

**Vitamin A Fortification  
of Sugar in Zambia  
1998–2001**

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## Acronyms

ASAZGUA	Sugar Growers Association of Guatemala
CBoH	Central Board of Health
FDCL	Food and Drug Control Laboratory
FHANIS	Food Health and Nutrition Information Systems
FTF	Fortification Task Force
GRZ	Republic of Zambia
INCAP	Institute of Nutrition of Central America and Panama
JICA	Japanese International Cooperation Agency
MAFF	Ministry of Agriculture, Food, and Fisheries
MOF	Ministry of Finance
MOH	Ministry of Health
MRDR	Modified Relative Dose Response Test
NCSR	National Council for Scientific Research
NFNC	National Food and Nutrition Commission
NGO	Non-governmental organization
NISIR	National Institute for Scientific and Industrial Research
OMNI	Opportunities for Micronutrient Interventions
PAHO	Pan American Health Organization
RDA	Recommended daily allowance
SFH	Society for Family Health
SI	Statutory Instrument
TDRRC	Tropical Diseases Research Center
UNICEF	United Nations Children's Fund
USAID	U.S. Agency for International Development
VAD	Vitamin A deficiency
VAT	Value-added tax
ZIHP	Zambia Integrated Health Program
ZRA	Zambian Revenue Authority
ZS	Zambia Sugar



## Executive Summary

The sugar fortification program in Zambia is a success story of cooperation between government, donors, and industry. Although significant problems have repeatedly brought the program near collapse, its continued operation testifies to the commitment of all three sectors to the fortification project.

Government agencies initiated research into the extent of vitamin A deficiency (VAD) levels in Zambia and undertook a supplementation program to reduce the problem. Simultaneously, they investigated food fortification and involved industry and donors with the effort. After implementation of the fortification program, government agencies did not initially fulfill expectations regarding legislation, enforcement, and public education. However, as problems arose, government commitment to the project remained firm.

Industry enthusiasm for the program was essential for its adoption. Business incentives led Zambia Sugar to support fortification legislation, which it hoped would bring a reduction in smuggling and an increase in domestic sales that would offset the cost of fortifying sugar. The onset of a more difficult economic climate, particularly the devaluation of the Kwacha, endangered the fortification program.

All parties believe that donor participation was a critical precondition for the program. Funding for technical training and equipment enabled fortification to begin. After a lack of adequate legal enforcement threatened the viability of the program, donors created a successful enforcement training program. Although donors did not initially provide a high level of promotional assistance, they have since followed through with a more viable vitamin A promotion campaign.

The Zambian experience with sugar fortification demonstrates the need to manage industry expectations and follow-up in the critical post-implementation period to ensure that enforcement and education campaigns are executed. A nationwide study to evaluate the extent to which sugar fortification has reduced VAD levels would help strengthen the appeal of a fortification program from a public health perspective. The economic appeal of fortification will be specific to the industry dynamics within a country. In each case it will be necessary to gain private sector support by creating a win-win situation. One way to strengthen the economic proposal would be to negotiate a lower price for fortificant, as this cost is the “single largest deterrent” to fortification.<sup>1</sup>

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<sup>1</sup> Correspondence with Jeff Hatt, former managing director of Zambia Sugar, May 11, 2001.



# 1. Overview of Sugar Fortification in Zambia

## 1.1 Initial Approach to Vitamin A Deficiency: Supplementation

Current efforts to combat vitamin A deficiency (VAD) in Zambia began in 1990, with a commitment to provide vitamin A supplements to vulnerable population groups. The Government of the Republic of Zambia (GRZ) began distributing vitamin A capsules by 1992 to children 6 to 72 months old and lactating mothers in drought-affected areas and then extended the distribution to health centers throughout the country, targeting these same groups.<sup>2</sup> Vitamin A is particularly important for children 6 to 72 months old because it helps reduce the severity of diarrhea and childhood illnesses such as measles. It also promotes normal growth and development and is associated with lower infant mortality rates. In all population groups, vitamin A supports normal sight and a healthy immune system.

By 1996, a consensus had formed that the supplementation program alone would not be enough to combat VAD. Cost may have been a factor in evaluating the effectiveness of the program,<sup>3</sup> but the primary obstacle to the success of the supplementation program rests in inadequate coverage of the population. The causes for this lie in healthcare worker education and supplement distribution. Specifically, reports indicate that

- Health centers did not know that they could request vitamin A or did not know that supplies were available at local distribution points;
- Health center staff did not know how and when to administer vitamin A; and
- Distribution of vitamin A capsules to regional health centers did not occur on the planned monthly schedule.<sup>4</sup>

In addition to logistical difficulties, the supplementation program suffered from a lack of publicity, both for health care providers and child caretakers.

## 1.2 Baseline Data on VAD Levels

Following the introduction of the supplementation program in 1992, the National Food and Nutrition Commission (NFNC) initiated discussions with the Ministry of Health (MOH) regarding VAD levels in Zambia. The NFNC focused on the technical aspects of the analysis, while the MOH concerned itself with matters of policy. The secretary of the Food and Drugs Board, who had a background in nutrition, became the point person for the discussions be-

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<sup>2</sup> National Food and Nutrition Commission et al., *Report on the Vitamin A Technical Planning Meeting for the 1997 Vitamin A Deficiency Programme*, held in Siavonga May 27–28, 1996, 5.

<sup>3</sup> Van den Wijngaart, Annoek, *Anatomy of a Public-Private Partnership that Achieved Vitamin A Sugar Fortification in Zambia* (December 13, 1999), 6.

<sup>4</sup> National Food and Nutrition Commission, 6.

tween the MOH and the NFNC.<sup>5</sup> An initial priority for the NFNC and the MOH was to quantify the magnitude of VAD, as well as other micronutrient deficiencies, in Zambia.

The 1996 Zambia Demographic Health Survey had indicated that deficiency levels might be high. The survey found that Zambia had an infant mortality rate of 107.5 and an under-five rate of 192.3. It was felt that “some of this mortality may be related to vitamin A deficiency as a result of impaired immune status.”<sup>6</sup> Since this report was published, new data show an infant mortality rate of 109 and an under-five rate of 197.

MOH and NFNC officials had identified the need for a national study of VAD levels. The National Survey on Vitamin A Deficiency in Zambia, conducted in 1997 and funded by USAID, confirmed that VAD levels were severe and that the supplementation program was not reaching enough of the population to affect the problem. Analysts from the University Teaching Hospital and the NFNC prepared the report, the first nationwide baseline survey of VAD levels. The report stated that 66 percent of Zambian children were deficient in vitamin A; i.e., their blood serum retinol levels were at or under 20 µg/dl. In comparison, surveys in Kenya and South Africa found child VAD levels of 35 percent and 33 percent, respectively.

The survey found that vitamin A supplementation had reached only 28.4 percent of under-five children and 13.5 percent of postpartum mothers. The authors of the report stated that, given Zambian VAD levels, a supplementation coverage rate of at least 65 percent was necessary. Estimates are that 65 percent supplementation coverage results in a 75–80 percent reduction of mild xerophthalmia in four-year-olds, and that 85 percent coverage brings a 90 percent reduction rate.<sup>7</sup> Since this study, the most recent supplementation effort resulted in national coverage for children aged 6 to 72 months of approximately 80 percent.

### **1.3 Fortification Program: General Considerations**

From the first stages of the supplementation program, food fortification had been considered as a complementary effort. Between 1992 and 1995, the NFNC and MOH examined the implications of food fortification. Their initial reflections included the following:

- What are the best vehicles for food fortification?
- What are the current consumption patterns for these foods?
- What capacities exist in-country for fortifying and monitoring?
- Is the fortificant available?

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<sup>5</sup> Interview with Mr. Malijani, Deputy Permanent Secretary, Ministry of Health (May 10, 2001).

<sup>6</sup> Luo, Chewe and Chipso M. Mwela, *National Survey on Vitamin A Deficiency in Zambia: A Random Cluster Study for Children (0–5 years) and Mothers Attending National Immunization Days in August 1997* (n.d.), 32.

<sup>7</sup> Luo and Mwela, 32.

- Will consumers be able to afford the food if fortification costs are passed on to them?
- Can fortification be sustained during the production process, without interruption?
- Does the GRZ have the capacity to monitor fortification?

It was government agencies such as the NFNC and the MOH that initiated discussions regarding fortification and conducted research evaluating the extent of the VAD problem.<sup>8</sup> Representatives from non-governmental organizations (NGOs) and the private sector began participating after the government began investigating fortification potential.

In May 1996, the NFNC convened a workshop attended by 24 participants, including representatives from Zambia Sugar, the National Milling Company, and Premium Oils. Others present included representatives from the National Council for Scientific Research (NCSR),<sup>9</sup> Food Health and Nutrition Information Systems (FHANIS), Tropical Disease Research Centre (TDRC), the MOH, and the Ministry of Agriculture, Food, and Fisheries (MAFF). The United Nations Children's Fund (UNICEF) sponsored the workshop.

