REPORT

SITUATION OF MICRONUTRIENT MALNUTRITION ON THE BASIS OF FOOD FORTIFICATION WITH MICRONUTRIENTS

(Document translated from the original text in Vietnamese)

I Background information

Human and animal's bodies are always in need of a small amount of vitamins and minerals for normal development. A majority of these substances cannot be synthesized by the body but originate from food supply. They are so-called micro-nutrients. Micro-nutrient deficiency causes an adverse effect on health, physical and intellectual development, but people hardly know about it. Therefore, shortage of micro-nutrients is also known as "hidden hunger." Deficiencies of micro-nutrients include: lack of vitamin A, D, B1, C, K, B12, riboflavin, folic acid, and minerals such as iodine, iron, zinc, manganese, selenium, etc.

Around the world, a quarter of the global population still suffers from deficiency of necessary vitamins and minerals. Lack of some significant micro-nutrients such as iodine, vitamin A, iron, folate and zinc, though very difficult to detect, can lead to tremendous consequences. Micro-nutrient deficiency can lead to blindness, brain damage, stillbirth, increased risk of spinal deformities, increased risk of infection and mortality in pregnant women and young children, reduce productivity in adults. Micro-nutrient deficiency negatively affects development both physically and intellectually.

In Vietnam, clinical diseases caused by micro-nutrient deficiency has been recognized for quite a long time. In recent years, prevention of micro-nutrient deficiencies continue to gain many significant achievements. However, high percentage of micronutrient deficiency such as preclinical vitamin A deficiency, anemia, zinc deficiency is still a matter of significant public health in Vietnam as classified by World Health Organization. Compared with other countries in the region and around the world, lack of micronutrients (iodine, vitamin A, iron, zinc, etc.) in our country is still quite high, which is mostly located in rural and mountainous areas. Deficiencies of significant micronutrients in Vietnam today include deficiencies of iodine, vitamin A, iron, folate and zinc. Solutions to prevent micronutrient deficiency include short-term ones (to take vitamin A, iron capsules, etc.); Mid-term ones (fortification in food); long-term solutions (to improve overall quality of people's meals).

Fortification of micronutrients in staple foods has been proven to be simple and effective measures to supplement micronutrients in daily meals, which contributes significantly to the success of prevention programs against lack of micronutrients, and thereby improving quality of life of people. Today been more than 100 countries have regulations on mandatory fortification of foods with micronutrients. Folic acid supplements to ready-to-eat cereal products is mandatory in the US, Canada, Costa Rica, Chile and South Africa. Vitamin A supplement to cooking oil is now compulsory in Indonesia, iron supplement to rice is obligatory in the Philippines, too.

II. Micronutrient deficiency in Vietnam

2.1. Deficiency of iodine

Significance to public health

Malnutrition of iodine is "hidden" hunger with significance in global scale. According to statistics of the World Health Organization, more than 100 countries have to deal with iodine deficiency issues, about 1.5 billion people living in areas of iodine deficiency and subject to the risk of iodine deficiency disorders, in which more than 11 million people suffer from cretinism due to iodine deficiency.

Vietnam belongs to the areas of iodine deficiency. Many years ago, goiter was a common disease in mountainous areas. However, iodine deficiency actually exists in all regions of the country. According to National Nutrition Survey 1992 (by UNICEF and Endocrinology Hospital in 28 provinces), 84% of the population suffer from iodine deficiency (based on quantitative urinary iodine results), in which rate of serious deficiency is 16% (urinary iodine below 2 (g/dl), medium deficiency rate is 45% (urinary iodine from 2-4.9 (g/dl), severe deficiency rate is 23% (urinary iodine from 5-9.9 (g/dl). In 1994-1995, a nationwide survey showed that the rate of goiter in Mekong Delta was 18%, goiter rate in Red River delta ranged from 10 to 30%. National Survey (1998) showed that goiter rate dropped significantly, rate of low urinary iodine levels decreased from 84% (1992) to 43.5%. In mountainous province, where iodized salt and iodized oil have been in use since 1976, the proportion of goiter has decreased and iodine urine test revealed average level to be achieved, whereas in the province having not taken preventive measured, iodine urine stayed at very low levels. Thus, iodine deficiency in Vietnam has become a national issue, of not only mountainous areas, but also cities and plain, coastal provinces

Besides, the situation of increasing proportion of patients with risk of iodine deficiency disorders in many areas has declined from 90% (2005) to 69.5% (2008) as a result of iodized salt coverage. A recent survey found that only 23/90 communes having minimum iodized salt coverage of 90%, 77.7% of pregnant women are iodine deficient, in which 44.6% of them are from moderate to severe iodine deficient.

Causes of iodine deficiency

In nature, iodine is mostly in reserves under seawater. From the seawater, iodine in the form of vapor is taken to ashore. Rain supplements iodine for soil but it is rain which causes erosion, and washing away iodine into the sea, iodine, thus depleting iodine in the soil. Food is the main source of iodine, human and animal eating food and plants grown in iodine depleting soil shall be subject to iodine deficiency. Pregnant women, nursing mothers, children are groups of subjects with high risk of iodine deficiency.

2.2. Lack of vitamin A and dry eye disease

Significance to public health

In Vietnam, according to a community survey (1985), the proportion of children under age 5 suffering from dry eye with active corneal lesion was 0.07%, which is 7 times higher than threshold of the World Health Organization world (WHO) and this is considered as a significant issue of public health. In 1994, a national survey by Institute of Nutrition, UNICEF and HKI showed that percentage of dry eyes was below the threshold defined by the World Health Organization. However, pre-clinical deficiency of vitamin A still exists in Vietnam. Survey

results of vitamin A status in children under 5 years of age in 2000 and 2005 revealed the rate of pre-clinical vitamin A deficiency in children, as indicated by concentration of low serum vitamin A, ranging between 10-25%. This rate was low rate in areas with high coverage of vitamin A capsules, but much higher in mountainous area with low coverage. Even in some areas of the city, before vitamin A capsule taking campaign, pre-clinical vitamin A deficiency rate still ranges around 10% (at average level of public health significance). Results of 2008-2009 national survey showed that about 14.2% of children under 5 years of age are deficient in vitamin A. Shortage of pre-clinical vitamin A remains its significance to public health. There were disparities in the proportion of pre-clinical vitamin A deficiency among regions, while this rate in some local mountain areas was over 20%, at serious significance to public health as ranked by the WHO. The proportion of vitamin A in breast milk still remained low at 35%, revealing not satisfactory Vitamin A level in diet of the community. Rate of vitamin A deficiency now depends on measures of vitamin A supplement in capsules of high doses for children. The World Health Organization still ranks Vietnam on the list of 19 countries with severe pre-clinical vitamin A deficiency (over 10% of children under 5 years of age).

