

Nutrition Policy Implementation Issues and Experience

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The Program of Fortification of Sugar with Vitamin A in Guatemala

Some Factors Bearing on Its Implementation and Maintenance

GUILLERMO ARROYAVE

THE IDEA

In November 1968, a technical group was convened by the Pan American Health Organization (PAHO) to analyze the problem of hypovitaminosis-A in the Americas (1). Certain basic concepts derived from the analysis determined my path of research for the following eight years. The most important of these were:

Results of many nutrition surveys show that a low dietary intake of vitamin A is widespread in sectors of the population in many parts of this hemisphere. Clinical and biochemical studies also indicate that hypovitaminosis-A exists in certain segments of the population. Cases of partial and total blindness resulting from severe vitamin A deficiency in association with protein-calorie malnutrition have been reported, often associated with high case-fatality rates. It may, therefore, be concluded that hypovitaminosis-A represents a public health problem in this hemisphere. . . .

The milder forms of hypovitaminosis-A present even greater problems in assigning priorities in the context of public health. Obviously, consider-

ably larger numbers of the population are affected, and yet our present lack of knowledge of the effects of the lesser degrees of this deficiency makes it difficult to assign priorities realistically. From experiments in animals, however, it can be assumed that prolonged low intake of vitamin A and its precursors may have serious effects on growth and development and on resistance to infectious diseases.

Despite the apparent interest in this subject in scientific literature and the considerable epidemiological data available for this hemisphere, relatively little action has been taken to combat or control this disorder either in its severe or milder forms.

THE PROBLEM IN CENTRAL AMERICA, 1965-1967

During the years 1965-1967, a nutritional evaluation of the region revealed the dietary and blood serum data shown in Tables 1 and 2 (2). In addition, children with corneal lesions and blindness could be found, particularly in pediatric wards of public hospitals (3).

At the Institute of Nutrition of Central America and Panama (INCAP), I began research in 1969 to find an appropriate short-term intervention measure to eliminate or reduce this hypovitaminosis-A (4). In November 1975, sugar began being fortified with retinyl palmitate in Guatemala and Costa Rica. What follows is an account of certain important stages in the development of the program at the national level, from the birth of the idea to the day when the first measure of vitamin A premix was officially added to sugar at the factory level, a practice that continues today.

TABLE 1. Nutritional Survey in Central America and Panama (1965-1967)

Country	Number of families surveyed	Level of adequacy of vitamin A in the diet (percent of adequacy)				
		< 25	25-49	50-74	75-99	≥ 100
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

*All values expressed as percent of families at each level.

TABLE 2. 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

*Values based on population estimates for July 1965.

PUBLIC PRESENTATION AND REACTIONS TO THE PROGRAM

RATIONALE OF THE CONCEPT

The concept that a fortification program may be justified on the basis of the existence of widespread dietary inadequacy and low biochemical indicators (nutritional basis) and the concept that it is not necessary and perhaps may even be unethical to wait until a high prevalence of incapacitating clinical lesions have occurred were difficult to explain. The interesting aspect of this was that the questioning and the opposition stemmed not only from non-nutritionally oriented groups, such as sugar manufacturers and ophthalmologists, but also, surprisingly, from some professionals working in the nutrition area, including some in specialized United Nations agencies.

Our argument, which eventually won favor, was that vitamin A deficiency affects important aspects of the organism before the “end of the straw” corneal lesions ensue. These are related to growth impairment, integrity of the epithelial tissues, resistance to infection, and night blindness, among others. All of these quantities are extremely difficult to assess as specific consequences of vitamin A deficiency in the complex situation of socially deprived populations, where the nature of most biological alterations is multicausal. The corneal damage is similar to kwashiorkor in the case of protein–energy malnutrition: it is the tip of the iceberg supported by an immense mass of a subclinically affected population.

TABLE 3. Distribution of Families by Percent Adequacy of Vitamin A Intake in Guatemala, 1975-1977

Survey period	No. of families surveyed	Level of adequacy of vitamin in diet (percent of adequacy)				
		< 25	25-49	50-74	75-99	> 100
Part A. Sugar without vitamin A						
Oct.-Nov. 1975 (basal)	358	60*	23	6	4	7
Apr.-May 1976	360	63	22	7	3	5
Oct.-Nov. 1976	360	54	27	10	4	5
Apr.-May 1977	360	43	25	14	7	11
Oct.-Nov. 1977	356	51	24	14	5	6
Part B. Sugar with vitamin A						
Oct.-Nov. 1975	358	—	—	—	—	—
Apr.-May 1976	360	13	15	22	15	35
Oct.-Nov. 1976	360	8	12	14	17	49
Apr.-May 1977	360	9	10	15	13	53
Oct.-Nov. 1977	356	8	9	15	13	55

* All values expressed as percentage of families at each level.

