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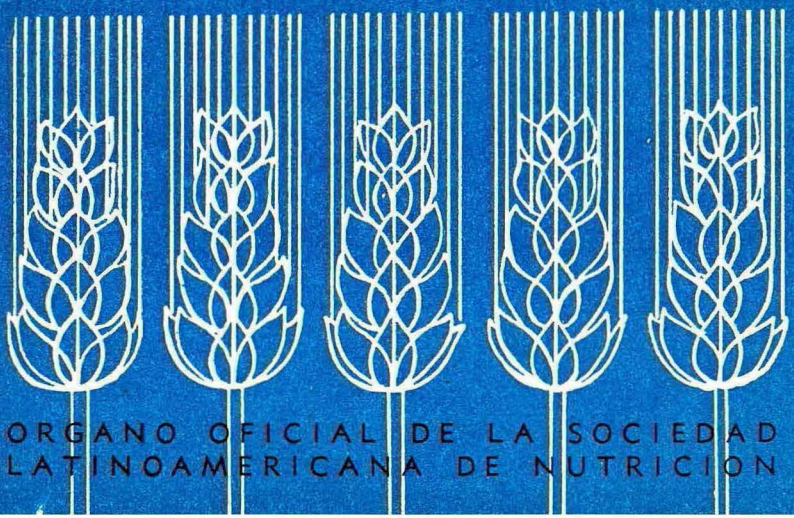

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SUMARIO

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TRABAJOS GENERALES

Economics and Nutritional Change

BARRY M. POPKIN*

SUMMARY

The positive or negative impact of economic measures or circunstances on nutritional changes in low income groups, are discussed and explained on hand of a number of actual programs and the analysis of their possible effects.

Until relatively recently, the paramount concerns of nutritionists and policymakers in nutrition seem to have been exclusively of a scientific nature. Although humanitarian concern has been the overriding basis for the application of their work and must not be neglected, many nutritionists have begun to realize that economic questions should also be of primary importance. We intend to show some ways in which economics can be integrated with nutritional science in order to assist in the development of needed nutritional policies.

Economics includes the study of how men choose to allocate scarce resources based on equity and efficiency. Each different pattern of resource allocation provides a positive or negative contribution to the society. Efficiency involves the most productive use of scarce resources, equity relates to the fairness of the distribution of these resources. Economic analysis assits our understanding of the tradeoffs between efficiency and equity. For example, allocating funds for a new factory to increase output might be more productive than

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providing food supplementation to workers in a less expensive facility while spending the same total funds. This is illustrative of the efficiency aspect of economic analysis. If the decision were based on equity, society's desire for healthy citizens may outweigh efficiency.

Society's resources are limited. Thus developing countries cannot design nutrition programs to completely end malnutrition when there are competing demands for funds.

Economists use a number of techniques to determine the most effective allocation of funds, such as benefit-cost analysis. Uses of economic analysis research beyond the estimation of the benefits and costs of a program to include factors such as income and price analysis.

Economic theory and economists who view all health and nutrition programs in terms of only their investment potential often ignore many of the more needy sections of society. It is important for us to continually ask: Are we reaching the unreachables? (5, 12). The distribution of resources and power in a society of the broader political economy considerations are often the reason for failure on this point.

Role of Income and Price Analysis

Several practical problems will be analyzed. The first is the question of the price of commercial nutritional foods. Existing nutrition programs and policy have often placed emphasis on low cost nutritious foods, usually dependent on commercial marketing. Various incentives have been introduced or proposed to encourage private investment and profit from developing such products. These have included: the provision of subsidies or loans to assist development and marketing efforts, special tax and other monetary incentives, duty-free import of machinery and materials, and lastly, guaranteed distribution of the final product through government supported programs and institutions.

The rationale for the development of low-cost nutritious foods is the need to reduce the extent of serious malnutrition in a particular country or region. This objective has seldom been realized (1). Often the more specific issue of the so-called protein crisis is used as the rationale. Sukatme provides an excellent review of this ussue (16).

Commerciogenic nutritious foods are defined as commercially produced products high in protein and designed mainly to reduce the seriousness and prevalence of protein-calorie malnutrition or to improve growth of children at risk. They include milk products for infant use, semisolid manufactured weaning foods, high protein snack foods and beverages, various commercial mixtures of cereal, legume, and oil seed flours, and similar products.

Very little analysis has been completed on the effects on children in low income families who purchase these foods. We know many of these products are purchased extensively (7, 11). One interesting survey of the use of Faffa, an Ethiopian supplementary children's food, pointed out a serious problem. Seventy-nine percent of the respondents who answered a question about Faffa's usage leading to any dietary substitution stated that one or more other dietary items were excluded (18). The primary products excluded were animal products followed by cereals and legumes. Simple economic techniques were utilized to understand the potential effects of introducing foods such as Faffa into the diet of the low income Indian[1].

Data from India have been analyzed to provide an example of the potentially dangerous effects of introducing commerciogenic nutritious foods into the diet of poor farmers and urban dwellers. The conclusions from this example almost certainly are valid for many countries in Asia, Africa, and Latin America. They dramatize the type of findings found in this Faffa study for the low income population among which poor nutrition is most serious.

This discussion centers on the bottom three income deciles (the lowest 30%) of the Indian population. Table 1 shows the per capita monthly consumer expenditures on various categories of products. The 'all others' income is the only available income from which expenditures could be made for new food products without reducing other food purchases. It is assumed that if the family is to buy a new commercial food, it will replace some other food purchase. Also, regular income will be assumed so that the amount of income available for food will be constant.

1. The following discussion reports some of the results of a study by this author and M. C. Latham (12).

TABLE 1
PERCENTAGE OF INCOME SPENT ON DIFFERENT FOOD GROUPS BY INCOME LEVEL[1]

Categories	Income level		
	Bottom 20%	Third decile	Upper 5%
	Per capita monthly consumer expenditure, Rupees		
	8.93	13.14	85.84
	% Spent	% Spent	% Spent
Food grains	54	52	15
Milk and milk products	2	4	10
Meat, eggs, and fish	1	2	3
Other foods	22	22	17
All others, clothing, fuel, light, miscellaneous	21	20	55
Total	100	100	100

[1]Estimated from the functions fitted to data from NCAER, All-India Consumer Expenditure Survey, 1964-1965, II, New Delhi, 1967, in (2).

In Table 2, the amount of calories and protein provided by these foods is shown for these two income groups[2]. The figures are mean estimates of per capita intake. The tables indicate the relatively high amount of cereals consumed by the poor and the fact that the lower income group gets more calories and protein per rupee. Thus, this group has a greater efficiency per rupee in their food purchases of protein foods and calories.

Table 3 shows the calories, protein, and cost per 100 g of a selection of processed nutritious foods from India including certain biscuits and beverages. The multimixes would not be classed as commercial low cost nutritious foods. They consist rather of unprocessed or semiprocessed combinations of cereals and legumes. Both multimixes in Table 3 have been shown to be nutritionally successful (19-21). The Indian multipurpose food, consisting of a mixture of groundnut (peanut) and chickpea flours, is produced in a factory with inexpensive and quite simple labor-intensive equipment. Bal Ahar also fits into this category, although the latter is not now com-

2. Sukhatme presents information from an earlier study in Maharashtra that shows a slightly higher calorie and protein intake for the low income families (16).

mercially available. In contrast, the Hyderabad mix which includes wheat flour, green gram, groundnuts, and sugar jaggery can be produced by the consumer.

TABLE 2
AMOUNTS AND SOURCE OF PER CAPITA CONSUMPTION OF PROTEIN (in grams) AND TOTAL CALORIES BY INCOME GROUP IN MAHARASHTRA[1]

Food groups	Bottom 30% income	Upper 5% income
Cereals	30.1	30.1
Pulses	7.4	15.3
Milk	0.8	9.1
Animal food (other)	0.4	5.3
Vegetables	0.3	2.8
Total protein	38.9	62.6
Total calories per person	1,220	2,238

[1]Data provided by Protein Foods Association of India in their Food Habits survey, India; Operations Research Group, Baroda 1969.

TABLE 3
CONTENTS OF CALORIES AND PROTEIN, AND COST PER 100 g OF SELECTED PROCESSED NUTRITIOUS FOODS

	Calories	Protein g	Cost, Rs
Biscuits[a]			
Uniprotein[a]	500	18	1.44
Threptin[a]	400	63	2.22
Other protein foods[a]			
Complan[a]	450	31	3.36
Protinex[a]	560	45	4.40
Skim milk powder[b]	357	35	0.60
Multimixes			
Hyderabad mix	385	13	0.12
Indian multipurpose food[b]	420	42	0.20

[a] Protein Food Association of India, Bombay.
[b] From (20). The cost of skim milk powder has increased substantially since this time.

Table 4 shows the economic efficiency or inefficiency of these various foods in terms of rupees per 100 kcal/10 g of protein supplied. The mean cost per 100 kcal is 0.02 Rs for the poor and 0.06 Rs for the wealthy; for 10 g protein, it is 0.06

and 0.21 Rs, respectively. The cost of 100 kcal provided by the commerciogenic nutritious foods is in the range of 0.17 to 0.79 Rs and of 10 g protein is in the range of 0.17 to 1.08 Rs. Calories purchased in this form are 8 to 40 times as expensive, and protein is 3 to 18 times as expensive as in the normal diet. In contrast, the two multimixes are extremely close in cost to the traditional diet. For the upper income group, the commerciogenic nutritious foods are a relatively expensive way of buying calories, but in terms of their present purchasing practices, they are not too expensive a way of buying protein.

TABLE 4
COST (in rupees) OF PURCHASING 100 KCAL AND 10 g PROTEIN, USING SELECTED FOODS

	Rs/100 kcal	Rs/10 g protein
Processed commercial products		
Uniprotein	0.29	0.80
Threptin	0.55	0.35
Complan	0.75	1.08
Protinex	0.79	0.98
Skim milk powder	0.17	0.17
Multimixes		
Hyderabad mix[a]	0.03	0.09
Indian multipurpose food[a]	0.05	0.05
Normal diet		
Overall cost of mixed diet	0.02[b]	0.06[b]
	0.06[c]	0.21[c]

[a] This market cost does not include advertising and promotion.
[b] Bottom 30%.
[c] Top 5%.

The effects of replacing the normal diet with purchases of these commercial foods and multimixes could have disastrous effects on the nutritional status of the individual. In contrast, the use of Hyderabad mix only moderately reduces caloric intake and increases protein intake. It should be noted that with 78 g, which is the recommended consumption level for the Hyderabad mix, there is a reduction of over 100 kcal and an increase of 22.8 g of protein; whereas at the 26-g consumption level of the Hyderabad mix, the calories are reduced by 49 and the protein intake increased by almost 10 g or a 25%

increase. Perhaps the higher recommended level should be lowered so that the poor can absorb these costs without substantially lowering their calorie intakes while benefiting from a useful increase in the amount of protein consumed. This mix is designed to supplement the normal diet of children. These results are shown in Table 5.

TABLE 5
SIMULATION SHOWING EFFECTS OF REPLACING TRADITIONAL DIET BY FIXED QUANTITIES OF SELECTED PROCESSED FOODS IN LOW INCOME GROUPS[a]

	Kcal/person	Protein, g person
Traditional family diet	1,220	38.9
Effect of replacement by:[b]		
Uniprotein, 133 g- 2 packets (1.91 Rs/month)	873 (—347)	31.0 (— 7.9)
Protinex, 125 g- 0.5 package (2.75 Rs/month)	725 (—495)	28.1 (—10.8)
Hyderabad mix, 78 g/day (2.85 Rs/month)	1,014 (—106)	61.7 (+22.8)
Hyderabad mix, 26 g/day (0.95 Rs/month)	1,151 (—49)	46.5 (+ 9.6)

[a] Bottom 30%.
[b] It is assumed that the diet will be reduced equally in all categories by an amount necessary to purchase the replacement.

The dangers of replacing part of the normal diet with the purchase of these selected commercial, low cost nutritious foods are many. This analysis uses an artificial simulation. As has been pointed out earlier, the poor are being induced to purchase these foods with the unrealistic assumption of better growth and health for their children (7).

Data from a Filipino home gardening program on which this author is working is discussed next: For this project, an increase in the intake of vitamin A was desired. The goal was provision of about 50 percent of the vitamin A intake of all households who can have gardens. Since the tradition of home gardening existed in the area studied, it was important to understand first who gardens, the contribution of these gardens, and the reasons why others don't have them.

While significant additions in absolute income are not produced by these home gardens, the relative importance to

poorer Cebuanos cannot be underestimated. The value of produce from the home garden was 8% of the income of the lowest income quartile for the entire sample. More significantly, it comprised 15% and 20% of the income of the first quartile families in the rural coastal and hinterland barrios, respectively. The home garden income consisted of only fruits and vegetables. In vitamin A terms, the contribution was just as meaningful. In the region studied, over 90% of the vitamin A was in the form of carotene from fruits and vegetables. Of the total vitamin A intake of a subsample of 60 people, 34% came from vegetables produced in the home garden and 8% from fruits produced in the gardens. The remainder of this subsample's vitamin A derived from fruit and vegetables was the result of food expenditures.

The next key question is, who does the home gardening? Home gardening practices were studied among the 626 families. There was a high percentage of people without any home garden, especially in the urban areas. In the urban squatter areas, 55% of the families do not have a garden. The same figures for the urban fringe, coastal, and hinterland barrios are 34%, 16% and 28%, respectively. The lack of home gardening are more common among the low income population. In the first income quartile, 33% do not have home gardens.

The urban-rural split is very important. When the percent of families with 10 or less square meters of home garden is examined, 81-84% of the urban families and only 47-52% of the rural families are found in this category.

Land is the main reason[3]. About 73% of the families who do not have home gardens report they have no space available to them for home gardening. Close to a fifth of the non-gardeners reported no desire as their prime reason. Of the remainder, land of poor quality and landlords who will not let them home garden are the other obstacles.

Income plays a key role in this situation. Among the non-gardeners who were physically unable to garden, the low income groups in the urban areas are predominant. Thus, 45%

3. The relationship of having or not having a home garden (a 0-1 variable) was analyzed using an ordinary least squares regression format. Land availability increases the probability of having a garden by 69% while a 10% increase in family size will increase this probability by 15%.

of the squatter families and 33% of the urban barrio families in the first income quartile do not have land available for home gardening.

The value of the gardens in both in-kind income and vitamin A are important for the families who have gardens. The average value of the home garden for all families with them is $19.60 per year. The vegetables produced were generally very high in carotene; that is the carotene-rich green leafy ones (e.g. drumstick leaves, water convolvulus, amaranth,....); nevertheless, there is a high incidence of xerophthalmia (severe vitamin A deficiency) among these families. It is the result of inadequate intakes of vitamin A or some other intervening health or nutritional variable such as hookworm, or a protein or fat deficiency. Without going into these issues, we will assume it is a vitamin A deficiency.

We must realize that there has been little research done on most horticultural crops in tropical countries except for the few export-oriented cash crops (citrus fruits, bananas, etc.). Furthermore, the question of carotene content has been even more neglected. In table 6, we examine the potential vitamin A yields of a variety of vegetables. The average size of home gardens for those with a garden of 18.5 square meters was used to estimated vitamin A yields.

The results can be compared with the recommended dietary allowance for a family of seven. Based on the WHO-FAO standard, a family with five children (ages 1, 3, 5, 6, 10) would need 17,210 I. U. of vitamin A daily. Assuming a 20% wastage, this family would need about 10,000 I.U. of vitamin A daily from their garden to obtain 50% of their vitamin A in two manners. Most of the more relevant yields (e.g. Java home garden) are less than this figure. However, several of the more professional vegetable yields do produce an adequate yield of vitamin A.

Thus, we see a technological constraint which must either force us to reevaluate our goal or to change the constraint. Some research by this author has shown that it is possible to increase significantly the carotene content of the popular vegetables in the area studied. The effort involved is minimal. For example, tomato varieties exist with 10 times the carote-

TABLE 6
DAILY YIELD OF VEGETABLES

Product	Days to last harvest	Economic yield/day/ha[a] Kg	Vitamin A/ 100 g IU	Daily yields of vitamin A/ 18.5 sq. meters
1. Swamp cabbage	30	333	4825	29711
1. Chinese cabbage[b]	60	283	3600	18852
2. 1972 Philippine average-all vegetables	c	12	3350	740
3. Bush sitao (green edible pod)	77	156	570	1645
3. Mung bean (edible pod)	67	229	1141	4834
3. Sweet potato				
roots	120	208	1025	3941
tips		69	5565	6590
				10531
3. Cauliflower	49	122	95	215
4. Home garden mixture in Java	c	2	3350	130
4. Market gardens in same Java area	c	68	3350	5328
4. Intensive market gardens (Java)	c	205	3350	12710
5. Tomato	85	165	735	2244

Sources: The vitamin A data was obtained from the Food Composition Table, Food and Nutrition Research Center, Manila, 1968. All the figures are based on Philipine equivalents.

[a] This yield is actual economic yield divided by length of growing period.

[b] It is assumed that pre-transplant growth requires no space and that maximum yield is obtained (Villareal, p. 15).

[c] Yields were only supplied on an annual basis.

ne content of a normal Filipino tomato and organoleptic qualities pleasing to the populace studied.

Of course, there are numerous other technical and social issues involved. However, the critical problem may not be yield of the garden; rather it may be the families who are ignored by developing a home garden program. This issue is discussed later in this paper.

A study of the effects of changes in either food supplies or food changes while holding the other constant on nutritional deficiencies in Cali, Colombia illustrates a third use (9). The research investigated the potential impact of food supply of various agricultural products on the nutritional deficiencies of the population so agricultural research resource allocation could be more effective. Of course, improved nutrition would have to be a goal of agricultural research and, as the authors noted, this is rarely the case. Farm returns and other economic and agricultural yield measures are the prevailing measures by which agricultural research is judged.

First the authors estimated the potential impact of hypothetical supply expansions of selected food commodities on the intake of calories and protein of a group at various income levels. To do this they obtained data on income, family size, quantities of foods consumed and prices paid for these consumed foods. The 230 families were selected using stratified random sampling techniques and visited in February 1969 and August 1970. The present levels of caloric and protein intake and the resultant deficiencies for 5 income groups were estimated. Table 7 shows this information.

The direct price-elasticities and flexibilities and time cross-elasticities were estimated. A price elasticity shows the percentage change (usually increase) of food purchases for a 1% reduction in its price. For example, a price elasticity for beef of -1.6 tells us that a 1% drop in the price of beef leads to a 1.6% increase in the consumption of beef. The estimated change in quantity consumed due to 10% increases in the supply were estimated using the above information. Assuming constant consumer incomes, the changes in prices and the subsequent changes in consumer purchases for each income strata were estimated. Each commodity was examined separately.

TABLE 7
CALORIE AND PROTEIN CONSUMPTION OF 230 FAMILIES OF CALI, COLOMBIA

	Income Strata				
	I	II	III	IV	V
US $/family month	0-37.50	37.6-50.	50.1-100.	100.1-150	150.1-up
% distribution	18.3	17.6	36.8	13.6	13.5
Daily per capita calorie intake	1808	1955	2323	2584	3391
Reommended intake	2150	2150	2150	2150	2150
Calorie balance	-342	-194	173	434	1241
Daily per capita protein intake	41.2	46.7	59.4	75.7	119.8
Recommended intake	62	62	62	62	62
Protein balance	-20.8	-15.3	2.59	13.7	57.8

Source: Tables 1, 3 and 4 (9).

TABLE 8
IMPACT OF A TEN PERCENT SUPPLY INCREASE ON CALORIE AND PROTEIN DEFICIENCIES

Product	Percent of total net addition of calories and protein consumed by the deficient strata		Reduction in nutrient deficiencies in percent of total deficiency	
	Calories	Protein	Calories	Protein
Beef	10.12	48.74	1.62	7.96
Pork	8.96	42.22	0.49	2.04
Milk	15.70	59.67	1.34	3.65
Rice	42.65	84.09	16.55	8.83
Maize	63.84	100.00[1]	18.62	10.17
Beans	45.95	83.48	5.08	5.42
Potatoes	49.87	79.85	6.74	3.37
Plantain	65.15	100.00[1]	13.94	3.95

[1] Since the direct price elasticities for maize and plantain is positive for the high income strata, the increase in the quantity consumed by low income strata exceeds the increase in supply.

