

codex alimentarius commission

FOOD AND AGRICULTURE
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CONSIDERATION OF INTAKE OF PESTICIDE RESIDUES: REPORT OF THE JOINT FAO/WHO EXPERT CONSULTATION ON FOOD CONSUMPTION AND EXPOSURE ASSESSMENT

PROGRESS REPORT BY WHO ON THE REVISION OF GEMS/FOOD REGIONAL DIETS¹

INTRODUCTION

1. In 1987, WHO developed a global and five regional/cultural diets which have been used to predict dietary intake of pesticide residues at the international level² (WHO 1989). These diets were based on FAO Food Balance Sheets from selected representative countries as well as on expert interpretation. For the past 10 years, the diets provided the food consumption component of the dietary intake calculations used by the WHO for predicting dietary intake of pesticide residues for the Codex Committee on Pesticide Residues (CCPR) and the Joint Meeting on Pesticide Residues (JMPR).

2. In 1995 the Joint FAO/WHO Consultation on Guidelines for Predicting Dietary Intake of Pesticide Residues in its report³ recommended that the GEMS/Food global diet be discontinued and the five existing regional/cultural diets be updated and where appropriate expanded. This recommendation was endorsed by the CCPR and JMPR with the immediate result that the global diet is no longer used for predicting dietary intake of pesticide residues⁴. In regard to the revision of the regional/cultural diets, the matter was further discussed at the Joint FAO/WHO Consultation on Food Consumption and Exposure Assessment of Chemicals held in Geneva in 1997. Based on initial work conducted by Barraj and Petersen⁶, the consultation recommended that a statistical cluster analysis be applied to the 1990-1994 FAO Balance Sheet data (FAOSTAT.PC, 1996, Version 3.0), to group countries by similarities in dietary patterns and to estimate the consumption of commodity components in those diets.

¹ Paper prepared by the Food Safety Programme, Department for Protection of the Human Environment, World Health Organization, Geneva, Switzerland in collaboration with Novigen Sciences, Inc., Washington, D.C., USA

² Guidelines for predicting dietary intake of pesticide residues, GEMS/Food, WHO, Geneva (1989)

³ Recommendations for the revision of the guidelines for predicting dietary intake of pesticide residues. Report of a joint FAO/WHO consultation, 2-6 May 1995, York, United Kingdom, WHO/FNU/FOS/95.11, WHO, Geneva (1995)

⁴ Guideline for predicting dietary intake of pesticide residues, GEMS/Food, WHO/FSF/FOS/97.7, WHO, Geneva (1997)

⁵ Food consumption and exposure assessment of chemicals. Report of a joint FAO/WHO consultation, 10-14 February 1997, Geneva, WHO/FSF/FOS/97.5, WHO, Geneva (1997)

⁶ Barraj, L. and B. Petersen (1997) 'A method for revising and redefining regional diets for use in estimating intake of pesticides', Presented at the Joint FAO/WHO Consultation on Food Consumption and Exposure Assessment of Chemicals, 10-14 February 1997, Geneva.

3. This paper reports on the application of the cluster analysis approach in identifying regional/cultural dietary patterns that could be used for evaluation of dietary exposure to pesticides. The methods that were used to develop and characterize these dietary patterns are presented. Finally, the estimated average consumption of the 36 major foods and food groups used in the analysis is presented for each regional/cultural dietary pattern, including identification of countries which have tentatively been assigned to the proposed regional/cultural groupings.

OBJECTIVES OF THE CLUSTER ANALYSIS

4. The primary objective of the cluster analysis was to identify a procedure that could be used to better estimate food consumption in representative regions of the world. These estimates of consumption are needed to predict dietary intake of pesticide residues, but may be applicable to other chemicals in food as well, such as contaminants. Since most pesticide MRLs are established on raw agricultural commodities and certain semi-processed commodities, a key objective was to estimate the intake of these major agricultural commodities. Another objective was to have consumption estimates that were derived using comparable data and methodologies so that the resulting estimates of pesticide intake are comparable. A practical objective was to develop data that are readily accessible and easily understood to ensure their transparency in the context of the Codex risk management process.

