MILK PRODUCTION SYSTEMS IN TROPICAL LATIN AMERICA[1]

by

J I Restrepo, E Murgueitio and T R Preston

INTRODUCTION

In many developing societies, cattle are more important as a source of manure - for fuel and/or fertiliser - and power, than of milk and meat. For the rural poor, they are more secure than the bank, as a means of safeguarding savings from inflation and devaluation.

In this paper, it is argued that it is more economical, in terms of national resource utilization, to satisfy the demand for milk and beef by combining both activities in the same animal. The justification for this approach is that: (i) the target levels of production - 2,000 litres of milk and 300 kg of beef per cow per year - are closely related to national demand ratios which vary from 4 to 5 litres milk per 1 kg of beef; (ii), as a result of (i), larger national cattle herds can be supported which increases employment opportunities and enables more efficient use to be made of presently under-utilised locally available feed resources, which are usually low in protein and high in cell wall material; (iii) advantage can be taken of important physiological traits, previously disregarded in intensive specialised systems - for example, the effect of suckling in stimulating milk yield, reducing stress in both cows and calves and permitting the calf to use supplementary feed of low protein content, more efficiently.

Of special importance to developing countries is that breeding programmes for dual purpose milk-beef systems permit a much greater degree of self-reliance (i.e. reduced dependence on expensive (imported) inputs), the technology is simpler and therefore more easily applied and with greater chance of acceptance than for specialised systems, especially milk production.

DUAL PURPOSE CATTLE PRODUCTION SYSTEMS

Dual purpose cattle production systems are those in which income is divided approximately equally between milk and beef. They are predominant in many parts of Latin America (see Table 1).

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[1]Parts of this article were taken from "Dual Purpose Cattle Production Systems" by T.R. Preston and Lucia Vaccaro, published in "New Techniques in Cattle Production" (Editor, C.J.C. Phillips). Butterworths, London. Chapter 2: 20-32.

Table 1. Cattle production systems in the coffee-growing region of Colombia

Type of farms	Altitude (m above sea level) >2,000 %	1,250-2,000 %	<1,250 %	Total %
Specialised beef	8	2	10	20
Specialised milk	9	9	2	20
Dual purpose	25	22	13	60

Source: Suárez and Jaramillo 1988

Their salient characteristics are that, almost invariably, the calves are raised on the cow by some form of restricted suckling. Usually milking is only once daily and the major feed resources are pasture or fibre-rich crop residues and by-products with minimum use of supplements.

The genetic resources vary enormously but the most popular animals for this system are crossbreds, derived from European *Bos taurus* types (Brown Swiss and Holstein predominantly) and *Bos indicus* (Zebu). Typical performance data from a number of countries are summarised in Table 2.

Table 2. Typical performance data for cattle managed according to the dual purpose system on demonstration or experimental farms in a number of tropical countries

	Milk/year		Weaning weight	Calving interval
	Saleable (kg)	Calf (kg)	(kg)	(days)
Dominican Republic (1)	1,750	470	165	380
México (2)	1,400	450	150	401*
Costa Rica (3)	1,300	400	155	400*
Malaysia (4)	1,860	?	?	438*

*Exclusively with AI

(1) Fernandez et al 1978; (2) Alvarez et al 1980; (3) M E Ruiz, personal communication; (4) Cheah and Kumar (1984)

The dual purpose system arose through the need to increase the income from typically extensive beef production systems. Often the first stage is the milking of a proportion of the cows, those with appropriate genetic potential and temperament being chosen for this purpose. The next step is usually to introduce a sire from a recognised dairy breed, in order to increase dairy traits. Further innovations may follow, such as pasture improvement, supplementation of cows and calves, twice daily milking and occasionally machine milking.

More recently (Preston, 1977), dual purpose systems have been advocated as an appropriate way to integrate cattle into intensive mixed farms, especially in the wet tropics. The arguments used are that such systems enable better use to be made of available resources, that they are well understood by farmers (who developed them in the first place) and that they satisfy the demand ratio for milk and beef.

Aside from these economic considerations, there are distinct biological advantages intrinsic to dual purpose systems. These features are not well known and even less well understood. It is important to describe them, and what is known about them, so that those scientists that are in research centres in industrialised countries, who have the necessary laboratory resources and expertise, may feel stimulated to direct some of their attention to these areas with a view to establishing the underlying mechanisms.

RESTRICTED SUCKLING

Effects on the cow

Use of the calf to stimulate milk let-down is the traditional technique employed to coax beef animals to surrender a part of their milk output for human consumption. In crossbred cattle derived from Zebu (*Bos indicus*), typically used in dual purpose systems, there appears to be a negative linear relationship between the proportion of genes derived from the Bos taurus parent and the incidence of short lactations (Table 3).