Causes of Vitamin A deficiency

- Due to lack of vitamin A in diet: This is a common situation. Children in the period of complementary diet are supplied with insufficient animal food, ripe fruit and vegetables (rich in vitamin A (carotene). Lack of oil in the diet also reduces absorption of vitamin A.
- Status of infection, especially measles, respiratory infections, diarrhea or intestinal infections (especially roundworm) are also important causes leading to deficiency of vitamin A.
- Malnutrition, high protein in high energy diet are often accompanied by severe vitamin A deficiency due to lack of protein, leading to adverse effects to metabolism and transport of vitamin A in the body. In addition, deficiency of other micronutrients such as zinc also affects metabolism of vitamin A.

2. 3. Anemia

Significance to Public Health

According to WHO, nutritional anemia is a condition that occurs when concentration of hemoglobin in the blood falls below its normal rate due to lack of one or more nutrients necessary for process of hematopoiesis, regardless of their cause. Anemia due to iron deficiency is the most common nutritional anemia, which can be combined with deficiency of folic acid, especially during pregnancy and in women of childbearing age.

Anemia due to iron deficiency is the micronutrient malnutrition of great significance to public health and of primary importance today. It is estimated that in worldwide scale, there are more than 2 billion people with iron deficiency, of which, one billion two hundred million people have symptoms of anemia. Anemia is more common in developing countries. Anemia is the most common in pregnant women, women of childbearing age and young children. Anemia is only the final stage of relatively long iron deficiency process with adverse effects on health and physical development and the number of people with iron deficiency not having expression of anemia is much higher than those with actual anemia.

Epidemiological investigations in Vietnam from 1989 and 1995 (national survey conducted by Institute of Nutrition, Disease Surveillance Centre of the United States (CDC) and UNICEF)

showed that anemia rate was popular in all regions of the country, while this rate was high in both pregnant women (45%), non-pregnant women (53%) and children, especially children under 2 years of age (60%). National Survey on nutritional status in 2008-2009 showed that 36.5% of pregnant women, 28.8% of non-pregnant women, 29.2% of children under 5 years of age were anemic. The prevalence of anemia was highest in children under 24 months of age (approximately 45%), and then decreased gradually. In South Central, Northern Mountainous areas, Central Highlands, anemia rate was still high. Mekong Delta, Red River Delta and city area had a lower rate of anemia than other areas, however, remained at above 20%. Monitoring anemia changes from time to time revealed that anemia rate tended to decrease, but at a slower level and now still remained average levels of significance to public health (> 20%).

Causes of nutritional anemia

- Insufficient iron in diet: Biological value of iron in Vietnamese diet stays low (5-10%). In general, source of iron-rich animal foods are not consumed regularly and fully for subjects of high risk of iron deficiency, namely women of childbearing age, young children. A diet rich in iron absorption inhibitors such as phytate and tannins. That diet will not ensure demand for iron for subjects with high demand of iron. For women of childbearing age, the amount of iron lost in menstrual period is 1.25 mg per day. Pregnant women need a total of 1,000 mg of iron to supplement placenta, fetus and increase in volume of mother's blood. That demand is not evenly distributed during pregnancy but focuses on final months, up to 6.3 mg / day. On the other hand, the amount of iron storage in bodies of women before pregnancy is often low, thus during pregnancy, anemia becomes more severe. Complementary diets for children are also very poor in iron.
- Status of hookworm and other infections: In Vietnam, hookworm infection is common, its high rate occurs in many areas with agricultural practices and hygiene practices, environmental conditions and clean water, all contributing significantly to causes of iron deficiency and anemia in Vietnam. In addition, infectious diseases, especially gastrointestinal infections are quite common, which also cause iron deficiency and anemia.

2.4. Zinc deficiency

Zinc plays an important role for health: Zinc involves in activity of enzymes, expression of genotype, cell division and body development of the body, immune function, appetite, appetite regulation.

Zinc deficiency in Vietnam is also an issue of public health significance. Results of Survey on nutritional status in six provinces in Vietnam in 2009 showed that the proportion of pregnant women with zinc deficiency was 90%, of children under 5 years of age was 81.2% and of women in childbearing age was 65%.

Causes of zinc deficiency

- Investigation of diet in Vietnam showed that diet of people which lacks zinc-rich foods, along with poor quality of meals, and lack of food of animal origin are among important reasons causing zinc deficiency and other micronutrient malnutrition.
- Studies on correlation between malnutrition and micronutrient deficiency: zinc deficiency slows down growth rate in children; children with vitamin A malnutrition have lower

serum zinc than children who are not malnourished. Similarly, children with diarrhea also have lower serum zinc concentrations than normal children. The more severe malnutrition in children, the more significantly low serum zinc concentrations.

2.5. Folate deficiency

Vietnam has no national data on folate deficiency in children and women. However, the survey results on micronutrient status conducted in 19 provinces in 2010 showed that 2.7% of women of childbearing age was deficient in folate, folate deficiency limit was 25.1%. The proportion of children with folate deficiency was 0.6% and folate deficiency limit is 6.4%. Thus, this study showed that there was no situation of folate deficiency in women and children in Vietnam, however, the rate of folate deficiency limits in women of childbearing age in the community may increase the risk of neural tube defects in newborns.

Causes of folate deficiency

- Diets insufficient of folate is the main cause of folate deficiency. Survey results in diet of children and women of childbearing age, female adolescents showed that dietary folate of this group only meets 45-75% of the recommended demand for Vietnamese people. Folate is not resistant against heat, water, air, and alkaline, therefore, prone to decay during storage and processing of food.

III. Consequences of micronutrient malnutrition for individuals, families and society

3.1. Harmful effects on health

Consequences of micronutrient malnutrition has been well-known. Visible consequences are goiter and iodine deficiency disorders due to iodine deficiency; dry eye disease, blindness and Vitamin A deficiency disorders due to Vitamin A deficiency; anemia and nutritional disorders due to iron deficiency;

Many other potential consequences caused by micronutrient deficiencies are more and more severe. Iodine is required for synthesis of thyroid hormone, which plays an important role in the body. Iodine deficiency leads to lack of thyroid hormone and affects many important functions, causing different disorders, which are collectively referred to as "iodine deficiency disorders": goiter, mental and height retardation, sexual retardation, cretinism, deafness, squint, spastic limbs, spontaneous abortion, premature birth, stillbirth, etc. The most serious consequences of iodine deficiency is the adverse effect to development of fetus. Iodine deficiency in women during pregnancy can cause miscarriage, stillbirth, premature birth, maternal severe iodine deficiency, and the child may be born with cretinism due to permanent brain damage. Continuous iodine deficiency in children and teenagers will reduce intellectual capacity, declining IQ, including physical retardation, malnutrition, dwarfness, passiveness, etc.

