Iron fortification of soy sauce in China

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The nutritional status of a population is one of the factors that significantly affect its health and productivity and consequently the economic development of the community. Among the nutritional deficiencies, iron deficiency is a global nutritional problem, especially in the developing countries. The main explanation for this deficiency is the low bioavailability of dietary iron in the plant-based diets that are typically consumed in many developing countries. Iron deficiency reduces mental development in infants and cognitive capacity in schoolchildren (Lozoff and Wachs, 2001) and decreases immune-system capability and working capacity in adults. It also adversely affects pregnancy outcomes, producing, for example, increased maternal morbidity and mortality, premature delivery and low birth weight of infants (Micronutrient Initiative, 2000).

Iron deficiency in China

The Chinese dietary pattern is predominantly plant based, and even among the general population, consumption of cereals and vegetables is higher than in the diets common in Europe and North America. The bioavailability of iron in a regular Chinese plant-based diet is as low as 2.57 percent, whereas in a diet with 144 g of meat the iron absorption is 10.39 percent (Liu, 1999). Information from a 1992 nationwide nutritional survey indicated anaemia prevalence in all age groups in China. The national average prevalence of anaemia among women was 22.7 percent, while for men it was 14.6 percent (Ge, 1996). According to the nutrition survey carried out in 2000, the prevalence of anaemia among children under the age of five was 12.3 percent in urban areas and 26.7 percent in rural areas. The peak of anaemia occurs in the first year of life, with 25.6 percent of infants aged less than six months affected in urban areas and 36.7 percent in rural areas; in children aged 6–12 months, the prevalence was 26.4 percent and 50.3 percent, respectively. In women of reproductive age, 27.5 percent in urban areas and 41.2 percent in rural locations were anaemic. Data collected on the iron status of

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infants showed that among iron-deficient mothers, 31.8 percent of the children were iron deficient, while among non-iron-deficient mothers, iron deficiency in infants was only 18.8 percent (Chen, 2001).

In the 1992 national nutrition survey, the anaemia prevalence of 60-, 70- and 80-year-old men was 21.6, 30.5 and 38.5 percent respectively in urban areas, and 26.3, 36.3, and 39.1 percent in rural areas. These figures are twice as high as those for adults aged 40–50 years (Ge, 1996).

Estimate of economic loss due to iron deficiency

The economic loss due to anaemia has been calculated based on the method known as PROFILES (Ross, 1999), a tool designed to calculate the effects of malnutrition on economic losses due to morbidity, mortality and productivity, all of which are important to policy-makers. The PROFILES process includes the use of computer spreadsheet workbooks with a series of user entry sheets that accept nutrition prevalence, demographic data, model coefficients and economic information. Alternative scenarios can be described, representing different degrees of improvement in nutritional status, providing estimates of both the consequences of malnutrition if there is no improvement and the benefits of improving nutrition in line with specified targets (Ross *et al*., 2002).

Productivity loss among adults

The PROFILES model assumes a direct relationship between the level of anaemia and adult manual labour productivity. Levin *et al*. (1993) reported that workers with iron deficiency anaemia are less productive in physical tasks than are non-anaemic workers, producing 1.5 percent less output for every 1.0 percent that their haemoglobin is below standard. This conclusion is based primarily on the results of a study conducted in Indonesia by Basta *et al.* (1979), but is supported by extensive literature (reviewed by Levin *et al*., 1993). Ross and Horton (1998) estimate that iron therapy in anaemic adults results in a 5 percent increase in manual labour productivity and an additional 12 percent increase in heavy manual labour productivity.

The calculation of lost productivity due to iron deficiency anaemia in adults uses these estimates together with the demographic data to calculate productivity losses. The anaemia rates for women at the national level were taken from a 1998 survey and have been adjusted for altitude (Institute of Pediatrics, 1998). For men, the only data available are from the 1992 National Nutrition Survey (Ge, 1996). No estimates of the consequences of iron deficiency in the 1992 model are reported because there is no evidence that anaemia has been reduced in the past ten years.

