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6. Food Fortification– The Indian Scenario

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Abstract:

WHO and FAO recognized that there are over 2 billion people worldwide, who suffer from a variety of micronutrient deficiencies. It is statistically proved that approximately 1 in 3 people worldwide were at risk for iodine, vitamin A, or iron deficiency. For obtaining compensation of micronutrients in the foods, innovative technologies like food fortification or enrichment of food products were used through which these micronutrients are compensated in the regular diet of the common people. Food fortification is defined as the addition of one or more essential nutrients to a food, whether or not it is normally contained in the food). Fortification is being promoted through both, the open market and the government safety net programmes, such as Integrated Child Development Services (ICDS), Mid-Day Meal Scheme (MDM) and public distribution system. Food safety and Standards Authority of India (FSSAI) operationalised standards for fortification of five staples, namely wheat flour and rice (with iron, vitamin B12 and folic acid), edible oil and milk (with vitamin A and D) and salt (with iron in addition to iodine).

Keywords:

Food fortification, milestones, Status, Micronutrients, Enrichment, Food safety and standards.

6.1 Introduction:

[1]India is 94 out of 107 countries on Global Hunger Index, 2020. One third of about two billion people who are suffering from vitamin and micronutrient deficiencies globally, are in India. Micronutrient deficiency diseases such as anaemia, vitamin A insufficiency, and iodine insufficiency are highly common in India.

Initially, India's focus has been on addressing iodine, vitamin A and iron deficiencies. While there has been substantial improvement in Iodine Deficiency Disorders (IDD), severe vitamin A deficiency and anaemia still continues to be a serious cause for concern. National Family Health Survey (NFHS) 2015- 16 showed that 58.4 per cent of children in the age of 6 to 59 months are anaemic, 35.7 per cent of children under 5 years are underweight, 53 per cent of women in the reproductive age group (15 to 49 years) and 22.7 per cent of men in the same age group are anaemic

The micronutrient deficiency also known as - hidden hunger is a serious health risk. Economically deprived people, lack access to safe and healthy meals, well-balanced diet with enough micronutrients. Often, there is considerable loss of nutrients during the processing of food.

Micronutrient deficits can be addressed in three ways: dietary adjustments, supplementation and food fortification with specific nutrients. While dietary modifications are good, they are a long-term solution that may include adjustments in food preparation procedures and societal norms. Supplementation is an effective and rapid approach, but it requires appropriate medical infrastructure/administration and thus it is costly. Food fortification is a cost-effective solution that requires no intentional action on the part of the customer and no changes in the target populations' dietary patterns. It may also be easily integrated into current food production and distribution networks.

6.2 Food Fortification:

The process of adding micronutrients (essential trace elements and vitamins) to food is known as food fortification or enrichment. It could be a strictly commercial decision to add extra nutrients to a meal, or it might be a public health policy aimed at reducing the number of persons suffering from dietary deficiencies in a population. Staple foods of a region can lack particular nutrients due to the soil of the region or from inherent inadequacy of a normal diet. In these circumstances, adding micronutrients to staples and condiments can help prevent large-scale deficiency disorders.

As defined by the World Health Organization (WHO) and the Food and Agricultural Organization of the United Nations (FAO), fortification refers to "the practice of deliberately increasing the content of an essential micronutrient, i.e. vitamins and minerals

(including trace elements) in a food irrespective of whether the nutrients were originally in the food before processing or not, so as to improve the nutritional quality of the food supply and to provide a public health benefit with minimal risk to health", whereas enrichment is defined as "synonymous with fortification and refers to the addition of micronutrients to a food which are lost during processing".