Source: Table 11 (8).

The various price reductions affect each strata differently. A 10% increase in supply of beef increases per capita daily protein consumption of the poorest strata by .5 grams while the increase is 3.2 grams in the richest strata. On the other hand, a 10% increase in the supply of rice adds one g of protein to the low-income diets and 0.5 grams to the high income consumers' diets. Table 8 shows the percentage of the net protein and calorie consumption which the deficient strata consume and the resultant net reduction in their calorie and protein deficiencies.

The impact of income increases is estimated with the use of income elasticities. Income elasticity measures the percent change in the consumption of each commodity for a 1% change in income. They found "A ten percent increase in the incomes of low-income consumers would result in an expansion of the consumption of meats and milk approximately equal to that caused by a ten percent supply expansion, while the impact on the consumption of stable foods would be less than associated with a 10 percent supply increase" (9, 18).

Table 9 shows the percent of total income increases necessary to meet the nutritional deficiencies of each strata .

This study points out the relative nutritional benefits of changes in the supply of different commodities. The benefits to the poor of expanded meat and milk production were limited while maize and rice were more beneficial. Once again, such comparisons are meaningful in a limited way without looking at the relative costs of expanding the production of each commodity. Also incomes were assumed to be constant. The interaction of large price and supply changes can produce significant positive and negative income effects for various strata. We also see what the magnitude of the income changes must be to eliminate the calorie and protein deficiencies when prices are held constant. Such an analysis can help to understand the potential of various types of economic development programs in eliminating malnutrition.

This analysis deals with average family data. Intrafamily distribution which is ignored in this study can certainly be analyzed. The effects of price and/or income changes on individual's nutritional needs could be analyzed. However, it must

4. Similar data was not provided for food supply increases.

TABLE 9
PERCENT INCREASE IN CONSUMER INCOMES NEEDED TO FULFILL NUTRITIONAL REQUIREMENTS, BY STRATA

	Strata		
Calories	I	II	III
Increase in per capita incomes (%)	28.88	15.40	—
Increse in per capita incomes (Col. $)	28.82	27.57	—
Increase in incomes per family (Col. $)	149.48	149.67	—
Incrase in incomes per family (U. S. $)	7.47	7.48	—
Protein			
Increase in per capita incomes (%)	55.33	38.42	11.17
Increase in per capita incomes (Col. $)	55.22	68.77	29.38
Increase in incomes per family (Col. $)	286.41	373.41	170.20
Increase in incomes per family (U S. $)	14.32	18.67	8.51

Source: Table 15 (8)

be noted that the distribution of food within the family most likely changes significantly as incomes and prices change. Also the author equates 10% increases in food supply and income. Such comparisons are only meaningful when the cost of producing a 10% rise in both food supply and income are considered. Failure to do this presents a false impression of the results.

Benefit-Cost Analysis[5]

Given this scarcity of resources, we should ensure that allocation of funds be made to all the various programs. Nutritionists and economists together must help establish the priorities between food and other types of programs. Benefit-cost analysis providing a thorough examination of the efficiency question is one basic approach toward establishing priorities (4; 17). This technique enables the analyst to determine the

5. Parts of the following discussion are taken from (13).

relative benefits obtained from a given set of expenditures for a variety of programs. However, benefit-cost analysis cannot answer all the questions, as it cannot deal with many non-quantifiable areas. Effects of nutrition on mental health and skeletal structure are two areas in which quantification is impossible, whereas other aspects are difficult to quantify accurately.

Moreover many of the effects of nutritional improvement (increased physical and mental performance, reduced morbidity and mortality, etc) are very difficult to quantify in any environment. In a laboratory it is quite easy to show the effects of changing a nutritional indicator such as the PER or calorie intake on behavior of rats. This is not the case where numerous social, health and other environmental factors interact synergistically. For example, one study in India attempted to show the relationship between improved caloric intake and work output among poorly fed coal miners but they could detect no effect. Then they finally realized that the organizational structure of the coal mine limited the amount of coal which could be placed in the coal train cars each day, thereby limiting the potential output of these individuals.

When dealing with more subtle changes in mental performance or morbidity among young children, the task is even more difficult. One heroic attempt estimated the effects of increased milk consumption among preschool chilean children on their future work performance (14).

First, Selowsky and Taylor estimated the effects of: poor nutritional status on preschool ability (IQ) of children aged 1-3; the effects of preschool ability on schooling; and the effects of both schooling and preschool ability on adult's ability at a mature age; and the effects on an adult's earnings of schooling and the adult's ability. From these four steps, they were able to estimate the total effects of a change in early earnings on the adult's income. This analysis showed very large economic benefits and a rate of return of 20% or more for a milk program for an infant during his first 2 years to avoid severe malnutrition.

One problem with the Chilean study and others of a similar nature is the lack of quantification of the economic effects of nutritional and health changes. This forces the economist or

planner to make crude assumptions about economic effects. Partially this is the result of the difficulty of determining these effects because of the synergistic interaction between nutrition and many other factors It is also the result of cross-sectional analysis, that is the lack of longitudinal studies which carefully attempt to analyze several effects.

This author is engaged in an attempt to understand the effects of eliminating xerophthalmia (severe vitamin A deficiency). One aspect is the effect of reduced xerophthalmia on children with and without the disease. To do this, 400 children's total morbidity was studied weekly for 3 months in Oct.-Dec. 1973[6]. Then the total morbidity will be studied in Oct.-Dec. 1974 after the xerophthalmia has been eliminated. If any medical effects are determined, economic analysis of the changes in the children's school performance, absenteeism, etc. will be estimated. It should be noted that an understanding of the direction of the effects and the types of effects (positive and negative) of nutritional change can be useful to the economist and the planner.

The analysis of costs of each program are as important as the benefit analysis[7]. This is because costs are rarely quantified but they can be measured easily and will provide a better basis for planning programs. It is useful to examine both the private and the public costs of a program. While we are usually more interested in how much the program will cost the government (public costs), the costs to the private individual are important in estimating the short run and long run success of the program.

These private costs should include the direct and indirect outlays. For instance, a home garden or some other agriculture program may require expenditures for seeds, equipment, or fertilizer. It will also require time to be spent on the gardening or farming. This indirect outlay can be conceptualized as the earnings foregone or the opportunity costs of the time devoted to these programs. If the person involved is unemployed, the opportunity cost of his labor can be viewed as

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6. This study is being conducted by Dr. Florentino S. Solon, Cebu Institute of Medicine, Dr. Michael C. Latham, Cornell and this author.
7. This point has been emphasized by D. L. Call and R. Longhurst, "Evaluation of the Economic Consequences of Malnutrition, "Proc. Western Hemisphere Nutrition Conference III, 1972, 312-317.

zero. Nevertheless, it is important to consider this time factor. This holds true for nutrition education and so many other programs. The sum of these direct and indirect outlays allows us to understand the direct impact of the program on each person. These costs should be considered for the entire population-not only the program recipients. Often the costs on the nonrecipients (if any) can affect the success of the program.

Public or social costs should include all fixed investments on training and other facilities and the operating and maintenance costs for the various programs. The net costs of any food or other subsidy are included. Separate foreign exchange costs might be analyzed if the country has a foreign exchange problem. The clearest example is the milk program in Chile. If the original designers of the programs had estimated the potential foreign exchange impact of the milk program under various funding arrangements, they might have taken steps to lower the foreign exchange needs earlier. For instance, they could have looked at the possibility of replacing part of the milk powder with some indigenous ingredients such as chickpea powder.

Of key importance to food program analysis is that this technique explicitly considers the time stream of benefits and costs. A program with large benefits in the future (preschool feeding) may be less valuable to a society than one with small benefits in the short run (i.e. factory lunch program). The present value of each stream of costs and benefits are estimated. This technique can include only an analysis of the present value of the costs of various programs. Then the costs can be compared. Cost-effectiveness analysis attempts to compare the costs of various programs which meet a given level of effectiveness such as eliminating a given nutritional problem.

It must be emphasized that benefit-cost analysis often gets misused by only examining changes in total production (gross national product). Since the goal of economic policy is an increase in welfare or a key aspect such as the patterns of consumption, a variety of considerations are crucial. One of these is the distribution of benefits and costs between various classes of society. It may be proper to weigh the benefits such that those accruing to the malnourished are given a much larger value than those going to the wellnourished.

Equity considerations: "Reaching the Unreachables"[8]

A fundamental problem in the development of social service programs in the areas of health, nutrition, housing, education and welfare is how best to reach those most in need. Few programs address themselves adequately to this problem when plans are formulated. Yet, 30, 40 or even 50 percent of the population of many developing countries are entrapped in conditions of poverty. Many of these people lie beyond the reach, not only of the public services, but often also of market forces which traditionally act to uplift large segments of a society. Prominent among these "unreachables" are the unemployed or underemployed urban squatters and slum dwellers; the landless agricultural workers and the sharecroppers and the poor peasants with small uneconomic land holdings. Developmental programs supported by governments and international agencies are intended to improve the lot of this segment of society. But in practice these programs too often are simply not reaching those most in need.

In reality, the lowest income 30 or 40 percent of the population have in the past 10 to 20 years experienced little or no increase in real income and often have experienced a decline. This is the case in India, the Philippines and numerous other low income nations including much of Latin America (4, 6, 15).

Economic change is taking place and incomes are growing but the poor are rarely reached. Priorities play a role. It was estimated "that with the annual operating expenditures of the three open heart surgery units in use today in Bogotá, a city with a population of over 2 million, a quarter of the children living there could receive a half liter of milk each day for one year" (8, 10).

Programs aimed at the poor usually don't reach them. Take the Applied Nutrition Program effort in India. One program for 3-6 year olds tried to reach the children of poor families but children came mainly from better-off poor families. The poor children had to stay at home to look after their younger siblings while their mothers worked. Or take the Applied Nutrition Program's emphasis on home gardens. What happens to

8. Parts of this discussion are excerpted from Popkin and Latham (12).

those families who do not have land for gardens. And the resources often do exist. Food supplies in India, Cali, Colombia, and most countries are adequate if an equitable distribution existed (6, 8, 9). Urban-rural, regional, and class imbalances are abundant.

Frequently the blame for the failure of these programs to benefit the very poor is laid at the door of the poor themselves rather than that of the program planners and professional workers. Social scientists explain the relative lack of participation of the poor as being due to social and cultural factors such as a lack of education or unprogressive religious beliefs. The wealthy members of the establishment often make moral judgments about the poor and suggest that they are lazy, spendthrifts and immoral.

In order to develop appropriate methods to reach the poor, it is necessary to examine the existing structure of the health care system and of nutrition programs in relation to the social milieu of the very poor. How successful are the programs in reaching their objectives? What changes are needed? Is a whole new program required which is sensitive to the local culture and to the social structure of the people?

The affluent and even the government agencies often regard those in the low socioeconomic class as being a relatively homogeneous group, "the poor". Although it may sound contradictory, and even inhuman, it is clear that in all countries there are "rich poor" and "poor poor". Most health and nutrition intervention programs have failed to reach the very poorest families. Many workers will agree with this assessment, but there is little understanding of this issue, very few evaluation studies related to it have been carried out, and the planning process gives it minimal consideration. This problem is not limited to low income nations. The programs aimed at "eliminating poverty" in the U. S. produced similar results

Why haven't we reached the poor poor. One basic issue is the lack of political clout among the poor. They are pushed around by many segments of society and have few weapons to challenge entrenched power. Other reasons include:

(1) *Lack of skills or of assets.* The "poor poor" function within a more unstructured labor market than do most laborers. If they are employed they have poorer working condi-

tions, less job security, more frequent non-cash payments, and longer working hours. They are often the landless peasants or the squatters paying their dues to the squatter colony politician. Also their poverty means lower school performance and higher absenteeism for the children.

(2) *Attitudes differ from those of the establishment:* The attitudes, the beliefs, and the life-style of the poor may be quite different from those in positions of power. For example, in Thailand the poor poor may more often be animists rather than Buddhists. In India, their lower subcaste may have subdued them to such an extent that they are fearful of any step forward.

(3) *Professionals look down on them:* The professional and auxiliary workers in health and social programs often show disdain for the very poor and may make it difficult or impossible for them to participate fully in a program designed for their benefit. Workers, often of the same nationality, may have different backgrounds, a lack of understanding of the poor's problems, and even speak a different dialect. In other cases, the poor who become educated are separated from their own class through the very subtle mechanisms of the educational process. As professionals they fail to communicate with and often look down on their former peers.

(4) *Lack of time and other attributes to make use of services:* Where incomes are very low often both men and women have little time away from work or household duties. Without good facilities it is time consuming to carry water, gather fuel, care for children, pound grain, prepare meals and do a hundred other chores. Frequently, they do not have time to utilize fully the available social services. They may also lack the needed low cost transportation to reach these services and they are hindered by illiteracy. A nutrition education program on radio or TV may not help those who cannot afford such appliances. A cereal fortification program will not help those who pound their own grain, and a fluoridated water supply does not assist those who draw water from a ditch or well.

(5) *Lack of meaningful community organizations among the poor:* Seldom are the villages (barrios) or squatters' areas organized in a manner whereby community resources can be

pooled to provide the manpower and financial resources necessary for attacking simple or complex problems. Cooperation on community health and other social welfare projects is often lacking. Of course, combining the few resources as the poor control can be of limited value. This is also the case for other stratas of society, but these middle and upper income groups can afford to purchase and develop the necessary commercial services.

Economists and planners have helped to neglect the poor. As John Mellor has pointed out, development planners have had a tendency to ignore the distribution of income, have placed more emphasis on urban than rural development, have ignored most high employment paths of development, have ignored the composition of consumption as a basis for policy (6). The latter has meant that they have not been concerned with health, nutrition and education programs for the role they will play in development. This has meant that those most lacking in these areas have been more deprived. Health planners have overemphasized curative rather than preventative environmental oriented programs. In Colombia only 8% of the health peso in the public sector goes for preventive services. Over 30% is for hospitals and the combined curative services take up about 91.2%[9].

The statistics used to judge the quality of health care tend to make this emphasis worse (Navarro). Statistics such as doctor/population and hospital bed/population ratios treat the curative-oriented hospital as the center of the health system.

How do we reach the poor poor? What shouldn't we do? The basic trait of poverty is, of course, a lack of money, i.e. of purchasing power. This may be the main reason for the poor nutritional status. Often money is not available for the family to procure either adequate quantities of food or a nutritionally balanced diet. The poor poor are often not in a position to follow the nutritional advice provided in the clinic or at the welfare center. It must be discouraging, even depressing, for a mother to be told that her children will suffer from ill health unless fed this or that protein-rich foodstuff, when she knows that these foods are out of her economic reach.

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9. Data in 8 from J. Margozzini, An Analysis of Cost and Expenditures in Latin America for the Period 1965-1970, John Hopkins University, 1973 (in process).

Nutrition and health workers cannot ignore any of these factors if they really wish to improve the well-being of the poor. Education and training are important to improve skills; a political revolution is often needed to provide the poor with the political power their numbers warrant; the nutrition, health and social workers need to be drawn from the poor communities themselves; and a whole range of services must be made available to them. Above all is a need to increase their purchasing power because this alone will have a marked effect on their dietary intake. In many poor countries a better distribution of resources could go a long way to improving the nutritional status and health of the very poor.

In certain types of programs there may be some logic in not aiming to reach the lowest levels in the community. Effort concentrated on the very poor might be doomed to failure at the outset in, for example, certain nutrition education or food promotion programs. It is important then to make the objectives of the program clear and not to cloud the issue by pretending that it is mainly humanitarian. Thus a government health program that will mainly serve the middle classes should in its objectives state that this is its goal. It should not pretend that it is dealing with problems related to poverty.

In most societies the most extensive and serious nutritional problems exist among the very poor but malnutrition is not limited to them. They are the most difficult group to reach and they are not the leaders or the pace setters, and they are often more traditional. They are the most in need of help though good evaluation studies will show that health and nutrition programs are not reaching them. Honesty in the statement of objectives when planning a program which omits the poor "unreachables" might result in questioning of the appropriateness of the target group selected, but once accepted will allow a realistic evaluation. At the present time, too often the evaluation is looking for changes in the very poor when the program in fact benefited people higher up the social scale.

Some other factors pointed out in this discussion include:

(1) Emphasize research on agricultural crops which will reach the poor Between 80-100% of the protein from the increased supply of rice, maize, and beans would reach the deficient strata in the Cali study (9,18).

(2) Emphasize preventative programs aimed at the poor poor.

(3) Emphasize statistical indicators such as population ratios for children immunized, nutritional status, etc.

Why should an economist be so concerned with nutrition. Isn't increased welfare the goal of all economists and planners. This view was popular in the past. According to it, increased factories, dams, schools, roads, etc., would lead to increased production. This increased national income would tricle down to the poor or reach them through direct subsidies. We have learned this does not happen. The direct nutritional implications of all development strategies must be examined. The problems of the malnourished must be understood and we must directly reach them either with income-producing productions (e.g. jobs) or with other types of nutritional programs.

RESUMEN

La economía como medida para la evolución nutricional

Se presenta una discusión del posible impacto favorable o desfavorable de diversas circunstancias y medidas económicas, sobre cambios nutricionales en grupos de bajos ingresos, como consecuencia de programas en cursos y se citan ejemplos concretos para ilustrar los puntos analizados.

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Evaluation of Nutrient Intake: New Statistical Approaches

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SUMMARY

An approach to the application of probability statistics to the interpretation of individual dietary data or to data for populations of individuals is outlined. It is emphasized that assessment of the adequacy of nutrient intake should be based upon a judgement of the probability or risk of deficiency rather than on an "adequate or inadequate" basis as has so often happenned in the past.

By extending these concepts, guidelines for the prediction of suitable dietary protein: calorie ratios for food planing purposes have been developed. These are compared with summary data relating to existing food supplies and it is concluded that in most situations, factors limiting the aetiology of protein-calorie malnutrition than the supply of protein itself.

INTRODUCTION

It is the objective of this paper to briefly review some new thoughts on an old problem, the proper interpretation of dietary data. The concepts involved are not new but their implications have not been fully appreciated in the past.

Before proceeding, two definitions must be clarified. First, *nutritional status* is taken to mean "the health condition of an individual as influenced by his intake and utilization of nutrient, determined from the correlation of information obtained from physical, biochemical, clinical and dietary studies" (1). Clearly, nutritional status cannot be judged from dietary data alone.

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Conversely, in the assessment of nutritional status it is necessary to make a jugement on the likelihood that the observed dietary intake is or is not adequate. In the remarks that follow, dietary *deficiency* is defined as the "situation in which the observed dietary intake is below the individual's true requirement".

For the purpose of this paper it is taken that the objective of a dietary study is the determination of whether or not deficiency exists in the individual, or in the case of a population, the proportion of the population that is deficient. It will be demonstrated that in each case, this is a matter of statistical probabilities. It might be better to think of them as the *risk to the individual* and *risk to the population.*

The Meaning of Dietary Standards

The obvious point of comparison for the interpretation of nutrient intake data is the recommended intake of the nutrient as pubished in a dietary standard. The problem is how should this be applied to the interpretation of intake data (2-7).

A series of FAO/WHO Committees have repeatedly defined the recommended intake (or more recently, th "safe level of intake") as "the amount considered sufficient for the maintenance of health in nearly all people (individuals)" (2). Similar definitions are to be found in other recent dietary recommendations (8, 9)[1]. A corollary of this is the published figure must exceed the actual requirement of most individuals. Obviously then, it is not possible to judge whether or not an observed intake is deficient by simple comparison with the recommended intake.