The meeting focused on future steps to address VAD. The participants recommended a multi-pronged approach, involving action in the following seven areas: supplementation, fortification, dietary diversification, research, publicity, training, and monitoring. Food fortification was integrated into an approach that included campaigns to promote vegetable gardens, further supplementation, breast-feeding, and greater public awareness of the problems associated with VAD.

In 1996, the food fortification program was “not well developed.”<sup>10</sup> Margarine had been fortified in Zambia since 1978, but this program had not contributed greatly to vitamin A levels in the population due to low margarine consumption levels, especially among the poor.<sup>11</sup> The initial target food for fortification was maize meal, largely because it is a daily staple that is consumed by nearly the entire population. The meeting participants identified the risk of rising costs for maize meal as a major deterrent to maize fortification. The only action they suggested regarding sugar fortification was to gather consumption data for sugar, oil, and margarine. Sugar was not the primary focus of food fortification efforts at this meeting of key parties in May 1996.

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<sup>8</sup> Correspondence with Paul Zeitz, formerly of USAID, May 14, 2001.

<sup>9</sup> The National Council for Scientific Research is now known as the National Institute of Scientific and Industrial Research (NISIR).

<sup>10</sup> National Food and Nutrition Commission, 4.

<sup>11</sup> Ministry of Health, *Manual for Sugar and Salt Fortification* (September 2000), 11.

## 1.4 Reasons for Fortifying Household Sugar

In Zambia, maize is ground at hundreds of small local mills, called hammer mills. This production method presented a logistical obstacle to implementing and monitoring a fortification program. Therefore, attention soon shifted from maize meal to sugar. Sugar was produced at a single point of manufacture, which supplied even remote rural areas. A centralized manufacturing process creates a greater opportunity for appropriate quality control. In 1996, Zambia Sugar was the only local sugar producer; today it still accounts for 99 percent of the household sugar produced in Zambia.<sup>12</sup> Other factors that contributed to the choice of sugar included the following:

- A reasonably high level of sugar consumption; i.e., consumption by at least half the population.
- Predictions of greater sugar consumption in the near future. The privatization of Zambia Sugar was expected to boost sugar consumption: increased efficiencies would lower prices, bringing sugar within the reach of more consumers, and a more effective distribution system would ensure that sugar was available in more rural markets.<sup>13</sup>
- The wide use of sugar in children's food, such as porridge.
- An extensive distribution system.
- Better binding characteristics than other potential target foods.<sup>14</sup>
- Zambia could profit from the experience of well-established sugar fortification programs in Central America.

Based on the assumption that only 50 percent of the population in Zambia consumes sugar, an application of the advocacy tool PROFILES, reported by the Academy for Educational Development, calculated that 3,700 lives would be saved per year through sugar fortification. In addition, it was estimated there would be considerable savings in both personal and government medical expenses related to treating illnesses caused by VAD.<sup>15</sup>

The fortification program did not encompass industrial sugar, as industrial producers are concerned that fortified sugar would affect their product. Coca-Cola purchases the vast majority of Zambia Sugar's industrial sugar, and any change to Coca-Cola's inputs would have

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<sup>12</sup> Zambia Sugar produces approximately 100,000 M.T. a year, while Kalungwishi produces approximately 1,000 M.T. a year. Zambia Sugar, *Report and Financial Statements for the Year ended 30 September 2000* and interview with Vahdat Alavian of Kalungwishi on April 5, 2001.

<sup>13</sup> A 1999 report indicates that although sugar distribution has improved, rural consumption levels have not risen as expected. Sugar is available from 98.5 percent of urban purchasing places and 82.7 percent of rural purchasing places. In spite of this wide availability, only 65.6 percent of urban households and 24.7 percent of rural households had sugar available in the household at the time of the survey. Mwela, Chipu M. et al., *Vitamin A Supplementation and Sugar Availability* (March 1999), 18. By way of contrast, estimates of 1997 rural consumption levels stood at 23.8 percent. Zambian Sugar Fortification Technical Committee, *Sugar Fortification in Zambia: A Step to the Future* (May 18, 1997), 15.

<sup>14</sup> Interview with Priscilla Likwasi (and others), Feb. 13, 2001.

<sup>15</sup> Spreadsheet contained within 1997 NFNC Sugar Fortification files.

to be approved at its headquarters. In addition to the difficulty of marketing fortified sugar to industrial purchasers, there is the further consideration that much of the retinol in industrial sugar is likely to be lost in the manufacturing process.

## **1.5 Government/Industry Cooperation**

A key factor in the choice of sugar as a vitamin A fortification medium was the willingness of Zambia Sugar to participate in the program. The timing of the vitamin A initiative coincided with a restructuring operation at Zambia Sugar, and the company perceived the fortification program as complementary to its own modernization initiatives. Initial conversations between Zambia Sugar, GRZ, and USAID occurred during a brand and service review at Zambia Sugar. Planning was under way to relaunch the Whitespoon brand, so that consumers would recognize the brand as Whitespoon rather than “Zambia Sugar.” Fortification and rebranding plans coincided with further changes in company headquarters and in the factory.

The company was assuming some risk by combining fortification with rebranding. There was concern that fortification would bring an unwelcome pharmaceutical association to the product, which they preferred to market as a natural product. There was no reliable market research to reassure the company that consumers would accept a fortified product. The company conducted its own survey and found that consumers would accept the product if it seemed similar to unfortified sugar.

One factor favoring fortification was a relatively easy integration of the fortification process with current operations. No large technical outlays would be necessary, as the factory could be adapted to sugar fortification; the initial expense would consist largely of the purchase of fortificant. Zambia Sugar’s current packaging procedures meant that it would be easy to separate fortified household sugar from unfortified industrial sugar, as the industrial sugar sold in much larger bags than household sugar. Monitoring of the fortification program need only be an added step in already existing sample collection schedules.<sup>16</sup>

Another factor that contributed to Zambia Sugar’s interest in the fortification program was an increase in less expensive sugar flooding the Zambian market.<sup>17</sup> One provision Zambia Sugar requested was legislation ensuring that only fortified household sugar be sold in Zambia. Zambia Sugar was feeling pressure from legal and illegal imports of sugar from Malawi and Zimbabwe in amounts they estimated to reach 25 percent of Zambia’s domestic market.<sup>18</sup>

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<sup>16</sup> Dary, Omar. Zambia Trip Report, May 12–23, 1997, 1.

<sup>17</sup> Interview with Paul. Zeitz, November 18, 2000.

<sup>18</sup> Hatt interview.

Prohibiting the sale of unfortified sugar required that the sugar fortification program be mandatory. The decision to make the program mandatory is an example of coinciding public and private interest. For industry, a mandatory program made sense because there would be legislation protecting its market. It was also an advantage from a public health perspective because it ensured that fortified sugar would be available to all. If the program were voluntary, more expensive fortified sugar would compete on the market with less expensive unfortified sugar; and those least likely to buy fortified sugar would tend to be the most vulnerable population groups.

Although both parties agreed on the benefits of a mandatory program, officials were concerned that a mandatory program would leave only one source of sugar in Zambia. At that time, there were no other local producers to supply sugar should Zambia Sugar fail or production be disrupted. The company assured the MOH that their production capacity of 250,000 tons was enough to supply the local market.

Both sides of the government/industry partnership expressed some frustration at the differences in their decision-making styles. In addition, the MOH felt that it had not been sufficiently clear during the process that the government's role is to set policy, not support a particular industry. For example, when a new sugar producer started operating in Zambia, it made a request to the MOH for the same support as that given to Zambia Sugar in terms of machinery and assistance, which was denied. Industry representatives did feel at points that government did not understand their pressures, and government officials felt that companies were requesting special treatment contravening public health priorities.

## **1.6 Developing the Program**

Government agencies encouraged the initial development of fortification: NFNC promoted initial research, sponsored meetings, and coordinated activities related to fortification; MOH researched the legal framework; the National Institute for Scientific and Industrial Research (NISIR) provided technical guidance; the Food and Drug Control Laboratory (FDCL) conducted monitoring and evaluation; and the Zambian Revenue Authority (ZRA) examined the tax structure. Industry acceptance allowed planning to begin, but donor support was critical to the development of the program: the U.S. Agency for International Development (USAID) was the lead financier of the project and provided technical assistance, UNICEF provided spare parts, and the Japanese International Cooperation Agency (JICA) provided spectrophotometers for Zambia Sugar and the FDCL.

The Fortification Task Force (FTF) is considered to have been essential to the project. Coordinated by the NFNC, and also known as the Sugar Fortification Technical Committee, each task force meeting had a slightly different composition. For example, a meeting regarding

value-added tax (VAT) ratings would include representatives from the Ministry of Finance (MOF) and the ZRA. The most common participants in the meetings were representatives from NFNC, MOH, NISR, FDCL, Zambia Sugar, and USAID. Meetings began in 1997 and continue to this day; meeting frequency ranges from every month to once every several months.

In October 1996, a Sugar Fortification Sub-Committee made a feasibility visit to Zambia Sugar. Zambia Sugar welcomed the program and requested assistance with monitoring vitamin A levels in sugar and with project funding.