For that reason we stated the objective of the fortification program as follows:

It is important to emphasize that the *main objective* of the program is to increase the adequacy of intake of vitamin A and, through this improved intake, to raise the body fluid and blood serum levels among the population at large, increasing thereby the supply of retinol to the tissues.

Our results were summarized in these words:

It is concluded that the program of fortification of sugar with vitamin A has definitely contributed toward allowing the population of this country to ful-

TABLE 4. Daily Per Capita Intake of Retinol Equivalents* in Guatemala, 1975-1977

Survey period	From natural food sources	From fortified sugar ^b	Total
Oct.-Nov. 1975 (basal)	221	0	221
Apr.-May 1976	178	336	514
Oct.-Nov. 1976	198	425	623
Apr.-May 1977	251	419	670
Oct.-Nov. 1977	182	445	627

* All values expressed as μg .

^b At a calculated level of fortification there are 10 μg retinol per gram of sugar.

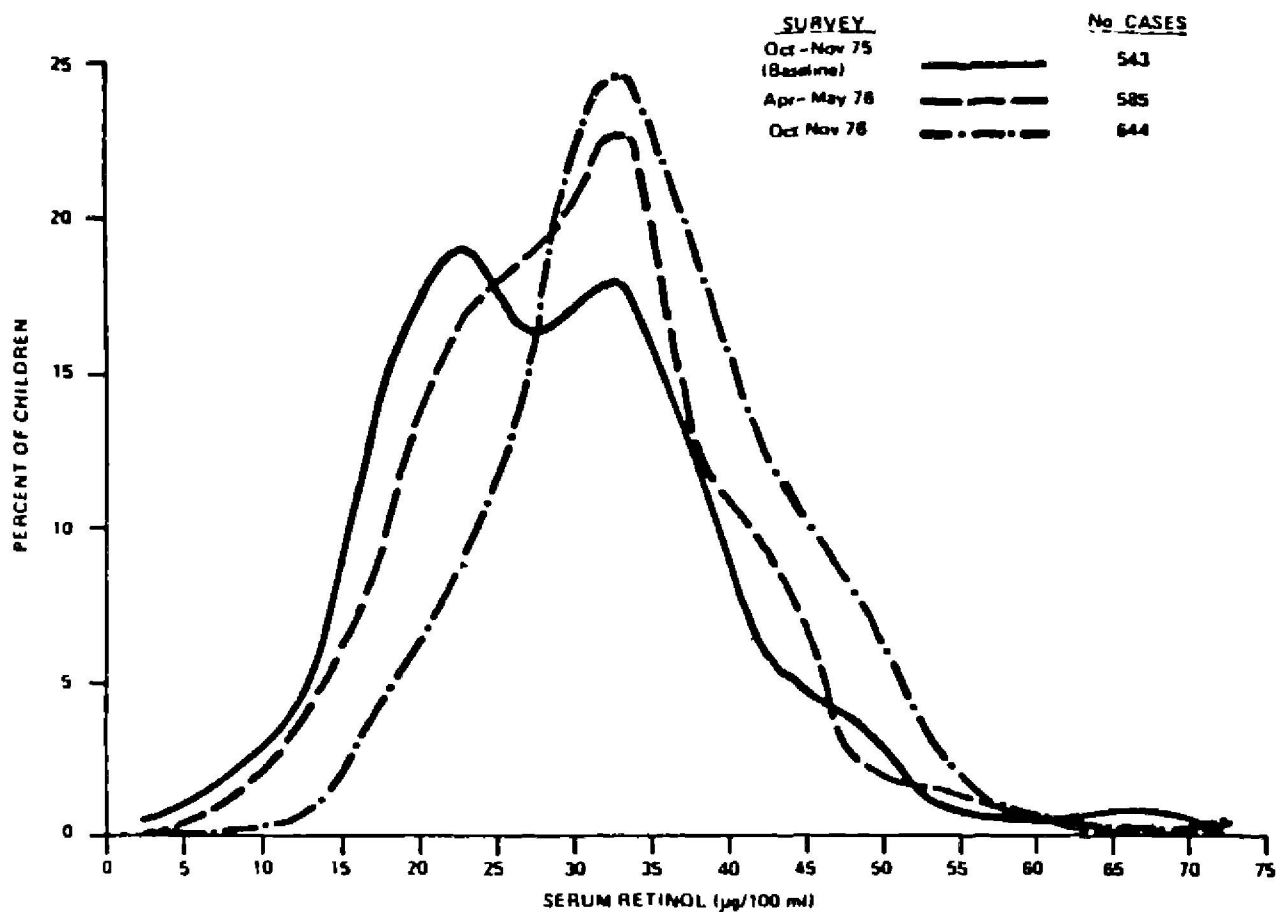


FIGURE 1. Effect of sugar fortification with vitamin A on the distribution of serum retinol levels of rural preschool children, 1975-1976.

fill its individual and social right to an intake of vitamin A in accordance with that considered necessary for maintaining adequate nutrition with respect to this essential nutrient.

The basis for these two statements are summarized in Tables 3 and 4 and in Fig. 1 (5).

OPPOSITION TO SUGAR AS THE DIETARY VEHICLE

The selection of white table sugar as the dietary carrier was made after a thorough analysis of many possible foods in accordance with certain criteria. A vehicle suitable for this purpose should have the following characteristics: (1) the vehicle must be consumed by essentially all of the population; (2) the vehicle must show little variation in its day-to-day per capita consumption; (3) fortification should result in unappreciable change in the organoleptic characteristics and acceptability of the vehicle; and (4) the cost and nature of the vehicle must be such as to allow for an economically feasible industrial process.

In a previous publication (6) I pointed out that in developed countries, the number of possible vehicles is large because of the equally large

number of components in the daily diet. The following foods have been used as vehicles for fortification:

Food	Coverage
Prepared infant formula	Infants
Instant breakfast	Principally children
Ready breakfast	Principally children
Margarine	All age groups
Milk	All age groups

The inapplicability of these to less developed countries is obvious. These foods, for all practical purposes, are not consumed by the population sectors in need of vitamin A in these countries. For some countries, like Guatemala, even wheat or rice are not universally available, and their consumption is significant only in the higher socioeconomic strata. Corn is most commonly eaten, but it is home-processed with no possibility of a central point in its food chain where the nutrient could be added. In addition, the corn is drastically cooked and the cooking water is discarded.