Individuals, even though similar with respect to age, sex, activity, body size, etc., still vary in many biological respects, including nutrient requirements. This is the well known individual variability and is illustrated in Fig. 1. When a dietary standard committee is asked to set a recommended intake, the approach has been to select an intake that meets or exceeds the needs of almost all of the individuals. If requirements are believed to be normally distributed, the practice has been to set

1. This does not hold for the description of energy requirements. Here the published figures are estimates of average needs (3, 5, 7, 8, 9).

the recommended intake at the mean + 2 standard deviations which then covers all but 2.5% of the population. This is illustrated in the figure.

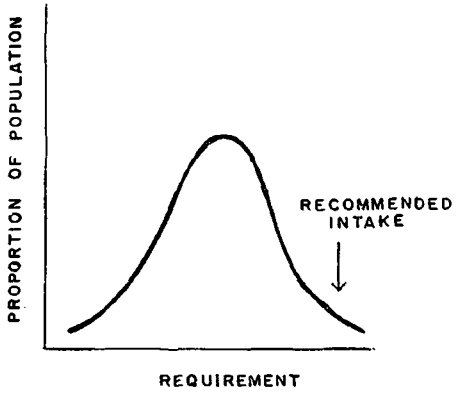

Figure 1. Individual variability in nutrient requirement. This plot assumes that individual requirements are normally distributed about the mean requirement. The Recommended Intake has been set at two standard deviations above the mean, a level which should meet or exceed the requirements of all but 2.5% of the individuals in the population.

The committee is really saying that at this level of intake the risk of deficiency is very low - a suitable approach for for counselling the individual.

Fig 1 demonstrates that the observation of an intake below the recommended does not necessarily mean the individual is deficient. His intake may still be above his own requirement.

The data in the graph can be transformed to a cumulative distribution describing the proportion of people with requirements above a certain level of intake (Fig. 2). But this is also a probability curve describing the risk of deficiency associated with particular levels of intake. As intake increases, the risk of deficiency decreases.

Nutrient intake data should be judged in the connotation of the probability or risk of deficiency. This, if you wish, is the crux of the "new approach".

Assessment of Nutrient Intakes

To exemplify the application of this approach, data on iron intakes of some Canadian women are shown in Fig. 3 (5). If the FAO/WHO recommended iron intake of 14 mg/day is applied to these data, it is observed that 74% of the women have intakes below the recommended level. That really doesn't tell us very much about the probable health status of these women. However, if one considers the risk, or probability of deficiency, associated with each interval of intake, it can be etimated that about 12-13% of these women are actually deficient (5). This estimate is consistent wtih biochemical and haematologic studies of similar populations (10). It is the estimate of 12% deficiency —the population risk— that is of interest in appraising nutritional status of these women, not the estimate of 74% having intakes below the recommended intake.

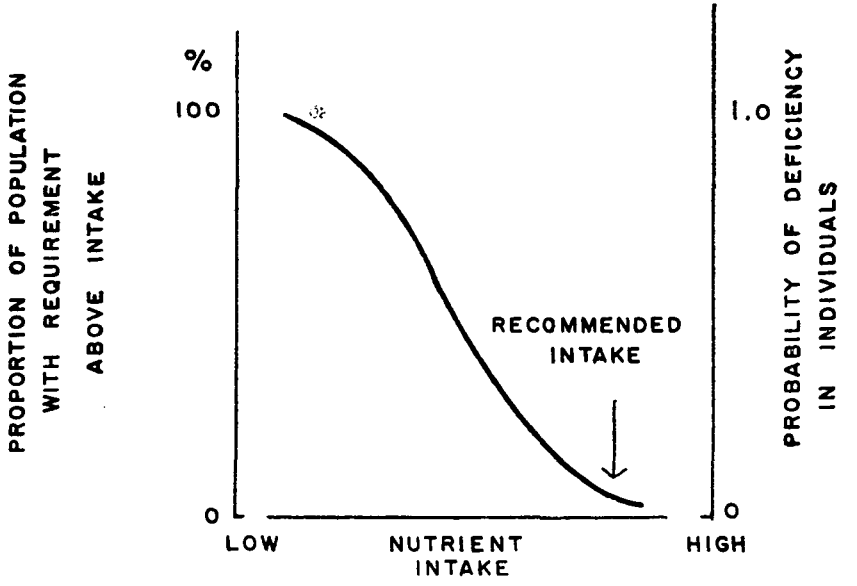

Figure 2. Probability of deficiency associated with particular intakes. The information from Fig. 1 has been replotted as a cumulative distribution showing the proportion of the population having actual requirements above a particular level. This also describes the probability of deficiency in the individual ingesting that level of intake.

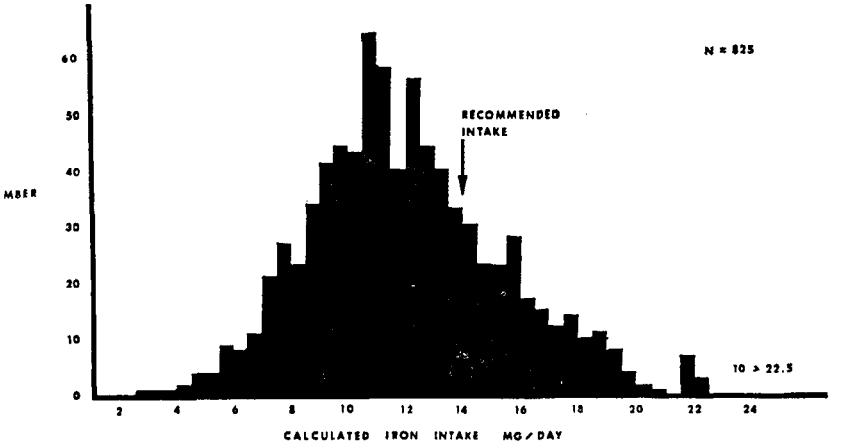

Figure 3. Distribution of iron intakes observed in groups of Canadian women (5). Individual records were collected over 37 day periods. The FAO/WHO recommended intake appropriate to these women is shown by the arrow.

A necessary prerequisite to this approach to the interpretation of dietary data is a knowledge of the nature of the distribution of individual requirements. Without this, or without some assumption about it, the risk factors associated with particular levels of intake cannot be estimated. Fortunately for our purpose, such descriptions have been published for several nutrients including: thiamine, riboflavin, niacin, iron and protein. We can begin to apply the newer approaches to these nutrients.

To employ this approach in a nutrition survey we must have a description of the average intake of the nutrient and of the variability of the intake. However there is a very particular requirement that has been emphasized by Hegsted (6). The intake data must describe the *usual* intake. The period of observation mut be long enought to eliminate the effects of day-by-day variations in intake by the individual. This effect is illutrated in Fig. 4 taken from Hegsted (6). As the period of observation increases, the apparent variability of intakes decreases. The estimation of the true variability of usual intake improves. Under Canadian conditions, three or four days of obervation is sufficient to give a constant estimate of variability of intake for many nutrients. However, in the case

of nutrients, such as vitamin A, where the individual's intake may vary considerably from day to day, a much longer period of observation is required before a reliable estimate of usual intake is obtained. This must be tested in the setting of the study.

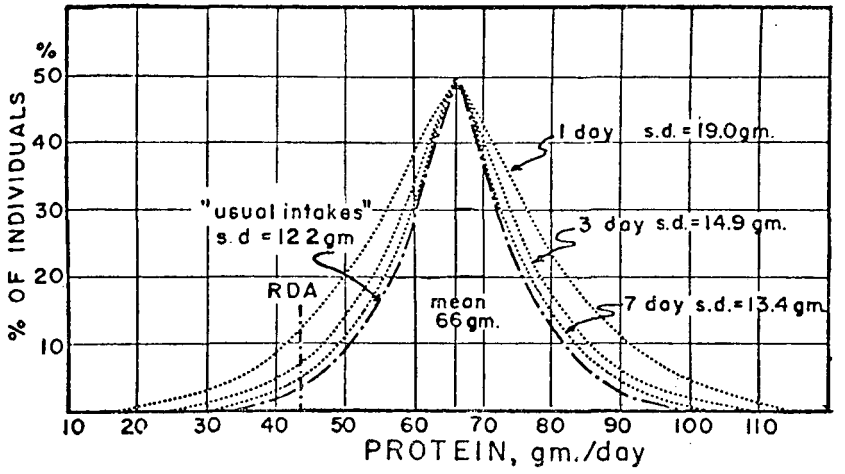

Figure 4. Effect of period of observation upon apparent variability of intake. The series of curves represent data for the same subjects observed for successively longer periods. Taken from Hegsted (6).

The statistical treatment of dietary data, involving the prediction of the risk or probability of deficiency, requires an estimate of the correlation coeficient between the individual's intake and his requirement. If the actual correlation coeficient is low, the assumption of a coefficient of 0 produces little error; if the correlation is high, a substantial error can be introduced in the statistical prediction if correlation is ignored. By taking a few precautions in the method of expressing and analysing the data to avoid spurious correlations, the conditions specified above can be met and an assumption of a very low correlation coefficient between intake and requirement can be made. For example, if thiamine intake and requirement are under consideration, it is apparent that total thiamine intake, mg/day, is likely to relate to the total amount of food consumed; it also apparent that total food consumption is one

of the determinants of thiamine requirement. Thus one would expect a correlation between thiamine intake and thiamine requirement when both are expressed as mg/day. However, if both intake and requirement are expressed as mg thiamine/ 1000 kcal, the common variable of food intake is eliminated and a spurious correlation is avoided. In the case of protein, both protein intake and protein requirement would be expected to vary with body size; if both are expressed as g protein/ kg body weight, the common variable is eliminated and again a spurious correlation is avoided. Under these conditions, the correlation between intake and requirement apprears to be very low (7).

For similar reasons, this approach should be applied to relatively homogenous subgroups of the population —young children, menstruating women, adult men, etc.— rather than to the total population.

The statistical techniques themselves involve the application of the bivariate distribution of intake and requirement to predict the incidence of deficiency among the members of the population. This has been described elsewhere (4, 7, 11).

One might ask why this approach has not been applied in field studies. The answer is probably three-fold. Until relatively recently, estimates of the variability of nutrient requirements were not available; even to-day they are available for only a few nutrients. Without such estimates the approach is impossible. Second, over the years, because of the apparent discrepancy between conclusions drawn from dietary data and from biochemical and clinical data, there has grown up an inherent distrust of dietary studies. The conclusions can now be drawn on a more appropriate basis, but the distrusts will take some time to overcome. Finally, this approach to the analysis of dietary data places special requirements on the type of data needed. Specifically, 1 day data and household data are of very limited value; these are the more common types of data now collected.

Again I suggest that we are now in a position to greatly improve the interpretation of dietary data, and hence to improve the assessment of nutritional status. However, we must be prepared to modify the design of nutrition surveys. It is essential that future studies begin to focus on the *usual* intake of the *individual,* not the average intake of a household.

The Special Case of Protein

Unfortunately, the particular approaches described above have limited applicability to protein. Protein deficiency, at the tissue level can develop as the result of an inadequacy of either protein intake or caloric intake or some combination of the two. Our knowledge of the quantitative aspects of these interactions is too meagre to permit meaningful predictions of the incidence of deficiency from dietary data (7).

However, Beaton and Swiss (7) have recently applied the principles outlined in this paper in a different way. Rather than attempting to predict the prevalence of deficiency in existing populations, attention was directed to a planning problem.

The objectives of food and nutrition planning are:

1. to provide a sufficient amount of food to meet energy needs,
2. to ensure that this food is of adequate quality to meet nutrient requirements when energy needs are satiated.

The relevant question then becomes, what concentration of dietary protein, as % calories, would meet the protein requirements of almost all individuals in the population when they ingested enough food to meet their particular energy needs? This problem was solvable on the basis of existing knowledge and the assumptions inherent in the FAO/WHO Report on Energy and Protein Requirements (3).

The data shown in Table 1 were derived from this study. The displayed figures were derived for preschool children, children and adolescents; adult figures were slightly higher[2]. These estimates appear to have wide empiric applicability; seemingly they are only marginally affected by growth rate[2] and are not affected by such parameters as body size.

Across the top of the Table are two population risk categories, a predicted prevalence of either 1% or 2.5% "deficiency". The conventional recommended intake is based upon a 2.5% risk at the level of the individual.

The two variables of concern in the population, the variability of the protein concentration among the usual intakes of individuals in the population, and the quality of the dietary protein are displayed in the Table.

2. No attempt has been made to examine this relationship for pregnant or lactating women of for young infants.

TABLE 1
CRITERIA OF ADEQUACY OF AVERAGE PROTEIN: CALORIE RATIO IN POPULATION DATA

Coefficient of Variation of Dietary Protein Concentration %	To Meet Needs of All but 1% Individuals	To Meet Needs of All but 2.5% of Individuals
	Protein with Utilization = 80% that of Egg or Milk	
15		
20	7.9[2]	7.2[2]
25	9.2	8.1
	11.4	9.4
	Protein with Utilization = 70% that of Egg or Milk	
15		
20	9.1	8.3
25	10.5	9.3
	12.1	10.7
	Protein with Utilization = 60% that of Egg or Milk	
15		
20	10.6	9.6
25	12.3	10.8
	15.3	12.6

1. Refers to the relative biological utilization of the dietary protein (3). This might be calculated as $\frac{\text{NPU (diet)}}{\text{NPU (milk or egg)}} \times 100$ or by some other biological assay in which both the diet and egg or milk were assayed under identical conditions. An approximation of the value may be obtained by use of amino acid scores as set out in the FAO/WHO report (3).
2. Protein calories as % of total calories, assuming a value of 4.0 kcal/g protein.

The presentation in the Table should prove useful in answering some very practical questions. Consider the situation of a country, region or sub-population in which protein caloric malnutrition is known to exist. In all probability, the total level of food consumption in this population, or among the members of the high risk sub-population, will be low. The planner can anticipate that more food will be needed if the problem is to be rectified. However, should he plan on more of the same type of food? Could he provide sources of energy (sugar or fat) that might be cheaper than increasing the general food supply? Or must the provide an increased concentration of protein in the diet? Table 1 should offer a reasonable answer

to the question, at least, the best answer we can now offer. If the concentration of protein in the existing diets approximates or exceeds the appropriate values in the Table, then increasing the types of foods now available would meet energy and protein needs. This appears to be the case in many if not most areas for which data are available (7). However, if the concentration of protein is below the values given in the Table, as it would be in a cassava-eating area, then protein rich foods must be added to raise the concentration. The Table can also be used to assess the danger of adding sugar and fat which would, in effect, dilute the protein concentration. It is a feasible approach only if the initial concentration is appreciably higher than the value shown in the Table.

Comment on Implications in Nutritional Studies

In areas or population groups in which the average or *per capita* protein: calorie concentration is above the critical levels suggested in Table 1, PCM may still exist. However, it is suggested that the prime cause is unlikely to be inadequate types of foods in terms of their protein concentration. Rather, the occurrence of PCM is more likely to be the result of inadequate amounts of food or the result of particular practices which keep the food away from the affected children.

It must be recognized that this approach does *not* predict the prevalence or risk of protein deficiency in the existing population. Indeed, at the present time, it is the contention of this author that appropriate statistical techniques to do that do not exist.

Rather, the present approach simply establishes a procedure for making qualitative judgements about the food supply itself, a judgement which may help to separate out those few areas of the world where protein fortification or amino acid fortification would seem to have a role to play. Typical data on observed intakes, derived from dietary surveys, are shown in Table 2; these may be compared with the figures given in Table 1.

In most areas of the world, it would appear that the basic problem remains two-fold: (a) a need to increase the *amount of food* effectively reaching the individual consumer, and (b) a need to ensure that there are appropriate and suitable foods *sufficiently high in caloric and nutrient density* for the feeding of young infants and children.

TABLE 2

APPARENT AVERAGE PROTEIN CONCENTRATIONS OBSERVED IN DIETARY SURVEYS CONDUCTED BY THE ICNND

Area and group	Average protein concentration, % kcal
Latin America	
Bolivia,[1] families	12,2
Chile, families	12.6
Colombia, families	10.2
Ecuador[1], families	13.0
Northeast Brazil[1],	
Families	14.0
Pregnant wmen	16.5
Infants under 2 years	11.9
Uruguay[1]	
Families	14.0
Children, 3-4 years	21.1
Children, 1-2 years	21.1
Caribbean	
Trinidad, families	13.2
St. Lucia, families	12.8
St. Kitts, families	17.1
Nevis, families	17.3
Anguilla, families	13.6
Alaska, males, all ages	29.3
Middle East	
Ethiopia, families	12.4
Jordan,[2] families	12.6
Lebanon,[2] families	12.6
Far East	
Burma, families	9.1
East Pakistan, families,	
Rural	10.2
Urban	11.2
Malaya	
Families	11.2
Children	10.7
Thailand, families	10.7
Vietnam, families	
Vietnamese[1]	10.4
Highlanders	10.4

1. Two or more regions studied; concentrations generally comparable.
2. Refugees and non-refugees studied; concentrations generally comparable.

The protein: calorie ratio data presented in this paper is a special application of the concepts described in the earlier part of the paper. In itself it is *not* a technique to be used in the appraisal of nutritional status. An example of the approach to be used in the assessment of nutritional status was given with reference to iron.

The major point that emerges from these examples is that dietary data, whether derived for the individual or the population —like biochemical, anthropometric and clinical data— must be interpreted in terms of the *probability* that inadequacy does or does not exist.

The few examples provided in this paper reflect some new approaches to the analysis of dietary data. These approaches are admittedly imperfect; they involve assumptions that are not yet well tested. They call for types of data that are not now being collected. Nevertheless, it seems clear that they provide interpretations that are much more meaningful and much more useful than do existing approaches. It is to be hoped that of this type will be applied in future studies.

Ultimately, if the intent is to truly judge nutritional status, it will be necessary to use statistical approaches that begin to combine the parameters of nutritional status at the level of the individuals within the population, not at the level of the population as a whole.

RESUMEN

Evaluación de la ingesta de nutrientes: Nuevos enfoques estadísticos

Se expone un enfoque relativo a la aplicación de la estadística de probabilidades para la interpretación de la información dietética individual o de la dimanante de grupos de población. Se enfatiza que la adecuación de la ingesta de nutrientes, debe ser apreciada a la luz de la probabilidad o riesgo de deficiencia en vez de sobre una base de "adecuado" o "no adecuado", como tan frecuentemente se ha hecho hasta ahora.

Extrapolando estos criterios se han desarrollado orientaciones para la adecuada predicción de la relación proteína/caloría, a ser usada en planificación alimentaria. Una comparación entre este concepto y el suministro existente de alimentos, permite concluir que en la etiología de la malnutrición proteínico-calórica, muchas veces los factores que limitan la disponibilidad y el consumo de los alimentos, pueden ser más importantes que el suministro mismo de proteínas.

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TRABAJOS DE INVESTIGACION

Efecto del gosipol libre de diferentes harinas de algodón sobre el crecimiento de ratas y niveles de lisina libre y gosipol libre en órganos, músculo y suero de animales [1]

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RESUMEN

Se estudiaron muestras industriales de harinas de semilla de algodón elaboradas por los métodos de prensa, pre-prensa solvente y de extracción con solvente, así como una muestra de harina de algodón cruda no industrializada, y otra que no contenía gosipol.

Las muestras fueron analizadas para establecer su composición química proximal y su contenido de gosipol libre y total, lisina disponible, e índice de solubilidad de nitrógeno en hidróxido de sodio a la concentración de 0.01 normal.

Con el propósito de determinar el efecto del gosipol libre sobre el comportamiento de ratas Wistar, a partir de las harinas de algodón analizadas se prepararon raciones isoproteínicas e isocalóricas suplementadas con lisina y con un contenido creciente de gosipol libre (de 6.3 mg a 199.3 mg/100 g).