In May 1997, Dr. Omar Dary, a consultant with prior experience in the successful Guatemalan sugar fortification program, examined the case for sugar fortification in Zambia for the USAID's Opportunities for Micronutrient Interventions (OMNI) project. Dr. Dary met with government health officials and NGOs and visited the Zambia Sugar mill in Mazabuka. He presented final recommendations on initiating a sugar fortification program to NFNC and outlined steps that could be taken once Zambia Sugar agreed to the program.

At the time of his visit, Zambia Sugar had not yet formally committed to a fortification program but had promised a response by July 1, 1997.<sup>19</sup> There were still a number of issues to be resolved, including funding of the first year's supply of fortificant, any necessary capital expenditure, initial staff training, public educational campaigns, the enactment of legislation to protect the Zambian market from unfortified sugar, duty-free and VAT zero-rating for fortificant, and the execution of research to confirm consumer acceptance of the new product.<sup>20</sup>

In the fall of 1997, OMNI sponsored a new Zambia Sugar logo design. There was some tension between the marketing objectives of the company and a public health message, and Zambia Sugar declined a logo proposed by the Society for Family Health (SFH) and NFNC.

At the beginning of 1998, a five-member Zambian team traveled to Guatemala to learn from sugar fortification efforts in that country. The team consisted of a nutritional coordinator, as well as representatives from the sugar industry and government food and drug agencies. OMNI funded the trip. One of objectives of the trip was to train individuals who would in turn train counterparts in other African countries starting a sugar fortification program. The team traveled to several sugar mills and met with the Sugar Growers' Association of Guatemala (ASAZGUA) and visited the manufacturer of the blender unit being shipped to Zambia

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<sup>19</sup> Dary, 6.

<sup>20</sup> Dary, 1-3.

for use in the Zambia Sugar factory. The team examined the Guatemalan experience with different blending methods, monitoring methods, and degradation of vitamin A over time.<sup>21</sup>

OMNI also funded publicity surrounding the launch of fortified sugar in May 1998. The bulk of the spending went towards radio and print ads.

## 1.7 Calculating Fortification Levels

Calculations by Dr. Dary had suggested that 15 mg/kg would be the optimal level of fortificant for Zambia, given other sources of vitamin A in the diet and the amount of sugar consumed on average. These calculations were based on the following assumptions:

- Sugar would eventually only be one part of a diet including other fortified foods and therefore need only contribute 30 percent of the RDA for vitamin A.
- The minimum fortification level should be calculated using the average daily sugar consumption by children, 15 g/day.
- The maximum fortification level should be calculated using three times the average daily sugar consumption by adults of 32g/day.
- Only half the initial retinol content would remain in the sugar over its shelf life.

Therefore, to arrive at the minimum level of fortification per gram of sugar, the RDA for infants (400 retinol equivalents) was multiplied by 30 percent (0.3). The result was then divided by the infants average sugar intake per day (15 grams). And, to account for losses in storage, the result of the division was doubled. To arrive at the maximum level of fortification to assure safety, the RDA for adults (600 retinol equivalents) was doubled and, to be safe, divided by three times the daily intake of an adult (66 grams). Again, to account for losses in storage, the result of the division was doubled.

The minimum level thus arrived at was 16 mg/kg and the maximum was 25 mg/kg. Dr. Dary suggested, for practical purposes, that the level be set at 15 mg/kg. Cost of fortificant was one consideration; another was the expected increase in sugar consumption in Zambia.<sup>22</sup>

## 1.8 Legal Levels

The NFNC recommended that packaged sugar be sold with a minimum fortification level of 10 mg/kg, and the Statutory Instrument (SI) No. 155 that was enacted on December 18, 1998, set this as the legal minimum level. This assumes that sugar should be fortified at a higher level, as there will be some fortificant degradation by the time sugar has reached its point of sale.

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<sup>21</sup> Kaputo, M.T., *Sugar Fortification Study Tour Report (22<sup>nd</sup> January–3<sup>rd</sup> February 1998)*, 2–5.

<sup>22</sup> *Zambian Sugar Fortification Technical Committee*, 3.

Statutory Instrument No. 155 amended the Food and Drugs Regulations of 1978. A process for revising the Food and Drug Act had begun in 1997 but had not yet been completed,<sup>23</sup> and the belief was that the quickest way to regulate sugar fortification would be through a Statutory Instrument. Both the Guatemalan sugar regulations and the earlier Zambian salt iodization regulations (Statutory Instrument No. 97 of 1994) served as models for the sugar fortification regulations. Zambia Sugar was consulted on the wording of the Statutory Instrument at least eight months before it was enacted.

While legislation was still being developed, Zambia Sugar went ahead with the launch of fortified Whitespoon Sugar on May 15, 1998. Zambia Sugar began its fortification program at 15 mg/kg, but cost considerations led the company to reduce the level to 10 mg/kg within three months. In May 1997, one year before fortification began, a consultant estimated the cost of fortifying 100,000 metric tons of sugar at 16 mg/kg to be around \$1 million U.S., while fortifying at 20 mg/kg would cost almost \$1.25 million.<sup>24</sup> Reducing the level from 16 to 10 mg/kg could thus have reduced costs by approximately \$375,000 a year.

The revised Food and Drugs Act has been approved and will take effect once the government gazette office has printed it. The new Food and Drugs Act maintains the same guidelines for sugar fortification as those set out in the Statutory Instrument. However, as part of the Food and Drugs Act, these guidelines will be able to be changed without an act of parliament. The MOH has expressed interest in lowering the mandatory minimum fortification level of 10 mg/kg, if research shows that VAD levels have dropped.<sup>25</sup>

## **1.9 Choosing a Fortificant Supplier**

Although initial reports named Roche as a participant in the fortification initiative, BASF was first chosen as the fortificant provider. Both Roche and BASF fortificant had been used in Guatemala's sugar fortification program. Zambia Sugar explains that BASF was chosen both because it was the first to establish a business relationship and because its fortificant was more quickly available to Zambia Sugar.

Records also show that in July 1997 BASF lowered its price and beat Roche's price: Fortification Task Force minutes for July 1, 1997, indicate that the BASF sold fortificant at \$46/kg while Roche sold it at \$38.50. Two weeks later, meeting notes indicate that while Roche was still at \$38.50, BASF was now at \$36.50. A significant deciding factor for Zambia Sugar was BASF's willingness to offer 150 days of credit, while Roche only offered 120 days. Meeting minutes from October 1997 mention that Roche pledged no price increases for two

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<sup>23</sup> Ministry of Health, 30.

<sup>24</sup> Dary, 5.

<sup>25</sup> Malijani interview.

years. The two companies offered slightly different products: BASF was the only producer of DRY-250, an acacia-gum beadlet that is smaller and thought to be more stable than gelatin-based beadlets such as Roche's CWS-250 or BASF's CWD-250.<sup>26</sup>

## **1.10 Core Concerns**

As economic decisions led Zambia Sugar to conclude that fortification was no longer advantageous, three factors compounded the company's frustration with the program: a delay of seven months in enacting legislation, inadequate enforcement of legislation when enacted, and insufficient social marketing of the benefits of vitamin A. The company gave these problems as reason enough to stop fortifying sugar in Zambia.

### **1.10.1 Equipment supply**

An initial concern was that parts donors had initially promised were not available when needed. Zambia Sugar bought some equipment and was reimbursed, while SFH supplied some reagents that UNICEF had promised. UNICEF invoices and letters indicate there were considerable delays in obtaining equipment and notifying the FDCL of its availability. Zambia Sugar considers this initial difficulty to have been simply a communication problem and that it no longer poses a problem.

### **1.10.2 Delay of regulations**

Several months after fortification, Zambia Sugar became concerned about the continuing lack of legal protection against unfortified sugar. NFNC informed Zambia Sugar that the Statutory Instrument was being held up because there were errors that had to be revised. According to a former executive of the company, the delay of the Statutory Instrument almost caused Zambia Sugar to stop the fortification program several months after it had begun.

### **1.10.3 Economic circumstances**

Like many Zambian companies, Zambia Sugar experienced cash flow problems in 1999. The company was owed \$10 million, and it owed \$8 million. Because fortification represented a large single expenditure in excess of \$1 million, it was a clear target for cost cutting. Kwacha depreciation meant that the cost of fortificant, priced in dollars, was rising in relative terms. In addition, the cost of other imported raw materials was affecting profit levels. Zambia Sugar believed that these costs threatened to make its product uncompetitive.

Zambia Sugar had not predicted these levels of depreciation during program planning in 1997. After the 1996 elections, the political situation appeared stable. After a 576 percent

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<sup>26</sup> Dary, Omar, and Mónica Guamuch, *Evaluation of Adherence and Chemical Stability of Vitamin A in Zambian Sugar* (June 12, 2000), 1.

devaluation from January 1992 to December 1993, the Kwacha remained relatively stable from 1994 through the end of 1997, devaluating only 122 percent.