From the start, the nutritional risk attached to excessive sucrose intakes was considered. The Guatemalan population at large (particularly rural) consumes sugar although not in excess (about 30-40 g/day average). Nevertheless, measures were taken to avoid any promotion of higher sugar consumption as a source of the vitamin. Any reference to vitamin A content in the labeling was legally prohibited, as well as any advertisement. Presidential Decree SP-G-105-74 (7) translated reads:

All promotion that attributes therapeutic properties to fortified sugar is prohibited, as is any presentation of this product as a unique source of this nutrient (vitamin A). The products that are formulated with fortified sugar cannot indicate it as a quality of the product. Those who fail to comply with, or violate, this law will be subject to the sanction stipulated in the law. (7)

In spite of this, strong criticism and opposition developed from some groups and even from some individuals belonging to scientific and technical organizations, such as WHO and PAHO. The battle was hard, but we succeeded. A typical, not unique, case is illustrated by the two letters that follow.

Vermont, November 5, 1972

Dear Dr. Arroyave,
It was reported by the New York Times Service that you plan to fortify sucrose with vitamin A in order to combat dietary shortages of this vitamin.

One of our biggest world problems is correcting one problem by a method that produces another less obvious, although just as serious a dietary predicament.

I direct your attention to research done in England on the effects of "pure" sucrose sugar on the body.

Dr. John Yudkin has written a book geared to lay people on the subject of sucrose sugar called, *Sweet and Dangerous*. His research papers, however, are more convincing for the professional and would no doubt still be available from Queen Elizabeth Hospital, London, England.

Dr. Emmanuel Cheraskin of the University of Alabama, Birmingham, Alabama, also has data available. They, too, have researched this area for thirty years. No one in government here listens because of the powerful pharmaceutical lobby in Washington. With hard work on our parts, we are hoping to correct this dreadful situation.

In the meantime, I do hope that you will not continue to support such a program to your people, but will instead find an alternate solution.

Sincerely,

A. J. H.

Guatemala, November 21, 1972

Dear A. J. H.:

Your letter disturbed me a great deal, as it made me realize how poorly informed you are about the nutrition problems of our third world and how little you care about them.