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1. Esta investigación se llevó a cabo con fondos de la Research Corporation, con sede en la ciudad de Nueva York, N. Y., E. U. A.
2. Jefe de la División de Ciencias Agrícolas y de Alimentos del INCAP.
3. Parte del estudio aquí descrito corresponde al trabajo de tesis que, en carácter de becario, desarrolló en la citada División el Lic. Aburto, previo a obtener el título de Licenciado en Nutrición del Centro de Estudios Superiores en Nutrición y Ciencias de Alimentos (CESNA), Universidad de San Carlos de Guatemala, Facultad de Ciencias Químicas y Farmacia/INCAP.
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Recibido: 14-8-1974

Los animales se sacrificaron después de un período de 28 días durante el cual recibieron agua y alimento ad libitum. Se llevó un registro semanal de su crecimiento e ingesta de alimento, y se recolectaron muestras de diferentes órganos y de sangre para analizar su contenido de lisina libre, proteína y gosipol libre.

Según pudo constatarse, se registraron índices de mortalidad de 50 y 100% en los animales que recibieron las raciones que contenían los dos niveles más altos de gosipol libre, respectivamente.

Los datos obtenidos fueron analizados estadísticamente, encontrándose diferencias significativas ($P<0.01$) entre los tratamientos aplicados en lo referente a peso corporal, lisina libre en suero e hígado, y gosipol libre en hígado.

El análisis químico no detectó gosipol en intestinos y músculo, y al igual que en el hígado su contenido de proteína total y de lisina disponible fue bastante similar para los diferentes tratamientos.

A partir de estos hallazgos, se sugiere la conveniencia de emprender un estudio más a fondo con miras a eliminar de la dieta aquellos factores que interfieren con las implicaciones que éstos puedan tener en el mecanismo de toxicidad del gosipol.

INTRODUCCION

El uso de productos de harina de semilla de algodón en la alimentación animal lo complica la presencia del gosipol, compuesto que según se ha demostrado, es tóxico para los animales monogástricos (1, 2).

Mucho se ha especulado acerca de los posibles mecanismos de acción y sobre la naturaleza acumulativa de la toxicidad del gosipol, sin que hasta la fecha se haya establecido claramente el verdadero mecanismo de esa toxicidad (1).

Menual, citado por Rohem (3), Athens, Cartwright y Wintrobe (4) y Smith (5), atribuyen la toxicidad de este compuesto a la inhibición de la conversión de oxihemoglobina a hemoglobina en la sangre, y también a la hemólisis de eritrocitos. El "stress" resultante que afecta los órganos circulatorios y respiratorios comúnmente produce edema de los pulmones, anemia hemolítica, y fallo cardíaco. Otros síntomas más generales son anorexia, depresión del crecimiento y, finalmente, la muerte (1).

Los hallazgos notificados por Smith (6), Smith y Clawson (7) y Clawson, Smith y Barrick (8) indican que el gosipol está presente en los tejidos de cerdos. En uno de sus estudios, Smith (6) aisló el pigmento de tejido de cerdo, identificán-

dolo químicamente. Los autores antes citados también han demostrado que en los tejidos corporales el gosipol libre y total aumentan conforme el período de alimentación se extiende hasta un máximo de 28 días.

Ahmad, citado por Albrecht *et al.* (9), estudió la absorción y excreción de gosipol marcado con C^{14} administrado a cerdos. Dicho autor encontró muy poca radiactividad en los metabolitos urinarios, demostrando así que el gosipol no se excreta ni metaboliza fácilmente a compuestos que pueden ser eliminados por vía urinaria. En contraste, Skutches, también citado por Albrecht *et al.* (9), notificó radiactividad en el CO_2 expirado de ratas, y encontró metabolitos urinarios radiactivos, hecho indicativo de que la molécula de gosipol estaba alterada metabólicamente. Cabe agregar que también han sido examinados otros efectos del gosipol sobre los animales monogástricos (1).

El objetivo principal del estudio aquí descrito fue determinar el posible efecto que el gosipol ejerce en el metabolismo proteínico de ratas, así como la localización de dicho compuesto en algunos órganos de los animales usados en la investigación.

MATERIALES Y METODOS

Muestras

Las harinas de semilla de algodón se obtuvieron de diversas plantas centroamericanas procesadoras de este producto, y de los Estados Unidos de América. Se utilizaron para el estudio, muestras de harina procesadas por el método de prensa, de pre-prensa solvente, y por solvente. Una de las harinas utilizadas se preparó directamente en nuestros laboratorios, sometiendo la semilla a desmote, molienda y desgrase con éter de petróleo, sucesivamente.

Previo a iniciar los análisis químicos y biológicos las muestras se tamizaron a un grueso de 80 mallas, guardándose submuestras representativas en frascos de vidrio. Tanto unas como otras se almacenaron en un cuatro refrigerado a la temperatura de 4°C hasta el momento de practicar los análisis químicos y las pruebas biológicas.

Análisis químicos

El contenido de proteína, grasa y humedad se determinó según los métodos de la AOAC (10), aplicándose también para los análisis de ácidos grasos libres y de gosipol libre y total, las técnicas de la AOAC (10).

El contenido de lisina total fue determinado por procedimientos microbiológicos usando *Leuconostoc mesenteroides*, y el de lisina disponible por el método de Conkerton y Frampton (11). La solubilidad del nitrógeno se estableció siguiendo de nuevo el procedimiento de la AOAC (10).

Análisis biológico

Estudio en ratas. Para este experimento se utilizaron 60 ratas blancas, raza Wistar, de la colonia animal del INCAP, distribuyéndose de acuerdo a su peso en 10 grupos de 6 ratas cada uno (3 machos y 3 hembras).

Los animales se alojaron en jaulas individuales con fondos levadizos de tela metálica. Durante los 28 días que abarcó el período experimental las ratas recibieron agua y alimento *ad libitum*, y durante ese lapso se llevó un registro semanal de su crecimiento e ingesta de alimento. Al término de los 28 días los animales fueron sacrificados, obteniéndose de cada uno muestras de sangre, hígado, músculo e intestino. Luego, las muestras correspondientes a hígado, músculo e intestino se disecaron y prepararon para efectuar el análisis químico correspondiente, determinándose su contenido de gosipol libre y proteína total. Asimismo, tanto en el suero como en el intestino, músculo e hígado se hicieron determinaciones de lisina disponible por métodos electroforéticos (12).

Las raciones preparadas para cada uno de los 10 grupos de animales fueron elaboradas a partir de harinas de semilla de algodón previamente analizadas para determinar su composición química, usándolas individualmente o combinadas entre sí para obtener el nivel de gosipol libre deseado. Todas las raciones se analizaron para determinar su contenido de gosipol libre usando el método de la AOAC (10).

En el Cuadro No. 1 se detalla la composición de las raciones utilizadas en los ensayos biológicos, indicándose además su contenido de lisina disponible y de gosipol libre y total. Como puede observarse, el contenido de gosipol libre determina-

do por análisis químico varía en orden ascendente, con un mínimo de 6.3 mg % y un máximo de 199.3 mg % para las raciones 1 y 10, respectivamente. Las raciones fueron isoproteínicas (al nivel de 20%) e isocalóricas, manteniéndose el contenido de lisina disponible en las diferentes raciones al grado más constante posible. El nivel de lisina disponible se refiere al contenido de lisina de los ingredientes, más el porcentaje de lisina libre agregado a las diferentes raciones.

RESULTADOS

Químicos

El Cuadro No. 2 muestra los resultados en cuanto a la composición química proximal de las muestras e indica también su contenido de gosipol libre y total, y de lisina disponible y total, así como el porcentaje de nitrógeno soluble en hidróxido de sodio (NaOH). Los datos señalan que las harinas obtenidas por el método de prensa contienen más grasa que el material procesado por solvente o aplicando el procedimiento de pre-prensa-solvente. Según se observa, el contenido de humedad y de proteína fue bastante similar en las diferentes muestras.

Por otra parte, las cifras revelan que el contenido de gosipol libre varió apreciablemente entre las diversas muestras, encontrándose los valores extremos en la harina de semilla de algodón cruda (1.761 g%) y en la harina de algodón libre de glándula ("glandless"), variedad Hopi (0.017 g%). En lo referente al contenido de gosipol total, puede aseverarse que éste siguió la misma tendencia que el del gosipol libre.

El promedio de nitrógeno soluble en NaOH a la concentración de 0.01 *N*, fue de 21.0 y 24.4% para las harinas producidas por el método de prensa, encontrándose los valores más altos (72.0 y 83.8%) en las harinas de algodón cruda y libre de glándula ("glandless"), respectivamente.

La cantidad de ε-amino lisina, o lisina disponible, acusa variaciones entre las harinas preparadas por los diferentes procesos, presentando la harina de semilla de algodón cruda el valor más alto (1.713 g%).

CUADRO Nº 1

COMPOSICION DE LAS RACIONES UTILIZADAS EN LOS ENSAYOS BIOLOGICOS CON RATAS EN CRECIMIENTO

(Expresada en g/100 g)

Ingrediente	Ración No.									
	1	2	3	4	5	6	7	8	9	10
Harina de algodón:										
Glandless	36.36						31.60		31.60	
Iodesa		38.76								
El Dorado			39.14							
Corona				40.16		37.30				
Adepsa					36.36			31.60		26.65
Almendra						2.50	5.00	5.00	7.50	10.00
L-lisina HCl	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Minerales*	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Aceite de hígado de bacalao	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Aceite de soya	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Almidón de maíz	53.34	50.95	50.56	49.54	53.34	49.90	53.10	53.10	53.10	53.05
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Lisina disponible g %**	0.89	0.88	0.96	0.86	0.80	0.95	0.88	0.80	0.94	0.84
Gosipol libre mg/100 g***	6.3	16.4	21.0	21.6	31.6	64.1	93.5	115.5	137.1	199.3
Gosipol total mg/100 g**	22.2	448.8	485.7	454.6	430.1	475.0	125.0	479.5	177.9	526.7

* Mezcla mineral Hegsted (17).

** Calculada a partir de los ingredientes.

*** Analizada químicamente

Solución de vitaminas, 5 ml/100 g de ración (18).

CUADRO Nº 2

COMPOSICION QUIMICA DE HARINAS DE SEMILLA DE ALGODON PRODUCIDAS EN CENTRO AMERICA Y EN LOS ESTADOS UNIDOS DE AMERICA, POR TRES METODOS DIFERENTES DE PROCESAMIENTO

(Expresada en g/100 g)

Tipo de harina	Iodesa*	Adepsa*	Corona*	Almendra**	El Dorado*	Glandess***
Obtención	Prensa	Prensa	Pre-prensa solvente	Solvente	Solvente	Solvente
Gosipol libre	0.042	0.087	0.053	1.761	0.053	0.017
Gosipol total	1.158	1.183	1.132	2.114	1.241	0.061
N soluble en NaOH	21.0	24.4	51.4	72.0	41.0	83.8
Proteína	51.6	55.0	49.8	53.4	51.1	55.0
Lisina disponible	1.494	1.372	1.418	1.713	1.631	1.617
Lisina total	1.785	1.703	1.610	2.139	2.440	2.233
Humedad	5.41	5.83	8.45	9.13	9.82	6.58
Extracto etéreo	8.09	4.13	3.53	3.79	2.06	3.19
Acidos grasos libres	8.4	7.6	9.2	8.2	11.2	18.4

* Obtenidas de fábricas centroamericanas.

** Harina de semilla de algodón cruda, preparada en los laboratorios de la División de Ciencias Agrícolas y de Alimentos del INCAP.

*** Obtenida de los Estados Unidos de América.

CUADRO Nº 3

PESO PROMEDIO DE 10 GRUPOS DE RATAS (6 en cada grupo) CLASIFICADAS POR SEXO Y ORDENADAS DE ACUERDO AL NIVEL DE GOSIPOL LIBRE EN LA RACION INGERIDA

Nivel de gosipol libre en la ración ingerida mg/100 g	Peso promedio, g							
	7 días		14 días		21 días		28 días	
	M	H	M	H	M	H	M	H
6.3	81	75	128	109	169	138	216	164
16.4	83	74	127	111	176	142	223	166
21.0	82	70	122	101	157	127	199	143
21.6	77	76	115	115	158	146	202	169
31.6	73	70	110	102	151	128	192	146
64.1	73	71	102	100	138	125	164	147
93.5	66	65	98	99	134	126	175	155
115.5	60	56	83	77	112	102	139	128
137.1	55	46	66	49	78	52	121	88**
199.3	46	39	42	24*	42*	***	***	***

M = Ratas machos H = Hembras.
* Promedio de dos ratas.
** Peso de una rata.
*** Mortalidad = 100%.

Biológicos

El comportamiento de los animales experimentales sometidos a las distintas raciones investigadas se aprecia en el Cuadro No. 3. Como los datos lo revelan, en las ratas alimentadas con los niveles más bajos de gosipol libre (raciones No. 1, 2, 3, 4 y 5) el promedio ponderal a los 28 días fue de 216, 223, 199, 202 y 192 g para las ratas macho, y 164, 166, 143, 169 y 146 para las hembras, en ese orden. El índice de eficiencia proteínica (IEP) que en el Cuadro No. 3 no se muestra en el mismo orden, fue de 1.87, 1.91, 1.48, 1.67 y 1.56 para los machos, y de 1.49, 1.42, 1.16, 1.40 y 1.19 para las hembras. Al final del período experimental los animales que recibieron las dietas con los niveles más altos de gosipol libre (raciones No. 6, 7 y 8) acusaron un promedio ponderal de 164, 175 y 139 g para las ratas macho, y de 147, 155 y 128 para las hembras, respectivamente. En el mismo orden se obtuvieron índices de eficiencia de utilización del alimento de 1.36, 1.86 y 1.36 para los machos, y de 1.29, 1.55 y 1.30 para las hembras.

En las ratas alimentadas con las raciones que contenían los dos niveles más elevados de gosipol libre (137.1 y 199.3 mg/100 g) se registraron índices de mortalidad de 50 y 100%, respectivamente, antes de que el período experimental llegara a su término. El peso promedio para el 50% de las ratas restantes que consumieron la ración No. 9, fue de 110 g con un IEP de 1.27. La relación entre crecimiento e ingesta de alimento se aprecia gráficamente en la Figura 1.

Los datos concernientes al peso del hígado de los animales sacrificados al concluir el período experimental se detallan en el Cuadro No. 6. Según se observa, el contenido de gosipol libre en la dieta ingerida afectó directamente el crecimiento de los animales y, en forma combinada, el peso del hígado de las ratas. Asimismo, la comparación estadística entre los diferentes grupos, aplicando el análisis de variancia, muestra claramente que el nivel de gosipol libre en cada una de las raciones tuvo un efecto significativo ($P<0.01$) sobre el peso de dicho órgano.

Determinaciones en Material Biológico

En algunos órganos de los animales. En el Cuadro No. 7 se presentan los datos concernientes al contenido de gosipol libre en el hígado de las ratas. Según los análisis de variancia

practicados, las diferencias observadas entre los distintos grupos muestran un efecto significativo ($P<0.01$) de la ingesta de gosipol sobre el contenido de gosipol libre determinado en el hígado. Este efecto no fue identificado por la curva de absorción de dianilinogosipol.

Los resultados de la determinación de lisina libre efectuada también en el hígado de los animales, se sumariza en el Cuadro No. 8. Según se observa, los valores de lisina para los grupos alimentados con la dieta de menor contenido de gosipol libre, fueron más altos que los determinados en aquéllos cuyas dietas contenían altos porcentajes de gosipol libre. El contenido de lisina libre en el hígado muestra una relación inversamente proporcional al nivel de gosipol libre en la ración.

Con respecto a los niveles de lisina libre en intestino y músculo, es evidente que no hubo diferencias apreciables entre los distintos tratamientos, tal como lo muestran los datos expuestos en el Cuadro No. 9. El análisis estadístico a que se sometieron estos resultados revela diferencias altamente significativas ($P<0.01$) en lo concerniente a niveles de lisina libre en el hígado, tanto entre los grupos experimentales, como según el sexo dentro de los propios grupos.

Por otro lado, como se indica en el Cuadro No. 10, no se constataron variaciones con respecto al contenido de proteína total en hígado, intestino y músculo entre los diferentes tratamientos.

En el suero sanguíneo de las ratas. Los resultados del análisis de lisina libre en el suero sanguíneo de los animales consta en el Cuadro No. 11. Como puede apreciarse, el contenido de lisina disminuyó a medida que el nivel de gosipol libre en la ración aumentaba. Las diferencias entre los distintos tratamientos resultaron ser altamente significativas ($P<0.01$) desde el punto de vista estadístico. La relación entre lisina libre en el hígado y en el suero sanguíneo, y entre lisina libre y gosipol libre hepáticos, se exponen en forma gráfica en las Figuras 2 y 3, respectivamente.

CUADRO Nº 4

INGESTA DE ALIMENTO EN RATAS JOVENES (clasificadas por sexo) ALIMENTADAS CON RACIONES QUE CONTENIAN NIVELES DIFERENTES DE GOSIPOL LIBRE

Nivel de gosipol libre en la ración ingerida mg/100 g	Ingesta promedio, g							
	7 días		14 días		21 días		28 días	
	M	H	M	H	M	H	M	H
6.3	78	74	110	92	129	107	129	114
16.4	78	75	106	101	137	123	136	114
21.0	87	76	115	100	122	109	181	119
21.6	81	81	104	108	138	126	136	113
31.6	76	72	108	103	133	125	141	108
64.1	71	73	90	93	135	107	126	104
93.5	54	56	74	79	101	100	110	106
115.5	53	53	76	75	97	86	102	92
137.1	45	46	57	53	57	46	57*	94**
199.3	39	38	38	29*	20*	***	***	***

* Ingesta promedio de dos ratas.
** Ingesta de una rata.
*** Mortalidad = 100%.

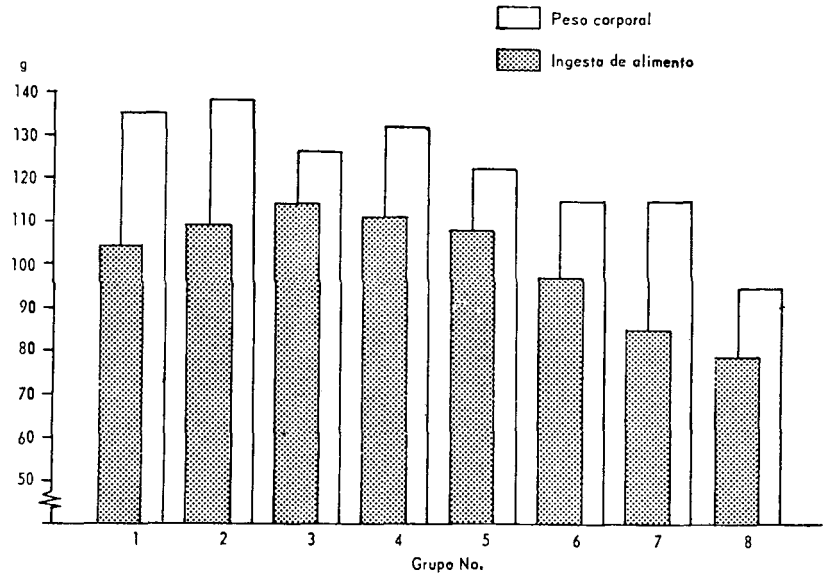

Figura 1. Crecimiento de ratas e ingestión de alimento.

CUADRO Nº 5

INGESTA TOTAL DE GOSIPOL LIBRE DURANTE UN PERIODO DE 28 DIAS EN 10 GRUPOS DE RATAS (6 en cada grupo) ORDENADAS DE ACUERDO AL NIVEL DE GOSIPOL LIBRE EN LA RACION INGERIDA

Nivel de gosipol libre en la ración ingerida mg/100 g	Ingesta total de gosipol libre promedio mg
6.3	26.27
16.4	71.32
21.0	89.78
21.6	95.80
31.6	136.95
64.1	249.96
93.5	318.18
115.5	365.67
137.1	330.00*
199.3	123.19**

* Ingesta promedio de tres ratas.
** Ingesta promedio durante un período de 14 días.