The cost of fortificant had always been a concern for the company, as it is the single largest cost of fortification. Prior to beginning fortification, Zambia Sugar requested \$1 million from USAID to cover the cost of the fortificant. USAID rejected Zambia Sugar's request in January 1998, citing its prior provision of equipment, chemicals, training, and protectionist regulation. USAID support exceeded \$250,000, in addition to the nearly \$100,000 spent on the 1997 baseline VAD survey. USAID did agree to clear the first shipment of vitamin A fortificant, thus exempting it from duty.

#### **1.10.4 Legal enforcement**

The lack of enforcement compounded the situation. Without enforcement, large amounts of smuggled sugar eroded the domestic market share. Prior to fortification, Zambia Sugar estimated that legally and illegally imported sugar accounted for 25 percent of the market share. Over a year later, the company estimated that losses due to smuggling had leveled to 10 percent of market share. In December 1999, Zambia Sugar still told NFNC that due to economic considerations it was likely to discontinue fortification as of the next production cycle in April 2000. In February 2000, the MOH responded that the law would be enforced, but that it understood the need for stronger enforcement of the current law regarding illegal imports of non-fortified sugar. Zambia Sugar chose to continue fortifying its sugar when production began in April 2000.

MOST, the USAID micronutrient program, sponsored the creation of training manuals for health inspectors and Food and Drug enforcement officers, as well as a national training workshop from September 24 to October 7, 2000. The workshop focused on inspection procedures and methods, provided laboratory training where appropriate, and included a trip to the Zambia Sugar plant. Since the implementation of that program, Zambia Sugar has expressed satisfaction with law enforcement efforts. UNICEF subsequently funded workshops at the district level, using reproductions of the training manuals that had been produced with MOST funding.

#### **1.10.5 Promotional campaign**

Zambia Sugar additionally objected to the lack of promised public health education campaign regarding vitamin A. In an April 4, 2000, letter to USAID, Zambia Sugar argued that due to the lack of such a campaign, there has been no greater consumer awareness of the fortified product and therefore less economic benefit to Zambia Sugar. The company requested greater efforts regarding the public information campaign.

From the beginning of fortification negotiations, there had been a clear separation between product promotion and vitamin A promotion. Zambia Sugar believed that it had heavily promoted its product but that more needed to be done to promote the health benefits of vitamin A.

Donors had clearly supported advertising at the launch of the fortified product but in 1999 that support had fallen off. A sub-committee was formed in September 1999 to address concerns about the need for a vitamin A promotional campaign. Donor activity during 1999 was affected by organizational changes within agencies in Zambia, such as BASICS, that had been involved early on with promotional discussions. Late in 1999, the Zambia Integrated Health Program (ZIHP) became involved with the demand creation for fortified sugar. Its initial promotional campaign, “sweet and healthy too,” was rejected by NFNC for promoting the health benefits of sugar. As it became unclear whether the fortification program would continue, development of the public ad campaign halted. Posters, point-of-sale danglers, stickers, and radio jingles supporting sugar as a source of vitamin A were produced by the middle of 2000 but are still awaiting government participation for their launch. Since the inception of ZIHP in October 1998, USAID has funded over \$100,000 on vitamin A promotion by ZIHPCOMM, the communications component of ZIHP.

USAID and the Central Board of Health (CBoH) had also funded a Better Health Campaign that incorporated a vitamin A initiative emphasizing the importance of vitamin A and listing sugar as a resource for vitamin A. In approximately two years of monthly campaigns, four months have been devoted to the benefits of vitamin A. The MOH has expressed its desire for continued assistance to promote the benefits of vitamin A.

### **1.11 Second Sugar Producer: Kalungwishi Estate**

A second sugar producer started operations in Zambia after the fortification program began. Kalungwishi Estate began producing sugar on an experimental basis in late 1998 and started commercial production in March 1999. Since Kalungwishi only began after the new Statutory Instrument requiring vitamin A fortification of sugar had been enacted in December 1998, the company has produced only fortified sugar for sale. Kalungwishi has not received donor support for its fortification efforts but has been fortifying continuously since its inception. At Kalungwishi’s request, the government sent a technical team to the company to advise on fortification.

Kalungwishi produces sugar from May through October, and its production and sales represent approximately 1 percent of the Zambian household sugar market. It is located in Kasama in the Northern Province, which represents its primary customer base.

Kalungwishi has been using Roche fortificant and produces its own premix. Sugar is mixed with the fortificant, while separately mixing oil and antioxidant, then adding the two mixtures. The premix is made using alternative technologies developed by the technical staff at Kalungwishi. They felt that investment in a mixer and a dosifier would be unjustified considering the scale of production at Kalungwishi. They bag the premix in one kilogram bags and store it for dosing into the processed sugar.

The premix is added to the sugar at a rate that produces a final concentration of 15 mg/kg vitamin A in the sugar, 5 mg more than the minimum. Although they have no facilities for testing the sugar, based on the amount of fortificant used they are confident that their vitamin A levels fall within the statutory guidelines. A December 1999 analysis by the FDCL indicated a level of 10.03 mg/kg in Kalungwishi's sugar.

Zambia Sugar's position is that Kalungwishi is not complying with the packaging, labeling, and testing guidelines, and that therefore there is an unequal application of the law. Further, Zambia Sugar categorically rejects any request that it sell premix to its only domestic competitor, as it understandably has no desire to support its competition.

Fortification costs are high for Kalungwishi due to its small production scale. Fortification accounts for 5 percent of its cost of production and reduces its profit by 20 percent. Kalungwishi believes that since its customers are predominantly rural, it cannot afford to pass on the cost of fortification.

## **1.12 Monitoring Actions and Results**

The first outside tests of fortificant levels in sugar were controversial. Four months after the launch of fortified sugar, a team consisting of representatives from the MOH, the NFNC, and NISIR visited the Zambia Sugar mill. The team tested samples from the mill at the FDCL; these tests showed far lower levels of vitamin A than those shown in tests by Zambia Sugar. The government's tests indicated a range of 0–13.6 mg/kg, while Zambia Sugar's tests indicated a range of 9–21 mg/kg for the same samples. Zambia Sugar believes that the samples suffered sedimentation in the transport to the government laboratory and that this explains the different results.<sup>27</sup>

The government team also went on to identify multiple problems with the operation:

- Technicians' initial difficulty following the laboratory manual. An easier manual has been compiled and made available.
- Non-receipt of glassware promised by UNICEF.
- Non-availability of cuvettes for the spectrophotometer.

- Technicians' laboratory not separate from main chemical laboratory, posing a risk of sample contamination.
- Lack of spare parts for mixers.
- Inconsistent mixing due to problems with packaging machines: the paper packaging machine removed dust, but the plastic packaging machine did not.
- Vitamin A's poor adherence to sugar crystals, resulting in fortificant segregation.

The report also mentions customer complaints about the smell and reduced sweetness of the fortified sugar.<sup>28</sup> Since that initial visit in 1998, insufficient resources prevented the FDCL from returning to Zambia Sugar's Mazabuka plant to collect samples. The plant is situated 160 km from the FDCL office in the capital city, Lusaka.

Low levels of vitamin A indicated a potential problem with poor vitamin A adhesion levels. To investigate the problem, BASF visited Zambia Sugar in April 1999, and met with representatives from NFNC, NISIR, and USAID. BASF recommended adding a higher level of oil to achieve a better adhesion rate (2.7 kg instead of 2.0 kg per 125 kg of premix). They also noted that sugar particle size affects adhesion levels and that Zambian sugar has a greater particle size range than Central American sugar (100–2000 µm instead of 425–800 µm). BASF believed that a higher amount of oil would also reduce the tendency of finer fortified sugar particles to sift to the bottom of the mixture. Pursuant to the visit, BASF committed to testing the stability of fortificant and analyzing levels of vitamin A in samples of Zambia Sugar and offered to help identify lower-cost oil, as the process now required larger quantities of oil than initially expected.

MOST tested Zambian household sugar samples from the end of 2000 and found significant variation in vitamin A levels, with most samples falling under the minimum level of 10 mg/kg of vitamin A. MOST also observed that the BASF product had reached the Zambia Sugar mill after its best-use date had expired. BASF is not providing fortificant for the current production season. As of April 2001, Roche is providing a fortificant that is larger in size and believed to be a better match for the size of Zambian sugar particles. This may alleviate some of the adhesion difficulties.

### **1.13 Evaluation: Effect on VAD Levels**

In November and December 2000, the Tropical Diseases Research Center (TDRC) conducted a study to determine whether vitamin A supplementation and fortified sugar had affected vitamin A levels in Zambian children. Sight and Life co-funded the study with the

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<sup>27</sup> Kaputo, M.T., *Vitamin A Sugar Fortification Programme: A Status Report* (October 1998), 4.

<sup>28</sup> Kaputo 1998, 1–2.

TDRC. The subjects of the study were 523 children living in “a sprawling shanty township” called Nkwazi, outside of Ndola.

The study methodology involved randomly selecting every fifth child attending an under-five clinic. A questionnaire asked whether the child received supplements and ate fortified sugar. Ninety-eight percent of the children both ate fortified sugar and received supplements. All of the children consumed fortified sugar. Only 10 children consumed fortified sugar but had not received supplements. The study results showed that the children who received fortification only through sugar had adequate vitamin A levels. Children generally consumed sugar twice a day, in their porridge.

