

29

2001

ANIMAL GENETIC
RESOURCES
INFORMATION

BULLETIN
D'INFORMATION
SUR LE RESSOURCES
GÉNÉTIQUES ANIMALES

BOLETIN
DE INFORMACION
SOBRE RECURSOS
GENETICOS ANIMALES



Food
and
Agriculture
Organization
of
the
United
Nations

Organisation
des
Nations
Unies
pour
l'alimentation
et
l'agriculture

Organización
de las
Naciones
Unidas
para la
Agricultura
y la
Alimentación



Initiative for
Domestic
Animal
Diversity

Initiative pour
la Diversité
des Animaux
Domestiques

Iniciativa para
la Diversidad
de los Animales
Domésticos

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Les appellations employées dans cette publication et la présentation des données qui y figurent n'impliquent de la part de l' Organisation des Nations Unies pour l'alimentation et l'agriculture aucune prise de position quant au statut juridique des pays, territoires, villes ou zones ou de leurs autorités, ni quant au tracé de leurs frontières ou limites.

Las denominaciones empleadas en esta publicación y la forma en que aparecen presentados los datos que contiene no implican, de parte de la Organización de las Naciones Unidas para la Agricultura y la Alimentación, juicio alguno sobre la condición jurídica de países, territorios, ciudades o zonas, o de sus autoridades, ni respecto de la delimitación de sus fronteras o límites.

All rights reserved. Reproduction and dissemination of material in this information product for educational or other non-commercial purposes are authorized without any prior written permission from the copyright holders provided the source is fully acknowledged. Reproduction of material in this information product for resale or other commercial purposes is prohibited without written permission of the copyright holders. Applications for such permission should be addressed to the Chief, Publishing and Multimedia Service, Information Division, FAO, Viale delle Terme di Caracalla, 00100 Rome, Italy or by e-mail to copyright@fao.org © FAO 2001

Tous droits réservés. Les informations ci-après peuvent être reproduites ou diffusées à des fins éducatives et non commerciales sans autorisation préalable du détenteur des droits d'auteur à condition que la source des informations soit clairement indiquée. Ces informations ne peuvent toutefois pas être reproduites pour la revente ou d'autres fins commerciales sans l'autorisation écrite du détenteur des droits d'auteur. Les demandes d'autorisation devront être adressées au Chef du Service des publications et du multimédia, Division de l'information, FAO, Viale delle Terme di Caracalla, 00100 Rome, Italie ou, par courrier électronique, à copyright@fao.org © FAO 2001

Todos los derechos reservados. Se autoriza la reproducción y difusión de material contenido en este producto informativo para fines educativos u otros fines no comerciales sin previa autorización escrita de los titulares de los derechos de autor, siempre que se especifique claramente la fuente. Se prohíbe la reproducción de material contenido en este producto informativo para reventa u otros fines comerciales sin previa autorización escrita de los titulares de los derechos de autor. Las peticiones para obtener tal autorización deberán dirigirse al Jefe del Servicio de Publicaciones y Multimedia de la Dirección de Información de la FAO, Viale delle Terme di Caracalla, 00100 Roma, Italia, o por correo electrónico a copyright@fao.org © FAO 2001

Editors - Editeurs - Editores:
S. Galal & J. Boyazoglu

Viale delle Terme di Caracalla 1, 00100 Rome,
Italy

Animal Genetic Resources Information is published under the joint auspices of the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Environment Programme (UNEP). It is edited in the Animal Genetic Resources Group of the Animal Production and Health Division of FAO. It is available direct from FAO or through the usual FAO sales agents.

ANIMAL GENETIC RESOURCES INFORMATION will be sent free of charge to those concerned with the sustainable development conservation of domestic livestock. Anyone wishing to receive it regularly should send their name and address to the Editor, at the address shown above.

AGRI can also be found in the "Library" of DAD-IS at URL <http://www.fao.org/dad-is>.

Le Bulletin d'information sur les ressources génétiques animales est publié sous les auspices conjoints de l'Organisation des Nations Unies pour l'Alimentation et l'Agriculture (FAO) et du Programme des Nations Unies pour l'Environnement (UNEP). Cette publication est éditée par le Groupe des Ressources Génétiques de la Division de la Production et de la Santé Animales de la FAO. On peut se le procurer directement au siège de la FAO ou auprès des dépositaires et agents habituels de vente de publication de l'Organisation.

LE BULLETIN D'INFORMATION SUR LES RESSOURCES GÉNÉTIQUES ANIMALES sera envoyé gratuitement aux personnes intéressées par le développement durable et la conservation du bétail domestique. Les personnes souhaitant recevoir cette publication régulièrement voudront bien faire parvenir leurs nom et adresse à l'éditeur, à l'adresse sus-indiquée.

AGRI peut être consulté également sur la "Librairie" de DAD-IS de URL <http://www.fao.org/dad-is>.

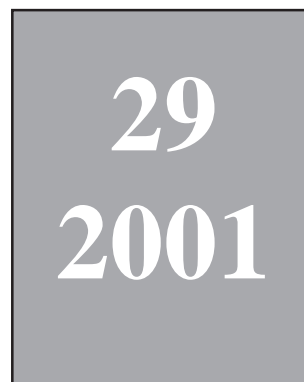
El Boletín de Información sobre Recursos Genéticos Animales se publica bajo los auspicios de la Organización de las Naciones Unidas para la Agricultura y la Alimentación (FAO) y del Programa de las Naciones Unidas para el Medio Ambiente (UNEP). Se edita en el Grupo de Recursos Genéticos de la Dirección de Producción y Sanidad Animal de la FAO. Se puede obtener directamente de la FAO o a través de sus agentes de venta habituales.

El BOLETIN DE INFORMACION SOBRE RECURSOS GENETICOS ANIMALES será enviado gratuitamente a quienes estén interesados en el desarrollo sostenible y la conservación del ganado doméstico. Si se desea recibirlo regularmente, se ruega comunicar nombre, apellido y dirección al editor a la dirección arriba indicada. AGRI puede consultarse también en la "Librería" de DAD-IS de URL <http://www.fao.org/dad-is>.

ANIMAL GENETIC RESOURCES INFORMATION

BULLETIN D'INFORMATION SUR LES RESSOURCES GÉNÉTIQUES ANIMALES

BOLETÍN DE INFORMACIÓN SOBRE RECURSOS GENÉTICOS ANIMALES



CONTENTS

	Page
Editorial	i
Why should we become involved in the State of World Process? A view from Asia <i>P.N. Bhat</i>	1
Caracterización de los animales domésticos en España <i>J.V. Delgado, C. Barba, M.E. Camacho, F.T.P.S. Sereno, A. Martínez & J.L. Vega-Pla</i>	7
Characteristics of the American Polypay: A review <i>G.D. Snowder</i>	19
Genetic diversity between Italian and Greek buffalo populations <i>B. Moioli, A. Georgoudis, F. Napolitano, G. Catillo, S. Lucioli, Ch. Ligda & J. Boyazoglu</i>	31
The Jakhrana Goat in India <i>B. Rai, S. Tiwari & B.U. Khan</i>	41
Productivité des ovins et des caprins de Race Locale élevés dans des conditions semi-intensives aux Antilles françaises <i>G. Alexandre, M. Mahieu & G. Aumont</i>	49
A propos d'un rapport sur la Chèvre du Rove en Provence <i>F. Poey d'Avant</i>	61
Phenotypic characterisation of native chicken lines in South Africa <i>E. van Marle-Köster & N.H. Casey</i>	71
Origin and characteristics of the Maltese Black-Bronze Turkey <i>J.G. Mallia</i>	79
Reports of selected meetings	91
Recent publications	97
Editorial policies and procedures	105

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
ORGANISATION DES NATIONS UNIES POUR L'ALIMENTATION ET L'AGRICULTURE
ORGANIZACION DE LAS NACIONES UNIDAS PARA LA AGRICULTURA Y LA ALIMENTACION

UNITED NATIONS ENVIRONMENT PROGRAMME
PROGRAMME DES NATIONS UNIES POUR L'ENVIRONNEMENT
PROGRAMA DE LAS NACIONES UNIDAS PARA EL MEDIO AMBIENTE

Editorial

Making the Report on the State of the World's Animal Genetic Resources a Success

International stakeholders, national and regional coordinators, professional colleagues in animal genetic resources have worked intensively since last September to put all necessary arrangements in place to make the State of the World's Animal Genetic Resources reporting process a success. Following the intergovernmental working group meeting in FAO in September 2000, the Secretariat and a core team of professionals from all over the world have invested a tremendous amount of time and effort to prepare the documentation and other tools for the necessary man-power training at all levels. In late February 2001, a global training workshop of trainers was organized at FAO Headquarters in Rome, in order to establish a pool of outstanding AnGR professionals to assist countries in the preparation of the country reports, analyze the global situation and prepare the first report on the State of Animal Genetic Resources.

An important milestone was the issuance of the formal letter of invitation to Member Nations and Organizations by the Director-General of FAO. An official "circular state letter" was sent to 180 member nations, one member organization (EU) and some of the non-FAO member nations, such as the Russian Federation, Belorussia, Ukraine and the FR of Yugoslavia. Governments were invited to participate in the preparation of *The State of the World's Animal Genetic Resources*, through an assessment of national animal genetic resources in the form of country reports, using the approved guidelines. As expressed by the Director-General of FAO, reports should constitute an official government document, which will clearly identify national priorities and set out a plan of action for the sustainable utilisation and conservation of farm animal genetic resources. The Commission on Genetic

Resources for Food and Agriculture urged that the State of the World on Animal Genetic Resources process be country-driven, which will require the full political, financial and human resources commitment of governments and national stakeholders.

The Director-General of FAO firmly assured member nations that the Secretariat was willing to co-ordinate donor support and assist Member Nations in implementing their national assessment whenever required. The Director-General of FAO also called on participating nations that, the global assessment was to be completed by the established deadline.

As a response to the above mentioned invitation, so far more than 50 member nations confirmed their participation in the preparation of the *First Report on the State of the World's Animal Genetic Resources*, together with details of the official title and address of the designated national authority responsible for co-ordinating the preparatory process in collaboration with FAO.

The Animal Production and Health Division (AGA) of FAO is the Organisation's focal point at the global level for the preparatory process. The Animal Genetic Resources Group of AGA, in close co-operation with national and regional partner institutions and organisations is now preparing the necessary regional training for country-nominated experts who will play key roles in preparing country reports for the State of the World process. Comprehensive training packs and DAD-IS modules have been prepared for this training to assist country stakeholders operationalise the Guidelines. Training workshops are scheduled to take place in Addis Ababa, Ethiopia in July 2001 for participating countries from Eastern and Southern Africa, followed by courses in Brasilia, Brazil (for

South America) in August, in Mexico City (for Central and North American countries), in New Delhi (for India and West Asian countries) in October and so on. Other regional training courses will be held for North European and Baltic states, as well as south-eastern European countries in Denmark and Hungary respectively, for south-east Asian countries in Bangkok, Thailand, for West-African countries and countries of the South Pacific.

It is well understood that such an important undertaking requires adequate financial support. Therefore FAO is allocating substantial share of its resources from the Regular Programme budget, which needs to be supplemented by extrabudgetary resources. The SoW Secretariat is working closely with countries and organisations, in order to secure funding of the core operation.

It should be underlined that the financial and technical assistance is part of a global initiative to enhance national capacities in order to prepare country reports in animal genetic resources. Funding of activities in the target countries under this project is complementary to similar projects (trust fund support from the Netherlands to West Asia, South America; support from Finland to south-east Europe and East Africa; from France to the European Regional Focal Point of the AnGR co-ordinators network; from the Nordic countries to countries in the Baltic Region; from the United States to the Caribbean etc.). Projects are identified and intended to last six to twelve months and the donor inputs will provide the funding necessary for the training of the AnGR Country Focal Points and for carrying out the preparation for a follow-up project to develop country-based inventories and plans of action.

These will include provision for related consultancy services and computer hardware and software for information management and reporting.

Consequently, the direct involvement in the SoW process of the range of international stakeholders is necessary for success. The Second Ad-Hoc Session of International Stakeholders was held in Rome, 5-6 June 2001, to provide further opportunity for stakeholder involvement and support of the SoW-AnGR process

The most important objective of the SoW-AnGR process is to develop national capacities and promote regional and international co-operation for sustainable intensification of livestock production systems at country level. The SoW-AnGR process will enhance the wise use and development of locally adapted animal genetic resources in target countries, whilst taking into consideration the constraints and opportunities of a country's livestock sector driven by growing food demands, changing climate, disease status and technologies.

The SoW-AnGR process is the opportunity to prepare for cost-effective action on better understanding the roles and values of farm animal genetic resources, better using and sustainably developing adapted resources, as well as better conserving and accessing genetic material for future benefit of local communities and the environment. Members of the animal genetic resources professional community should take the lead to develop quality country and regional reports as a strategic policy document and bring AnGR to their right place in food security, sustainable development, while maintaining agricultural biodiversity for beneficiaries today and in the future.

Editorial

Assurer le Succès du Rapport sur la Situation Mondiale des Ressources Génétiques Animales

Les intéressés au niveau international, les coordonateurs nationaux et régionaux, et les collègues du domaine des ressources génétiques animales ont travaillé intensivement depuis le mois de septembre dernier pour que le rapport sur le déroulement de la Situation Mondiale (SM) des Ressources Génétiques Animales soit un succès. Suite à la réunion du groupe de travail inter-gouvernemental qui s'est tenue à la FAO en septembre 2000, le Secrétariat SM et une équipe restreinte de professionnels venant de toutes les parties du monde ont investi une énorme quantité de temps et d'effort pour préparer la documentation et les outils nécessaires à la formation d'experts à tous les niveaux. Vers la fin février 2001 un atelier de formation pour les formateurs a été organisé au Siège de la FAO à Rome pour établir un groupe de professionnels du domaine des Ressources Génétiques Animales qui doivent assister les pays dans la préparation de leurs rapports nationaux, analyser la situation mondiale et préparer le premier rapport sur la Situation des Ressources Génétiques Animales.

Un point déterminant a été l'envoi officiel de la lettre d'invitation aux Etats Membres et aux Organisations intéressées de la part du Directeur Général de la FAO. Une "lettre circulaire aux Etats" a été envoyée à 180 pays, une organisation membre (UE) et certains des pays non membres de la FAO, tels que la Fédération Russe, la Biélorussie, l'Ukraine et l'ex République Yougoslave. Les gouvernements ont été invités à prendre part à la préparation sur la Situation Mondiale des Ressources Génétiques Animales, à travers une enquête nationale sur les ressources génétiques animales et sur présentation d'un rapport national en utilisant les directives approuvées. Tel que l'a exprimé le Directeur Général de la FAO, les rapports devraient constituer un document officiel qui identifiera clairement les priorités nationales et soulignera un plan d'action à suivre pour une meilleure utilisation durable et la conservation

des ressources génétiques d'animaux domestiques. La Commission des Ressources Génétiques pour l'Alimentation et l'Agriculture a insisté pour que le processus sur la Situation Mondiale des Ressources Génétiques Animales soit développé dans chaque pays, ce qui implique, de la part des gouvernements et des personnes au niveau national directement intéressées, un compromis total politique et financier ainsi que de ressources humaines.

Le Directeur Général de la FAO a assuré fermement les pays membres que le Secrétariat sera à disposition pour coordonner l'apport des donateurs et pour assister les Etats Membres à mettre en oeuvre leur enquête nationale, si nécessaire. Le Directeur Général de la FAO a aussi fait appel aux pays participants pour que l'enquête mondiale soit menée à terme dans les délais prévus.

En réponse à l'invitation ci-dessus, plus de 50 pays membres ont confirmé leur participation à la préparation du *Premier Rapport sur la Situation Mondiale des Ressources Génétiques Animales*, tout en communiquant les détails relatifs au titre officiel, nom et adresse complète des personnes désignées parmi les autorités responsables au niveau national pour coordonner le processus de préparation en collaboration avec la FAO.

La Division de la Production et de la Santé Animale de la FAO (AGA) est le *Point Focal* de l'Organisation au niveau mondial pour la préparation du processus. Le Groupe de Ressources Génétiques Animales de AGA, en étroite collaboration avec les institutions et organisations partenaires nationales et régionales, prépare en ce moment au niveau régionale la formation des experts només dans chaque pays et qui joueront un rôle important dans la préparation des rapports nationaux sur le processus de la Situation Mondiale. Une série de documents de formation et formulaires DAD-IS ont été préparés pour cette formation afin d'assister les pays intéressés dans la mise en oeuvre des Directives. Des ateliers de

formation ont été programmés pour les pays participants, de l'Est et du Sud de l'Afrique à Addis Abeba, en Ethiopie, en juillet 2001. Ces ateliers seront suivi d'une série de cours à Brasilia (Brésil) au mois d'août, pour l'Amérique du Sud, à Mexico City (Mexique) pour les pays de l'Amérique Centrale et du Nord, puis en Nouvelle Delhi (Inde) au mois d'octobre pour les pays de l'ouest asiatique, etc. D'autres cours de formation au niveau régional se tiendront au Danemark et en Hongrie respectivement, pour les pays de l'Europe du nord et les pays baltiques, ainsi que pour les pays du sud-est de l'Europe. Ensuite, pour les pays du sud-est asiatique à Bangkok (Thaïlande), ainsi que d'autres pour les pays de l'Afrique de l'ouest et ceux du Pacific sud.

Il est évident que cette importante initiative demande un soutien financier substantiel. Dans ce sens, la FAO a destiné à cet effet une grande partie de ses ressources provenant du budget du Programme Ordinaire, mais qui devra être augmentée par des ressources extra-budgétaires. Le Secrétariat du SM travaille en étroite collaboration avec les pays et les organisations intéressées afin d'assurer les fonds nécessaires pour la partie centrale de l'opération.

On doit souligner que l'assistance financière et technique est une partie de l'initiative globale qui permet de faire ressortir les capacités nationales afin de pouvoir préparer les rapports nationaux sur les ressources génétiques animales. Le financement des activités dans les pays retenus pour ce projet est complémentaire à d'autres projets similaires (fonds fiduciaire de support des Pays-Bas pour l'Asie de l'ouest et l'Amérique du Sud; soutien de la Finlande aux pays du sud-est de l'Europe et de l'Afrique de l'est; de la France pour le *Point Focal* Régional Européen pour les coordonnateurs du réseau AnGR; des pays du nord européen pour les pays de la région baltique; des Etats-Unis vers la région des Caraïbes). Des projets ont été identifiés et se réfèrent aux derniers six à douze mois et les intrants des donateurs apporteront les fonds nécessaires pour la formation des *points focaux* Nationaux et pour mener à terme la préparation d'un projet de suivi pour développer pour chaque pays des inventaires et

des plans d'action. Ceux-ci comprendront aussi les provisions pour les services des consultants impliqués et l'achat d'ordinateurs et de programmes pour la gestion de l'information et l'élaboration des rapports.

En conséquence, l'implication directe dans le processus SM d'un grand nombre d'intéressés au niveau international est nécessaire pour obtenir le succès désiré. La Deuxième Séance *ad-hoc* d'Experts Internationaux dans ce domaine s'est tenue à Rome les 5 et 6 juin 2001 afin de donner une autre occasion d'implication et de soutien de la part des intéressés au processus SM.

L'objectif principal du processus SM-AnGR est de développer des capacités nationales et de promouvoir la coopération régionale et internationale pour une intensification durable des systèmes de production animales dans chaque pays. Le processus SM-AnGR soulignera la large utilisation et le développement des ressources génétiques animales adaptées localement dans des pays déterminés; tout en gardant à l'esprit les contraintes et les opportunités du secteur de production animale au niveau national, poussé par la demande croissante d'aliments, les changements climatiques, l'état sanitaire et l'évolution technologique.

Le processus SM-AnGR représente l'occasion de préparer, à un coût intéressant, une action dans laquelle les rôles et les valeurs des ressources génétiques animales seront plus claires, avec une meilleure utilisation et développement durable des ressources adaptées au milieu, ainsi qu'une meilleure conservation et accès au matériel génétique afin de favoriser dans le futur les communautés locales et l'environnement. Les professionnels chargés des ressources génétiques animales de chaque communauté devraient prendre en main la direction pour développer des rapports nationaux et régionaux de qualité en tant que document de politique stratégique et porter ainsi les ressources génétiques animales à la place qui leur revient vis-à-vis de la sécurité alimentaire et le développement durable, tout en conservant la biodiversité en agriculture, pour les bénéficiaires d'aujourd'hui et de demain.

Editorial

Asegurar el éxito del Informe sobre la Situación Mundial de los Recursos Genéticos Animales

Los interesados a nivel internacional, los coordinadores nacionales y regionales, así como los colegas del sector de los recursos genéticos animales han trabajado de forma intensiva desde el pasado mes de septiembre para que el informe sobre el desarrollo de la Situación Mundial (SM) de los Recursos Genéticos Animales sea un éxito. Tras la reunión del grupo de trabajo inter-gubernamental que tuvo lugar en la FAO en septiembre del 2000, la Secretaría SM y un equipo restringido de profesionales provenientes de todas las partes del mundo, han invertido una cantidad enorme de tiempo y esfuerzo para preparar la documentación y las herramientas necesarias para la formación de expertos a todos los niveles. Hacia finales de febrero del 2001 se organizó en la Sede de la FAO en Roma un taller de formación para extensionistas, con el fin de establecer un grupo de profesionales del sector de los Recursos Genéticos Animales que deberá asistir a los países en la preparación de sus informes nacionales, analizar la situación mundial y preparar el primer informe sobre la Situación de los Recursos Genéticos Animales.

Un punto determinante ha sido el envío oficial de la invitación a los Estados Miembros y a las Organizaciones interesadas por parte del Director General de la FAO. También ha sido enviada a 180 países, a una organización miembro (UE) y a un cierto número de países no miembros de la FAO, tales como la Federación Rusa, Belorusia, Ucrania y la ex República Yugoslava, una "circular a los Estados". Los gobiernos han sido invitados a tomar parte en la preparación de la Situación Mundial de los Recursos Genéticos Animales a través de una encuesta nacional sobre recursos genéticos animales y de la presentación de un informe nacional conforme a las directrices aprobadas. Tal como sugirió el Director General de la FAO, los informes deberían constituir un documento oficial que identificará claramente las prioridades nacionales y subrayará un plan de acción a seguir para una mejor utilización

sostenible y conservación de los recursos genéticos de animales domésticos. La Comisión para los Recursos Genéticos para la Alimentación y la Agricultura ha insistido para que el proceso sobre la Situación Mundial de los Recursos Genéticos Animales sea desarrollado en cada país, lo que conlleva, por parte de los gobiernos y de las personas directamente interesadas a nivel nacional, un compromiso total político y financiero, así como de recursos humanos.

El Director General de la FAO ha asegurado firmemente a los países miembros que la Secretaría estará a disposición para coordinar el aporte de los donantes y para asistir a los Estados Miembros si es necesario en la implementación de su encuesta nacional. El Director General de la FAO también ha hecho un llamamiento a los países participantes para que la encuesta mundial quede concluida en los tiempos previstos.

En respuesta a la invitación mencionada anteriormente, más de 50 países miembros han confirmado su participación a la preparación del *Primer Informe sobre la Situación Mundial de los Recursos Genéticos Animales*, comunicando asimismo los detalles relativos a títulos oficiales, nombres y direcciones completas de las personas nombradas entre las autoridades responsables a nivel nacional para coordinar el proceso de preparación en colaboración con la FAO.

La División de Producción e Higiene Animal de la FAO (AGA) es el *Punto Focal* de la Organización a nivel mundial en la preparación de dicho proceso. El Grupo de Recursos Genéticos Animales de AGA, en estrecha colaboración con las instituciones y organizaciones asociadas nacionales y regionales, prepara en estos momentos a nivel regional la formación de los expertos nombrados en cada país que jugarán luego un papel importante en la preparación de los informes nacionales sobre el proceso de la Situación Mundial. Una serie de documentos de

formación y formularios DAD-IS han sido preparados en vistas de esta formación con el fin de asistir a los países interesados en la implementación de las Directrices. Ha sido programado un taller de formación para los países participantes del Este y Sur de África en Adis Abeba, Etiopía, en julio 2001. A este taller seguirán una serie de cursos en Brasilia (Brasil) en el mes de agosto, para América del Sur; en Ciudad de Méjico (México) para los países de América Central y del Norte; luego en Nueva Delhi (India) en el mes de octubre para los países del Oeste asiático, etc. Otros cursos de formación a nivel regional vendrán organizados en Dinamarca y en Hungría respectivamente, para los países del Norte de Europa y Bálticos, así como para los países del Sur Este de Europa. Más adelante, se organizarán para los países del Sur Este asiático en Bangkok (Tailandia), y otros países del Oeste africano y del Sur del Pacífico.

Es evidente que esta importante iniciativa necesita de un aporte financiero consistente. En este sentido, la FAO ha destinado para ello una parte substancial de sus recursos provenientes del presupuesto del Programa Ordinario, pero este monto deberá ser aumentado con recursos extra presupuestarios. La Secretaría de la SM trabaja en estrecha colaboración con los países y las organizaciones interesadas con el fin de asegurar los fondos necesarios para cubrir la parte central de la operación.

Se debe subrayar que la asistencia financiera y técnica es parte de la iniciativa global que permitirá resaltar las capacidades nacionales y preparar los informes nacionales sobre los recursos genéticos animales. El financiamiento de las actividades en los países seleccionados para este proyecto es complementario al de otros proyectos similares (fondos de fideicomiso de apoyo de los Países Bajos para el Oeste de Asia y América del Sur; apoyo de Finlandia a los países del Sur-Este de Europa y del Este de África; de Francia para el *punto focal* Regional Europeo para los coordinadores de la red AnGR; de los países del Norte de Europa hacia los países de la región del Báltico; de Estados Unidos hacia la región del Caribe). En los seis a doce últimos meses se han identificado proyectos y los aportes de los donantes servirán para cubrir los fondos necesarios para la formación de *Puntos Focales* Nacionales y para

llevar a cabo la preparación de un proyecto de seguimiento para desarrollar en cada país los inventarios y los planes de acción oportunos. Estos incluirán también las provisiones para los servicios de los expertos implicados y para la compra de ordenadores y programas para la gestión de la información y la elaboración de los informes.

Por consiguiente, la implicación directa en el proceso SM de un gran número de interesados a nivel nacional es necesaria para alcanzar el éxito deseado. La Segunda Sesión *ad-hoc* de Expertos Internacionales en este sector tuvo lugar en Roma el 5 y 6 junio 2001 con el fin de proporcionar otra ocasión para una mayor implicación y apoyo por parte de los interesados en el proceso SM.

El objetivo principal del proceso SM-AnGR es desarrollar las capacidades nacionales y promover la cooperación regional e internacional para una intensificación sostenible de los sistemas de producción animal en cada país. El proceso SM-AnGR resaltarán la amplia utilización y el desarrollo de los recursos genéticos animales adaptados localmente en ciertos países; teniendo en cuenta siempre las limitaciones y oportunidades del sector de la producción animal a nivel nacional que se encuentra sujeto a la demanda creciente de alimentos, a los cambios climáticos y a la situación sanitaria y la evolución tecnológica.

El proceso SM-AnGR representa la ocasión de preparar, a un costo interesante, una acción en la que el papel y el valor de los recursos genéticos animales sean más claros, con una mejor utilización y desarrollo sostenible de los recursos adaptados al ambiente, así como una mejor conservación y acceso al material genético con el fin de favorecer en el futuro las comunidades locales y el ambiente. Los profesionales encargados de los recursos genéticos animales de cada comunidad deberían tomar en mano la dirección para el desarrollo de informes nacionales y regionales de calidad, como documento de política estratégica, y llevar así los recursos genéticos animales al lugar que les corresponde en relación con la seguridad alimentaria y el desarrollo sostenible, conservado al mismo tiempo la biodiversidad en la agricultura para beneficio de hoy y mañana.

Why should we become involved in the State of the World of Animal Genetic Resources process? A view from Asia

P.N. Bhat

*World Buffalo Trust, Flat No.205, No.F64-C/9, Sector 40, Noida,
Gautam Budh Nagar, UP 201 303, India*

Biological diversity is the vital organic resource on which the present and future sustenance of humankind depends. The farm animal genetic resource (AnGR) sector of this diversity provides the variety and variability of species, breeds and populations including unique genotypes which underpin an essential component of food and agriculture production. Judicious use and enhancement of these living resources must be ensured, also with their conservation, so that we may meet the increasing demands for food.

The Asian sub-continent is one of the world's mega biodiversity centres. It was in this region that domestication of flora and fauna was carried out in ancient times. With respect to domesticated mammals and birds, ranges of species encountered are astounding. From Vedic to British times, the improvement in livestock has been made in response to community utilities, which have changed from time to time. In cattle for example, the primary thrust in Europe has been on bullock power as opposed to horsepower. The main emphasis was on the development of breeds, which produced the most effective motive power for agricultural operations.

Now, the relative importance of animal energy has considerably decreased, due to mechanization in agriculture. Bullocks, within the next 50 years, will be phased out from the agricultural operations, even from small holders' farms, effecting a major shift in the utilities of bullocks, the backbone of a traditional system for almost 5000 years. Our development objectives for cattle are to be redefined. India has a bovine population of about 200 million, far too many than required for a pulsating and vibrant milk economy.

Technological challenges, e.g. cross-breeding *versus* selection within local breeds, total replacement of populations *versus* a balance of stable mixes in context with the environment of performance, relative cost of producing animal products and shifts between peri-urban and rural production, need new thinking and policy shifts.

The management requirements and demands for animal foods and ways to meet these with the human population growth of 1-2 percent per annum and technologies available, need to be taken into consideration when developing new strategies and frameworks, practical policies and decisions to move forward.

There are groups of countries which have common resources, (Zebu cattle, buffaloes, tropical sheep and goats), production systems and interdependence of institutions. In this context, there is a need to look at the problems regionally so that resources in people and material are put to the best use.

It would be desirable for each of the countries involved to concentrate on what they have in terms of animal genetic resources, their strengths and weaknesses, what are they likely to do with them and how they propose to handle these resources so that wealth and food security is assured.

If for example, the nations want to alleviate poverty and convert small and marginal livestock holders into livestock entrepreneurs to increase their production of food from the present 20 to 40 percent in the next 25 years, they will need to assess and analyze the available AnGR and based on this assessment, develop strategies for wealth and employment generation. FAO's State of the

World Process for AnGR is a most important opportunity to develop an effective country strategy, with realistic priorities and needs to be firmly identified for each of its elements and to become part of the global action plan.

The reasons for most countries becoming involved in the State of the World of Animal Genetic Resources (SoW-AnGR) process are two-fold. The primary interest in most countries in South and South-Eastern Asia is to make an objective assessment of the kind of resources which exist in each country and throughout the region. It will be necessary for them to assess food requirement and plan to produce food sustainability within the available ecosystems. It will assist in countries evaluating the kind of breeding strategies introduced over the past 50 years. If we examine one particular aspect for cattle, we will broadly notice that breeds of temperate origin were inducted for introducing high milk yield and fast growth in the indigenous locally adapted cattle, without bringing in the technology used in developed countries to sustain high milk production in these inducted breeds. Consequently, although these crossbreds did well under enhanced inputs, they were unable to produce due to poor sustainability of the production system and were invariably reduced to mongrels. It would have been more correct in the first place before these introductions were made, for the country to have comparatively evaluated various parameters of the indigenous and temperate cattle and made careful analysis and judgement of the strengths, weaknesses, opportunities and threats caused by these high producing temperate new breeds when directly compared to local breeds in the perspective of initial and perhaps on-going cross-breeding as a technology input.

It is therefore necessary, that each of us should become seriously involved in producing a State of the World report for the country, thus allowing countries to clarify these issues and develop the priorities in a strategic manner and to provide clear directions for action. A cadre of global level expertise is being developed to train and

assist countries in the development of their State of the World report. It would also be necessary to take action to train a cadre within the country and provide direct assistance for development of a highly effective country report with the assistance of a package of tools developed by FAO so that the country system can be efficiently built up.

Objectives of the Sow-AnGR Process

The basic purpose of the SoW-AnGR process is essentially to assist countries to substantially improve understanding, use, improvement as well as conservation of their AnGR and to develop a common structure across the countries for the country reports which will identify priorities and analyze information on the state of management of AnGR. To develop coherence to the common structure, it is necessary to develop basic formats which can cover major issues which need to be addressed. This is the first requirement which has been undertaken and completed with satisfaction by FAO Headquarters, with substantial input from country expertise of all regions of the world. The global cadre of expertise developed by FAO will support the SoW-AnGR process to:

- 1) conduct regional training workshops for key country operatives, and
- 2) provide for direct in-country assistance in the development of a country report.

For this, it is necessary that uniform training materials be developed. These materials have also been drafted and will be tested at regional training workshops.

At the global and country levels it is important that the necessary additional funds be provided, to complement the substantial inputs by FAO and to ensure the success of the country-driven SoW-AnGR Process. Let us hope that major international collaborators will also want this important SoW-AnGR activity for the livestock sector globally and will also want to help to ensure its success and contribute to the international

stakeholders and donors mechanism which FAO is further developing to facilitate the SoW-AnGR work.

At country level, the process has suggested a number of enabling activities recommended by FAO to progress the capacity building and country report developments are strongly supported. Following government acceptance of the FAO Director-General's invitation to participate in the SoW-AnGR Process, it is firmly recommended that the government establish a balanced working group and a national consultative committee (NCC), which is capable of being highly effective and which begins work immediately, with terms of reference for developing in a step-by-step approach the entire country report following the plan of action chalked out and accepted globally. The NCC's work to frame the country report is recommended to begin immediately, whilst action is also beginning in parallel on the in-country training, network development and involvement of stakeholders, support data gathering, mobilization of funds and special budget to follow up steps of preparing the various elements of the country report.

Initiation of Activities at FAO

In the mid-nineties a major decision was taken by the FAO Council of Country Membership to prepare a Global Strategy for AnGR management. This was followed by meetings of a panel of experts and the regionally-balanced Intergovernmental Technical Working Group on AnGR (ITWG-AnGR) which is developing the framework for the Global Strategy. As a further step and within the Global Strategy framework the ITWG-AnGR developed the guidelines for country use in preparing the SoW-AnGR. In addition, FAO has developed an informatics package called Domestic Animal Diversity Information System (DAD-IS) which is a unique system of tools which can be used by each country to gather and store, retrieve information on AnGR in electronic format, to use in further developing the Country Network for AnGR and for

developing and delivering the SoW-AnGR Country Report as a strategic policy document. The ITWG-AnGR recommended that the SoW-AnGR Process should be consultative and cost-effective and it is impressive to learn of the efforts being made by FAO to realize consultation and cost-effectiveness.

It is also obvious that this country-driven SoW-AnGR Process has outstanding potential to build up the so badly needed additional country capacity in policy, technical and operational aspects required for effective AnGR management - *the lack of understanding, poor use and development and very poor conservation action on these irreplaceable resources cannot be permitted to continue if we are to realize sustainable food security for all!*

The Global Strategy

Presently, farm AnGR accounts for 30-40 percent of total agricultural outputs. There is an increasing demand in animal products fuelled by population growth, urbanization and a rise in income, also intensification and industrialization of livestock production systems with uniform breeds. In developed countries with high availability of all production inputs, concentration is on high input/high output breeds and replacement of locally adapted breeds. While in the developing world traditional production systems are transforming and the use of exotic breeds is promoted leading to dilution or loss of locally adapted breeds. Environmental stress factors will however, remain in most parts of the world for the medium-term future. There is a need for farmers to have access to a diversified gene pool and to all available knowledge and technology, only global action can make this possible.

The Convention of Biological Diversity (CBD) came into force in 1993 and 170 Member Governments of FAO accepted in 1995 the further development of the Global Strategy, to provide a framework for use in establishing effective national, regional and global policies, strategies and actions. It was

decided that FAO would facilitate and coordinate the activities of organizations interested in AnGR within sustainable agriculture and rural development and assist countries in developing the capacity to manage AnGR through planning, designing and implementing sustainable livestock production systems and promoting the establishment of cost-effective approaches for conserving AnGR.

This was to be driven through the institution of a Global Focal Point (GFP) at FAO Headquarters in Rome and Regional Focal Points (RFP) at the regional level throughout the world to help ensure that countries of the region are well supported in establishing sustainable programmes of action within country and regionally and to best utilize the region's capacity. The responsibility of GFP is to develop the framework for the Global Strategy and to detail the constituent parts of this framework, for country use, a country-based global infrastructure, including regional and national focal points and the DAD-IS, a technical programme of work developing guidelines for sound management of AnGR and an early warning and early reaction system, a reporting, progress evaluation and priority action development component, including the SoW-AnGR Process and an intergovernmental mechanism to review and guide the Strategy's development and to serve as a forum for harmonizing country policy and as necessary to develop an international policy for AnGR.

The FAO Commission on Genetic Resources for Food and Agriculture (CGRFA) with advice from its ITWG-AnGR, coordinates policy and sectoral matters related to sustainable use and conservation of AnGR. It is important in terms of driving the SoW-AnGR Process that this be guided by this important global Commission and that the Commission debate the acceptance in 2003 of the Strategic Priority Actions Report and in 2005, the first full Report on the SoW-AnGR. These two major reports will be drafted by the FAO Secretariat using the Country Reports on the SoW-AnGR. Therefore, *countries can expect to benefit*

substantially within-country and internationally by agreeing to be directly involved in the SoW-AnGR from the outset!

National and state governments would implement national policy and strategies for sustainable development and conservation of AnGR enabled by the country reporting process and also draft such legal instruments identified as required. While GFP would lead planning, development and implementation of the Global Strategy, international policy development, development and maintenance of DAD-IS and AnGR management guidelines and decision-support tools for country use, assist with mobilizing donor resources, etc., the RFP would facilitate communication, initiate development of regional policy, assist in identification of priorities and interact with government, donors and NGOs.

National Focal Points (NFP) would coordinate country activities, identify capacity building needs of the country network, assist development and implementation of policy and interface with stakeholders, RFP and GFP. It is also ensured that the donor and stakeholder involvement mechanism, provides a means for donors and stakeholders to have opportunities to influence design and implementation of regional and global work.

DAD-IS

DAD-IS provides countries with advanced communication and information tools, country secure storage and communication of AnGR data and information, it is the basis for early warning and is a reaction system for AnGR. This will help countries prepare their national management plans for AnGR, characterize their breeds and production systems and advance AnGR sustainable use and development.

The DAD-IS SoW-AnGR module has been developed to support the in-country preparatory process. It has eight elements. The SoW Manager assists in the building of the National Consultative Committee, the Country Network. The SoW data enables

countries to develop their National SoW-AnGR Databank for on-going use in planning, the reviewing progress and action. The SoW Report assists the NCC in methodically stepping through the development of a strong country report on strategic policy for AnGR management. Each of the eight elements has specific operational tasks which function on three distinct levels, the NCC, national coordination and the supporting data contributor, all of whom contribute to the development of the appropriate preparation of the country report.

Country Report

The country report should be a strategic policy document which gives the country an opportunity to create a vision and strategic plan for better management of AnGR on:

- 1) where are we in terms of management of AnGR?
- 2) where do we want to be? and
- 3) how do we get to where we want to be?

Its objectives are to establish essential baseline data and information on the status of animal genetic diversity in the country, to assess roles and values of local and introduced breeds and the impacts of traditional agricultural systems on AnGR. It should include improved understanding of the status of breeds that are currently not of value to farmers and of wild relatives of domesticated animals, the capacities of public and private institutions and farmers and tribal communities in the management of AnGR. It should also examine the methodologies being used, to understand the value of AnGR, to better use, develop and conserve them in a sustainable manner.