Table 3. Effect of genetic makeup on incidence of short lactations in Holstein:Zebu crosses in México

Percentage of Holstein genes	Incidence of short lactations (<70 days) (%)
25	76
50	40
75	10
100	None

Source: Alvarez et al (1980).

In an unselected F1 herd (derived by crossing Zebu females with Holstein and Brown Swiss sires), milked by machine (Table 4), half the animals had lactations lasting less than 70 days when the calf was not present at milking. In their second lactation, those cows which had short lactations previously, milked normally when the calf was used to stimulate let-down. By contrast, the cows which milked normally in their first lactation (without calf stimulation), regressed to the mean in their second lactation, half of them becoming dry before 70 days.

Table 4. Milk production from F1 European (Holstein or Brown Swiss)/Zebu crosses milked with and without calf stimulation

	33 first-calvers	
First lactation	Without calf-stimulation	
	16 milked adequately	17 became dry <100d
Second lactation:	Without calf stimulation	With calf stimulation
Prematurely dry <100d	8	0
Lactation length* (days)	216	270
Total milk* (kg)	590	1680
Saleable milk* (kg)	590	1000

*For the cows which milked more than 100 days

Source: Alvarez *et al.*, 1980.

As well as ensuring normal length lactations in crossbred cattle, restricted calf suckling brings other benefits. In a recognised dairy breed (e.g. Holstein), cows that suckled their calves after milking gave more milk during the period that suckling was practised and subsequently after the calf had been weaned (Table 5). There is less mastitis in cows that are milked and also suckle their own calves or calves from other cows (Table 6), compared with cows that are milked by hand or machine but do not suckle.

If cows which suckle their calves give more milk than those which do not suckle, it would be expected that either they must eat more food or mobilise more body tissue. However, in an experiment designed to test this hypothesis (Table 7), Holstein cows that suckled their calves after machine milking, gave more milk and lost less weight immediately after calving than cows which had their calves removed permanently 3-5 days after birth. The differences in body weight

continued to be manifested at least through the first 3 months of lactation. Feed intake was maintained constant in both groups. The implication is that the stress on the dam caused by taking away its offspring led to adrenalin-stimulated demand for glucose and resulting increased mobilization of body reserves.

Table 5. Effect of two systems of restricted suckling on milk yield of Holstein cows and milk intake by their calves.

	Control (did not suckle)	Suckled	
		2xdaily for 70days	2xdaily for 28days then 1xdaily for 42days
Saleable milk (kg/d)			
5-28 days	12.5	9.7	9.5
29-70 days	11.5	9.5	13.5
71-112 days	10.0	11.8	12.9
Consumed by calf (kg/d)			
5-28 days	-	5.8	5.4
29-70 days	-	6.3	2.5
Total milk yield (kg/d)			
5-28 days	12.5	15.5	14.9
29-70 days	11.5	15.8	16.0
71-112 days	10.0	11.8	12.9

Source: J. Ugarte and T.R. Preston, unpublished data.

Table 6. Effect of suckling on incidence of sub-clinical mastitis (expressed as % of all quarters examined) in F1 (European x Zebu) and Holstein cows in the tropics.

Authors:	Breed	Calf suckling	
		No	Yes
Alvarez *et al.*, 1980	F1(EXZ)	21	6
Ugarte and Preston, 1972	Holstein	6	2
Ugarte and Preston, 1975	Holstein	8	2

Table 7. Effect of suckling on milk production and bodyweight change in Holstein cows in Venezuela (The control cows had their calves removed permanently after the first 4 days; the experimental group suckled their own calves for 20 minute periods twice daily immediately after the cows had been machine-milked)

	Control (no suckling)	Restricted suckling	SEx
Milk production (kg/d)			
Saleable	7.9	9.0	±0.8
Consumed by calf	4.0	6.1	
Total	11.9	15.1	
Liveweight change (kg)			
Pre- to 7 days post-partum	-72	-46	±15
From 7 to 84 days post-partum	+15	+3	±5

Source: Velazco *et al.*, 1982.

Table 8. Calves use milk more efficiently by suckling rather than by bucket feeding (calves were crossbred European x Zebu raised from birth to 84 days of age either by bucket feeding of whole milk or by restricted suckling for 20 minutes following milking.

	Bucket	Suckling	SEx
Condition Score*	1.61	1.35	±0.04
Milk intake (kg/d)	3.08	2.73	±0.12
Milk conversion (kg milk/kg LW gain)	9.7	4.9	±1.0

*Belly girth (cm)/liveweight(kg): low value = more tissue and less gut fill

Source: Fatullah Khan and T.R. Preston, unpublished data.

Effects on the calf

Efficiency of milk utilization is higher in calves that are suckled than when they take the same amount of milk from a bucket (Table 8). This is understandable in the light of Ørskov's work (Ørskov, 1983) which demonstrated that psychological stimuli, rather than physical factors, were the mechanisms which controlled the closing of the oesophageal groove which directs milk to the abomasum. Bucket feeding, by contrast, results in much milk spilling over into the rumen where the fermentative mode of digestion leads to losses in both the quality and quantity of nutrients available to the animal.