Lack of preclinical vitamin A has been confirmed as cause of increased morbidity, mortality and growth retardation in children. Iron deficiency and anemia increase the risk of obstetric complications and death for pregnant women, reduce working capacity and intellectual development in children. According to calculations, among 1,600 cases of maternal deaths every year, 192 of them (12%) were caused by anemia due to iron deficiency. Anemia is not only harmful to health, intellectual ability, but also affects economic development of the country due to low productivity and costs for illness treatment-as a result of iron deficiency and anemia.

According to calculations by economists, overcoming of deficiencies of iodine, vitamin A and iron can improve Intelligence Quotient (IQ) of the community by 10-15 points, reduce maternal mortality by 1/3, and reduce infant mortality to 40% and increase working capacity by one and a half time.

Folate deficiency is the cause of a number of neural tube defects. Table 1 shows neural tube defects in babies born in the years from 1995 to 1998 admitted to National Hospital of Obstetrics and Gynecology.

Neural tube malformation

Neural tube malformation are included with babies in the National Hospital of Obstetrics and Gynecology

Year	Number of babies were born in the hospital	Number of babies were neural tube malformation	Mortality due to neural tube malformation
1995	7.466	17 (2.28/1000 babies)	17 (100%)
1996	7.478	17 (2.27/1000 babies)	16 (94%)
1997	7.440	18 (2.419/1000 babies)	17 (94.4%)
1998	5.138	13 (2.53/1000 babies)	12 (94%)

* Non skull, hydrocephalus, meninges hernia.

The rate of neural tube malformation is about 2.5 babies/1000 babies. Data from other studies is estimated that the rate of neural tube malformation in the community is higher about 2-3 times the rate in the hospital, it is about 4-5/1000 babies in the Central Children Hospital. LN. Thang & his partners observed that 189 babies in total of babies is meningitis malformation (in which 90% of meninges, marrow malformation -meningomyelocoeles membrane; 10% meningocoeles-meninges hernia); and 110 cases of cerebral hernias- Encephalo from 2000 to 2005.

At Children's Hospital 11 (Ho Chi Minh City) ND. Tuan showed that on average, there are 52 malformation cases in each year, accounting for 0.11% of the babies were hospitalized from 2000 to 2006. In which cerebrospinal and marrow-marrow membrane hernias malformations which are majority.

Cardiovascular disease

In addition neural tube malformation, lack of folate is also considered as factors causing cardiovascular disease and hypertension disease. A number of studies around the world showed that supplement of acid folic in daily diets had significantly reduced the incidence of cardiovascular disease, hypertension disease, and mortality from cardiovascular disease in the community and this help to reduce medical costs for social.

According to statistic of the Institute of Cardiology, the incidence of cardiovascular disease, hypertension disease and mortality from cardiovascular disease in the community has increased rapidly in recent years. Common diseases in the area major cities, where the risk factors of diet

and chronic diseases such as fatty, stagnant increase rapidly, even in rural areas, the rate of cardiovascular disease also increases about 10 times compared to the last decade (Table 2).

The mortality rate of cardiovascular disease in the country (Khai & his partners 2002)

	Disease	**Number of patients / 100,000 people**	**Mortality**
1	Primary Hypertension	131.13	0.4
2	Myocardial infarction	7.62	1.02
3	Stroke	46.84	3.02
4	Heart Failure	43.70	1.20

3.2. Lack of micronutrients and economic damages

Lack of micronutrients affects to the country of health and economy. Over 2 billion people in the world are lack of micronutrients; 136,000 women and children die every year due to lack of anemia; 190 million preschool children are deficient in vitamin A; 1.1 million people die every year due to lack of vitamin A and zinc; 300,000 children born with inborn defects caused by maternal folate deficiency. Lack of nutrition in Asia and Africa reduces 11% of gross domestic product (GDP).

The problems of lack of micronutrients is meaningful to public health, particularly, lack of iodine, vitamin A, iron and zinc as mentioned above wastes many costs to the society. Currently, in Vietnam, the death rate of children under 1 year old is 30/1000 surviving children, the death rate of children under 5 years old is 39/1000 surviving children, the death rate of babies is 7.5 / 1000 surviving children, the maternal death rate is 95/100.000 of surviving children and the death rate due to lack of vitamin A of babies over six months old is 1.75 and the maternal death rate is caused by lack of anemia.

According to calculations, among 1,600 of maternal death cases every year, about 192 (12%) cases are related to lack of anemia. Lack of anemia is not only harmful to health, intellectual ability, but also affects the economic development of the country due to low labor productivity and costs of diseases-a result of the lack of anemia. According to the estimations of economists, improvement of the lack of iodine, vitamin A and iron can improve IQ of the community up to 10-15 points, reducing the maternal death rate about 1/3, the baby death rate about 40% and increase the working capacity about half.

Lack of iron can also cause a similar effects such as: reduce working capacity due to intellectual ability. The loss of labor force's working capacity of mind and physical will cause losses of $ 228 million every year and 2.408 million dollars in the next 10 years if the situation is not improved.

IV. Strategy of micronutrient deficiency improvement

4.1. Strategy of micronutrient deficiency improvement in Vietnam

Prevention of micronutrient deficiency is a tough fight to improve the "hidden hunger", boost labor capacity, intellectual and healthy life of Vietnamese. Prevention of micronutrient deficiency is the goal of the National Nutrition Strategy in 2011-2020.

Strategy for preventing micronutrient deficiency is the combination of solutions. Micronutrient supplements are an important and necessary solution to overcome rapidly and timely the micronutrient deficiency. Diversification of meals and micronutrient supplement in food is long term method. Some international organizations such as UNICEF, WHO, GAIN ... are supporting actively Vietnam in the field of technique, policy and funding to implement programs of nutrition deficiency prevention.

4.2. Micronutrient supplement in the foods

Micronutrient supplement in the foods is a certain amount of one or several types of nutrients in the foods used the most by people Micronutrient supplement in the foods helps to avoid micronutrient deficiency.

Micronutrient supplement in the foods is simple, effective and easy method and has high coverage and sustainability for micronutrient supplement in daily meals. If nutritional deficiency is common in the community, necessary micronutrient supplement is required to implement by adding these micronutrients in the foods.

Adding micronutrients to food has been applied in many countries since the early 20th century. Micronutrient fortification of foods has been ranked as one of the most effective interventions in global development by Copenhagen Consensus Center in 2012 and the solution was recommended by WHO, WFP, UNICEF, FAO and the World Bank for micronutrient deficiency improvement.