The fact that excessive sugar consumption is undesirable is well documented. I do know the literature on that subject. But it is also true that sugar *per se* in amounts that are not excessive is not harmful. This is also true for many foods such as fats, and even several minerals and vitamins. For those populations already consuming too large an amount of sugar there is room for efforts to try to decrease it. Those same privileged populations are also enjoying an abundance of practically every food and everything else. But that is your problem. Ours is the opposite. Our people consume sugar (not excessively) and badly need vitamin A. We do not see how we could make them stop eating sugar, even if we wanted to. Therefore, we think we can use it as a vehicle for a needed nutrient. No one is thinking of promoting a higher consumption of sugar because it will be fortified, nor would anyone promote a higher consumption of table salt, for example, because it is iodized. We have done a lot of research and thinking about this and find no better solution for the vitamin A deficiency problem in our areas. If you can think of some alternate solutions, let me know. But *please* don't try to suggest fortifying milk or margarine until you have a chance to know the socio-economic and socio-cultural patterns of the populations of our concern.

In the meantime, we will continue to support the program. Let me add that, as undesirable as dental caries are, I still prefer to see a child with poor teeth to seeing him *blind*.

I will welcome further comments.

Sincerely yours,

Dr. Guillermo Arroyave

THE PROS AND CONS OF THE PROFESSIONAL GROUPS

When the laboratory and pilot research was in progress, but well advanced at INCAP, the news about the program filtered out and became a subject of public debate. The first reaction—and indeed a violent one—came from the president of the Association of Chemical Engineers of Guatemala, who argued a number of technological objections that, in his opinion, made it impossible to mix vitamin A with sugar. He carried with him the whole official opinion of this association. The main objections were: (1) the danger of toxicity, and (2) the technological impossibility of mixing vitamin A with sugar, in view of the fat-soluble character of one and water solubility of the other. This public debate was carried out through meetings, letters, and even the mass media (newspapers, television, radio). The professional in question even consulted with technical persons of the U.S. Food and Drug Administration, but asking the questions in such a way as to receive the answer that he needed, for example: Is vitamin A toxic? The answers, usually recommending caution in its use, were put to use to frighten lay sectors about the proposed program.

In fact, the president of this society had business and family ties with one of the most powerful sugar manufacturers in Guatemala. With carefully presented scientific and technical arguments, and with the support of health and social science professional sectors, the opposition was defeated after three years. Among the strongest supporters of fortification were the Guatemalan Medical Association, the Pediatric Association, the Association of Chemists and Pharmacists, the School of Medicine and the School of Pharmacy of the University of San Carlos, and the National Committee for the Blind and Deaf.

THE REACTION OF THE GOVERNMENT

When the process was fully developed and tested, the time came to propose it to the government through the Ministry of Health. The idea was officially received well and a green light was given to INCAP to continue with the work. Liaison professionals from the Maternal and Child Care Division of the Ministry of Health were appointed to work with INCAP and with representatives of the sugar manufacturing sector in the elaboration of the law. When the law was finally drawn up, it included an article making the sugar manufacturing sector responsible for covering the cost of fortification, including the purchase of the vitamin A product. The law went through the offices of executive power with "normal" sluggishness. The trouble began in Congress. The lob-

bying by the sugar manufacturers was hidden but powerful, and the law was defeated on September 12, 1973. Later, we learned that the sugar manufacturing sector was divided in its opinion, a large and powerful majority being against fortification of sugar. One particular man in this private sector deserves special mention because of his support and cooperation for the project. He is Mr. Roberto Dorión, then President of Ingenio El Salto, S.A., Guatemala. To the others he was a black sheep among the flock.

Then the mass media began to play a role, with overwhelming support in the form of editorials and news releases emphasizing the need of the "poor" for such a program. Literally hundreds of articles were published criticizing the decision of Congress. As the election day for congressional representatives approached, we began a second offensive. At this stage, the Committee for the Blind and Deaf played an instrumental role in generating very strong social pressure, and the law was formally approved on June 11, 1974 (8). The political circumstances at that particular moment had added the necessary political appeal and value to the program.