WHO/FAO identified food fortification as the second of four strategies (the four strategies are dietary diversification, food fortification, public health and food safety measures) to begin reducing the global incidence of nutritional deficiencies. Cereals (and cereal-based goods), milk (and milk derivatives), fats and oils, auxiliary food items, tea and other beverages, and newborn formulas are the most prevalent fortified foods, according to the FAO. Under nutrition and nutrient deficiency is estimated globally to cause between 3 and 5 million deaths per year. Restoration is the addition of a nutrient to a food in order to restore the original nutrient content. The inclusion of nutrients that are naturally available or present in the food product is common in both restoration and enrichment programmes.

6.3 Milestones in Food Fortification[2]:

Food fortification or enrichment is the process of addition of key vitamins and minerals to the staple foods to improve their nutritional value and could address nutritional gaps in the population. Food fortification is not a new concept. The earliest evidence of food fortification was discovered around 4000 BC when the Persian physician Melampus added iron filings to sweet wine to strengthen the sailor's resistance to spears and arrows and to enhance sexual function. In the modern times, United States and Switzerland started adding iodine to the salt at the same time in 1920. Later, in 1932 they started adding vitamin D and vitamin A to the dairy products, and in 1941 they started adding thiamine to flours. Subsequently, the addition of iron and folic acid to flour become common in the western countries. Vanaspati has been fortified with Vitamin A since 1953 and iodine fortified salt since the late 1950s took significant role eradicating goiter in India. However, the attention was not enough which could satisfy the nutritional level of the population. Despite evidential malnutrition, according to Food Safety and Standard (Food Products Standards and Food Additives) Regulation 2011, manufacturers were not obliged to fortify a significant number of foodstuffs except margarine and infant formula. FSSAI established a panel on food fortification and nutrition to identify major nutritional gaps in the Indian diet, realising the urgency of the situation. Rice, salt, milk, flour (products) and vanaspati are all required to be fortified under the revised food safety and standards (fortification) regulation 2016.[3]

6.4 Fortification Efforts in India:

Food fortification comprises biofortification, microbial biofortification and synthetic biology; commercial and industrial fortification, and home fortification. The numerous methods of Food fortification are distinct because different techniques and procedures are employed to fortify the target foods. Biofortification is the process of using traditional breeding techniques and/or technologies to create micronutrient-dense staple crops. Biotechnology (genetic engineering) is a more modern method of biofortifying staple crops, and it has received a lot of attention in recent years.

The transgenic 'Golden Rice,' which contains twice the normal levels of iron and large amounts of beta carotene and other nutrients, is the most well-known example of this strategy. Microbial biofortification involves using probiotic bacteria (mostly lactic acid bacteria), which ferment to produce β-carotene either in the foods we eat or directly in the human intestine. Home fortification is providing deficient populations with micronutrients in the form of packets or pills that can be added to meals prepared at home (basically a merger of supplements and fortification). Commercial and industrial fortification is the process of adding micronutrients to commercially available items such as flour, rice, cooking oils, sauces and butter while they are being manufactured. Some of the FSSAI certified commercial products are.

6.4.1 Fortified Rice:

Rice is the staple food for 65 percent of India's population. Hence, fortification of rice can address micronutrient malnutrition caused by lack of Iron, folic acid, zinc and B Vitamins in the diet. Nearly 33.7 MT of rice is distributed annually through public funded programmes nationwide. Fortified rice can, reach 740 million vulnerable people in India, especially women and children. Globally, rice fortification began in the 1940's. Since then, 86 countries have mandated fortification of at least one industrially milled grain–wheat flour, maize, or rice. Six countries have mandated rice fortification[4].

6.4.2 Fortified Wheat Flour:

Fortification of wheat flour is cost-effective public intervention that can reduce micronutrient deficiencies (MNDs) and prevent birth defects (NTDs) due to folic acid deficiency. Wheat flour is an appropriate vehicle to fortify with iron, folic acid, zinc and the B Vitamins as per FSSAI standards, to address micronutrient deficiencies and reach a large segment of the population[3].