It has been estimated that the total productivity loss due to anaemia in adults in China over the next decade (2001–2010) will be 702 billion yuan renminbi (equivalent to US$85.03 billion). In 2001, it was 51.6 billion yuan renminbi (equivalent to US$6.25 billion), which accounted for a loss of 0.73 percent of gross national product (GNP) (see Table 1).

Productivity loss among children

Observational studies of the relationship between iron deficiency anaemia and mental performance are remarkably consistent in finding that infants with moderate iron deficiency anaemia have test scores that are 0.5 to 1.5 standard deviations lower than those of infants with sufficient iron stores (see reviews by Lozoff, 1988; Pollitt, 1993). Similarly, children aged two years and above scored about one-half a standard deviation lower on intelligence tests than did the non-deficient control group (Pollitt, 1993).

The implications for educational performance and future productivity of such iron-deficient groups have been reviewed recently by Ross and Horton (1998), who estimate that anaemic children will suffer a 2.5 percent future productivity loss. Unlike productivity declines resulting from anaemia in adults, the loss among children will not be restricted to manual labour but could apply to any economic activity. It is assumed, further, that the effect of iron status on cognition is permanent and cumulative. The implication is that the lifetime discounting factor for all children under 15 in any given year can be calculated as the average lifetime

TABLE 1

Effects of iron deficiency anaemia on the economic productivity of adults

VARIABLE	CHINA	
	WOMEN	MEN
Working-age population in 2001 *(millions)*	442.0	431.6
Anaemia, prevalence in 2001 *(%)*	35.6	13.7
Annual wage (manual sectors) *(yuan renminbi)*	8 353	
Effective employment rate *(percent)*	46.5	56.0
RESULTS		
Productivity lost due to anaemia over ten years *(billions of yuan renminbi)*)	484	218
Total productivity losses in 2001 *(yuan renminbi/capita)*	51.6	
GDP *(yuan renminbi/capita)*	7 078	
Lost productivity as percentage of GNP	0.73	

SOURCE: J. Ross, *et al.* (forthcoming).

TABLE 2

Data and results related to the effects of iron deficiency anaemia on the future productivity of children

VARIABLE	CHINA
Population, age 0–14 *(millions)*	305 392
Prevalence of child anaemia in 2001 *(percent)*	21.7
Target prevalence in 2010 *(percent)*	15.2
Effective employment rate (all sectors) *(percent)*	80.1
Annual wage (average, all sectors) *(yuan renminbi)*	9 371
Mean lifetime discounting factor *(in years, age 1–15)*	20.9
RESULTS	
Net present value of future productivity lost over 10 years due to childhood anaemia if no improvement *(billion yuan renminbi)*	2 378.7
10-year productivity gains from reducing anaemia *(billion yuan renminbi)*	348.3
Total productivity losses in 2001 *(yuan renminbi/capita)*	204
GNP *(yuan renminbi/capita)*	7 078
Lost productivity as percentage of GNP	2.9

SOURCE: J. Ross, 1999.

TABLE 3

Chinese soy sauce consumption (g/capita/day) in 1992

	AVERAGE	HIGH INCOME (g/capita/day)	LOW INCOME
National	12.6	15.6	9.7
Urban	15.9	17.7	14.0
Rural	10.6	13.0	8.4

SOURCE: Ge, 1996.

discounting factor for all one-year cohorts from 0 to 14. Further assumptions and results of the application of this model in China are presented in Table 2.

If the rate of anaemia among children remains at its current level (21.7 percent), the value of lost productivity over the next ten years will be 2.4 trillion yuan renminbi (US$291 billion). The present value of lost productivity for 2001 is 204 billion yuan renminbi (US$24.7 billion), which represents 2.9 percent of GNP.