THE FIRST THREE YEARS OF THE PROGRAM ON A NATIONAL SCALE

IDENTIFYING THE MAIN CONSTRAINT: THE ECONOMIC FACTOR

Sugar is produced in Guatemala during a certain period of the year called "zafra." This sugar production season normally begins at the end of November and extends through June or the beginning of July. During these seven months, sugar cane is converted into either crude sugar for export or centrifuged white sugar for internal use. It is estimated roughly that about 75% of the latter goes for direct table use. The rest is used for industrial purposes, mainly sweet drinks and processed foods. It is that 75% of table sugar that has the highest priority in terms of vitamin A fortification, as processed foods and beverages are very infrequent dietary items for the poor sectors, particularly in the case of the rural population, where vitamin A intakes are most inadequate.

At the time this paper is being written, the sugar from four "zafras" has been fortified: 1975-1976; 1976-1977; 1977-1978, and 1978-1979. The evaluation has been completed and published (5). The publication includes: (1) the efficiency of the delivery system for fortified sugar to the population, (2) the nutritional effectiveness, and (3) estimates of the cost.

This evaluation allowed us to determine that 75% of the total white

sugar production for local consumption was fortified in 1976-1977, and 72% was fortified in 1977-1978. Without going into a detailed analysis of this situation, this was considered quite satisfactory, and indeed, resulted in dramatic positive effects on the indicators of vitamin A nutritional status of the population (5).

The results of 1978-1979 were somewhat disappointing. Data on the efficiency of fortification are now emerging that show that during this third sugar production season, only 52% of white sugar for local consumption was fortified.

In this section I shall try to describe the economic-financial factors that, directly or indirectly, have become constraints threatening the maintenance of the fortification program and that, in my view, specifically explain the low efficiency during the 1978-1979 "zafra."

There are several ways in which the economic aspects of the program on a national scale can be analyzed in order to identify the positive as well as the negative factors that affected its implementation and maintenance. This is discussed in the following two sections.

THE CONSUMER'S POCKET

The national laws of fortification of sugar with vitamin A in Guatemala, as well as in three other countries of the Central American region, specify that the cost of the fortification process must be absorbed by the sugar manufacturers and that the price of sugar to the consumer cannot be increased on the basis of the costs of the program. The facts behind the rationale supporting that decision are explained thus:

In 1974, at the time the Guatemalan law was approved by Congress, the cost of the water-dispersible retinyl palmitate specified by the technology was U.S. \$10/kg. Then the purchase of the product was calculated as representing about 90% of the total cost of the fortification program, the remaining 10% being the costs of the operation at the factory level, plus supervision and control. On that basis, the cost of fortification was 11 U.S. cents per qq,* or 0.11 cents (about one-tenth of a cent per pound).

At that time, the retail price of sugar was 8 cents per pound and the smallest fractional coin in Guatemala is 1 cent (U.S. \$1 = 1 quetzal). Obviously, it was impossible to put into practice an exact increase in price per pound to compensate for the actual fortification costs. In addition, 0.11 cents is only 1.3% of 8 cents, which was considered by Government economists to be a light "load."

*qq is the Spanish measure of weight equal to 100 lb, or 46,000 g.

Although the figures changed somewhat in 1979, the relative "load" essentially has not. Repeating the calculations with the present cost of the vitamin product (U.S. \$19.50 per kg)* gives a total of 21 cents per qq, or 0.21 cents per pound. At present, for various reasons obviously unrelated to the cost of fortification, sugar is selling at 15 cents per pound, and $0.21/15$ is equivalent to a 1.4% overcost.

THE SUGAR MANUFACTURERS' SIDE

In dealing with this aspect we shall consider again the total cost (90% for the product and 10% for other costs), although we realize that this method overestimates slightly the costs absorbed by the manufacturers, because they are responsible for only part of the supervision and control.

According to the figures shown previously, the fortification of each qq of sugar costs 21 cents (U.S.). The wholesale cost of the qq (at the factory), where money goes directly to the manufacturers, is U.S. \$13.50. Therefore, the ratio shows a 1.6% increase ($0.21/13.50$). To all concerned outside of the sugar business, this looks like a very favorable price to pay for "some" nutrition.

But how do the manufacturers look at it? Exact figures are not easy to obtain, but I do not think they are necessary for the purpose of this argument. We will assume, in addition, that the total production of white sugar subject to vitamin A fortification is now (1979) the same as it was in 1975, which is a harmless assumption. The value could be rounded to 3.6 million qq sacks. Multiplying this figure by U.S. 11 cents per qq gives a total investment of U.S. \$396,000 for 1975, while in 1979, the same 3.6 million \times U.S. 21 cents was U.S. \$756,000.