Once the national priorities are identified for action on sustainable conservation and utilization of AnGR, requirements in international or regional cooperation in germplasm exchange and management can also be stated such that networking of stakeholders (NGOs, farmers' group, breeders' association, etc.) can be developed to increase awareness of the many roles and values of AnGR, promoting their better

utilization, development and conservation, enhancing existing networking between countries with shared or common AnGR and/or common production systems or issues and promoting communication and collaboration within and between networks and among government and NGOs involved in the management of AnGR.

Once the Country Report is prepared, its importance becomes clear as it becomes the basic document for use in establishing an effective short-, medium- and long-term plan for development of AnGR and to commit national resources. It will also identify main directions for future national policies and programmes, determine priorities for action for government and stakeholders, identify emerging issues directly related to the management of AnGR in relation to animal welfare, animal health and impact on the environment, etc. It will assist farmers, indigenous and local communities in the identification of AnGR that can increase production, productivity and product quality.

It will enhance the capacity to both manage and report on AnGR through improved communication and organization capacity and identify situations where an emergency response could be required to prevent the loss of AnGR.

The country report will in addition to the AnGR themselves, also take into consideration:

- 1) agricultural biodiversity;
- 2) production systems and environments in which AnGR are used;
- 3) range of animal products and services which they provide;
- 4) consumption patterns and socio-cultural practices associated;
- 5) ecosystems functions which they sustain; and
- 6) their role in the agricultural production and food security of the country.

The range of activities to be addressed in the report should include:

- 1) *in-situ* and *ex-situ* conservation;
- 2) characterization; and
- 3) use and development.

Regional Coordination

Regions with common problems in terms of common assets, breeds and species will need to develop a regional approach to problem solving. A regional report or plan of action should be prepared which will take into account the inter-dependence between the countries to optimally utilize their resources and provide a framework for coordination of regional activities and collaboration and develop a regional constituency for conservation and sustainable use of AnGR.

Coordination mechanisms should facilitate communication, information sharing, networking and collaboration, facilitate sharing of technical expertise and resources amongst countries, capacity sharing and initiate cross-cutting activities such as facilitating development of regional policies.

It would be highly desirable that collaboration amongst the involved countries identifies regional priorities for implementation, mobilizes support and resources for regional and country activities, assists development of regional information for the SoW-AnGR process and commits support and directs the countries involved.

It is therefore, in the interest of each country, regardless of its status or the capacity in manpower to quickly get involved in this SoW-AnGR process and be a partner in the building of a better world. The animal genetic resources group at FAO has developed a vision for a new world where they have taken into account everyone's needs and plans accordingly. We will all share in this vision.

Caracterización de los animales domésticos en España

*J.V. Delgado¹, C. Barba¹, M.E. Camacho²,
F.T.P.S. Sereno¹, A. Martínez¹ & J.L. Vega-Pla³*

¹*Unidad de veterinaria, Departamento de Genética, Universidad de Córdoba,
Av. Medina Azahara, 9, 14005 Córdoba España*

²*Laboratorio de Sanidad y Producción Animal, Consejería de Agricultura, Junta de
Andalucía, Carretera Córdoba-Alcolea, Córdoba, España*

³*Laboratorio de Grupos Sanguíneos,
Apartado Oficial Sucursal 2, 14071 Córdoba, España*

Resumen

La expansión actual de los criterios conservacionistas han promovido la utilización de las modernas metodologías que brinda la genética molecular para la caracterización de las razas, aunque la caracterización genética clásica basada en marcadores bioquímicos e inmunogenéticos se ha aplicado durante muchos años sobre todo en rumiantes y equinos en pruebas de identidad y control de filiación. El estudio del polimorfismo de los microsatélites del ADN han ofrecido muy buenos resultados, aunque también se ha trabajado con éxito en la investigación del ADN mitocondrial y de fragmentos de ADN amplificados aleatoriamente. En España estos métodos han sido utilizados en las especies bovina, ovina, caprina, porcina, equina y canina.

De cualquier forma, es importante considerar que la obtención de perfiles genéticos poblacionales para los caracteres morfológicos y productivos, es obligada en una aplicación práctica de los resultados obtenidos con los marcadores genéticos. En el presente trabajo se describen las principales iniciativas desarrolladas en los aspectos mencionados, ubicando los equipos españoles especializados.

Summary

The present expansion of the conservationism has stimulated the use of the modern methodologies based on the molecular genetics for the breed characterization. Characterization based on biochemical and immunogenetics markers has been used intensely, especially in ruminants and equines for identification and paternity control. Microsatellites of DNA have given very good results as has the study of the mitochondrial DNA and random amplified polymorphism of DNA. In Spain these methods have been used in cattle, sheep, goats, equines and dogs.

It is important to consider that the investigation on population genetic profiles of morphological and productive characters is necessary to apply the results obtained from the genetic markers.

This paper describes the principal Spanish initiatives in the above-mentioned subject, the Spanish teams specialized in these types of research.

Key words: *Genetic resources, Conservationism, Genetic markers, Polymorphism.*

Introducción

Hasta mediados del presente siglo no se alcanzó en España una implantación total de los criterios zootécnicos modernos basados en la gestión genética de poblaciones cerradas,

con fines de cría en pureza o bien con destino al cruzamiento. Estos criterios nacieron con Bakewell en Inglaterra durante el siglo XVIII y fueron impulsados por ilustres genetistas como Lush ya en épocas más recientes, cuando se contó con los fundamentos de genética cuantitativa necesarios para dotar de contenido los métodos intuitivos de los grandes zootecnistas del XVIII.

Por tanto, la unidad de trabajo en la zootecnia actual es la raza, o bien otras estructuras intraraciales de menor rango genético como son la variedad, la estirpe o la línea. Por esta razón es imprescindible conocer los límites que definen a las mismas con respecto al resto de unidades de su mismo nivel, es decir, una línea frente a otras líneas de la misma raza, o una raza frente al resto de razas de la misma especie. Esa es la razón por la cual la caracterización de estas estructuras biológicas tan vital importancia dentro de la Producción Animal, al menos en los países desarrollados.

Hoy en día aparte de la importancia de fundamento mencionada anteriormente, surgen otras de tipo aplicativo y comercial, como es el caso de la necesidad de definir los productos catalogados dentro de las marcas de calidad y denominaciones de origen de los alimentos. También la efervescencia de los nacionalismos está induciendo a los distintos pueblos que forman el viejo continente a reclamar las razas como un patrimonio cultural, y por ello, demandan su total definición frente a las razas de otros pueblos. Ambos apuntes tienen una especial relevancia en la España del siglo XXI.

Asimismo es de destacar la presión a la que se asiste en el ámbito mundial a favor de la conservación de los recursos genéticos con vistas a su utilización racional y al reparto justo de los beneficios por ellos producido. Especialmente, después de la cumbre de Río de Janeiro, estos conceptos se han introducido en las legislaciones de muchos países, y por supuesto en la Unión Europea y consecuentemente en España.

Lo descrito nos sitúa en un presente donde el concepto de raza está totalmente asumido, como base de trabajo en Producción Animal, y

como reservorio de la variabilidad genética de las especies, pero en España esto no siempre fue así. En nuestro país, desde los años 20 se creó una corriente de importantes etnólogos que estudiaron y divulgaron las características de las razas españolas. Entre ellos destacaron D. Rafael Castejón y D. Gumersindo Aparicio. Esta base teórica creó escuela prolongándose hasta la actualidad con insignes figuras de esta disciplina como los Dres. Sánchez Belda, Tejón, Aparicio Macarro, Sierra, Herrera y Sotillo, todos ellos continuadores en la descripción fenotípica de las razas españolas, esfuerzo que se ha visto plasmado en múltiples publicaciones de relevancia (Sánchez Belda y col. 1974, 1981, 1984, 1986; Tejón. 1986; Herrera y col. 1986, 1988, 1990; Herrera y col., 1988, 1991).

Más recientemente la encomiable labor de los etnólogos se vio apoyada por los genetistas que se incorporaron al estudio de las razas dotándolo de nuevas perspectivas, fundamentalmente basadas en la búsqueda del perfil genético de las poblaciones (razas, variedades, estirpes o líneas). La incorporación de los genetistas, que acontece en los años setenta, supuso un cisma en el que resultaron dos corrientes. La "etnoexéptica" anidada en las escuelas de Agronomía, en la que se interpretaba a la raza como un artificio que no se correspondía con una realidad biológica como era el propio concepto de especies. Y otra corriente defensora de las razas como unidad fundamental de la zootecnia, asentada esta vez en las Facultades de Veterinaria. En este caso, se observaba a las razas como una realidad biológica dotada de algunos fundamentos antropológicos, como es la fijación de sus características en un patrón racial, su delimitación en el seno de un libro genealógico y su gestión por parte de una asociación de criadores.

En la actualidad el etnoexcepciónismo ha desaparecido ante el indiscutible reconocimiento internacional de las razas apoyado por estructuras como la Federación Europea de Zootecnia (EAAP) y la Organización para la Alimentación y la Agricultura (FAO).

Una vez que admitimos la existencia de razas, no sólo desde el punto de vista etnológico, sino también desde la óptica genética, el primer y más importante paso es la caracterización de las mismas, ya que esta información nos permite establecer el patrón racial, sobre el que se desarrollara el reconocimiento oficial de las razas plasmado en las normas gestoras de su libro genealógico; y por supuesto, ofrecerá una base para el trabajo de las asociaciones específicas de las razas.

Caracterización de las Razas en España

En este epígrafe haremos una breve descripción de la metodología de trabajo que se sigue en España para la caracterización de nuestras razas.

La caracterización se consigue a través de la obtención del perfil genético de la población (Figura 1), para ello se trabaja en tres vertientes, dos de ellas comunes con los trabajos desarrollados a este respecto en el mundo salvaje y una tercera exclusiva de los animales domésticos. Las dos primeras serían la caracterización morfológica y la caracterización basada en marcadores genéticos. La tercera, al tratarse de animales de renta sería la caracterización productiva y reproductiva.

La caracterización morfológica se basa en la obtención de los valores promedio poblacionales para una serie de caracteres externos de naturaleza cuantitativa (peso, alzadas, perímetros y diámetros) bien a través de la medición de todos los animales de la población, cuando esto es posible, o bien desde una muestra estadísticamente representativa. También se realizan recuentos de las frecuencias de aparición de distintas variantes de caracteres exteriores de naturaleza cualitativa (color de la capa, forma de cuerno, perfil cefálico, etc.).

La caracterización basada en marcadores genéticos utiliza características genéticas estructurales de naturaleza cualitativa de nulo o escaso interés productivo, detectables mediante análisis laboratoriales más o menos

complejos. En este caso se buscan expresiones genéticas directas en forma de proteínas como los polimorfismos bioquímicos (Figura 2), el funcionamiento de la bomba de sodio y potasio, o formas antigénicas ligadas a los hematies (grupos sanguíneos) o a los leucocitos y resto de células somáticas (sistema mayor de histocompatibilidad). Y más recientemente se utilizan los avances de la genética molecular para detectar variaciones en regiones hipervariables del ADN, siendo los más usados hoy en día los microsátelites (Figura 3). En esta faceta de la caracterización genética de las razas profundizaremos en un epígrafe posterior.

Finalmente, tenemos la caracterización productiva, que de manera similar a la descrita para los caracteres morfológicos, se basa en la obtención de valores promedio raciales para distintas variables de interés económico que se expresan en los animales de renta, variables cuantitativas que casi siempre tienen naturaleza continua, pero en ocasiones aparecen como discontinuas. En este caso y según la especialización de la raza en concreto, medimos caracteres lácteos (cantidad y composición de la leche), cárnicos ligados a la productividad individual (pesos y crecimientos a distintas edades) y a la productividad numérica (prolificidad y tamaño de la camada al destete), y en otra funcionalidad caracteres laneros, peleteros, hueveros e incluso comportamentales y deportivas (perros, toro de lidia, caballos).

Cuando observamos la expresión individual en cada animal de los caracteres morfológicos y productivos, se trata de expresiones fenotípicas fuertemente influidas por los efectos ambientales, que me imposibilitan la definición genética de ese individuo. Pero cuando se accede al valor promedio del carácter en la población, bien a través de la medición de toda ella, o bien a través de un muestreo estadísticamente adecuado, la expresión poblacional del carácter cuantitativo se transforma en una expresión directa del genotipo medio de la población, ya que las desviaciones ambientales en sentido positivo y negativo se han neutralizado entre sí. Por tanto, la

Caracterización genética de los animales domésticos en España

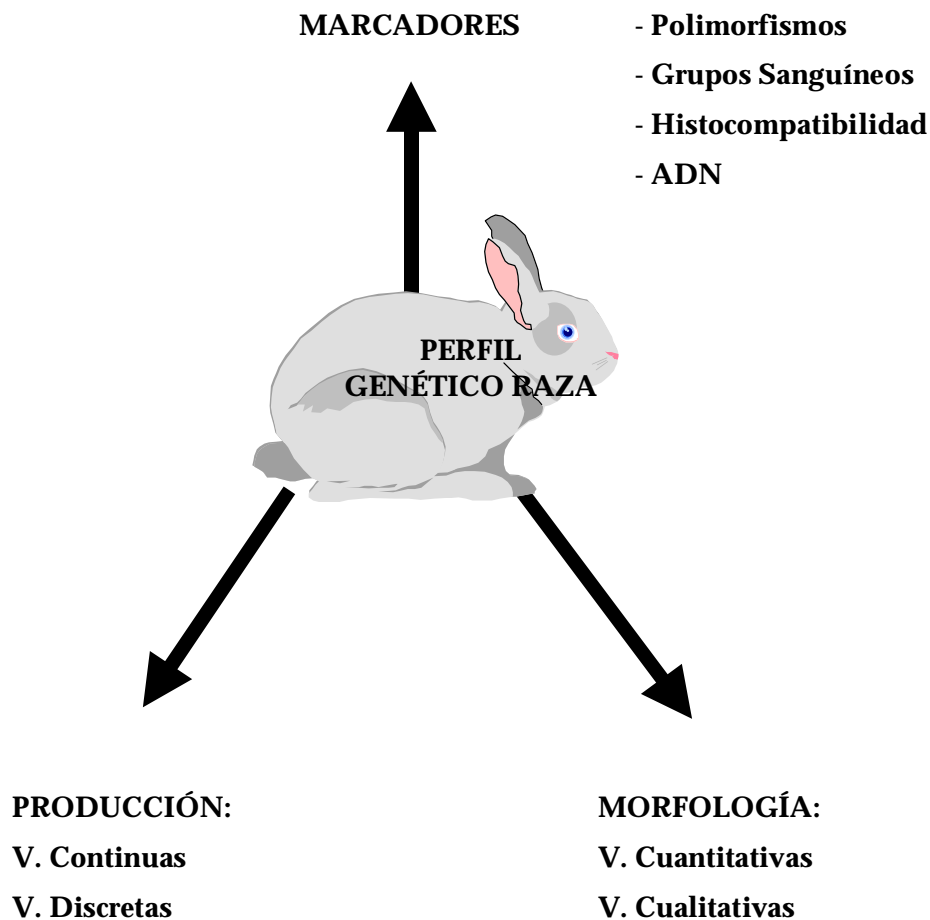


Figura 1. Esquema general de caracterización genética.

caracterización morfológica y productiva es una caracterización genética de la población basada en caracteres de naturaleza cuantitativa y por tanto poligénica. Hacemos esta aclaración ya que con frecuencia se entiende como caracterización genética sólo a aquella basada en marcadores genéticos, mientras que en realidad toda aproximación al genotipo medio de la población nos es de utilidad en la definición de las poblaciones (razas, variedades, estirpes o líneas).

El procedimiento que se sigue en la caracterización morfológica y productiva se puede resumir en el siguiente protocolo (Herrera y col., 1996; Capote y col, 1998; Delgado y col., 1998 y 2000; y Barba, 1999):

- Diseño del muestreo y plan de mediciones.
- Creación de bases de datos
- Calculo de estadísticos descriptivos
- Análisis de la varianza para cada variable entre poblaciones.
- Análisis Discriminante Canónico
- Establecimiento de distancias de Mahalanobis entre poblaciones
- Construcción de clusters con las relaciones filogenéticas estimadas mediante las distancias.

Caracterización genética basada en marcadores en España

La caracterización basada en marcadores tiene como fundamento el polimorfismo en la expresión genética de fragmentos activos del ADN en forma de proteínas o enzimas y también en la observación directa del polimorfismo en fragmentos hipervariables del ADN. Entendemos el polimorfismo como un cambio en la forma, pero no en la naturaleza de las estructuras mencionadas, cambios que han ocurrido por mutaciones estabilizadas en la población (Fernández-Piqueras, 1993). Según Lucotte (1977) un determinado *locus* se considera polimórfico cuando el alelo más común se encuentra con una frecuencia igual o inferior a 0.99.

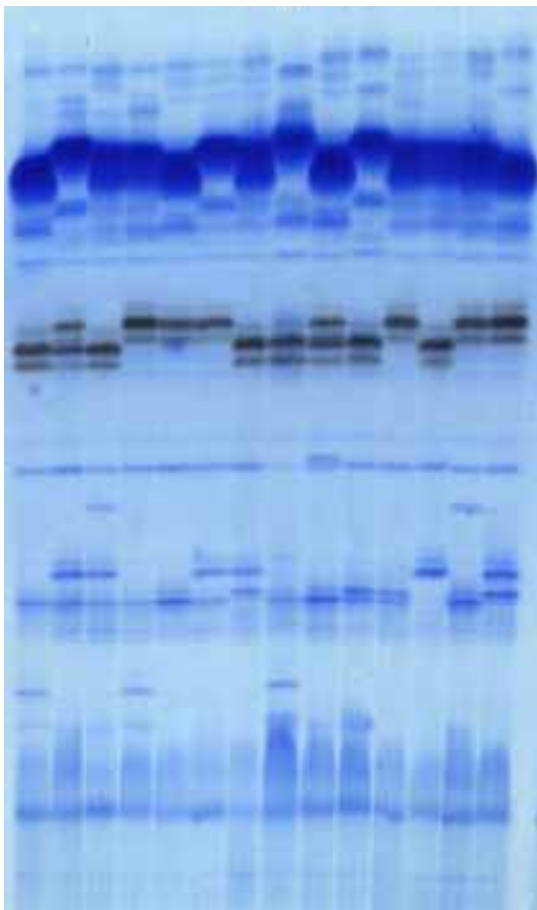


Figura 2. Electroforesis en gel de poliacrilamida de proteínas del suero.

Polimorfismos bioquímicos en España

Los distintos métodos electroforéticos permiten separar las distintas formas moleculares que pueda tener una proteína presente en todos los individuos de una especie. La influencia del campo eléctrico sobre las proteínas disueltas en solución acuosa hace que sus distintas formas migren a velocidad distinta desde un polo al otro en función de su carga y masa, separándose de esta forma en fracciones sencillas.

En España estas técnicas se imponen a principios de los ochenta con un triple fin, en primer lugar el apoyo al control genealógico de los animales con el propósito de la mejora; el segundo buscar ligazones de estos caracteres relativamente fáciles de medir con algunos caracteres de tipo cuantitativo de difícil medida y gran interés económico. Y finalmente la propia caracterización genética de las poblaciones.

Estas técnicas se desarrollan en tres facultades de Veterinaria de las cuatro que existían en España en aquellas fechas; el grupo de Zaragoza dirigido por el Prof. Zarazaga; el equipo de León coordinado en principio por el Prof. Vallejo y después por el Prof. San Primitivo y el equipo de Córdoba cuyo responsable era el Prof. Rodero. Estos equipos por separado y en ocasiones trabajando conjuntamente desarrollaron profundos estudios en el bovino español (González y col., 1987; Vallejo y col., 1977; y Vallejo y col., 1990) donde se caracterizaban trece razas bovinas españolas al mismo tiempo que se establecían las relaciones filogenéticas entre ellas.

En España los polimorfismos más profusamente estudiados en la especie bovina han sido el de la Hemoglobina, la Anhidrasa Carbónica, la Ceruloplamina, la Transferrina y la Albúmina.

Los pequeños rumiantes quizás por la complejidad de los controles genealógicos en sus sistemas de cría fueron las especies más estudiadas desde este punto de vista. En el ovino se abordó la caracterización de distintas razas individuales como fue el caso de la raza

Merina (Llanes, 1979, Morera y col., 1983; Garzón y col., 1976), la raza Rasa Aragonesa (Lasierra, 1974, Lamuela, 1974) y la Churra (San Primitivo y col., 1976; y Ordas y San Primitivo, 1986) y estudios conjuntos sobre distanciamiento genético basado en la información polimórfica (Rodero y col., 1982; Vallejo y col., 1977).

Algo similar ocurrió con los caprinos, donde también fueron profusos los trabajos de este tipo destacando en este caso los análisis conjuntos realizados sobre múltiples razas (Barbancho, 1979; Tuñón y col., 1984; Tuñón y col., 1989; Moreno y col., 1991; y Garzón 1975) sobre estudios individuales

sobre razas concretas como la Murciano-Granadina (Garzón y col., 1976), la Malagueña (De la Haba y col. 1991) y la Canaria (Baena, 1990).

En el caso de los pequeños rumiantes la Hemoglobina, Anhidrasa Carbónica, la Proteína X, la Transferrina, la Esterasa, la actividad de la Glutation Peroxidasa y la Catalasa, además de los niveles de sodio y potasio.

Otra especie muy estudiada a este nivel ha sido la equina, manteniéndose aún un servicio de control genealógico en el Laboratorio de Grupos Sanguíneos, desarrollado mediante un convenio de

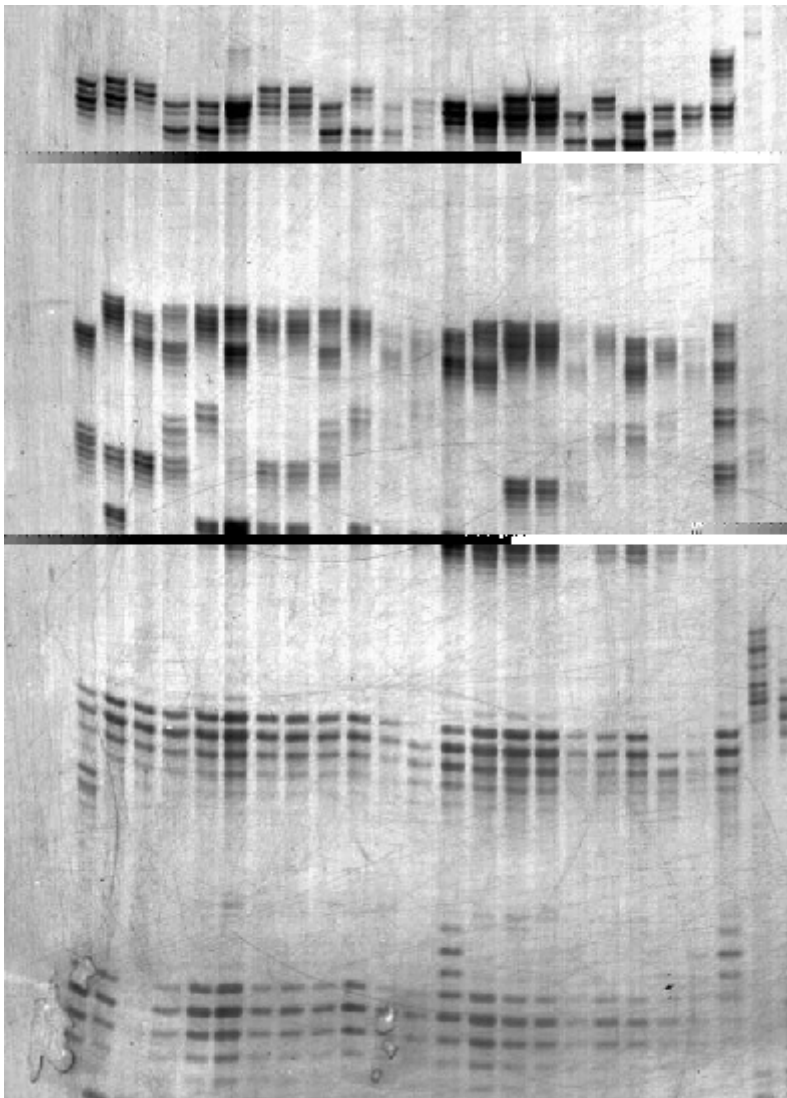


Figura 3. Electroforesis de productos de amplificación con PCR de microsatélites de ADN equino teñidos con plata.

colaboración entre el Ministerio de Defensa y la Universidad de Córdoba que aplica tanto esta metodología de los grupos sanguíneos como los microsatélites del ADN. Aunque el fin primordial de este grupo no era la caracterización, la fuente de información disponible les ha permitido desarrollar importantes estudios centrados en la Pura Raza Española en comparación con otros grupos raciales (De Andrés, 1982; Rodríguez y col., 1992).

En esta especie los polimorfismos más estudiados corresponden a la Hemoglobina, Esterasa, Transferrina, glicoproteína A1B, Albúmina, Proteína ligada a la vitamina D, G-fosfogluconatodeshidrogenasa, fosfoglucomutasa, alfa-1-antitripsina y glucosafosfatoisomerasa.

El procedimiento de trabajo es común y consiste de los siguientes pasos:

- Obtención de la solución acuosa de la proteína tras su extracción de la muestra, generalmente suero y células sanguíneas o suero lácteo.
- Electroforesis en distintos substratos
- Tinción de los geles
- Identificación de alelos e interpretación de resultados.
- Cálculo de frecuencias genotípicas y alélicas
- Establecimiento de distancias genéticas entre poblaciones
- Diseño de clusters con las relaciones filogenéticas establecidas con las distancias.

Las actividades enzimáticas precisan del contacto del enzima con un sustrato para determinar la alta o baja actividad. Para el estudio de la bomba de sodio y potasio se utiliza la espectrofotometría.

Grupos sanguíneos en España

Existen unas estructuras proteicas en los hematíes que actúan como sustancias antigénicas produciendo reacciones inmunológicas específicas cuando son introducidos en individuos que carecen de las mismas. La utilidad de este fenómeno para la caracterización y para el control genealógico radica en la existencia de polimorfismo en

dichos antígenos, constituyendo caracteres que desde el punto de vista genético se comportan como series alélicas, que dan un importante grado de variabilidad individual, si bien en el ámbito poblacional sus aportaciones son más limitadas que en el caso de los polimorfismos bioquímicos.

La identificación de los alelos y genotipos individuales se lleva a cabo a través de una reacción antígeno-anticuerpo aglutinante o hemolítica, utilizando sueros reactivos previamente tipificados y obtenidos de individuos sensibilizados con el antígeno específico.

En España se han utilizado los grupos sanguíneos en las especies ovina y equina fundamentalmente aunque escasamente en el ámbito de caracterización. En ovinos son destacables los trabajos desarrollados en la Facultad de Veterinaria de León (San Primitivo, 1976; San Primitivo y col., 1976, San Primitivo y col., 1977). Aunque debemos apuntar algunos trabajos desarrollados en la Universidad de Córdoba (Morera, 1982).

En la especie equina, al igual que ocurría en los polimorfismos bioquímicos, el estudio de los grupos sanguíneos ha sido liderado por el Laboratorio de Grupos Sanguíneos (Aguilar, 1985).

Complejo mayor de histocompatibilidad en España

Desde el punto de vista genético los fundamentos y utilidades de este sistema son similares a las descritas para los grupos sanguíneos. En este caso los antígenos se encuentran en las membranas celulares de las células nucleadas, como los linfocitos. Por esta razón la identificación de alelos y genotipos se lleva a cabo mediante reacciones antígeno-anticuerpo. Tras la relevancia observada por el estudio de este complejo en humanos como consecuencia de la evolución de los trasplantes, se trató de implementar estas técnicas en las especies domésticas con los mismos fines que los grupos sanguíneos, pero además tratando de encontrar ligazones con algunas resistencias genéticas a enfermedades infecciosas y parasitarias.

En España se desarrollaron trabajos de esta naturaleza en Córdoba y el País Vasco, pero nunca con fines de caracterización.

Polimorfismo del ADN en España

Con el advenimiento de la tecnología del ADN recombinante en los años setenta se consiguió una nueva oportunidad para la identificación de marcadores genéticos, esta vez el polimorfismo se detectaba directamente sobre las propias moléculas del ADN.

Estos polimorfismos eran fundamentalmente de tres tipos:

- Fragmentos de restricción polimórficos (RFLP). Cuya variabilidad se debía a mutaciones en la secuencia de reconocimiento de una endonucleasa de restricción. La consecuencia de esto era el cambio en los patrones electroforéticos de estos fragmentos.
- Polimorfismos debidos a mutaciones puntuales que no afectan a dianas ni a la longitud del fragmento. Se detectan de forma indirecta como los Single Strand Conformation Polymorphism, SSCP, que aprovechan los cambios en la movilidad electroforética que presentan dos cadenas sencillas de ADN cuando se diferencian en una única sustitución de bases. También se detectan mediante secuenciación del ADN de la zona de interés o con técnicas de hibridación alelo-específicas.
- Repeticiones en tandem. El polimorfismo se debe a las repeticiones en tandem de un fragmento de ADN formado por un número variable de pares bases. Dependiendo del tamaño de la unidad que se repite nos encontramos con macrosatélites, en los que la secuencia repetida contiene entre 500 y varios miles de pares de bases. Los midisatélites, en los que la secuencia solo tiene entre 100 y 500 pares de bases. Los minisatélites, con secuencias entre 6 y 100 pares de bases. Finalmente los microsátélites, que repiten una pequeña secuencia de entre 1 y 6 pares de bases.

De todos estos polimorfismos, son los microsátélites los que presentan una mayor variabilidad y son muy fáciles de tipificar. Por esta razón son los más empleados para la caracterización genética de las poblaciones y para la identificación individual, de ahí que a continuación nos centraremos en ellos.

El protocolo de trabajo con los microsátélites se puede reducir a los siguientes pasos,

- Extracción del ADN de la muestra de sangre u otros tejidos (piel, pelo, músculo, etc.).
- Cuantificación del ADN extraído, utilizando generalmente la espectrofotometría.
- Amplificación mediante la reacción en cadena de la polimerasa (PCR).
- Evidenciación del producto amplificado mediante electroforesis en gel de agarosa para observar la eficiencia y rendimiento del proceso.
- Detección de alelos mediante electroforesis en gel de poliacrilamida.
- Visualización de los microsátélites mediante tinción con sales de plata, utilizando sales de plata o mediante cebadores marcados con fluorocromos empleando secuenciadores automáticos.
- Identificación de los alelos. La metodología de análisis estadístico utilizada es como sigue:
 - a) Cálculo de frecuencia alélicas y genotípicas.
 - b) Cálculo de distancias genéticas
 - c) Diseño de clusters filogenéticos entre poblaciones utilizando las distancias.

En España, la utilización de los microsátélites como herramienta para la caracterización de poblaciones ha desplazado casi por completo al resto de marcadores genéticos descritos en el presente trabajo. En nuestro país debido a la estructuración política regional se han transferido a las comunidades autónomas las competencias en investigación agraria, y además se ha incrementado el número de universidades así como las dotaciones de las mismas. Esta

situación ha contribuido a que los equipos que trabajan en caracterización se han incrementado ampliamente.

La sensibilización por la conservación de los recursos genéticos animales también ha contribuido a que cada vez más equipos españoles se dediquen a la caracterización de nuestras razas autóctonas. Este interés ha afectado prácticamente a todas las especies de interés zootécnico.

En bovinos destacan los interesantes trabajos realizados por el equipo de la facultad de Veterinaria de León (Arranz, 1996; Arranz y col., 1997), aunque se han publicado otros trabajos de interés como los de Ruiz (1997) centrado en cinco razas bovinas, el de Zamorano (1998), que incluyó algunas razas criollas argentinas junto a los Berrendos españoles, y los trabajos del equipo de Viana en razas bovinas gallegas (Viana y col., 1998a, 1998b y 1998c).

En ovinos debemos destacar los trabajos de Arranz y col. (1995) en la raza Churra y de Zamorano y col. (1998) en el Merino de Grazalema y el Churro Lebricano y Monteagudo y col. (1993) en la Rasa Aragonesa. Otros equipos trabajan en esta especie aunque sus resultados aun no han sido publicados, como es el caso del equipo de Valdepeñas que se ocupa del ovino Manchego.

En el caprino Canario, Mata y col. (Enviado) han empleado los microsatélites para clarificar la compleja estructura poblacional de la Agrupación Caprina Canaria, aunque sus resultados aun no han sido publicados.

En el Porcino, nuestro equipo ha utilizado la batería de 30 microsatélites propuesta por la ISAG y la FAO para la caracterización porcina para definir la estructura poblacional del cerdo ibérico y el Manchado de Jabugo (Delgado y col., 1998; Martínez y col., 2000a; Martínez y col., 2000b), estando en proceso la misma aplicación el Cerdo Negro Canario y el Chato Murciano. Otros equipos de Baleares y Zaragoza han trabajado sobre el Chato y el cerdo Negro Mallorquín. Así mismo el CIT/INIA de Madrid ha realizado interesantes estudios para la caracterización del cerdo ibérico.

En equinos son fundamentalmente tres equipos los que se ocupan de la aplicación de los microsatélites en estas especies. El Laboratorio de Grupos Sanguíneos de Córdoba (Vega-Pla, 1996) aportando incluso tres nuevos microsatélites de aplicación (Vega y col., 1996). El equipo del Departamento de Producción Animal de la Universidad Complutense de Madrid que se ha ocupado del estudio de los ponies españoles (Checa y col., 1998, Cañón y col., 2000). Y el equipo de la Facultad de Veterinaria de Zaragoza que ha centrado su estudio en el poni vasco Pottoka.

En la especie canina también se han aplicado los microsatélites con intensidad para estudios de caracterización racial. Morera y col. (1999) han aplicado una batería de microsatélites en el análisis comparativo de cuatro razas autóctonas españolas de perros. También es de interés el trabajo realizado por Gómez y col. (1998) con ADN mitocondrial en cuatro razas caninas.

Finalmente queremos destacar que cada vez se introduce mas en la bibliografía internacional la aplicación de los RAPD (Random Amplified Polymorphic DNA) con fines caracterizadores. Esta técnica se basa en la creación de conjuntos de ADN raciales desde la mezcla de muestras de animales aleatoriamente escogidos en la población. Tras la amplificación con cebadores inespecíficos y sometimiento a electroforesis, se detectan polimorfismos poblacionales a modo de patrón. Este método ha sido utilizado en España por Parejo y col. (1998) en la raza bovina Blanca Cacereña, si bien se están aplicando en la actualidad por otros equipos en la especie porcina.

Referencias

Aguilar, P. 1984. Grupos sanguíneos en el caballo español. Tesis Doctoral. Universidad de Córdoba, pp. 179.

Arranz, J.J. 1994. Estudio genético en poblaciones bovinas mediante polimorfismos bioquímicos y de DNA (variaciones puntuales y microsatélites). Tesis Doctoral. Universidad de León, pp. 176.

-
- Arranz, J.J., Ftirich, C.D., Tascón, C.D. Bayón, Y. & San Primitivo, F.** 1995. Utilidad de los microsatélites en el control de parentesco en ganado ovino. ITEA. 16 (1), 303-305.
- Arranz, J.J., Bayón, Y. & San Primitivo, F.** 1997. Variabilidad genética en razas bovinas españolas mediante análisis de polimorfismos bioquímicos y de DNA. Arch. Zootec., 46, 249-258.
- Baena, C.** 1993. Caracterización de la Agrupación Caprina Canaria en base a determinados polimorfismos bioquímicos. Tesis de Licenciatura. Universidad de Córdoba, pp. 132.
- Barbancho, M.J.** 1979. Estructura y relaciones genéticas entre algunas razas caprinas españolas en razón a determinados polimorfismos sanguíneos. Tesis Doctoral. Universidad de Córdoba, pp. 232.
- Cañón, J., Checa, M.L., Vega-Pla, J.L., Vallejo, M. & Dunner, S.** 2000 The genetic structure of Spanish Celtic horse breeds inferred from microsatellite data. Animal Genetics 31, 39-48
- Capote, J.F., Delgado, J.V., Fresno, M.R., Camacho M.E., & Molina, A.** 1998. Morphological variability in the Canary Goat Population. Small Ruminant Research. Vol. 27, 167-172.
- De Andrés Cara, D.F.** 1982 Pura Raza Española de Caballos. Comparación con otras razas mediante sus polimorfismos enzimáticos sanguíneos. Tesis Doctoral. Servicio de Publicaciones. Universidad de Córdoba, pp. 258.
- De la Haba, M.R., Moreno, A. & Morera, L.** 1991. Erythrocyte GSH, hemoglobin and potassium concentrations during the postnatal period in Granadina goats. Small Rumin. Res., 4, 189-196.
- De la Haba, M.R.** 1989. Polimorfismo enzimático relacionado con la bomba de potasio en ovinos. Tesis Doctoral. Universidad de Córdoba, pp. 186.
- Delgado, J.V., Barba, C., Diéguez, E., Cañuelo, P., Herrera, M. & Rodero, A.** 1998. Caracterización exteriorista de las variedades del cerdo Ibérico basada en caracteres cualitativos. Arch. Zootec., 49, 201-207.
- Delgado, J.V., Barba, C., Diéguez, E., Cañuelo, P., Herrera, M. & Rodero, A.** 2000 Caracterización morfológica de las variedades del tronco ibérico basada en caracteres cuantitativos. En, IV Simposio Internacional do Porco Mediterraneo. Evora. Portugal. Options Méditerranéennes Serie A(41): 63-66.
- Delgado, J.V., Vega-Pla, J.L., Barba, C., Martínez, A. M. & Zamorano, M.J.** 1998. Caracterización morfológica y genética de las variedades del Tronco ibérico. Sólo Cerdo Ibérico. AECERIBER. N° 1, Zafra, Badajoz, 27-44.
- Fernández Piqueras, J.** 1993. Polimorfismos en el ADN humano. I Reunión científica en Biología Celular y Molecular. Ed. Universidade da Coruña, pp. 24.
- Garzón, R.** 1975. Contribución al estudio del polimorfismo bioquímico de los caprinos españoles. Tesis Doctoral. Universidad de Córdoba, pp. 213.
- Garzón, R., Zarazaga, I., Vallejo, M. & Rodero, A.** 1976. Polimorfismo bioquímico de la raza caprina Granadina. Arch. Zootec., 25 (98), 147-170.
- González, F.** 1986. Estructura e interrelaciones genéticas de siete razas bovinas autóctonas españolas estimadas mediante diez sistemas genéticos sanguíneos. Tesis Doctoral. Universidad de León, pp. 176.
- Herrera, M. & Subires, J.** 1988. La cabra malagueña Ed. Excma. Diputación de Málaga. Servicios de Actividades Agropecuarias, pp. 127.
-

- Herrera, M., Rodero, E., Gutiérrez, M.J., Peña J. & Rodero J.M.** 1996. Application of multifactorial discriminant analysis in the morphostructural differentiation of Andalusian caprine breeds. *Small Ruminant Research*, 22, 39-47.
- Herrera, M., Sánchez, M., Alvarez, J.J. & Sánchez, S.A.** 1991. Raza caprina Florida Sevillana. Ed. Patronato de Asesoramiento Económico. Diputación de Sevilla, pp. 120.
- Lamuela, J.M.** 1978. Estructuración genética mediante polimorfismos bioquímicos (albúminas y transferrinas) con vistas al estudio filogenético de los ecotipos de la raza Rasa Aragonesa. *Avances Alim. Mej. Anim.*, XIX, 1-2
- Lasierra, J.M.** 1974. Aportaciones al estudio de los polimorfismos bioquímicos en las razas ovinas españolas. Hemoglobina en cinco ecotipos de la raza Rasa Aragonesa. *An. Fac. Vet. Zaragoza*, IX, 9, 349-375.
- Lucotte, G.** 1977. Le polymorphisme biochimique et les facteurs de son maintien. Masson. Paris. Francia, pp. 245.
- Llanes, D.** 1979. Polimorfismos enzimáticos en ovinos. Tesis Doctoral. Universidad de Córdoba, pp. 215.
- Martínez, A.M., Rodero, A. & Vega-Pla, J.L.** 2000a. Estudio con microsatélites de las principales variedades de ganado porcino del tronco ibérico. Comunicación II Congreso SERGA. Mallorca. *Arch Zoot.* 49 (185-186): 45-52.
- Martínez, A.M., Delgado, J.V., Rodero, A. & Vega-Pla, J.L.** 2000b. Genetic structure of the iberian pig breed using microsatellites. *Animal Genetics* 31, 295-301.
- Monteagudo, L.V., Ferreira, E., Tejedor, M.T. & Arruga, M.V.** 1993. Exclusión de parentesco en la raza ovina Rasa mediante genética molecular. *ITEA*, 12 (1), 227-229.
- Moreno, A., de la Haba, M.R., Morera, L. & Rodero, A.** 1991. Enzyme activity and electrophoretic phenotypes of erythrocytes catalase in goats. *Small Rumin. Res.* 4, 39-46.
- Morera, L., Llanes, D., Barbancho, M. & Rodero, A.** 1983. Genetic polymorfism in Spanish Merino Sheep. *Anim. Blood Grps Biochem. Genet.* 14, 77-82.
- Ordás, J.V. & San Primitivo, F.** 1986. Genetic variation in blood proteins within and between Spanish dairy sheep. *Animal Genetics*, 17, 255-266.
- Rodríguez-Gallardo P.P., Aguilar, P., Vega, J.L. & De Andrés, D.F.**, 1992 Blood group and protein polymorphism gene frequencies for the Andalusian horse breed. A comparison with four American horse breeds. *Arch. Zoot.* 41, 433-442
- Rodero, A., Garzón, R., Llanes, D., Zarazaga, I., Vallejo M., & Monje, E.** 1982. Genetic distances between Spanish breeds. *Arch. Zootec.*, 31, 97-108.
- Rodero, E.** 1994. Uso de marcadores genéticos en la caracterización de poblaciones raciales ovinas y caprinas autóctonas de Andalucía en peligro de extinción. Tesis Doctoral. Universidad de Córdoba, pp. 234.
- Ruiz, B.M.** 1997. Análisis de la estructura genética de cinco razas bovinas mediante polimorfismos de ADN. *FEAGAS*, 11,25-29.
- San Primitivo, F., Vallejo, M. & Zarazaga, I.** 1976. Grupos sanguíneos, hemoglobinas, albúminas y transferrinas en la raza Churra. *Zootechnia*, 25, 10-12, 525-565.
- San Primitivo, F., Vallejo, M. & Zarazaga, I.** 1976. Grupos sanguíneos, hemoglobinas, albúminas y transferrinas en la raza Churra. *Zootechnia*, 25 (10), 462-468.
- San Primitivo, F., Vallejo, M. & Zarazaga, I.** 1977. Blood groups, hemoglobins, transferrins and albumins of the

Churra breed sheep. XV Int. Conf. Anim. Blood Grps Biochem. Polymorph. Dublín, Irlanda, 1976. Anim. Blood Grps Biochem. Genet., 8 (suppl,1), 38.