Initiation of programme on food fortification

The International Life Sciences Institute (ILSI) Focal Point in China and the Institute of Nutrition and Food Hygiene (INFH) of the Chinese Academy of Preventive Medicine sponsored the National Workshop on Food Fortification in China, held in Beijing on 6 and 7 November 1997. Workshop participants included government officials from relevant agencies (including Health, Planning, Light Industry and Internal Trade), scientists from academia and industry in China, recognized international consultants and experts, and representatives from international nutrition organizations. The workshop provided an appropriate forum for nutrition scientists from the Chinese Government, academia and industry to discuss scientific matters related to production and distribution, successful vehicles for fortification and information about the public-health outcomes of fortification programmes in other countries.

The workshop participants decided that soy sauce would be an appropriate vehicle for a national fortification programme, as it is consumed by about 70 percent of the Chinese population. The processing of this product is relatively centralized, thereby facilitating quality control. Moreover, it is a food item with low risk of excess consumption in the Chinese dietary tradition – the average consumption is 12.6 g per capita per day (see Table 3). The failure in earlier attempts to fortify soy sauce with ferrous sulphate ($FeSO_4$) was raised at the workshop, and a decision was made to use sodium iron ethylenediaminetetra-acetic acid (NaFeEDTA).

Storage/stability

In collaboration with ILSI Japan, studies on the stability and organoleptic properties of NaFeEDTA-fortified soy sauce were carried out. Stability tests show that NaFeEDTA-fortified soy sauce remains stable for at least 1.5 years. NaFeEDTA is the best fortificant compared with other iron compounds such as sulphate and citrate, as it does not affect the taste or colour and no unusual precipitation appears. In addition to carrying out this study, the Chinese scientists successfully synthesized NaFeEDTA, and a medium-scale production of food-grade NaFeEDTA has been initiated. The specification and quality of the product is internationally comparable (Table 4).

The technology for fortification was developed in collaboration with Zhenji Soy Sauce Company. It was demonstrated that fortification of soy sauce with NaFeEDTA can easily be integrated into the production line, and that only limited equipment is required.

Bioavailability study

A study, based on stable isotope techniques, of the iron bioavailability of NaFeEDTA-fortified soy sauce in the Chinese diet was conducted by INFH. The iron absorption of NaFeEDTA was compared with that of $FeSO_4$ in ten healthy female volunteers with a typical urban Chinese diet; the absorption rate of iron in NaFeEDTA was 10.51 percent, and in $FeSO_4$, 4.73 percent (Huo *et al.*, 2001a).

TABLE 4

Comparison of the quality of NaFeEDTA from different sources

	JECFA	INFH[1]	DPL
Colour	Yellow/brown	Yellow/brown	Yellow/brown
Solubility in water (at 25 cc) *(%)*	10	10	10
pH (1%)	3.5–5.5	5.1	3.5–5.5
Water insoluble matter *(%)*	≤0.1	≤0.1	≤0.1
Iron (Fe)*(%)*	2.5–13.5	13.6	13.4
Arsenic (As) *(%)*	≤0.0003	≤0.00003	≤0.0003
Copper (Cu) *(%)*	≤0.001	≤0.00032	≤0.001
Lead (Pb) *(%)*	≤0.0005	≤0.00004	≤0.0005
Zinc (Zn) *(%)*	≤0.0025	≤0.001	≤0.0025

[1] Data from Institute of Nutrition and Food Hygiene, Chinese Academy of Preventive Medicine.

TABLE 5

Haemoglobin level of students in efficacy study (g/litre)

GROUP	BEFORE INTERVENTION	AFTER 1 MONTH	AFTER 2 MONTHS	AFTER 3 MONTHS
Control (n = 102)	116.9 ± 5.5	117.9 ± 6.3	118.6 ± 5.3	118.5 ± 5.7
5 mg Fe in 5 ml soy sauce (n = 102)	115.4 ± 5.1	117.2 ± 8.5	128.4 ± 7.8[1]	135.7 ± 8.5[1]
20 mg Fe in 5 ml soy sauce (n = 100)	116.1 ± 5.1	124.0 ± 10.6[1]	131.6 ± 11.6[1]	140.0 ± 8.5[1]

[1] Compared with control group, p<0.01.

