SPECIAL ARTICLE

FOOD FORTIFICATION — A FEASIBLE, COST-EFFECTIVE OPTION IN THE FIGHT AGAINST VITAMIN A DEFICIENCY IN SOUTH AFRICA

Michael K Hendricks, John L Fiedler

More than a decade ago, the world collectively pledged to combat the scourge of vitamin A deficiency (VAD). In 1990 at the World Summit for Children and in 1992 at the International Conference on Nutrition high priority was given to the elimination of VAD by the year 2000.[1] Although considerable progress has been made in combating VAD, it remains a major health problem for much of the world. According to the World Health Organisation (WHO), VAD is a public health problem in more than 60 countries, putting at risk the lives of 250 million children, while at least 5 million develop xerophthalmia and half a million go blind every year.[2] In South Africa, 33% of children under 6 years of age are marginally deficient in vitamin A (serum retinol level < 20 µg/dl), making VAD a significant public health problem.[3]

Both clinical and subclinical VADs may lower resistance to infection, placing mothers and children in particular at increased risk of mortality and morbidity.[4] Generally, a combination of interventions is needed to reach the VAD population and to control VAD effectively. High-dose vitamin A supplementation in postpartum women and preschool children is a quick-acting solution that can prove effective in the short term while planning and implementing more sustainable, medium- to long-term solutions such as food fortification and dietary modification. Periodic evaluation of the coverage and impact of the specific combination of these three interventions may be used to adjust programmes. Generally, adjustments consist of down-sizing national supplementation programmes and targeting them on populations whose needs are not adequately addressed when a fortification programme is implemented, or as the generally much slower dietary modification approach takes effect.[5]

Child Health Unit, Department of Paediatrics and Child Health, University of Cape Town

Michael K Hendricks

Social Sectors Development Strategies, Sturgeon Bay, Wisconsin, USA

John L Fiedler,

Around the world fortification with vitamin A has been demonstrated to be among the most effective and efficient interventions in reducing VAD. For example, a recent comparative analysis of three Guatemalan vitamin A interventions, namely fortification of sugar, high-dose supplementation and home gardens together with nutritional education, found that the fortification programme was the most cost effective. The programme's annual cost per person covered was a mere US$0.29, and it reduced the prevalence of VAD by 94% within 2 years.[6,7] Although the programme of choice depends on a number of country-specific factors, experience to date suggests that if food consumption patterns, particularly those of the VAD population, are such that food fortification can have a large impact in reducing VAD, then it is the programme of choice. It is more cost effective, more sustainable and achieves wider coverage than supplementation.

There is a wealth of experience of fortifying foods with vitamin A in both developed and developing countries. Success has been achieved with vitamin A fortification of sugar in Costa Rica, El Salvador, Guatemala, Honduras, Panama and Zambia; margarine in the Philippines, Brazil, Chile, Colombia, El Salvador and Mexico and wheat flour in the Philippines. In South Africa, efforts to combat VAD have focused on the development of a high-dose vitamin A supplementation programme and a food fortification programme.[6] A Food Fortification Task Group consisting of representatives from the Department of Health, industry, non-governmental organisations and the academic institutions was established to oversee the development of a national fortification programme in 1997. A major task of this group has been the selection of one or more food vehicles.

Identification of the appropriate food vehicles that meet the criteria for fortification, viz. wide consumption by the at-risk population, affordability, accessibility and inability to be affected organoleptically by the fortification process, is a fundamental first step in establishing an effective food fortification programme.[6] As part of this work a National Food Consumption Survey (NFCS) was conducted among children aged 1 - 9 years. It showed that maize meal, wheat flour and sugar were among the most commonly consumed foods.[8] Data from the Bureau of Market Research confirmed that these were the foods most commonly purchased by the lowest income quintile of the population, a group particularly vulnerable to VAD, thereby making them ideal food vehicles in a national fortification programme.[9] However, before South Africa can select the best food vehicle or vehicles some additional considerations must be addressed.