San Primitivo, F. 1976. Obtención de sueros reactivos en la determinación de grupos sanguíneos ovinos y su aplicación con los polimorfismos bioquímicos al estudio inmunogenético de la oveja Churra. An. Fac. Vet. León. 22 (2), 525-565.

Sánchez Belda, A. 1974. Conservación de razas ovinas. Libro de actas del I Congreso de Genética aplicada a la producción ganadera, 53-59.

Sánchez Belda, A. 1981. Catálogo de razas autóctonas españolas. II. Especie bovina, pp. 219.

Sánchez Belda, A. 1984. Razas bovinas españolas. Publi. Extensión Agraria pp. 257.

Sánchez Belda, A. 1986. Razas ovinas españolas. MAPA, pp. 887.

Tejón, D. 1986. Catálogo de razas autóctonas españolas. I. Especies ovina y caprina. Edit. MAPA, pp. 250.

Tuñón, M.J., González, P. & Vallejo, M. 1989. Genetic relationship between 14 native Spanish breeds of goats. Animal Genetics, 20, 205-212.

Tuñón M.J., González, P., Díaz, M., & Vallejo, M. 1984. Distribución del sodio en sangre, plasma y eritrocitos en doce agrupaciones autóctonas españolas. An. Fac. Vet. León, 30, 127-135.

Vallejo, M., Iglesias A., Sánchez García, L., González P. & Tuñón, M.J. 1990. Variabilidad genética y relaciones filogenéticas de trece razas bovinas autóctonas españolas. Archivos de Zootecnia, 39, 197-210.

Vallejo, M., Monje, E., Rodero, A., Zarazaga, I., Garzón, R. & Lamuela, J.M. 1977. Polimorfismos bioquímicos en razas vacunas españolas. I. Rubia gallega, pirenaica, retinta y morenas del n.o. Trab. Cient. Univ. Córdoba, pp. 24.

Vallejo, M., Zarazaga, I., San Primitivo, F., Monje, E., Lamuela, J.M. & Lasierra, J.M. 1977. Clasificación etnológica de ovinos españoles. I. Primeras aportaciones mediante polimorfismos bioquímicos. Av. Alim. Mej. Anim. 18, 73-83.

Vega-Pla J.L., J.J.Garrido, G. Dorado, de Andrés-Cara, D.F. 1996 Three new polymorphic equine microsatellites: HLM2, HLM3, HLM5. Animal Genetics 27, 215

Vega-Pla, J.L. 1996. Polimorfismo de ADN equino. Obtención de marcadores moleculares y su aplicación al control de filiación. Tesis Doctoral. Universidad de Córdoba, pp. 103.

Viana, J.L., Fernández, A., Sánchez, L., Rodríguez-Calvo, M.S. & Iglesias, A. 1998(a). Análisis del locus microsatelite ILST002 en la raza bovina Barrosa. Archivos de Zootecnia 47 (178-179): 157-162.

Viana, J.L., Fernández, A., Sánchez, L., Rodríguez-Calvo, M.S. & Iglesias, A. 1998(b). Análisis del locus microsatelite bovribo (BBR) en la raza bovina Maronesa. Archivos de Zootecnia 47 (178-179): 163-168

Viana, J.L., Fernández, M., Rivero, C.S., Fernández, A. & Sánchez, L. 1998 (c) Utilización de la biotecnología del ADN en el programa de conservación de las razas bovinas Morenas del Noroeste. Archivos de Zootecnia 47 (178-179): 294

Zamorano, M.J. 1998. Utilización de medidas genéticas coadyuvantes a los planes de mejora del vacuno de carne. Tesis Doctoral. Universidad de Córdoba, pp. 191.

Characteristics of the American Polypay: A review

G.D. Snowder

USDA, ARS, U. S. Sheep Experiment Station, Dubois, Idaho 83423, USA

Summary

The Polypay sheep breed was developed at the U.S. Sheep Experiment Station with a reproductive capacity markedly superior to that of domestic US western range breeds. The Polypay is a four breed composite of Targhee, Rambouillet, Dorset and Finnish Landrace breeds. It is a medium-sized wool sheep (average mature ewe weight of 72 kg) with a smooth body free of excessive skin wrinkles on the neck and body and a poll head. Comparative studies with other US domestic breeds have shown the Polypay to have earlier sexual maturity, higher fertility and prolificacy rates. Mature ewes give birth to an average of 2.4 lambs and wean an average total litter weight of 63.8 kg per ewe at 120 days post partum. Lamb survival rates to 21 and 120 days are greater than those of other breeds compared. Average individual lamb weaning weight at 120 days (36.1 kg) exceeded that for Rambouillet and Targhee lambs (34.5 and 33.8 kg, respectively). Polypay carcasses are similar to those of Rambouillet and Targhee for dressing percentage, body wall thickness, kidney and pelvic fat, and ribeye area. Measures of carcass fat are less in the Polypay when compared to the Rambouillet and Targhee while qualitative leg scores for the Polypay were more favorable. Productive longevity under western range herded conditions does not differ among Polypay, Rambouillet, Targhee and Columbia sheep. In a farm flock production system, the average number of productive years for Polypay ewes exceeded that of most crossbred types. Wool characteristics are defined as a coarse to medium grade wool with a fiber diameter ranging from 24 to 33 μm . Fiber staple length ranges from 7.6 to 12.7 cm with a common

mean of approximately 10 cm. Raw fleece weights are considered light and range from 2.7 to 4.5 kg. Yield of clean wool is approximately 57 percent. Economic evaluations favored the Polypay in all production systems considered with 15 to 36 percent increase in sales or profits compared to other US domestic breeds. When considering the Polypay breed for importation, some prudence should be exercised because it may not be suitable to all environments and production systems in the world, especially where nutritional and management resources are not sufficient to support lactating ewes rearing twins.

Resumen

La raza ovina Polypay fue desarrollada en la Estación Experimental Ovina de EE.UU. con una capacidad de reproducción claramente superior a la media de las razas locales de la zona oeste de EE.UU. La raza Polypay está compuesta por cuatro razas: la Targhee, la Rambouillet, la Dorset y la Finnish Landrace. Se trata de una raza de lana de mediana estatura (el peso medio de la oveja en edad madura es de 72 kg), con un cuerpo suave sin exceso de piel arrugada en la nuca y en el cuerpo y ausencia de cuernos. Estudios comparativos con otras razas locales estadounidenses han mostrado que la Polypay posee una madurez sexual precoz, y mayor grado de fertilidad y prolificidad. Las ovejas maduras paren una media de 2,4 corderos y los crían hasta un peso medio de 63,8 kg a los 120 días del parto. La supervivencia de los corderos de 21 a 120 días es superior a la de otras razas comparadas. La media individual de peso al destete a los 120 días (36,1 kg) es mayor que para la raza Rambouillet y Targhee (34,5 y 33,8 kg, respectivamente). Las canales de Polypay son semejantes a las de

Rambouillet y Targhee en cuanto al porcentaje de manto, espesor corporal, grasa entorno a riñones y zona pélvica, y área del músculo dorsal. Las cantidades de grasa de la canal son inferiores en la Polypay comparadas con la Rambouillet y la Targhee, mientras que los índices cualitativos de las patas son más favorables en la Polypay. La longevidad productiva en condiciones de rebaño en las regiones del oeste no es diferente entre la Polypay y las razas Rambouillet, Targhee y Columbia. En un sistema de producción en granja la media de años productivos en las ovejas Polypay no excede la media de la mayor parte de tipos de razas cruzadas. Las características de la lana vienen definidas de gruesa a media con un diámetro de fibra que va de 24 a 33 μm . La longitud de la fibra a la raíz va de 7,6 a 12,7 cm con una media aproximada de 10 cm. Los pesos de vellón crudo están considerados como bajos y van de 2,7 a 4,5 kg. La superficie de lana limpia representa aproximadamente el 57%. Las evaluaciones económicas favorecen a la raza Polypay en todos los sistemas de producción considerados, con un porcentaje de 15 a 30% de aumento en la venta o en las ganancias en comparación con las demás razas locales en EE.UU. Si consideramos la raza Polypay para la importación debemos tener cierta prudencia, ya que no resulta adecuada a todos los medios y a todos los sistemas de producción en el mundo, en particular allí donde los recursos nutricionales y de manejo son insuficientes para consentir la lactación de ovejas con partos gemelares.

Key words: *Polypay sheep, Reproduction, Genetics, Wool, Lamb.*

Introduction

A new synthetic breed is usually created to meet a need not currently met by existing breeds and may be developed more quickly than by waiting over a longer period for the slower selection response of existing breeds. The Polypay breed is perhaps the best example of a successful new breed with increasing popularity in the USA and Canada.

The breed was developed as a four-breed composite at the U.S. Sheep Experiment Station, Dubois, Idaho during the 1970's. The Polypay breed was originally developed as a range breed with superior reproductive performance compared to traditional sheep breeds under herded grazing conditions of the Rocky Mountain region of the northwest USA. However, the breed was quickly accepted by many farm flock producers because of its high prolificacy rate, out-of-season breeding ability, and capability to produce two lamb crops annually. The profitability of the Polypay has been demonstrated to exceed that of other American range breeds (Knight and Snowder, 1995). This paper reviews the characteristics of the Polypay breed.

Discussion

Characterization of the Polypay must be based on research findings and in comparison with known reference breeds. Research on the Polypay breed has generally been performed at the U.S. Sheep Experiment Station under extensive range management. Limited research has been reported under intensive farm flock production. The Polypay breed has been compared with reference breeds including the Rambouillet, Columbia and Targhee. The Rambouillet is a wool breed of Merino descent and a common US western range breed. The Columbia and Targhee breeds were developed at the U.S. Sheep Experiment Station and are less known abroad. The Columbia was developed about 1912 from mating Rambouillet ewes to Lincoln rams (Marshall, 1949) to produce a large-frame ewe that would produce lambs with the potential for heavier carcasses. The Targhee was developed in 1926 by backcrossing the Lincoln-Rambouillet crossbred to the Rambouillet (Terrill, 1947) with the breeding objective of improved wool characteristics. The acceptance of the Polypay depends on its ability to improve profitability when compared with these traditional breeds under similar management and production systems.

Breed development

The Polypay breed was developed by Dr. Clarence Hulet at the U.S. Sheep Experiment Station. Dr. Hulet's breeding objective was to develop a breed with a reproductive capacity markedly superior to that of domestic western range breeds (Hulet *et al.*, 1984). He selected four breeds with desirable characteristics to produce the composite breed: Finnish Landrace with its high prolificacy and early puberty; Rambouillet and Targhee because of their adaptability to western range conditions, herding instinct, and fleece characteristics; and the Polled Dorset with early puberty, extended breeding season, milking ability, and favorable carcass characteristics. In 1968, six imported Finnish Landrace rams were bred to foundation Rambouillet ewes to produce Finnish Landrace x Rambouillet crosses. Four unrelated large-bodied Dorset rams born as twins from ewes with outstanding lifetime production records were mated to Targhee ewes to produce Dorset x Targhee crosses. In 1970, the first 4-breed composites were born from crossing Finnish Landrace x Rambouillet sheep to Dorset x Targhee sheep. The 4-breed composites were then *inter se* mated and selected heavily for lamb production.

Evaluation of the 4-breed composite occurred for several years with the conclusion that the composite met the original breeding objectives. In 1975, Dr. Hulet named the composite "Polypay" from 'poly' meaning many or much, and 'pay' to indicate profitability. The first Polypay sheep were sold to the public at the U.S. Sheep Experiment Station in 1975. The American Polypay Sheep Association was formed in 1980. Today, there are an estimated 150 Polypay purebred sheep flocks with an undetermined number of commercial flocks in the USA.

Criticisms of the breed occurred early in its development and were based on comparison with the more familiar range breeds of Targhee and Rambouillet. Some criticisms were justified while others were unfounded.

Polypay sheep were smaller in mature body size and often exhibited conformation characteristics of the Finnish Landrace such as fine bone structure and pink skin pigmentation of the eye, nose, and ear areas. Because of the larger litter sizes born to Polypay ewes, lamb birth weights were lighter and there were concerns about lamb survival and growth rates. Initially, Polypay fleeces were too variable in fiber diameter and staple length, and too light weight. Continued selection and research on the Polypay at the U.S. Sheep Experiment Station and on private farms has affirmatively addressed all of these early criticisms.

Ewe body size and conformation

During the early stages of the breed development, a moderate body size that would be reproductively efficient was desirable. Initial selection criteria always emphasized superior reproductive performance with no concurrent selection pressure applied to increase body size. However, mature body size gradually increased among Polypays. During a recently concluded 12 year selection study at the U.S. Sheep Experiment Station in which selection was based solely on total litter weight weaned at 120 days postpartum under western range grazing conditions, total litter weight increased an average of 0.70 kg per year and the correlated response in ewe body weight was an increase of 0.82 kg per year (Ercanbrack and Knight, 1998). Consequently, the mature size of the breed has increased with increased lamb production under range conditions. Currently, the average body weight for a mature Polypay ewe is 72 kg, and in some flocks the average mature ewe weight may range from 60 kg to 82 kg. By comparison, Polypay ewes are approximately 95 percent of the mature size of Rambouillet and Targhee ewes at the U.S. Sheep Experiment Station.

The general appearance of the Polypay is a medium sized wool sheep with a smooth body free of excessive skin wrinkles on the neck and body (Figures 1 and 2). The head is



Figure 1. Yearling Polypay ram.



Figure 2. Mature shorn Polypay ewes and lambs.

Table 1. Reproductive performance of Polypay ewes by age.

Age	Number of observations	Breeding Season	Fertility (%)	Lambs			Litter weight weaned (kg)	Source
				Born	Weaned	Weaning age		
7 to 8 months	98	Fall	95	n/a	n/a	n/a	n/a	Hulet <i>et al.</i> , 1984
6 to 18 months	1 921	Fall	n/a	1.50	n/a	n/a	n/a	Notter, 2000
1 year	53	Fall	94	n/a	1.17	90	26.4	Ramdas <i>et al.</i> , 1993
1 to 6 years	236	Fall	96	1.74	n/a	n/a	n/a	Nawaz and Meyer, 1992
Mature, > 2 years	50	Fall	90	2.07	1.64	120	n/a	Hulet and Ercanbrack, 1979
Mature, > 30 months	2 392	Fall	n/a	2.13	n/a	n/a	n/a	Notter, 2000
Mature, > 3 years	789	Fall	96	2.37	1.73	120	63.8	Snowder (unpublished data)
Mature	2 031	Fall	95	2.03	1.44	120	41.6	Ercanbrack and Knight, 1998
6 to 18 months	45	Spring	n/a	1.26	n/a	n/a	n/a	Notter, 2000
1 year	14	Spring	52	n/a	n/a	n/a	n/a	Hulet <i>et al.</i> , 1984
18 to 30 months	225	Spring	n/a	1.62	n/a	n/a	n/a	Notter, 2000
Mature, > 30 months	697	Spring	n/a	1.74	n/a	n/a	n/a	Notter, 2000

polled with an open white face. Ears are medium length and covered with white hair. Mature ewes are 70 to 85 cm tall when measured to the shoulder. Undesirable pink skin pigmentation on the eye, nose, and ear was frequently observed in the early generations of the breed's development but has been largely eliminated by selection.

Reproductive characteristics

The Polypay breed is well known for its early puberty and high prolificacy rate. Reproductive performance of the Polypay has been well investigated (Table 1). Hulet *et al.* (1984) reported a conception rate at fall season breeding of 94 to 97 percent for 7 to 8 month old Polypay ewes compared to 16 to 37 percent for Rambouillet and 57 to 73 percent for Targhee ewe lambs. At older ages, conception rates for fall season breeding generally average 95 percent. Average number of spring born lambs per yearling ewe exposed is 1.5 (Notter, 2000). Mature ewes typically give birth to 1.7 to 2.4 spring born lambs, depending upon management and production system. By comparison with most other non-Finnish Landrace crossbred and purebred breeds in the USA, the Polypay has one of the highest levels of fertility and prolificacy (Hulet *et al.*, 1984; Nawaz and Meyer, 1992; Ramdas *et al.*, 1993; Ercanbrack and Knight, 1998; Notter, 2000).

Also, the Polypay has been reported to have heavier litter weight weaned per ewe

and adjusted individual lamb weaning weights compared to many different crossbred and purebred types (Hulet and Ercanbrack, 1979; Hulet *et al.*, 1981; Ercanbrack and Knight, 1985 and 1989; Nawaz *et al.*, 1992; Knight and Snowden, 1995). Litter weight weaned at 120 days postpartum has steadily increased in selected Polypay lines at the U.S. Sheep Experiment Station. The average 120 day litter weight weaned at the U.S. Sheep Experiment Station from 1976 to 1988 was 41.6 kg (Ercanbrack and Knight, 1998) while the present average is 63.8 kg (Snowden, unpublished data). Because direct and genetic responses to selection for litter weight weaned in this flock have shown steady improvement (Ercanbrack and Knight, 1998) the biological optimal production level for this trait has not been observed under the management and production system evaluated. Litter weight weaned is a composite trait and genetic improvement in this trait was attributed to correlated improvements of prolificacy, lamb survival, lamb weaning weight, ewe fertility, and ewe viability (Snowden *et al.*, 1996; Ercanbrack and Knight, 1998).

Ovulation rate and uterine efficiency of the Polypay exceeded that of numerous crossbred types (Nawaz and Meyer, 1991). At 5 and 6 years of age, the average ovulation rate for Polypay ewes was observed to be 1.94. This resulted in 1.88 lambs born per ewe ovulating, or uterine efficiency of 96 percent.

Table 2. Average reproductive performance of mature Polypay ewes in once- and twice-a-year lambing groups^a.

Lambings per year	Number exposed	Lambs born	Lambs weaned	Litter weight weaned (kg)
Once in fall	165	1.83	1.49	46.5
Twice				
Winter	242	1.74	1.41	47.9
Summer	190	0.47	0.37	11.7
Total annual	242	2.11	1.70	57.1

^a Production expressed on a per ewe exposed basis.

Source: Hulet *et al.*, 1984.

Nawaz and Meyer (1991) also reported that the association between body weight and ovulation rate was largest in the Polypay compared to crossbred types and predicted a 10 percent increase in body weight increases ovulation rate by 6 percent. This agrees with the correlated increase in Polypay body weight observed by Ercanbrack and Knight (1998) when selection emphasized total litter weight weaned.

Season of lambing alters the expression of prolificacy in Polypays. Compared to spring lambing, average prolificacy of mature ewes was reduced by 0.24 lambs in the summer and 0.31 lambs in the autumn (Notter, 2000).

Occasionally, the Polypay has been managed in commercial twice-a-year lambing production systems. Comparisons of once- and twice-a-year lambings suggest that lamb production can be increased (Table 2; Hulet *et al.*, 1984). However, the economic parameters for lambing twice-a-year can vary significantly and producers should consider such parameters to estimate the profitability of twice-a-year lambing. Twice-a-year lambing is not common in the USA, rather production systems with 3 lambings in 2 years occasionally exist.

Reproductive characteristics were reported on a small sample of Polypay rams (n=4) by Fitzgerald and Stellflug (1990). They concluded that two and one-half year old Polypay rams exhibited greater libido in long season days, had greater epididymal reserves of sperm and similar scrotal circumferences when compared to Rambouillet and Columbia rams.

Birth and growth characteristics

Polypay lambs weigh less at birth than those born to Rambouillet and Targhee ewes. This difference is due to both a maternal influence and a result of the higher percentage of lambs born in multiple birth litters. Average birth weights of twin or triplet born Polypay lambs are 4.1 and 3.7 kg, respectively. Lower incidences of dystocia or assisted births have been observed for both single and multiple births in Polypay ewes when compared to crossbred ewes (Nawaz and Meyer, 1992).

Survival of Polypay lambs exceeds that of traditional breeds (Snowder and Knight, 1995). Table 3 shows the superiority of the Polypay's survival from both birth to 21 days of age and from 21 days of age to 120-day weaning age compared to Rambouillet and Targhee lambs under western range conditions of the USA. Increased survival rates of Polypay lambs may be the result of its Finnish Landrace genetic component; higher survival rates for crossbred Finnish Landrace lambs have often been reported (Oltenacu and Boylan, 1981; Ercanbrack and Knight, 1985 and 1989; Gama *et al.*, 1991).

The maternal influence of the Polypay breed on lamb survival may also be important. Snowder and Knight (1995) investigated the effect of breed of foster dam on lamb survival to weaning at 120 days when breed of lamb and foster dam differed. They reported higher rearing success for Polypays (86 percent) than for Rambouillet (84 percent), Targhee (75 percent), or Columbia foster ewes (82 percent).

Table 3. Survival rate (%) of lambs by breed from birth to 21-day of age and thereafter to 120-day weaning age.

Breed	21-day	120-day
Polypay	96.2	92.8
Rambouillet	93.1	89.9
Targhee	91.4	86.7

Source: Snowder and Knight, 1995.

A production concern associated with the Polypay is inadequate milk production for first parity ewes especially those rearing twin lambs (Snowder *et al.*, 2001a and 2001b). This is a common production concern among high prolificacy breeds. Generally, commercial producers will remove one twin lamb from a ewe with inadequate milk production and attempt to graft it onto a ewe capable of raising the orphan, but this is labor intensive and not always successful. First parity subjective milk scores are associated with both lamb survival and pre-weaning growth rate (Snowder *et al.*, 2001a), and milk production at first parity can be improved at a moderate rate by selection (Snowder, 2001b).

Because the American Polypay Sheep Association (Milo, Iowa) maintains an open registry book which permits the introduction of new germplasm for breed improvement, crossbreeding the Polypay with a milking sheep breed may be feasible. The U.S. Sheep Experiment Station used crossbreeding to produce $\frac{1}{4}$ East Friesian $\frac{3}{4}$ Polypay ewes and is evaluating their first parity milking performance when compared to purebred Polypays.

Growth rate of Polypay lambs compares favorably to other white-faced western breeds. Under western range conditions where ewes and lambs are herded in flocks of approximately 1 000 ewes on open mountain ranges at elevations ranging from 2 000 to

2 900 m, lambs are weaned at approximately 120 days of age. Average weaning weight was heavier for Polypay lambs (36.1 kg) than for Rambouillet (33.8 kg) or Targhee lambs (34.5 kg) (Snowder and Knight, 1995). Post weaning growth rate of Polypay lambs has also been found to be comparable to that of Rambouillet and Targhee lambs, both in grazing and feedlot situations (unpublished data).

Carcass characteristics

During the early years of the Polypay development, lambs with Finnish Landrace breeding were disliked by the US lamb packing industry because of their lighter carcasses and smaller frames. However, extensive research studies under a wide variety of production conditions found that when $\frac{1}{4}$ and $\frac{1}{2}$ Finnish Landrace ewes were mated to meat-type terminal rams such as the Suffolk, resulting crossbred lambs were hardy and of acceptable carcass quality (Boylan *et al.*, 1976; Thomas *et al.*, 1976; Dickerson, 1977; Dahmen *et al.*, 1979; Magid *et al.*, 1981; Snowder *et al.*, 1986).

A recent study found lamb carcasses of purebred Polypays similar in most respects to those of Rambouillets, Targhees, and Columbias. (Snowder *et al.*, 1994). Carcass measures of Polypay and traditional breed

Table 4. Least squares means for carcass traits of four sheep breeds^a.

Trait	Polypay	Rambouillet	Targhee	Columbia	SEM
Slaughter wt., kg	53.7	53.3	52.3	53.9	0.61
Dressing, %	51.5 ^b	50.4 ^b	50.1 ^b	49.3 ^c	0.21
Backfat depth, mm	7.2 ^{bd}	8.6 ^c	7.7 ^{bc}	6.3 ^d	0.03
Body wall thickness, cm	2.4 ^{bd}	2.5 ^b	2.7 ^c	2.3 ^d	0.05
Kidney and pelvic fat, %	3.9 ^b	4.2 ^b	4.0 ^b	3.1 ^c	0.11
Ribeye area, cm ²	12.3	12.9	12.3	12.3	0.18

^a Source: Snowder and Knight, 1995.

^{b,c,d} Values within a row with different superscripts differ (P>.05).

lambs are presented in Table 4. Polypay carcasses were similar to those of Rambouillet and Targhee for dressing percentage, body wall thickness, kidney and pelvic fat as a percentage of the carcass weight, and ribeye area. Measures of fat (back fat depth, body wall thickness, and kidney and pelvic fat percentage) were less in the Polypay when compared to the Rambouillet and Targhee. Visually evaluated qualitative leg scores were more favorable for the Polypay than the other three breeds in the study.

Wool characteristics

Polypay sheep produce coarse to medium grade wool with a fiber diameter ranging from 24 to 33 μm . Fiber staple length ranges from 7.6 to 12.7 cm with a common mean of approximately 10 cm. Raw fleece weights are considered light and range from 2.7 to 4.5 kg. Polypay ewes at the U.S. Sheep Experiment Station typically shear 3.6 kg of wool. The average clean wool yield is approximately 57 percent. Average lifetime fleece weights for $\frac{1}{4}$ Finnish Landrace crossbred ewes were reported to be 95 percent as heavy as those of purebred sheep (Columbia, Rambouillet and Targhee; Ercanbrack and Knight, 1989). Yearling fleece weights of first generation Polypay ewes were 8 percent lighter than those of Targhees (3.05 vs 3.33 kg; Ramdas *et al.*, 1993). Table 5 summarizes four years (1997 to 2000) of Polypay ram wool data collected from the U.S. Sheep Experiment Station. Ram lambs produce lighter fleeces (2.8 kg) with finer fiber diameters (23.5 μm) wool than 2 year old rams (4.1 kg and 26.9 μm , respectively). The Polypay breed has

improved in fleece uniformity during the 25 years since its release. Selection for improved wool characteristics has been practiced in private flocks but is less emphasized since the worldwide decline in wool prices.

Processing characteristics of Polypay wool were not favorable as a worsted yarn (Stobart *et al.*, 1986). Yield of processed scoured top ranged from 77 to 82 percent with a high level of waste (noils) 18 to 24 percent. The high percentage of noils was related to a fiber strength problem caused by breakage during the high stresses imposed by the worsted processing system. The percentage of medullated fibers ranged from 0.2 to 1.6 percent across the ages of 1 to 4 years; levels exceeding 0.5 percent decrease the economic value of the yarn. Additionally, yarns of Polypay wool did not have acceptable evenness values (coefficient of variation of 16 to 26 percent) when compared with Uster standard values. Tenacity values (tensile strength of 4 to 7 cN/tex) were lower than the Uster Statistics, indicating fabrics made of Polypay wool would be of marginal quality for worsted processing. However, Polypay wool would be of similar value to that of most coarse to medium grade wool breeds.

Flocking behavior

The flocking behavior of Polypay sheep has not been reported; however, the frequent use of Polypay sheep under herded conditions on open range of the intermountain western region of the USA suggests that they have an acceptable herding instinct. Hulet *et al.* (1992)

Table 5. Fleece and fiber characteristics of Polypay rams.

Age	No. of rams	Fleece weight, kg	Fiber diameter, μm	
			Average	Range
10 to 11 months	251	2.8	23.5 \pm 1.6	19.3 to 28.9
2 year	105	4.1	26.9 \pm 1.8	22.5 to 32.5

reported no differences in the flocking behavior between Rambouillet and Rambouillet x Polypay female sheep but did observe significant differences in flocking behavior as affected by flock size and age groups.

Production longevity

Polypay sheep tend to live and produce as long as Rambouillet, Targhee and Columbia sheep under western range herded conditions (Snowder, unpublished data). In a university farm flock production system, the average number of productive years for Polypay ewes has exceeded that of some crossbred types (Nawaz *et al.*, 1992; Ramdas *et al.*, 1993). When observed from 1 to 7 years of age, the length of time a ewe remained productive under range conditions did not differ between $\frac{1}{4}$ Finnish Landrace crossbred ewes and Rambouillet, Targhee and Columbia purebred ewes (Ercanbrack and Knight, 1985 and 1989) although the highest attrition rates occurred in purebreds. Iniguez *et al.* (1986) reported that production longevity of Rambouillet x Finnish Landrace and Dorset x Finnish Landrace crossbred ewes in a farm flock fall lambing production system was equal to or greater than that of Rambouillet or Dorset ewes.

Economic evaluation

In most sheep producing countries of the world today, the production trait with the highest profitability is weight of quality lamb marketed per ewe exposed. This is a composite trait dependent upon reproduction, maternal ability, lamb survival, lamb growth, and slaughter value. The value of wool accounts for less than 10 percent of the gross income and may even be a cost when shearing expenses exceed the return. Therefore, sheep producers would be wise to seek out those breeds that enhance profitability.

The economic advantage of the Polypay breed in the USA has been well documented. Hulet *et al.* (1981) compared gross sales from

wool and lamb production in four breeds and Finnish Landrace crosses under range conditions. Gross sales from Polypay and Finnish Landrace cross mature ewes were significantly higher than Rambouillet, Targhee, and Columbia mature ewes by 21, 30, and 36 percent, respectively. Hulet *et al.* (1981) concluded that the Polypay's moderate body size and increased reproductive rate made it more profitable. Ercanbrack and Knight (1985 and 1989) reported a 15 to 18 percent greater net value of lifetime production from a $\frac{1}{4}$ Finnish Landrace crossbred compared to adapted domestic breeds. Knight and Snowder (1995) considered the economic status of production systems with reproduction and wool levels varying according to traditional breeds (Rambouillet) and Finnish Landrace crosses (Polypay) as affected by increased grazing fees on public range and the loss of the federal wool incentive program. The early puberty and increased lamb production of Polypay ewes resulted in a profitable range sheep production system while production systems with traditional breeds were predicted to be unprofitable under most scenarios studied.

Biological efficiency as defined as the annual litter weight weaned divided by mean ewe weight^{0.75} was reported to be highest in the Polypay breed compared to various crossbred types in a farm flock production system (Nawaz *et al.*, 1992).

Limitations to the environment and production systems in which the Polypay may be profitable probably exist. Some sheep producers found Polypay or Finnish Landrace crossbreds to be undesirable for their production system (Snowder *et al.*, 1986). These unsuccessful attempts have usually occurred in desert regions where environmental conditions would be expected to be less conducive to maintaining a lactating ewe rearing twin lambs. Some producers have objected to the increased labor required at lambing to assist more new born lambs to suckle, although this concern may be minimal.

Conclusions

The Polypay breed, by comparison to most other US sheep breeds, is a highly productive breed under the range and farm flock production systems where it has been studied. The breed may also be profitable in other parts of the world where lamb production is the most economically important trait. The medium coarse wool is not of significant value at present wool prices. Also, importation by foreign countries may expose the breed to diseases to which it is not immune. The Polypay breed appears to meet most criteria to be a profitable breed under current US production systems.

References

- Boylan, W.J., Berger, Y.M. & Allen, C.E.** 1976. Carcass merit of Finnsheep crossbred lambs. *J. Anim. Sci.* 42, 1413-1420.
- Dahmen, J.J., Hinman, D.D., Jacobs, J.A. & Everson, D.O.** 1979. Performance and carcass characteristics of Suffolk sired lambs from Panama and Finn x Panama dams. *J. Anim. Sci.* 49, 55-62.
- Dickerson, G.E.** 1977. Crossbreeding evaluation of Finnsheep and some U.S. breeds for market lamb production. North Central Regional Publication No. 246. North Central Project NC-111, USDA, ARS, Beltsville, MD, pp. 30.
- Ercanbrack, S.K. & Knight, A.D.** 1985. Lifetime (seven years) production of ¼- and ½-Finnish Landrace ewes from Rambouillet, Targhee and Columbia dams under range conditions. *J. Anim. Sci.* 61, 66-77.
- Ercanbrack, S.K. & Knight, A.D.** 1989. Lifetime (seven years) production of ¼- and ½-Finnish Landrace ewes from Rambouillet, Targhee and Columbia dams as affected by natural attrition. *J. Anim. Sci.* 67, 3258-3265.
- Ercanbrack, S.K. & Knight, A.D.** 1998. Responses to various selection protocols for lamb production in Rambouillet, Targhee, Columbia, and Polypay sheep. *J. Anim. Sci.* 76, 1311-1325.
- Fitzgerald, J.A. & Stellflug, J.N.** 1990. Comparison of scrotal circumference, sperm output and libido of Booroola Merino, Polypay, Rambouillet and Columbia rams in a controlled photoperiod. *SID Sheep Res. J.* 6(2), 11-14.
- Hulet, C.V. & Ercanbrack, S.K.** 1979. Polypay sheep on the range. *National Wool Grower*, June, 17-18.
- Hulet, C.V., Ercanbrack, S.K. & Knight, A.D.** 1981. The future for new synthetic breeds or types of sheep. *Int. Goat and Sheep Res.* 4, 248-257.
- Hulet, C.V., Ercanbrack, S.K. & Knight, A.D.** 1984. Development of the Polypay breed of sheep. *J. Anim. Sci.* 58, 15-24.
- Hulet, C.V., Anderson, D.M., Shupe, W.L. & Murray, L.W.** 1992. Effects of age and flock size on flocking behavior in Rambouillet and Rambouillet x Polypay female sheep. *Sheep Res. J.* 8(3), 112-115.
- Iniguez, L.C., Bradford, G.E. & Mwai, A.O.** 1986. Lambing date and lamb production of spring-mated Rambouillet, Dorset and Finnsheep ewes and their F1 crosses. *J. Anim. Sci.* 63, 715-728.
- Gama, L.T., Dickerson, G.E., Young, L.D. & Leymaster, K.A.** 1991. Effects of breed, heterosis, age of dam, litter size, and birth weight on lamb mortality. *J. Anim. Sci.* 69, 2727-2743.
- Knight, A.D. & Snowder, G.D.** 1995. Genetic alternatives addressing the economic impact of changes in public lands grazing

policy and loss of the wool incentive program on intermountain range sheep production systems. *Sheep and Goat Res. J.* 3, 140-148.

Magid, A.F., Swanson, V.B., Brinks, J.S., Dickerkson, G.E., Crouse, J.A. & Smith, G.M. 1981. Border Leicester and Finnsheep crosses. III. market lamb production from crossbred ewes. *J. Anim. Sci.* 52, 1272-1279.

Marshall, F.R. 1949. The making of the Columbia sheep. *National Wool Grower* 39(4), 9-11.

Nawaz, M. & Meyer, H.H. 1991. Effects of genotype and mating weight on ovulation rate, litter size, and uterine efficiency of Coopworth, Polypay, and crossbred ewes. *J. Anim. Sci.* 69, 3925-3930.

Nawaz, M. & Meyer, H.H. 1992. Performance of Polypay, Coopworth, and crossbred ewes: I. reproduction and lamb production. *J. Anim. Sci.* 70, 62-69.

Nawaz M., Meyer, H.H. & Thomas, D.R. 1992. Performance of Polypay, Coopworth, and crossbred ewes: II. survival and cumulative lamb and wool production over 4 years. *J. Anim. Sci.* 70, 70-77.

Notter, D.R. 2000. Effects of ewe age and season of lambing on prolificacy in US Targhee, Suffolk, and Polypay sheep. *Small Rum. Res.* 38, 1-7.

Oltenacu, E.A.B. & Boylan, W.J. 1981. Productivity of purebred and crossbred Finnsheep. I. Reproductive traits and lamb survival. *J. Anim. Sci.* 52, 989-997.

Ramdas, S., Dally, M., Bradford, E. & Sakul, H. 1993. Lamb and wool production of Targhee and prolific breed crossbred ewes. *Sheep Res. J.* 9(2), 62-70.

Snowder, G.D., Shelton, M. & Thompson, P. 1986. Evaluation of Finn-cross and Rambouillet ewes under Texas range conditions. *SID Research Digest*, Winter, 31-35.

Snowder, G.D., Glimp, H.A. & Field, R.A. 1994. Carcass characteristics and optimal slaughter weights in four breeds of sheep. *J. Anim. Sci.* 72, 932-937.

Snowder, G.D. & Knight, A.D. 1995. Breed effects of foster lamb and foster dam on lamb viability and growth. *J. Anim. Sci.* 73, 1559-1566.

Snowder, G.D., Hatfield, P.G. & Knight, A.D. 1996. Composite trait for lamb production. In: *Proceedings of the National Sheep Genetics Symposium*, Sept 5-6, 1996. Columbus, OH. American Sheep Industry Association, Engelwood, CO, pp. 137-144.