Efficacy study

The efficacy of a specific iron-fortification strategy can be evaluated in well-controlled studies in targeted population groups with iron deficiency anaemia. A group of 304 anaemic students aged 14–17 consumed NaFeEDTA-fortified soy sauce for three months under standardized conditions, and its efficacy was monitored by measuring changes in haemoglobin or other iron-status parameters. As a control, a second group receiving non-fortified soy sauce was monitored. After three months, the haemoglobin levels of the students consuming soy sauce fortified with 5 mg and 20 mg of iron were significantly increased, and the anaemia of all students consuming iron-fortified soy sauce was eliminated (Table 5) (Huo *et al.*, 2001b)

Effectiveness study

An effectiveness study was conducted in a community with a population of 10 000 in Bijie in Guizhou Province in western China. Soy sauce fortified with a concentration of 4 mg of iron per 15 ml was supplied to all households in the treated group for one year. Changes in iron status in subgroups of the population were evaluated during the study. Consumer acceptability and consumption were monitored during the study using questionnaires and overall consumption data. A community in which the iron-fortified food was not available was also monitored during the same period for comparison. The iron contents of NaFeEDTA-fortified soy sauce (active group) and the non-fortified soy sauce (control group) were 26.7 mg and 4 mg per 100 ml respectively, so the estimated average daily iron intake from soy sauce of the active group was 4 mg and that of the control group was 0.6 mg.

Figures 1 to 4 show the changes in haemoglobin and prevalence of anaemia of the active group compared with the control group after six months and one year of intervention. The prevalence of anaemia in all age groups decreased greatly. In women aged 19–30, it decreased from around 50.3 to 17.5 percent in six months, and further decreased to 8.7 percent after taking the fortified soy sauce for one year. The reduction in the control group was from 35 to 31.3 percent (Figure 4). The changes in haemoglobin level of the treated group were 8–10 g/litre, compared with the changes in the control group of 2–4 g/litre in one year (Figure 2). In the 3–6 year-old age group, the prevalence of anaemia dropped from 42.5 to 7.1 percent in boys, and from 45.6 to 15.1 percent in girls in one year in the fortified group, even though the amount of soy sauce consumed was much lower than in the adult group. The average change of haemoglobin level of this age group was 9.5 g/litre compared with 1 g/litre for the control group. In the active group of adults, the anaemia prevalence of people over age 55 decreased from 49.0 to 23.3 percent in women and from 52.3 to 21.4 percent in men, while in the control group anaemia was reduced from 58.3 to 40.2 percent and 44.8 to 37.6 percent in women and men, respectively.

In the one-year intervention, the growth of children aged 3–6 improved dramatically. Figure 5 shows that the z-scores of weight for age increased by 0.3, which is significantly higher than in the control group.

Estimated productivity gains due to reduction of iron deficiency anaemia

Using the results presented above, it is possible to estimate the potential productivity gains if a goal is set to reduce anaemia in the future. If anaemia is reduced by 30 percent from current prevalence over the next ten years, according to calculations by PROFILES, the productivity gains will be 107 billion yuan renminbi (US$12.9 billion). For children, if anaemia prevalence is reduced by 30 percent over the next ten years, the

FIGURE 1

Changes in haemoglobin level after six months and one year of intervention (male)

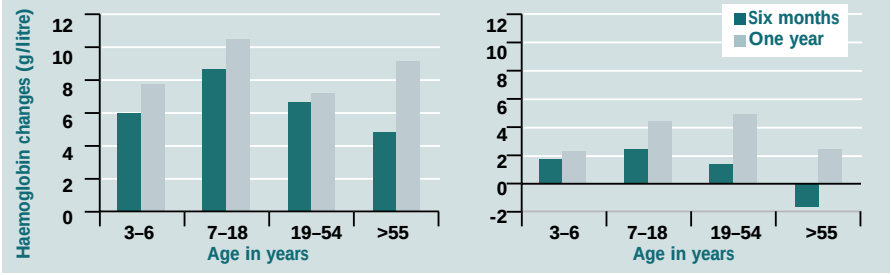


FIGURE 2

Changes in haemoglobin level after six months and one year of intervention (female)