Results from the 2000 study were compared with a baseline study the TDRC conducted in 1996. One hundred children in the same location, Nkwazi, had been selected in the same manner, by randomly choosing every fifth child. Children were questioned and tested in the same manner as the later study, using a Modified Relative Dose Response Test (MRDR), which has been shown to provide a good proxy for vitamin A liver stores. The author of the TDRC study believes that MRDR is a better indicator of vitamin A levels in children than a vitamin A blood concentration test. The MRDR test suggested remarkable results that must be verified.

The preliminary MRDR results indicate that while 78 percent of children in the area had inadequate vitamin A levels ( $p < 0.05$ ) in 1996, only 7 percent of children who had received supplements and/or fortified sugar still had inadequate vitamin A levels in 2000. Those children who were deficient were more likely to have had malaria. The analysis of vitamin A blood concentrations showed positive, yet less dramatic, results: while 64 percent of children in 1997 had vitamin A concentrations under 20  $\mu\text{g}/\text{dl}$ , only 50 percent of children in 2000 were under the limit, and thus classified as vitamin A deficient.<sup>29</sup>

The study’s principal investigator believes that these children are representative of the urban population, with similar lifestyles and supplementation levels. Further studies are necessary to evaluate the true extent to which fortification and supplementation have reduced VAD levels nationwide in Zambia. The MOH would like to source funding for a TDRC survey of vitamin A levels in rural children.

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<sup>29</sup> Kafwembe, E. M., *Does Vitamin A Supplementation Improve the Vitamin A Status of Children* (N.D.).



## **2. Procedure for Fortifying Sugar**

### **2.1 Premix**

To facilitate even distribution of fortificant in household sugar, it is necessary to create a premix of concentrated fortified sugar; this premix is not suitable for direct human consumption. Premix production begins one month prior to the initial sugar harvest. The household sugar used in the premix comes from the previous production cycle. The process of ensuring that all the other necessary ingredients are present should begin several months before premix production. Besides household sugar, the other four ingredients in the premix are retinyl palmitate (vitamin A beadlets), peanut oil, the antioxidant Ronoxan, and nitrogen. The standard combination ratio is 100 kg of household sugar to 25 kg of retinyl palmitate and 2 liters of peanut oil. There are three main steps in the premix process: creation of a sugar-retinyl palmitate blend, creation of a peanut oil blend, and the combination of the two blends.

To blend the sugar and retinyl palmitate, a technician sandwiches retinyl palmitate between layers of sugar in the mixer and blends them for 10 minutes. The first step in creating the peanut oil blend is to heat the oil in the heating chamber to 50–60° C. The other ingredients then mix with the oil for five minutes: first 10 grams of antioxidant and then a nitrogen gas mix. The antioxidant and nitrogen are present to minimize any oxidation potentially caused by the peanut oil. An oil injection pump adds the peanut oil mixture to the mixer. The mixer blends the sugar, retinyl palmitate, and peanut oil mixture for 10 minutes.

The premix is packed in 25 kg bags, then stored for later mixing with processed household sugar just prior to packing. Premix should be used as quickly as possible after its production. If it is not used within the current production season, it should be tested for vitamin A and peroxide levels.

### **2.2 Fortifying Sugar with Premix**

Because of the pronounced rainy season in Zambia, Zambia Sugar harvests sugar cane for only seven months of the year, from April through November. During the wet season, the large haulage equipment cannot harvest the sugar cane. Sugar processing occurs soon after harvest: extract from the sugar cane is centrifuged, and the output from the centrifuge is dried in a drying turbine. After being dried, the product is ready for packing.

Although harvesting is limited to this seven months, packaging occurs year round. Most sugar is fortified and packaged during the production season. However, towards the end of the production season some sugar is bulk-packed and stored for later processing. If all sugar

were packaged directly after production, some sugar packages could wait up to five months on the shelf before being sent out and would absorb moisture and harden. Therefore, during the five months when sugar is not harvested due to heavy rains, bulk-packed sugar is systematically unpacked, dosified with vitamin A premix, and repacked in packaging ready for sale.

Sugar fortification occurs in the dosifier, which is placed between the drying turbine and the packing chute. Fortifying just prior to packing means that there is no further processing of the sugar that could diminish the efficacy of the fortification. One reason for not fortifying sugar long before packing is that vitamin A degrades over time. It is in its most stable state as unopened retinyl palmitate. Another reason is that once sugar has been fortified and packaged for sale, there is a strong potential for vitamin A to segregate from the sugar crystals and settle to the bottom of the package.

## 3. Technical Difficulties

### 3.1 Poor Adhesion

Vitamin A fortificant is purchased in the form of microencapsulated retinyl palmitate. (Although some reports refer to fortificant as retinol, retinol is the form of vitamin A that is absorbed into the body following hydrolysis of retinyl palmitate.) The greatest difficulty in Zambian sugar fortification has been with the adhesion of the retinyl palmitate to the sugar crystals. Manufacturers use oil, such as peanut oil, to create a physical bond between the sugar crystals and the vitamin A beadlets. If adhesion is sub-optimal, this results in segregation: the fortificant settles to the bottom of the package because it is smaller than the sugar crystals. If segregation occurs, consumers are not using sugar with appropriate fortificant levels. Additionally, consumers object because fortificant segregation causes the sugar at the bottom of the bag to look, smell, and taste unusual.

#### 3.1.1 Technical causes

Zambia Sugar has been using a vitamin A beadlet that is different in size from the average Zambian sugar crystal. Zambian sugar particles are generally larger than Central American sugar crystals, and are also less consistent in size. Segregation would be less prevalent if the vitamin A and sugar particles were more closely matched in size.

Because vitamin A is attached to sugar via physical, not chemical, adherence, it can segregate from sugar crystals when exposed to excessive shaking or handling. Sugar manufactured and distributed by Zambia Sugar gets handled excessively due to the heavy dependence on manual labor in the manufacturing and distribution chain, thus promoting vitamin A segregation from the sugar crystals.

#### 3.1.2 Compounding factors

The effect of segmentation is worsened by the common practice of reselling sugar in markets. In Zambia, resellers commonly repackage sugar into small clear plastic bags of 100–300 g. because many consumers cannot afford larger packages of 1–2 kg. In addition to widespread financial restrictions, average household size contributes to consumer demand for repackaged sugar in small amounts. In large extended-family households, individuals prefer to buy food in quantities they can consume quickly. Otherwise, other household members will consume the food they buy.

If there is segmentation in the factory-packaged sugar, it is reasonable to be concerned that only trace amounts of vitamin A may be present in these small bags of sugar. Repackaged sugar from the bottom of the original bag, which would contain the highest concentration of vitamin A, would not appeal to consumers because the color would be more yellow and the

taste and smell less sweet than standard sugar. Any vitamin A present in the repackaged bags also risks speedy deterioration due to UV penetration of the clear plastic bags. As the plastic bags are not labeled, neither consumers nor health inspectors can be certain that they contain sugar that was initially fortified. Rural border areas have the highest levels of non-fortified imported household sugar, usually from Zimbabwe or Malawi.

### **3.1.3 Attempted solutions**

BASF analyzed the adhesion problem in April 1999 at the Mazabuka plant where the production process and sugar crystal sizes were examined. BASF's principle recommendation was that Zambia Sugar increase the amount of oil from 2 to 2.7 kg per 125 kg of premix. Zambia Sugar did add more oil to the premix, adding at times up to 3.5 kg per 125 kg of premix. Although the cost of the added oil is not significant in terms of production costs, higher amounts of oil affect the quality of the sugar, in terms of its color, taste, and smell.

It is possible that the larger beadlets of the Roche fortificant first used in the April 2001 production cycle could reduce segregation, but there are no tests confirming this.

## **3.2 Degradation**

Vitamin A is a relatively sensitive compound that can degrade when exposed to direct UV light or subjected to industrial processing. To date, this sensitivity has not presented extensive problems: fortification guidelines specify the use of packaging materials that shield the product from UV rays. Further, fortified sugar is not subject to industrial processing, as only household sugar is fortified.

As of April 2001, the ownership of Zambia Sugar has shifted from Tate & Lyle to Illovo Sugar of South Africa. The company is looking to cut costs and packaging is an attractive area for this purpose since it accounts for 10 percent of the total cost of production. Zambia Sugar currently uses paper and plastic packaging but has also begun to use some clear plastic bags (paper plus plastic costs four times as much) that could increase the rate of vitamin A degradation. This plastic packaging is currently used on a small scale, but the company is exploring the possibility of using it exclusively. They are also considering shifting to opaque plastic. There are no studies of the effect plastic packaging and UV degradation would have on fortificant levels in Zambia sugar.

## 4. Enforcement Issues

### 4.1 Legal Framework

Statutory Instrument No. 155 of 1998 supports the sugar fortification program in several ways:

- It legally obliges all domestic manufacturers to fortify sugar.
- It protects the domestic market from the sale of non-fortified imported sugar.
- It establishes a uniform standard for the content of fortified sugar across the nation.