Snowder, G.D., Knight, A.D., Van Vleck, L.D., Bromley, C.M. & Kellom, T.R. 2001a. Usefulness of subjective ovine milk scores. I. associations with range ewe characteristics and lamb production. *J. Anim. Sci.* 79, 811-818.

Snowder, G.D., Knight, A.D., Van Vleck, L.D., Bromley, C.M. & Kellom, T.R. 2001b. Usefulness of subjective ovine milk scores. II. genetic parameter estimates. *J. Anim. Sci.* 79, 869-876.

Stobart, R.H., Gott, N. & Parker, C.F. 1986. Processing characteristics of Polypay wool. *J. Anim. Sci.* 63, 692-699.

Terrill, C.E. 1947. Breed crosses in the development of Targhee sheep. *J. Anim. Sci.* 6, 83-92.

Thomas, D.L., Whiteman, J.V. & Walters, L.E. 1976. Carcass traits of lambs produced by crossbred dams of Finnsheep, Dorset and Rambouillet breeding and slaughtered at two weights. *J. Anim. Sci.* 43, 373-379.

Genetic diversity between Italian and Greek buffalo populations

B. Moiola^{*}, A. Georgoudis², F. Napolitano¹, G. Catillo¹,
S. Luciolì¹, Ch. Ligda² & J. Boyazoglu²

¹*Istituto Sperimentale per la Zootecnia, via Salaria 31,
00016 Monterotondo, Italy*

²*Dept. of Animal Production, Aristotle University of Thessaloniki,
54006 Thessaloniki, Greece*

Summary

The present study is a first step of a global project aiming at the estimation of the genetic distances and relationships among buffalo breeds and sub-populations and the investigation of the production potential and adaptability of different buffalo genotypes in various environments.

Genetic diversity of Italian and Greek buffalo populations was estimated on the basis of allele frequencies at nine polymorphic microsatellite loci: CSSM43, CSSM38, DRB3, D21S4, CYP21, CSSM47, CSSM60, CSSM36 and CSSM33. The number of detected alleles per locus varied from two (D21S4) to thirteen (CSSM47). Allele frequency distribution was similar in the two populations, which have the same alleles at the highest frequency at all loci, except loci CSSM47 and CSSM60. Average gene diversity over all loci was 0.60. Across-loci average gene diversity increased with the number of alleles. Observed average heterozygosity was 0.167 and 0.177 in the Italian and Greek populations, respectively. The degree of differentiation between Italian and Greek buffalo was moderate and estimated at 0.021 ± 0.009 .

Resumen

El presente estudio representa un primer paso dentro de un proyecto global orientado a la estimación de las distancias genéticas y relaciones entre las razas de búfalos y las sub

poblaciones y la investigación sobre la producción potencial y la adaptabilidad de los distintos genotipos de búfalos en condiciones ambientales diversas.

La diversidad genética de las poblaciones italianas y griegas de búfalos fue estimada en base a las frecuencias de alelos en nueve loci microsatélites polimórficos: CSSM43, CSSM38, DRB3, D21S4, CYP21, CSSM47, CSSM60, CSSM36 y CSSM33. El número de alelos detectados por locus varió de dos (D21S4) a trece (CSSM47). La distribución de la frecuencia de los alelos fue similar en las dos poblaciones, que poseen los mismos alelos en la frecuencia más alta en todos los loci, excepto los loci CSSM47 y CSSM60.

La media de diversidad de genes en todos los loci fue de 0,60. Entre los loci la media de diversidad de genes aumentó con el número de alelos. La media observada de heterocigosidad fue de 0,167 y 0,177, en las poblaciones italianas y griegas respectivamente. El nivel de diferenciación entre el búfalo italiano y griego fue estimado en $0,021 \pm 0,009$.

Keywords: *Buffalo, Microsatellites, Genetic diversity.*

^{*}Corresponding author.
Tel.: +39-06-900901; Fax: +39-06-9061541
E-mail address: isz@flashnet.it

Introduction

Domestication of water buffalo occurred 5 000 years ago, more recently than the domestication of *Bos taurus* and *Bos indicus* (10 000 years ago) (Loftus *et al.*, 1994). Compared to cattle, buffalo productivity in meat and milk is generally lower, therefore, buffalo farming was abandoned in many countries and left to the areas where cattle were not able to produce efficiently due to climate, parasites, muddy lands, etc. and draught power is still needed. Buffaloes are now raised only in thirty countries in the world, from which over 96 percent are in Asia (Cockrill, 1974, 1984; Bhat, 1992).

Although in past centuries a worldwide exchange of cattle breeds, together with the adoption of similar management and selection schemes have taken place, every country followed their own path in the management of their respective populations as dictated by local conditions. The result of

this process was a wider differentiation of populations and productive traits, accentuated by the non-consistent exchange of genetic material between countries (Bhat, 1992; Mahadevan, 1992; Boyazoglu, 1996).

The scientific community is aware of the negative effects produced by the loss of variation in animal genetic resources, due to human interference. Livestock biodiversity is important because the genes and gene combinations they carry may be useful in the future for traits that are presently unknown or difficult to define, e.g. disease and stress resistance, quality and composition of products, adaptation to different environments or farming systems (Boyazoglu and Flamant, 1990; Matassino and Moili, 1996; Hammond, 1998; Boyazoglu, 1999).

In this context, the investigation of genetic relationships among buffalo populations in order to study their origin, domestication and



Figure 1. Italian buffalo in Tor Mancina farm, Rome, Italy.

genetic structure, will provide a useful tool in supporting conservation decisions and designing of breeding schemes.

The present study is a first step of a global project aiming at the evaluation of the genetic distances and relationships among buffalo populations and the investigation of production potential and adaptability of different buffalo genotypes in various environments. The implementation of the project started with the comparison of Italian and Greek buffalo populations.

In Italy in the past, buffalo was neglected, it was a poor milk producer but able to survive in unhealthy swampy lands. It has now become a highly desired livestock, which produces top quality and the highest-in-demand cheese (Rossi *et al.*, 1998). There are 150 000 buffaloes in Italy, 85 percent of them concentrated in Central-Southern regions. The average herd size is 50-100 animals. The low rate of AI use and the little exchange of breeding stocks among farms could lead to the independent genetic development of the herds (Pilla and Moioli, 1992).

In Greece, due to the rapidly changing socio-economic conditions, including the mechanization of the agricultural sector and the introduction of imported dairy cattle breeds, the number of buffaloes has declined dramatically over the last decades. As a result, from the 75 000 animals counted at the end of the 1950s, today only 1 000 heads remain in some wetlands in Northern Greece, particularly in the regions of Macedonia and Thrace. The population is distributed in 12 herds with an average herd size of 85 heads. These animals are mainly used for milk and meat production (Georgoudis *et al.*, 1994, 1998).

Recently, the developments in DNA technology for identification of genes and QTLs, provide useful tools in analyzing the genetic diversity and managing farm animal genetic resources. Microsatellites, which are now generally considered the most powerful genetic markers to describe genetic animal population variability, were proposed for the analysis of animal genetic diversity by the

Expert Working Group in the Secondary Guidelines for Development of Farm Animal Genetic Resources Management Plans, Measurement of Domestic Animal Diversity (FAO, 1998). The protocol in these guidelines is being followed in the present project, regarding the sampling, markers and statistical analysis.

Material and Methods

Sampling of animals of the two populations and DNA extraction

Buffaloes for genotyping were chosen in order to assure that they were a representative sample of the two populations. The sample of the Italian buffalo population analyzed in the present study was composed of 38 animals, 28 bulls in progeny testing, from 12 different farms located in six provinces and ten cows from different dams and sires of the research farm of the Ministry of Agriculture (Rome). The Greek population analyzed in the present trial consisted of 32 animals belonging to eight herds between which no exchange of breeding stock had occurred. Animals of each herd were chosen from different years of birth, to assure that they were born from different sires; in fact, it is common practice to use different breeding bulls every year.

DNA was extracted either from semen with the GENOMIX extraction kit (Talent, Trieste, Italy) or from frozen blood with the Qiagen extraction kit (Qiagen GmbH, Hilden Germany).

Microsatellite polymorphism detection

From the set of microsatellites, which were shown to be polymorphic in cattle and buffalo (FAO, 1998; Moore *et al.*, 1995), nine, CSSM043, DRB3, CYP21, D21S4, CSSM38, CSSM47, CSSM60, CSSM36 and CSSM33 were preliminarily amplified with polymerase chain reaction (PCR) using primer sequences as suggested in literature (Moore *et al.*, 1995). For all microsatellites, except CSSM36, PCR



Figure 2. Italian lactating buffaloes at the paddock.

products were analyzed with seven percent denaturing polyacrylamide-sequencing gels. Visualization was achieved by the silver staining procedure (Comincini *et al.*, 1995). Allele sizes were determined by comparison with a ten bp sequencing ladder (Life Technologies, TM). Microsatellite CSSM36 was analyzed for all samples, with a Perkin Elmer ABI Prism 310 Genetic Analyzer, purchased during the trial, using the Genescan software (Perkin Elmer) which detects different alleles by comparing sizes with standard DNA sizes (Tamra, Perkin Elmer).

Statistical analyses

Allele frequencies and mean heterozygosity estimates for each population were obtained using the FSTAT programme (Goudet, 1995). Average gene diversity at each locus was

calculated according to Nei's formula (Nei, 1973), for each population separately and for the two populations together. Average gene diversity across loci was regressed on the number of alleles at each locus, as in Barker *et al.* (1997).

Wright's fixation indices (Wright, 1943 and 1951) were computed using the FSTAT programme to assess genetic differentiation of populations. They represent the probability that two alleles chosen at random within the same population in generation t are identical by descent. F_{it} is the fixation index calculated for the total population, a measure of the global heterozygosity deficit (total inbreeding) (Barker *et al.*, 1997); F_{st} is the fixation index calculated for each of the two sub-populations, a measure of the between populations heterozygosity deficit and F_{is} is a measure of the within population heterozygosity deficit (inbreeding).

Table 1. Number of microsatellite alleles at each locus in Italian and Greek buffaloes, and number of shared alleles between the two populations.

Locus	Numbers of alleles			
	Total	Italian population	Greek population	Shared
CSSM43	4	2	4	2
DRB3	9	9	5	5
CYP21	4	4	4	4
D21S4	2	2	2	2
CSSM38	6	5	5	4
CSSM47	13	7	12	6
CSSM60	8	6	7	5
CSSM36	6	4	6	4
CSSM33	3	3	3	3
Mean	6.1	4.6	5.3	3.9

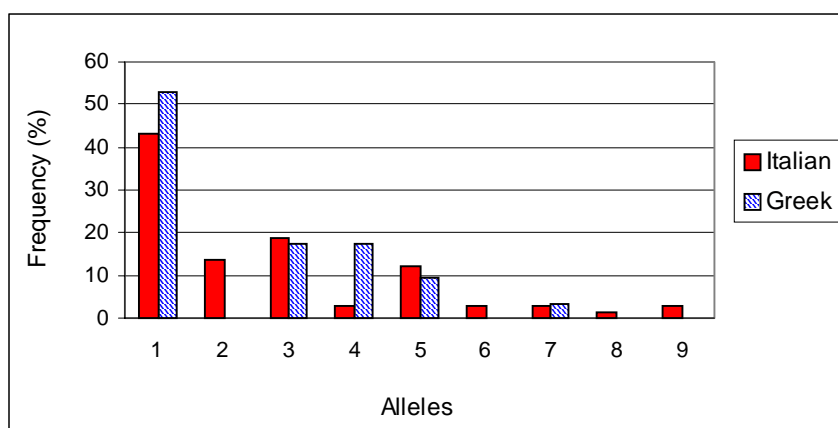


Figure 3. Allele frequencies at locus DRB3.

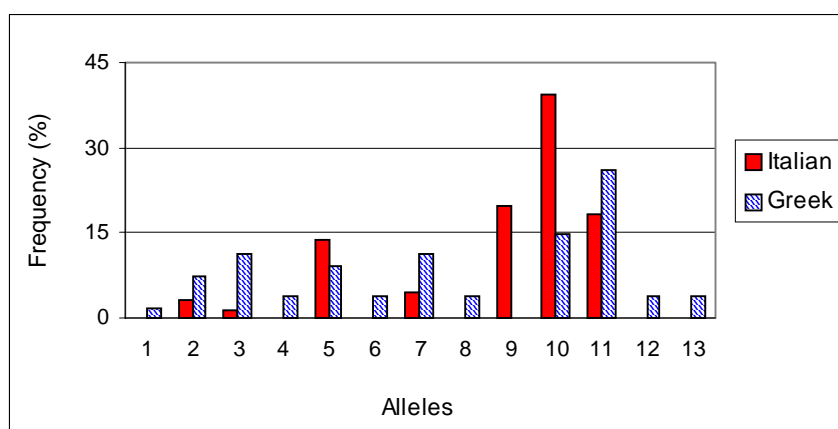


Figure 4. Allele frequencies at locus CSSM47.

Table 3. Average gene diversity.

Locus	Italian Population	Greek Population	Total
CSSM43	0.167	0.469	0.320
DRB3	0.741	0.649	0.712
CYP21	0.665	0.675	0.682
D21S4	0.437	0.452	0.444
CSSM38	0.660	0.680	0.686
CSSM47	0.751	0.866	0.835
CSSM60	0.754	0.812	0.801
CSSM36	0.603	0.691	0.650
CSSM33	0.312	0.327	0.320
Mean/locus	0.565	0.624	0.605

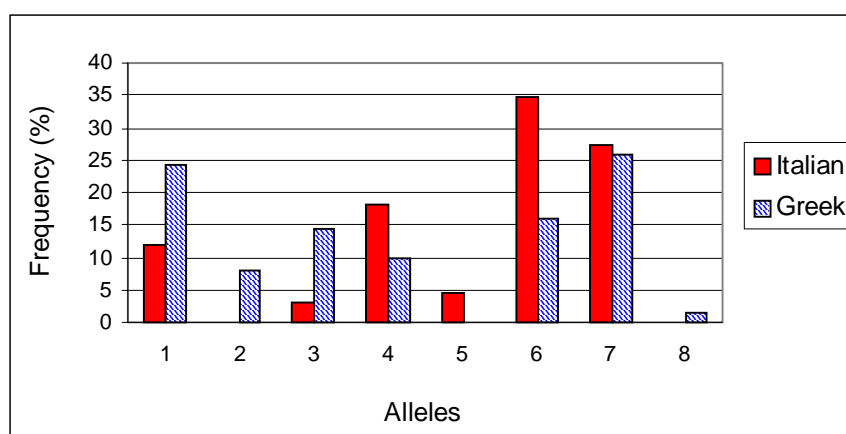


Figure 5. Allele frequencies at locus CSSM60.

Results

In table 1, allele frequencies for each of the nine microsatellite loci in each of the two populations are reported. The number of alleles per locus varied from two (D21S4) to thirteen (CSSM47). Only for three loci, CYP21, D21S4 and CSSM33, were all detected alleles found in both Italian and Greek buffaloes. The mean number of alleles per locus is slightly lower in the Italian groups (4.6) than in the Greek (5.3). In DRB3 locus, nine alleles were found in the Italian population, while in the Greek samples four of them were not detected (Figure 3). Conversely, in CSSM43 locus, four alleles were found in the Greek population of which only two were detected in the Italian one.

Allele frequency distribution at the nine analyzed loci is given in table 2. For six loci (CSSM43, CSSM38, DRB3, D21S4, CSSM36 and CSSM33) the same alleles are at the highest frequency in the Italian and Greek populations. At locus CYP21, the two populations showed consistent frequencies, although different, at loci 1, 2 and 3, while both of them have a very low frequency at locus 4. Locus CSSM47 is the most polymorphic, especially in the Greek population (Figure 4), followed by DRB3 (Figure 3) and CSSM60 (Figure 5).

Average gene diversity (Nei, 1973) over all loci in the two populations was 0.605, while for individual loci average gene diversity ranged between 0.320 (CSSM43; CSSM33) and 0.835 (CSSM47) (Table 2). Across loci, average

gene diversity increases by the number of alleles (regression co-efficient = 0.03 ± 0.01 , $P < 0.05$).

Observed heterozygosity averaged on all loci was 0.167 for the Italian and 0.177 for the Greek population. It was insignificantly lower than the expected heterozygosity (0.222 and 0.247, respectively for the Italian and the Greek).

Estimated means of the total fixation index separately for the two populations were 0.350 for the Italian and 0.242 for the Greek, indicating that the Italian population is more inbred.

Estimated mean for F_{st} (differentiation between Italian and Greek buffalo) was 0.021 ± 0.009 . The overall estimate of inbreeding co-efficient was 0.313 ± 0.054 .

Discussion

This is the first study on the genetic diversity of buffalo populations in Europe and the Near East, which are all considered to be of the Mediterranean type on the basis of their phenotype and performances where the results provide an indication on the feasibility of the methodology and give a preliminary description of some loci.

Observed heterozygosity (0.167 for the Italian and 0.177 for the Greek buffaloes) was not significantly different from the expected under the random mating assumption in either population (0.222 for the Italian and 0.247 for the Greek buffaloes). The lower values of the observed and expected heterozygosities, compared to the values found by Barker (1997) for river buffaloes in Asia (0.558 and 0.579), confirm that a considerable loss of biodiversity in buffalo has occurred in Europe, as a consequence of the decline in numbers and increased inbreeding.

Differentiation of the Italian and Greek buffaloes (0.021) resulted in even lower than the average differentiation (0.038) that Barker (1997) found between three different river buffalo populations, South Sri Lankan, Sri Lankan Murrah and Malaysian Murrah. Considering that the value of differentiation between swamp type buffalo obtained by

Barker (1997) was much higher (0.178) and that rates up to 0.15 indicate moderate differentiation between populations (Hartl, 1980), the obtained results (0.021) suggest that there is a need to investigate more thoroughly the genetic differences between the two populations through the analysis of further loci.

The Greek population seems to have a lower rate of inbreeding (0.242) in spite of its small size compared to the Italian (0.350), which may be explained by the absence of any directional selection. In addition, the expected heterozygosity in the Greek population is higher than in the Italian, indicating that the population has retained the presence of several alleles, although at a small frequency. This implies a higher amount of genetic variability that might be used in planning breeding strategies and can be exploited particularly in populations of small size. Furthermore, such variability could also be employed to detect genetic markers that might be linked to quantitative trait loci (QTL).

In order to have a better picture of the genetic diversity of the considered populations and to accurately estimate the diversity parameters when more than two populations are analyzed, FAO (1998) suggested that the number of polymorphic loci to be analyzed should not be less than 20. The present work will therefore be extended to include more microsatellite loci as well as other river buffalo populations.

References

- Barker, J.S.F., Moore, S.S., Hetzel, D.J.S., Evans, D., Tan, S.G. & Byrne, K.** 1997. Genetic diversity of Asian water buffalo: microsatellite variation and a comparison with protein-coding loci. *Anim. Genet.* 28, 103-115.
- Bhat, P.N.** 1992. Genetics of River Buffaloes. In Tulloh, N.M. & Holmes, J.H.G. (Eds), "Buffalo Production", Elsevier, pp. 13-58.

- Boyazoglu, J.** 1996. Growing interest in the Water Buffalo: A short bibliographic update. *Animal Genetic Resources Information* 19, 7-16.
- Boyazoglu, J.** 1999. Mediterranean systems of production. In "The world of pastoralism". Guilford Press, new York (USA), pp. 353-393.
- Boyazoglu, J. & Flamant, J. C.** 1990. Livestock production systems and local animal genetic resources with special reference to the Mediterranean Region, 7th Congress of the Mediterranean Federation for Ruminant Health & Production, Santarem, Portugal, 22-24 April, 1999, 31-40.
- Cockrill, W. Ross (Ed.)**, 1974. The Husbandry and Health of Domestic Buffalo. FAO, Rome, pp. 650.
- Cockrill, W. Ross**, 1984. Water Buffalo. In Mason, I.L. (Eds), *Evolution of Domesticated Animals*, Longman, pp. 52-63.
- Comincini S., Leone, P., Redaelli, L., DeGiuli, L., Zhang, Y. & Ferretti, L.** 1995. Characterization of bovine microsatellites by silver staining. *J. Anim. Breed. Genet.* 112, 415-420.
- FAO.** 1998. Secondary Guidelines for Development of Farm Animal Genetic Resources Management Plans, Measurement of Domestic Animal Diversity (MoDAD), Rome, 25-29.
- Georgoudis, A.G., Ligda, Ch. & Boyazoglu, J.** 1994. Population characteristics of water buffaloes in Greek wetlands. *Anim. Genet. Res.* 14, 83-95.
- Georgoudis, A.G., Papanastasis, V.P. & Boyazoglu, J.G.** 1998. Use of water buffalo for the environmental conservation of waterland. Review. 8th World Conference on Animal Production, Seoul, Korea, 341-350.
- Goudet, J.** 1995. FSTAT, Version 1.2: A computer program to calculate F-statistics. *J. Heredity* 86, 485-486.
- Hammond, K.** 1998. Development of the global strategy for the management of farm animal genetic resources. Proc. of the 6th World Congress on Genetics Applied to Livestock Production. Armidale, Australia, 11-16 January 1998. Vol 28, 43-50 .
- Hartl, D.** 1980. Principles of population genetics. Sinauer Associates Inc., Sunderland, Massachusset, USA, 164-165.
- Loftus, R.T., Machugh, D.E., Bradley, D.G., Sharp, P.M. & Cunningham, P.** 1994. Evidence for two independent domestications of cattle. *Proc. Natl. Acad. Sci.*, 91: 2757-2761.
- Mahadevan, P.** 1992. Distribution, Ecology and Adaptation. In "Buffalo Production", Tulloh, N.M. and Holmes, J.H.G. (Eds), Elsevier, pp. 1-12.
- Matassino, D. & Moioli, B.** 1996. The genetic improvement and the germplasm conservation for quality. Proc. Int. Symp. on Buffalo Products. Paestum, 1-4 December 1994. EAAP Publication no. 82, 131-144.
- Moore, S., Evans, D. & Byrne, K.** 1995. A set of polymorphic DNA microsatellites useful in swamp and river buffalo. *Animal Genetics* 26, 355-359.
- Nei, M.** 1973. Analysis of gene diversity in subdivided populations. *Proc. Nat. Ac. Sci. USA* 70, 3321-3323.
- Pilla, A. & Moioli, B.M.** 1992. Genetic evaluation of buffalo for milk production with an Animal Model. *Zoot. Nutr. Anim.*, 18, 207-218.
- Rossi, G., Moioli, B.M. & Borghese, A.** 1998. Buffalo farming: present situation and perspectives. I Georgofili, Quaderni, IV, Studio Editoriale Fiorentino, Firenze, Italy, 37-69

.....

**Vaz Portugal, A. , Pires da Costa, J.,
Mira, J.F. & Cortes Martins, L.** (Eds). Proc. of
the 7th Congress of the Mediterranean
Federation for Ruminant Health and
Production, Santarem, Portugal, 22-24 April
1999, 19-26.

Wright, S. 1943. Isolation by distance.
Genetics 28, 114-138.

Wright, S. 1951. The genetical structure
of populations. Ann. Eugen. 15, 323-354.

The Jakhrana Goat in India

B. Rai, S. Tiwari & B.U. Khan

Central Institute for Research on Goats, Makhdoom, P.O. Farah-281 122, Mathura, India

Summary

Jakhrana is an important dairy breed of the semi-arid tract of the Rajasthan State of India. The habitat of this breed is a small hamlet in the Aravali hill ranges. The breed is spread over a limited area and the population size is small. The breed is of medium size, with a predominantly black coloured coat with white spots on ears and muzzle. Body weight, body length, punch girth, heart girth and body height at 12 months of age were respectively, 30.9 ± 1.7 kg, 69.5 ± 1.9 cm, and 69.1 ± 1.4 cm, 61.9 ± 0.6 cm and 77.2 ± 1.6 cm in males and 22.6 ± 0.7 kg, 62.1 ± 0.8 cm and 63.3 ± 0.6 cm, 60.1 ± 0.6 cm and 69.1 ± 0.7 cm for the females. Pre-weaning and post-weaning body weight gains were higher in males. Overall milk yield in 181 days was 116 kg. Kidding rate was 75 percent in field conditions with a twinning percentage of 79.1 percent. The field survey on this breed indicated that the goats were managed in a traditional system. The goats were kept by the farmers to meet their nutritional as well as economic needs. The marketing of live goats and goat products had limitations. There is no breed conservation/improvement programme at the moment, this is urgently needed to improve this goat breed.

Resumen

La Jakhrana es una importante raza caprina de leche de la zona semi árida del Estado de Rajasthan en la India. El habitat de esta raza se encuentra en una pequeña aldea de las colinas de Aravali. La raza se extiende por una zona limitada y el tamaño de la población es bastante reducido. Esta raza es de tamaño medio, el color del manto es prevalentemente

negro con manchas blancas en las orejas y hocico. El peso corporal, largura, cinchera, circunferencia torácica, y altura a los 12 meses son, respectivamente, de 30.9 ± 1.7 kg, 69.5 ± 1.9 cm, y 69.1 ± 1.4 cm, 61.9 ± 0.6 cm y 77.2 ± 1.6 cm para los machos, y 22.6 ± 0.7 kg, 62.1 ± 0.8 cm y 63.3 ± 0.6 cm, 60.1 ± 0.6 cm y 69.1 ± 0.7 cm para las hembras. La ganancia de peso corporal pre y post destete es elevada en los machos. La producción total por lactación de 181 días fue de 116 kg. Los partos tienen lugar en condiciones de campo en 75% de los casos, con una incidencia gemelar del 79,1%. Una encuesta realizada sobre el terreno sobre esta raza indicó que normalmente el sistema de conducción era tradicional. Los agricultores crían a los animales para cubrir sus necesidades nutricionales así como económicas. El mercado de animales vivos y de productos caprinos presenta ciertas limitaciones. No existe actualmente un programa de conservación/mejora de la raza; por lo que resulta urgente tomar medidas a este respecto.

Key Words: *Jakhrana goat, Management practices, Production performance.*

Introduction

Goats have played a very vital role for man since prehistoric times. They were probably among the first animals to be domesticated around 9000-7000 BC (Zeuner, 1963). There are 20 defined goat breeds in India which constitute 20-25 percent of the total goat population and the remaining 75-80 percent are of a non- descript type with variable features. Goats are one of the dependable sources of income and provide nutritional support to the people living in the arid and

semi-arid, hilly and tribal areas. Seventeen percent of the world and 26 percent of the Asian goat population are found in India alone (FAO, 1997), which contribute significantly to the income of poor farmers by production of meat, milk, skins and other by-products.

The Jakhrana breed of goats found in the Rajasthan Province of the country, is well known for their production potential all over the country. This breed is well-recognized as a dairy breed with a good record of milk production. The name of the breed derives from the name of a village called 'Jakhrana' where the goat with the highest concentration is found. Jakhrana village is located in Behror Tehsil region of the Alwar district in Rajasthan, however, the breed is also found in neighbouring areas. Due to its dark black colour, the breed is locally known as '*Kali kotri*'. A survey conducted in the breeding area of Jakhrana indicated that the average herd size was 5.5 does and 4.1 kids per herd. Almost 50 percent of the herds was kept under extensive systems of management. The goats are mainly kept in improvised thatched houses with mud floors (76 percent farmers). Grazing was mostly dependent on poor range lands and lopping of trees (*P. cinreria*, *Z. numularia*) due to the shortage of biomass in the grazing area most of the time. Crop stubbles and residues are the potential source of seasonal grazing. During inclement weather goats are also fed on straw, dry fodder and tree leaves along with small quantity of grains.

Population and Distribution

Rajasthan with 13 percent of the total goat population of India had 5.56 million goats in 1951 which increased to 15.31 million in 1992 as per the Livestock Census of India (1992). Jakhrana is a hardy goat breed well adapted to the semi-arid climatic conditions of Rajasthan. The breed is found in Jakhrana village and neighbouring areas near Behror in the Alwar districts of Rajasthan (Acharya, 1982). However, cross goats of this breed are also found in neighbouring areas.

According to a rough estimate, the number of goats which are true to the breed is no more than 6 000. The total goat population of the Alwar district was 480 000 heads during the year 1988 (Census Report, 1988).

Climate/Adaptability

The agro-climatic conditions in the natural habitat of this breed is semi-arid with very low and erratic rain-fall. The Rajasthan State normally experiences an annual rainfall of 20 to 40 cm. However, in the home tract of the breed the average annual rainfall is 64.81 cm. The average temperature ranges between 8.3 and 40.6°C in this area (Acharya, 1982). During the rainy season good pastures are available whereas during the dry season only poor quality grazing is available and Jakhrana goats are well adapted to the semi-arid climatic conditions and thrive on such poor quality grazing. The natural habitat of this breed has sandy soil, lower water level and intermittent dry spells. Due to the climatic and soil conditions, agricultural activities are limited during the year. The grazing area for goats includes forest, wasteland and hillocks where trees and bushes are scanty.

Management Practices

A pilot study conducted during the year 1993-94 in the home tract of the Jakhrana breed revealed that extensive management systems (48 percent) prevailed in village conditions followed by semi-intensive (31 percent) while 20 percent of the goats are mainly kept in intensive systems, including breeding bucks and high yielding does. No specific housing is provided in this area. Only improvised thatched housing was provided by 76 percent of the goat keepers whereas 23 percent of the goats was kept in the family houses. The flooring of houses was mud based (*Kachcha*) in all cases. The goats were let out for grazing in the field but due to lack of biomass (bushes and grasses) the lopping of fodder trees was adopted. The grazing hours were limited to 5.4 hours per day. Goats were preferably grazed by old people (79 percent)

Table 1. Management practices in the home tract of Jakhrana Goats (Khan, 1994).

Practice	Respondents (N = 68) (percent)
Management system	
Extensive	48
Intensive	20
Semi-Intensive	30
Housing	
Thatched house	76
Improved Shed	0
Own House	23
Floor	
Mud based (Kachcha)	100
Pacca	---
Grazier	
Ladies	4
Children	0
Old person	79
Additional Feeding	
Leguminous Fodder (Gwar)	26
Straws (Gram + Gwar)	14
Tree leaves	25
Cooked millets (Dalia)	19
Concentrate	5
Sale of Goats*	
Kids	Rs. 400/kid
Adult	Rs.1500/goat

*Sale prices are based on the year 1993-94.

in the village. Additional feed was provided to the goats in the form of leguminous fodder (46 percent), straw (15 percent), tree leaves (25 percent) and dalia (cooked millets) by 19 percent of the goat keepers (Table 1). However, concentrate was provided by only six percent of the respondents. The sale of the goats was made in the village itself, although this fetched lower prices (Rs. 400/per kid, Rs.1500/per adult goat) due to middleman intervention in the sale/purchase system. The study indicated that the Jakhrana goats were managed under the traditional management

system. It is necessary to popularize scientific rearing methods in field conditions to increase the production of the goats (Khan, 1994).

Phenotypic Characters

The animals of this breed are fairly large in size with narrow forehead and raised faces. Legs are long with a deep and compact body. The udder is well developed with long and conical teats. The coat colour is predominantly black with white spots on the ears and muzzle (Figures 1 and 2). The coat is short and lustrous. The face line is straight with shining eyes. Ears are of medium size and drooping in most cases. Both sexes are horned, males had comparatively thick horns directed upwards. The adult body weight of the male and female were 57.8 ± 3.5 kg and 44.4 ± 0.5 kg, respectively (Acharya, 1982).

Body size

The mean values of body size in terms of body length, heart girth, paunch girth and body height is presented in table 2. It is noted that all the measurements in the males had higher values than the females at all ages.

Body weights

The average mean body weights at birth, 3, 6 and 12 months of age were 2.7 ± 0.1 , 11.9 ± 0.6 , 17.3 ± 0.5 in males and 2.4 ± 0.1 , 10.4 ± 0.6 , 15.7 ± 0.5 and 22.6 ± 0.7 kg in females, respectively (Table 3). The body weights of adult bucks and doe were recorded as 57.8 ± 3.5 kg and 44.4 ± 0.5 kg, respectively. The pre-weaning growth (0-3 months) was higher in males and female kids as compared to post-weaning growth (Table 4).

Reproduction and Breeding

A pilot survey conducted in the breeding tract of the Jakhrana goats indicated that May and June were the pronounced season of breeding which resulted in 83.3 percent kidding during

Table 2. Body measurements(cm) of Jakhrana goats (Anonymous, 1994).

Age group	Body length		Heart girth		Paunch girth		Body height	
	Male	Female	Male	Female	Male	Female	Male	Female
At birth	29.9±0.2 (92)	29.0±0.3 (83)	35.3±0.3 (92)	34.2±0.3 (83)	29.2±0.2 (92)	28.2±0.2 (83)	35.3±0.3 (92)	34.2±0.3 (83)
3 month	50.5±0.9 (80)	49.9±1.0 (79)	55.3±0.9 (80)	53.0±0.9 (79)	49.8±1.0 (80)	48.3±0.9 (79)	55.3±0.9 (80)	53.0±0.9 (79)
6 month	57.5±0.6 (64)	55.8±0.6 (43)	61.9±0.6 (64)	60.1±0.6 (43)	55.9±0.4 (64)	55.0±0.5 (43)	61.9±0.8 (64)	60.1±0.6 (43)
12 month	69.5±1.9 (4)	62.1±0.8 (27)	77.2±1.6 (4)	69.1±0.7 (27)	69.1±1.4 (4)	63.3±0.6 (27)	77.2±1.6 (4)	69.1±0.7 (27)

Figures in parentheses indicate the no. of observations.

Table-3. Body weight (kg) at different ages in Jakhrana Goats (Anonymous, 1994).

Parameter	No.	Male	No.	Female
Birth weight	92	2.7±0.1	83	2.4±0.1
Weaning weight	80	11.9±0.6	79	10.4±0.6
6 Months weights	64	17.3±0.5	43	15.7±0.5
12 Months weight	04	30.9±1.7	27	22.6±0.7

Table 4. Body weight gain (gm/day) in Jakhrana Goats (Anonymous, 1994).

Parameter	No.	Male	No.	Female
Pre-weaning (0-3 Month)	84	100±8.0	85	70±7.0
Post-weaning (3-6 Month)	05	65±4.3	31	45±1.8

October (Table 1). The kidding rate in field conditions was 75 percent, the twinning percent was quite high (79.1 percent) in comparison to single (16.6 percent) and triplet (4.1 percent). The age at first kidding was 574±45 days in farm conditions, however, Acharya (1992) reported a lower estimate (316±51 days). Kidding interval was 319.2±12.2 days in farm conditions (Table 5). These estimates indicated that Jakhrana is a

prolific breed and there is a fair scope to improve its breeding efficiency further in field/farm conditions of management.

Production Performance

Milk production performance of Jakhrana goats is presented in table 5. The part lactation yield of 90 days and 150 days was 74±2 kg and 101.5±3 kg, respectively in farm conditions. Milk yield was 116±3 kg in a lactation length of 181±4 day. The peak yield



Figure 1. Jakhrana buck.



Figure 2. Jakhrana doe.

Table-5. Production characteristics of Jakhrana goats (Anonymous, 1994).

Parameters	No.	
Age at first kidding (day)	6	574±46
Weight at first kidding (kg)	89	34.8±0.5
Kidding interval (day)	42	319±12
90 days milk yield (kg)	89	74±2
150 days milk yield (kg)	79	101±3
Lactation milk yield	89	116±3
Lactation length (day)	89	181±4
Peak yield (kg)	89	1.2±0.0
Peak week	89	2.81±0.3

was 1.2±0.1 kg in farm conditions. Acharya (1982) reported higher lactation yield in this breed. The milk yield in village conditions was higher and the highest yield was recorded as 3.5 kg per day. This was due to individual attention paid to care and feeding of the goats.

Survivability and Disease Resistance

A study was conducted at CIRG, Makhdoom on Jakhrana kids (298) to assess their adaptability and survivability in semi-arid conditions of India. The results indicated that mortality in kids was 1.6 percent per annum. The major causes (81 percent) for mortality were pneumonia, colibacillosis, toxemia, pneumoenteritis and coccidiosis. The least square analysis of variance revealed that birth weight and season of kidding had a significant effect on mortality. Findings further revealed that this breed is well adapted to semi-arid climatic conditions (Goel *et al.*, 1997).

Improvement Programme

Little effort has been made to improve this goat breed. Production performance was evaluated in a closed flock maintained at

CSWRI Avikanagar, Rajasthan under the auspices of the All India Coordinated Project on Goats (AICRP). Results accrued from AICRP on goats indicated that this breed had a considerable production potential for milk and meat production in semi-arid climatic conditions. Jakhrana goats have been introduced in different places and buck are used for upgrading the local goats for increasing milk production. Since this breed has been enlisted as endangered, it needs more concerted efforts towards conservation as well as improvement. There is an urgent need to launch an effective breed improvement programme in the home tract of the breed with the help of national and international collaboration. In general NGOs can play a vital role in the breed development programmes in India as their role in goat improvement has been commendable in the Maharashtra and Rajasthan States particularly to improve Osmanabadi and Sirohi goats, respectively.

Acknowledgement

The authors acknowledge the Director, CIRG Makhdoom for providing the facilities for this study.

References

Acharya, R.M. 1982. Sheep and goat breeds of India. Animal production and health paper 30. Food and Agriculture Organization of United Nations. Rome, Italy, pp. 61.

Acharya, R.M. 1992. Goat Production in Asia. In: Souvenir of V International Conference on Goats held in New Delhi, 2-8 March 1992, pp. 56.

Anonymous. 1994. Evaluation of Jakhrana Goats in farm conditions. Western Regional Research Centre, Avikanagar, Rajasthan (Unpublished data).

Census Report. 1988. Livestock census of Rajasthan. Directorate of Animal Husbandry, Govt. of Rajasthan, Jaipur, India.

FAO. 1997. Production Yearbook 50. Food and Agriculture Organization of the United Nations, Rome, Italy.

Goel, A.K., Agrawal, K.P. & Saxena, V.K. 1997. Survivability and disease incidence in Jakhrana kids in semi-arid conditions. (Abstr.) In: Third National Seminar on Small Ruminant Diseases held at the Central Institute for Research on Goats, Makhdoom, Mathura (U.P.), 2-3 December 1997, pp. 108.

Khan, B.U. 1994. Pilot survey on Jakhrana goats in its home tract. (Personal Communication).

Livestock Census 1992. Directorate of Economics and Statistics, Ministry of Agriculture, Government of India.

Zeuner, F.E. 1963. History of Domesticated Animals. Harper and Raw Press, New York. Cited from Sundaresan, D. (1976). Livestock Breeding in India. Vikas Publishing House Pvt. Ltd. New Delhi, pp. 4.

Productivité des ovins et des caprins de Race Locale élevés dans des conditions semi-intensives aux Antilles françaises

G. Alexandre, M. Mahieu & G. Aumont

Unité de Recherches Zootechniques, INRA Antilles-Guyane, Domaine Duclos Petit-Bourg 97170, Guadeloupe, French West Indies
E-mail: alexandre@antilles.inra.fr

Résumé

Le potentiel de production du mouton Martinik et de la chèvre Créole de Guadeloupe a été évalué en station. Les conditions d'élevage semi-intensives étaient basées sur un rythme de 3 mises-bas en 2 ans, sur l'utilisation de pâturages irrigués et fertilisés, exploités à fort chargement animal (1.6 t/ha) et en rotation et sur l'application d'une prophylaxie rigoureuse et adaptée. Les brebis Martinik et les chèvres Créole sont caractérisées par une très bonne fertilité (85 vs 92%), une prolificité élevée (1.7 vs 2.1) et une mortalité pré-sevrage réduite (10 vs 16%) qui les classent parmi les meilleurs génotypes tropicaux. La chèvre Créole présente comparativement à la Brebis Martinik une supériorité quant à sa productivité numérique annuelle: 2.90 vs 2.17 jeunes/femelle à la naissance ou 2.44 vs 1.97 au sevrage. Le même paramètre rapporté à l'unité de surface varie de 174 à 87 jeunes/ha à la naissance, ou de 147 à 78 au sevrage, respectivement pour les chèvres et les brebis. A l'inverse, le système ovin génère une productivité pondérale largement supérieure à celui des caprins avec 27.9 vs. 19.5 kg de jeunes sevrés/femelle/an ou encore 1 400 vs 1 130 kg de jeunes produits post-sevrage/ha/an. D'autres paramètres sont présentés dans le papier et une discussion est menée sur l'intérêt respectif des deux espèces pour le développement de la production de viande en zone tropicale. En effet le système allaitant est prometteur avec une productivité, quelle que soit l'espèce animale, de 1.3 t de jeunes sevrés/ha/an.