V. Situation of micronutrient supplement in the foods

5.1. In the world

Today, over 100 countries in the world are required to add micronutrient in the food. Adding iron and folic acid to cereal products (wheat flour, maize flour, and/or rice) is required in more than 70 countries including the US, Canada, Costa Rica, Chile and South Africa. Vitamin A additions to cooking oil are required in Indonesia, Thailand, Turkey, and Argentina.

The success of the global campaign for iodized salt is an example of approaches to micronutrient fortification based on the cooperation between the partners of the government and the private sector. In just over 10 years, the sustainability commitment of the salt production industry, conditions that the government gives, public health organizations and non-governmental organizations, and the social investment in 3-5 xen (VND 500-800) per person has brought as a result of two-thirds of salt in all development countries added iodine. The result giving children are tremendous: annually, 90 million babies are protected against the risk of mental retardation caused by iodine deficiency.

Micronutrient fortification such as iron and acid folic in flour is familiar with many developing countries and has contributed significantly to reduce micronutrient deficiency. For example, after adding folic acid to wheat flour, as is mandatory in the United States, Canada and Chile, in just

five years, the proportion of babies born with serious birth defects have dropped more than one third.

The economist has estimated that if the deficiency of micronutrients is not improved in the next 10 years, the world economy will have to spend from 180 to 250 billion dollars to solve the results due to the decline of intellectual, immune system decline, maternal and child death as well as the damages caused by the decline in labor productivity However, to deal with these deficiencies, the society should invest about 4 to 5 billion US dollars.

5.2. Situation of micronutrient supplement in the foods in Vietnam

The products added micronutrient are becoming popular such as salt, flour, cooking oil, sugar, fish sauce, soy sauce, spices, rice .... Some foods required to add the important micronutrients are studied and applied by the authorities to contribute to the success of programs of micronutrient deficiency prevention and improve of Vietnamese's life.

Technology for micronutrient supplement in the food is quite simple. The necessary foods added micronutrient fluids may be the poor.

Supplement of iodine in salt has been deployed the most successful in the world, including Vietnam in the period of 1999-2005. Results of the survey in 2005 showed that 92.8% of Vietnam's population consume iodized salt. Results of the survey in 2011 showed that 45.1% of Vietnam's population consume iodized salt. Decree of all population shall use iodized salt and iodized salt was approved by the government of Vietnam in 1999 and has been deployed. However, in 2005, program of iodine deficiency prevention was changed from a "national target program" into a regular medical activity of the public health sector.

Fortifying fish sauce with iron was deployed by Nutrition Institute in many ecological zones with the support of GAIN. Adding vitamin A to cooking oil and adding iron, zinc, and vitamin A in granules are being implemented by companies

Many studies about adding vitamin A, iron, and zinc to biscuits; using fortified flour to make instant noodles, and supplement foods for children have also been implemented.

VI. Micronutrient supplement in salt, flour, cooking oil and soy sauce

Consumption of flour, cooking oil, salt and soy sauce in **Vietnam:**

Consumption of food (VDD 2009-2010) (*)

Group TP	**Consumption (g/person/day)**
Cooking oil	5.8
Wheat	16.5
Sauce	13.6
Salt (**)	11.7

(*) General Nutrition Survey in 2009-2010

(**) Hien VTT,. and partners Medical Magazine Ho Chi Minh City, 2012

6.1. Supplement of vitamin A in cooking oil

Vietnamese's cooking oil consumption from 2000 to 2009 (*)

Kg / person	**2000**	**2005**	**2006**	**2007**	**2009**	**Increase:**
Cooking oil	2.3	3.75	4.12	4.44	5.38	+134%

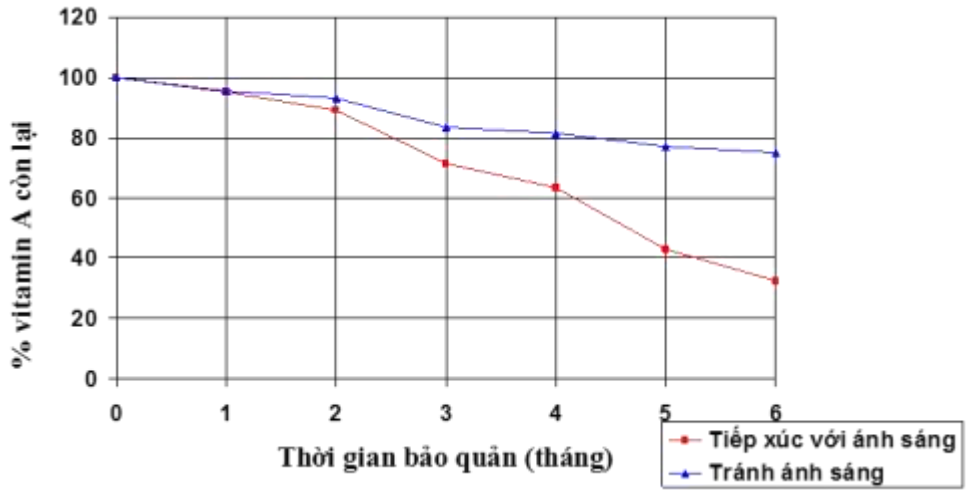
***(*)** *General Statistics Office, Ministry of Industry and Trade*

Advantages of adding vitamin A in cooking oil:

Vietnamese's cooking oil consumption is high and cooking oil is widely distributed and produce centralization. The ingredients in cooking oil of slow oxidation help to maintain the highest vitamin A content after the process of transport, storage and cooking. Cost for supplement of vitamin A in cooking oil is estimated about US $ 2 per ton. Cost of supplement of vitamin A in cooking oil increases about 0.012 US $/person/year. There are about 20 countries around the world require to add vitamin A in cooking oil, many studies have shown that vitamin A supplement in cooking oil significantly improves the people's health of the as well as the body's vitamin A.

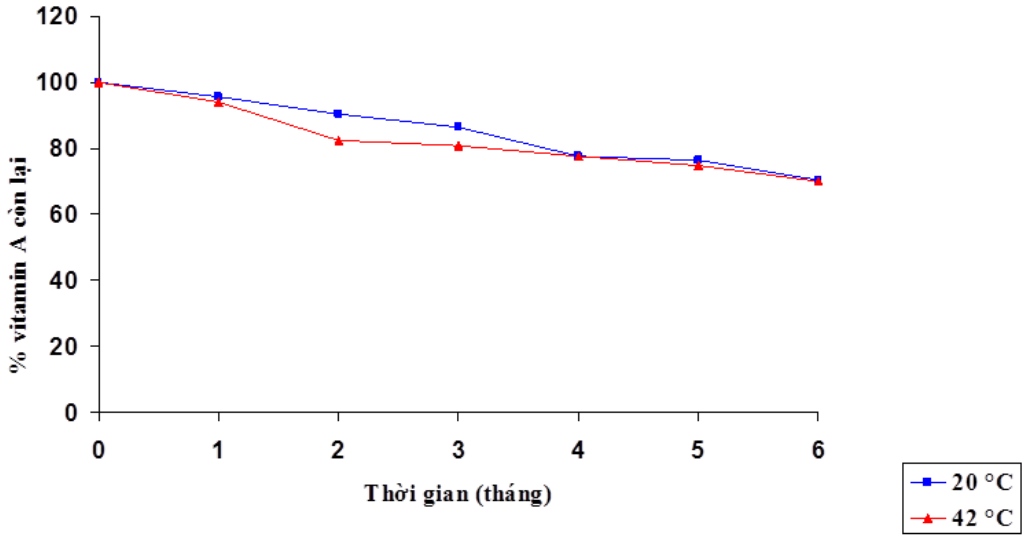
The sustainability of vitamin A in oil and food