In creating this Statutory Instrument, the government consulted with the Food and Drugs Board, appointed by the Ministry of Health to carry out revisions of the law such as regulations on fortified sugar and iodized salt, pursuant to part 4, sec. 22 and 23 of the Food and Drugs Act.

The SI covers four types of sugar: refined, white, brown, and yellow or golden. Sub-regulation 1 specifies that these sugars shall be fortified with vitamin A premix, and that the sugar shall not contain less than 10 mg/kg of vitamin A content (as retinol). The sub-regulation also details appropriate polarization, sucrose, invert sugar content, conductivity ash, humidity, and color levels for refined and white sugar.

Sub-regulation 2 ensures that markets sell only fortified sugar: “A person shall not sell, display or distribute sugar unless the sugar complies with the compositional specifications set out in the sub-regulation (1).”

There has been some confusion over whether the SI also forbids the importation of non-fortified sugar or only forbids the selling of non-fortified sugar on the market. A February 2001 report issued by the National Food and Nutrition Commission, for example, stated that “[t]he challenge in law enforcement however is that the SI does not forbid unfortified sugar coming into the country.”<sup>30</sup>

Part III of the Food and Drugs Act explicitly prohibits the importation of any article that is not in compliance with the act. Section 20 allows importation of such articles for a period of three months only, during which time the importer may take action to bring the article into compliance with the regulations:

- (1) Subject to the provisions of subsection (2), the importation of any article which does not comply with the provisions of this Act is hereby prohibited.

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<sup>30</sup> Besa, E.M., *Sugar Fortification in Zambia. Paper Presented at the Vitamin A Symposium, 6–7 February 2001* (n.d.), 8.

- (2) Where an article sought to be imported into Zambia would, if sold in Zambia, constitute a contravention of this Act, the article may be imported into Zambia for the purposes of satisfactorily relabelling or reconditioning the same so that the provisions of this Act are complied with and, where such relabelling or reconditioning is not carried out within three months of the importation, such article shall be exported by the importer within a further period of one month or such other period as the Minister may determine and, where it is not so exported, it shall be forfeited and disposed of as the Minister may direct.

Those authorized to enforce the regulations include officials from the Ministry of Health and others authorized by the Ministry of Health. Some members of the police force and customs department may carry out certain duties, such as collecting samples. Part I, Sec. 2 of the Food and Drugs Act describes those qualifying as authorized officers:

...“authorised officer” means a Medical Officer of Health, a Health Inspector, or any suitably qualified person authorised in writing by the Minister or by a local authority with the approval of the Minister for the purposes of this Act, and—

- (a) for the purpose of taking of samples under sections *twenty-four* and *twenty-six* and sending them to a public analyst, and for receiving reports thereof under section *twenty-five*, includes a police officer of or above the rank of Assistant Inspector and an officer of the Department of Customs and Excise authorised in that behalf by the Controller of Customs and Excise...

Part IV, Sec. 25 of the Food and Drugs Act enumerates the powers of authorized officers to search and seize evidence. They may

- (a) enter any premises...examine any...article and take samples thereof...;
- (b) stop or search or detain any aircraft, ship or vehicle in which he believes on reasonable grounds that any article...is being conveyed and examine any such article and take samples thereof...;
- (c) open and examine any receptacle or package which he believes contains any article ...;
- (d) examine any books, documents or other records found in any premises mentioned in paragraph (a)...;
- (e) seize and detain for such time as may be necessary any article by means of or in relation to which he believes any provision of this Act has been contravened.

In addition, public analysts, appointed with approval of the minister, are charged with examining samples and issuing a certificate with the results of the analysis, according to Sec. 25 of the Food and Drugs Act.

Contravention of the sugar fortification regulations incurs the standard penalties: A fine not more than one thousand penalty units or imprisonment for less than three months, or both, for first offences, and twice these amounts for subsequent offences.

One piece of legislation has the potential to create difficulties for the sugar fortification program. In 1996, amendment no. 16 to the Zambian Customs and Excise Act specified that vitamin A is a tax-able commodity, subject to a 5 percent duty and 17.5 percent VAT. Currently, ch. 29, sec. XI, subsec. 2936.21.00 of the ZRA Customs and Excise Tariff sets customs duty at 5 percent and VAT at the standard rate of 17.5 percent. For the first year of fortification, Zambia Sugar bought the fortificant through USAID, avoiding the customs duty. Since then, there has been a waiver on the duty but it can be rescinded at any time. The VAT is a different issue. Zambia Sugar pays VAT for all items it purchases that incur VAT. As it turns out, most of what it needs to make sugar is sugar cane, which is grown, so it does not incur VAT. When Zambia Sugar sells its sugar, it collects VAT for the government. Before turning this VAT over to the government, Zambia Sugar is allowed to discount any VAT it has paid for any items purchased, such as fortificant. Since the VAT collected from selling sugar is far greater than the VAT paid on items purchased, Zambia Sugar can always be reimbursed. Since sugar is sold year round, Zambia Sugar accrues a positive VAT balance and when the VAT is due for the fortificant, it all becomes a paper payment, with no actual money exchanging hands.

## **4.2 Scope of Infringement**

Zambia Sugar estimates that up to 10 percent of the household sugar sold in Zambia is non-fortified sugar that has been smuggled into the country but believes that the situation has been improving due to efforts to reduce the smuggling, such as training customs officers.

## **4.3 Key Obstacles to Enforcement**

There is broad agreement that more could be done to strengthen enforcement mechanisms:

- Increasing the number of authorized officers.
- Improving the training of authorized officers, especially in methods of identifying sugar that is being smuggled into the country.
- Providing authorities with the means to test samples in a timely fashion.
- Assuring that authorities have the resources, such as storage facilities, to impound suspect sugar.
- Increasing the financial resources of the Zambian Revenue Authority and the Ministry of Health.

In 1999 and 2000, customs officers received training in enforcement methods, such as identifying whether sugar should be tested and sampled. USAID and UNICEF funded the on-site training and the creation of manuals for the officers.

## 5. Monitoring and Evaluation

### 5.1 Developed Resources

OMNI funded a project carried out by the Institute of Nutrition of Central America and Panama (INCAP) and the Pan American Health Organization (PAHO) that involved creating *Quality Assurance System for Food Fortification Programs: A Manual for Developing Countries*. The manual addresses the specific situations in developing countries that prevent an ideal implementation of standard industry quality assurance methods and outlines methods for quality control that are more appropriate to developing countries. A lack of quality control contributed to the suspension of sugar fortification programs in Central America after the first two to three years. According to the authors of the manual, the lack of proper inspection and documentation resulted in an inability to “monitor program development, estimate the derived benefits, and make necessary adjustments.”<sup>31</sup>

Under ideal circumstances, food producers would be responsible for ensuring the quality of the fortified product and government would test fortified food at distribution and marketing points. It is, however, not realistic to expect government inspection at distribution and marketing locations. Due to a weak enforcement infrastructure in developing countries, it is more appropriate for governments to be involved in monitoring production processes at the factory and at customs points.

The manual details a number of adjustments to standard quality assurance mechanisms that are appropriate for developing countries:

- Testing limited quantities of product samples in quick corroborating tests, rather than systematic food sampling at each visit.
- Conducting a technical audit of the producer’s quality assurance system to confirm the producer is effectively supervising the quality of the food. This is in place of an analysis of a statistically representative number of samples to verify product compliance with standards.
- Training environmental health officials and municipal inspectors to conduct sampling at local distribution points and providing them with fast-analyzing qualitative field kits to test products for nutrients.
- Evaluation of the program’s impact by nutrition agencies and other government officials, NGOs and technical cooperation agencies; e.g., conducting representative household sampling.

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<sup>31</sup> Dary, Omar et al., *Quality Assurance System for Food Fortification Programs: A Manual for Developing Countries*. Edition for Zambia. Part 1: Quality Assurance System for Vitamin A Sugar Fortification (September 2000).

In addition to these adjustments to standard evaluation processes, there are specific needs that developing countries need to address:

- Repackaged foods (foods sold in markets by resellers) should carry fortification labeling.
- Since micronutrient levels deteriorate over time, food packages should indicate guaranteed dates through which there is a minimum level of micronutrients.
- Because food safety units are weak, countries should create a national food fortification committee to supervise fortification programs and issue status reports.

Interviews with several NGOs who contributed to the fortification process in Zambia underscored the need for a central coordinating committee. Organizations that provided initial funding and assistance sometimes did not keep records of their involvement or continue to monitor the project over time. This is currently being rectified. Generally, employees who were present at the initiation of the project from 1996–1998 were no longer present to be interviewed. Thus, in many cases organizations were unclear about the extent of their own participation in the program. Zambia did have a Sugar Fortification Task Force early in the development of the program, but it has not continued to monitor the program.