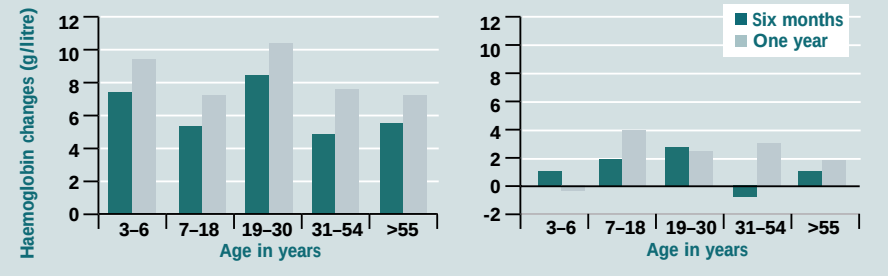


FIGURE 3

Changes in anemia prevalence (percent) after six months and one of year of intervention (male)

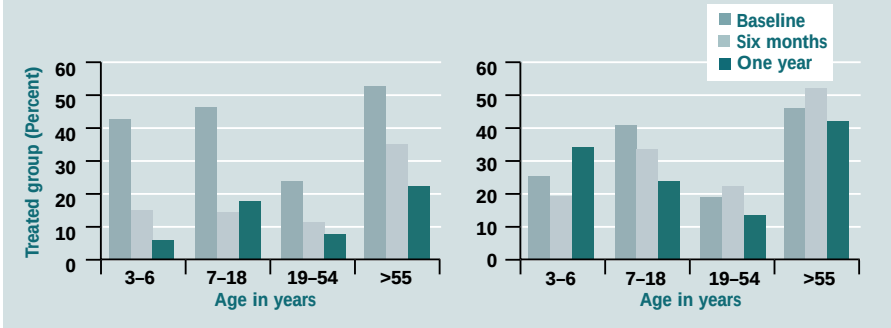
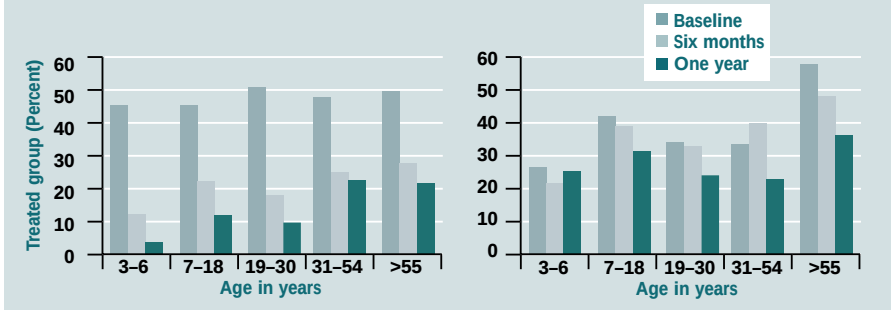


FIGURE 4

Changes in anemia prevalence (percent) after six months and one of year of intervention (female)



net present value of future productivity gains will be 348.3 billion yuan renminbi (US$22 billion) (Ross *et al*., 2003).

In conclusion, the fortification of soy sauce with NaFeEDTA is technologically feasible, scientifically effective and acceptable to consumers – all of which provide strong arguments in favour of formulating a national programme.

Cost of fortification

When estimating the cost of a fortification programme, three items should be included:

1. the price of NaFeEDTA (the 2002 price was US$7.5/kg; it will be lowered when demand increases);
2. the total costs of equipping plants (approximately $12 500 per plant) with a mixing tank and pipelines, and special laboratory instruments for the analysis of NaFeEDTA in soy sauce products;
3. plant operating costs, including the implementation of good manufacturing practices (GMP), a Hazard Analysis and Critical Control Point (HACCP) system and the daily laboratory analysis of NaFeEDTA in the products.