66.6 IU/G stored at ambient temperature: 20 ° C



Source:
1. M. Rahmani, Institut Agronomique et Vétérinaire Hassan II; Rabat / MOROCCO
2. H. Aguenaou, Faculté des Sciences; Kénitra / MOROCCO

Temperature effects to the sustainability of vitamin A 33.3 IU/g



Source:
1. M. Rahmani, Institut Agronomique et Vétérinaire Hassan II; Rabat / MOROCCO
2. . Aguenaou, Faculté des Sciences; Kénitra / MOROCCO

The sustainability of vitamin A supplement in cooking oil of vitamin A when frying potatoes several times at a temperature of 180 ° C (Repeat 2 times)

Number of frying	% of remaining Vitamin A	
	33.3 IU/G	66.6 IU/g
1	90.5	93.5
2	87.0	86.5
3	77.5	82.0
4	72.5	76.5
5	68.0	70.5

Source:
1. M. Rahmani, Institut Agronomique et Vétérinaire Hassan II; Rabat / MOROCCO
2. H. Aguenaou, Faculté des Sciences; Kénitra / MOROCCO

The sustainability of vitamin A in the use of cooking, stewing food (Repeat 2 times)

Food	Processing method	Cooking time (min)	% of remaining Vitamin A	
			34 IU/g	62 IU/g
Mixture of types of beans	**Stew normally**	**40**	***53.6***	***55.7***
Cook beans + meat	**Stew by pressure cooker**	**30**	***75.8***	***72.3***

Source:
1. M. Rahmani, Institut Agronomique et Vétérinaire Hassan II; Rabat / MOROCCO
2. H. Aguenaou, Faculté des Sciences; Kénitra / MOROCCO

6.2. Wheat flour fortification:

According to the statistics of Food Fortification Initiative as of 2015, 82 countries worldwide have implemented mandatory wheat flout fortification. Many studies have shown that mandatory wheat flour fortification has significantly improved the health status of people: reduce anemia, zinc deficiency, percentage of birth defects, etc. In the region, the Philippines, Indonesia, Australia and Fiji have regulations on mandatory wheat flour fortification.

Wheat flour fortification can be combined with other interventions in an effort to reduce vitamin and mineral deficiency when it is confirmed as issue of public health. The programs of wheat flour fortification are able to bring greater efficiency in generating the impact on public health if they are applied at the national level and can help achieve international goals in community health. Although wheat flour can be supplemented by several micronutrients, but a professional conference focused on iron, folic acid, vitamin B12, vitamin A and zinc; these are 5 types of micronutrients recognized as having important implications for public health in developing countries (WHO, 2009).

Table of average nutrient levels should be considered for wheat flour fortification based on flour extraction rate, supplements and available flour amount estimated per capita (WHO, 2009)

Chất dinh dưỡng	Tỷ lệ xay bột (Flour extraction rate)	Hợp chất	Mức chất dinh dưỡng cần bổ sung (phần triệu - ppm) theo số lượng bột mỳ trung bình đầu người sẵn có ước tính (g/ngày)[1]			
			<75[2] g/ngày	75-149 g/ngày	150-300 g/ngày	>300 g/ngày
Sắt	Thấp	NaFeEDTA	40	40	20	15
		Sulfate sắt	60	60	30	20
		Fumarate sắt	60	60	30	20
		Sắt điện phân	NR[3]	NR[3]	60	40
	Cao	NaFeEDTA	40	40	20	15
A-xít Folic	Thấp hoặc cao	A-xít Folic	5,0	2,6	1,3	1,0
Vitamin B12	Thấp hoặc cao	Cyanocobalamin	0,04	0,02	0,01	0,008
Vitamin A	Thấp hoặc cao	Vitamin A	5,9	3	1,5	1
Kẽm [4]	Thấp	Ô-xít kẽm	95	55	40	30
	Cao	Ô-xít kẽm	100	100	80	70

Source: WHO, 2009

Currently, Vietnam consumes about 1.5 million tons of wheat flour/year. Survey on food consumption in 2000 shows that subjects with risk of anemia consuming wheat flour products (bread, instant noodles, biscuits, etc) have increased, from 10-20% of population, with an average consumption is 125.3 g/day in women of reproductive age, 139 g/day in pregnant women and 105g/day in children <5 years old. With this consumption amount, it will provide

3.8mg; 4.2mg; 3.2 mg iron/day respectively if the wheat flour is fortified with iron in doses of 30 ppm.

Costs for 10 years to develop wheat flour fortification: ratio of benefit/cost to reduction of anemia and iron deficiency is 4,3; internal rate of return of the investment is 263%. Such rate of return is very high, not including benefits in reducing fatal diseases, bringing health and human life.

Analysis of Internal Rate of Return of the investment to wheat flour fortification with iron

Year	**Benefits (000 US$)**	**Cost (000 US$)**	**Real benefit per year**	**Internal Rate of Return**
1	0.0	1.113,4	-1.113,4	
2	3.693,9	782,0	2.911,9	
3	3.754,1	788,7	2.965,4	
4	3.812,9	782,0	3.030,8	
5	3.869,5	782,0	3.087,5	
6	3.924,9	788,7	3.136,2	
7	3.979,8	782,0	3.197,8	
8	4.033,7	782,0	3.251,7	
9	4.086,9	782,0	3.304,9	
10	4.141,8	842,8	3.299,0	
Total	35.297,4	8.225,6	27.071,7	**263%**