Summary

This work deals with the assessment of productivity of local small ruminant breeds in the French West Indies. On-station conditions were semi-intensive with improved general husbandry (high frequency of matings, good culling policies, adequate feeding levels and regular prophylaxis) and the use of irrigated, fertilized, high stocked (1.6 t/ha/year) and rotative pastures. Creole goats of Guadeloupe and Martinique ewes exhibited good performance levels, higher than other tropical genotypes. As far as numerical productivity indexes are concerned, goats showed higher results than sheep, up to 2.90 vs 2.17 offspring/female at birth or up to 2.44 vs 1.97 at weaning. The same parameters related to surface unit were 174 vs 87 young/ha at birth and 147 vs 78 at weaning, respectively for goat and sheep. On the contrary, indexes calculated on the weight basis, were in favour of sheep. For individual performances or at the flock level, for pre- or post-weaning periods or all-year long, a sheep intensive system displayed higher levels of weight productivity than did that of a goat one: 27.9 vs 19.5 kg weaned offspring/female/y or 1 400 vs 1 130 kg fattened animals/ha/y; respectively for sheep and goat. Other advantages are discussed. The relative advantages of both species are presented with the aim of increasing meat production in the tropical zone and in limited land resource conditions.

Key-words: Martinik sheep, Criollo goat, Productivity indices, Semi-intensive production system, Humid tropics.

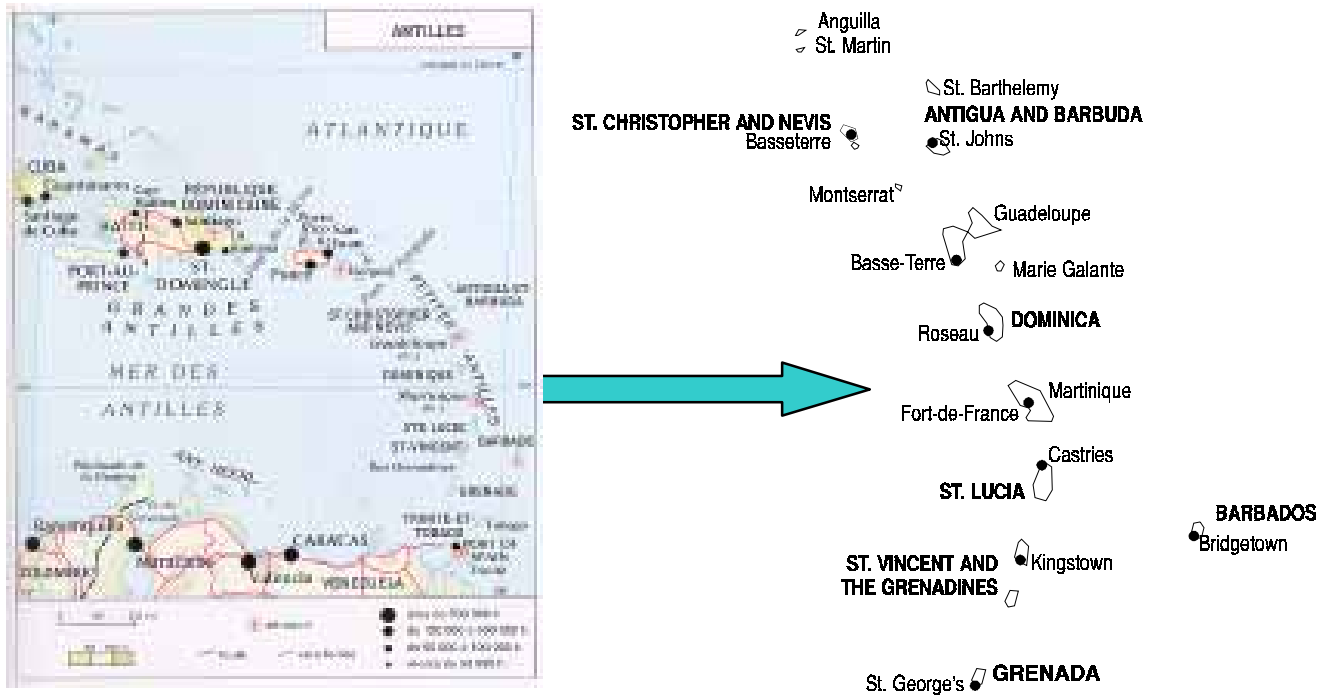


Figure 1. Carte des Antilles françaises.

Introduction

Dans la Caraïbe les populations d'ovins et de caprins s'élèvent à 810 milles têtes et à 2.8 millions de têtes, respectivement (FAO, 1997). La production est obtenue en grande partie, dans le cadre de systèmes d'élevage extensifs et au sein de petites unités de production (Devendra et Mc Leroy, 1982). Les ressources principales sont les pâturages naturels et les parcours arbustifs. L'intérêt des petits ruminants en zone tropicale est reconnu depuis longtemps pour l'exploitation de zones difficiles marginalisées, la fourniture de produits divers et variés orientés vers l'autoconsommation ou vers les marchés de proximité et l'apport de revenus complémentaires dans l'économie familiale (Devendra et Mc Leroy, 1982; Alexandre *et al.*, 1991; Leimbacher, 1996). De nombreux facteurs limitants affectent les niveaux de production obtenus: incidences climatiques contraignantes, faible valeur alimentaire des fourrages tropicaux, fortes charges parasitaires. Cependant dans le cas des Antilles françaises, le marché de viande des

caprins et des ovins pour une consommation festive est suffisamment rémunérateur pour justifier l'intensification de ce type d'élevage (Alexandre *et al.*, 1997c). Les résultats enregistrés depuis près de 20 ans par l'institut national de la recherche agronomique (INRA) en Guadeloupe sur caprins et en Martinique sur ovins montrent la capacité des génotypes locaux à valoriser la production fourragère et à répondre à l'intensification. Cet article s'appuie sur une synthèse des différentes données d'élevage et aboutit à une évaluation des productivités numérique et pondérale des génotypes locaux dans leur système d'élevage. En conclusion il tente de montrer leur intérêt respectif pour l'augmentation de la production de viande dans la Caraïbe.

Materiels et Méthodes

La Guadeloupe et la Martinique, îles françaises de la Caraïbe (16.1°N; 61.6°W et 14.4°N ; 61.0°W, respectivement), reportées sur la figure 1, sont caractérisées par un climat tropical humide. Les élevages expérimentaux où ont été conduits les

travaux sont situés dans la zone sèche des îles. Le climat de ces régions est marqué par une saison sèche de 6 mois où il tombe moins de 70 mm de pluie par mois. Les thèmes de recherche que l'INRA a développés sur la chèvre Créole en Guadeloupe et sur le mouton Martinik concernaient la reproduction, l'alimentation, la pathologie et la génétique.

Animaux et mode d'élevage

Les génotypes locaux se sont développés à partir de races africaines et européennes. La chèvre Créole de Guadeloupe (Figure 3 et 5) exploitée exclusivement pour la viande, est une race de petite taille et est originaire de l'Afrique de l'Ouest (voir synthèse de Alexandre *et al.*, 1999). Le mouton appartient aux génotypes à poils où figurent le West African, le Blackbelly de Barbade (Figure 2 et 4) ou le Pelibuey de Cuba. Récemment, a été créée la race "Ovin Martinik" des Antilles françaises (Leimbacher,

1996). Les deux espèces ne présentent aucun arrêt saisonnier de leurs activités ovariennes (Chemineau *et al.*, 1991). C'est pourquoi un système de 3 mises-bas en 2 ans a été suivi avec l'emploi de l'effet mâle qui est appliqué avec succès depuis plus de 20 ans. Trois périodes de reproduction ont été choisies, durant la saison sèche (mi-Mars à mi-Avril), la saison intermédiaire (mi-Juillet à mi-Aout) et la saison humide (mi-Novembre à mi-Décembre). Les chevreaux et les agneaux étaient sevrés entre 2 à 3 mois d'âge. Une prophylaxie régulière a été appliquée : détiqage toutes les 2 semaines et déparasitage tous les mois pour les jeunes sous la mère et tous les 1.5 ou 2 mois pour les jeunes sevrés et les adultes.

Pour les deux espèces, le troupeau exploitait toute l'année, selon le système rotatif, des pâturages de *Digitaria decumbens* fertilisés et irrigués. Les âges de repousse du fourrage ont varié entre 35 ou 28 jours avec 7 jours de présence/parcelle. Seules les chèvres allaitantes ont reçu une



Figure 2. Brebis Martinik à poils du type Black Belly.



Figure 3. Chèvres Créoles de Guadeloupe sur paturage.

complémentation durant leur cycle de reproduction. L'aliment du commerce avait 0.86 UFL et 135 g PDIN/kg matière sèche. Les niveaux d'apports ont varié en fonction des expérimentations. Durant le stade de croissance post-sevrage aucune complémentation n'a été distribuée. Les moutons en allaitement ou en croissance n'ont jamais été complémentés.

Données et indices de productivité

Un contrôle de performances a été appliqué régulièrement sur les troupeaux expérimentaux et a permis la constitution de bases de données pour chaque espèce s'étalant sur plus de 15 ans. Les données individuelles ont été analysées selon un même principe mais séparément pour les chèvres Créole par Alexandre *et al.*, (1997a, b) et pour l'ovin Martinik par Mahieu *et al.*, (1997a, b). Différentes analyses de variance avec le modèle linéaire général de SAS ont été menées. Les principales sources de variation étaient l'année, la saison de mise-bas, la

parité, la taille de portée et le sexe des animaux. Les moyennes corrigées des principales performances animales des deux espèces ont été utilisées pour cette présente étude selon les procédures suivantes. La productivité des troupeaux et des systèmes évaluée fréquemment dans le cas des ovins a été calculée aussi pour les caprins selon différentes méthodes revues par Galal et Younis (1988). La méthode de détermination de la productivité numérique (PN) s'est basée sur les valeurs de fertilité, de prolificité et de viabilité. La PN à la naissance (PNN) a décompté le nombre de jeunes nés viables, la PN au sevrage (PNS) a pris en compte la viabilité au sevrage. La prise en compte de l'intervalle entre mise-bas a permis de rapporter la PN à l'échelle de l'année. La PN s'exprime en nombre de jeunes nés ou sevrés/femelle mise à la reproduction/an. La productivité pondérale (PP) s'est calculée à partir de la PN multipliée par le poids vif des jeunes soit à la naissance pour la PP à la naissance (PPN) ou au sevrage pour la PP au sevrage (PPS). Ces différents indices ont été

calculés relativement au poids métabolique de la femelle. A l'échelle du système de pâturage, les différentes PN et PP ont été rapportées à l'unité de surface exploitée par les différents troupeaux selon les espèces et les stades de production.

Afin de permettre la comparaison entre les modes d'élevage ovin et caprin, les coûts d'alimentation complémentaire des chèvres Créoles allaitantes ont été déterminés durant un cycle de reproduction puis rapportés à l'année. L'équivalent en valeur de la vente de chevreaux sevrés nécessaires à couvrir ces frais supplémentaires a été déterminé. Le nombre ou le poids de chevreaux concernés ont été déduits de la productivité numérique ou pondérale brute de départ.

Résultats

Performances individuelles

Le poids adulte de la brebis Martinik est plus élevé que celui de la chèvre Créole: 45 vs 28 kg poids vif (PV). Les taux de fertilité et de prolificité ont atteint 85% vs 92% et 170% vs 210 % chez les brebis et les chèvres, respectivement (Tableau 1). Les taux de mortalité présevrage étaient de 10.4 vs 15.7, respectivement. Les poids moyens à la naissance et au sevrage (effectué à 70 et 82 jours chez les agneaux et les chevreaux, respectivement), ainsi que les différents gains moyens quotidiens post sevrage des mâles et des femelles sont présentés dans le tableau 1

Productivité du troupeau

Les productivités numériques à la naissance et au sevrage ont atteint 2.17 vs 2.90 jeunes nés/femelle/an et 1.94 vs 2.44 jeunes sevrés/femelle/an chez les brebis



Figure 4. Brebis Martinik avec suite au paturage.

Tableau 1. Performances de reproduction et de croissance des ovins* Martinik et des caprins** Créole de Guadeloupe élevés en conditions semi-intensives au pâturage (moyennes des estimées des modèles).

Espèce	Ovin Martinik (Mahieu <i>et al</i> , 1997a,b)		Chèvre Créole (Alexandre <i>et al</i> , 1997a,b)	
	Mâle	Femelle	Mâle	Femelle
Poids vif femelle adulte (kg)	45		28	
Fertilité mises-bas/femelles en lutte	0.85		0.92	
Prolificité jeunes/mise-bas	1.7		2.1	
Mortalité pré-sevrage (%)	10.4		15.7	
Production de lait g/j/kgPV ^{0.75} femelle	92		103	
Poids de naissance (kg)	3.85	3.66	1.84	1.66
GMQ 10-30 jours (g)	190	175	91	86
Poids au sevrage (kg)	15.2	13.5	8.21	7.53
Age au sevrage (jours)	70	70	82	82
GMQ post-sevrage*** (g)	99	84	36	34

* Les brebis sont élevées strictement à l'herbe, sur pâturage de Pangola avec une charge animale de 1400 Kg PV/ha.

** Les chèvres sont élevées dans le même système de pâturage de Pangola avec une charge animale de 1600 kg/ha, avec de plus une complémentarité de 26 UFL/fem/cycle de reproduction

*** Les agneaux et les chevreaux sont élevés strictement à base de Pangola avec une charge respective de 900 et de 1200 kg PV/ha pour une durée d'engraissement respective de 4 et de 8 mois.

et les chèvres, respectivement (Tableau 2). Durant la période pré-sevrage les productivités pondérales étaient de 27.9 vs 19.5 kg PV de jeunes sevrés/femelle/an. Ces mêmes variables rapportées au poids métabolique de la femelle ont représenté 1.60 vs 15.8 kg PV de jeunes sevrés/PV^{0.75}femelle/an, respectivement.

La prise en compte du coût de l'alimentation des chèvres Créole allaitantes a permis de corriger la productivité pondérale

du troupeau caprin qui n'était plus que de 16 kg PV de chevreaux/chèvre/an (Tableau 2).

Productivité du système pâturé

La productivité numérique annuelle rapportée à l'unité de surface du système pâturé par chacun des troupeaux était de 87 vs 174 jeunes nés et de 78 vs 147 jeunes sevrés/ha/an dans le système ovin et caprin allaitant, respectivement (Tableau 3). La productivité pondérale pré-sevrage des deux

Tableau 2. Productivités numérique et pondérale calculées à l'échelle du troupeau chez les ovins Martinik et les caprins Créole de Guadeloupe élevés en conditions semi-intensives au pâturage.

Espèce	Ovin Martinik	Chèvre Créole
Productivité numérique à la naissance (PNN) jeunes/femelle/an	2.17	2.90
Productivité numérique au sevrage (PNS) jeunes/femelle/an	1.94	2.44
Productivité pondérale à la naissance (PPN) kg sevrés/ femelle/an	31.5	22.5
Productivité pondérale au sevrage (PPS) kg sevrés/ femelle/an	27.9	19.5
PPS rapportée au poids métabolique kg sevrés/ PV ^{0.75} femelle	1.60	1.58
PPS corrigée pour le coût alimentaire kg sevrés/ femelle/an	28	16

espèces était similaire et a atteint le niveau très élevé de 1.4 T de jeunes agneaux ou chevreaux sevrés/ha/an. Durant la période post-sevrage, la productivité pondérale des ovins a surpassé celle des caprins avec 1 400 vs 1 130 kg PV/ha/an, respectivement (Tableau 3).

Discussion

Une productivité très élevée en conditions semi-intensives

Quelle que soit l'espèce, les modes d'élevage semi-intensifs mis en oeuvre en station expérimentale permettent l'expression du potentiel de production de ces génotypes locaux rustiques et aboutissent à des productivités très élevées. Ce sont des cas rarement reportés dans la littérature tropicale (voir les synthèses de Devendra & McLeroy, 1982; Gonzalez-Stagnaro, 1983 ; Wilson *et al.*, 1985). Il est vrai que l'irrigation des pâturages permet de s'affranchir des problèmes de disponibilités alimentaires et d'augmenter très nettement le chargement. L'augmentation de productivité permise par l'irrigation est considérable: 26.8 vs 18.8 kg

d'agneaux sevrés/brebis/an pour un système pâturé irrigué comparativement à un système sec (Mahieu, 1991).

La comparaison des deux espèces montre que pour les indices de productivité numérique la chèvre Créole de Guadeloupe est supérieure à la brebis Martinik avec plus de 174 chevreaux nés/ha/an par exemple contre 87 agneaux nés/ha/an. En effet, les performances de reproduction de la chèvre sont plus élevées que celles de la brebis. Ces conclusions sont en concordance avec celles de nombreux auteurs dans la Caraïbe (Gonzalez-Stagnaro, 1983; Chemineau *et al.*, 1991). Néanmoins, les taux de mortalité présevrage quoique très en deçà des valeurs rapportées dans la zone tropicale (jusqu'à 50%) par Wilson *et al.*, (1985) ou par Aumont *et al.*, (1997), augmentent dans le système caprin intensif au pâturage (15.4 % vs 10.4 %). Selon Aumont *et al.*, (1991), ce pourrait être dû aux risques élevés d'infestation parasitaire fréquemment associés aux systèmes pâturés intensifs d'élevage de petits ruminants basés sur l'emploi de l'irrigation et l'application de charge animale élevée. Il est à noter que la charge a atteint (60 vs 40 femelles/ha/an) dans le système caprin comparativement au système ovin. Un chargement plus élevé pourrait conduire à une disponibilité

alimentaire moindre et des incidences parasitaires plus marquées. Par ailleurs, le phénomène pourrait être accru en raison de la sensibilité supérieure des caprins aux strongles gastro-intestinaux comparativement aux ovins (Aumont *et al.*, 1997).

Alors que les indices de productivité numérique des caprins dépassent ceux des ovins, la situation est inverse pour les productivités pondérales. Quels que soient les stades de production (allaitant ou post-sevrage) et l'échelle considérés (individu, troupeau ou système entier), les ovins présentent une productivité pondérale plus élevée que celle des caprins. Ce pourrait être lié au poids de naissance ou aux niveaux de GMQ plus élevés (2 fois plus) pour l'ovin Martinik que pour le caprin Créole de Guadeloupe. En revanche, les valeurs exprimées relativement au poids métabolique des deux espèces sont quasi similaires (1.6 kg de jeunes sevrés/PV 0.75 femelle/an).

Il est à noter que l'engraissement des ovins à l'herbe ne nécessite que 4 mois contre 8 mois aux caprins. A l'échelle temporelle et

spatiale les ovins surpassent les caprins qui nécessitent davantage de surface pour permettre l'élevage d'un nombre supérieur de jeunes sevrés (147 vs 78 sevrés/ha/an). Dans notre mode d'élevage, le système pâturé caprin était très certainement trop chargé avec 1 200 kg PV/ha/an comparativement à 900 kg PV/ha/an pour le système ovin.

Une comparaison plus complète devrait être menée en prenant en compte les conditions de marché de la viande de moutons et la viande de cabris. Cette dernière est très prisée sur le marché antillais et est payée près de 3 fois plus chère.

Mais de grosses variations dans les fermes privées.

Des contrôles de performances en fermes ont été appliqués régulièrement en fin des années 80. Pour les caprins, les valeurs de fertilité annuelle, de prolificité et de mortalité présevrage ont varié de 118 % à 140 %, de 130 à 185 % et de 5 à 43 %, respectivement



Figure 5. Chèvre Créole âgée de 13 ans à la 18ème mise bas.

Tableau 3. Productivités numérique et pondérale calculées à l'échelle du système pâturé chez les ovins Martinik et les caprins Créole de Guadeloupe élevés en conditions semi-intensives au pâturage.

Espèce	Ovin Martinik	Chèvre Créole
Productivité numérique à la naissance (jeunes/ha/an)	87	174
Productivité numérique au sevrage (jeunes/ha/an)	78	147
Productivité pondérale au sevrage (kg sevrés/ha/an)	1 250	1 385
PPS corrigé pour le coût alimentaire (kg sevrés/ ha/an)	1 250	1 140
PP post-sevrage (kg PV/ha/an)	1 400	1 130

Tableau 4. Niveaux de productivités des ovins Martinik et des caprins Créole obtenus en fermes et variations observées selon les espèces, les milieux et modes d'élevage aux Antilles françaises.

	Contrôles de performances en fermes (4 années)	
	Ovin Martinik (Leimbacher & Tatareau 1991)	Chèvre Créole (Leimbacher & Pensédent 1991)
Nombre de femelles reproductives (fermes)	500 (6)	250 (5)
Productivité num. à la naissance	1.47 - 2.37	1.93 - 2.37
Productivité num. au sevrage	1.23 - 2.26	1.35 - 2.11
<i>Productivité du troupeau d'ovins Martinik selon le niveau de complémentation dans une ferme privée (Isabeth-Moreau 1998 ; 6 mois, 166 brebis)</i>		
Niveau de complémentation	0 kg/tête/jour	0.3 kg/tête/jour
Mortalité présevrage (%)	19	9
Productivité présevrage (kg) agneaux sevrés/femelle/an	12.8	17.9
<i>Productivité des chèvres Creole (nombre chevreaux/mère) selon le système de pâturage dans les fermes guadeloupéennes (Alexandre & Borel, 1988; 3 ans, 11 éleveurs, 475 chèvres)</i>		
Continu	Rotatif	A l'attache
1.25	0.86	1.64

(Leimbacher et Pensédent-Herblon, 1911). Les productivités numériques au sevrage des fermes classées les meilleures ont surpassé de 56 % les plus mauvaises (Tableau 4). Pour les ovins les performances de reproduction étaient de 107 % à 131 % de fertilité annuelle, de 120 à 190 % de prolificité et de 8 à 52 % de mortalité présevrage (Leimbacher et Tatareau, 1991). Les écarts entre les meilleures et les mauvaises fermes ont atteint 84 % (Tableau 4). Les niveaux atteints en station comparativement à ceux observés en fermes montrent les progrès à accomplir. Il apparaît bien qu'il existe des marges de manoeuvre encore importantes pour augmenter les productivités des systèmes d'élevage avec des animaux de race locale sur la base de l'amélioration des conditions d'élevage. En fermes en Martinique, l'apport de compléments aux brebis pendant la lactation augmente les productivités pondérales au sevrage de près de 39 % (Isabeth-Moreau, 1998 ; Tableau 4, données recalculées). En Guadeloupe, la mauvaise maîtrise des modes de pâturage en fermes diminue la productivité numérique au sevrage pour une campagne de reproduction, de 1.64 pour le système traditionnel à 0.86 chevreaux sevrés/mère pour le système rotatif (Alexandre et Borel , 1988 ; Tableau 4).

Conclusions

Ces systèmes d'élevage testés à l'échelle de la station expérimentale sont très hautement productifs. Ils sont basés sur le potentiel génétique élevé des races locales de petits ruminants - mouton Martinik et chèvre Créole de Guadeloupe - et sur l'amélioration des conditions d'élevage. Ces dernières s'appuient sur un rythme de reproduction élevé, sur une politique de réforme correcte, sur une alimentation adéquate et sur une prophylaxie rigoureuse. Ce sont des techniques d'élevage à la portée de nombreux éleveurs de la zone. La fertilisation et l'irrigation des pâturages permettent une meilleure qualité et régularité de l'alimentation et autorisent une intensification de l'utilisation de l'espace. En conséquence, il

y a de réelles opportunités de développement de la production de viande de petits ruminants aux Antilles et dans la Caraïbe. Cependant, la transférabilité du système irrigué INRA, considéré dans l'absolu, est critiquable et il conviendrait d'éviter des transferts de technologies inadéquates. Des adaptations aux situations locales de chaque pays sont nécessaires; elles reposent notamment sur l'exploitation judicieuse de ressources alimentaires locales telles que les sous-produits ou les arbres fourragers très bien étudiés dans la zone latino-américaine. Les principales conclusions de ce travail argumentent en faveur d'une intensification raisonnée des systèmes de production et surtout sur une valorisation des ressources animales et végétales locales.

Références

- Alexandre, G., Aumont, G., Fleury, J., Coppy, O., Mulciba, P. & Nepos A.** 1997a. Production semi-intensive au pâturage de caprins à viande en zone tropicale humide. *Inra Prod. Anim.*, 10 (1), 43-53.
- Alexandre, G., Aumont, G., Fleury, J., Mainaud, J.C. & Kandassamy, T.** 1997b. Performances zootechniques de la chèvre Créole allaitante de Guadeloupe. *Inra Prod. Anim.*, 10 (1), 7-20.
- Alexandre, G. & Borel, H.** 1988. Production des petits ruminants aux Antilles 2. Premiers résultats d'élevage dans les fermes privées guadeloupéennes. *Bull. Agron. Antilles-Guyane*, 8, 10-16.
- Alexandre, G., Borel, H., Matheron, G. & Remy, C.** 1991. Elevages caprins en Guadeloupe. *Rev. Elev. Med. Vet. Pays trop.* (special issue), 27-40.
- Alexandre, G., Leimbacher, F. & Aumont, G.** 1997c. Etude du secteur productif de la filière des petits ruminants aux Antilles. Document de travail INRA-URZ, pp. 53.

- Aumont, G., Gruner, L. & Berbigier, P.** 1991. Dynamique des populations de larves infestantes des strongles gastro-intestinaux des petits ruminants en milieu tropical humide. Conséquences sur la gestion des pâturages. *Rev. Elev. Med. Vet. Pays trop.* 1991 (spécial issue), 123-132.
- Aumont, G., Pouillot, R., Simon, R., Hostache, G., Barré, N. & Varo, H.** 1997. Parasitisme digestif des petits ruminants des Antilles françaises. *Inra Prod. Anim.* 10 (1), 79-90.
- Chemineau, P., Mahieu, M., Varo, H., Shitalou, E., Jago, Y., Grude, A. & Thimonier, J.** 1991. Reproduction des caprins et des ovins Créoles de Guadeloupe et de Martinique. *Rev. Elev. Med. Vet. Pays trop.* (special issue), 45-50.
- Devendra, C. & Mc Leroy, G.B.** 1982. Goat and sheep production in the Tropics. *Trop. Agric. Series, Longman*, pp. 271.
- FAO.** 1997. Annuaire de la production. vol. 51.
- Galal, E.S.E. & Younis, A. A.** 1988. Methods of evaluating productivity of native sheep under both research farm and producers conditions. In "Small ruminants research and development in the Near East" 2-4, Novembre 1988, Cairo, Egypt, 184-191.
- Gonzalez-Stagnaro, C.** 1983. Comportamiento reproductivo de las razas locales de rumiantes en el tropico americano. In «Reproduction des ruminants en zone tropicale». INRA Publications, 20, 1-80.
- Isabeth-Moreau, L.** 1998. La complémentation de moutons au pâturage dans un élevage traditionnel de la Martinique. *DESS Gestion des systèmes agro-sylvo-pastoraux en zones tropicales*, pp. 46.
- Leimbacher, F.** 1996. La sélection du Mouton Martinik. INRA-CRAG Unité de Recherches Zootechniques, pp. 22
- Leimbacher, F. & Pensédent-Herblon, J.** 1991. Evolution des résultats du contrôle de performances caprine en Guadeloupe. *Rev. Elev. Med. Vet. Pays trop.* (special issue), 63-68.
- Leimbacher, F. & Tatareau, J.C.** 1991. Evolution des résultats du contrôle de performances des ovins à la Martinique. *Rev. Elev. Med. Vet. Pays trop.* (special issue), 69-74.
- Mahieu, M.** 1991. Production ovine sur pâturage de *Digitaria decumbens* Stent. irrigué ou non. Résultats technico-économiques. *Rev. Elev. Med. Vet. Pays trop.* (special issue), 17-22.
- Mahieu, M., Aumont, G. & Alexandre, G.** 1997; Elevage intensif des ovins tropicaux à la Martinique. *Inra Prod. Anim.* 10 (1), 21-32.
- Mahieu, M., Aumont, G., Michaux, Y., Alexandre, G., Archimède, H., Boval, M. & Theriez, M.** 1997. L'association d'ovins et de bovins sur prairies irriguées à la Martinique. *Inra Prod. Anim.* 10 (1), 55-65.
- Wilson, R.T., Peacock, C.P. & Sayers, A.R.** 1985. Prewaning mortality and productivity indices for goats and sheep on a Masai group ranch in south-central Kenya. *Anim Prod.* 41, 201-206.

A propos d'un rapport sur la Chèvre du Rove en Provence

F. Poey d'Avant

*Président d'Ovicaprinae de Provence, 1, rue Fontanette,
Saint-Tropez (Var), 83990 France*

Résumé

Le rapport Danchin/Lauvergne de mai 2000 qui traitait de la situation actuelle de la chèvre du Rove est analysé par un acteur passionné de sauvegarde de la race. La Rove est une chèvre qui, en Provence, accompagnait jadis les troupeaux ovins transhumant à pied. Pour sa sauvegarde deux axes de travail sont actuellement privilégiés: 1) l'accès aux primes pour les bergers des troupeaux qui nettoient avec leurs dents les pare-feux forestiers permettant l'accès des intervenants contre les feux de forêt et 2) la recherche de débouchés pour la viande de cabris lourds, unique produit commercialisable puisque les chèvres débroussailleuses ne produisent pas de lait. Des solutions sont en vue avec la mise en place de CTE (contrats territoriaux d'exploitation) pour le premier point et la montée en puissance d'une entreprise bouchère locale pour le second. Toutes ces actions vont dans le sens d'une gestion écologique et économique bien comprise des troupeaux Rove existant encore. Elle combine la conservation d'une ressource génétique domestique, une contribution à la protection de la forêt contre le feu, la production d'une viande saine car élaborée à partir d'une flore arbustive sauvage et la sauvegarde d'emplois dans des zones menacées par la désertification des campagnes.

Summary

This paper reports the point of view of a person who is passionately interested in the safeguard of the Rove goat breed, on the

report by Danchin and Lauvergne of May 2000. The paper dealt with the present situation of the endangered Rove goat, a breed which was formerly used in sheep transhumance in Provence, France, leading the sheep to and from mountain grazings. Two directions of safe-keeping are presently developed: 1) a better access of the shepherds to public lands and subsidies for cleaning fuel breaks with their flocks, 2) the search for an appropriate trading of goat meat which is the only marketed product of these goats which are not milked. Solutions consist of the development of CTE (Territorial contracts of exploitation) for the first point and the rise of local slaughter activities for the second. These activities fit in with a proper ecological and economic management of the still remaining Rove herds, combining the conservation of local domestic genetic resources with a contribution to the safe keeping of an endangered forest environment, the production of healthy meat from a feeding based on the flora of wild woods and the safeguarding of employment in zones in danger of rural exodus

Key words: *Goat, Genetic conservation, Rove breed, Provence.*

Editors' note

This note reports on a unique example of a private sustained conservation experience of an endangered goat breed, in its natural habitat.

Introduction

Sous le patronnage de l'*Institut de l'Élevage* de Paris et de mon association¹ une mission d'information a enquêté en avril dernier sur la situation actuelle de la chèvre du Rove en Provence-Alpes-Côte-d'Azur². Le rapport de mission³ est parvenu à l'éditeur d'AGRI qui m'a prié de le commenter pour les lecteurs de sa revue. J'accède bien volontiers à sa demande en le remerciant de faire appel à un acteur passionné de la sauvegarde de la race du Rove.

Je suis d'autant mieux disposé à écrire le présent article que, depuis quelques années, je sais que le mot boucher vient précisément de bouc⁴. Cela atteste la grande importance de la viande de chèvre pour nos ancêtres.

En ce qui me concerne je fais tout mon possible non seulement pour que l'on mette sur le marché une viande provenant de la consommation de végétaux forestiers qui, évidemment, n'ont pas grand chose à voir

avec les fourrages transgéniques, actuel objet d'un débat écologique, que l'on économise sur la mise en œuvre de moyens

¹*Ovicaprinae de Provence*, association sans buts lucratifs régie par la loi française de 1901 dont les statuts ont été déposés à la sous-préfecture de Draguignan (Var) en décembre 1990; en 1999 l'association comptait 100 membres résidant principalement dans la région de St Tropez.

²La région *Provence-Alpes-Côte-d'Azur* (PACA) est une région de programme française située au sud-ouest de l'hexagone; elle comprend les départements des Alpes-de-Haute-Provence des Alpes maritimes, des Hautes Alpes, des Bouches-du-Rhône, du Var et du Vaucluse.

³Le rapport de C. Danchin et J.J. Lauvergne paru en mai 2000.

⁴D'après Bloch et Von Wartburg (1975 : 79). le boucher était : "celui qui abat les boucs; ce mot désignait peut-être d'abord le serf chargé dans les grands domaines d'abattre les jeunes boucs destinés à la consommation sur place, un seul bouc adulte suffisant pour un grand troupeau de chèvres, formation qui a éliminé à peu près complètement les représentants du latin *macellarius* "



Figure 1. Le troupeau Rove Dahl/Del Olmo à Allemagne-en-Provence, le 26 avril 2000.



Figure 2. Troupeau du Plan de Suvière patronné par l'association Ovicaprinae de Provence et conduit par le berger Joël Cotton, le 25 avril 2000: un menon.

lourds (giro-broyeurs, Canadairs) et que l'on sauve quelques emplois de berger.

La race du Rove

Comme les auteurs du rapport je dois rappeler tout d'abord que la race du Rove est une émanation de populations caprines occupant la Provence et, plus généralement, le pourtour de la Méditerranée depuis fort longtemps. La particularité de la Rove est d'avoir été spécialisée en tant que chèvre accompagnatrice des ovins transhumants.

Ces troupeaux de brebis se déplacent à la fin du printemps depuis les basses terres littorales situées au sud de la région vers le nord, dans les Alpes où ils estivent. Au cours de ces déplacements qui s'effectuaient à pied jusqu'aux années soixante de ce siècle chaque troupeau s'adjoignait un petit noyau caprin avec des boucs castrés dits menons préposés

à l'entraînement de la masse ovine et des chèvres en lactation pour alimenter les agneaux orphelins.

Une fois la transhumance à pied abolie par la généralisation du transport automobile les jours de la race du Rove étaient évidemment comptés. C'est donc à juste raison que l'ami Jean Blanc - disparu au début de cette année - a tiré la sonnette d'alarme⁵.

La transhumance ovine en Provence remonte à quelques siècles seulement et la Rove hivernait dans la région et se ressourçait localement. De ce fait, la Rove ne s'écarte pas beaucoup génétiquement de la population

⁵Dans un article de 1972 dans lequel l'appellation Rove apparaissait pour la première fois.



Figure 3. Les missionnaires dans le troupeau Dahl/Del Olmo à Allemagne- en-Provence le 26 avril 2000: de gauche à droite Richard Del Olmo, Coralie Danchin, Arnika Dahl (Présidente de l'ADCR) et J.J. Lauvergne.



Figure 4. A Cogolin avec le Président F. Poey d'Avant le 25 avril 2000: de gauche à droite A. Le Cam (responsable logistique de la mission), F. Poey d'Avant et C. Danchin.

locale existant encore et connue sous le nom de *Commune de Provence*, d'ailleurs elle-même fortement menacée⁶.

Il y a quand même un point sur lequel la Rove se distingue des populations locales, c'est le développement plus marqué de son cornage⁷ qui faisait l'objet de toute l'attention des bergers transhumants lors du choix des reproducteurs. On note également dans certains troupeaux une tendance à la standardisation de la robe.

Toutes ces notions sont bien connues des acteurs locaux de l'élevage caprin mais il ne fallait pas manquer une occasion de les rappeler à un public plus large.

Historique de la Sauvegarde de la Race

Les efforts de conservation de la Rove ont été initiés et orchestrés pendant 20 ans par le regretté Alain Sadorge fondateur en 1971 de l'*Association de Défense des Caprins du Rove* (ADCR).

Alain Sadorge avait bénéficié à l'époque de l'appui du *Parc naturel régional de Camargue* pour constituer au Mas du Pont du Rousty un troupeau pépinière Rove. Il a pu ensuite déployer ce troupeau dans le *Parc naturel régional du Luberon* dans le cadre d'un programme d'entretien biologique des pare-feux, sur le territoire de la commune de la Bastide-des-Jourdans (Vaucluse). Notons au passage que ce programme a sans doute été le premier du genre à être soutenu en France par les pouvoirs publics: Office National des Forêts, Parc naturel du Luberon, Institut national de la Recherche agronomique, région Paca, Université de Provence, communes etc... Ce programme était malheureusement à durée déterminée et, au bout de trois ans, fin 1987, Alain Sadorge s'est retrouvé sans point de chute.

C'est alors que je lui ai proposé de s'établir sur ma propriété au Plan de Suvrière (commune de Collobrières, Var) et de joindre son troupeau au mien, de manière à pérenniser l'existence d'un troupeau Rove voué au débroussaillage, à la production de

viande et à la conservation de la race en conjugant son action à la mienne qui remontait à 1971. L'affaire a prospéré jusqu'à la mort subite de Sadorge en 1990.

À ce moment là j'ai continué à exercer quelque temps encore la fonction de Président de l'ADCR (dont Sadorge était le secrétaire) jusqu'à ce que les éleveurs professionnels reprennent eux-mêmes la gestion de leur race. Je me suis alors consacré uniquement au gouvernement de ma propre association (*Oviscaprinae de Provence*) créée en 1990 comme il a été dit, de manière à prolonger l'oeuvre menée avec Sadorge en maintenant un troupeau dans ce coin des Maures. Je dois dire que, jusqu'à présent, je n'ai pas été déçu par mes sociétaires.

Pour sa part l'ADCR, dont l'état-major est actuellement basé dans le département des Alpes-de-Haute-Provence, continue à assumer les responsabilités administratives de la défense de la race.

Le Débroussaillage

La première action de terrain que le rapport décrit et encourage pour la sauvegarde de la race est le débroussaillage des pare feux. Cette rubrique est illustrée par les activités du troupeau patronné par mon association qui est à l'oeuvre dans une zone considérée comme zone rouge. par la DFCI (*Défense contre l'incendie*) du Var, un des départements français les plus sujets aux feux de forêt .

⁶Comme le montre un autre rapport de Coralie Danchin (1999). Douze ans plus tôt Lauvergne *et al.* (1987) estimaient même que, si aucune mesure de sauvegarde n'était prise, la *Commune Provençale* était condamnée à disparaître à l'horizon 2000.

⁷La longueur des cornes en race Rove a été étudiée à partir des données du troupeau du Plan de Suvrière. La valeur asymptotique de la longueur de corne chez les mâles est de 90 cm, elle est inférieure à celle du bouquetin (103 à 107 cm) mais supérieure à celle de boucs italiens communs (50 à 60 cm), les cornes des chèvres adultes mesurent 44 cm dépassant en longueur celles des bouquetins femelles (17 à 29 cm), Lauvergne *et al.* (1998).