## **5.2 Actual Monitoring Procedures**

Currently, there is no government monitoring of the fortification program. The Food and Drug Control Laboratory has not been able to analyze samples because it lacks funds for transport and reagents. Ideally, laboratory officials would travel every two weeks to the Zambia Sugar factory, collect samples, and analyze them. The FDCL did some sampling in the first few months of the program, but is no longer doing it because it cannot afford to travel the 160 km from Lusaka to Mazabuka. The laboratory should also analyze samples each week from a different point of sale, but it cannot do this because it does not have the reagents necessary to conduct the analyses.

Zambia Sugar must continuously test its production line every two hours so that it can adjust the dosifier to ensure a consistent vitamin A presence of 10 parts per million. The company also tests its final fortified sugar product, but these tests are done soon after manufacturing so they do not account for segregation and degradation that occurs over time or because of handling and transport. Zambia Sugar does attempt to measure segregation in these early tests, however. When taking samples, testers first wet a bag so that sugar sticks to its side. In this way, sugar is fixed on the sample at the same location as it was inside the bag. This is a more exact procedure than pouring out sugar, which could cause resettling and reshifting and make it more difficult to determine whether there is segregation.

Although Zambia Sugar carries out its own internal quality assurance, the inability of the FDCL to carry out sample analysis means that there is no outside monitoring of sugar fortification.



## 6. Economic Assessment

### 6.1 Zambia Sugar's Positioning

At the end of 1999, Zambia Sugar began talks with the GRZ and the donor community in Zambia regarding the economic impact of the fortification program. The company was in the midst of a poor fiscal year (October 1999–September 2000) for several reasons:

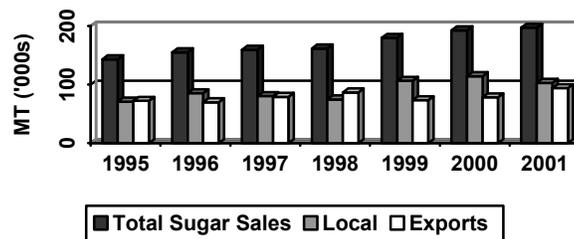
- There were fewer crop days projected due to an early wet season.
- Sales were projected to be down in all critical categories.
- The exchange rate had depreciated over 35 percent during the past year.
- Exports earning hard currency dropped drastically, in part due to unrest in D. R. Congo.
- Production costs, which had dropped for four straight years, had leveled off at the same level as the previous year without dropping. The effort to continue production cost reduction has been impeded by the relatively high cost of fortification.

The government remained committed to the fortification program. There was little USAID could do to assist with the costs of fortification as it would not directly purchase fortificant. When Zambia Sugar argued that it could not compete against the lower production costs of neighboring countries, USAID offered to help fund efficiency initiatives while also remaining committed to funding efforts to enforce existing legislation. At that time, Zambia Sugar was in a state of flux; Tate & Lyle was to sell its shares to Illovo a year later. Zambia Sugar was also unprepared to tie itself to continued fortification as a condition for accepting funding for an efficiency exercise.

### 6.2 Sales Figures

Domestic sales of household sugar have increased markedly since fortification. Zambia Sugar began fortifying in May 1998. The chart below shows that domestic sales increased by over half from March 1998 to March 2000. Prior to fortification, from 1995 to 1998, sales of domestic sugar had been relatively steady.

Chart 1: Sugar Sales  
(April-March)



Several factors contributed to the rise in 1999 figures:

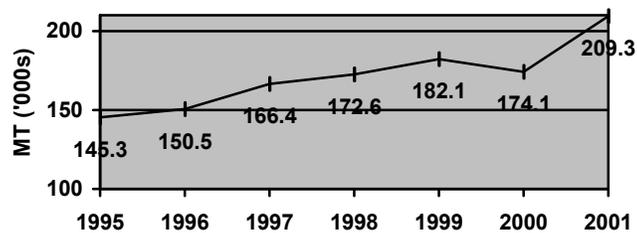
- Zambia Sugar's aggressive marketing campaign of the new fortified household sugar brand.
- The government's media campaign to promote fortified sugar.
- Improved sugar distribution.

The results in 1999 belied the poor economic conditions in Zambia at the time. The domestic sales for fiscal 2001 were slightly more modest, but are probably a better indicator of the expected sales levels for Zambia Sugar. Nonetheless, domestic sales have improved significantly compared to sales prior to fortification.

### 6.3 Production Levels

Zambia Sugar has been increasing its production steadily since 1995 and, in fact, surpassed 200,000 MT of sugar produced for the first time in its history during the 2000 production season.

Chart 2: Zambia Sugar Production History  
(April-March)



Since production can only take place during the dry season, the length of the wet season significantly affects production levels. The early onset of the rainy season at the end of 1999 contributed to the lower production levels for the 1999 production season. In most years, Zambia Sugar is in production through November and has 220–240 crop days per year. In 1999, Zambia Sugar was forced to terminate production early, and fiscal year 2000 production occurred over only 212 crop days. Despite the shorter season, fiscal year 2000 data showed the highest ever production amount per crop day to that point.

The limits to production appear to lie in the amount of sugar cane that Zambia Sugar can harvest rather than market demand. Historically, Zambia Sugar has been able to expand its market in order to sell whatever is made.

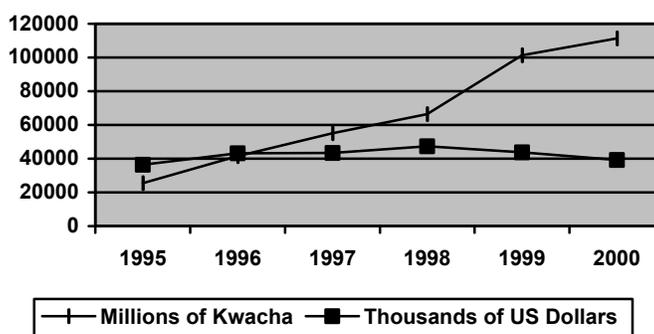
## 6.4 Income and Expenses

In an effort to become more efficient, Zambia Sugar has continuously reduced its cost of production in hard currency terms. Its factory costs have dropped by nearly 40 percent from 1995 to 2000.

Although the cost of production has dropped, the real cost of sales has remained constant. While Zambia Sugar's cost of sales has increased in Kwacha terms, in hard currency terms it has remained steady. Chart 3 shows the cost of sales both in absolute Kwacha costs and relative U.S. dollar amounts. The exchange rate for each year is provided to help interpret the charts. Cost of production represents the costs associated with the production of sugar, while cost of sales includes production costs and all other marketing and overhead costs.

The following charts illustrate the gap between rising Kwacha figures and flat U.S. dollar figures for income and expenses. Although charts 1 and 2 show increases in sales and production, chart 4 shows a drop in the price of sugar in dollar figures and chart 5 demonstrates that real turnover has decreased. Zambia Sugar's turnover has eroded in real terms due to the accelerated depreciation of the Kwacha in the past three years. It would have been difficult to increase the Kwacha price of sugar any more because devaluation also decreased consumer purchasing power in what is already a very price-sensitive market.

Chart 3: Cost of Sales\*



\*1995–1998 data is from April–March and 1999–2000 data is from October–September.

Table 1: Exchange Rates<sup>32</sup>

	1995	1996	1997	1998	1999	2000
Kwacha/US Dollar	700	960	1270	1400	2320	2840
Percent Change		+37%	+32%	+10%	+66%*	+22%

\*The 66 percent depreciation is over an 18-month period corresponding to Zambia Sugar's decision to change its end of fiscal year from March to September. The annualized depreciation would be 44 percent.

<sup>32</sup> Official Bank of Zambia exchange rates.

Chart 4: Sale Price of 1 MT of Sugar

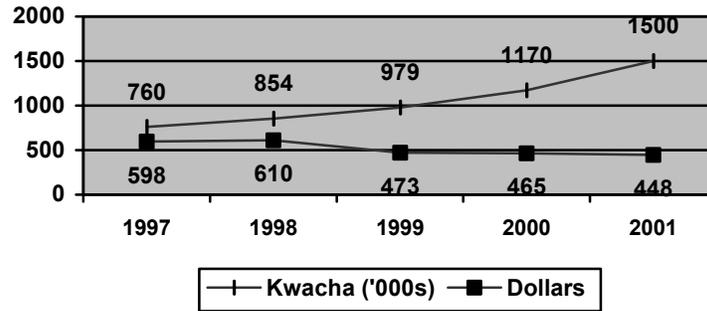
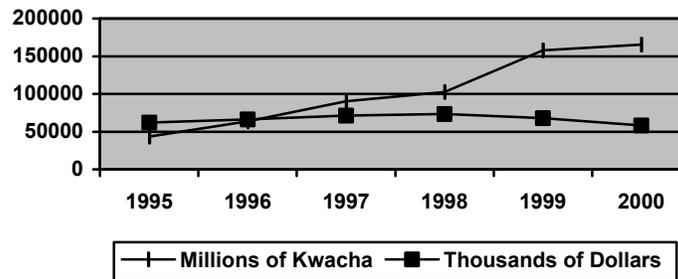


Chart 5: Net Turnover\*



\*1995–1998 data is from April–March and 1999–2000 data is from October–September.

