Sugar fortification represents a major contribution toward finding a permanent solution to the problem of vitamin A deficiency. During the 1970s, the Institute of Nutrition of Central America and Panama (INCAP), which is associated with the Pan American Health Organization (PAHO), developed fortification technology and carried out activities aimed at promotion, advocacy, and implementation of sugar fortification programs in various Central American countries. Since that time, a wealth of program experience has accumulated. This paper summarizes the information about this experience, with specific reference to the sugar fortification efforts in El Salvador, Guatemala, and Honduras.

**THE SUGAR FORTIFICATION EXPERIENCE**

**Advocacy and Promotion**

After the existence of significant vitamin A deficiency (VAD) in the Central American region was documented and appropriate technology for fortifying sugar developed, a sugar fortification program was first implemented in Guatemala in 1975. The population's vitamin A intake practically tripled as a result of the program, the prevalence of VAD decreased from 22 to 5 percent over a one-year period, and retinol levels in breast milk and in hepatic reserves increased significantly. Today, more than 95 percent of households consume sugar, and above three-quarters of sugar samples collected in households contain the desired levels of vitamin A (equal to or greater than 5 mg/g). During the 1970s, the program was also promoted in other Central American countries. In Costa Rica, the program was launched in 1975 but was suspended in 1981 upon confirmation of sufficient vitamin A intake from other sources and a dramatic decrease in the prevalence of VAD among children. The program was implemented in Honduras in 1977, suspended in 1980, reinstated in 1983, and continued irregularly with very low coverage levels until 1993. However, since 1993, coverage levels have progressively increased, reaching more than 80 percent of households, with above two-thirds of collected sugar samples containing adequate levels of vitamin A. In El Salvador, the program was formally launched in 1994 and continues to operate, with coverage and quality levels similar to those in Guatemala.

**Legislation and Regulations**

Mandatory sugar fortification has been established through a variety of legal instruments, whether by presidential decrees based on a legal framework or by laws passed by legislative bodies, complemented with regulations prepared by the ministries of health or other regulatory agencies. Agreements signed with the World Trade Organization and the FAO/WHO Codex Alimentarius have begun to have an impact on food legislation in the countries of the region.
Technological Development
Fortification technology involves the preparation of a vitamin A-sugar premix, which is then added to sugar at the refineries. Initially, this process was carried out manually by loading the needed amount of premix inside the centrifuge where sugar is separated from the molasses. However, the progressive automation of sugar processing since 1987 has required the use of mechanical dosifiers, which created problems with respect to the accurate amount of premix to add and the homogenous blending of premix within the product. It was also observed that some vitamin A is lost in the drying process. To solve these problems, mechanical dosifiers equipped with a variable flow mechanism and a mixing system that guarantees uniform blending of premix throughout the product are currently being tested. In addition, new fortifying compound formulas with greater stability and different methods for attaching vitamin A to sugar crystals are being developed.

Quality Assurance and Control
Development and testing of a quality assurance system was carried out in Honduras and subsequently transferred to the other countries in the region. The system, which was finally implemented on a permanent basis in 1995, consists essentially of a quality control and assurance process for fortified sugar by producers and the inspection and monitoring of sugar quality at production centers and retail locations by the Department of Food Control of the Ministry of Health. In Honduras, the system has proven to be effective in improving fortified sugar quality and coverage levels. The key elements of the system have been continuous quality assurance by producers, periodic government inspections, the introduction of product labeling, and the analysis of the vitamin A content in household sugar samples, collected through multipurpose annual surveys.

Program Monitoring and Evaluation
A monitoring and evaluation system has been useful in determining the extent to which a population is covered and the program quality at the consumer level. Epidemiological surveillance has been carried out through national surveys in order to evaluate the program’s biological effects. Results indicate that significant quantities of vitamin A are received by the population through sugar consumption, which constitutes the main dietary source of the vitamin. In 1995, fortified sugar was the source of approximately half of the vitamin A intake of Guatemalan children between two and five years of age. National surveys conducted between 1995 and 1998 in the three countries demonstrated a significant reduction in VAD among preschool-aged children with respect to earlier surveys. However, the program has had less of an impact on under-two children, possibly because this group consumes less sugar.

Cost Analysis
The total annual cost of the program per 100,000 metric tons (MT) amount to US$940,125 or $9.40 per MT, of which 98 percent (US$918,125) is covered by the sugar industry and passed on to consumers, while the remaining 2 percent (US$22,000) is assumed by the government. During the 1998–99 harvest, approximately 700,000 MT of sugar were fortified in the three countries studied, serving a total population of 24 million inhabitants. In terms of annual costs, this represents a total cost of US$6.58 million; a per capita cost of US$0.27; a cost of US$0.30 per person covered; a cost of US$0.51 per high-risk person covered; and a cost of US$0.76 per vulnerable high-risk person covered.