Il faut alors savoir que les acteurs au sol de la DFCI pour le massif des Maures - en l'occurrence les responsables forêt du SIVOM (Syndicat intercommunal à vocation multiple) du Pays des Maures basé à Cogolin - ont en charge le nettoyage des pare-feux forestiers avec, comme premier impératif, un aménagement permettant en tous temps et en tous lieux l'intervention des pompiers sans mettre en danger leur vie.

Or il se trouve que les bergers ne peuvent pas se conformer à un cahier des charges trop strict pour des actions de nettoyage. Qu'à cela ne tienne précisent les responsables de Cogolin on leur délimitera des périmètres d'intervention sur lesquels ils iront quand ils voudront et quand ils pourront.

C'est d'ailleurs bien ce qui se passe déjà pour notre troupeau du Plan de Suvière mais, pour le moment, ses vacances ne sont pas

rétribuées et, jusqu'à présent, nos efforts auprès des autorités pour obtenir une juste rétribution sont restés vains. Il s'agit donc de pallier à cette injustice, ce que l'on nous promet dans le cadre de *Contrats territoriaux d'exploitations*, les fameux CTE, qui se mettent lentement en place en France.

Dans le cadre de tels CTE les responsables forêt du SIVOM vont évaluer le travail du troupeau, faire rétribuer le berger et se débrouiller pour intervenir sur les zones non nettoyées. Au coût actuel du nettoyage mécanique et manuel, le SIVOM est largement gagnant.

Voilà qui est bien parler. Je me rallie entièrement à ce point de vue et je ferai tout pour que le berger et les responsables locaux constituent et fassent avancer le dossier CTE dont l'examen nous est promis pour la fin de l'an 2000.



Figure 5. Visite à la SOVICAL de Forcalquier le 26 avril 2000 : de gauche à droite C. Danchin, M. Aquilué (gérant de la société), J.-M. Patoureaux (salarié de VIVALOR, association de soutien de la SOVICAL) et J.J. Lauvergne.



Figure 6. Réunion au siège de la FRÉCAP: de gauche à droite M. Maurel (FRÉCAP), L. Escoffier (technicien caprin des Bouches-du-Rhône) et A. Gouiran, vice-président de l'ADCR et auteur d'un ouvrage récemment paru sur la Rove.

La Commercialisation des Produits

La recherche de débouchés commerciaux pour les cabris des troupeaux de chèvres à viande que sont les troupeaux Rove est la deuxième action préconisée dans le rapport.

Après avoir souligné les difficultés de la commercialisation des produits carnés de l'élevage en PACA qui handicapent fortement les troupeaux débroussailleurs qui ne produisent pas de lait le rapport décrit la mise en place d'un acteur viande: la SARL (société à responsabilité limitée) SOVICAL (*Société des viandes de qualité*) créée fin 1999 à Forcalquier dans le département des Alpes-de-Haute-Provence et qui monte lentement en puissance

Ayant été sollicité pour que mon association prenne des parts sociales dans la SOVICAL je n'ai pas hésité à le faire, avec

l'appui de mon Conseil d'administration. Le but est d'exercer un certain contrôle sur la gestion et de s'assurer que les produits caprins sont bien collectés, abattus, contrôlés dans les normes et commercialisés à un prix rémunérateur.

Bien sûr la SOVICAL est une petite entreprise mais les tonnages à traiter restent modestes. Quoiqu'il en soit nos amis de l'ADCR (la Présidente Arnika Dahl et Richard Del Olmo, basés à Allemagne-en-Provence, dans les Alpes-de-Haute-Provence) - auxquels d'ailleurs les missionnaires ont rendu visite - soutiennent une telle entreprise.

De plus, pour valoriser l'écoulement des cabris de nos troupeaux débroussaillant qui sont élevés sous la mère bien au-delà de l'âge auquel l'élevage laitier se débarrasse de ses jeunes animaux, la SOVICAL se propose de lancer un nouveau produit carné sur le marché, le cabri lourd de Provence (de 20 à 30 kg en vif).

Autre Initiative Positive

Le rapport se termine sur une autre note positive. À Manosque, lors de la réunion des missionnaires avec les responsables des organismes techniques et professionnels caprins de Provence, ces derniers, jusqu'alors très orientés vers le développement qualitatif et quantitatif de la production fromagère, ont promis d'apporter un soutien plus marqué à la chèvre à viande.

Comme première mesure il a été convenu de procéder à un indispensable recensement des éleveurs et des reproducteurs Rove avec, comme maître d'œuvre, *l'Institut de l'Élevage*.

En Conclusion

On ne peut que se réjouir des perspectives ouvertes par le rapport que nous commentons tout en constatant que la situation est paradoxale en France où, depuis trois siècles, on ne fait que lutter pour interdire la forêt à la chèvre tout en lui déniaient le statut d'espèce bouchère. On semble revenir à des conceptions plus écologiques qui, un moment, avaient fait défaut⁸.

Est-ce à dire que les actions analysées et encouragées par le rapport Danchin/Lauvergne soient une panacée pour les autres races caprines menacées dans la zone méditerranéenne ? Non sans doute mais, à nos yeux, elles jalonnent une démarche écologico-économique à quadruple fin : conservation d'un stock génétique menacé, participation biologique à l'entretien et la protection de l'environnement, fourniture d'une viande de qualité et sauvegarde d'emplois dans des zones qui ont tendance à se désertifier.

Dans une telle perspective les clés de la réussite sont la coordination des initiatives privées avec celles émanant des pouvoirs publics et la constance dans les efforts. La coordination est actuellement en bonne voie et la constance dans l'effort ne fait pas défaut.

Remerciements

Je suis redevable à Coralie Danchin et à J.J. Lauvergne de leur assistance rédactionnelle. Ils m'ont également fourni les photos de la figure 1 qui illustre leur mission. En outre J.J. Lauvergne a eu la gentillesse de mettre à ma disposition sa documentation, ce qui a permis de donner plus de rigueur à mon propos .

Note de la Rédaction

Coralie Danchin (Institut de l'élevage, 149 rue de Bercy 75595 Paris Cédex) et J.J. Lauvergne (bât 211, CRJ/INRA, 78 352 Jouy-en-Josas, France) nous signalent que leur rapport sera envoyé à tous ceux qui leur en feront la demande écrite.

Références

Blanc, J. 1972. Sauvegarde des espèces domestiques, espèce caprine, race du Rove. *Ethnozootechnie* 8, 5-6.

Bloch, O. & Wartburg, W. Von. 1975. Dictionnaire étymologique de la langue française. Presses Universitaires de France, Paris, pp. 682.

Danchin, C. 1999. Race caprine *Commune Provençale*, situation au 31 octobre 1999. CR N°2878, Institut de l'Élevage, Paris, pp. 10 + annexes.

Danchin, C. & Lauvergne, J.J. 2000. Rapport de mission sur la situation de la race caprine du Rove en Provence-Alpes-Côte d'Azur, avril 2000. Institut de l'Élevage et Laboratoire de Génétique factorielle de l'INRA, Paris et Jouy-en-Josas, pp. 8.

⁸Un tableau de la politique caprine des pouvoirs publics en France sous l'ancien régime a été dressé par Solakian (1988) : ils étaient des ennemis systématiques et pas toujours bien inspirés de la présence de chèvres en forêt. Selon cet auteur les incohérences d'une telle politique qui a perduré jusqu'à nos jours sont criantes.

Lauvergne, J.J., Renieri, C. & Audiot, A. 1987. Estimating erosion of phenotypic variation in a French goat population. *J. Hered.*, 78, 307-314.

Lauvergne, J.J., Bouchel, D. & Minvielle, F. 1998. Étude morpho-biométrique de la chèvre du Rove.

III. Longueur de corne (LC) dans les deux sexes et indices de dimorphisme sexuel du cornage (IDSC). *Rev. Méd. Vét.*, 149, 141-148

Solokian, D. 1988. De la gestion des chèvres en France au XVIII^e siècle. *Ethnozootecnie*, 41, 33-45.

Phenotypic characterisation of native chicken lines in South Africa

E. van Marle-Köster & N.H. Casey

Animal and Wildlife Sciences, Faculty of Natural & Agricultural Sciences, University of Pretoria, Pretoria 0002, South Africa

Summary

Native chicken lines in South Africa are associated primarily with rural households. A programme was established only as recently as 1994 to conserve the different lines found in South Africa. As no scientific data was available on the production traits of these lines, a research trial was conducted to describe them phenotypically in terms of their growth, carcass traits and egg production. Four different native lines, the Koekoek, Naked Neck, Lebowa-Venda and Ovambo chicken were included in the study. Significant differences were observed among the lines, which means that the lines could be described as different native lines in terms of their phenotypic traits. The Ovambo chicken had the best growth performance, while the Koekoek showed the highest performance for egg production. Although production is poor in comparison with commercial lines, the contribution of these birds to household food security and application in low-input systems should be recognized and further investigated.

Résumé

Les races de poules originaires d'Afrique du Sud sont surtout associées à l'habitat rural. Ce n'est qu'en 1994 qu'on a établi un programme de conservation des différentes races d'Afrique du Sud. Comme il n'existait aucunes données scientifiques sur les caractéristiques de production de ces races, on a entrepris des projets de recherches pour les décrire de manière phénotypique en fonction

de leur croissance, des caractéristiques de leur squelette et de leur production d'oeufs. On a inclus dans l'étude 4 différentes races indigènes: la poule koekoek, la poule à cou nu, la poule du Lebowa-Venda et la poule Ovambo. On a observé des différences importantes parmi les races, ce qui signifie qu'on peut les considérer comme des races indigènes différentes en fonction de leurs caractéristiques phénotypiques. La poule Ovambo montrait la meilleure performance de croissance des races, alors que la poule koekoek avait la meilleure performance dans la production d'oeufs. Bien que leur production soit faible en comparaison des races commerciales, la contribution de ces volatiles à la sécurité alimentaire des foyers ruraux et leur application dans des systèmes de basse production devraient être reconnues et demande des études plus approfondies.

Keywords: *Native chickens, Phenotype, Growth and carcass traits, Egg production, Food security.*

Introduction

The introduction of chicken to Africa is not well documented. Skeletal remains found in Qasr Ibrim, Egypt, indicated that chickens were present in 332 BC, while the earliest remains in Sub-Saharan Africa can be traced to the late 5th Century AD (MacDonald and Edwards, 1993). Domesticated chickens were introduced most probably to South Africa by traders on route to India and by European settlers during the early 15th and 16th centuries. It is therefore difficult to confirm the origin of the so-called native or local chicken lines presently found in South

Africa. These chickens are kept for eggs and meat and are associated mainly with rural households. It was only as recently as 1994 that the chickens' potential contribution to household food security was recognized, as well as it being a poultry genetic resource that should be conserved for posterity.

A programme was established at the Agricultural Research Centre (Poultry Supply Unit) at Irene, with the aim of conserving the gene pool of all the different native lines and to promote their application in rural food production. The populations consist of different lines that were collected in different geographical locations in South Africa and Namibia. As no scientific data were available on the production potential of these chicken lines, trials were conducted in order to provide a phenotypic characterization with the different lines and to test for differences in growth, carcass traits and egg production.

Material and Methods

Description of the native lines

The Potchefstroom Koekoek has been used widely by farmers in South Africa for household egg production for many years. The breed originated from a cross between the Black Australorp and the White Leghorn during the 1950s, at the former Potchefstroom Agricultural College. The Plymouth Rock was later included into the breeding programme and eventually the Koekoek was registered as a South African breed with the South African Poultry Association in 1976 (Viljoen, 1986). These birds have a characteristic black and white speckled colour pattern. The bargene, a sex-linked gene, is inherited by males, which can be easily distinguished having light grey bars on the feathers, while the females are darker (Figure 1). The Koekoek is classified as a heavy breed, with the adult bodyweight varying between 3 and 4 kg for cocks and 2.5 and 3.5 kg for hens. The skin colour is yellow (Viljoen, 1986).

The Naked Neck chicken was introduced to South Africa most probably via the early traders from Malaysia. These chickens carry

the major gene *Na-* for Naked Neck and have approximately 30 percent less feathers than chickens without the Naked Neck gene. Chickens that are homozygous for the *Na*-gene have no feathers on the neck area, while the heterozygous chickens have a little tuft of feathers on the lower portion of the neck. The Naked Necks of South Africa are very colourful, with white, red and black combinations (Joubert, 1996) (Figure 2).

The first recording of the Lebowa-Venda chickens was made during 1979 in Venda in the Northern Province. These birds are found mostly in this area, which is in the most northern part of South Africa, bordering Zimbabwe. The name Lebowa-Venda is associated with the two largest ethnic groups living in the Northern Province. The Lebowa-Venda chickens have white and black or white and brown plumage with shades of dark green on the feather tips (Joubert, 1996) (Figure 3).

The Ovambo was found originally in the rural areas of Namibia and Ovambo. Its name refers to the geographical area, where they were distinguished by the local people as a group of chickens native to the area. These chickens have predominantly dark red, brown and black feathers. They are aggressive and capable of flying to avoid predators (Joubert, 1996) (Figure 4).

Production evaluation

Trials were carried out at the Hatfield Research Farm of the University of Pretoria to provide base-line data for growth and egg production for the different lines. Groups of 160 Koekoek, 113 Naked Neck, 120 Lebowa-Venda and 105 Ovambo chickens were tested for growth over a period of 11 weeks. A commercial broiler line, the Cobb was included as a benchmark. Males and females were not separated. Birds were kept in an environmentally controlled house and reared on commercial rations. A vaccination programme, recommended by the Faculty of Veterinary Science at the University of

Pretoria for small farming enterprises, was followed. Body weight and feed intake per pen were recorded on a weekly basis.

At the end of the growth period, ten birds of each line were selected, weighed and slaughtered. Chickens were electrically stunned and killed by manual exsanguination. Feathers, viscera and heads were removed and carcasses were stored at -40°C until dissected. Live weight and carcass weight with and without viscera and heads were recorded. Carcasses were thawed before dissection and the feet and abdominal fat were removed. The weights of the *M. pectoralis* and *M. supracoracoideus*, as well as the appendicular and axial skeleton were recorded. The dissected carcasses, which included the muscle, bone, fat, skin and feet were ground with a mincer to obtain a homogenous sample for a proximate analysis.

At completion of the growth trial of 11 weeks, the females were kept and raised up to 18 weeks of age. Twenty-four females of each of the native lines were randomly selected for evaluation of egg production. The Amberlink (commercial layer type) was included as a benchmark. A natural ventilated house, equipped with a battery system was used, where the hens were kept in separate cages in order to record individual egg production. Hens were fed on a commercial layer's mash. Egg production per day per hen and egg mass were recorded for 51 weeks. Live weight was recorded when placed in the battery at 20 weeks of age and again at marketing at the end of production (70 weeks of age). Mortality was recorded during the growth and egg production trials.

Differences among lines for growth and carcass traits were tested using a General Linear Model (GLM) procedure of SAS[®]. A chi-squared test was done to test for significant differences among all lines for egg production.

Results and Discussion

Significant differences were found among the native lines for the production traits evaluated. For growth, the Ovambo chickens

had the heaviest average weight (1.18 kg), followed by the Koekoek (1.1 kg) and the Naked Neck (1.06 kg), while the Lebowa-Venda had a significantly lower growth, only reaching an average weight of 0.937 kg at 77 days of age (Table 1). The total feed intake was very similar for all the lines (3.61-3.72 kg), except for the Lebowa-Venda chickens which had a lower intake of 3.39 kg during the study period. Feed efficiency ratios varied from 3.0 for the Ovambo to 3.6 for the Lebowa-Venda. (Table 1). These lines have adapted to their natural environment and grow and produce accordingly. Their growth is poor in comparison to the commercial Cobb line. As a consequence of the comparatively poor growth rate, it will not be profitable to feed males for broiler production purposes.

However, the growth performance of these South African local lines was similar to those of other native or indigenous lines evaluated in similar conditions in Malaysia and Malawi. The Malaysian village fowl had an average weight of 1.1 kg at 15 weeks of age (Ramlah, 1996) and the Malawi local chicken weighed 2.1 kg at 20 weeks of age (Safalaoh *et al.*, 1996).

The native lines seem to differ distinctly in feeding behaviour from the Cobb broiler. The native chickens had difficulty feeding from the feeding troughs during the first week and feed was provided on flat cardboard. The native lines also spent much more time feeding around the feeding troughs as well as scavenging in the pen. This behaviour may have an influence on their performance. These results were obtained for an intensive system with adequate nutrition, housing and disease control. A poorer performance could be expected if they were left to scavenge, although the type of feed while scavenging in combination with their genetic potential to utilize poor feed should also be considered.

All the native lines had a higher dressing percentage than the Cobb broiler. The Ovambo had the highest dressing percentage (79.6 percent) and the other local lines showed a dressing percentage of 75 percent, followed by the commercial Cobb line with a dressing percentage of 70 percent. The lines differed

Table 1. Initial and final weights, cumulative feed intake and feed conversion for the different chicken lines over a period of 11 weeks.

	Koekoek	Naked neck	Lebowa-Venda	Ovambo	Cobb
No. of chickens	160	113	120	105	150
Initial weight in grams	35.43	35.49	33.47	27.02	0.40
Final weight in grams (11 weeks)	1 114	1 062	937	1 183	2.00*
Total feed intake (g)	3 680	3 720	3 390	3 610	4 100
Feed conversion ratio	3.3	3.5	3.6	3.0	2.0

*Cobb was slaughtered at 6 weeks of age.

Table 2. Least squares means and standard errors for dressed carcass weight (DCW) (g), percentage muscle, percentage breast muscle, percentage fat, percentage skin and percentage bone.

Chicken line	Dressed carcass weight (g)* \pm SE	Muscle (%)	Fat (%)	Skin (%)	Bone (%)	Breast muscle %/DCW %
Koekoek	831.6 ^{abc} \pm 35.9	54.9 ^{ac} \pm 0.81	1.2 ^{ac} \pm 0.47	10.6 ^a \pm 0.5	33.2 ^a \pm 0.9	17.0 ^{ac} \pm 0.5
Naked Neck	795.6 ^{cd} \pm 35.9	54.9 ^c \pm 0.80	1.8 ^a \pm 0.40	11.7 ^{ab} \pm 0.5	31.5 ^a \pm 0.9	18.0 ^c \pm 0.5
Lebowa-Venda	703.9 ^d \pm 35.9	53.0 ^b \pm 0.80	0.4 ^c \pm 0.40	10.3 ^a \pm 0.5	36.2 ^b \pm 0.9	15.2 ^d \pm 0.5
Ovambo	939.8 ^e \pm 37.5	51.9 ^{ab} \pm 0.80	2.5 ^a \pm 0.40	12.1 ^{cb} \pm 0.5	33.5 ^a \pm 0.9	15.9 ^{ab} \pm 0.5
Cobb	1 405.0 ^f \pm 37.5	55.2 ^d \pm 0.80	6.5 ^d \pm 0.40	14.2 ^{bd} \pm 0.5	24.1 ^c \pm 0.9	20.4 ^d \pm 0.8

*Dressed carcass weight: head and viscera removed.

Variables with different superscripts differ significantly (P<0.05).

Table 3. Total number of eggs, mean weight (g) for eggs produced (51 weeks), average hen weight and productivity ratio for the Koekoek, New Hampshire, Naked Neck, Lebowa-Venda and Ovambo.

Line	Total eggs/hen	Mean egg weight (g); \pm SE	Average hen weight (g)	Productivity ratio ²
Koekoek	204	52.1 \pm 0.09	2 100	6.1
Naked Neck	139	49.8 \pm 0.120	1 650	4.7
Lebowa-Venda	122	50.9 \pm 0.120	1 900	3.8
¹ Ovambo	91	43.8 \pm 0.18	1 900	2.5
Amberlink	311	58.7 \pm 0.068	2 250	9.9

¹Based on 43 weeks of production.

²Calculated as number of eggs x mean weight/average hen weight ⁷⁵



Figure 1. Potchefstroom Koekoek chickens.



Figure 2. Naked Neck chickens.



Figure 3. Lebowa-Venda chickens.



Figure 4. Ovambo chickens.

($P < 0.05$) from each other for dressed carcass weight (Table 2). For the native lines the Ovambo had the highest dressed carcass weight, but not the highest percentage breast muscle. The percentage of bone was relatively high for all the native lines (31.5-36.2 percent), especially if compared to the broiler line with only 24.1 percent (Table 2). The higher bone percentage in the native lines may be associated with their adaptation to flight and scavenging.

Chemical analyses indicated that native lines had a higher protein (42.2-46.1 percent) and lower fat (28.8-36 percent), while the reverse was true for the Cobb (CP 39.9 percent and CF 40.6 percent). Among the native lines the Ovambo (36 percent CF) and Naked Neck (34.9 percent CF) had a higher percentage of fat, while the Koekoek and Lebowa-Venda only had 28 percent fat.

The native lines reached sexual maturity (age at first egg) between 16 and 22 weeks of age. The Ovambo started laying at 16 weeks, but also stopped laying by 61 weeks of age, while the other lines laid up to 72 weeks of age. Literature indicates that native fowls were found to reach sexual maturity, on average, at 23 weeks of age (Horst, 1997; Nahm, 1997).

The colour of the eggs produced were brown for the Koekoek, Lebowa-Venda and Amberlink (commercial layer) and cream to light brown for the Ovambo and Naked Neck. Egg production for the native lines varied from 203 for the Koekoek to 91 for the Ovambo hens (Table 3). Egg production figures reported in literature varies from 25-150 eggs per hen per year depending on the production system applied. Egg production of the South African lines compare well with the Fayoumi (141) and Dandarawi (128), native lines of Egypt (Horst, 1991). The Koekoek, Lebowa-Venda and Naked Neck hens laid a medium sized egg (52.1 g, 50.9 g and 49.8 g), while the eggs of the Ovambo hens were small (43.8 g). The average weights for the hens over the production period were 2.1 kg for the Koekoek, 1.65 kg for the Naked Neck, 1.9 kg for the Lebowa-Venda and 1.9 kg for the Ovambo. The Lebowa-Venda, which

had the poorest growth up to 11 weeks, eventually showed compensatory growth and became robust with final weights of up to 2.2 kg at the end of production. These lines have the potential to produce between 4.2 kg (Ovambo) and 10.6 kg (Koekoek) of eggs per year for the household and cull hens can be sold for income or slaughtered for meat. Egg weight and average weight⁷⁵ of the hen can be used to calculate a productivity ratio (Horst *et al.*, 1996). The Koekoek and Naked Neck had the best productivity ratio of the native lines indicating the most potential for egg production (Table 3).

The mortality was less than 3 percent for the Naked Neck, Lebowa-Venda, Ovambo and New Hampshire chickens during the growth trial. The Koekoek had the highest mortality of 6 percent. The mortalities occurred between day one and day seven of age for all the lines. During the egg production trial mortality varied from 0 percent for the Naked Neck, 4 percent for the Lebowa-Venda to 20 percent for the Koekoek, New Hampshire and Ovambo hens. Mortality was mainly due to poor adaptation to the battery system, as post mortems showed no signs of disease.

Despite their lower productivity, the contribution of these lines to household food security is not underestimated. A relatively large section of the South African population is dependent always on a form of low-input agriculture for household food security. These native lines can play an important role as a relatively affordable protein source. Production for low-input and scavenging systems with these native lines should be investigated.

Conclusion

The native lines found in South Africa differ significantly in their production traits and it is possible to distinguish them as different lines according to their phenotypic differences (colour and production traits). Their production also compared well with other native and indigenous lines found in developing countries.

References

Horst, P. 1991. Native fowl as a reservoir for genomes and major genes with direct and indirect effects on the adaptability and their potential for tropically orientated breeding plans – A Review. 1991. *Animal Research and Dev. Institut für Wissenschaftliche Zusammenarbeit. Federal Republic of Germany.* 33: 63-79.

Horst, P. 1997. Project Coordinator. Compendium of results of the EEC-Research Project, No. TS3-CT92-0091. Final Workshop at M'Bour, Senegal. 12 December 1997, 14-18.

Horst, P., Mathur, P.K. & Valle Zarate, A. 1996. Breeding policies for specific tropical environments using appropriate combination of major genes. *Proc. World's Poultry Congress, New Delhi, India.* 2-5 September 1996. 1: 663-640.

Joubert, J.J. 1996. Personnel communication. Agricultural Research Centre, Private Bag X2, Irene. South Africa.

MacDonald, K.C. & Edwards, D.N. 1993. Chickens in Africa: the importance of Qasr Ibrim. *Antiquity.* 67(256): 584-589.

Nahm, K.H. 1997. Korean Native Ogol fowl. *World's Poultry Science Journal.* 53: 71-77.

Ramlah, A. H. 1996. Performance of village fowl in Malaysia. *World's Poultry Science Journal,* 52: 75-79.

SAS system. 1999. SAS Institute (Pty) Ltd, 93 Central Street, PO Box 2837, Houghton 2041, South Africa.

Safalaoh, A.C.L., Kadigi, H.J.S. & Phoya, R.K. 1996. Growth performance and carcass characteristics of male Black Australorp, Dwarf Malawi local chicken and their crosses from 8-20 weeks of age. *Uiswa Res J. Agric. Sci. and Tech.* 1(1): 61-67.

Viljoen, W.C.J. 1986. Hoenderrasse. *Pluimvee A2/ Boerdery in Suid-Afrika.* Department of Agriculture, Pretoria. South Africa. 1-8.

Origin and characteristics of the Maltese Black-Bronze Turkey

J.G. Mallia

Institute of Agriculture, University of Malta, Msida MSD 06, Malta

Summary

The Maltese Black-Bronze Turkey is a previously undescribed, rustic breed of turkey raised exclusively in backyard conditions. The broad-breasting trait (prevalence, P=100 percent), “bronzing” on the rump and tail (P=100 percent) and “wild type” wing markings (P=78 percent) were present. The average weight (AW) and standard error (SE) and weight range (WR) of turkeys (N=50) at 12 weeks, 20 weeks and 24 weeks of age was of 3.34 ± 0.04 kg and WR = 2.80-3.80 kg, 8.14 ± 0.09 kg and WR = 7.10-9.10 kg, 10.37 ± 0.10 kg and WR = 9.40-11.70 kg, respectively.

The AW \pm SE and WR of a skinned, excised breast muscle (*P. major* and *P. profundus* combined) and of a skinned leg of turkey at 24 weeks was of 1.37 ± 0.08 kg and WR=1.05 \pm 1.65 kg and 0.98 ± 0.08 kg and WR=0.9-1.10 kg, respectively. There were no mortalities during the study (P=0 percent) and no birds were condemned at slaughter (P=0 percent) at 24 weeks. Although growth rates were not as fast as commercial strains raised in industrial conditions, carcass quality and conformation were good. Persons (N=2) visually assessing meat colour found only 2 percent breast muscle to be darker than that of industrially-raised turkey. However, poor intra-rater agreement and inter-rater agreement for darkness of breast muscle indicated that it was indistinguishable from the breast muscle of industrially raised birds. When only feed costs were included, the price per kg live weight was of US\$ 0.99, US\$ 0.74 and US\$ 0.98 for 12, 20 and 24 weeks of age, respectively. Raising this breed of turkey for 20 weeks appears to be the most profitable age for marketing under small-scale

semi-intensive conditions, but it is slower growing than industrial birds as the latter reach 8-16 kg at 14–20 weeks. A questionnaire based on 322 respondents identified that there was a high, but unsatisfied demand for slower growing turkeys raised in “more natural” backyard conditions (P=89 percent). The Maltese Black-Bronze Turkey had the necessary characteristics to fill this niche market.

Resumen

El pavo Maltese Black-Bronze pertenece a una raza rústica no descrita hasta la fecha que se cría únicamente en condiciones de corral. Encontramos la característica de pecho amplio (normalmente P=100%) y de “tipo silvestre” de alas (P=78%). El peso medio (PM) y la desviación estándar (DE) así como el ranking de peso (RP) de esta raza (N=50) a 12, 20 y 24 semanas es de $3,34 \pm 0,04$ y RP=2,80-3,80 kg, $8,14 \pm 0,09$ kg y RP=7,10-9,10 kg, $10,37 \pm 0,10$ kg y RP=9,40-11,70 kg, respectivamente.

El PM \pm DE y RP de tallo de músculo de pecho sin piel (*P. major* y *P. profundus* combinados) y de una pata sin piel de pavo de 24 semanas fue de $1.37 \pm 0,08$ kg y el RP=1,05 \pm 1,65 kg y $0,98 \pm 0,08$ kg y RP=0,9-1,10 kg, respectivamente. No hubo mortalidad durante el estudio (P=0%) y no fue necesario llevar ningún animal al matadero (P=0%) con 24 semanas. A pesar de que la media de crecimiento no fue tan alta como para las razas comerciales criadas en condiciones industriales, la calidad de la canal y la conformación fueron buenas. Las personas (N=2) que controlaron visualmente el color de la carne encontraron sólo un 2% de músculo del pecho más oscuro que en los pavos criados industrialmente. Sin embargo,

la falta de acuerdo “intra-rater” e “inter-rater” sobre el color oscuro del músculo del pecho indicó que era imposible distinguirlo de los animales criados industrialmente. Si consideramos sólo los costes alimentarios, el precio por kg vivo fue de US\$ 0,99, US\$ 0,74 y US\$ 0,98 para 12, 20 y 24 semanas, respectivamente. Criar este tipo de raza de pavo durante 20 semanas parece sea el período más interesante económicamente para mercados, en condiciones semi intensivas en pequeña escala, pero crece más despacio que los animales criados industrialmente ya que éstos alcanzan 8-16 kg en 14-20 semanas. Una encuesta basada sobre 322 respuestas identificó que existía una alta, pero no satisfecha demanda, de pavos de crecimiento más lento pero en condiciones “más naturales” de corral (P=89%). El pavo Maltese Black-Bronze posee las características necesarias para cubrir esta demanda del mercado.

Kew words: *Meleagris gallopavo mexicana*, *Meleagris gallopavo silvestris*, *Carcass characteristics*, *Carcass disposition*, *Cost analysis*, *Roman and Maltese rooster*, *Doondyan*.

Introduction

Turkeys are still widely raised in backyard conditions, particularly in the countries on the Mediterranean southern shoreline and islands. They have retained their popularity as a backyard bird as many parts of the southern Mediterranean basin are also not serviced by large industrial-type turkey farms. Relatively little work in the characterization and evaluation of genetic resources of local poultry has been carried out (Traoré, 1999), yet turkeys are widely kept in several parts of the world and represent an undervalued genetic resource with substantial potential for use in many regions. It is therefore important to identify the origin and describe relatively unknown populations of turkeys that thrive in non-industrial conditions of management. How may the Maltese Turkey fit in with the first turkeys brought to Europe from Mexico?

Domesticated turkeys (*Meleagris gallopavo mexicana*) were brought to Britain in 1821-1824 by the Spanish and the first English Poultry Show of 1845 had a single class for turkeys (Anon, 1971). Subsequent selection resulted in Norfolk and Cambridgeshire and also a strain with pure white feathers (Brown, 1906). However, several colours (black, brown and red) and white were already observed in

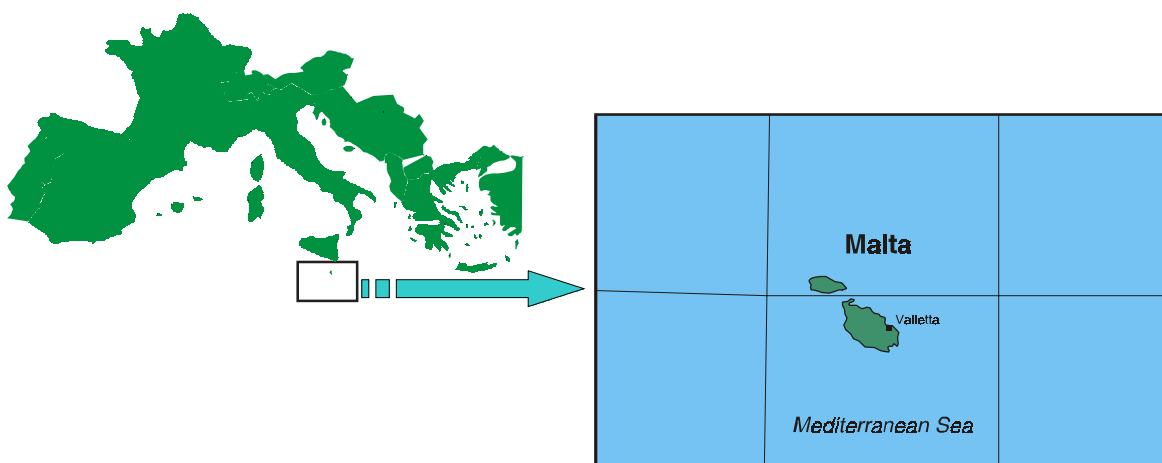


Figure 1. The position of Malta in the Mediterranean sea.

Mexico by the Spaniards (Sahagun, 1938, in Schorger, 1964) and are still present in contemporary Mexican turkey populations (Mallia, 1998a). The Spanish were also responsible for disseminating Mexican turkeys in the rest of Europe and much of the Mediterranean. Malta had strong historical ties with Spain and France through the Knights of the Order of St John. The position of the Maltese Islands within the Mediterranean basin is shown in figure 1. The population of black-bronze turkeys in this study may therefore represent a relict population of birds originating from the initial distribution of turkeys in the 1800s by the Spanish (Anon, 1971). Specimens from this line were subsequently out-bred at some unknown, more recent stage, with turkeys having the broad-breasting (BB) trait. How did the BB trait, present in the population of Maltese Turkeys arise? Around 1830-1840, European stock (probably the Norfolk Black) was crossed with *M. g. silvestris* in the USA, to produce the Bronze and Narragansett breeds (Myrick, 1902, in Brown, 1906). Selection for greater size and weight and feather markings resulted in the American Mammoth Bronze (AMB) Turkey (Myrick, 1902, in Brown, 1906). The AMB probably had little impact on the Mexican or "Spanish-type" turkey populations in Europe and was replaced by broad-breasted (BB) turkeys introduced to the USA from Britain in the 1930s (Crawford, 1990). BB turkeys had a better carcass conformation and all industrial strains were developed from this nucleus of turkeys. Further intense selection for larger muscle mass and adaptability for industrial conditions have resulted in only one breed, the Broad-Breasted White (large white) being of international importance (Sponenberg *et al.*, 2000). Despite its success in industrial conditions, it is totally inappropriate for raising in backyard conditions.

In developing countries the backyard poultry sector represents the backbone on which a sustainable well-adapted semi-commercial subsector could be progressively developed (Sonaiya *et al.*, 1999). Therefore, birds in this study were raised under a small-scale intensive system and included details common to the standard

methods of raising "backyard" turkeys in the Maltese Islands. The main aim of this paper is to report on the origin and performance potential of a previously undescribed local population of turkeys in Malta when raised in a small-scale intensive system.

Materials and Methods

Fifty male six-week old local turkeys were purchased from growers raising poultry in backyard or small-scale intensive systems of management. They were ringed for identification and randomly allocated to five contiguous pens within the same shed, ten birds per pen.

Strict biosecurity measures were adopted and persons attending the turkey flock had no contact with any other poultry. Pens were constructed in a new stone shed (unheated) in which no other poultry had ever been raised. Caution was taken to exclude the presence of other domestic animals, rodents and the ubiquitous Spanish sparrow (*Passer hispaniolensis*). The flooring of the pens was of concrete to exclude the possibility of contact of the turkey poults with earth and regularly covered in fresh sawdust; apertures had wire screens placed across them. Feed and water were placed in sealed containers to further exclude the presence of rodents, wild birds and insects.

The turkeys were watered and fed *ad libitum* on starter pellets from age six to eight weeks, grower pellets from age nine to eighteen weeks and finisher pellets from age nineteen to twenty-four weeks. They were weighed weekly for the entire duration of the study. All data were entered into a database file (Statistix v.4.1, St Paul, Minnesota). Weight gain was studied in conditions of a constant day length of 12 hours, established by means of a time-switch regulated neon-tube light source. The flock was closely monitored for the presence of disease, particularly the presence of "poor-doers". After the final weighing at the age of 24 weeks, birds were euthanased by means of cervical dislocation and exsanguinated. A necropsy was performed by a veterinary

pathologist on all turkeys in the flock. The gross lesions were described and organoleptic properties of the carcass evaluated. The weight of the deboned breast (*Pectoralis major* and *Pectoralis profundus* combined) and leg (including femur, patella, tibia, fibula and associated muscles) were also recorded. A one-way analysis of variance was conducted on the turkey flock (pen being the “treatment”) as a possible “pen effect” on the weights was present at 12, 20 and 24 weeks, respectively. Descriptive statistics and costs incurred to raise the turkeys for all three ages were also investigated (Quattro Pro, Version 5.0, Scotts Valley, CA, USA). As weight measurements for the three ages were conducted on the same population of 50 turkeys, the Bonferroni approach was used to control the overall level of significance. This method accounts for the greater chance of declaring a significant difference due to the larger number of tests (three) being performed on the same group of turkeys. Thus, $\alpha^* = \alpha/n$, where α^* is the Bonferroni-corrected level of significance, α is the desired level of significance ($P = 0.05$) and n is the number of tests performed on the same sample of turkeys (Shoukri and Edge, 1996).

Two persons visually assessed the meat colour within 15 minutes of slaughter (*P. major* and *Gastrocnemius lateralis*). The following technique used for muscle colour evaluation was based on that suggested by Mallia (1998b) and was chosen to avoid areas with prominent connective tissue that may bias colour evaluation. Therefore, the *P. major* was skinned and immediately the ventral aspect was assessed, 2.5 cm from the proximal extremity of the muscle and the *G. lateralis* was assessed 2 cm from the medial, distal aspect of the *Iliotibialis cranialis*. The colour scale adopted, ranging from unity to seven, was as follows: 1 (markedly light), 2 (moderately light), 3 (slightly light), 4 (normal), 5 (slightly dark), 6 (moderately dark), 7 (markedly dark). Samples were tagged for identification and each rater evaluated the same meat sample twice (the “intra-rater agreement”, to see if the same

rater’s second evaluation agreed with the first; the sample identification was changed so that the previous score would not bias the second rating). The agreement between colour evaluation of the two different persons (raters) was also assessed (“inter-rater agreement”), both raters being unaware of the other’s ratings. A mathematical computation, Cohen’s kappa statistic, 6 (Cohen, 1960) was used to assess the agreement. This statistic was divided into categories based on guidelines suggested by Landis and Kock (1977). Therefore, agreement for the meat colour of a sample was said to be “poor” for a computation of 0.01-0.20, “fair” when it ranged from 0.21-0.40, “moderate” from 0.41-0.60, “substantial” from 0.61-0.80 and “almost perfect” from 0.81-1.00.

A preliminary assessment of the marketability of this type of turkey was performed by means of a telephone-based questionnaire administered to 350 randomly chosen households from the local telephone directory. A household was defined as a minimum of one or more persons living in the same premises, of which at least one person was non-vegetarian. Questions asked were aimed at identifying the availability and consumer preferences for turkey meat in Malta and are summarized in table 1.

Results

Carcass characteristics

The turkeys had a moderate to marked broad-breasting trait, with ample “dimpling” over the sternum (prevalence, $P=100$ percent). They also had relatively shorter legs ($P=100$ percent) and a calmer temperament than other backyard populations, for example, those described in Central America (Mallia, 1998a, Mallia, 1999a). There was little variation in plumage type: all were “black-bronze”, this colour form having a mainly black plumage (Figure 2) and “bronzing” (Figure 3) only on the rump and tail ($P=100$ percent). Most specimens also had a varying degree of “wild type” light markings on the wing primaries

Table 1. Results of questionnaire to assess acceptance and marketability of backyard, and industrially-raised turkeys in Malta (based on 322 respondents).