CUADRO Nº 6

PESO DE HIGADO EN RATAS ALIMENTADAS CON RACIONES QUE CONTENIAN NIVELES DIFERENTES DE GOSIPOL LIBRE Y SACRIFICADAS AL TERMINO DE 28 DIAS

Nivel de gosipol libre en la ración ingerida mg/100 g	Peso en gramos					
	Machos			Hembras		
6.3	12.4	10.2	9.8	9.7	10.4	10.3
16.4	11.3	12.0	9.6	8.7	8.6	9.6
21.0	8.7	8.4	9.2	10.2	10.1	8.1
21.6	8.1	8.2	9.4	9.1	8.0	9.1
31.6	7.1	8.6	8.7	8.8	7.8	8.2
64.1	7.6	7.5	7.4	7.8	8.5	7.1
93.5	7.6	7.4	7.2	7.8	7.9	7.6
115.5	6.6	7.0	6.9	6.7	6.4	7.1
137.1	5.3	5.9	*	4.8	*	*

* Mortalidad = 100%.

CUADRO Nº 7

CONTENIDO INDIVIDUAL DE GOSIPOL LIBRE EN EL HIGADO DE RATAS ALIMENTADAS CON RACIONES QUE CONTENIAN NIVELES DIFERENTES DE GOSIPOL LIBRE

Nivel de gosipol libre en la ración ingerida, mg/100 g	Contenido de gosipol, mg/100 g					
	Machos			Hembras		
6.3	2.8	4.8	2.8	4.4	4.8	4.5
16.4	6.2	5.6	6.2	6.9	5.5	6.7
21.0	7.3	7.2	7.2	7.4	7.4	7.8
21.6	7.1	7.2	7.1	7.0	7.4	7.2
31.6	8.1	7.8	8.0	7.8	7.9	8.4
64.1	8.9	8.9	8.6	8.8	8.4	8.5
93.5	9.1	9.6	9.8	9.6	9.0	9.4
115.5	12.0	13.2	13.2	13.4	10.2	10.1
137.1	17.2	17.1	*	15.6	*	*

* Mortalidad = 100%.

CUADRO Nº 8

CONTENIDO INDIVIDUAL DE LISINA LIBRE EN EL HIGADO DE RATAS ALIMENTADAS CON RACIONES QUE CONTENIAN NIVELES DIFERENTES DE GOSIPOL LIBRE

Nivel de gosipol libre en la ración ingerida mg/100 g	Contenido de lisina, mg/100 g					
	Machos			Hembras		
6.3	7.33	7.14	7.28	7.31	7.65	7.96
16.4	6.46	6.36	6.66	6.96	7.00	6.82
21.0	5.15	5.15	5.83	5.80	6.21	6.32
21.6	5.21	5.35	5.48	6.21	6.36	5.81
31.6	4.69	4.57	4.55	5.28	5.31	4.81
64.1	4.18	4.16	4.21	4.05	4.00	4.28
93.5	3.80	3.10	3.80	3.36	3.21	3.31
115.5	2.09	2.50	2.50	2.89	2.94	2.51
137.1	1.97	1.99	*	1.50	*	*

* Mortalidad = 50%.

CUADRO Nº 9

CONTENIDO DE LISINA LIBRE EN MUSCULO E INTESTINO DE RATAS ALIMENTADAS CON RACIONES QUE CONTENIAN NIVELES DIFERENTES DE GOSIPOL LIBRE

Nivel de gosipol libre en la ración ingerida mg/100 g	Contenido de lisina promedio, mg/100 g	
	Intestino	Músculo
6.3	12.57	2.49
16.4	12.57	2.82
21.0	13.47	3.64
21.6	13.91	2.51
31.6	12.74	2.81
64.1	12.86	3.10
93.5	13.89	2.57
115.5	13.29	3.18
137.1	16.60*	2.97*

* Promedio de tres ratas.

CUADRO Nº 10

CONTENIDO DE PROTEINA EN HIGADO, INTESTINO Y MUSCULO DE RATAS ALIMENTADAS CON RACIONES QUE CONTENIAN NIVELES DIFERENTES DE GOSIPOL LIBRE

Nivel de gosipol libre en la ración ingerida mg/100 g	Contenido proteínico promedio, g%		
	Hígado	Intestino	Músculo
6.3	36.25	44.38	47.50
16.4	38.75	43.75	48.12
21.0	37.50	45.62	48.75
21.6	38.12	45.00	46.25
31.6	36.88	44.38	48.12
64.1	38.75	45.00	47.50
93.5	37.50	45.00	46.88
115.5	37.50	43.21	48.75
137.1	40.00*	45.12*	46.88*

* Promedio de tres ratas.

CUADRO Nº 11

CONTENIDO INDIVIDUAL DE LISINA LIBRE EN EL SUERO DE RATAS ALIMENTADAS CON RACIONES QUE CONTENIAN NIVELES DIFERENTES DE GOSIPOL LIBRE

Nivel de gosipol libre en la ración ingerida mg/100 g	Contenido de lisina, mg/100 ml					
	Machos			Hembras		
6.3	6.255	5.074	4.803	5.671	5.760	6.879
16.4	3.651	3.702	5.261	4.583	4.128	5.777
21.0	6.045	3.994	4.644	4.025	6.255	*
21.6	4.539	*	3.514	3.811	3.613	*
31.6	3.702	3.596	4.184	3.788	*	3.512
64.1	2.896	2.328	2.760	*	2.125	2.068
93.5	2.720	*	1.835	1.912	*	1.998
137.1	1.860	1.652	**	1.712	**	**

* Pérdida de muestra.
** Mortalidad = 50%.

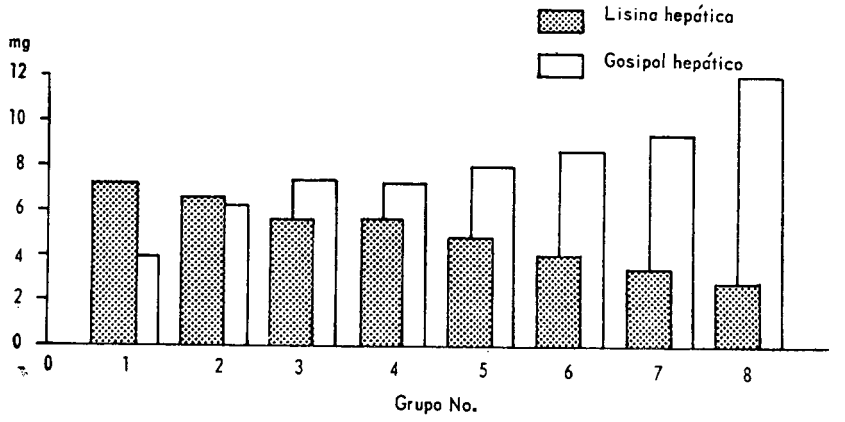

Figura 2. Lisina libre y gosipol libre en hígado.

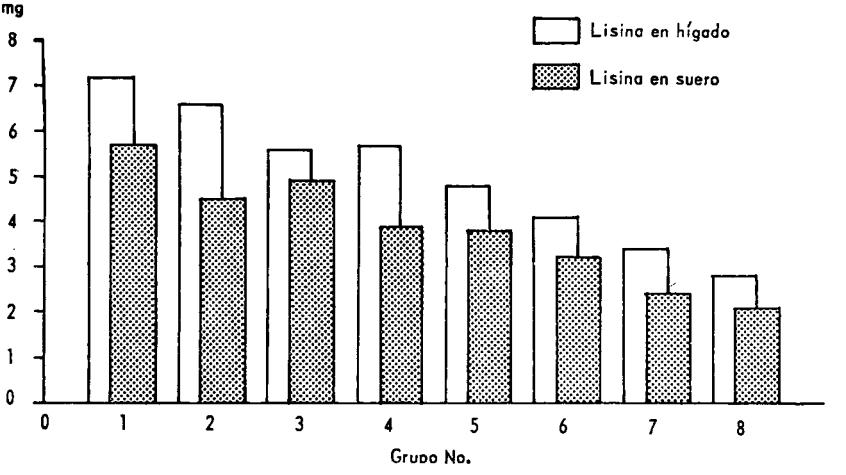

Figura 3. Lisina libre en hígado y suero de ratas.

La comparación estadística de los grupos 1 a 8 por análisis de variancia, indicó que los niveles de gosipol libre, tiempo y sexo de los animales alimentados con cada una de las raciones tuvieron un efecto significativo ($P<0.01$) sobre el crecimiento de los animales. En vista de que en el grupo 9 la mortalidad fue de 50%, no se pudo realizar el análisis estadístico a que se alude. Sin embargo, la tendencia a disminución en crecimiento puede observarse en el Cuadro No. 3.

El peso promedio del alimento ingerido por los animales durante el período experimental se presenta en el Cuadro No. 4. La evaluación estadística de los datos —por análisis de variancia— revela que los niveles de gosipol, tiempo y sexo de las ratas que recibieron cada una de las raciones incluidas en el estudio tuvo un efecto significativo ($P<0.01$) sobre su ingestión del alimento.

El Cuadro No. 5 expone la cantidad total de gosipol libre ingerido por las ratas (sin distinción de sexo) de acuerdo a las diferentes raciones y a través de todo el período experimental.

DISCUSION

Los efectos fisiológicos del gosipol sobre el organismo de animales monogástricos son conocidos tan sólo en términos de toxicidad general. Ello se debe a que los síntomas resultantes de su ingesta ofrecen poca especificidad relativa, hecho que ha dificultado la determinación del lugar y del mecanismo de acción de este pigmento.

Los resultados biológicos obtenidos en el curso de esta investigación sugieren que el gosipol libre afecta principalmente el crecimiento de animales monogástricos, a causa de que la ingesta de alimento disminuye por el efecto tóxico *per se* del gosipol. Este efecto se manifiesta también en las concentraciones hepáticas de gosipol libre y lisina libre así como en el nivel sérico de este aminoácido esencial. Los datos recolectados indican que no hubo deposición de gosipol en la pared intestinal ni en el tejido muscular; estas conclusiones se basan en que no se detectó gosipol en dichos tejidos, y en que los niveles de lisina libre en ambos no difirieron de los del grupo control (ración No. 1).

El peso corporal de los animales, así como el peso del hígado, acusaron una relación inversa con el contenido de gosipol libre en la ración, y una relación directa con el tiempo de duración de este tratamiento. Un punto de interés lo constituye el hecho de que los grupos de animales que ingirieron menos alimento tuvieron ganancias de peso que aquéllos cuya ingesta fue mayor, siendo obvio que al incrementar el consumo de alimento la cantidad total de gosipol libre ingerido también aumenta.

Eagle (13) obtuvo resultados similares en sus experimentos con ratas, los cuales parecen indicar que las pérdidas de peso corporal sufridas por éstas eran proporcionales a la cantidad de gosipol puro administrado. Otros autores relacionan dicha reducción de peso con la cantidad de ración ingerida y no con el contenido de gosipol libre de ésta (7). En el estudio aquí descrito se administró en la dieta, gosipol libre en dosis crecientes, y la cantidad total de éste ingerido al concluir el período experimental, también siguió un orden creciente, independiente de la cantidad de ración consumida por los diferentes grupos.

Los resultados obtenidos en la presente investigación sugieren, pues, un efecto tóxico directo del nivel de gosipol libre en la ración sobre el contenido de lisina en el hígado y suero de ratas, así como en las ganancias ponderales y niveles hepáticos de gosipol libre.

La información de que se dispone en la actualidad no permite establecer si las variaciones encontradas en el contenido de lisina en el hígado y suero de los animales, son el resultado de una acción específica del gosipol libre sobre el metabolismo de la lisina. Bien puede ser que tales variaciones se deban a cierto efecto de la ingesta del alimento, pero, como ya se dijo, a pesar de que hubo diferencias en la ingestión del alimento, la ingesta total de gosipol libre acusó una relación inversa con el contenido de lisina informado.

Los niveles hepáticos de gosipol libre y la ingesta total de este compuesto tienen una relación inversa con el nivel hepático de lisina libre, hallazgo que confirma el efecto tóxico asociado al gosipol libre dietético. Cabe subrayar que, según se indicó, el gosipol libre hepático no fue identificado por la curva de absorción del dianilinogosipol, y que bien puede ser

la expresión de otros pigmentos hepáticos o de compuestos resultantes del metabolismo del gosipol.

Este hallazgo concuerda con los resultados obtenidos por Buitrago, Clawson y Smith (14), Clawson, Smith y Barrick (15) y Smith (16). Este último (6, 16) aisló este pigmento en forma cristalina del hígado de cerdos, identificándolo como dianilinogosipol por su espectro de absorción con luz ultravioleta e infrarroja.

SUMMARY

Effect of free gossypol in the diet on the growth of rats and free lysine and free gossypol content of several organs, muscle and blood serum.

Several industrial samples of cottonseed meal processed by either screw press, screw press followed by solvent extraction, or by solvnt extraction alone, as well as a raw, unextracted meal were studied. The samples were analyzed for their proximate chemical composition and for their free and total gossypol and available lysine content and nitrogen solubility in 0.01 N sodium hydroxide.

Isoproteic and isocaloric diets supplemented with lysine and containing increasing amounts of free gossypol (from 6.3 to 199.3 mg/100 g) were fed to rats of the Wistar strain. All experimental animals were sacrificed after receiving diets and water ad libitum for 28 days, during which weekly records of weight gain and food intake were kept. Blood and samples of several organs and muscle were collected and analyzed for their lysine, protein and free gossypol content.

Mortality ranged from 50 to 100 percent respectively in the groups fed the diets containing the two highest levels of gossypol tested. The data showed significant ($P<0.01$) differences among the various treatments for weight gain and free lysine in blood serum and liver, and for free gossypol in liver. Chemical analysis did not detect any gossypol in the intestine and muscle, and their protein content was, as in the liver, similar among the different treatments.

The findings suggest that further studies are necessary in which those factors in the diet that affect or modify the toxicity of gossypol should be eliminated.

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Estudo bromatológico de concentrados proteicos obtidos a partir da *Sardinella Aurita* e da *Tilapia Melanopleura*

I. - Ensaio das proteinas

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RESUMO

Os autores ensaiaram as proteinas de concentrados proteicos de Sardinha e de Tilápia, obtidos com isopropanol e dirigidos para consumo humano, por métodos químicos e biológicos.

O cômputo químico em relação à metionina (fator limitante principal) foi de 74, 69, 58, 100, para os concentrados de Tilápia, Sardinha, Caseína e ovo respectivamente.

O valor biológico foi ensaiado nos níveis de 10 e 20% de proteina na ração com e sem suplementação mineral.

O C.E.P. (10% de proteina na ração) foi de 3,37 para o concentrado de Tilápia, 3,56 para o de sardinha e 3,00 para Caseína. O NPU aparente foi na mesma ordem de 64.57, 58.55, 51.29. Os grupos sem suplementação mineral tiveram aproveitamentos biológicos menores do que os da Caseina.

INTRODUÇÃO

Um dos mais sérios problemas resultantes do binômio população produção de alimentos é representada pela deficiência de proteinas alimentares de alto valor biológico.

Dentre as principais fontes dessas proteinas, destacam-se os peixes e pescados, cujo potencial, infelizmente, sofre profundas perdas como decorrência da perecibilidade desses produtos. Esse desperdício, é acompanhado de graves implicações econômicas, e de Saúde Pública.

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Uma das formas de equacionar o problema, seria a obtenção de concentrados proteicos, produzidos a partir de peixes inteiros ou de resíduos de sua industrialização, pelas características fundamentais que esses concentrados apresentam de: elevado valor biológico, baixo custo, fácil conservação e aproveitamento de alimentos potencialmente condenados à destruição.

Para melhor atender às exigências do consumo humano, existem dois tipos principais de CPP (Concentrados proteicos de pescado) que podem ser obtidos (6): tipo A, desengordurado e desodorizado contendo no máximo 0,7% de lípides e que se destinaria às pessoas que não apreciam o sabor de peixe; tipo B, com um teor de até 3% de gorduras, mais adequado àqueles que estão habituados a esse sabor e odor.

No Brasil em razão dos hábitos tradicionais da população, a preferência seria o tipo A. Este concentrado, além do mais, não apresenta o inconveniente de rancificação e consequente desenvolvimento de odores estranhos e formação de compostos nocivos.

A maior parte dos métodos utilizados na produção de concentrados do tipo A, báseia-se no emprêgo de solventes para a desidratação e desengorduramento do material. Neste sentido, trabalhos foram desenvolvidos seja empregando o 1,2 dicloroetano (9) ou o isopropanol (21), seja utilizando misturas de hexano-etanol ou apenas etanol (4) (22): o método do isopropanol não foi porém testado com peixes gordurosos. Devem ser ainda citados os métodos autolíticos (17) e a produção de "isolados proteicos" de peixes (12).

Em 1967, o Food and Drug Administration aprovou dois processos para a obtenção de concentrados proteicos (20), um deles baseados na extraãço com o 1,2-dicloroetano e, o outro com isopropanol.

Morrison e Murno (16) estudaram comparativamente concentrados obtidos com hexano, etanol isopropanol e dicloroetano, constatando que este último causava extensa destruição, da cistina e da histidina, diminuindo além disso, a capacidade de liberação por hidrólise enzimática desses dois tipos de amino-ácidos e também a da metionina. Recentemente Dubrow e Stillings (5) estudaram a influência do calor seco e do calor úmido sôbre concentrados proteicos.

Por outro lado, comparatívamente aos trabalhos efetuados sôbre concentrados de peixes marinhos, poucos estudos existem sôbre os peixes de água doce, podendo ser citados os de De (1), De e Hannam (2) e March e col. (11). Uma excelente revisão bibliográfica sôbre concentrados proteicos até 1970 foi publicada pela Library of Congress Whashington (10).

O objetivo do nosso trabalho foi o de estudar as possibilidades nutricionais de concentrados proteicos obtidos a partir de duas espécies brasileiras de peixes, uma de água doce, a *Tilápia melanopleura* e a outra de água salgada, a *Sardinella aurita*. A Tilápia aparece como "subproduto" devido à necessidade do desbaste periódico em tanques de criação necessário para obtenção de peixes maiores.

MATERIAL E MÉTODOS

Material utilizado

As tilápias foram obtidas nos tanques de criação da Estação Experimental de Piscicultura de Pirassununga e mediam de 9 a 16 cm de comprimento. No mesmo dia da captura foram lavadas com água, trituradas em moedor de carne, adicionadas de isopropanol e processadas no dia seguinte. As sardinhas foram adquiridas no comércio local, medindo de 13 a 18 cm de comprimento e sofreram tratamento idêntico.

A ração básica fornecida aos animais tinha em sua composição 76% de Amido de milho, 10% de Sacarose, 8% de Oleo de Soja, 1% de Mistura vitamínica, 4% de Mistura salina, 1% de Celulose e 0,1% de Acido benzóico como conservador.

A mistura vitamínica e a mistura salina foram descritas anteriormente (24).

A partir da ração de base preparamos as rações experimentais adicionando as fontes proteicas às expensas do amido e da mistura salina, de forma a obter o nível desejado de proteína e de minerais.

Os grupos foram designados por T, T_1, e T_2 (tilápia), S, S_1, e S_2 (Sardinha) e C_1 e C_2 (caseina). As de índices 1 e 2 referem-se aos níveis de proteina utilizados, respectivamente 10 e 20%; nos grupos T e S, os níveis de proteina também foram de 10% mas continham exclusivamente os concentrados

TABELA 1
COMPOSIÇÃO DAS RAÇÕES, RESULTADOS PERCENTUAIS (g/100 g)

RAÇÃO	UMIDADE	PROTEINA	LÍPIDES	CINZA	FIBRA	GLÍCIDES*
C_1	9,21	9,68	8,11	3,45	0,96	68,59
C_2	8,19	19,08	8,90	3,58	1,02	59,23
T	8,69	10,58	8,29	1,66	1,01	69,77
T_1	8,57	9,60	8,65	3,70	0,93	68,38
T_2	8,77	18,35	8,93	3,94	0,86	58,83
S	7,88	11,76	8,80	1,41	1,09	69,06
S_1	8,82	10,05	7,54	3,56	0,94	69,09
S_2	5,18	20,00	7,59	4,04	1,12	62,07

* Resultados obtidos por diferença.

de peixe como fontes de minerais, sem qualquer suplementação. A análise das rações encontra-se na Tabela 1.