Although maize meal is widely consumed, there is substantial interprovincial variability in consumption rates, which detracts from its attractiveness as a single food vehicle in a vitamin A fortification programme.[10] The 1994 Household

Expenditure Survey found that while nationally 78% of households consumed maize meal, consumption among households varied from 53% in the Western Cape and Gauteng, to 90% in the Northern Province and Eastern Cape. To reach the most at-risk households, where consumption of maize meal is low, another or an additional food vehicle, such as wheat flour, which is more commonly consumed in the provinces where the prevalence of VAD is high (National Association of Maize Millers — unpublished data), would need to be fortified. Unlike maize meal or wheat flour, sugar is consumed by 91% of households, with little inter-provincial variability in consumption (range 78 - 97%), making it the preferred, single food fortification vehicle from a coverage perspective.

Moreover, there are a number of factors favouring the selection of maize meal together with wheat flour as fortification vehicles. Food consumption survey-based simulations reveal that fortifying maize meal would be more effective than fortifying sugar in increasing vitamin A adequacy in rural children, the group at greatest risk of VAD (84% and 48%, respectively); while in the case of peri-urban children, the converse was found.[10] Fortifying maize meal was found be much less costly — 40% of the R58.1 million it would cost to fortify sugar (based on a vitamin A intake of 100% of the recommended daily allowance (RAD)).[10] However, the study did not investigate the impact or cost of fortifying wheat flour. If these costs were similar to the cost of fortifying maize meal, it would still be cheaper to fortify both maize meal and wheat flour compared with sugar.

Another factor favouring the fortification of maize meal and wheat flour over sugar is the greater already-demonstrated potential for multiple micronutrient fortification of flour. To date, sugar has been fortified exclusively with vitamin A, whereas in some countries, Venezuela for example, corn flour is fortified with vitamin A, iron, thiamine, niacin and riboflavin.[6] Due consideration should be given to fortifying with multiple micronutrients, as the NFCS has revealed that there are widespread deficiencies of calcium, iron, zinc, selenium and vitamins D, C, E, B_2, B_3 and B_6, in addition to the 70% deficiency in vitamin A, and there are economic reasons for considering the concurrent addition of other micronutrients.[8] Although the addition of multiple micronutrients increases the cost of fortification, it is a cost-effective method for addressing different micronutrient deficiencies simultaneously. Furthermore, the combination of micronutrients such as iron and vitamin A could enhance the effect of fortification.[6]

There are, however, some obstacles to the selection of maize meal and wheat flour, including high losses during storage and cooking, problems in ensuring homogeneity of the fortified food[11] and the large number of small millers,[10] making the monitoring of the fortified product difficult. In contrast, the sugar industry consists of a small number of large plant operations, which facilitates monitoring. Sugar fortification, however, is not without its pitfalls. A concern of national refineries is that illegal imports of non-fortified sugar could undermine the programme by undercutting the price and competitive position of the fortified product.[10]

Apart from the selection of food vehicles, perhaps the main constraint to establishing a food fortification programme is cost. The start-up costs could be supported by foreign exchange through donor agencies for the purchase of the requisite fortification and monitoring equipment and the fortificant. In the long term, recurrent production costs are likely to be passed on to the consumer, and the government should be expected to bear the costs of regulating the programme to ensure its impact and integrity. The extent to which cost considerations may require some type of government intervention will depend on how expensive the programme is and how much it is likely to increase the price of the fortified food. While experience with flour is very limited, to date the increase in the price of the fortified food has been minimal, and has not required any type of government price regulation or permanent subsidy. In Guatemala, for example, the cost of sugar fortified with vitamin A was only 2% more than the cost of non-fortified sugar. Where multiple micronutrients are introduced, however, the increased costs may require some type of government action.[6,12]

Key factors determining the success of a fortification programme are the political will and support of industry and government in establishing the programme. Public education and information dissemination about the extent of vitamin A and other micronutrient deficiencies, their impact on health and economic productivity and the benefits likely to accrue through fortification can play an important role in promoting the development and maintaining this commitment. Support should include political and financial incentives as well as legislation for mandatory fortification and regulation. Ongoing promotion of fortified foods to consumers is critical in creating and sustaining the demand for these products and in ensuring that the programme achieves its goal of reducing VAD.[13]

Finally, food fortification is a feasible and cost-effective strategy in eliminating VAD and meeting the nutritional needs and rights of children in South Africa. It is essential, based on the next steps identified, that action be taken to make this important programme a reality.