1. Do you consume turkey meat? (one answer only)	yes (100%)	no (0%)	
2. Do you eat turkey outside the Christmas period? (one answer only)	yes, > 5 times (0%)	occasionally (4%)	no (96%)
3. How do you purchase turkey? (one answer only)	frozen, industrially-raised (58%)		
	fresh/processed, industrially-raised (32%)		
	fresh/processed, semi-intensive/backyard (8%)		
	purchased live, semi-intensive/backyard (2%)		
4. What would be your ideal purchase choice for turkey? (one answer only)	frozen, industrially-raised (0%)		
	fresh/processed, industrially-raised (11%)		
	fresh/processed, semi-intensive/backyard (86%)		
	purchased live, semi-intensive/backyard (3%)		
5. (Dis)advantage (%) of purchasing frozen/processed, industrially-raised turkeys?	price (D 100%, A 0%)	availability (D 0%, A 100%)	
	meat quality (D 47%, A 53%)	meat safety (D 46%, A 54%)	
6. (Dis)advantage of purchasing fresh/processed, industrially-raised turkeys?	price (D 100%, A 0%)	availability (D 0%, A 100%)	
	meat quality (D 23%, A 77%)	meat safety (D 43%, A 57%)	
7. (Dis)advantage of purchasing fresh/processed, semi-intensive/backyard systems?	price (D 5%, A 41%, ? 54%)	availability (D 83%, A 3%, ? 14%)	
	meat quality (D 0%, A 100%)	meat safety (D 4%, A 96%)	
8. (Dis)advantage of purchasing live turkeys, from a semi-intensive/backyard system?	Price (D 2%, A 36%, ? 62%)	availability (D 98%, A 2%, ?)	
	meat quality (D 0%, A 100%)	meat safety (D 3%, A 97%)	
9. Any feather colour preference for a live turkey? (one answer only)	white (2%)	coloured (37%)	no preference (61%)
10. Any concerns over very small feathers on carcass?	white feathers	yes (42%)	no (58%)
	coloured feathers	yes (44%)	no (56%)
11. Would you purchase a carcass that is:			
	markedly dark**	yes (0%)	no (100%)
	markedly light **	yes (0%)	no (100%)
	moderately dark***	yes (12%)	no (88%)
	moderately light***	yes (14%)	no (86%)
	slightly dark****	yes (87%)	no (13%)
	slightly light****	yes (89%)	no (11%)
	irregularly coloured	yes (0%)	no (100%)

* D = disadvantage, A = advantage, ? = do not know. ** Visibly different in colour

*** Careful viewing reveals moderate difference in colour

**** Only comparison with other carcasses reveals slight colour difference



Figure 1. Malta backyard turkey, 20 weeks of age.



Figure 2. Malta backyard turkey with with bronze markings on rump, tail and wings.

Table 2. Average weight (kg) of turkeys from 6- 24 weeks of age (n=50; SE = standard error)

Age (weeks)	AW ± SE	Age (weeks)	AW ± SE (kg)
6	0.61 ± 0.00	16	6.05 ± 0.02
7	0.92 ± 0.01	17	6.39 ± 0.03
8	1.27 ± 0.01	18	6.87 ± 0.03
9	1.84 ± 0.02	19	7.35 ± 0.04
10	2.13 ± 0.02	20	8.14 ± 0.10
11	2.80 ± 0.04	21	8.83 ± 0.07
12	3.34 ± 0.04	22	9.40 ± 0.09
13	3.94 ± 0.02	23	9.76 ± 0.14
14	4.70 ± 0.04	24	10.37 ± 0.10
15	5.30 ± 0.04		

(P=78 percent). The plumage of the poults is shown in figure 4 and is predominantly black even at eight weeks of age.

A one-way analysis of variance showed that there was no significant difference (P<0.05) among the weight of turkeys in the five pens at 12 weeks of age. There were also no significant differences at 20 weeks (P<0.05) and 24 weeks (P<0.05) of age for turkeys housed in different pens. As there was no significant difference among weights in different pens (i.e. the weight of turkeys in different pens was not distorted by the effect of being in different pens), descriptive statistics were based on the summed weights of all 50 turkeys. The average weight (AW) and standard error (SE) of a turkey at 12 weeks of age was of 3.34±0.04 kg, with a range of weights from 2.80-3.80 kg. At 20 weeks of age, the AW±SE was of 8.14±0.09 kg, with a weight range of 7.10-9.10 kg. At 24 weeks of age, the AW±SE was of 10.37±0.10 kg, with a range of weights from 9.40-11.70 kg. The AW±SE for the entire length of the study are summarized in table 2.

The AW ± SE of a skinned, excised breast muscle (*P. major* and *P. profundus* combined) of turkeys slaughtered at 24 weeks was of 1.37±0.08 kg, with a weight range of 1.05-1.65 kg. The AW±SE of a skinned leg at the same age of slaughter was 0.98±0.08 kg, with a weight range of 0.9-1.10 kg.

None of the breast and leg samples (0 percent) were considered to be moderately or markedly dark (with respect to the same muscle groups from industrially-raised birds) by evaluators A or B. Evaluator A only classified two and eight percent of breast and leg samples, respectively, as slightly darker than normal when evaluated twice. Evaluator B only classified two and ten percent of breast and leg samples, respectively, as slightly darker than normal when evaluated twice. Evaluators A and B did not classify as “slightly dark” any of the same breasts (0 percent) and only two percent of legs. Therefore, evaluator A showed only moderate agreement (6) when evaluating the same breast samples twice (intra-rater agreement); evaluator B also only showed moderate agreement. Intra-rater agreement of evaluator A for leg colour could not be assessed due to limitations of the mathematical computations. Evaluator B showed substantial agreement when evaluating the same leg samples twice (intra-rater agreement). The agreement on breast and leg colour between the two evaluators (inter-rater agreements) ranging from poor to fair was almost absent. No samples were classified as moderately dark or markedly dark and agreement as to which samples were slightly dark was rather modest. This suggests that the colour differences between the meat samples in the study and those regularly available



Figure 3. Malta backyard turkey, 8 week.

(i.e. industrially raised synthetic strains of turkeys) were negligible. The difference was so subtle that the same evaluator rarely identified the same meat sample twice as, for example, “slightly dark”.

Disease and carcass disposition

The flock had no mortalities (0 percent incident rate) up to the day of slaughter at 24 weeks. There were no signs of depression, loss of appetite or any other symptoms of possible on-going syndromes for the entire duration of the study. All had moderate to severe superficial traumatic lesions on the head, especially the snood and caruncle turkeys (100 percent incident rate); although haemorrhage was widespread, the lesions were not complicated by infection and were left untreated. Mild to moderate bilateral opacity of the anterior thoracic air sacs, compatible with early-stage airsacculitis was present in two turkeys (four percent incident rate). Unlike several other strains of broad-breasted bronze turkeys, crooked keels were not observed (0 percent incident rate).

Deep pectoral myopathy (DPM) and dark, firm, dry (DFD) carcasses were not observed at necropsy (0 percent incident rate).

Airsacculitis lesions were localized to the anterior thoracic air sacs and were very mild with no consolidation of exudate. No other air sacs or associated bones, such as the clavicular air sac and humerus, were involved by the process. Furthermore, there were no signs of systematic involvement and lesions compatible with septicaemia. Due to the mild nature and localization of the lesions these carcasses were therefore considered fit for consumption after the removal of the affected parts, based on the criteria of Agriculture and Agrifood Canada and the United States Department of Agriculture (Herenda and Franco, 1996).

Cost analysis and marketing

The costs necessary for raising the 50 poults to three different ages were assessed: 12, 20 and 24 weeks of age. The cost incurred for the six-week chicks was of US\$150 (US\$3 a head); this was constant for cost calculations at all three ages. Bales of litter (sawdust) were purchased at US\$9 per bale; five bales (US\$45)

were necessary if slaughtered at 12 weeks, eight bales (US\$72) for slaughter at 20 weeks and US\$10 bales (US\$90) when slaughtered at 24 weeks. The cost of feed concentrate was of US\$0.3 per kg, therefore, 550 kg (US\$165) were necessary to raise the poult to 12 weeks, 1 000 kg (US\$300) up to 20 weeks of age and 1 700 kg (US\$510) for slaughter at 24 weeks. Heat costs for raising of poults under this system of management were absent. Person-hour (labour) costs were not factored in, as rearing usually occurs under "family poultry" systems of management.

The cost per kg (live weight) was calculated for all three age groups and included: (i) chick price, litter and feed; (ii) chick price and feed; and (iii) feed only. When chick price, litter and feed were included, the price per kg live weight was of US\$2.16, US\$1.28 and US\$1.45 for 12, 20 and 24 weeks of age, respectively. When the cost of the litter was excluded, the price per kg live weight was of US\$1.89, US\$1.11 and US\$1.27 for 12, 20 and 24 weeks of age, respectively. When only feed costs were included, the price per kg live weight was of US\$0.99, US\$0.74 and US\$0.98 for 12, 20 and 24 weeks of age, respectively. Marketing of black-bronze broad-breasted turkeys appears to be the most profitable at 20 weeks of age when raised in small-scale semi-intensive conditions.

The questionnaire to assess acceptance and marketability of small-holder reared black-bronze turkeys had a high percentage of respondents (92 percent). Results from the questionnaire indicated that turkey meat is widely consumed (100 percent of participants), but most (96 percent) only ate it around Christmas time. Most people bought their turkey frozen (58 percent) or fresh, processed industrially raised birds (32 percent); few bought semi-intensive or backyard turkeys (ten percent), of which only two percent were purchased live. In direct contrast, most people (89 percent) thought that the "ideal" turkey purchase was one raised in semi-intensive or backyard systems of management.

Frozen industrially raised turkeys were purchased because of their availability (100 percent). However, almost half the participants had concerns regarding the quality and safety of the meat and all commented that the price was not favourable. Fresh, processed, industrially raised turkeys had similar comments, except that many participants (77 percent) reported favourably about meat quality.

Fresh, processed, turkey raised in semi-intensive or backyard systems was considered to be safe (96 percent) and of good quality (100 percent). Most participants did not think (83 percent) or know (14 percent) if it was readily available. Almost half (41 percent) thought the price was favourable, but more than half (54 percent) had no idea of the price. The purchase of live turkeys raised in semi-intensive or backyard systems of management had a similar response, but almost all persons (98 percent) were uncertain about the availability of live turkeys from small-holder growers. Results are summarized in table 1.

Discussion

The backyard turkeys in this study were, at best, only comparable in weight to industrially raised commercial hybrids at 20 weeks of age. Even at this age, they only reached the lower end of the weight scale range, as the hybrids reach eight to 16 kg (17-35 lb) at 14 to 20 weeks (Anon, 1987). Clearly, this population of turkeys should not be grown for more than 20 weeks, unless the market specifically requires a heavier bird. However, the backyard turkeys are utilized for "non-industrial" semi-intensive or backyard systems of management and can easily find use in certain communities. For example, in Mexico a slower growing, but well-fleshed carcass is highly esteemed because of the richer flavour of the meat (Mallia, 1998a) and the questionnaire in this study also indicated an appreciation for the quality of meat from slower-growing backyard turkeys. Artificial selection has resulted in the *P. major* of domesticated

turkeys exhibiting 90-100 percent alpha-white fibres, with the remaining fibres being alpha-red (Wiskus *et al.*, 1976); but selection for rapid growth, increased breast width or muscle mass resulted in situations where some metabolic or anatomical limits were exceeded (Wilson *et al.*, 1990). It is possible that the Maltese Black-Bronze lies in an intermediate position between the (fully) BB industrial strains of turkeys and non-BB Mexican turkeys. Although double muscled, they appear to be slower growing than industrial birds and less prone to metabolic disorders such as deep pectoral myopathy (Siller, 1985) and dark, firm, dry (DFD) meat (Mallia, 1998b). Although not assessed in this study, the (microscopic) damage to muscle tissue due to rapid growth of BB turkeys, such as loosely packed, rounded and degenerating fibres in breast and leg muscles (Wilson *et al.*, 1990; Mallia, 1998b) would here be expected to be modest as the BB trait was not extreme. This damage may be due to the smaller proportion of connective tissue fibres and supporting cells and tissues for the muscle fibres, interfering with normal cell-to-cell relationships (Wilson *et al.*, 1990, Siller, 1985). Indeed, the growth of intramuscular connective tissue does not keep pace with the growth of pectoralis fibres (Swatland, 1990). This may also explain why breast meat from heavier turkeys tends to be more tender than that from lighter birds (Grey, 1989) and why no consumers commented on any particular toughness of meat from these moderately heavy turkeys.

A dark feathered, “naturally-grown” turkey was also seen to be more appropriate as a “special occasion” gastronomic speciality. This is particularly important, as the questionnaire clearly showed that although many people in the country consume turkey, this is almost exclusively around the Christmas period. Production costs may be reduced by using a local and/or cheaper source of litter (e.g. old newspapers), or eliminating the use of litter beyond a certain age, once the birds are hardened off. As the poults hatch in the height of the dry season, they are hardened off by the time the wet

season starts, therefore, they may be allowed to graze outdoors, reducing feed and litter costs. Social acceptance of “family-grown” turkeys, as evidenced by the questionnaire, was very marked, however, product availability was surprisingly lacking and there is a clear opportunity for development of this niche market.

Conclusions

The Maltese name for turkey is “doondyan” (dundjan), probably a corruption of the French “dindon”. The population of turkeys from which specimens in this study were obtained are known locally as “dundjan malti” in the local language and “Maltese Turkey” or simply “the Maltese” in English.

Although French has never been the language of Malta, the country has strong historical ties with several European countries through the Order of St John. The French name was therefore “imported” with the birds and altered so as to be more pronounceable locally. However, Malta also had strong links with Algeria, Egypt and Tunisia, earlier this century when thousands of Maltese were stationed there (Attard, 1989) and it is also possible that this was an additional route (to that of Spain and France) for turkeys into North Africa. It is interesting to note that in Egypt the name for turkey is (usually) “Deek Rumi” (“Roman rooster”) and “Dindi”, however it is also known as “Deek Malti” (“Maltese rooster”). Some people use these terms interchangeably, whereas others insist that the term “Deek Malti” was originally reserved for a strain of turkeys that was distinctly heavier than other strains (populations) present in Egypt (Mallia, personal observations, 1999). The heavy trait may be linked to the BB trait observed in the relict population still present in Malta, as identified by this study. The former mixing of “Deek Malti” with other strains present in Egypt (“Deek Rumi”, “Dindi”) may therefore represent an outbreeding strategy to “upgrade” the local stock of turkeys in Egypt.

“Improved” stock from Europe may therefore have reached parts of North Africa via Malta through Maltese emigrants, for example, birds that are larger and with some degree of broad-breasting. Turkeys however, with other favourable traits, such as ecotypes that were better adapted for living in a hot, dry Mediterranean climate, may also have been brought to Malta from North Africa by returning Maltese emigrants. This may have combined rustic characteristics with good production traits such as broad-breasting. This breed or ecotype of turkey may therefore be an ideal candidate for projects involving the raising of poultry by small-holders in non-industrial conditions.

It is hoped that the population of turkeys described in this paper will be safeguarded and utilized in a manner similar to the Black Maltese chicken described recently (Mallia, 1999b) that now benefits from an *in-situ* conservation project (Mallia, 1999c) at the Agriculture and Research Centre (Malta). It is hoped that the Maltese Turkey, which is hardy and rustic, but also has a good growth rate and favourable carcass traits (broad-breasting), will also be preserved and utilized in a similar manner.

References

- Anon**, 1971. British poultry standards, 3rd Edn. Butterworth & Co (Publishers) Ltd., Oxford; 298 pp.
- Anon**, 1987. Guide to farm practice in Saskatchewan: poultry factsheets No. 6, turkeys. <http://eru.usask.ca/saf_corp/livestok/poultry/turkey.htm> Saskatchewan Agriculture and The University of Saskatchewan, Saskatoon, Canada.
- Attard, L.E.** 1989. Man and means: the great exodus (1918-1939). Publishers Enterprises Group (PEG) Ltd., Marsa, Malta, pp. 23-29.
- Brown, E.** 1906. Races of domestic poultry. Edward Arnold, London, pp. 136-139.
- Cohen, J.** 1960. A co-efficient of agreement for nominal scale. Educational and Psychological Measurement, 20: 37-46.
- Crawford, R.D.** 1990. Poultry Breeding and Genetics. Amsterdam, Elsevier, pp. 1123.
- Grey, P.** 1989. Turkey meat texture. In Nixey, C. & Grey, T.C. (Ed.), Recent advances in turkey science, Butterworths, London, England, pp. 241-245.
- Landis, J. & Koch, G.** 1977. The measurement of observer agreement for categorical data. Biometrics, 33: 159-174.
- Mallia, J.G.** 1998a. Indigenous domestic turkeys of Oaxaca and Quintana Roo, Mexico. Animal Genetic Resources Information, 23: 69-78.
- Mallia, J.G.** 1998b. Epidemiological studies of cyanosis in poultry in southern Ontario. PhD thesis, Department of Population Medicine, Ontario Veterinary College, University of Guelph, Guelph, Canada, pp. 173.
- Mallia, J.G.** 1999a. Observations on smallholder “family poultry” units in parts of Central America and sustainable development opportunities. First INFPD/FAO Electronic Conference on Family Poultry: 7 December 1998-5 March 1999. Theme: “The Scope and Effect of Family Poultry Research and Development”. <<http://www.fao.org/WAICENT/FAOINFO/AGRICULT/AGA/AGAP/lps/fampo/Intropap.htm>>, FAO, Rome.
- Mallia, J.G.** 1999b. The Black Maltese: a Mediterranean, light breed of poultry. Animal Genetic Resources Information, 24: 41-48.
- Mallia, J.G.** 1999c. In-Situ conservation of the Black Maltese and performance evaluation under a small-scale intensive system. First INFPD/FAO Electronic Conference on Family Poultry: 7 December 1998-5 March 1999. Theme: “The

Scope and Effect of Family Poultry Research and Development". <<http://www.fao.org/WAICENT/FAOINFO/AGRICULT/AGA/AGAP/lps/fampo/Intropap.htm>>, FAO, Rome.

Schorger, A. 1964. The wild turkey. University of Oklahoma Press, Norman, Oklahoma, pp. 625.

Shoukri, M.M. & Edge, V.L. 1996. Statistical methods for health sciences. CRC Press Inc., Boca Raton, Florida. pp. 258.

Siller, W.G. 1985. Deep pectoral myopathy: a penalty of successful selection for muscle growth. Poultry Sci. 64: 1591-1595.

Sonaiya, E.B., Branckaert, R.D.S. & Guèye, E.F. 1999. Research and development options for family poultry. First INFPD/FAO Electronic Conference on Family Poultry: 7 December 1998-5 March 1999. Theme: "The Scope and Effect of Family Poultry Research and Development". <<http://www.fao.org/WAICENT/FAOINFO/AGRICULT/AGA/AGAP/lps/fampo/Intropap.htm>>, FAO, Rome.

Sponenberg, D.P., Hawes, R.O., Johnson, P. & Christman, C.J. 2000. Turkey conservation in the United States. Animal Genetic Resources Information, 27: 59-66.

Swatland, H.J., 1990. A note on the growth of connective tissues binding turkey muscle fibres together. Can. Inst. Technol. J. 23: 239-241.

Traoré, A., 1999. Requirements for family poultry development. First INFPD/FAO Electronic Conference on Family Poultry: 7 December 1998-5 March 1999. Theme: "The Scope and Effect of Family Poultry Research and Development". <<http://www.fao.org/WAICENT/FAOINFO/AGRICULT/AGA/AGAP/lps/fampo/Intropap.htm>>, FAO, Rome.

Wilson, B.W., Nieberg, P.S. & Buhr, R.J. 1990. Turkey Muscle Growth and Focal Myopathy. Poultry Sci. 69: 1553-1562.

Wiskus, K.J., Addis, P.B. & Ma, R.T-I. 1976. Distribution of beta-red, alpha-red and alpha-white fibres in turkey muscles. Poultry Sci. 55: 562-572.

Seventh International Conference on "Goats in Retrospect" Tours, France, 15-18 May 2000

Ten French scientists under the leadership of Mr François Etevenon, President of the French National Federation of Goat Farmers assisted by a technical committee of scientists from 23 countries and an organizing committee staged from 15-21 May 2000, the 7th International Conference on Goats held in Tours in the scenic centre of North-western France's tourism in the centre of the intensive French goat farming and goat cheese industry.

Thus, the 7th International Conference on Goats was held in a region, where dairy goats contribute much to the welfare of people. The Conference Proceedings, published in two volumes with a total of 1 049 pages contain 78 full-length papers, mostly in English but with some in French with English summaries. Copies of the Proceedings can be obtained from the Conference Secretary, Dr. Y. Chabert, Institut de l'Élevage, 149 rue de Bercy, Paris Cedex 12, France 75595; Fax.: +33-1-4004-5280; e-mail: sirdoc@inst-elevage.asso.fr.

The full-length papers were presented in 12 plenary sessions, covering

- Goats and sustainable development;
- Technology transfer;
- Transgenesis;
- North-South relationships;
- Nutrition and feeding strategies;
- Genetics and selection;
- Pathology;
- Production systems;
- Reproduction;
- Economic and social issues;
- Quality of milk and dairy products; and
- Meat, hair and skin products.

The Proceedings also contain 101 papers, which were presented in 16 Roundtable discussions, covering

- Contribution of women to goat production;
- Goat genome;
- Mother-young relationships;
- Detection and prevention of mastitis;
- Goat farming and the environment;
- Integrated control of nematode parasites;

- Detection and prevention of CAEV;
- Meat production in the tropics and sub-tropics;
- Main diseases in hot climates;
- Specificity and quality of goat products;
- Goat milk as a health food;
- Organization of goat research;
- Genetic resources: present use and prospects;
- Publishing research results;
- Effects of European sanitary policy on dairy farms and products; and
- Feeding strategies in arid rangelands.

Finally, the Proceedings also contain abstracts of four of the seven Satellite Symposia on

- Results and prospects of European projects on small ruminants in Africa;
- Organization and development of a local goat industry;
- Partnerships for development in goat activity: review of achievements in various countries;
- Goat milk quality for cheese making;
- Semen and embryo preservation and evaluation;
- Reproduction in the tropics and sub-tropics; and
- Applied genetic programmes for dairy goats.

In addition to these papers, there were 293 posters presented by the Conference participants which are also contained in the Proceedings. The Conference in addition conducted on a separate day, seven simultaneous technical visits and all-day workshops on

- Caprine genetics;
- The goat industry in the local Poitou-Charentes region;
- Businesses processing goat's milk;
- The technology of milk and cheese production;
- Reproduction;
- Feeding and the system of farming; and
- Pathology.

.....

For the interest of the general public, there were goat exhibits on the street in front of the Conference Centre, to “get the congress out of the classroom”, including dairy and Angora goats, products, Angora shearing, a children’s workshop on how to enjoy goat products and a farmers’ market. During the weekend of this full week of goat science and activities, there was in a neighbouring town a two day “Cheese Fair” with a cheese contest, goat meat products and goat cheeses for sale in a big farmers’ market throughout several streets, together with folk group parades and family entertainment. Throughout the Conference, each breakfast, lunch and dinner featured many delicious goat cheeses. To make the Conference even more complete, two post-Conference tours were added, one for four days to Bordeaux and another for eight days, east through the central mountains to Provence and Monaco.

The post-Conference four-day excursion had an especially interesting programme, visiting the international CAPRIGENE A.I.

Centre, which has an intensive buck proving programme, semen collection, processing and frozen embryo supply for over 1 000 participating goat breeders, over 2 300 goat farmers with milk recording systems and more than 400 000 annual goat inseminations. Three goat farms were also visited.

More than 800 participants from more than 70 countries attended the Conference with more than 200 accompanying persons. The moving spirit behind the entire programme was Dr. Pierre Morand-Fehr, Director of Goat Research at the French Ministry of Agriculture, who deserves much praise. During the Conference he was elected as the new President of the International Goat Association, succeeding Dr. Adel Aboul Naga, for the next four years, which will include the holding of the next International Goat Conference to be held at the Pretoria University in the Republic of South Africa in the year 2004.

World EXPO-Workshop on "Animal Breeding and Animal Genetic Resources" Mariensee, Germany, 17-18 July 2000

The objective of the Workshop was to explore the relevance of animal genetic resources (AnGR) to breeding programmes in different animal production systems.

With a still increasing world population on a shrinking acreage of arable land, overall productivity has to increase to satisfy rising needs. In developed countries, market forces have led to improved breeds leaving less performing ones behind. In contrast, in the developing world the introduction of "improved" breeds generally failed but still leaving indigenous breeds threatened due to indiscriminate crossing. Breeds in the developed world tend to be evaluated on the basis of market requirements, while those in the developing world usually have other criteria besides marketing.

A series of three papers dealt with the AnGR in high input systems for egg, meat (pigs) and dairy milk production. It is generally accepted that the current breeding populations contain all the genetic variability required for future breeding work. There is some concern about the within population variability which leads to the view that the increase of inbreeding should be kept below one percent per generation. Given the large differences in the production level between current production populations and breeds at risk, it seems highly unlikely that they will be able to contribute to current breeding programmes in any substantial way. This would leave as reasons for conservation the general insurance aspect, scientific interest and cultural considerations. As a result, the speakers took the view, that breed conservation ought to be a public concern going beyond the financial prowess and responsibility of the breeding companies or organizations.

All contributions dealing with low input systems showed a very different focus of conservation of genetic resources. Here, it is

seen as a vital pre-requisite for genetic improvement of production populations whereas in the high input systems it is viewed as a more moral obligation.

The 12 countries covered in the Asian perspective represent about one third of the world's breeds. So far, breed improvement has been mostly focussed on the importation of semen. The F_1 tends to perform higher than the indigenous breeds. However, systematic cross-breeding programmes require structures that usually do not exist in the countries. Furthermore, decisions for the introduction of breeding material are influenced by dubious economics like externalizing costs or use output as criterion instead of analyzing the complete production system. Additionally, research results tend to be ignored in many cases, in particular, by decision-makers.

This aspect was also stressed in the African Perspective: "conservation is appealing only if it results in economic benefit". Molecular genetic techniques are seen here as an instrument to enhance characterization and utilization of animal genetic resources. The South America Perspective gave a number of breeding programmes with breeds in use that are specifically adapted to the low intensity tropical environment. On the other hand, high input systems also played their role in the South American sub-continent. Many adapted breeds are used in well established breeding programmes with the introduction of the Zebu being a good example of utilization of a genetic resource also for low input systems.

In the global strategy for the management of AnGR in lower-input production environments as presented from the FAO perspective, evaluation and utilization of adapted local breeds play the most important role. The necessity for improved animal productivity is required by the increase in human populations in the low input areas of the world.

EAAP Mediterranean Symposium on "Prospects for sustainable dairy sector in the Mediterranean" Hammamet, Tunisia, 26-28 October 2000

The Symposium reviewed the historical development of the dairy sector in the Mediterranean, its present status and achievements in satisfying the needs of the growing population and changes in market conditions as well as challenges and prospects for the future.

The Symposium identified a variety of technically viable and scientifically sound policy options, as well as major fields requiring more in-depth scientific research and development of new sustainable technologies. It confirmed the readiness of the scientific community of the Region to continue serving the sector and providing it with new solutions and horizons.

During the last decade, the dairy sector of the Mediterranean Basin, representing one sixth of the global cow, half of sheep and one quarter of goat milk production, was marked by a slight decrease in the total production in the northern part of the basin, mainly due to the saturation of the market and measures undertaken within the EU Common Agricultural Policy and a dynamic growth in the South. A number of countries of the South basin have reached self-sufficiency in milk production, while others are still importing milk and dairy products. The Symposium noted with satisfaction the contribution of researchers, technicians and farmers from countries of the South and East banks of the Mediterranean in increasing dairy production and thus, contributing to the welfare of farmers and consumers in their respective countries. Participants of the Symposium underlined the need for the continuous exchange of experience and information among professionals and policy-makers from all countries of the Region.

In reviewing prospects for future developments, the Symposium analyzed production potential, socio-economic factors, including trends in demand for dairy

products and the capacity of the sector to contribute to sustainable rural development, as well as available technologies, institutional framework and human resources.

In spite of problems related to the shortage of water, the Region is endowed with production potential sufficient to meet all or almost all future increased demand for the major part of dairy products arising from population growth, urbanization and changes in nutritional habits.

The role of dairy products in the Mediterranean diet, the healthiest in the world, should be maintained by improving quality and safety of typical local products. These products should be registered and protected in order to safeguard their place in the future markets and their role in producing income to farming population by linking these products to local breeds and traditional technologies. Science and research were called upon to contribute to the improvements in productivity of local breeds and in quality of their products.

The available technologies for intensive, semi-intensive and extensive production systems and the existing institutional framework, research education, extension systems, organization of the sector, although requiring continuous adjustments and improvements, have proved to be in a position to meet variety of demands and challenges for future development. In this respect, the Symposium called for an increase in research for the semi-intensive farming systems in the South (e.g. local feed base, productivity of local breeds of cattle, sheep, goats, quality of local products) and emerging issues connected with changes in agricultural policies in the North. It emphasized the importance of producer associations as representatives of interests of the sector and partners in the policy dialogue and in identification of research needs.

FAO Global Training of Trainers' Workshop preparing for the SoW-AnGR Process Rome, 26 February-3 March 2001

Following the mandate of the Commission on Genetic Resources for Food and Agriculture in 1999, and the recommendations of the Intergovernmental Technical Working Group on Animal Genetic Resources for Food and Agriculture in September 2000, FAO organized The Global Training of Trainers' Workshop in Rome, from 26 February to 3 March 2001, as a key step in developing the *First Report on the State of the World's (SoW) Animal Genetic Resources (AnGR)*. The workshop developed a core of trained experts for use in the Regional Training Workshops throughout planned to occur in all regions during the second half of 2001, and as international consultants assisting needy countries to develop both their capacity and their Country Reports.

Workshop:

- Reviewed the components of the Global Strategy for the Management of Farm AnGR, and the mandate and context of the SoW-AnGR report;
- studied the process for the development of the Country Report on the SoW-AnGR, as a strategic policy document;
- became fully familiar with the Guidelines and the Background Questions, their function and purpose;
- examined and commented on the pre-prototype version of the DAD-IS SoW-AnGR Module, being developed to assist countries further develop their AnGR Network, their SoW-AnGR Databank as well as their Country Report;
- considered how best to efficiently and effectively carry out their tasks as trainers and consultants.

Twenty five 25 participants from all regions, along with FAO staff and supporting consultants attended the workshop. Groups of participants were organized in order to:

- analyze and discuss the key elements of DAD-IS SoW-AnGR Module;
- to evaluate the tabulation tools;
- to propose added explanations for better use of the Guidelines and Background Questions;
- to develop a checklist for the preparation of the Country Report; and
- to propose the programme for both the Regional Training Workshop and the First Country Workshop.

Participants were very positive about the country-driven approach to the development of the SoW-AnGR Process which is being taken by FAO. They firmly agreed that the development of the Country Reports, of the planned Strategic Priority Actions Report and of the first Report on the SoW-AnGR itself provides an important opportunity for countries to increase awareness of the important role played by AnGR for food and agricultural services, to further develop their capacity to manage AnGR and to obtain the necessary support and funding for this action.

World Watch List for Domestic Animal Diversity, 3rd Edition

B.D. Scherf (Editor),

Food and Agriculture Organization of the United Nations,
V.le delle Terme di Caracalla 1, 00100 Rome, Italy. Published in 2001

ISBN: 95-5-104511-9

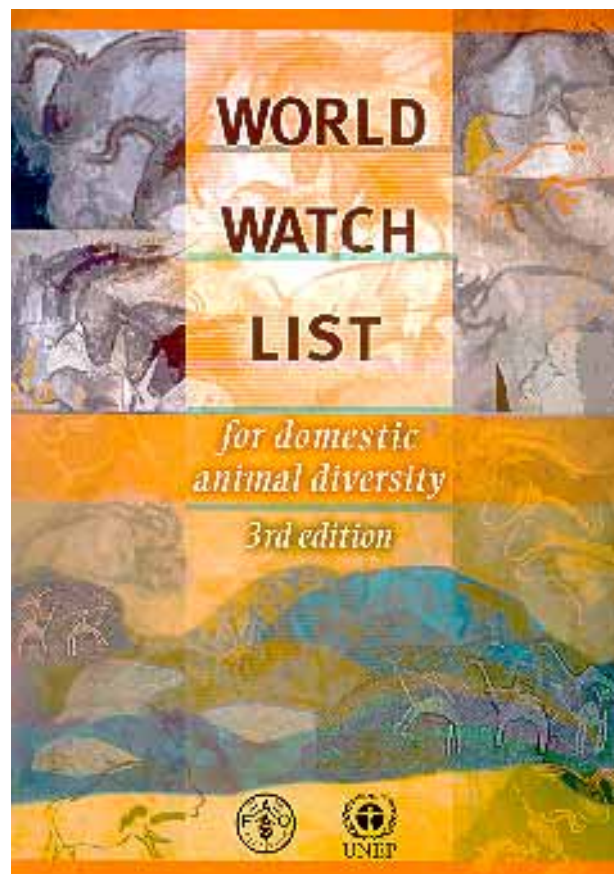
pp. 725

World Watch List for Domestic Animal Diversity (WWL-DAD: 3) issued by FAO and the United Nations Environment Programme (UNEP) consists of 43 chapters in four parts and four annexes. This third edition contains summary results of the analysis of thirty mammalian and avian species, together with their wild relatives and feral populations. WWL-DAD: 3 is the result of ten years of data collection in 170 countries, covering 6 500 breeds of domesticated mammals and birds. The publication provides information on existing viable breeds, breeds that exist but in dangerously low numbers (The Endangered Breed List) by region and country, information on breeds on the verge of extinction (The Critical Breed List) and details of domestic animal breeds that are already extinct (The Extinct Breed List). The book also provides documentation on the wild relatives of domestic animal species and an introduction to the issue of feral populations associated with domestic animal diversity. When reading the book, the reader should bear in mind the FAO definition of “breed” and “region”; on the other hand, one should recall that the information on breeds was provided by the country/regions themselves.

An important aspect of the book is the analysis of trends in domestic animal diversity since the publication of the first edition in 1995. WWL-DAD: 3 also provides the communication coordinates of the National Co-coordinators for the Management of Animal Genetic Resources identified by their respective governments.

The information in the book is easily accessible. The size of the pages is A4 and the book includes 50 figures, 33 photographs and six plates, all in colour and 20 tables.

The material in WWL-DAD: 3 makes it essential reading for those concerned with the management of animal genetic resources and conservation of biodiversity.



Animal Recording for Improved Breeding and Management Strategies for Buffaloes

ICAR Technical Series no. 4

B. Moioli, J. Mäki-Hokkonen, S. Galal & M. Zjalic (Editors)

Proceedings of the Workshop held in Bled, Slovenia, 16-17 May 2000.

Published in 2001

ISSN: 1563-2504

ISBN: 92-95014-00-6

Buffalo contributes significantly to the economies of many countries and there is a need for establishing guidelines and standards for recording that can be universally applicable.

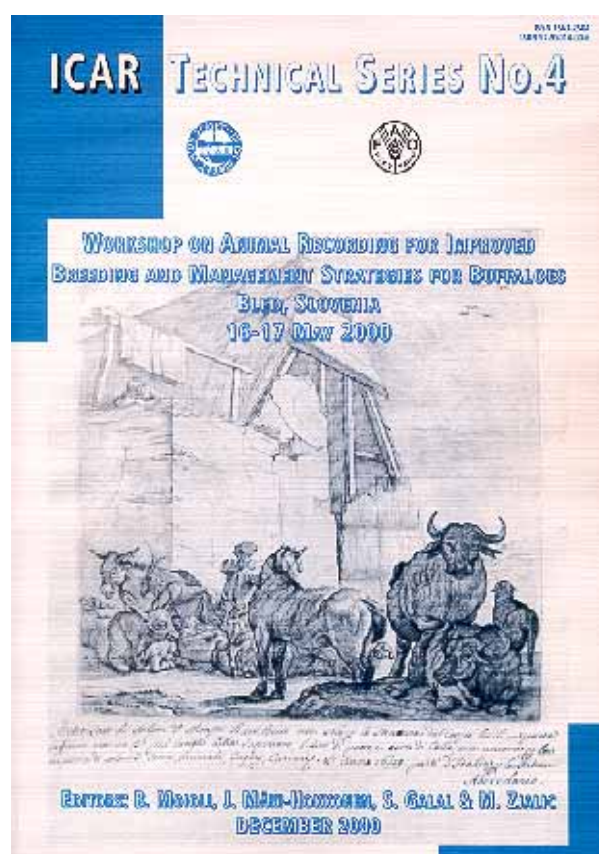
Bearing in mind that buffalo recording is still not practised in many developing countries, the aim of this Workshop was to promote buffalo milk recording systems by considering the already existing experiences of buffalo recording activities and by giving an opportunity to the participating experts to discuss the constraints, requirements and benefits of implementing standardized milk recording systems for buffalo.

Experts from fifteen countries prepared case studies describing the experience of animal recording, particularly for buffalo, in their country. These case studies served as a basis for the discussion held during the two day Workshop, held in Bled, Slovenia, from 16 to 17 May 2001.

Objectives of the Workshop were to:

- encourage buffalo recording in developing countries and to make possible the comparison of animal productivity in different production systems;
- contribute to the international collaboration for the development of buffalo production;
- increase the awareness of the value of recording systems for the management of the breed; and
- promote the use of records to evaluate the rank of animals, improve farm management systems and increase the benefits of farming.

This ICAR Technical Series no. 4 includes the 15 Case Studies presented, the Workshop Discussion and the Recommendations and Guidelines agreed upon.



.....

Eleven örökség - Régi magyar háziállatok (Live Heritage - Old Hungarian Domestic Animals)

I. Bodó (Editor)

Agroinform Publishing and Printing House Ltd.,

Budapest, Hungary

(Text in Hungarian). Published in 2000

ISBN: 963-502-720-6

pp. 125

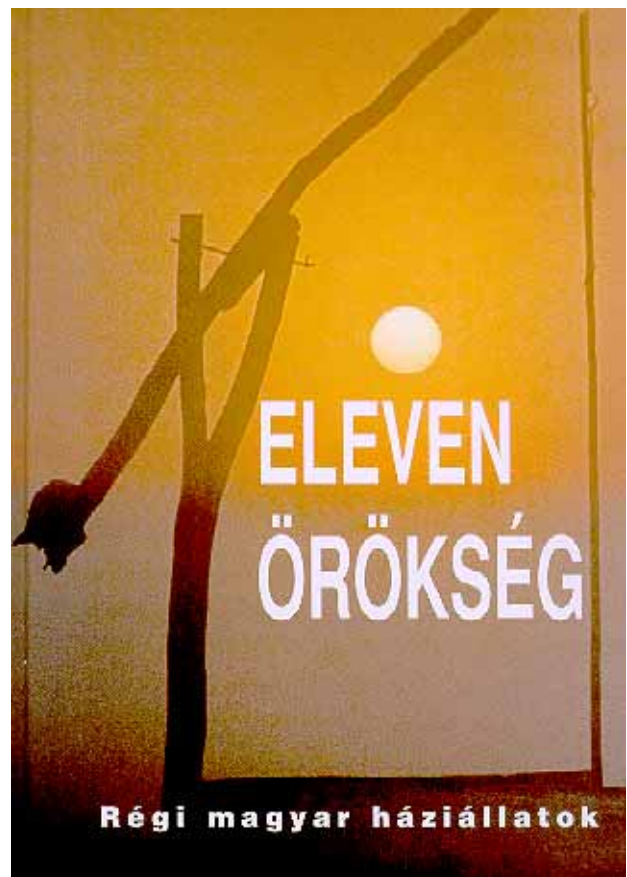
Hungary was among the first countries to recognize the necessity of conserving the genetic diversity present in the gradually disappearing animal population. The Government of Hungary has provided financial support for the conservation work since the early 1960s. Most of the endangered populations were kept on state farms and cooperatives. The early 1990s have brought about considerable changes in the former Eastern-block countries, among others, the beginning of the privatization of the above-mentioned farms. This process has created a new situation, the Government has had to take further measures to rescue the old native species and breeds. The new project today concerns not only the so called gene reserve populations, but also those breeds which have been recently developed, but due to their lower production capacity, they are not competitive in the present economic conditions (Hungarian Simmental cattle for example).