6.3. Soy sauce fortification with iron:

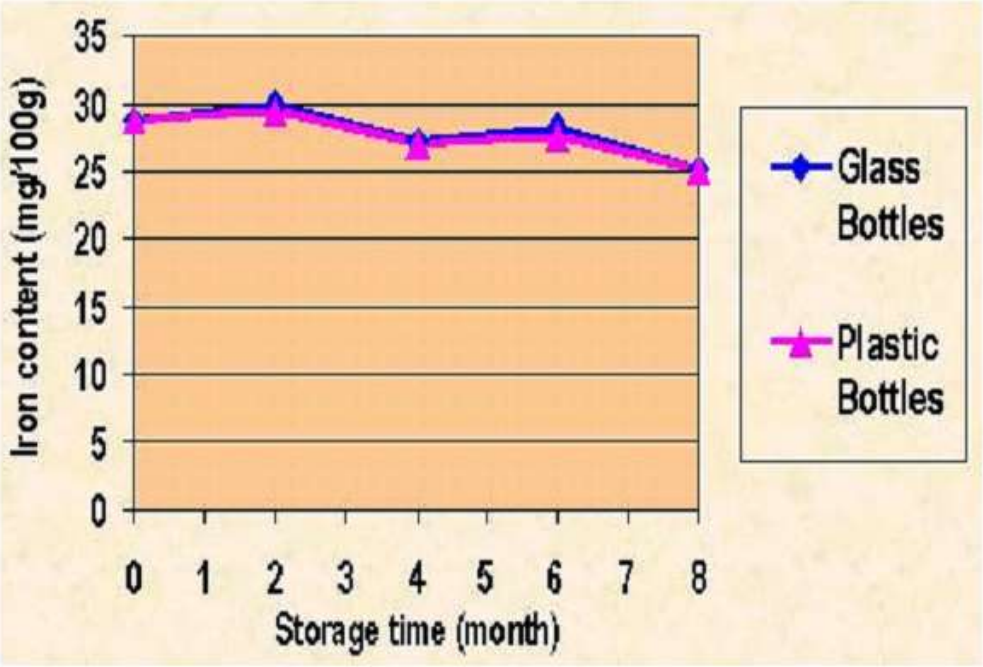
Situation of soy sauce consumption

According to a dietary survey of Institute of Nutrition in 2009-2010, the consumption of sauces (including soy sauce, fish sauce, etc) is 14g/person/day.

According to the survey of GAIN and FTA in 2009, consumption of spices as follows :

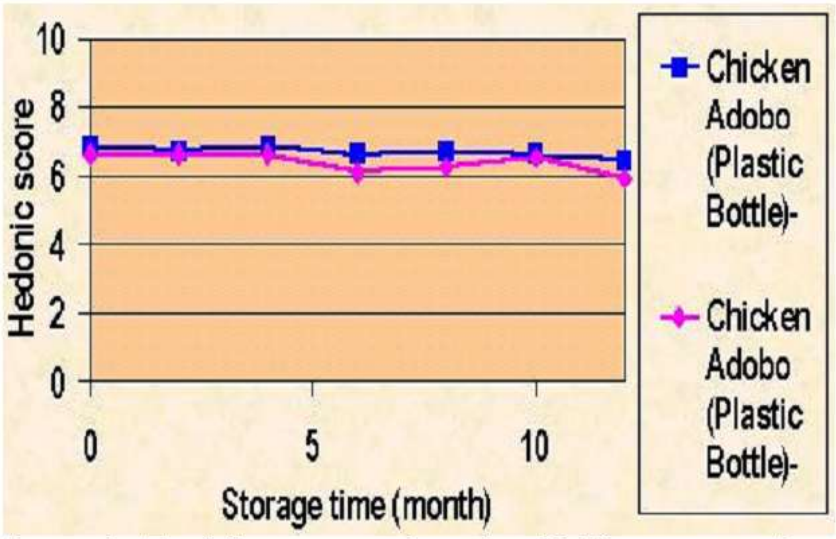
Food Groups	**Production on the market**	**Consumption (person/day)**
Soy sauce	65.000.000 (liters)	0.0022 (liter)
Soup	83.000 (tons)	0.00529 (kg)
Seasoning	50.000 (tons)	0.0028 (kg)
Fish sauce	250.000.000 (liters)	0.011 (liter)

The iron content in soy sauce fortified iron that are stored in glass bottles and plastic bottles after one year is still in an acceptable level.



Source: *Philippines Food and Nutrition Research Institute (FNRI-DOST)*

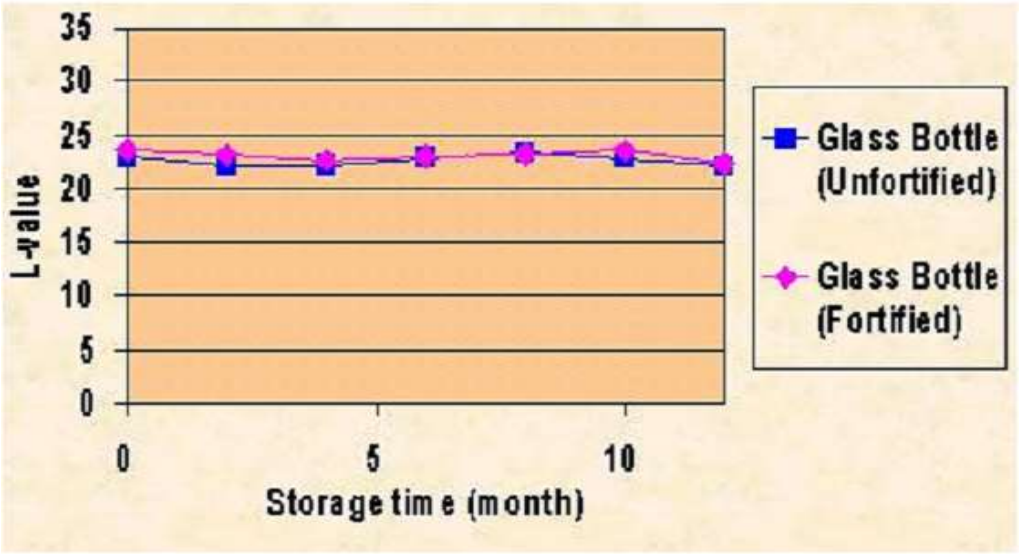
In sensory evaluation of food when used with soy sauce fortified iron, the consumers rate at relatively like and like (6-7/10 points out of 10 hedonic scale)



Legend: 7 = Like very much =, 1 = Dislike very much

Source: Philippines Food and Nutrition Research Institute (FNRI-DOST)

Fortified soy sauce with iron has no change in color in comparison with ordinary soy sauce without fortification with iron



Legend: L = 100 white, L= 0 black

Source: Philippines Food and Nutrition Research Institute (FNRI-DOST)