LESSONS LEARNED

The Central American Context
The experience gained from sugar fortification in Central America should be examined within the specific context of the three relatively small countries studied. The poor in these countries represent between two-thirds and three-quarters of the total population. Between 1960 and 1997, the countries achieved reductions in their infant and child mortality rates of between 70 and 80 percent. All three countries have democratic systems of government. However, the public sector in each is limited in its capacity and efficiency to set standards and monitor compliance with legislation, as opposed to the better-organized and responsive private sector. Sugar production in the three countries constitutes one of the most active industries of the economy; it is essentially a private sector activity, with a relatively small number of easily accessible refineries set up in strategic locations. Sugar production in all three countries is sufficient to meet domestic demand, and between one- and two-thirds of production is exported. Sugar is consumed by most (>90 percent) of the population, from all socioeconomic strata. Initially, fortification costs were covered by producers, but were later passed on to consumers as part of inflationary price increases.
Advocacy and Promotion
1. The starting point in developing a food fortification program with public health objectives is thorough documenta-
tion of nutritional deficiency to establish the scope, severity, distribution, and characteristics of the problem.
2. The widespread dissemination of information—regarding vitamin A deficiency, its implications for health and the
country’s social development, the analysis of alternative interventions, the advantages of fortification, and how to
identify fortified products—is an essential element in sensitization, advocacy, and program development.
3. The presence of an institution with the capacity to bring the involved actors together can help establish and main-
tain food fortification and other nutrition programs.
4. The participation of producers in a program from its early planning stage is necessary in order to enlist the industry’s
support for and commitment to these programs by establishing a mutually rewarding public/private partnership.

Legislation and Regulations
5. Adequate legal or statutory instruments—including a fortification law, standards of identity, technical regulations,
and universal labeling—should be in place to support sugar fortification.
6. The establishment of legal criteria regarding the nutrient content of the fortificant in terms of a minimum acceptable
level for the consumer is preferable to establishing criteria to govern the production process.
7. The harmonization of legislative instruments and technical regulations among neighboring countries is important
to satisfy free trade initiatives and agreements.
8. Given the limited stability of vitamin A in the industrial processing of some soft drinks, the sugar used in the
production of such soft drinks can be exempted from mandatory fortification.

Technological Development
9. The level of vitamin A fortificant should be established based upon per capita sugar consumption and the size of
the vitamin A intake gap in the population.
10. Both producers and governments should be kept abreast of advances made in the development of more stable
fortifying compounds and better techniques for adding premix in order to incorporate program changes in a timely
manner.

Quality Assurance and Control
11. It is crucial for governments to adopt a positive and collaborative attitude toward producers—instead of a repres-
sive and punitive regulatory disposition—and for producers to assume responsibility for conscientiously ensuring
the quality and control of their products.
12. Depending on the local industry’s level of development, it may be necessary for governments to provide training
and guidance in quality assurance to refineries, especially during the initial program stages.
13. The governmental entity responsible for the fortification program may need to design and implement a formal
plan for external auditing at the central level, which may gradually shift emphasis from production plants to retail
outlets.

Monitoring and Evaluation
14. Program monitoring and evaluation activities can be strengthened at low cost by assessing levels of vitamin A in
sugar during other, scheduled household surveys.
15. The development of practical, low-cost epidemiological micronutrient surveillance systems is needed to facilitate
both program monitoring and impact evaluation.
16. Under-two children and other groups that may not be fully covered by the program because they do not consume
sufficient sugar on a regular basis should be targeted for periodic supplementation.

Cost Analysis
17. To a large extent, the economic feasibility of fortification depends on whether producers are sufficiently motivated
and willing to make the initial investment in necessary equipment, facilities, and inputs, which can be passed on
to consumers as part of inflationary price increases.
18. The government can help facilitate the initial first-year capital investment by acting as the industry's guarantor on financing applications.

19. Start-up costs can be reduced by adapting existing facilities for use as premix processing plants, donation of equipment used in premix preparation, or the use of existing laboratory equipment at refineries.

**Sustainability of Supply**

*Financial Sustainability*

20. It is important that external cooperation agencies concentrate their financial support in technological development and the design and implementation of policies and programs rather than in assuming operating costs for the system of inspection and monitoring.

*Institutional Capacity*

21. A governmental unit with adequate managerial and logistic capability, and charged with specific responsibility for program coordination and management, is essential for a well-functioning program.

22. Research and development organizations at the regional level and national associations/groups can play an important role in providing technical assistance to strengthen institutional capacity.

23. Human resources development and periodic retraining are essential institutional-strengthening activities.

*Political Environment*

24. A solid political commitment of both the government and the industry and an effective policy development and implementation process are key elements for ensuring long-term sustainability of fortification programs.

25. The political sustainability of fortification programs is strengthened by the creation and effective operation of a multisectoral committee or commission.

26. Regional research and development institutions in the field of nutrition and external cooperation agencies can play a critical role in maintaining communication and dialog in order to ensure the stability of the political commitment to sugar fortification.

27. It is essential that the government abide by its commitments to the private sector in order to promote the level of confidence necessary to ensure the political sustainability of the program.

28. Appropriate fortification technology and compatibility between the capacity of existing technology to achieve certain quality results and the technical specifications established by the government are needed to ensure a solid industry commitment.

29. Reinforcing policy decision making within the government and the industry requires long-term, ongoing efforts in promotion and advocacy in key areas.

**Sustainability of Demand**

30. Information media are key to ensuring that consumers are fully informed and aware of the importance of fortification in health and nutrition, can identify the fortified foodstuff, and, if needed, can eventually take part in social mobilization in support of the program.

The full document on which this summary is based can be found on the MOST Web site, www.mostproject.org. Requests for hard copies should be sent to most@istiinc.com or MOST, International Science and Technology Institute, Inc., 1820 N. Fort Myer Drive, Suite 600, Arlington, VA 22209.