Old Hungarian animals and their short history are presented in this book together with photographs of excellent quality. A short description of the characteristics of each breed is followed by the discussion of the possible ways for their profitable utilization (for example commercial crossing).

An interesting part of the book is the presentation on Hungarian dogs, fishes and doves.

The aim of this book is not only the presentation of the old Hungarian animals, but also to draw attention to the necessity of their conservation.

.....



Improving health and welfare in animal production EAAP publication no. 102

J. H. Blokhuis, E. D. Ekkel & B. Wechsler (Editors)

Proceedings of a workshop held in The Hague 21-24 August 2000
Wageningen Pers, P.O. Box 42, 6700AA Wageningen, The Netherlands
Published in 2001. ISBN: 9074134866

ISSN: 0071-2477

pp. 130

Health and welfare of domestic animals is a prominent issue in society and in all public discussions on animal production. The public is concerned about the health and welfare of production animals, the lack of individual control, the large group sizes and high technology input. As a response, governments have been integrating requirements about animal welfare, use of medication and product safety in national and international regulations. Parallel to this, more and more producers of animal products claim to meet specific health and welfare standards and these products are marketed as e.g. 'safe' with respect to human health or as 'animal friendly produced'. Moreover, supermarkets take advantage of the need for 'high quality food' by developing specific health and welfare standards. Such standards may be diverse and well above the legally required standards to accommodate niche markets.

As a consequence of these developments, there is an increasing need for methods to measure and monitor health and welfare, to control the (quality of) production (ISO, HACCP) and to certify farms that comply with health and/or welfare requirements of their customers. This need is not only related to existing housing systems; both governments and the society want to have an insight into the health and welfare aspects of new, alternative housing systems preceding introduction into practice.

The above-mentioned issues were covered in three sessions of the Commission on Animal Health and Management of the EAAP held in The Hague; 'Management of Health and Welfare' (Parts I and II) and 'Alternative

housing systems for pigs and laying hens'. This publication presents a selection of the oral presentations in these sessions, which give a broad overview of the different perspectives on how management and certification systems as well as new housing systems can contribute to a society and consumer-accepted animal husbandry.



**Animais do descobrimento.
 Raças domésticas da história do Brasil
 (Animals of the Discovery.
 Domestic breeds in the history of Brazil)**
A. Mariante da Silva & N. Cavalcante (Editors)
EMBRAPA, Recursos Genéticos e Biotecnologia
Parque Estação Biológica, W5 Norte, 70770-900 Brasília DF, Brazil
Published in 2000
Phone: +55-61-4484700; www.cenergen.embrapa.br
(Text in Portuguese and English)
pp. 230

In the context of the commemorations of the 500 years of the discovery of Brazil, the Ministry of Agriculture and Supply, through the Brazilian Company of Agricultural Research (Embrapa), has edited this book on domestic animals in Brazil which did not exist in the country before the arrival of the Portuguese.

This book, written in Portuguese, recuperates the importance of domestic animals in art and culture and shows the history of their arrival in Brazil, as well as their development over the last five centuries. Submitted to a detailed process of natural selection, the breeds brought from the Iberian Peninsula acquired unique adaptive characteristics, such as rusticity and resistance to diseases in the different Brazilian habitats.

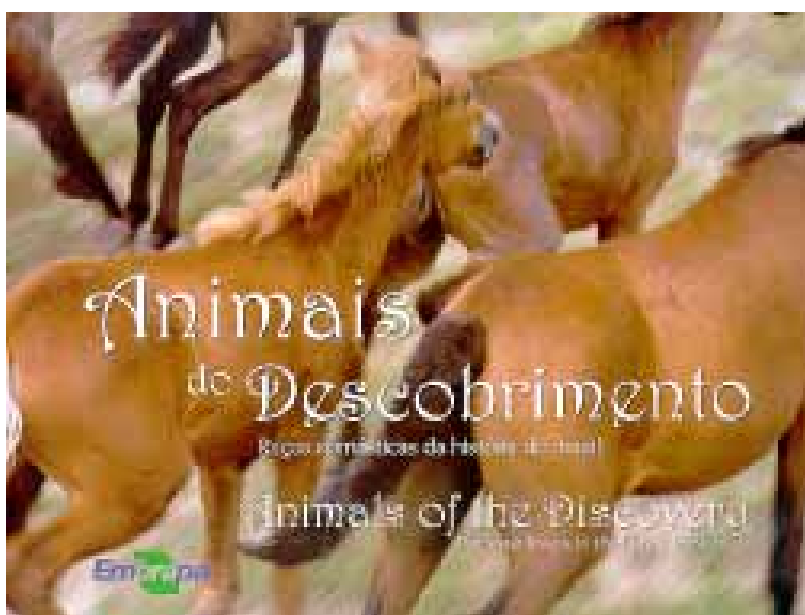
As a result of cross-breeding, these breeds known as “*crioulas*” were little by little, substituted by breeds brought from other lands and today the greater part of these breeds is threatened with extinction.

The origin of these local breeds goes back to the historical roots of Brazil, when their ancestors were brought over by the colonizers at the dawn of the discovery and is well documented in this book, with clear Portuguese and English texts. Notwithstanding

their lower productivity levels, these breeds are extremely well adapted to tropical conditions and particularly to the various Brazilian ecosystems where they have been submitted to a long natural selection process.

The present work intends to rescue the centuries-long history of the animals of Brazil, from the time of their arrival up to the present day, as well as to design future procedures and determine the conservation prospects of the various endangered breeds.

Extremely good and large photos, taken from historic pictures, easily transport the reader into the times of the colonization as well as deeply inform on the various historical breeds of the country.



Italian animal production
AIA, Associazione Italiana Allevatori,
Via Tomassetti 9, 00161 Rome, Italy. Published in 2000
pp.65

This short book presents the Italian Breeders Association (AIA) activities carried out for cattle, sheep and goats, horse and other domestic animals, in the field of breeding, husbandry and genetic improvement.

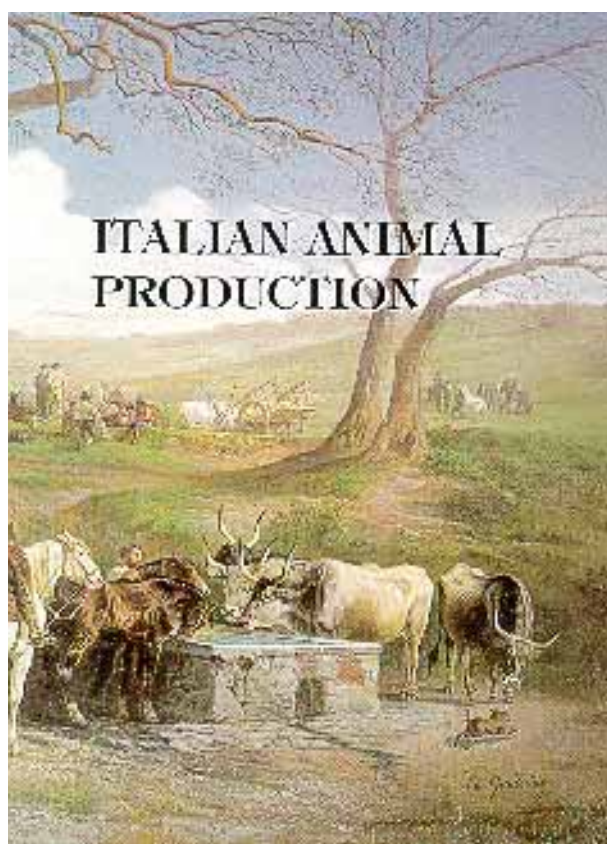
Firstly, a presentation of the Italian national production system is discussed, together with the demonstration of the economic relevance of the sector within the national economic frame. A summarized description of the organization and structure is then introduced, with the explanation of existing national and international cooperation.

Activities performed with exotic cattle breeds (Holstein, Jersey) and with numerous local genetic resources (Chianina, Marchigiana, Romagnola, Maremmana, Podolica, Piemontese, Italian Brown, Italian Red and White) are also presented, with a description of each association involved and clear photos of the most represented animals.

The same expositive structure is repeated when the operations involving pigs and buffalo are mentioned, showing the aims of the herd book for each breed and the description of national genetic resources. The numerous Italian sheep and goat breeds are also presented with bright photos and productive/reproductive characteristics.

This book certainly makes the animal production context in Italy more comprehensible to all and allows to lay the foundations for future and more consolidated technical and economic relations with those interested

With this volume, AIA and its system also intend to establish a dialogue with economic and technical partners and institutions that operate in the area of animal production in other countries.



Analysis and definition of the objectives in genetic improvement programmes in sheep and goats. An economic approach to increase the profitability
Options Méditerranéennes no. 43

D. Gabiña (Editor)

**Proc. of the Meeting of the Sub-Network on Genetic Resources of the
 FAO-CIHEAM Inter-Regional Cooperative Research and Development
 Network on Sheep and Goats , held in Zaragoza 18-20 November 1999**

CIHEAM, Apartado 202, 50080 Zaragoza, Spain

Published in 2000. ISSN: 1016-121-X ISBN: 2-85352-218-0

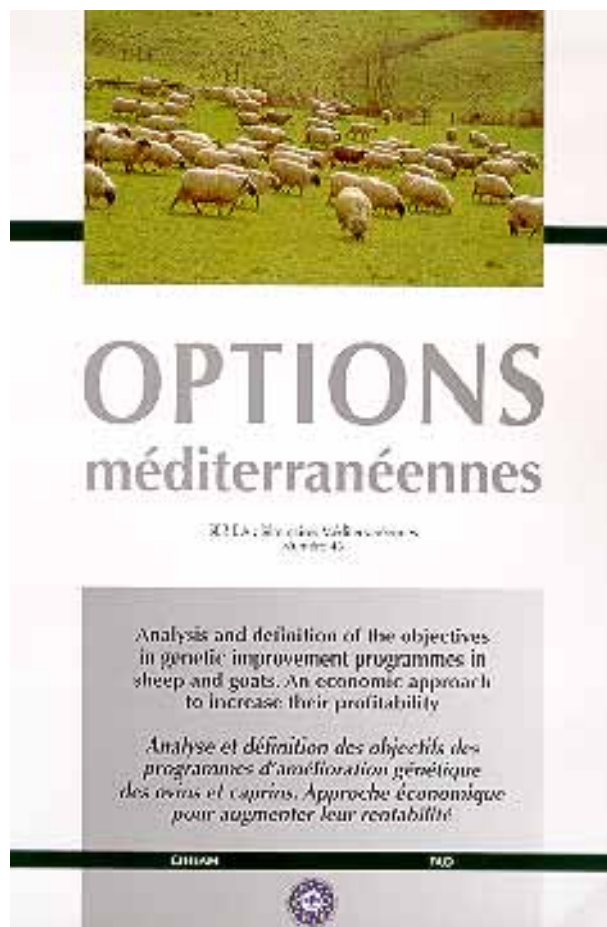
pp. 140 Price 150 FF

This publication originated from a meeting of the Animal Resources Subnetwork of the FAO/CIHEAM Cooperative Research Network on Sheep and Goats, held in Zaragoza, 18-20 November 1999. The objectives of the Meeting were the revision and definition of the genetic improvement objectives for sheep and goats, from the technical and economic point of view, in different countries and productive situations of the Mediterranean area and in other non-Mediterranean European countries.

The Meeting was attended by 26 participants from Algeria, Croatia, Cyprus, France, Greece, Hungary, Italy, Spain, Tunisia and Turkey and 18 reports were given on the subject. In some, very precise results were presented based on analysis of technical and economic data obtained in a large number of flocks.

During the meeting it was demonstrated that for dairy sheep the milk yield is the technical index that most widely affects the economic profitability of the farm while the reproductive performances may also consistently influence this profitability in some production systems. For meat sheep, litter size appears to be the most important trait for farm profitability although other traits such as lamb growth may be more important and appropriate for genetic improvement in some harsh conditions. On the contrary, when the litter size is large after an intensive selection, the uniformity of litter sizes around the desired optimum may be an

objective for breeding instead of increasing prolificacy. In dairy goats it has been shown that selection schemes based on artificial insemination have, in general, a higher social internal rate of return than those based on natural service, the latter frequently being negative or close to zero.



Management of animal genetic diversity at community level

I. Koehler-Rollefson (Editor)

and

Incentive measures appropriate to enhance the conservation and sustainable use of agrobiodiversity

E. Thies (Editor)

Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ)

P.O. Box 5180, 65726 Eschborn, Germany. Published in 2000

Both of the two booklets refer to the conservation of agro-biodiversity, carried out through the responsible use of economic and natural resources.

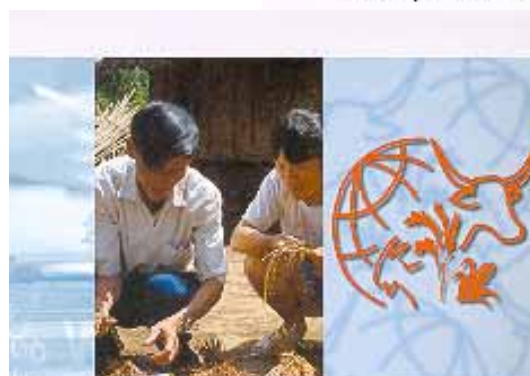
The first one deals with local livestock breeds that are crucial for sustaining rural livelihoods by producing a wide range of products while requiring relatively low levels of input. Thus, their maintenance is ecologically more sustainable and they entail a lower work load for women in comparison to improved breeds.

The second booklet analyzes whether incentive measures designed for the promotion of conservation and sustainable use of natural resources are transferable to agrobiodiversity and if so, which ones. For this purpose, existing activities that apply incentive measures in development cooperation have been evaluated with regard to their design, implementation and impact.



Iris Koehler-Rollefson

Management of Animal Genetic
Diversity at Community Level



Evy Thies

Incentive Measures Appropriate
to Enhance the Conservation and
Sustainable Use of Agrobiodiversity

GTZ
Deutsche Gesellschaft für
Technische Zusammenarbeit
P.O. Box 5180, 65726 Eschborn, Germany

Editorial Policies and Procedures

The mission of the Animal Genetic Resources Information Bulletin (AGRI) is the promotion of information on the better use of animal genetic resources of interest to food and agriculture production, under the Global Strategy for the Management of Farm Animal Genetic Resources. All aspects of the characterization, conservation and utilization of these resources are included, in accordance with the Convention on Biological Diversity. AGRI will highlight information on the genetic, phenotypic and economic surveying and comparative description, use, development and maintenance of animal genetic resources; and on the development of operational strategies and procedures which enable their more cost-effective management. In doing this AGRI will give special attention to contributions dealing with breeds and procedures capable of contributing to the sustainable intensification of the world's medium to low input production environments (agro-ecosystems), which account for the substantial majority of the land area involved in livestock production; the total production of food and agriculture from livestock; and of our remaining farm animal genetic resources.

Views expressed in the paper published in AGRI represent the opinions of the author(s) and do not necessarily reflect those of the institutions which the authors are affiliated, FAO or the Editors.

The suitability of manuscripts for publication in AGRI is judged by the Editors and reviewers.

Electronic publication

AGRI is available in full electronically on the Internet, in addition to being published in hard copy, at:

<< <http://www.fao.org/dad-is>>>

Types of Articles

The following types of articles are published in AGRI.

Research articles

Findings of work on characterization, conservation and utilization of farm animal genetic resources (AnGR) in well described production environments, will be considered for publication in AGRI. Quality photographs of these genetic resources viewed in the primary production environment to which they are adapted, accompanying the manuscripts are encouraged.

Review articles

Unsolicited articles reviewing agro-ecosystems, country-level, regional or global developments on one or more aspects of the management of animal genetic resources, including state-of-the-art review articles on specific fields in AnGR, will be considered for publication in AGRI.

Position papers

Solicited papers on topical issues will also be published as deemed required.

Other published material

This includes book reviews, news and notes covering relevant meetings, training courses and major national, regional and international events and conclusions and recommendations associated with the outcomes of these major events. Readers are encouraged to send such items to the editors.

Guidelines for Authors

Manuscript submission

Manuscripts prepared in English, French or Spanish with an English summary and

another summary in either French or Spanish, should be submitted to AGRI Editor, AGAP, FAO, Viale delle Terme di Caracalla, 00100 Rome, Italy. Alternatively a manuscript may be sent as a WinWord Electronic Mail attachment to < agri@fao.org >. Photographs, coloured or black and white, and figures must be always sent by mail.

Manuscripts should be typed double-spaced and with lines numbered in the left margin. All pages, including those of references, tables etc., must be consecutively numbered. The corresponding author is notified of the receipt of a manuscript.

For manuscripts that are accepted after revision, authors are encouraged to submit a last version (3½" disc format) in Word 6.0 for Windows of their revised manuscript along with the printed copy.

Preparation of the manuscript

The first page of the manuscript must include the running head (abbreviated title), title, names of authors, institutions, full addresses including postal codes and telephone number and other communication details (fax, e-mail, etc.) of the corresponding author. The running head not exceeding 45 characters plus spaces, should appear at the top of page 1 of the manuscript entirely in capital letters. The title of the manuscript is typed in upper and lower case letters. The title should be as brief as possible not exceeding 150 characters (including spaces) with species names when applicable. Authors, institutions and addresses are in upper and lower case italics. There is one blank line between the title and the authors. Addresses are typed as footnotes to the authors after leaving one blank line. Footnotes are designated numerically. Two lines are left below the footnotes.

Headings

Headings of sections, for example Summary, Introduction, etc., are left-justified. Leave two blank lines between addresses footnotes and Summary and between the heading Summary and its text. Summary should not exceed 200

words. It should be an objective summary briefly describing the procedures and findings and not simply stating that the study was carried on such and such and results are presented, etc. Leave one line between the summary text and Keywords which is written in italics as well as the keywords themselves. All headings of sections (14 regular) and sub-sections (12 regular) are typed bold and preceded and succeeded by one blank line and their text begins with no indentation. The heading of a sub-subsection is written in italics, and ends with a dot after which the text follows on the same line. Keywords come immediately after the summaries. They should be no more than six, with no "and" or "&".

Tables and figures

Tables and figures must be enclosed with the paper and attached at the end of the text according their citation in the document. Photos will not be returned

Tables

Tables, including footnotes, should be preceded and succeeded by 2 blank lines. Table number and caption are written, above the table, in italics (12) followed by a dot, then one blank line. For each column or line title or sub-title, only the 1st letter of the 1st word is capitalized. Tables should be numbered consecutively in Arabic numerals. Tables and captions should be left justified as is the text. Use horizontal or vertical lines only when necessary. Do not use tabs or space-bar to create a table but only the appropriate commands.

Figures

Figures including titles and legends should be preceded and succeeded by two blank lines. Figure number and title are written, below the figure, in italics (12) and end with a dot. The term figures includes photos, line drawings, maps, diagrams etc.

All the submitted diagrams, must be

.....

accompanied with the original matrix of the data used to create them. It is strongly advised to submit diagrams in Word 6.0 or Excel 5.0. Figures should be numbered consecutively in Arabic numerals.

References

Every reference cited in the text should be included in the reference list and every reference in the reference list should have been mentioned in the text at least once. References should be ordered firstly alphabetically by the first author's surname and secondly by year.

Example for reference in a periodical is:

Köhler-Rollefson, I., 1992; The camel breeds of India in social and historical perspective. *Animal Genetic Resources Information* 10, 53-64.

When there are more than one author:

Matos, C.A.P., D.L. Thomas, D. Gianola, R.J. Tempelman & L.D. Young, 1997; Genetic analysis of discrete reproductive traits in sheep using linear and nonnlinear models: 1. Estimation of genetic parameters 75, 76-87.

For a book or an ad hoc publication, e.g., reports, theses, etc.:

Cockril, W.R., (Ed), 1994; *The Husbandry and Health of the Domestic Buffalo*. FAO, Rome, Italy, pp 993.

For an article in the proceedings of a meeting:

Hammond, K., 1996; FAO's programme for the management of farm animal genetic resources. In C. Devendra (Ed.) *Proceedings of IGA/FAO Round Table on the Global Management of Small Ruminant Genetic Resources*, Beijing, May 1996, FAO, Bangkok, Thailand, 4-13.

Where information included in the article has been obtained or derived from a World Wide Web site, then quote in the text, e.g. "derived from FAO. 1996" and in the References quote the URL standard form:

FAO, 1996; *Domestic Animal Diversity Information System* <<http://www.fao.org/dad-is/>>, FAO, Rome

Prof. Galal left FAO on the 1st February 2000 for Cairo (Ain Shams University, Faculty of Agriculture, Animal Production Dept.).

There is no change in the editorial responsibility of AGRI.

For all future manuscript dispatch and correspondence regarding AGRI, please use the following mailbox:

agri-bulletin@fao.org

Thanks for the collaboration

.....

Normes et règles éditoriales

L'objectif du Bulletin d'Information sur les Ressources Génétiques Animales (AGRI) est la vulgarisation de l'information disponible sur la meilleure gestion des ressources génétiques animales d'intérêt pour la production alimentaire et agricole, d'après les recommandations de la Stratégie Mondiale pour la Gestion des Ressources Génétiques des Animaux Domestiques. Tous les aspects relatifs à la caractérisation, la conservation et l'utilisation de ces ressources seront pris en considération, suivant les normes de la Convention pour la Biodiversité.

AGRI désire diffuser de l'information sur la génétique, les enquêtes phénotypiques et économiques et les descriptions comparatives, l'utilisation et la conservation des ressources génétiques animales, ainsi que toute information sur le développement de stratégies opérationnelles et de normes qui puissent permettre une meilleure gestion de la relation coût/efficacité. C'est pour cela que AGRI prendra spécialement en considération toutes les contributions référées aux races et aux normes capables de permettre une intensification durable des milieux (agroécosystèmes) à revenus moyens et bas dans le monde; qui comprennent la majeure partie des terres consacrées à l'élevage, à la production totale des aliments et l'agriculture provenant de l'élevage; et tout ce qui reste comme ressources génétiques des animaux domestiques.

Les opinions exprimées dans les articles publiés dans AGRI appartiennent seulement aux auteurs et donc ne représentent pas nécessairement l'opinion des instituts pour lesquels ils travaillent, la FAO ou les éditeurs.

L'opportunité ou non de publier un article dans AGRI sera jugée par les éditeurs et les réviseurs.

Publication électronique

En plus de sa version imprimée, la version totale de AGRI se trouve disponible sur Internet, sur le site:

<<<http://www.fao.org/dad-is/>>>

Types d'articles

Les articles suivants pourront être publiés sur AGRI:

Articles de recherche

Seront prises en considération pour leur publication sur AGRI les études sur la caractérisation, la conservation et l'utilisation des ressources génétiques des animaux domestiques (AnGR) accompagnées d'une bonne description du milieu. On encourage les auteurs à envoyer des photographies de bonne qualité qui montrent les races en question dans leur milieu naturel de production.

Révisions

Occasionnellement, des articles contenant une révision des agroécosystèmes, au niveau national, régional ou mondial, avec un ou plusieurs aspects se rapportant à la gestion des ressources génétiques animales, y comprises les mises à jour des différentes zones de AnGR, seront pris en considération.

Articles spécifiques

Ponctuellement, des articles sur des thèmes spécifiques pourront être demandés pour la publication d'éditions spéciales.

Autre matériel pour publication

Ceci comprend la révision de livres, nouvelles et notes de réunions importantes, cours de formation et principaux événements nationaux, régionaux et internationaux; ainsi que les conclusions et recommandations par rapport aux objectifs de ces principaux événements. Les auteurs sont priés d'envoyer ce genre de matériel aux éditeurs.

Guide pour les auteurs

Présentation du manuscrit

Les articles se présenteront en anglais, français ou espagnol, avec un résumé en anglais et sa traduction en français ou en espagnol; et seront envoyés à l'éditeur de AGRI, AGAP, FAO, Viale delle Terme di Caracalla, 00100 Rome, Italie. L'autre possibilité est d'envoyer l'article par courrier électronique avec le document adjoint en version WinWord à <agri@fao.org>. Les photographies, en couleur ou en blanc et noir, seront toujours envoyées par courrier normal.

Les manuscrits se présenteront à double interligne et avec le numéro correspondant à chaque ligne sur la marge gauche. Toutes les pages seront numérotées, y comprises celles avec les références bibliographiques, les tableaux, etc. L'auteur recevra une lettre lui donnant bonne réception de son document.

Lorsqu'un article, après sa révision, sera accepté, on demandera à l'auteur d'envoyer la version finale révisée sur disquette (format 3 1/2") en Word 6.0 x Windows, ainsi qu'une copie sur papier.

Préparation du manuscrit

Sur la première page du manuscrit on indiquera le titre de l'article en abrégé, le titre et noms des auteurs, des institutions, les adresses complètes (y compris code postal et numéro de téléphone); ainsi que tout autre moyen de contact tel que fax, e-mail, etc. avec l'auteur principal. Le titre abrégé ne devra pas dépasser les 45 caractères, plus les espaces nécessaires, et s'écrira sur la partie supérieure de la page 1 du manuscrit en majuscules. Le titre en entier du manuscrit sera écrit en majuscules et minuscules; il devra être aussi bref que possible, sans dépasser les 150 caractères (y compris les espaces nécessaires), et avec l'indication des noms des espèces. Les noms des auteurs, des institutions et les adresses seront en italique et en lettres majuscules et minuscules. On laissera un espace en blanc entre le titre et les noms des auteurs. Les adresses seront indiquées comme

des notes à pied de page pour chacun des auteurs après avoir laissé un espace en blanc après les noms. Chaque note de pied de page sera numérotée. On laissera deux espaces en blanc après les adresses.

Titres

Les titres de chaque chapitre, par exemple Résumé, Introduction, etc. seront alignés à gauche. Laisser deux espaces en blanc entre les notes de pied de page avec les adresses et le Résumé, et entre le titre Résumé et le texte qui suit. Le résumé ne devra pas dépasser les 200 mots. Il s'agira d'un résumé objectif qui fasse une brève description des processus utilisés et des résultats obtenus, et non pas une simple présentation du travail réalisé avec une description générale des résultats. Laisser un espace en blanc entre la fin du texte du résumé et les mots-clés, qui seront écrits en italique ainsi que le titre Mots-clés. Les mots-clés seront au maximum six et il ne devra pas y avoir de "et" ou "&". Tous les titres principaux de chapitre (14 regular) et sous-chapitre (12 regular) seront en gras avec un espace en blanc avant et après. Le texte commencera sans retrait. Un titre à l'intérieur d'un sous-chapitre s'écrira en italique, suivi d'un point, avec le texte à continuation.

Tableaux et figures

Les tableaux et les figures iront à la fin du texte en suivant l'ordre d'apparition dans le texte. Les photographies ne seront pas dévolues aux auteurs.

Tableaux

Les tableaux, y compris les notes de pied de page, devront avoir un espace en blanc avant et après. Le numéro du tableau et le titre s'écriront sur la partie supérieure en italique (12) avec un point à la fin et un espace en blanc en dessous. Sur chaque colonne, titre d'en-tête ou sous-titre, seulement la première lettre du premier mot sera en majuscule. Les tableaux et leur titre seront alignés à gauche, ainsi que le texte. Les lignes verticales et

horizontales seront utilisées seulement si nécessaires. Ne pas utiliser les tabs ou la barre de séparation pour créer un tableau.

Figures

Les figures, y compris les titres et les légendes, seront précédés et suivis de deux espaces en blanc. Le numéro de la figure et le titre s'écriront sur la partie supérieure en italique (12) avec un point à la fin. Sous la rubrique figure on trouvera les photographies, les graphiques, les cartes, les diagrammes, etc. Dans le cas des diagrammes, la matrice originale avec les données utilisées pour son élaboration devra être envoyée. On recommande l'utilisation de Word 6.0 ou Excel 5.0 pour la présentation des diagrammes.

Références

Toute référence présente dans le texte devra apparaître sur la liste des références, et chaque référence de la liste aura été citée au moins une fois dans le texte. Les références iront en ordre alphabétique du nom de l'auteur, suivi de l'année. Exemple dans le cas d'une référence sur une revue:

Köhler-Rollefson, I., 1992; The camel breeds of India in social and historical perspective. *Animal Genetic Resources Information* 10, 53-64.

Lorsqu'il s'agit de plus d'un auteur:
Matos, C.A.P., D.L. Thomas, D. Gianola, R.J. Tempelman & L.D. Young, 1997; Genetic analysis of discrete reproductive traits in sheep using linear and nonnlinear models: 1. Estimation of genetic parameters 75, 76-87.

Dans le cas d'un livre ou d'une publication ad hoc, par exemple un rapport, une thèse, etc.:

Cockril, W.R., (Ed), 1994; *The Husbandry and Health of the Domestic Buffalo*. FAO, Rome, Italy, pp 993.

S'il s'agit d'un acte d'une réunion:

Hammond, K., 1996; FAO's programme for the management of farm animal genetic resources. In C. Devendra (Ed.) *Proceedings of IGA/FAO Round Table on the Global Management of Small Ruminant Genetic Resources*, Beijing, May 1996, FAO, Bangkok, Thailand, 4-13.

Lorsque l'information contenue dans l'article ait été obtenue ou dérive d'un site World Wide Web, il faudra mettre le texte entre guillemets; par exemple "tiré de la FAO. 1996" et indiquer dans les Références la forme standard URL:

FAO, 1996; Domestic Animal Diversity Information System <<http://www.fao.org/dad-is/>>, FAO, Rome

Le Prof. Galal a quitté la FAO le 1er février 2000 pour aller au Caire (Ain Shams University, Faculty of Agriculture, Animal Production Dept.). Aucun changement n'a eu lieu en ce qui concerne la responsabilité éditoriale pour AGRI.

Pour tout envoi de manuscrits ou correspondance au sujet d'AGRI, vous êtes prié d'utiliser l'adresse suivante:

agri-bulletin@fao.org

Merci pour votre collaboration

Reglas y normas editoriales

El objetivo del Boletín de Información sobre Recursos Genéticos Animales (AGRI) es la divulgación de la información sobre una mejor gestión de los recursos genéticos animales de interés para la producción alimentaria y agrícola, siguiendo la Estrategia Mundial para la Gestión de los Recursos Genéticos de los Animales Domésticos. Todos los aspectos referidos a la caracterización, la conservación y el uso de estos recursos serán tomados en consideración, de acuerdo con la Convención sobre la Biodiversidad.

AGRI publicará información sobre genética, encuestas fenotípicas y económicas y descripciones comparativas, uso, desarrollo y conservación de los recursos genéticos animales, así como sobre el desarrollo de estrategias operacionales y normas que permitan una gestión más eficaz de la relación costo/eficacia. Por ello, AGRI prestará especial atención a las contribuciones referidas a razas y normas capaces de contribuir a la intensificación sostenible de los medios (agroecosistemas) con ingresos medio y bajos en el mundo, que comprenden casi la mayor parte de las tierras dedicadas a la producción ganadera; la producción total de alimentos y agricultura provenientes de la ganadería; y el resto de los recursos genéticos de animales domésticos.

Los puntos de vista expresados en los artículos publicados en AGRI son solamente las opiniones de los autores y, por tanto, no reflejan necesariamente la opinión de las instituciones para las cuales trabajan dichos autores, de la FAO o de los editores.

La oportunidad o no de publicar un artículo en AGRI será juzgada por los editores y revisores.

Publicación electrónica

Además de su publicación impresa, la versión íntegra de AGRI se encuentra disponible electrónicamente sobre Internet, en el sitio: <<<http://www.fao.org/dad-is/>>>

Tipos de artículos

Serán publicados en AGRI los siguientes tipos de artículos:

Artículos sobre investigación

Se tomarán en consideración para su publicación en AGRI los estudios sobre la caracterización, conservación y uso de los recursos genéticos de los animales domésticos (AnGR) con una buena descripción del entorno. Se agradecerá el envío de fotografías de calidad que presenten a las razas en cuestión en su ambiente natural de producción.

Artículos de revisión

Se podrán tener en consideración ocasionalmente aquellos artículos que presenten una revisión de los agroecosistemas, a nivel nacional, regional o mundial, con el desarrollo de uno o más aspectos referidos a la gestión de los recursos genéticos animales, incluidas las revisiones sobre el estado actual de las distintas áreas de AnGR.

Artículos específicos

Se solicitarán puntualmente artículos sobre temas específicos para ediciones especiales.

Otro material para publicación

Incluye la revisión de libros, noticias y notas referidas a reuniones importantes, cursos de formación y principales eventos nacionales, regionales e internacionales, así como conclusiones y recomendaciones relacionadas con los objetivos de estos principales eventos. Se invita a los lectores a enviar este tipo de material a los editores.

Guía para los autores

Presentación del manuscrito

Los artículos se presentarán en inglés, francés o español, junto con un resumen en inglés y su traducción en francés o español, y se enviarán al editor de AGRI, AGAP, FAO, Viale delle Terme di Caracalla, 00100 Roma, Italia. Otra posibilidad es enviar el artículo por correo electrónico adjuntando el documento en versión WinWord a <agri@fao.org>. Las fotografías, a color o en blanco y negro, se enviarán siempre por correo normal.

Los manuscritos se presentarán con doble espacio y con el número correspondiente a cada línea en el margen izquierdo. Todas las páginas serán numeradas, incluidas las de las referencias bibliográficas, cuadros, etc. El autor recibirá una notificación sobre la recepción de su documento.

En el caso de aceptación de un artículo después de su revisión, se solicitará al autor una versión final de su artículo revisado en disquete (formato 31/2") en Word 6.0 x Windows, así como una copia impresa del mismo.

Preparación del manuscrito

En la primera página del manuscrito se indicará el título abreviado del artículo, títulos y nombres de los autores, instituciones, direcciones completas (incluido código postal y número de teléfono); así como otros medios de contacto tales como fax, e-mail, etc., del autor principal. El título abreviado no deberá sobrepasar los 45 caracteres más los espacios correspondientes, y aparecerá en la parte superior de la página 1 del manuscrito en mayúsculas. El título entero del manuscrito viene escrito en mayúsculas y minúsculas. Dicho título debe ser lo más breve posible y no sobrepasar los 150 caracteres (incluidos los espacios necesarios), con los nombres de las especies, si necesario. Los nombres de los autores, instituciones y direcciones se escribirán en cursiva y en letras mayúsculas y minúsculas. Se dejará una línea en blanco

entre el título y los nombres de los autores. Las direcciones se escribirán como notas de pie de página de cada autor después de dejar una línea en blanco entre los nombres y éstas. Cada nota de pie de página con la dirección vendrá indicada numéricamente. Se dejarán dos líneas en blanco después de las direcciones.

Títulos

Los títulos de cada sección, por ejemplo Resumen, Introducción, etc., vienen alineados a la izquierda. Dejar dos líneas en blanco entre las notas de pie de página con las direcciones y el Resumen y entre el título Resumen y el texto que sigue. El resumen no deberá exceder de 200 palabras. Deberá ser un resumen objetivo que describa brevemente los procesos y logros obtenidos, y no una presentación de cómo se ha llevado a cabo el estudio y una descripción genérica de los resultados. Dejar una línea en blanco entre el final del texto del resumen y las palabras clave, que se escribirán en cursiva así como el título Palabras clave. No deberán ser más de seis y no deberán contener "y" o "&". Todos los títulos principales de capítulo (14 regular) y subcapítulo (12 regular) serán en negrita e irán precedidos y seguidos de una línea en blanco. El texto correspondiente empezará sin sangrado. Un título dentro de un subcapítulo se escribirá en cursiva e ira seguido de un punto con a continuación el texto correspondiente.

Cuadros y figuras

Los cuadros y las figuras se incluirán al final del texto siguiendo el orden de cita dentro del mismo. Las fotografías no serán devueltas a sus autores.

Cuadros

Los cuadros, incluidas las notas de pie de página, deberán ir precedidos y seguidos por dos líneas en blanco. El número del cuadro y su título se escribirán en la parte superior en cursiva (12) con un punto al final y seguido

de una línea en blanco. En cada columna o título de encabezamiento o subtítulo, sólo la primera letra de la primera palabra irá en mayúscula. Los cuadros irán numerados de forma consecutiva con números árabes. Los cuadros y sus títulos se alinearán a la izquierda, así como el texto. Se utilizarán líneas horizontales o verticales sólo cuando sea necesario. No utilizar tabuladores o la barra espaciadora para crear un cuadro.

Figuras

Las figuras, incluidos los títulos y leyendas, irán precedidas y seguidas de dos líneas en blanco. El número de la figura y el título se escribirán en la parte superior en cursiva (12) con un punto al final. La palabra figura incluye las fotografías, los gráficos, los mapas, los diagramas, etc. En el caso del diagrama se enviará la matriz original con los datos utilizados para crearlo. Se recomienda encarecidamente la utilización de Word 6.0 o Excel 5.0 para la presentación de los diagramas.

Referencias

Toda referencia presente en el texto deberá aparecer en la lista de referencias y, de la misma manera, cada referencia de la lista deberá haber sido citada por lo menos una vez en el texto. Las referencias deben ir en orden alfabético del apellido del autor, seguido por el año.

Ejemplo en el caso de una referencia de una revista:

Köhler-Rollefson, I., 1992; The camel breeds of India in social and historical perspective. *Animal Genetic Resources Information* 10, 53-64.

Cuando se trata de más de un autor:

Matos, C.A.P., D.L. Thomas, D. Gianola, R.J. Tempelman & L.D. Young, 1997; Genetic analysis of discrete reproductive traits in sheep using linear and nonnlinear models: 1. Estimation of genetic parameters 75, 76-87.

En el caso de un libro o de una publicación ad hoc, por ejemplo informes, tesis, etc.:

Cockril, W.R., (Ed), 1994; *The Husbandry and Health of the Domestic Buffalo*. FAO, Rome, Italy, pp 993.

Cuando se trate de un artículo dentro de las actas de una reunión:

Hammond, K., 1996; FAO's programme for the management of farm animal genetic resources. In C. Devendra (Ed.) *Proceedings of IGA/FAO Round Table on the Global Management of Small Ruminant Genetic Resources*, Beijing, May 1996, FAO, Bangkok, Thailand, 4-13.

Cuando la información contenida en el artículo haya sido obtenida o derive de un sitio World Wide Web, poner el texto entre comillas; por ejemplo "sacado de la FAO. 1996" e indicar en las Referencias la forma estándar URL:

FAO, 1996; *Domestic Animal Diversity Information System* <<http://www.fao.org/dad-is/>>, FAO, Rome

El Prof. Galal dejó la FAO el 1 de febrero del 2000 para ir al Cairo (Ain Shams University, Faculty of Agriculture, Animal Production Dept.).

No ha habido ningún cambio en cuanto a la responsabilidad editorial de AGRI.

Se ruega enviar los manuscritos o la correspondencia relativa a AGRI a la dirección siguiente:

agri-bulletin@fao.org

Gracias por su colaboración