METHODS

5. For most countries, data on food production (including imports, but minus exports and diversion to non-food uses) for the years 1991 to 1995 were provided by FAO, except for fish and seafood, where the data referred to the period 1990 to 1993. Data were reported from 186 countries, including the former USSR and Czechoslovakia. However, data for these two countries were not used in the analysis because data for the new countries that succeeded these were available in the FAO database. The production data were generally expressed in metric tons, and referred to the production of the entire country over a specific year. The values were transformed, where appropriate, into grammes per person per day using population estimates in the FAO database for the years in question. These daily consumption values were averaged over the years for which consumption data were available and were used in the assessment.

6. The approach used to derive the proposed regional/cultural diets consisted of a three-stage process, as follows:

- At the first stage, the statistical method known as k-means clustering was used to group the 184 countries into clusters based on the similarity in their consumption levels of the 36 major foods. The method resulted in the selection of 9 countries as “cluster seeds” which had the largest with respect to their consumption of major foods. The remaining countries were then assigned, in an iterative process, to one of the 9 clusters that was most similar to them. Even though this procedure did not incorporate information about geographical regions, and thus did not necessarily group adjacent countries together, the resulting statistically determined clusters did reflect, to a great extent, geographical proximities
- At the second stage, a visual inspection determined that additional subdivisions by geographic region would provide more homogeneous groups in terms of food consumption patterns. Therefore, the nine clusters were subdivided into secondary clusters based on appropriate geographical regions. A total of thirteen secondary clusters were identified, after considering both the similarity of the countries with respect to their consumption levels of the 36 major foods and their geographic proximity.
- At the third stage, estimates were made of the intake of each of 36 foods and food groups in each of the 13 cultural/regional diets. The estimates were derived as population weighted averages of the individual country intakes in the regional/cultural grouping. The population estimate given in the FAO database was used in the derivation of these averages.

RESULTS AND CONCLUSIONS

7. Based on the cluster analysis and geographical considerations, countries have been tentatively assigned to thirteen regional/cultural dietary groups are shown in Table 1 and Figure 1. Please note that the designations employed and the presentation of the map in Figure 1 do not imply the expression of any opinion whatsoever on the part of WHO concerning the legal status of any country, territory, city or area or of its authorities or concerning the delimitation of its frontiers or boundaries.

8. The per capita consumption of the 36 foods and food groups used in the cluster analysis is presented for each of the thirteen regional/cultural diets in Table 2.

9. WHO requests that each member country review these estimates of consumption to ensure that these are applicable for their country. It is acknowledged that FAO Food Balance Sheet data overestimate actual per capita food consumption because wastage and inedible portion are not taken into consideration. However, for the purpose of assessing dietary exposure at the international level, such overestimates are considered acceptable given the need to error on the side of caution and the uncertainty and variability in other components of the risk assessment.

10. Countries are requested to provide their comment to the GEMS/Food Coordinator, Food Safety Programme, Department of Protection of the Human Environment, World Health Organization, CH-1211 Geneva 27, Switzerland; fax (41 22) 791 4807; e-mail moyg@who.ch; with a copy to the Codex Secretariat.

Table 1
Country Assignments
to the 13 Proposed Regional/Cultural Diets

FINAL CLUSTER	COUNTRY	FINAL CLUSTER	COUNTRY	FINAL CLUSTER	COUNTRY
A	Angola	B	Cyprus	D	Albania
A	Burundi	B	Greece	D	Armenia
A	Cameroon	B	Israel	D	Azerbaijan
A	Central African Republic	B	Italy	D	Belarus
A	Comoros	B	Lebanon	D	Bosnia and Herzegovina
A	Congo, Democratic Republic of	B	Portugal	D	Bulgaria
A	Côte d'Ivoire	B	Spain	D	Georgia
A	Djibouti	B	Turkey	D	Iran, Islamic Rep of
A	Eritrea	B	United Arab Emirates	D	Kazakhstan
A	Ethiopia	C	Algeria	D	Kyrgyzstan
A	Gabon	C	Egypt	D	Moldova, Republic of
A	Guinea	C	Iraq	D	Romania
A	Guinea Bissau	C	Jordan	D	Russian Federation
A	Liberia	C	Kuwait	D	Tajikistan
A	Madagascar	C	Libya Arab Jamahiriya	D	The former Yugoslav Republic of Macedonia
A	Mauritius	C	Morocco	D	Turkmenistan
A	Rwanda	C	Saudi Arabia	D	Ukraine
A	Sao Tome & Principe	C	Syrian Arab Republic	D	Uzbekistan
A	Seychelles	C	Tunisia		
A	Sierra Leone				
A	Somalia				
A	Uganda				
A	Yemen				