Reduced exports and a depreciating currency increase the cost of sales. By and large, Zambia Sugar’s expenses are in Kwacha, but the company does incur significant hard currency expenses, specifically in regards to equipment and spares. The declining export market, coupled with a depreciating Kwacha, has reduced the hard currency value of sales.

## 6.5 Fortification Costs

Zambia Sugar suffers significant exchange losses when the Kwacha depreciates. One of the most significant hard currency expenses for Zambia Sugar is vitamin A fortificant. The cost of fortificant has stayed constant in U.S. dollar terms since 1998, but is two and a half times as high in Kwacha terms. The dollar cost for each part per million (ppm) fortification of sugar has remained at approximately \$1 per metric ton. Since Zambia Sugar’s domestic earnings are in Kwacha and its exports (which earn hard currency) have been declining, the cost of fortifying sugar has increased as a percentage of cost for these three years. Due to the competitive regional environment, Zambia Sugar does not allow the release of exact production cost figures, but fortification represents approximately 5 percent of the total cost of production.

## 7. Conclusion

During initial planning for a sugar fortification program in Zambia, the focus was naturally on technical concerns such as the feasibility of adding fortificant to a food and monitoring fortificant levels. Attention also centered on public health objectives: research was conducted regarding the extent of the problem to be addressed as well as consumption levels and availability of potential fortified foods.

The example of the Zambian fortification program illustrates that it is also advisable to analyze an industry's capability to absorb the economic impact of fortification. In the case of Zambia Sugar, such an initial analysis would have indicated that the company was well situated to pay for fortification because it would profit from an increased domestic market, heightened efforts to curb smuggling, and a public health campaign promoting the value of the vitamin it was providing. General economic circumstances then changed to such a degree that the fortification program represented a greater economic burden than initially anticipated. Fortification programs implemented in economically and politically unstable environments should consider how to maintain a viable fortification program when conditions change, as they have in Zambia. Fortification programs in other African countries with currency devaluations are likely to face the same obstacle of the hard currency price of fortificant. Any means of negotiating more favorable conditions for purchasing fortificant would increase the economic argument in favor of fortification.

It was not only a difficult economic situation that jeopardized fortification in Zambia. Zambia Sugar's perception that it was no longer receiving support from the fortification team led it to conclude that it, too, could opt out of the program. Promised regulation was long delayed, customs enforcement suffered from a lack of training, and the public health education message was not adequately sent out. Key to the resolution of these problems and the eventual success of the program was the communication network that existed, due in part to the existence of the Fortification Task Force. The task force maintained a core membership throughout the entire fortification program and was flexible enough to respond to various problems. A more stable structure (e.g., meetings at more regular intervals) would have allowed the task force to respond more quickly to problems as they arose. Although government, donor, and industry representatives operated according to different interests, all supported the public health objectives of the program. Further research demonstrating the effectiveness of sugar fortification as a means of reaching all population groups, both urban and rural, would strengthen the public health argument for such a program.



## Appendix A

### Chronology

- 1990 Vitamin A supplementation program begins.
- 1993 Three national task forces (on vitamin A, iodine, and iron deficiencies) were combined to form a National Task Force for the control of micro-nutrient malnutrition.
- 05/1996 Vitamin A technical planning meeting, organized by NFNC and UNICEF, held in Siavonga
- 07/1995– Privatization of Zambia Sugar PLC: Tate & Lyle purchases 51 percent of  
06/1996 Zambia Sugar shares for \$14.8 million.
- 08/1996 Exploratory visit by FTF to ZS; ZS machinery compatible with sugar fortification technical requirements
- 10/1996 NFNC and NISIR make first visit to ZS
- 03/1997 First meeting of FTF
- 05/1997 ZS commits to decide on fortification by 07/1997
- 09/1997 Zambia National Baseline Survey on VAD
- 01/1998 Zambian delegation travels to Guatemalan sugar fortifiers.  
Five-person team consists of representatives from NFNC, NISIR, ZS, and FDCL.  
ZS requests a spectral photometer based on Guatemala meeting.
- 05/1998 ZS introduces new brand name, packaging, fortified sugar at once; moves offices from Lusaka to Mazabuka.  
UNICEF procures glassware and chemicals for testing
- 09/1998 Team visits ZS factory to assess program implementation.  
Indications that FDCL results differ greatly from ZS lab results.
- 12/1998 Statutory Instrument No. 155 of 1998 enacted
- 03/1999 BASF lab tests indicate more oil needs to be added to the premix to boost adhesion of fortificant to sugar.
- 04/1999 BASF visits ZS: informs NFNC, NISIR and ZS that 2 main components in adhesion problem are oil quantities and sugar particle size.
- 09/1999 FTF renews commitment to public education campaign, which has been delayed.
- 09/2000 Quality Assurance System is published. Written by members of INCAP and supported by USAID, MOST, and the International Eye Foundation.
- 02/2001 Tate & Lyle sells its 50.87 percent share in ZS to Illovo Sugar Limited for \$11.4 million.
- 04/2001 Roche begins providing vitamin A fortificant to ZS.



## Appendix B

### Key Roles

FTF	Fortification Task Force	Members include representatives from: NFNC, NRDC, TDRC, ZRA, ZS, NISIR, MOH, NFDL, MOF, UNICEF, USAID, OMNI, SFH, JICA, Roche, BASF	To meet every 6–8 weeks to monitor program. Initially responsible for analyzing feasibility of sugar fortification. Responsible for developing other food fortification programs.
ZS	Zambia Sugar Plc	Managing Director, Sales & Marketing Manager, Factory Manager, Marketing Services Manager, Production Manager, Factory Chemist	Purchases fortificant. Ensures that supplies are available to begin premix production one month before sugar harvest. Tests fortificant level in daily composite samples of premix. Checks that dosifier is dispensing accurate amounts of premix. Tests retinol content of daily composite samples of fortified sugar. Stores last 30 days' composite samples to be made available to health inspector. Advertises fortified sugar brand.
NFNC	National Food and Nutrition Commission		Leads national efforts to reduce VAD Coordinates all sugar fortification-related activities Provides secretarial services to fortification program. Visits the sugar mill one month before sugar harvest to ensure premix preparation is ready to begin. Conducted dietary survey of sugar consumption, together with National Institute for Scientific and Industrial Research and Natural Resource Development College.
NISIR	National Institute for Scientific and Industrial Research <sup>33</sup>	Food Technology Research Unit	Tests sugar fortification process Evaluates shelf life of fortified sugar in Zambia. Visits the sugar mill one month before sugar harvest to ensure premix preparation is ready to begin.
FDCL	Food and Drug Control Laboratory		Responsible for certifying retinol levels in factory samples of premix and sugar, as well as retinol levels in household sugar samples. <sup>34</sup> Visits factory to review premix production. Tests fortified sugar samples if requested by MOH. Gathers results from provincial laboratory analyses of local sugar samples Tests imported sugar to confirm that it is fortified.

<sup>33</sup> Formerly National Council for Scientific Research

<sup>34</sup> Dary, 6.

CSO	Central Statistical Office		Collects sugar samples from households in the semi-annual household survey. National Vitamin A Program manager would coordinate this household surveillance system. Food Science & Technology department of the University of Zambia analyzes the sugar samples.
FHANIS	Food, Health and Nutrition Information Systems		Conducts semi-annual household surveys.
TDRRC	Tropical Diseases Research Centre		Conducts research on VAD levels.
ZABS	Zambia Bureau of Standards		Formulated standards for fortified sugar and participates in compliance monitoring. Requests “appropriate authorizations by the World Trade Organization.” <sup>35</sup>
USAID	US Agency for International Development		Provides spare parts for blender/mixer for premix; dosifier; prepares manuals for enforcement; funds national workshop; funds IEC material for vitamin A fortification through ZIHPCOM.
OMNI	Opportunity for Micronutrient Intervention		Funded initial consultant analysis of potential for sugar fortification in Zambia.
MOST	Micronutrient Operational Strategies and Technologies		Analyzed household sugar samples from 3 areas in Zambia in Q4 2000.
BASICS			Assisted in social marketing campaign.
JICA	Japanese International Cooperation Agency		Bought spectrophotometers for the FDCL and ZS
UNICEF	United Nations Children’s Fund		Funded 1996 meeting and year 2000 training manuals
WHO	World Health Organization		
INCAP	Institute of Nutrition of Central America and Panama		Developed comprehensive quality assurance system for sugar fortification
SFH	Society for Family Health		Assisted JICA’s purchase of spectrophotometers
MOH	Ministry of Health	Environmental and Food Safety Unit, Central Board of Health	Ensures that imported sugar complies with statutory instrument Receives copies of ZS purchase orders of fortification material, 4 months before harvest, to ensure program will be ready to proceed on time, 1 month before harvest
ZRA	Zambia Revenue Authority	Health Inspectors	Ensures that imported sugar complies with statutory instrument: issues Inspection Certificate
MoL	Ministry of Legal Affairs		Responsible for drafting Revised Food and Drugs Regulations.

<sup>35</sup> Zambian Sugar Fortification Technical Committee, 7.