The previous analysis and the relationships derived therefrom, are only a partial view. To it I would like to add what I call "the impact of the New Economic Order on a nutritional intervention in an underdeveloped country."

The facts and figures to be considered in the discussion are as follows: From 1975 through 1979, the sugar manufacturers in Guatemala produced about 50% of the total white sugar for local consumption, and the other approximately 50% crude sugar for export markets. This, according to their economists—and it seems to make sense—means that to a large extent their financial stability depends on international sugar prices. Any drop in this international price cannot be easily compensated by an increase in the price of local sugar because sugar, which is consid-

*In May 1979, the price of retinyl palmitate 250 CWS was U.S. \$25/kg.

ered as a basic food in Guatemala, has a top price control placed on it by the Government and, for political reasons, it is extremely difficult to adjust the price frequently and repeatedly.

In connection with this, it is appropriate to analyze the data in Table 5. This table shows the changes undergone by the international market prices for export sugar and for retinyl palmitate imported for the fortification of sugar. Note that in 1974, the year that fortification was approved and that the sugar industry adopted responsibility for its financing, the ratio "price of export sugar/price of vitamin A" was 1.3; the ratio was only 0.4 in 1978, with a tendency to drop even lower by the end of 1979. This type of phenomenon, of questionable ethical basis, has been perhaps the most important negative factor affecting the maintenance of the program. With local sugar prices under government control, the "slight" gain obtained at the local level through a strenuous political struggle is claimed not to compensate the loss resulting from the deterioration of the international sugar market. Not being in a position to analyze this particular relationship in more technical detail, I present it only as the main complaint from the sugar manufacturing sector. Panama has, in fact, interrupted the program on this basis and has accused the vitamin manufacturers of monopoly and price abuse.

DISCUSSION

The question to consider is: *Should a private industrial sector pay for a nutrition-public health intervention?*

The answer from the private-enterprise economic expert: "They never will. They will find a way to charge it to the consumer. If they cannot, because of strong government price control on the commodity, they will not cooperate, laws or no laws."

The answer from the consumer: "They should; they are making enough money as it is; they are all millionaires" [in general, they are!]; "they have an obligation to do it." The government says the same thing. That is, it accepts in theory the same premise, an attitude that is politically *wise* (votes!).

The opinion of INCAP at present: The view of the consumer seems logical and INCAP favored the inclusion in the law of the specific article charging the sugar manufacturers with the responsibility to absorb the costs. This position appeared, at the time, to be supported by precedents in developed countries, where literally hundreds of manufactured food products are enriched with nutrients at the expense of the producer, and

TABLE 5. Market Prices of Export Sugar and
of Retinyl Palmitate 250 CWS in U.S.
Dollars

Year	Sugar ^a (100 lb)	Retinyl palmitate (1 kg)
1972	9.00	7.00
1974 ^b	29.50	10.00
1975	22.48	11.00
1976	13.32	13.00
1977	11.00	15.00
1978	7.82	19.50
1979 (latest)	8.86	25.00

^a Farrman & Co., New York.

^b Year that the fortification law was approved in Guatemala.

even in developing countries, in some instances, such as in the case of salt iodization in Central America.

In regard to this crucial point, our recent analysis of the situation leads to the following conclusions: (1) When there is no government control on the price of a food, such a premise is a fallacy, because in the long run, the price tag is manipulated so that the consumers finally do pay the bill. (2) When there is price control by the government because the food is considered a basic item (such as sugar, corn, and salt) and the manufacturer sees that it is impossible, or very difficult, to apply the mechanisms described in (1), resistance against compliance develops among manufacturers; a number of imaginary faults are attributed to the process and program, ending in partial (Guatemala) or total (Panama) boycott and failure.

CONCLUSION

In my opinion, as a "scientist-biochemist, self-made public health nutrition worker-dreamer," a nutrition intervention program of this type should be structured in such a way that it constitutes an integral part of the Food and Nutrition National Plan. In this context, its cost must be borne by the public sector (government), which should obtain and allocate appropriate funds for such purposes, perhaps within a programmatic policy of "short-term measures to improve the dietary adequacy of the population at large."

Finally, I believe that, of all of the possible aspects and constraints discussed with regard to the fortification of sugar with vitamin A, the conceptual, technological, political, and operational aspects have feasible and relatively easy solutions. The key to success is the wisdom to design the most appropriate and politically acceptable policy to ensure financial support on a long-standing, sound economic basis.

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