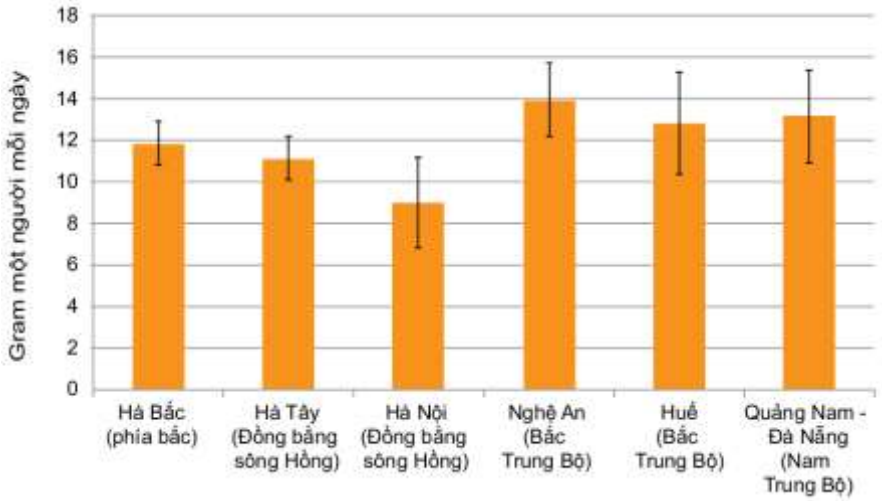
Research on the effectiveness of fortified soy sauce with iron for nutritional anemia due to iron deficiency shows that fortified soy sauce with iron help to improve iron status (Hb and serum ferritin) in children after 6-12 months.

Thus, the soy sauce fortification with iron does not affect the senses (color, smell) of the product and has effect in prevention of iron deficiency and anemia, one of the issues of public health significance in Vietnam

6.4. Salt fortification with iodine:

Consumption of salt

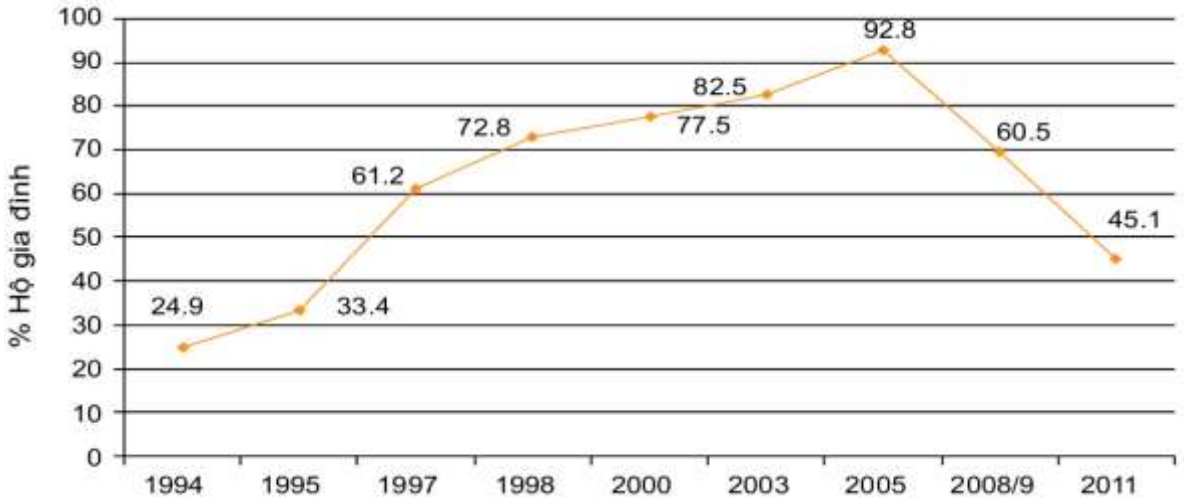
The amount of salt consumed per capita in some northern and central provinces



Source: National Institute of Nutrition

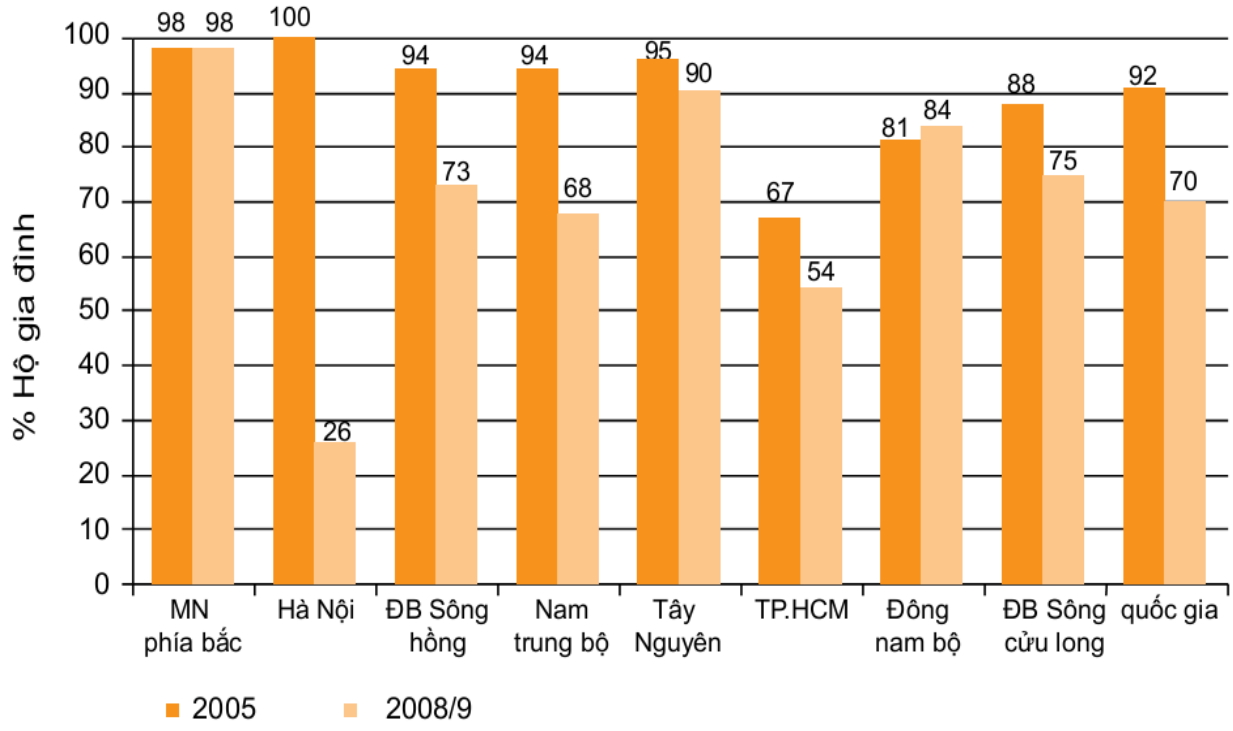
Results of national survey in 2005-2006 show that Vietnam has achieved the goal of global program of iodized salt (iodized salt coverage qualified for prevention > 90%), the Median values of urinary iodine of women nationally and in 5/7 ecoregions of Vietnam within recommendation scope and goiter rate in children has reached the national and global target, equivalent to less than 5%. The Vietnamese government has downgraded the priority level of program of iodine deficiency prevention from program of national target to regular medical activities. This decision has led to a change in management and supervisory structure, reduction of budget and issuance of a new Decree (Decree No. 163). Decree No.163 sets out the conditions and criteria for iodized salt to ensure that iodized salt has high quality and hygiene, and prohibits the production, circulation and business of fake iodized salt and poorly qualified iodized salt. This Decree also suggests Ministry of Health and Ministry of Culture, Sports & Tourism to encourage people to use iodized salt but not required iodization of all salt (or food processing). This has led a significant decline in coverage of iodized salt and urinary iodine, and iodine deficiency disorders have become a public health issue in Vietnam. Nationally, the median value of urinary iodine is 83mcg/L in 2008, less than needed safety range (100-199mcg/L), and is the lowest value in the past 10 years. Less than half of Vietnam's population is currently using iodized salt meeting disease prevention standards.