FINAL CLUSTER	COUNTRY	FINAL CLUSTER	COUNTRY	FINAL CLUSTER	COUNTRY
E	Austria	I	Benin	L	Brunei Darussalam
E	Belgium	I	Botswana	L	French Polynesia
E	Croatia	I	Cape Verde	L	China, Hong Kong
E	Czech Republic	I	Ghana	L	Japan
E	Denmark	I	Kenya	L	Kiribati
E	France	I	Lesotho	L	Democratic People's
E	Germany	I	Malawi		Republic of Korea
E	Hungary	I	Mozambique	L	Republic of Korea
E	Ireland	I	Namibia	L	Madagascar
E	Malta	I	Reunion	L	Malaysia
E	Netherlands	I	South Africa	L	Maldives
E	Poland	I	Swaziland	L	New Caledonia
E	Slovakia	I	Togo	L	Papua New Guinea
E	Slovenia	I	United Republic of	L	Philippines
E	Switzerland		Tanzania	L	Solomon Islands
E	United Kingdom	I	Zambia	L	China (Taiwan
E	Yugoslavia	I	Zimbabwe	L	Province)
				L	Vanuatu
F	Estonia				
F	Finland	J	Burkina Faso		
F	Iceland	J	Chad	M	Argentina
F	Latvia	J	Congo, Republic of	M	Australia
F	Lithuania	J	Gambia	M	Canada
F	Norway	J	Mali	M	Chile
F	Sweden	J	Mauritania	M	New Zealand
		J	Niger	M	United States
G	Afghanistan	J	Nigeria	M	Uruguay
G	Bangladesh	J	Senegal		
G	Cambodia	J	Sudan		
G	China				
G	India				
G	Indonesia	K	Antigua & Barbuda		
G	Laos	K	Aruba (Neth.)		
G	Mongolia	K	Bahamas		
G	Myanmar	K	Barbados		
G	Nepal	K	Belize		
G	Pakistan	K	Bermuda		
G	Sri Lanka	K	Brazil		
G	Thailand	K	Colombia		
G	Viet Nam	K	Costa Rica		
		K	Cuba		
H	Bolivia	K	Dominica		
H	El Salvador	K	Dominican Republic		
H	Fiji	K	Ecuador		
H	Guatemala	K	French Guyana		
H	Haiti	K	Grenada		
H	Honduras	K	Guadeloupe		
H	Mexico	K	Guyana		
H	Nicaragua	K	Jamaica		
H	Panama	K	Martinique		
H	Paraguay	K	Saint Lucia		
H	Peru	K	Suriname		
H	Saint Kitts & Nevis	K	Trinidad and Tobago		
H	St. Vincent & Grenadine	K	Venezuela		