The additional costs for producing NaFeEDTA-fortified soy sauce at non-fortified soy sauce production facilities are low, but costs for promoting its production and for conducting public education activities and social marketing are very important, and to encourage a national programme, certain costs for monitoring and inspection should also be considered.

Regulatory framework

Three key issues require attention in a national fortification programme when dealing with a fortified food: availability, accessibility and sustainability. Five specific goals should be attained: affordability, good quality, sound implementation of the HACCP system at the production site, consumer demand and social marketing. In order to achieve these goals a regulatory framework is

FIGURE 5

Changes in height and weight in children aged 3-6 between baseline and one year after intervention

Notes:
HAZ = height for age;
WAZ = weight for age;
WHZ = weight for height.
* Compared with control group, $p < 0.05$;
** compared with control group, $p<0.01$.

needed, which may consist of the elements outlined below.

- The government commitment to food fortification is documented in several existing national plans, such as the National Plan of Action for Nutrition issued in 1997, which includes two provisions on micronutrient fortification. The National Programme for Food and Nutrition Development for 2001–2010 promulgated in 2002 by the State Council requests the industry to accelerate food fortification. The multiministerial *Report on improvement of fitness and health status of children and youth* and the *Report on child development of western China* call for action on micronutrient fortification in more detail.
- On the basis of the Joint FAO/WHO Expert Committee on Food Additives (JECFA) approval on use of NaFeEDTA for iron fortification, the Ministry of Health of China promulgated NaFeEDTA as an iron fortificant. This substance was included in the *National standard for food additives* in 1999, and soy sauce was approved in 2002 as a target food for NaFeEDTA fortification. The intake of NaFeEDTA from iron-fortified soy sauce should not exceed the maximum level recommended by JECFA, i.e. 0.5 mg/kg body weight. The level of NaFeEDTA in soy sauce is set as 2g/kg of soy sauce. With average daily consumption of soy sauce at 15 g, the daily intake from soy sauce would be around 4 mg.
- There is an existing regulation for the Management of Nutrient Fortified Food, under which a specific code for the iron fortification of soy sauce is documented.
- A logo for a national programme of fortified food has been designed, and a logo specified for fortified food and its regulation has been documented.
- GMP regulations for iron-fortified soy sauce production have been documented.
- A HACCP System for iron-fortified soy sauce production has been developed and applied in the pilot factories for formal documentation of HACCP for soy sauce plants.
- The regulation of NaFeEDTA production has been documented.

Public–private partnership

The role of government in the operation of a food-fortification programme includes political commitment to the nutritional well-being of the population and the creation of an enabling environment for programme operation through policy and regulations. For an operation to be feasible, the partnership with industry is extremely important, not only because of the social obligations of the food industry in such nutrition programmes, but also because the direct influence of the government on technology, quality assurance, costs and pricing is critical for a successful and sustainable programme operation.

At the very beginning, the Ministry of Health in China encouraged partnership with the private sector, and Zhengji Condiment Company (a large factory) and the Chinese Condiment Factory Association have been involved in the process of developing the technology for NaFeEDTA fortification and undertaking the studies on product stability tests. Jingshi Soy Sauce Factory in Beijing produced the large batch of NaFeEDTA-fortified soy sauce for the effectiveness study.

During the process of collaboration between the ILSI Focal Point in China and INFH, the industrial sector has been kept well informed about the public benefit of the programme, and it has expressed great interest in development of the product. Discussions between the public and private sectors on the consumer affordability of the product resulted in positive response from the industry. Since the cost of NaFeEDTA and the investment required for the fortification were minimal, the industry promised to absorb as much of the cost as possible to keep the price of the product low.

