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DIETARY DEFICIT OF VITAMIN A IN POPULATIONS - APPROACHES TO CORRECT IT

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In recent years there has been increased recognition that the food and nutrition problem of populations is of multicausal origin, with predominantly social and economic roots and that the solutions to it should be designed accordingly. That is, the attack to this problem should be wholelistic. Nevertheless, the required socio-political changes that would permit these wholelistic approach are rarely foreseeable in the near future, and scientists and technologists are laboring hard to design so called independent nutrition interventions for potential short term application. These are specific measures to attack each one of the specific dietary deficits and/or nutrition problems of a population, based on a critical analysis leading to a listing of these dietary-nutrition problems in order to priority. Table 1 illustrates the results of this type of analysis for the Central American region. For the purpose of this paper we will single out hypovitaminosis A among the five most serious problems to be solved. The magnitude and extension of this particular problem for the Central American countries at large was amply documented in 1965-67 mainly through dietary and biochemical studies as shown in Tables 2 and 3[1].

More recent studies had confirmed that the hypovitaminosis A problem continued and had even become more serious in the last ten years[2]. The basic dietary characteristics of the rural populations of the area which are directly related to this problem are: a) the nill or insignificant consumption of animal foods containing retinol; b) the consequent dependence on sources of carotenes (leafy green and yellow vegetables).

In theory, the latter could be conceived as a relatively easy solution. However, for reasons of complex nature, some not well

TABLE 1

ANALYSIS OF THE NUTRITIONAL PROBLEMS
AND IMMEDIATE PLAN OF ATTACK
IN CENTRAL AMERICA AND PANAMA

What are the nutrient deficits of the population?	SOURCE	ACTION
Calories & Proteins	Basic foods, e.g.: corn-beans, rice-beans, wheat, sugar, fats and oils, etc.	The production availability and effective demand of basic foods as defined by the National Food and Nutrition Policy is a Government responsibility as part of the National Development Plan (by direct means: government-producer or by indirect means: subsidies, other incentives).
Other Nutrients Iodine, vitamin A, iron, etc.	Addition of the needed nutrients to appropriate food vehicles.	Implementation of simple inexpensive technology for food enrichment or fortification applicable to underdeveloped countries (in some cases already available: iodine, vitamin A).

TABLE 2

NUTRITIONAL SURVEY IN CENTRAL AMERICA AND PANAMA
(1965-1967)

COUNTRY	NUMBER OF FAMILIES SURVEYED	LEVEL OF ADEQUACY OF VITAMIN A IN DIET (percent of adequacy)				
		<25	25-49	50-74	75-99	100 or more
		Percent of families at each level				
Guatemala	200	45	22	10	6	17
El Salvador	278	69	19	7	3	2
Honduras	323	57	26	9	2	6
Nicaragua	331	45	23	13	8	11
Costa Rica	414	44	26	11	7	12
Panama	352	42	32	13	5	8

TABLE 3

NUTRITIONAL SURVEY IN CENTRAL AMERICA AND PANAMA
(1965-1967)

Prevalence of Hypovitaminosis A in Children Younger than 15 Years
(Determined According to Serum Levels)

COUNTRY	0-4 YEARS		5-9 YEARS		10-14 YEARS		0-14 YEARS	
	Percent prevalence	Number of cases	Percent prevalence	Number of cases	Percent prevalence	Number of cases	Percent prevalence	Number of cases
Guatemala	26.2	219,100	16.2	108,300	11.1	62,700	18.8	390.100
El Salvador	43.5	241,200	43.5	190,700	22.4	82,300	37.8	514,200
Honduras	39.5	137,000	29.0	81,200	21.9	51,609	31.3	269,800
Nicaragua	19.8	56,900	18.5	50,500	6.4	14,400	15.5	121,800
Costa Rica	32.5	96,600	25.6	60,300	11.7	22,400	24.6	179,300
Panama	18.4	38,300	12.1	20,600	9.7	13,600	14.0	72,500
TOTAL	31.2	789,100	24.7	511,600	14.3	247,000	24.4	1.547,700

understood, the consumption of these sources of provitamin A is very low. Furthermore, the evidence from the literature indicates that under the best circumstance the biological utilization of carotenes is quite inferior to that of retinol and may be more drastically affected by interfering factors such as intestinal alterations, parasitism, etc.[3].