Consumption of iodized salt meeting disease prevention standards of households through the years



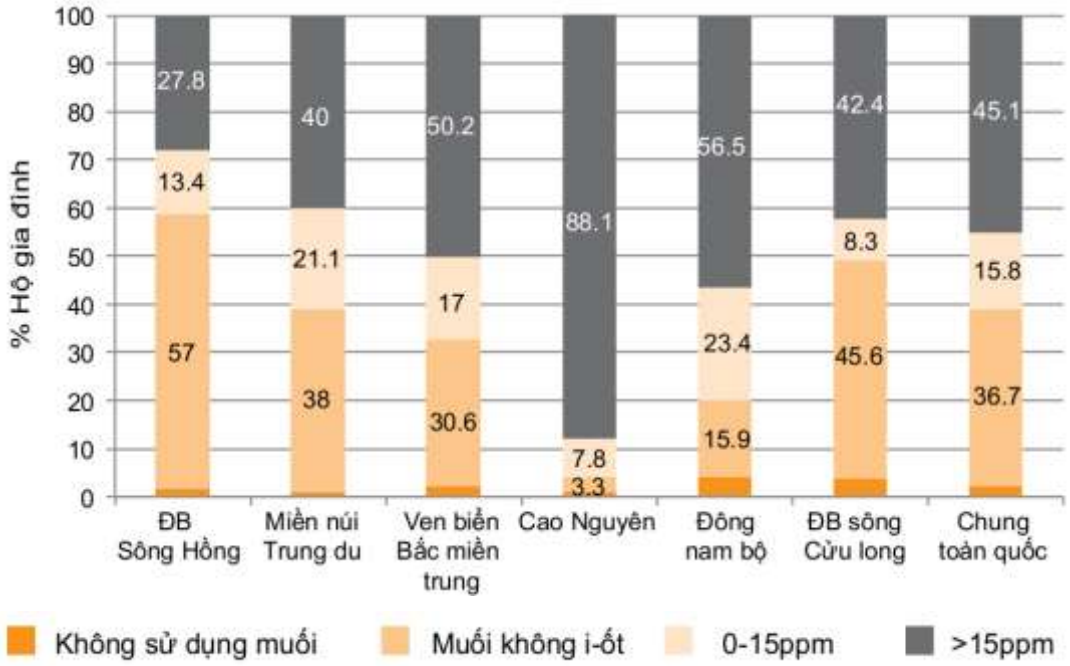
Source: National research of disorders due to iodine deficiency and research in cluster in 2011

Coverage of iodized salt meeting disease prevention standards in 2005 and 2008-2009



Source: Report on Prevention of iodine deficiency disorders in Vietnam, National Hospital of Endocrinology, 07/2012

Consumption of iodized salt meeting disease prevention standards of households in 2011



Source: Multiple Index Cluster Survey in 2011, General Statistics Office

Cost-effectiveness of food fortification

The ratio of cost of fortification with micronutrient get average value of 6: 1 calculated by physical labor productivity or 36: 1 calculated by intellectual interests

Micronutrient deficiency is classified as the second high nutrient risk with 2.4% of global DALY (disability rate adjusted under life expectancy, one DALY corresponding 1 year of healthy life). Remove global micronutrient deficiency contributes to increase 1 year of healthy life of more than 35 million people worldwide. Food fortification makes an effective approach to high prices by providing micronutrients for the majority of people through fortification of foods and spices commonly used in comparison with other approach such as diversification of meal or ingestion. The annual cost of providing iron tablets for pregnant women when achieving coverage of 95% is approximately 10.42 US$ to 50.16 US$/person, but the cost of food fortification with the same coverage only accounts for 0.06 to 0.15 US$. Average price per capita of the solution of diversification of meals, ingestion and food fortification is respectively 1148 US$, 11.4 US$ and 0.06 US$. Price effectiveness of ingestion supplementation, diversification of meals and food fortification is in turn 179 US$, 103 US$ and 66 US$ in one DALY (1 year of healthy life).

VII. Conclusion

In recent years, the prevention of micronutrient deficiency in Vietnam continues to gain many significant achievements. However, the percentage of micronutrient deficiency such as iodine deficiency, vitamin A preclinical deficiency, anemia, zinc deficiency is still a matter significant to public health in Vietnam as classified by the World Health Organization. In comparison with other countries in the region and around the world, micronutrient deficiency (iodine, vitamin A, iron, zinc, etc) in our country is quite high. Deficiency of vitamin A causes nutritional blindness and increases risk of death in young children. Iron deficiency cause nutritional anemia, affects the physical and intellectual growth, and reduces capacity to work or study. Iodine deficiency causes cretinism, poor intellectual development, and affects the fetus.

There are three main solutions to prevent micronutrient deficiency: Short-term solution (micronutrient supplementation such as vitamin A, iron, oil tablets); Medium-term solution (food fortification); long-term solution (overall improvement of quality of people's meals).

Currently there are over 100 countries around the world having mandatory food fortification. Improvement of micronutrient in essential food has been proven to be simple and effective measures to supplement micronutrient in the daily menu, considered an important contribution to the success of programs against micronutrients deficiency, enhance the quality of life of people. With the ability of the centralized and modern processing industry, fortification with micronutrient in wheat flour, cooking oil, soy sauce should soon be deployed. The fortification with micronutrients in wheat flour, salt, cooking oil, soy sauce does not cause adverse changes in color, taste, use time.

For the success of food fortification, it is necessary to have regulation on mandatory fortification of some foods. Regulation on mandatory fortification of some foods applies to humans, animals, use in iodized salt processing, mandatory wheat flour fortification with iron, zinc and folic acid, mandatory cooking oil fortification with vitamin A and soy sauce fortification with iron.