Como proteina padrão, usamos a caseina alimentar (80% de proteina 5,3% de minerais, 11,2% de umidade e 3,5% de lípides + glícides).

MÉTODOS

Preparação dos concentrados proteicos

No preparo dos concentrados proteicos, procedemos à desidratação, desengorduramento e desodorização dos peixes triturados, por extrações sucessivas com isopropanol, segundo o método preconizado pelo "Bureau of Commercial Fisheries" (21), segundo o esquema seguinte: cerca de 20 quilos de peixe foram tratados com 30 litros de isopropanol a 91% durante 12 horas, após o que a mistura foi agitada por uma hora e centrifugada. A torta foi então extraída com 15 litros de isopropanol a 91% a 70°C por uma hora, em recepiente com camisa de vapor sob agitação e a seguir a micela foi centrifugada, mantendo-se a temperatura. Nas duas extrações seguintes, utilizamos isopropanol a 99% á mesma temperatura, sendo que na terceira extração utilizamos 12 litros e na quarta, 8 litros do solvente.

Após a operação de extração, as tortas obtidas foram secas a 60°C durante 10 horas em corrente de ar, e finalmente, 4 horas a 80°C. A seguir o material foi pulverizado em moinho de bolas e tamizado em peneira (malha de 0,177 mm). O pó obtido constitui-se no concentrado proteico utilizado para o preparo das rações experimentais, o que foi feito seguindo técnica já descrita.

Análises

As determinações de umidade, minerais, lípides e proteinas foram feitas pelos métodos convencionais, o triptofano foi determinado pela técnica de Miller (13) após hidrólise alcalina e outros aminoácidos após hidrólise ácida e em analizador Beckmam 120 C.

Avaliação do aproveitamento biológico

O animal usado foi o *Rattus norvegicus*, var. *albinus* de raça Wistar, macho, idade entre 23 e 25 dias mantidos em

gaiolas do tipo metabólico, testados anteriormente em nosso Departamento (24). Após 28 dias de experiência os animais foram sacrificados, sendo eliminados o estômago e os intestinos. A carcaça foi pesada, subdividida, desecada em estufa a 105°C, desengordurada e conservada para análises posteriores.

Um grupo "G" de animais foi sacrificado no início da experiência, sofrendo o mesmo tratamento referido e servindo como controle.

Na avaliação do aproveitamento biológico, utilizamos: Coeficiente de eficácia alimentar (C.E.A.), aumento de peso por g de ração ingerida, Coeficiente de eficácia proteica (C.E.P.), aumento de peso por g de proteina ingerida e a relação nitrogênio retido na carcaça/Nitrogênio ingerido (NPU aparente).

Na comparação das médias dos resultados obtidos em cada grupo, valemo-nos do teste "T" de Student e Fisher. A significância doi testada ao nível de 5% e de 1%. Cada grupo era composto de seis ratas.

RESULTADOS E DISCUSSÃO

A técnica utilizada com o uso de isopropanol permitiu obter concentrados proteicos de sardinha e de tilápia inodoros, insipidos e com teor mínimo de lípides residuais (Tabela 2) sendo portando do tipo A, (6) para consumo humano. Essas características se mantiveram por dois anos nos concentrados guardados em sacos plásticos.

Com relação ao aminograma, o concentrado de Tilápia mostrou relação E/T (aminoácidos essenciais/aminoácidos totais), superior ao da sardinha (Tabela 3) ambos porém semelhantes aos aminogramas obtidos para outros concentrados (7). tais), superior ao da sardinha (Tabela 3) ambos porém semelhantes aos aminogramas obtidos para outros concentrados (7). Os aminoácidos sulfurados, especialmente no concentrado de sardinha mostraram-se baixos, inferiores aos dos peixes frescos e refletindo sua labilidade termica (3) (5).

TABELA 2

COMPOSIÇÃO CENTESIMAL DOS CONCENTRADOS PROTEICOS RESULTADOS MÉDIOS, EXPRESSOS EM g/100 g.

Fração	Concentrado	
	Tilápia	Sardinha
UMIDADE RESIDUAL	6,43	3,40
PROTEINA (Nx6,25)	80,75	86,34
EXTRATO ETÉREO	0,26	0,10
CINZA	12,10	10,19
INDETERMINADOS POR DIFERENÇA	0,86	—

TABELA 3

COMPOSIÇÃO EM AMINO-ACIDOS ESSENCIAIS DOS CONCENTRADOS PROTEICOS. RESULTADOS EXPRESSOS EM g/100g DE PROTEINA

Amino - Ácido	Concentrado	
	Tilápia	Sardinha
ISOLEUCINA	4,705	3,733
LEUCINA	7,296	6,050
LISINA	8,810	7,753
FENINALANINA	3,978	3,448
TIROSINA*	3,305	3,013
1/2 CISTINA*	1,045	0,576
METIONINA	2,273	2,176
TREONINA	4,528	3,581
TRIPTOFANO	1,560	1,569
VALINA	4,390	4,708

* Aminoácido não considerado essencial.

O computo proteico, calculado a partir do aminograma, segundo proposto pela FAO (8) mostrou que os sulfurados são o fator limitante principal, com valores de 74, 69, 58, 100, respectivamente para os concentrados de Tilápia, Sardinha, Caseina e Ovo.

A existencia de um fator limitante representado pelos ulfurados não surpreende e já foi verificada por outros autores (15) (17) (18) (22) (23). A lisina por outro lado está em excesso em relação à proteina padrão considerada (ovo), fato importante para uma possível utilização na suplementação de farinhas de cereais.

Os resultados relativos aos ensaios com animais estão na Tabela 4; verifica-se que o crescimento dos animais submetidos a rações com 20% de proteina, eliminaram possíveis indicações de toxicidade, apresentando maior consumo de ração e logo maior CEA.

Comparando os grupos que receberam 10% de proteinas, vemos que o consumo de ração dos grupos T_1, e S_1 foi superior ao do grupo C, ($P<0,01$) tendo-se verificado, em correspondência que o C.E.A. dos animais alimentados com os concentrados era superior ao dos animais alimentados com a caseina. Tal fato indica a superioridade dos concentrados sôbre a caseína, não se evidenciando, porém superioridade de um sôbre outro.

Comparando os mesmos índices com as rações contendo 20% de proteina, apesar de os ratos submetidos às dietas de caseina ingerirem menos ração ($P<0,01$) do que os que a recebiam com os concentrados, não se verificou diferença significativa no pêso da carcaça sêca e desengordurada (em gramas os Pesos foram de: 44,75 $\pm$ 0,91; 46,02 $\pm$ 1,83 e 43,94 $\pm$ 0,73 respectivamente para os grupos C_2, T_2, e S_2). C.E.A. porém foi superior para a ração contendo caseina.

O C.E.P., medido ao nível de 10% de proteina na ração, nas rações balanceadas, mostrou serem as proteínas dos concentrados de qualidade superior à da caseina ($P<0,01$), resultado que concorda com o obtído para o C.E.A. Não foi, porém, evidenciada, superioridade significativa de um concentrado sôbre outro, ao nível estatístico registrado.

Como a medida do valor biológico de uma proteina pelo C.E.P. baseia-se apenas no aumento de peso, também deter-

TABELA 4

AUMENTO DO PÊSO, CONSUMO DE RAÇÃO, C.E.A., C.E.P., N RETIDO %

GRUPO	P E S O (g) INICIAL	P E S O (g) FINAL	RAÇÃO INGERIDA (g)	C.E.A.	C.E.P.	N RETIDO %
C_1	40,6 ± 1,0	131,3 ± 4,6	312,2 ± 8,9	0,291 ± 0.007	3,003 ± 0,076	51,29 ± 2,00
C_2	41,0 ± 1,0	189,6 ± 4,5	330,2 ± 2,9	0,450 ± 0,013	2,357 ± 0,068	36,69 ± 1,00
T	34,7 ± 0,7	106,3 ± 2,8	251,1 ± 5,4	0,286 ± 0,010	2,703 ± 0,096	55,06 ± 1,27
T_1	39,7 ± 1,6	165,8 ± 5,6	350,7 ± 9,1	0,359 ± 0,008	3,376 ± 0,081	64,57 ± 0,66
T_2	40,8 ± 1,2	195,8 ± 7,2	371,3 ± 11,0	0,417 ± 0,005	2,273 ± 0,02	42,86 ± 0,55
S	34,8 ± 0,7	110,9 ± 3,7	247,9 ± 6,3	0,307 ± 0,005	2,607 ± 0,048	48,99 ± 0,82
S_1	41,6 ± 1,3	172,8 ± 6,7	365,9 ± 9,9	0,358 ± 0,007	3,567 ± 0,007	58,55 ± 1,03
S_2	41,4 ± 1,3	188,2 ± 3,8	357,2 ± 4,1	0,415 ± 0,009	2,074 ± 0,045	36,55 ± 0,31

minamos a retenção de nitrogênio; para este fim, o exame de carcaça pode dar informações sôbre a utilização proteica líquida aparente, aparente pois a retenção do nitrogénio foi estabelecida pela diferença entre o nitrogênio final-inicial obtido do grupo G a não por análise da carcaça de animais mantidos sob dieta aproteica, normalmete usada para a determinação da utilização proteica líquida (14).

Os valores obtidos para o aproveitamento do nitrogenio, comparados aos do cômputo proteico, confirman as indicações fornecidas pela análise dos aminoácidos (Tabela 3).

Na Tabela 5, estão representados os valore do cômputo e do aproveitamento do nitrogênio, calculados em relação à caseina fixada como 100, ilustrando a correspodência existente. Isto confirma a superioridade dos concentrados sôbre a caseina e permite considerarmos o concentrado de tilápia superior ao da sardinha, superioridade que o C.E.P. não evidenciara.

TABELA 5
COMPARAÇÃO ENTRE CÔMPUTO QUÍMICO E NPU APARENTE

Método	Fonte Proteica		
	Caseina	Sardinha	Tilápia
CÔMPUTO PROTEICO	100	119	127
APROVEITAMENTO % DO N (10% DE PROTEINA NA RAÇÃO)	100	114	126

A Tabela mostra ainda a correspondência entre o cômputo químico e o aproveitamento do nitrogênio (NPU aparente). As rações que continham apenas os concentrados de peixes como fontes de minerais mostraram valor biológico inferior, indicando alguma deficiência mineral.

CONCLUSÕES

O uso de isopropanol para a desidratação, desengorduramento e desodorização de *Sardinella aurita* e de *Tilápia melanopleura*, peixes de alto teor de gordura, permitiu a obtenção de concentrados proteicos inodoros e insípidos, com baixo teor de lípides residuais e boa estabilidade.

O cômputo proteico, calculado en relação à proteina do ovo foi de 74 para a tilápia e de 69 para a sardinha e correspondeu ao valor biológico obtido pelo NPU aparente, sendo que a fator limitante principal é representado pela metionina.

O valor biológico da proteina, medido pelo C.E.P. e NPU aparente mostrou-se superior ao da Caseina.

SUMMARY

Bromatological study of protein concentrates from Sardinella aurita and Tilapia melanopleura. I.-Assay of the protein

The authors studied the protein from Fish Protein Concentrates (FPC) obtained by isopropanol extraction of Sardinella aurita and Tilapia melanopleura.

Data from amino acid analysis are presented and the Chemical Score in relation to methionine was 74; 69; 58; 100 for Tilápia, Sardine, casein and egg protein and aggreed with NPU, the PER was 3.73 for the tilapia concentrate, 3.56 for Sardine and 3.00 for casein; the NPU in the same order was 64.57; 58.55; 51.29. The minerals of FPC, without any suplementation did not support the normal growth of young rats.

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La Cocción de Frijoles, (*Phaseolus vulgaris*)

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RESUMEN

Frijoles de tres variedades se remojaron por 2 h y luego se cocinaron por 2 h a 85°C ó por 30 min en autoclave a 15 lb de presión. Como medio de remojo y cocción se usó agua destilada, ácido acético al 0.1% ó una solución de bicarbonato de sodio al 0.1%. La actividad de los inhibidores tripticos y quimotripticos quedó destruída por todos los tratamientos, no así la actividad del inhibidor de amilasa y de las hemaglutininas. La cocción a 85°C resultó en mejorar la digestibilidad y la capacidad de las dietas preparadas con las semillas así tratadas de inducir crecimiento en las ratas. Sin embargo, con una excepción, estos valores fueron inferiores a los observados con las semillas cocidas en autoclave. No había correlación entre la actividad de inhibición de tripsina, quimotripsina y amilasa de los frijoles tratados y su valor nutricional, pero la actividad hemaglutinante estuvo en relación inversa con la capacidad de inducir crecimiento en ratas.

Se concluyó que la actividad de los inhibidores enzimáticos no es índice útil para determinar la eficiencia de los tratamientos térmicos de los frijoles. La prueba de hemaglutinación resultó ser más apropiada. Además, se concluyó que las variedades de frijoles con baja actividad hemaglutinante son preferibles cuando, por razón de la situación geográfica a altas alturas sobre el nivel del mar o cualquier otra circunstancia, no está asegurada una cocción completa.

INTRODUCCION

Los frijoles crudos son tóxicos. Por cocción adecuada se elimina la toxicidad (1) mientras que el calentamiento en exceso puede resultar en una reducción del valor nutricional (2). Por lo tanto, es importante conocer las condiciones de cocción, que resulten en la destrucción de las propiedades antinutricionales con un mínimo de calentamiento. Otra razón para el interés en conocer las condiciones mínimas de cocción son la escasez y alto costo de combustibles, factores que frecuentemente,

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son de importancia en la economía familiar de grupos de población desposeídos. Además, hay que considerar el hecho de que numerosa población latinoamericana habita en regiones montañosas en donde, por su situación geográfica a grandes alturas sobre el nivel del mar, la temperatura de ebullición del agua está por debajo de los 100°C, condición que influye en el proceso de la cocción. Estas consideraciones nos indujeron a emprender un estudio sobre la cocción de frijoles bajo condiciones de mínimo calentamiento y sus efectos sobre factores antinutricionales y valor alimenticio de los mismos.

MATERIALES Y METODOS

Se utilizaron lotes de semillas de tres variedades de frijoles (*Phaseolus vulgaris*): caraotas negras del cultivar "Cubagua" y frijoles blancos y rojos, estas dos últimas variedades comerciales. Las semillas habían sido almacenadas en el laboratorio a temperatura y humedad ambiente aproximadamente 24°C y 80% saturación, por aproximadamente 8 meses, previo al inicio de los ensayos. Los lotes se sometieron a cinco diferentes tratamientos. Primero se remojaron durante dos horas a temperatura ambiente y con agitación ocasional. La proporción medio-semilla fue de 2:1. Los medios usados para remojar las muestras fueron: agua destilada, solución de CH_3COOH al 0.1% y solución de $NaHCO_3$ al 0.1%. Dos de las tres muestras remojadas en agua destilada fueron luego autoclaveadas durante 30 min, a 15 lbs de presión. A una de ellas se le separó la cutícula pasándola a través de una malla metálica. Las otras muestras fueron cocidas en baño de María a 85°C durante dos horas. Después de los diferentes tratamientos fueron secadas por corriente de aire a temperatura ambiente y molidas en un molino Wiley de laboratorio.

En cada ensayo fue incluída una muestra de semillas crudas como control.

Las dietas se prepararon siempre con el agregado de metionina para facilitar la detección de los efectos tóxicos en los ensayos biológicos (1).

Se usaron 6 ratas por experimento; 3 de cada sexo, de 4 semanas de edad y un peso inicial de 60-70 g. Como comparación se incluyó una dieta a base de caseína. La duración de los ensayos biológicos fue de 2 semanas.

TABLA 1
COMPOSICION DE LAS DIETAS

Frijoles c.s.p.	10% proteína
Mezcla de sales U.S.P. XIV	4%
Mezcla completa de vitaminas (1) ..	1%
Aceite de maíz	5%
Aceite de hígado de bacalao	1% .
D, L-metionina	0.3%
Almidón de yuca/c.s.p.	100%

La digestibilidad aparente se calculó por el método de balance de nitrógeno ingerido y fecal (3) determinada mediante micro-Kjeldhal y se calculó en cada caso el cambio del peso del animal por gramo de proteína consumida.

El poder hemaglutinante de los extractos se determinó usando un equipo de "Micro-Titer" (Coke Eng. Comp. Alexander, Virginia, U.S.A.) según la técnica descrita anteriormente (4). Los eritrocitos usados (buey y conejo) se prepararon de sangre tratada con citrato como anticoagulante y se sometieron a tres lavados en solución de NaCl al 0.85%. Para su activación se procedió como sigue: Una suspensión de glóbulos de buey al 4% con 10 ml de suero fisiológico se sometió a digestión por una hora a 37°C con 1 mg de tripsina cristalizada. Glóbulos de conejo al 4% en 10 ml de suero fisiológico se trataron durante 30 min con 1 mg de pronasa (Calbiochem); posteriormente ambas suspensiones fueron centrifugadas y lavadas tres veces con NaCl 0.85% y suspendidas al 4% para uso posterior.

Los inhibidores de tripsina y quimotripsina fueron determinados usando los métodos de Kakade y col. (5. 6). Los extractos se prepararon por suspensión de las semillas molidas en agua destilada en la proporción 1:20 ajustando el pH a 7.6. Se agitaron durante una hora a temperatura ambiente y se centrifugaron. Una alicuota del sobrenadante fue diluída en proporción de 1:50 en buffer de borato y fosfato respectivamente, para la determinación de los inhibidores de la quimotripsina y la tripsina. Para la determinación del inhibidor de amilasa se usó el método de Bernfeld (7) con la modificación de este laboratorio (8). Los extractos se prepararon en solución de NaCl al 1% en la proporción 1:10, con 2 horas de agi-

tación. Las enzimas usadas para determinar la actividad inhibidora de los extractos fueron: tripsina, 40 mcg/ml, quimotripsina, 40 mcg/ml, y pancreatina (Merck) 40 U/ml al 1% en buffer fosfato pH 6.9.

La digestibilidad proteica se determinó "in vitro" por digestión de las muestras finamente molidas, con pepsina por 3 horas, seguido por una digestión con pancreatina (Merck) por 24 horas y determinación del nitrógeno en el sobrenadante de la precipitación con ácido tricloroacético.

En la Tabla 2 se indican los cálculos estadísticos correspondientes a los índices de digestibilidad *"in vivo"* y a los cambios de peso por animal por día y por proteína consumida. En las columnas marcadas "A" se comparan los resultados de los 18 experimentos con relación al experimento Nº 5. Las columnas marcadas "B" se refieren a los mismos resultados, pero comparándolos dentro de cada variedad de caraotas, tomando como patrón las muestras autoclaveadas Nº 5, 11 y 18. Para los ensayos con frijoles blancos, ambas columnas contienen, por lo tanto, valores idénticos. Se utilizó un nivel de significación de 95% con 5 grados de libertad.

RESULTADOS

En los experimentos efectuados con las tres muestras crudas se observaron índices de digestibilidad "in vitro" e "in vivo" muy bajos. Las tres variedades de frijoles tenían niveles elevados de inhibidores de amilasa, de tripsina y de quimotripsina, como también de actividad hemaglutinante.

Después de la cocción en el autoclave la digestibilidad aumentó a valores que, aunque más elevados, eran inferiores al de la caseína. La prueba de hemaglutinación resultó débilmente positiva con los eritrocitos de buey en los extractos correspondientes a las muestras de frijoles blancos y negros autoclaveados, mientras que los extractos de frijoles rojos cocidos en el autoclave aglutinaban de manera franca, lo que significa que estas últimas son portadores del tipo más tóxico de hemaglutininas (4). La actividad de inhibición frente a la tripsina y la quimotripsina había desaparecido después de la cocción en autoclave, mientras que la inhibición de la amilasa disminuyó a valores tan bajos, que su medición se hizo difícil (Tabla 1 y 2).