The Chinese Condiment Factory Association is the managing body of the factories in this programme. A decision was made to start with pilot factories followed by stepwise expansion to keep the market for iron-fortified soy sauce development under control, thus ensuring that the low cost and high quality of the product could be maintained. After the assessment, the association chose pilot factories using a group of experts from the food-safety control, soy sauce technology, public-health and industry-planning sectors. The association will be authorized to play an important role in self-monitoring the management and quality control of future production, under the supervision of the food-safety authorities.

Communication

Communication is an essential component of the fortification programme. The message delivered to the public should be focused on the health consequences and cognitive effects of iron deficiency to make people aware that iron deficiency, even without anaemia, has health and cognitive consequences. Because the iron fortification of soy sauce will not be mandatory (as is the iodization of salt in China), both fortified and non-fortified soy sauce will be available on the market. The enhancement of demand is therefore extremely important for the success of the programme. Preparations for intensive public education are thus under way.

Communication with industry involves mainly the education and training of the workers. Messages on the health benefits and economic outcomes of iron fortification and the concept of citizenship could stimulate the voluntary cooperation of the workers and quality-control staff in the factories.

The key to achieving wide support for the fortification programme is to communicate with the decision-makers and to translate the benefits of iron fortification into economic terms. The application of PROFILES to estimate the economic gains due to reduction of anaemia prevalence is therefore very useful. Demonstration of gains implies conceptual understanding that iron fortification means more than combating anaemia; it is rather an issue of human resource development that will affect the economy in the future. Messages of this nature make a deep, positive impression on government officers and economists.

Challenges

The progress in iron fortification of soy sauce in China is exciting, but for this to become a national programme, major challenges still remain:

- investment in the nationwide expansion of iron-fortified soy sauce production;
- further policies for facilitating the production and market development of NaFeEDTA-fortified soy sauce;
- post-market monitoring and adjustment of legislation to facilitate production of NaFeEDTA-fortified soy sauce of good quality;
- the continual education of consumers to increase the demand;
- quality-control management to encourage and promote consumption of iron-fortified soy sauce and to make the programme sustainable – a widespread joint effort of government, industry, community and non-governmental organizations is expected.

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ANAEMIA IS AN IMPORTANT PUBLIC HEALTH PROBLEM in China. The national average prevalence of anaemia among women is 22.7 percent and among men, 14.6 percent. For women of reproductive age, in 1998 the figures were 27.5 percent in urban areas and 41.2 percent in rural areas.

Most cases of anaemia occur during the first year of life. In 2000, prevalence was 25.6 percent in infants aged less than 6 months in urban areas and 36.7 percent in rural areas; in children aged 6–12 months the prevalence was 26.4 percent and 50.3 percent, respectively. Calculations using the method known as PROFILES show that the economic loss due to the current prevalence of anaemia in adults and children in 2001 was 0.73 percent and 2.9 percent of gross domestic product.

Research on NaFeEDTA fortification of soy sauce was initiated in 1997. The technology has been developed, and along with the product, a bioavailability study and an efficacy study with 304 anaemic children aged 14–17 were carried out. A one-year effectiveness study was also conducted in a community with a population numbering approximately 10 000 people. Results show that the absorption rate of iron in NaFeEDTA (10.51 percent) is twice that of ferrous sulphate; anaemia in children was eliminated in three months of consumption of the product; and a one-year intervention in the community reduced the prevalence of anaemia in various age groups by 30–70 percent.

A programme on NaFeEDTA fortification of soy sauce has been set up, and steps for implementation of the programme, a regulatory framework, public–private partnerships and communication issues are described in the article.

Enrichissement en fer de la sauce de soja en Chine

L'ANÉMIE EST UN PROBLÈME DE SANTÉ PUBLIQUE MAJEUR en Chine. A l'échelle nationale, la prévalence de l'anémie est en moyenne de 22,7 pour cent chez les femmes et de 14,6 pour cent chez les hommes. Chez les femmes en âge de procréer, elle atteignait 27,5 pour cent dans les zones urbaines et 41,2 pour cent en milieu rural en 1998.