Other benefits are a reduced incidence of diarrhoea and elimination of navel sucking, as a result of which suckled calves can be housed in groups, permitting lower investment in housing, simpler feeding and management and less stress on the calves.

DISADVANTAGES OF RESTRICTED SUCKLING

Poorer fertility is generally ascribed to calf suckling, due to extension of the interval between calving and conception. It is generally believed that this is due to delay in initiation of ovarian activity. However, there is some evidence that the impaired fertility is due not to delay in ovarian activity but to poor manifestation of oestrus (silent heats) due to a reduced amplitude of the progesterone peaks which regulate ovarian cycles (Velazco *et al*., 1982).

Use of natural mating rather than artificial insemination is therefore advocated in dual purpose systems. This is substantiated by observations in a dairy enterprise in Mauritius where calves were raised by restricted suckling. When there was exclusive use of AI, calving intervals were long and variable; running bulls with the herd reduced both the average calving interval and variability (Naidoo *et al*., 1981).

RESTRICTED SUCKLING IN BOS TAURUS HERDS

Modifications to the management of cows and calves may be needed when calf suckling is introduced into herds in which the cows are mainly of Bos taurus origin and therefore do not need the physical presence of their calves to stimulate milk let-down. In such cases the calves are suckled when milking is completed, either in the shed where the cows are milked or in a pen designated for that purpose. It has been observed that, in this system, up to 20% of cows may withhold most of their milk during milking, retaining it for their calves. This problem can be overcome by cross-suckling, in a way which does not allow cows to suckle their own offspring (E. Murgueitio, unpublished data). For example, the cows in early lactation suckle the calves from cows in late lactation, and *vice versa*.

BREEDING PROGRAMMES FOR DUAL PURPOSE SYSTEMS

There is now broad agreement that in the humid tropics, the most appropriate animals for dual purpose systems are those derived by crossing native cattle (usually *Bos indicus*) with any of the recognised dairy breeds and that the optimum proportion of European genes will vary according to the harshness of the environment (McDowell, 1985). The results from the on-farm evaluations in Brazil, made by Madalena *et al*. (1982), show that there are few advantages and many disadvantages when the proportion of genes from a specialised European dairy breed exceeds 50%.

The most popular crossing sires are Holstein, Brown Swiss, Normandy and Simmental. Few breed comparisons have been made but the more reliable data indicate a significant advantage to the use of Holstein sires compared with Brown Swiss (Vaccaro, 1984). While there are many who advocate the merits of the native Criollo breeds in Latin America, their numbers are small and there are almost no data which permit valid comparisons to be made with other breeds and crosses (Vaccaro, 1987).

It is frequently argued that it is difficult to stabilise a cattle population in order to maintain approximately equal proportions of *Bos taurus* and *Bos indicus* genes. However, in practice this is not a major problem, once it is accepted that the appropriate way is by using F1 bulls. The recommended system is to "manufacture" such bulls by crossing native "adapted" females with imported semen from progeny tested sires of the selected European breed (Vaccaro L., personal communication). Hardiness and fertility are ensured by selecting the female parent for these characteristics. A sustainable level of milk production (1,000 to 1,500 kg per lactation) is guaranteed by choosing semen from a bull with a proven capability to maintain yields (in purebred dairy females) of about 5,000 kg per lactation (the potential yield of the F1 offspring is then at least 2,500 kg, ignoring both the dam's contribution and the effects of heterosis). Almost all dairy bulls presently standing at approved insemination centres in the industrialised countries have this capacity. F1 bulls can be run with the herd which facilitates natural mating. This is recommended in view of the difficulties of heat detection in cattle that raise their calves by restricted suckling systems.

CONCLUSIONS

The basic justification for the dual purpose concept is that the target levels of production - 2,000 litres of milk and 300 kg of beef per cow per year - are closely related to national demand ratios which vary from 4 to 5 litres milk per 1 kg of beef. The total cattle population required to support these yield levels is no higher than if the milk and beef were produced in separate herds, but with the

additional benefits (for most developing countries) of supporting more employment opportunities and enabling greater and more efficient use to be made of presently under-utilised local feed resources.

Another important issue is that advantage can be taken of important physiological traits, which have been disregarded in intensive specialised systems - for example, the effect of suckling in stimulating milk yield, reducing stress in both cows and calves and permitting the calf to use more efficiently supplementary feed of low protein content.

Breeding programmes for dual purpose milk-beef systems are simple and low cost because they take advantage of F1 sires produced by combining imported "proven" (for milk!) semen with the adaptability and fertility of native females. This avoids the need to set up national progeny testing schemes which besides being expensive are also unreliable due to the difficulty of obtaining the necessary herd records.

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