TABLA 2

PRUEBAS BIOLOGICAS Y BIOQUIMICAS CON TRES VARIEDADES DE FRIJOLES SOMETIDOS A DISTINTOS PROCESOS DE COCCION

	VARIEDAD	TRATAMIENTOS	Digestibilidad "in vivo"		"in vitro"	I		II		III	IV	V
						A	B	A	B			
1	BLANCAS	CRUDAS	15.6 ± 5.3	*	31.6	0.7 ± 0.3	*	-1.7 ± 0.8	*	185.6	16.3	15.8
2		Cocidas en H_2O dest., 85°C	48.7 ± 4.3	*	62.9	2.4 ± 0.4	*	2.3 ± 0.4	*	23.7	0.0	0.0
3		Cocidas en sol. CH_3COOH 0.1%,85°C	46.6 ± 3.3	*	49.3	2.0 ± 0.5	*	2.0 ± 0.3	*	30.1	0.0	0.0
4		Cocidas en sol. $NaHCO_3$ 0.1%,85°C	52.9 ± 3.8	*	56.3	3.4 ± 0.9	NS	3.0 ± 0.5	NS	34.3	0.0	0.0
5		Cocidas en autoclave 15 lbs. 30'	71.2 ± 2.6		87.8	4.1 ± 0.6		3.1 ± 0.3		2.8	0.0	0.0
6		Cocid. autoclave 15 lbs. 30' decort.	73.9 ± 3.9	NS	92.0	3.6 ± 0.9	NS	2.7 ± 0.4	*	0.0	0.0	0.0
	NEGRAS "Cubagua"											
7		CRUDAS	18.2 ± 3.0	* *	31.0	-1.2 ± 0.2	* *	-2.0 ± 0.4	* *	170.1	15.3	17.2
8		Cocidas en H_2O dest., 85°C	45.0 ± 3.8	* *	48.2	2.5 ± 1.0	* *	2.0 ± 0.4	* *	17.2	0.0	0.0
9		Cocidas en sol. CH_3COOH 0.1%, 85°C	46.3 ± 4.4	* *	38.7	2.4 ± 0.4	* *	2.2 ± 0.1	* *	24.7	0.0	0.0
10		Cocidas en sol. $NaHCO_3$ 0.1%, 85°C	47.4 ± 4.4	* *	43.4	2.8 ± 0.6	* *	2.6 ± 0.3	* *	11.8	0.0	0.0
11		Cocidas en autoclave 15 lbs. 30'	68.9 ± 2.1	NS	73.1	4.5 ± 0.6	NS	3.3 ± 0.3	NS	1.6	0.0	0.0
12		Cocid. autoclave 15 lbs. 30' decort.	70.1 ± 3.4	NS NS	74.6	4.3 ± 0.6	NS NS	2.9 ± 0.4	NS *	2.4	0.0	0.0
	ROJAS											
13		CRUDAS	14.3 ± 2.6	* *	30.0	-1.4 ± 0.2	* *	-2.33± 0.4	* *	144.0	32.0	7.4
14		Cocidas en H_2O dest., 85°C	50.4 ± 2.0	* *	64.8	0.9 ± 0.3	* *	1.7 ± 0.6	* *	17.0	0.0	0.0
15		Cocidas en sol. CH_3COOH 0.1%, 85°C	48.0 ± 4.2	* *	37.9	-0.4 ± 0.2	* *	-0.8 ± 0.6	* *	11.4	0.0	0.0
16		Cocidas en sol. $NaHCO_3$ 0.1%, 85°C	45.9 ± 4.3	* *	59.4	0.8 ± 0.6	* *	-1.5 ± 0.4	* *	8.3	0.0	0.0
17		Cocidas en autoclave 15 lbs. 30'	67.1 ± 2.1	*	82.1	3.1 ± 0.8	*	2.8 ± 0.2	*	0.3	0.0	0.0
18		Cocid. autoclave 15 lbs. 30' decort.	69.5 ± 2.4	NS *	83.0	2.7 ± 0.5	* NS	2.6 ± 0.3	* NS	7.1	0.0	0.0
19		CASEINA	91.0 ± 2.1		100.0	4.3 ± 0.8		2.9 ± 0.4				

I - Cambio de peso (g)/animal/día.
II - Cambio de peso (g)/proteína consumida.
III - Unidades de inhibición de amilasa/gramo de muestra.
IV - Unidades de inhibidor tríptico/gramo de muestra.
V - Unidades de inhibidor quimotríptico/gramo de muestra.
* Estadísticamente significativo (diferentes) NS: no significativo. Columna A: Comparación con el valor correspondiente a la muestra Nº 5, frijoles blancos cocidos en autoclave, Columna B: Comparación con los valores de las mismas variedades cocidas en autoclave (Nº 5, 11, 17 resp.)

El crecimiento de las ratas que fueron alimentadas con dietas preparadas con frijoles cocidos en autoclave y suplementadas con metionina, fue comparable al de los animales que consumieron la dieta control de caseína, con excepción de las ratas alimentadas con frijoles rojos que crecieron menos.

También el índice de eficiencia proteica fue menor en este caso, comparado con el valor observado en el ensayo Nº 5 con frijoles blancos cocidos en autoclave y con el valor control de caseína.

De los datos reportados en la Tabla 1 se deduce que la cocción por 2 horas a 85°C de los frijoles previamente remojados por 2 horas resultó insuficiente para lograr que la digestibilidad medida "in vitro" e "in vivo" llegara a valores similares de las semillas cocidas en autoclave. Igualmente se puede observar la persistencia de una considerable actividad hemaglutiante en las muestras negras y rojas, (Tabla 2) aunque no era posible detectar actividad inhibidora sobre la tripsina y la quimotripsina. El aumento de peso de los animales alimentados con las dietas correspondientes y los valores de la eficiencia proteica fueron inferiores en los experimentos efectuados con los frijoles cocidos a 85°C en comparación con los calentados en autoclave.

La cocción en presencia de bicarbonato de sodio a 85°C dió resultados superiores en comparación con la cocción en presencia de ácido acético y con agua destilada, tanto en relación a la digestibilidad como a su efecto sobre crecimiento y eficiencia proteica. La digestibilidad de los frijoles cocidos en autoclave y decorticados fue ligeramente más elevada comparada con las semillas enteras. Sin embargo, los valores de la eficiencia proteica de las últimas muestras fueron superiores a las de los primeros en los experimentos con los 3 tipos de frijoles.

DISCUSION

Los resultados señalados, además de confirmar observaciones previas, permiten algunas conclusiones de importancia sobre el problema de la cocción de frijoles. La baja digestibilidad de las semillas crudas y la pérdida de peso de los animales alimentados con dietas preparadas con éstas, ha sido observada previamente en este tipo de experimentos (1). Estos

efectos no se pueden atribuir, por lo menos no exclusivamente, a la presencia de inhibidores tripticos o quimotripticos, como lo demuestran los resultados de los experimentos efectuados con frijoles cocidos a 85°C, porque en este caso no se pudieron detectar estos inhibidores y sin embargo, tanto el cociente de digestibilidad como el crecimiento de los animales correspondientes eran muy bajos comparados con los valores obtenidos con las semillas cocidas en el autoclave.

Al comparar las tres variedades de frijoles entre sí, se detectan grandes diferencias. La variedad blanca era la menos tóxica. Sólo en ella la cocción a 85°C en presencia de bicarbonato de sodio era suficiente para que el crecimiento y la eficiencia proteica en las ratas que las consumieron, resultaran iguales a los valores correspondientes obtenidos con las semillas cocidas en autoclave, aunque la digestibilidad siempre fue superior en el último caso. Los frijoles rojos eran los más tóxicos y los que menos mejoraron sus cualidades nutricionales por la cocción incompleta. Las diferencias eran tan importantes y consistentes que parece recomendable considerar este aspecto en las semillas que se usen en las labores de extensión agrícola y en la selección genética de frijoles. Los valores para la actividad inhibidora de amilasa eran más elevadas en las diversas muestras de frijoles blancos, lo que demuestra que este factor no es el principal responsable de la reducida capacidad de inducir el crecimiento de ratas observado en los frijoles parcialmente cocidos.

Las dietas preparadas con frijoles crudos producían pérdidas de peso y diarrea. Los ensayos no se prolongaron por tiempo suficiente para causar la muerte, que suele ocurrir en las ratas así tratadas al cabo de 2-3 semanas (1). En los animales alimentados con frijoles cocidos a 85°C no se observó diarrea ni ningún otro signo de toxcidad franca, con excepción del crecimiento lento.

Llama la atención de que en todos los casos, los animales crecieron mejor, cuando se alimentaron con dietas preparadas con frijoles autoclaveados enteros, comparado con aquellos que recibieron dietas con frijoles colados, aunque estos últimos mostraron índices de digestibilidad superiores a los primeros. La explicación más probable debe buscarse, por lo tanto, en la comparación de la cáscara eliminada por el cola-

do. Al recordar que todas las dietas fueron preparadas con el agregado de 0,3% de D, L-metionina, es poco probable que la diferencia referida se debe a un contenido más elevado de aminoácidos azufrados en la cáscara.

El cambio de peso de los animales experimentales (Tabla 1) y la actividad hemaglutinante (Tabla 2) guardan una relación inversa. Las semillas que presentaron mayor título de hemaglutinación con eritrocitos de buey tripsinados, produjeron mayor pérdida de peso en las ratas, que consumieron las dietas correspondientes. El pequeño número de muestras estudiadas en el presente trabajo no permite llegar a conclusiones definiitvas acerca de la importancia relativa de las hemaglutininas en frijoles. Sin embargo, en un estudio con mayor número de muestras se había demostrado la resistencia a la inactivación por el calor de las fitohemaglutininas más tóxicas de los frijoles (4) de manera que los resultados del presente trabajo confirman y amplían las conclusiones previas.

En algunos programas de alimentación infantil se han usado mezclas de frijoles y cereales molidos que requieren poca cocción para su preparación . En estas circunstancias, la completa inactivación de las hemaglutininas no está siempre garantizada y en consecuencia se han observado casos de diarrea en los niños que consumieron dichas mezclas y que hicieron necesaria la suspensión del referido programa (10). Sería por lo tanto, interesante seleccionar para todos los casos de posible cocción insuficiente, variedades de frijoles, como los blancos de los presentes ensayos, que requieren un tratamiento térmico mínimo. Según los datos de la Tabla 2, la prueba de la aglutinación es más sensible si es hecha con eritrocitos de buey, activados con tripsina que con eritrocitos de conejo. Además, hemos demostrado en trabajos previos (4, 15), que existen cultivares de frijoles tóxicos, que no aglutinan estos últimos. Por lo tanto, se recomienda el uso de glóbulos rojos de buey para esta prueba. Por la sencillez del método, la detección de inhibidores trípticos y quimotrípticos en leguminosas se ha usado frecuentemente como un índice de la efectividad de los tratamientos térmicos. Nuestros resultados comprueban, sin lugar a dudas, que este procedimiento es inadecuado, porque la desaparición de cantidades detectables de estos inhibidores no coincide con el tratamiento térmico que

resulta en el mayor cociente de digestibilidad y mayor inducción de crecimiento. Esto no significa que los inhibidores tríp-ticos y quimotrípticos no tengan ningún papel antinutricional (12).

En ningún caso, excepto uno solo en los experimentos presentados, la cocción a 85°C por 2 horas, previo un período de remojo de igual duración, fueron suficientes para lograr crecimiento y eficiencia proteica satisfactorias con dietas preparadas a base de frijoles así tratados (Tabla 2), aunque en estos casos no se observaron los síntomas de franca toxicidad que siempre presentan los animales que consumieron los frijoles en forma cruda. Los frijoles cocidos en estas condiciones eran más duros que los cocidos en el autoclave y presentaron un ligero sabor extraño.

Los ensayos biológicos utilizados en la presente investigación son poco prácticos para ser aplicados en trabajos de selección de variedades, donde se prefieren pruebas sencillas de métodos *"in vitro"*. Según los resultados presentados, las pruebas de digestibilidad y la hemaglutinación puede servir para este fin. La última es mucho más sencilla que la primera y permite la ejecución de un gran número de análisis simultáneamente, condición muy importante para los trabajos genéticos. Se debe incluir siempre un testigo preparado por un extracto de frijol de actividad positiva conocida, porque no todas las muestras de sangre de buey son apropiadas para la prueba (11). Este método no es aplicable a otras leguminosas.

El tiempo de cocción en el autoclave de 30 min utilizado en los presentes ensayos, es probablemente excesivo. Molina y col. (13) observaron que 10 min de tratamiento en autoclave era el tiempo óptimo para lograr un valor nutritivo elevado al trabajar con frijoles negros recién cosechados y aplicando mayor tiempo de remoio que nosotros, mientras que un calentamiento de 20 min resultó mejor con semillas almacenadas por tres meses. En experimentos efectuados recientemnte en este laboratorio, trabajando con frijoles que se habían almacenado por 8 meses y aplicando un tiempo de remojo de 2 horas se observaron valores óptimos de digestibilidad, cuando la cocción en autoclave se prolongó por 20 min (14). Por lo tanto, es de esperar que hubiéramos obtenido valores para la digestibilidad y la eficiencia proteica mayores a los obser-

vados en el presente estudio, al aplicar la cocción en autoclave por un tiempo más corto. Sin embargo, este hecho no afecta a ninguna de las conclusiones del presente estudio.

TABLA 3
ACTIVIDAD HEMAGLUTINANTE DE EXTRACTOS DE FRIJOLES CRUDOS O SOMETIDOS A DIVERSOS TRATAMIENTOS TERMICOS

Variedad	Tratamiento	Título de Hemaglutinación I	II
BLANCA	CRUDAS	+7	+6
	Cocidas en H_2O dest. 85° C.	0	+2
	Cocidas en sol. CH_3COOH 0,1% 85° C	+1	+1
	Cocidas en sol. $NaHCO_3$ 0,1% 85° C	+2	0
	Cocidas en autoclave 15 lbs. 30'	+1	+1
	Cocidas en autocave 15 lbs. 30' decort.	0	0
NEGRA "Cubagua"	CRUDAS	+8	+8
	Cocidas en H_2O dest. 85° C.	0	+5
	Cocidas en sol. CH_3COOH 0,1% 85° C.	0	+5
	Cocidas en sol. $NaHCO_3$ 0,1% 85° C.	0	+4
	Cocidas en autoclave 15 lbs. 30'	0	+2
	Cocidas en autoclave 15 lbs. 30 decort.	0	+1
ROJA	CRUDAS	+8	+11
	Cocidas en H_2O dest. 85° C.	+2	+6
	Cocidas en sol. CH_3COOH 0,1% 85° C.	+2	+6
	Cocidas en sol. $NaHCO_3$ 0,1% 85° C.	+1	+7
	Cocidas en autoclave 15 lbs. 30'	+2	+4
	Cocidas en autoclave 15 lbs. 30' decort.	0	+2

I. Con eritrocitos de conejo tratados con pronasa.
II. Con eritrocitos de buey tratados con tripsina.

SUMMARY

Cooking of Beans (Phaseolus vulgaris)

Cooking at 85° for 2 h of beans previously soaked for 2 h in water, 0.1% acetic acid, or 0.1% sodium bicarbonate solution destroyed trypsin and chymotripsin inhibitor activities, but did not result in optimal digestibility, or optimal growth in rats fed the corresponding diets, nor was the amylase inhibitor activity and the hemagglutinating activity completely destroyed by these treatments. A sample of white beans was more improved by the low-temperature cooking than the sample of red kidney beans. Heating in sodium bicarbonate solution was more effective than heating

in acetic acid solution. No correlation between nutritional value and enzyme inhibitor activity could be detected, but hemagglutining activity was inversely related to growth promoting value.

It is concluded that enzyme inhibitor activity measurement is inadequate to study the efficiency of heat treatment in beans and that the hemagglutination test using trypsin-activated cow red blood cells is better suited. Beans with low hemagglutinating activity should be selected for use where, due to high altitude and corresponding low water boiling temperature or to other reasons complete heat destruction of thermolabil antinutritional factors is not assured.

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Parte de los experimentos se efectuaron en el Instituto Nacional de Nutrición.

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ARGENTINA

Alimentación Parenteral Normo e Hipercalórica.—B. Javkin, M. O. de Leonardis y E. Bermúdez. (Hospital de "San Roque" de Gonnet. Servicio de Cirugía. Buenos Aires, Argentina). Pren. Méd. 61: 533-536, 1974.

La labor de distintos investigadores en un método práctico que permite desarrollar y mantener el organismo en correcto anabolismo con alimentación parenteral durante periodos prolongados, abre perspectivas de incalculable valor en el permanente afán médico de luchar por la conservación y prolongación de la vida útil. 12 referencias.

BRASIL

Mucosa Jejunal em Pacientes com Desnutrição Proteica, Anemia e Parasitoses.—H. Vannucchi; M. F. de Franco & A. O. Campana. (Departamento de Medicina da Faculdade de Ciencias Médicas e Biológicas de Botucatu, SP, Brasil). Arq. Gastroent., S. Paulo, 11: 61-64, 1974.

Os AA. estudaram 19 pacientes adultos com diagnóstico de anemia carencial e ou desnutrição proteica. A desnutrição foi classificada em dois graus; constituiram-se dois grupos de doentes segundo o grau da anemia. Avaliou-se presença de parasitoses intestinal, tendose estudado as alteraçoes histológicas do jajuno em fragmentos de mucosa obtidos por biopsia peronal.

Os dados sugeriraia associação entre a gravidade da desnutrição proteica e a intensidades de alterações da mucosa jejunal. A presença de ancilostomiase nao pareceu acompanhar-se de enteropatia mais grave; observou-se o inverso com a estrongiloidiase. Aparentemente nao houve relação entre a intensidade da anemia e o grau de alteração da mucosa. 24 referencias.

Avaliação do Factor Nutricional na Gênese das Pancreatites crônicas em Nosso Meio.—C. de B. Mott; N. L. Oliveira & A. Bettarello. (Departamento de Clínica Médica do Hospital das Clínicas da Faculdade de Medicina da Universidade de Sao Paulo, Brasil). Arq. Gastroent., S. Paulo, 11: 65-68, 1974.

A participação do fator nutricional na génese das pancreatites crónicas foi investigada através de enquete alimentar em 40 portadores desta afeccao. Foi calculado o consumo médio de proteínas, gorduras e hidratos de carbono em gramas diárias. Foi também calculada a ingestao alcoolica pregressa em gramas de etanol puro diário. As medias dos resultados obtidos para o consumo alimentar e ingestao alcoolica destes pacientes foram comparadas as respectivas medias dos valores obtidos em 40 individuos controles e analisadas estatísticamente. Os AA. verificaram que os portadores de pancreatite crónica nao apresentam, deficiencia nutricional, consumindo, significativamente mais proteínas ($p<0.01$) e alcool ($p<0.001$) que os controles. Sao discutidas as implicações destas associações na patogenia da pancreatite crônica. 24 referencias.

Algumas Caracteristicas de Uvas Cultivadas no Municipio de Caldas (M.G.) com vistas a Aproveitamento Industrial do Producto.—V. de Carvalho. (Departamento de Alimentos e Nutrição Experimental Faculdade de Ciencias Farmacéuticas da Universidade de Sao Paulo, Brasil). Rev. Farm. Bioquím. Univ. S. Paulo, 11: 67-104, 1973.

Foram determinadas certas caracteristicas das uvas mais cultivadas no Estado de Minas Gerais (Brasil), Municipio de Caldas, com o fim de identificar quais as variedades de cultivo mais aconselhável nessa regiao vitivinícola, com vista a melhor aplicação industrial am termos de elaboração de "surcos". 54 referencias.

Influencia das condições de aquecimento sobre a temperatura e porcentagem de agua remanescente do café, durante o processo de liofilização.—A. J. Colombo, R. Baruffaldi e E. Aquarone. (Departamento de Tecnologia Bioquímico-Farmacéutica da Fa-

culdade de Ciencias Farmacéuticas da Universidade de Sao Paulo, Brasil). Rev. Farm. Bioquím. Univ. S. Paulo, 11: 51-60, 1973.