References

1. World Health Organisation/Food and Agricultural Organisation (WHO/FAO). *International Conference on Nutrition: Final Report of the Conference*. Rome: FAO, 1992.
2. Potter AR. Reducing vitamin A deficiency could save the eyesight and lives of countless children. *BMJ* 1997; **314**: 317-318.
3. The South African Vitamin A Consultative Group (SAVACG). *Children aged 6 to 71 Months in South Africa, 1994: Their Anthropometric, Vitamin A, Iron and Immunisation Coverage Status*. Isando: SAVACG, 1995.
4. Sommer A. Vitamin A: its effects on childhood sight and life. *Nutr Rev* 1994; **52**: S60-S66.
5. ACC/SCN. State-of-the-art series nutrition policy discussion paper no. 14. *Controlling Vitamin A Deficiency*. A report based on the ACC/SCN Consultative Group Meeting on Controlling Vitamin A Deficiency 28 - 30 July 1993, Ottawa, Canada, January 1994.
6. Nilson A, Piza J. Food fortification: a tool for fighting hidden hunger. *Food and Nutrition Bulletin* 1998; **19**(1): 49-60.

7. Phillips M, Sanghvi T, Suarez R, McKigney J, Fiedler J. The costs and effectiveness of three vitamin A interventions in Guatemala. *Soc Sci Med* 1996; **42**: 1661-1668.
8. Labadarios D, Steyn N, Maunder E, *et al. The National Food Consumption Survey (NFCS): Children Aged 1- 9 Years, South Africa.* Pretoria: Department of Health, 1999.
9. de van Wyk H. *An Investigation Into the Suitability For Fortification of a Range of Food Products.* Report by the Bureau of Market Research, University of South Africa, Pretoria, 1999.
10. Hendricks MK, Saitowitz R, Fiedler J, *et al.* An assessment of the feasibility, coverage and cost of fortifying maize meal and sugar with vitamin A in South Africa. *South African Journal of Clinical Nutrition* 2001; **14**(2): 46-52.
11. National Food Science and Technology Programme. *Report on Stability Tests and Sensory Evaluation of Fortified Food Vehicles for the National Food Fortification Programme.* Pretoria: Bio/Chemteck, CSIR, 2000.
12. World Bank. *Enriching Lives. Overcoming Vitamin and Mineral Malnutrition in Developing Countries. Development in Practice.* Washington DC, 1994.
13. Darnton-Hill I. Overview. rationale and elements of a successful food-fortification programme. *Food and Nutrition Bulletin* 1998; **19**(2): 92-100.

Accepted 8 June 2001.

A PROPOSED VITAMIN A SUPPLEMENTATION PROGRAMME FOR SOUTH AFRICA – DESIGN, COVERAGE AND COST

R Saitowitz, M Hendricks, J Fiedler, I le Roux, G Hussey, B Makan

Background. A national survey of the micronutrient status of preschool children in South Africa established that vitamin A deficiency is a significant public health problem, requiring urgent attention. A number of immediate and long-term interventions were recommended, including the introduction of a vitamin A supplementation programme and a food fortification programme.

Objectives. The aim of the study was to assist in the development and implementation of a national vitamin A supplementation programme at primary health care facilities for mothers and children. This was achieved by determining the design, coverage and cost of a national primary health care facility vitamin A supplementation programme.

Methods. Based on an extensive review of the literature, the main components of a primary health care facility vitamin A supplementation programme were identified. The annual, recurrent costs of each of the programme components were estimated for the nine provinces in South Africa. Immunisation coverage rates were used as a proxy for estimating the coverage of the programme.

Results. The main components of the programme were identified as: promotion, training, purchase of vitamin A capsules, distribution of vitamin A capsules to primary health care facilities, distribution of capsules to the programme beneficiaries, and monitoring and evaluation. The programme would operate from primary health care facilities and would target all children between 6 and 24

Child Health Unit, Department of Paediatrics and Child Health, University of Cape Town
R Saitowitz, BSc Hons, MSc
M Hendricks, MB ChB, MMed (Paed), MTropPaed, DCH
G Hussey, MB ChB, MMed (CH), FFCH, MSc (Trop Med), DTM&H
Social Sectors Development Strategies, Wisconsin, USA
J Fiedler, PhD
Nutrition Subdirectorate, Provincial Administration of the Western Cape
I le Roux, Med Lic (Sweden)
Health Economics Unit, University of Cape Town
B Makan, BCom Hons, MPH