In the light of that background we initiated in 1969 research aimed at the development of a process through which we could add retinol to a "universal" food vehicle as a means to carry this needed nutrient to essentially all the population[4]. This research led to the selection of white sugar as the vehicle and a water dispersable retinyl palmitate as the enriching material. Tests of chemical stability, taste and acceptability, and biological availability proved satisfactory. A segregation problem of the vitamin A preparation from the sugar was solved by the development of a premix where the two ingredients become attached. This premix can be added manually at the level of the centrifuge of the sugar factory, requiring no additional personnel or equipment. However, simple, inexpensive feeders have been developed and locally manufactured in Guatemala and Panama to replace the manual addition. With this process at hand INCAP proposed the implementation of National Programs of Sugar Fortification with Vitamin A to all its member countries, and by this date, four countries, Costa Rica, Guatemala, Panama and Honduras, have approved national laws making the fortification compulsory, and are actually carrying on this intervention.

Although vitamin A fortification of sugar had demonstrated effectiveness in the laboratory and in pilot studies with small population groups, its effectiveness and cost had to be assessed at the national level. An evaluation program was, therefore, designed and implemented in Guatemala with the following objectives: 1) to determine the biological effectiveness; 2) to assess the feasibility and efficiency of the delivery system; and 3) to estimate the cost of the intervention. Baseline information was secured about the vitamin status of the population in which the fortification was to be applied, prior to the iniciation of the program. In addition, the vitamin A status was periodically evaluated at six month-intervals during a two-year period. The major variables studied were: 1) intake of food sources of vitamin A; 2) intake of sugar; 3) blood serum retinol levels of children below six years of age; 4) retinol concentration of human milk; 5) clinical examination with particular emphasis on signs associated with vitamin A deficiency; 6) hospital and clinic registration of cases of eye lesions attributed to hypovitaminosis A, and 7) retinol content of liver samples from coroner's autopsies from a General Hospital.

The data so far obtained suggest a significant effect of this major public health nutritional intervention as judged principally by marked improvements in the biochemical parameters of the popula-

TABLE 4

EVALUATION OF FORTIFICATION OF SUGAR WITH VITAMIN A BLOOD SERUM RETINOL CONCENTRATIONS* IN PRE-SCHOOL CHILDREN

Guatemala, 1975-1977

SURVEY PERIOD		Nº CASES	PERCENT OF SERUM LEVEL BY CATEGORY			
			<10	10-19.9	20-29.9	30>*
Basal	Oct-Nov 75	549	3.3	18.2	34.4	44.1
1	Apr-May 76	586	1.0	13.1	35.5	50.4
2	Oct-Nov 76	645	0.3	4.8	25.6	69.3
3	Apr-May 77	674	0.9	10.2	28.0	60.9
4	Oct-Nov 77	721	0.3	8.9	36.1	54.6

* µg/100 ml

TABLE 5

EVALUATION OF FORTIFICATION OF SUGAR WITH VITAMIN A CHANGES IN RETINOL CONCENTRATION OF HUMAN MILK* ASSOCIATED WITH FORTIFICATION OF SUGAR

Guatemala, 1975-1977

SURVEY PERIOD		No. OF CASES	PERCENT OF CASES	
			<30*	30>*
Basal	Oct-Nov 75	283	61.2	38.8
1	Apr-May 76	312	54.1	45.9
2	Oct-Nov 76	237	41.3	58.7
3	Apr-May 77	289	29.4	70.6
4	Oct-Nov 77	254	39.4	60.6

* µg/100 ml

tion. This is illustrated by the summarized information presented in Table 4 for children's blood serum and Table 5 for human milk. Analysis of the dietary data shows complete stability of the population regarding intakes of vitamin A from natural sources indicating that the changes observed are due to the fortification.

The studies referred to above were conducted in population samples of each of the major ecological regions of Guatemala. The study is based on the premise that the application of a public health intervention without adequate built-in evaluation is wasteful, since the potential of the intervention for application to similar situations elsewhere would be undetermined. Most population groups in the underdeveloped world are suffering from vitamin A deficiency, and it would be expected that if the experience in Central America with sugar fortification is positive, that is, if the program is proved to be effective, many countries would be interested in considering its implementation.

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