Propos-se estudar a influencia das condições de aquecimento sobre a temperatura e porcentagem de água remanescente do café em liofilização.

Escolheram-se tres temperaturas finais de produto, que foram 30, 60 e 90°C.

Com base em testes preliminares, escolheram-se tres concentrações de extratos para serem liofilizados: 8, 12 e 16° Brix. 9 referencias.

Influencia da temperatura dos alimentos sobre a motilidade esofágica no megaesófago grupo II. Estudo eletromanométrico. — F. Montalváo, J. Marcondes de Rezende. (Departamento de Clínica Médica da Faculdade de Medicina da Universidade Federal de Goias). Rev. Goiana Méd., 20: 67-76, 1974.

Os autores comunicam os resultados referentes aos estudos eletromanométricos realizados em portadores de megaesofágo do tipo hipercinético, visando demonstrar a influencia da temperatura dos alimentos ingeridos sobre a motilidade esofágia.

Em 7 de 10 pacientes nos cuais o esófago fora estimulado pela instilação de água, respectivamente 15° e a 38°C, observou-se maior resposta motora do corpo do esófago com água a 15°C.

Esta maior atividade motora incoordenada podería ser responsável pela acentuação da disfagia referida por muitos pacientes quando ingerem alimentos frios. 22 referencias.

COLOMBIA

Características de Harinas Compuestas.—F. Moncada (Instituto de Investigaciones Tecnológicas, Colombia). Rev. I.I.T., 90: 9-31, 1974.

Se presentan los resultados de pruebas reológicas y de panificación efectuadas con 2 harinas de trigo, duros importados y 2 harinas blandos con harinas de arroz IR8 y harina de soya. 5 referencias.

Elementos Traza Esenciales en dos Variedades de Trigo y Cambios de Distribución de los mismos causados por el procesamiento.— G. Mahecha. (Departamento de Química de la Universidad Nacional de Colombia, Colombia). Rev. Colombiana Quím., 3: 1-16, 1974.

Se analizaron por espectrofotometría de absorción atómica los elementos minerales esenciales en dos trigos duros comerciales, en las fracciones de la molienda del trigo (harina, salvado y mogolla) y en el pan preparado de la harina.

Las fracciones de salvado y mogolla contienen mayor cantidad de todos los minerales que el trigo original, en cambio el contenido en el pan y la harina es más bajo.

Estos resultados sugieren la posibilidad de enriquecer el pan con las fracciones de salvado y mogolla, las cuales son obtenidas del trigo en altas proporciones.

La variedad IS68 contiene mayor cantidad de todos los elementos traza esenciales estudiados, siendo también superior su contenido que el reportado por otros investigadores que trabajaron en muestras americanas y francesas de diferentes áreas geográficas. 22 referencias.

Susceptibilidad del Almidón presente en Harinas Crudas y Modificadas al ataque Enzimático con α-Amilasa.—A. Lozano, I. Cabrera y T. Salazar (Universidad Nacional de Colombia, Colombia). Rev. Colombiana Quím. 3: 43-63, 1974.

Se determinaron las ratas de hidrólisis de almidones, para algunas harinas de alimentos (yuca, maíz y plátano) y la influencia de ciertos procedimientos industriales y caseros, de dichos productos, sobre las constantes anteriormente mencionadas. 10 referencias.

COSTA RICA

Hemoglobinas Anormales en una Población Estudiantil Universitaria.—Germán F. Sáenz, G. Arroyo, M. A. Alvarado, G. Montero, J. Jiménez y E. Valenciano. (Cátedra de Hematología, Depar-

tamento de Análisis Clínicos, Facultad de Microbiología, Universidad de Costa Rica, Costa Rica). Rev. Biol. Trop., 21: 417-424, 1974.

En 1.500 estudiantes de ingreso de la Universidad de Costa Rica, nacionales y extranjeros se encontró un 1,26% de hemoglobinas anormales (1,06% para el fenotipo A-S, y 0,20% para el A-C). En nacionales de raza blanca hay un 0,24% de hemoglobinas anormales fundamentalmente causadas por el egene S, o 0,50% si se toma en cuenta 3 casos aparentemente debidos a talasemia beta menor con hemoglobina F alta (variante delta-beta). Entre las hemoglobinas anormales se encontró dos fenotipos heterocigotos asintomáticos de persistencia hereditaria de hemoglobina fetal, (uno blanco y otro pardo). Se comenta brevemente las diferencias encontradas entre los grupos estudiantiles según nacionalidad y tipos raciales. 14 referencias.

GUATEMALA

Soya entera como medida para aumentar las Calorías y Proteínas de una Dieta a base de maíz.— R. Bressani, B. Murillo y L. G. Elías. (Instituto de Nutrición de Centro América y Panamá, INCAP). J. Food Sci., 39: 577-580, 1974.

Se describe la preparación de tortillas de maíz y soya entera y sus características físico químicas y nutricionales. La mayor eficiencia proteica se observó con una mezcla de 28% de soya y 72% de maíz. El rendimiento en sólidos totales disminuyó con el aumento de la proporción de soya, probablemente debido a la solubilidad de las proteínas de esta leguminosa en la lejía de cal, usada para la preparación de las tortillas. 15 referencias.

JAMAICA

Prevalence and Persistence of Lactose Malabsorption among young Jamaican Children.-M. Stoopler, W. Frayer and M. H. Alderman. (University Hospital of Kingston, Jamaica). Am. J. Clin. Nutr. 27: 728-732, 1974.

Lactose malabsorption ocurred in 56% of a random sample of 94 rural Jamaican children under 4 years of age. There was a significant decrease in the percentage of children able to absorb lactose after the first year of life. When the original malabsorbers were retested 7 to 8 months later, 21% had normal lactose tolerance curves. Similar lactose tolerance tests on 20 urban Jamaican children revealed that 14, or 70%, were lactose malabsorbers. Neither sex, anthroprometric status, milk consumption, symptoms of lactose intolerance, nor duration of breast feeding correlated with the occurrence of lactose malabsorption or its persistence. 26 references.

MEXICO

Use of Coatings of Candelilla wax for the Preservation of Limes. O. Paredes-López, E. Camargo-Rubio and Y. Gallardo-Navarro. (Department of Biotechnology, Laboratorios Nacionales de Fomento Industrial, México D.F.). J. Sci. Fd. Agric. 25: 1207-1210, 1974.

Aqueous emulsions containing 10,15 and 20% of candelilla wax (CW) were used for coating limes. The best preservation was got with 15% CW. Fruits treated with emulsions of different pH-6.50, 9.20 and 9.80- showed no reduction in the weight loss. The coatings of deresinised CW presented a non- beneficial effect.

Limes coated with commercial wax lost slightly less weight than those with 15% CW. In all cases, citrus fruits were stored at room temperature. Changes of pH, acidity and ascorbic acid during storage were very similar with commercial or CW emulsions. 6 references.

Evaluación Antropométrica de la Grasa Corporal Total.—P. Arroyo, M. Coronado y S. E. Quiroz (División de Nutrición del Instituto Nacional de la Nutrición. México). Rev. Invest. Clín. (México), 26: 103-110, 1974.

Dos métodos antropométricos independientes, desarrollados para predecir la grasa corporal total, fueron evaluados en un grupo de sujetos. Uno de ellos se basa en la correlación entre el

espesor del pliegue cutáneo en cuatro sitios diferentes y la densidad corporal; el otro se basa en la correlación entre peso y talla y el agua corporal total. Se estudiaron 158 trabajadores, 131 varones y 27 mujeres cuya actividad física laboral variaba desde muy intensa hasta muy ligera. Además, se estudiaron 68 atletas varones, de nivel olímpico, que practicaban 12 especialidades deportivas. En los tres grupos se encontraron elevados coeficientes de correlación entre los valores de grasa corporal obtenidos por ambos métodos. Las diferencias entre los promedios no fueron estadísticamente significativas en los trabajadores de ambos sexos. En los atletas, la diferencia promedio de 2.3 kg. a favor del método de peso y talla, fue estadísticamente significativa. Se sugiere que esta discrepancia es debida a cambios en la composición corporal inducidos por el entrenamiento físico intenso alternado con períodos de reposo y que probablemente las suposiciones implicadas en una o en ambas ecuaciones de regresión no son aplicables a este grupo. Se concluye que ambos métodos, especialmente el de peso y talla por sus ventajas prácticas, son de utilidad para obtener una estimación de la grasa corporal a nivel clínico en casos individuales o cuando se desea estudiar los factores responsables de su variabilidad en poblaciones. 10 referencias.

Contenido de Hierro de Alimentos Industrializados.—A. Loría, R. C. Montalbán R. y J. Piedras (Departamento de Hematología. Instituto Nacional de Nutrición, México). Rev. Invest. Clín. (México), 26: 141-151, 1974.

Se presentan los resultados de dosificaciones cuadruplicadas, hechas con un método de digestión húmeda, del contenido de hierro en 23 alimentos industrializados (16 de ellos de consumo básicamente infantil) y de 4 leches pasteurizadas que están disponibles en el mercado de la ciudad de México.

Entre los hallazgos obtenidos por los autores, sugieren que desde el punto de vista de satisfacción de requerimientos de hierro, el bebé que recibe alimentos industrializados no enriquecidos está en desventaja con respecto a aquél que recibe alimentos naturales.

Lactase Deficiency in a Rural Area of Mexico.—R. Lisker, G. López-Habib, M. Daltabuit, I. Rostenberg and P. Arroyo. (Instituto Nacional de la Nutrición, Department of Genetic, Mexico, D. F.). Am. J. Clin. Nutr. 27: 756-759, 1974.

The prevalence of the adult type of intestinal lactase deficiency in three groups of residents of a rural area of México was studied. Of the 401 individuals tested, 73.8% were intolerant, and the relative frecuency of intolerance in in each group was similar. However, traditional milk consumption habits of the lactose-intolerant individuals were quite different. In one group few people had consumed any milk since they were breast fed; in another, over 50% ingested more than one glass of milk daily, and the other was intermediate.

The syntomatology following the lactose load was more frequent in those individuals classified as intolerant, but some tolerant ones also had symptoms, whereas some of the intolerant ones did not. Whether low intestinal lactose levels interfere with milk consumption is not definitively answered by this study, but it seems clear that many individuals classified as intolerant are able to ingest milk without difficulty, at least in the relatively small quantities that are typical of this and many other regions of Mexico. 11 references.

VENEZUELA

Leukocytic Enzyme Differences Between the Clinical Forms of Malnutrition.— J. L. Avila; G. Velázquez-Avila; C. Correa; C. Castillo y J. Convit. (Inst. Nac. Dermatología, Caracas, Venezuela). Clin. Chim. Acta, 49: 5-10, 1973.

The enzymic activities of peripheral polymorphonuclear leukocytes obtained by dextran sedimentation from 15 children with both clinical forms of malnutrition were compared to the activity found in normal children. No differences were detected in peroxidase and lysozyme activities between control subjects and children affected with marasmus or kwashiorkor. However, nitro-blue tetrazolium reduction was in-

creased in marasmus and kwashiorkor, while acid cathepsin decreased only in marasmus and acid phenyiphosphatase and alkaline phosphatase increased only in kwashiorkor. These striking differences found between marasmus and kwashiorkor concerning some of the leukocytic enzyme activities measured suggest that when studying protein-calory malnutrition it is important to consider saparately the results obtained from both clinical forms of malnutrition.

Situación Nutricional y Alimentaria de la Población , Venezuela. Hernán Méndez Castellano. (Departamento de Pediatría, Universidad Central de Venezuela, Caracas). Arch. Venez. Pueric. Ped. 37: 23-40, 1974.

Se trata de un estudio sobre la situación nutricional en Venezuela y Latinoamérica, en donde se discute en forma amplia tomando en consideración sus repercusiones socioeconómicas, culturales y psicológicas en cuanto a la relación *individuo y comunidad.*

Se hace una amplia exposición con respecto a producción, distribución y consumo de los alimentos tomando en cuenta de que Venezuela es un país en vías de desarrollo y todos los factores que pueden influir en una forma u otra, para que dichos renglones sean deficitarios, se discute, la necesidad de una única y verdadedra reforma agraria.

Además se estudia la morbilidad del país en base a los días de hospitalización los cuales son mayores para las avitaminosis y las anemias que para otras enfermedades como la tosferina sarampión, anoxias, etc.

Manejo Hospitalario del Niño Desnutrido.— Gustavo Rojas Hernández, (Sección de Pediatría del Centro Clínico Nutricional (I.N.N.) Caracas). Arch. Venez. Pueric. Ped. 37: 51-68, 1974.

Se comentan algunas consideraciones generales sobre las circunstancias por las que atraviesa el niño cuando acude a consultar, debido a la gran masa que acude por diferentes afecciones. En tales circunstancias la atención médica se orienta en el problema agudo; en lo referente a la alimentación se hace en forma precipitada con dificultad, no dedicándole el tiempo necesario. Alta precoz por falta de capacidad Hospitalaria y el niño regresa a su hogar donde a menudo se presentan las recaídas.

A nivel del Hospital se debe impartir educación y entrenamiento en materia alimentaria a todo el personal que por una u otra razón tiene ingerencia sobre el renglón dietético.

El objetivo fundamental en el manejo hospitalario del niño desnutrido es conseguir una dieta que sea efectiva, rápida y económica. Desafortunadamente estos 3 requisitos no se llenan a cabalidad por falta de apreciación del problema.

En el trabajo en el Centro Clínico Nutricional, los pacientes son evaluados y se cuantifica su déficit nutricional. Para los desnutridos de 1º y 2º grado se dispone de atención a nivel de consulta externa y son evaluados periódicamente; los desnutridos severos de 3er. grado se hospitalizan. Se imparte además educación teorico-práctica a las madres de los niños desnutridos.

Finalmente se hace un breve análisis de la patología más frecuente en los desnutridos. Entre las más frecuentes están: hipotermia, hipoglicemias, diarreas, insuficiencia cardiaca, infecciones. 6 referencias.

Estimación Bioquímica de la Desnutrición.—Eduardo Tovar (Centro Clínico Nutricional, Instituto Nacional de Nutrición, Caracas). Arch. Venez. Pueric. Ped. 37: 69-85, 1974.

Durante los últimos años ha sido notable la tendencia a desarrollor índices prácticos y confiables que permitan estimar el estado nutricional de grupos de población. La búsqueda de índices de malnutrición proteica se ve confrontada con muchas dificultades prácticas. En muchas partes del mundo las dietas deficientes en proteínas son también deficientes en calorías en diverso grado y también en otros nutrientes, debido a lo cual, en la práctica diaria, los segmentos pobres de la población en muchos países sufren los efectos de múltiples deficiencias nutricionales. Bajo estas condiciones, la identificación de parámetros clínicos o bioquímicos que pudieran ser considerados indicati-

vos específicos del estado nutricional proteico, es obviamente muy difícil. Debido a la bien conocida interrelación entre los nutrientes, la presencia de otras deficiencias nutricionales viene a condicionar, modificar o agravar el cuadro de deficiencia proteica.

El interés de los médicos y de los investigadores en el campo de la nutrición en la búsqueda de pruebas bioquímicas para la estimación del estado nutricional, deriva de la relativa insensibilidad e inespecificidad de las mediciones clínicas y antropométricas.

A raíz de la experiencia obtenida en el Centro Clínico Nutricional (I.N.N.) en el estudio de algunos parámetros bioquímicos, es indudable que si bien los desnutridos venezolanos presentan algunos rasgos bioquímicos similares a los desnutridos de otros países, en otras ocasiones difieren, todo lo cual apunta hacia la gran importancia que tiene el continuar y profundizar este tipo de estudios de manera de caracterizar en forma más completa el cuadro bioquímico del desnutrido venezolano. 39 referencias.

Tratamiento Dietético del Niño Desnutrido.—M. Fossi de Mejías (Servicio Dietético del Centro Clínico Nutricional, Instituto Nacional de Nutrición, Caracas). Arch. Venez. Pueric. Ped. 37: 87-101, 1974.

Este trabajo surgió de la necesidad de establecer el tratamiento dietético acorde a las necesidades reales de los pacientes, ya que anteriormente estos eran tratados con dietas elaboradas sin tomar en cuenta las características propias del desnutrido venezolano. El hecho de que la edad promedio del desnutrido haya bajado, fue también un factor importante que hizo pensar en la necesidad de hacer ajustes y modificaciones de las antiguas dietas empleadas en este centro. La efectividad del nuevo tratamiento puede medirse en los siguientes hechos: rápida mejoría del apetito, el niño muestra interés por los alimentos, aumento progresivo en la curva de peso, perímetro cefálico y más tardíamente en la talla, desaparición del edema, normalización de las cifras de proteínas, curación clínica de las lesiones de la piel, signos de buen estado general, sonrisas y otros signos de sociabilidad.

Esto se hace principalmente con el fin de ver la posibilidad de bajar el costo de tratamiento, lo que redundaría en un mayor rendimiento de los recursos disponibles. 7 referencias.

Isolation and Partial Characterization of Bean Phytohemagglutinins.—Werner G. Jaffé, A. Levy and D. I. González. (Escuela de Biología, Universidad Central, Caracas, Venezuela). Phytochemistry, 13: 2685-2693, 1974.

Extracts of seeds of 21 bean cultivars were screened for hemagglutinating specifity and for mitogenic activity. Four types could be distinguished in different beans, two of which are mitogens. Two lecitin fractions (α and β were isolated from each of the four bean types. Their MW were estimated by exclusion chromatography and component sugars by paper chromatography.

They were characterised in physicochemical and biochemical aspects. The mitogenic bean types were the most toxic. 32 references.

Formation of Retinol [α,β-^{32}P] Pyrophosphate with [γ-^{32}P] ATP Catalysed by whole Homogenates of Rat Thyroid.—Karl Gaede and P. Rodríguez. (Instituto Venezolano de Investigaciones Científicas (IVIC) Caracas, Venezuela). Biochem. Biophys. Res. Communic. 54: 76-81, 1973.

This phosphate derivative of vitamin A is soluble in chloroform-methanol (3:2, v/v) and can be separated by chromatography on a column prepared with butanol-washed cellulose powder. The isolated compound was retinol pyrophosphate since it contained retinol and phosphate in a molar ratio of 1:2 shown by double isotopic labelling techniques and was found to be free of galactose.

The results show that in the metabolism of the tyroid gland vitamin A probably plays a certain role. 8 references.

OTRAS PUBLICACIONES RECIBIDAS

Microbial Protein from Agricultural Wastes.—Tate and Lyle Ltd., Goup Research and Development, P. O. Box 68, Reading, Berks, Inglaterra, 7 pág. $ 5.00.

The Microbial Production of Alginates.—Tate and Lyle Ltd., Group Research and Development, P. O. Box 68, Reading, Berks, Inglaterra, 10 pág. $ 5.00.

Microbial Protein Production for Developing Countries.—Tate and Lyle Ltd., Group Research and Development, Philip Lyle Memorial Research Laboratory, P. O. Box, 68, Reading R G 62 BX, Berks, Inglaterra. 13 pág. $ 5.00.

"Food Composition Tables. For use in the english-speaking Caribbean", 1974.—Caribbean Food and Nutrition Institute, P. O. Box 140, Kingston 7, Jamaica W. I. $ 5.00.

Report on Graduate Degrees in Nutrition by Committee 8 of Commission V "Nutrition Education and Training" of the International Union of Nutritional Sciences. Voeding.—Vol. 35, Nº 7, 1974.

1972 Evaluation of some pesticide residues in food, Geneva, World Health Organization, 1973 **(WHO Pesticide Residues Series Nº 2)**, 587 pages. Price: Sw. fr. 25.

The second volume in the **WHO Pesticide Residues Series** contains, in the form of monographs, the evaluations prepared by the 1972 Joint Meeting of the FAO Working Party of Experts on Pesticide Residues and the WHO Expert Committee on Pesticide Residues.

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