**Table 2: Average Consumption for the Final Clusters
(Weighted averages - g/person/day)**

FOOD GROUPS	FINAL A	FINAL B	FINAL C	FINAL D	FINAL E	FINAL F	FINAL G	FINAL H	FINAL I	FINAL J	FINAL K	FINAL L	FINAL M
alcohol, including beer and wine	90.9	176.1	6.8	70.5	339.1	184.4	24.0	102.4	109.2	109.5	100.8	138.7	272.4
apples and products	1.3	66.0	17.4	39.1	64.2	59.6	8.9	12.5	3.8	0.8	8.5	21.4	43.5
bananas	34.5	17.5	11.0	3.0	25.4	30.2	15.5	42.6	18.5	3.6	78.7	32.2	30.6
oranges, tangerines and mandarins	4.7	79.5	56.5	17.8	54.7	57.6	10.1	60.4	8.5	1.0	66.1	37.7	104.0
other fruits	20.2	163.5	95.4	68.5	83.3	58.6	55.7	81.0	23.4	40.0	58.8	73.2	65.2
fruits	183.5	403.1	246.8	154.9	263.2	228.3	98.9	258.2	101.5	106.9	276.9	192.4	310.2
pulses	31.0	23.7	17.9	9.6	7.5	3.2	16.3	31.9	17.6	24.1	36.3	8.9	10.4
potatoes	16.4	186.4	60.3	250.4	243.9	230.6	31.2	48.0	27.5	2.1	50.8	49.0	157.9
starchy roots	392.1	187.2	65.1	250.4	244.3	230.6	111.8	93.4	356.1	344.4	172.1	110.0	165.8
brassica	2.4	33.1	11.4	54.7	45.0	39.0	22.2	6.2	5.5	0.1	4.4	55.2	15.8
all cucurbits	5.0	30.9	26.2	21.7	14.3	13.6	14.7	5.7	4.2	1.4	6.1	16.0	14.3
tomatoes and products	11.8	164.8	121.1	59.6	43.1	31.4	14.7	27.5	12.3	11.9	34.5	12.8	98.5
onions	4.2	55.3	33.1	24.0	26.4	14.9	17.7	11.1	6.4	8.6	11.7	34.6	27.9
other fresh vegetables	23.5	97.2	48.3	43.4	55.8	24.2	125.0	18.8	38.5	57.1	20.4	114.1	24.5
dried or dehydrated vegetables	0.2	0.5	0.5	0.1	0.5	0.5	0.2	0.0	0.1	0.1	0.0	1.7	0.2
vegetables	59.6	451.2	270.5	223.6	261.2	172.7	209.8	92.0	77.5	89.3	85.8	276.7	277.4
maize	65.6	17.0	62.0	13.0	16.8	2.2	31.1	247.8	241.3	55.3	67.3	55.1	31.7
wheat	67.1	406.3	436.4	405.5	238.2	228.4	170.3	111.5	66.3	45.0	118.3	106.9	241.8
rice, husked equivalent	47.4	22.9	62.4	27.8	8.9	10.5	307.5	44.3	27.6	56.8	119.5	246.9	22.2
other cereals	25.3	0.2	1.1	0.2	1.3	8.5	1.3	6.9	2.1	3.9	0.8	1.4	0.2
cereals	255.3	448.1	602.8	482.5	295.0	324.5	492.2	410.6	359.8	409.7	292.8	379.3	310.3
soyabean oil	1.1	9.3	6.4	3.9	9.2	9.3	2.3	11.8	1.5	0.9	26.6	8.3	41.6
vegetable oils	14.2	62.6	36.6	22.6	41.7	31.6	16.1	24.6	19.0	26.8	37.9	29.2	59.5
oil crops	13.4	12.0	10.4	4.8	7.6	3.6	23.9	8.9	9.5	16.0	14.2	25.1	12.6
cocoa, coffee, tea	2.7	13.0	5.9	4.5	22.4	25.0	1.4	7.2	2.0	4.4	8.3	8.7	18.2
spices	2.8	1.3	2.9	0.4	1.4	0.8	2.5	1.0	1.5	2.0	0.5	1.9	1.6
sugar, refined	17.0	75.8	74.0	71.6	96.4	98.4	24.9	106.0	43.6	23.1	116.2	54.7	84.8
sweeteners	19.2	85.3	82.1	80.0	112.3	111.8	37.6	120.8	48.6	25.8	137.1	80.2	166.1
eggs	3.3	31.1	11.4	27.4	33.8	30.6	14.2	24.3	5.7	5.5	19.2	34.5	32.6
milk	44.9	274.8	113.9	317.0	344.8	472.5	73.0	177.2	91.5	104.7	250.6	102.1	379.1
meat products, other	5.3	7.1	3.2	2.8	5.3	6.1	1.0	3.0	4.8	4.5	0.8	1.3	2.2
sheep	6.8	13.6	12.0	9.7	7.4	4.8	2.9	3.1	5.3	8.2	1.9	1.6	6.1
bovine	14.4	42.6	15.3	50.9	53.5	55.7	6.7	37.1	22.7	13.3	62.9	21.0	118.9
pork	6.9	68.3	0.1	39.0	120.4	77.1	32.3	24.2	3.8	3.3	19.4	46.1	71.4
poultry	7.3	46.7	25.1	22.8	44.4	17.6	8.7	37.5	11.2	5.2	46.9	39.2	101.5
fish	18.6	61.0	15.1	22.1	41.4	86.6	25.2	29.5	23.8	21.4	20.0	137.6	56.0