La plupart des cas d'anémie surviennent au cours de la première année de vie. En 2000, la prévalence de l'anémie chez les nourrissons de moins de six mois était de 25,6 pour cent en zone urbaine et de 36,7 pour cent dans les campagnes. Chez les enfants âgés de 6 à 12 mois, elle atteignait 26,4 pour cent en ville et 50,3 pour cent dans les zones rurales. Les calculs effectués selon la méthode des profils montrent qu'en 2001, les pertes économiques dues à la prévalence de l'anémie chez les adultes et les enfants équivalaient à 0,73 pour cent et 2,9 pour cent respectivement du produit intérieur brut.

Les recherches sur l'enrichissement de la sauce de soja en sodium, fer et acide éthylène-diamine-tétracétique (EDTA) ont démarré en 1997. Un procédé d'enrichissement et un produit composé ont été mis au point. Par la suite, une étude sur la biodisponibilité du fer et une étude d'efficacité thérapeutique ont été menées sur 304 enfants anémiques âgés de 14 à 17 ans. Une autre étude d'efficacité d'une durée d'un an a été réalisée auprès d'une communauté de quelque 10 000 personnes. Les résultats indiquent que le taux d'absorption du fer contenu dans le composé de sodium, de fer et d'EDTA (10,51 pour cent) est deux fois supérieur à celui du sulfate de fer. Au bout de trois mois, les enfants auxquels le produit avait été administré ne présentaient plus aucun signe d'anémie. Dans la communauté, un an après le début du traitement, la prévalence de l'anémie avait baissé de 30 à 70 pour cent selon les groupes d'âge.

Un programme d'enrichissement de la sauce de soja en sodium, fer et EDTA a été lancé. L'auteur décrit les différentes étapes de la mise en place du programme, du cadre réglementaire et des partenariats entre secteurs public et privé et aborde diverses questions de communication.

Enriquecimiento con hierro de la salsa de soja en China

LA ANEMIA ES UN PROBLEMA DE SALUD PÚBLICA IMPORTANTE en China. La prevalencia nacional de la anemia es en promedio del 22,7 por ciento entre las mujeres y del 14,6 por ciento entre

los hombres. En cuanto a las mujeres en edad reproductiva, las cifras correspondientes a 1998 fueron el 27,5 por ciento en las zonas urbanas y el 41,2 por ciento en las zonas rurales.

La mayor parte de los casos de anemia se manifiestan durante el primer año de vida. En el año 2000, la prevalencia fue del 25,6 por ciento en los lactantes de menos de 6 años de edad de las zonas urbanas y del 36,7 por ciento en las zonas rurales; en los niños de 6-12 meses, la prevalencia fue del 26,4 por ciento y del 50,3 por ciento, respectivamente. Los cálculos realizados utilizando el método denominado PROFILES indican que la pérdida económica debida a la prevalencia actual de la anemia en los adultos y los niños en 2001 fue del 0,73 por ciento y el 2,9 por ciento del producto interno bruto. La investigación sobre el enriquecimiento de la salsa de soja con NaFeEDTA comenzó en 1997. Se ha desarrollado la tecnología necesaria y, junto con el producto, se llevó a cabo un estudio de biodisponibilidad y de eficacia en 304 niños anémicos de entre 14 y 17 años de edad. También se realizó en una comunidad con una población que rondaba las 10 000 personas un estudio de un año de duración para determinar la eficacia. Los resultados ponen de manifiesto que la tasa de absorción de hierro contenido en el NaFeEDTA (el 10,51 por ciento) es el doble que en el caso del sulfato ferroso; la anemia que sufrían los niños se eliminó en tres meses de consumo del producto, y una intervención de un año en la comunidad redujo la prevalencia de la anemia en diferentes grupos de edad entre el 30 y el 70 por ciento.

Se ha elaborado un programa sobre el enriquecimiento de la salsa de soja con NaFeEDTA y en el artículo se exponen las medidas adoptadas para la aplicación del programa, el marco reglamentario, las asociaciones entre el sector público y privado y cuestiones relacionadas con la comunicación.