6.4.3 Fortified Edible Oil:

Edible oil is considered an appropriate vehicle for fortification to address vitamin A and D deficiency in our population. Fortification of edible oils and fats with vitamin A and D is a powerful practice for combating micronutrient malnutrition, with fortified oil providing 25–30 % of the required dietary intakes for vitamin A and D. Globally, oil fortification was first introduced in 1965 with 27 countries mandating it since then Vitamin A and/or vitamin D are used for the fortification of oil, being fat soluble vitamins[1].

6.4.4 Fortification of Milk:

Vitamin A and D are important for various body functions. In India, there has been a rapid rise in consumption of milk, growing from 178 grams per day in 1990-91 to 337 grams per day by 2015-16. This sustained growth in availability of milk and milk products for a growing population offers an excellent vehicle to address the vitamin A and D deficiencies through fortification. Mandatory milk fortification legislation was first introduced in 1935. Total milk production in India for 2015-16 was 155.5 million MT. Fortification of milk is extremely affordable and cost effective[3].

6.4.5 Double Fortified Salt:

Double fortified salt is a fortified food product that provides humans with a modest but critical amount of iodine and iron through their diet. In general, double fortified salt formulations are intended to provide 100 per cent of daily dietary iodine requirement, and 30 to 60 per cent of daily dietary iron requirement. Daily consumption of salt is 7 to 9 g/person; Therefore, it is an excellent vehicle to deliver micronutrients to the entire population. Fortification of salt with iodine since 1962 has been one of the most successful public health programmes in India and has significantly reduced goitre and iodine deficiency disorders. A complementary technique to combat widespread anaemia in the country is to fortify iodized salt with iron, known as doubly fortified salt (DFS)[7]. In October 2016, the Food Safety Standards Authority of India published draft standards for food fortification. The preliminary fortification of wheat flour complies with worldwide iron, vitamin B_{12} and folic acid fortification requirements. It is believed that fortifying flour for the mid-day meal, infant child development, and public distribution systems will have a substantial health benefit in Haryana. Darjeeling, West Bengal was the first place in the world to fortify wheat flour in latest years. At present, the fortification status of industrially milled wheat flour in India is about 7.6 per cent. In the states of Odisha and Karnataka, fortified rice is offered through social safety net programmes. Rajasthan leads the way in enriched oil and fortified milk products, which are available throughout the state. The statuses of food fortification in India are furnished in Table 6.1. The Indian government and various state governments promote flour fortification. International organisations and national health and nutrition research institutes are actively involved and flour milling professionals have contributed toward wheat flour fortification. Most fortified flour in India is distributed in the government ‘s welfare system[4].

Table 6.1: Status of Food Fortification Across Indian States

States	Rank	MDM (Mid-day meal scheme)	ICDS (Integrated Child Development Services)	PDS (Public Distribution System)
Andhra Pradesh	1	Fortified rice (2 districts) DFS (4 districts) Fortified oil (4 districts)	Fortified rice (2 districts), DFS (All) Fortified oil (All)	DFS (All), Fortified rice (1 districts)
Uttar Pradesh	2	Fortified wheat flour (2 districts), fortified rice (districts),DFS(1districts), fortified oil (1 District)	Fortified wheat flour (1 district), fortified rice (1 districts), DFS (1 district), fortified oil (1 district)	DFS (10 districts), fortified wheat flour (1 district), fortified rice (1 district)

States	Rank	MDM (Mid-day meal scheme)	ICDS (Integrated Child Development Services)	PDS (Public Distribution System)
Tamil Nadu	3	DFS (All), fortified rice (5 districts), fortified oil (All)	DFS (All), fortified oil (All), fortified rice (5 districts)	DFS (All), fortified oil (All), fortified rice (pipeline)
Gujarat	4	Fortified wheat flour (4 districts), fortified rice (1 districts), DFS (pipeline)	Fortified edible oil (All), DFS (All), fortified wheat flour (pipeline)	Fortified oil (All), fortified wheat flour (Pipeline), fortified rice (1 district)
Madhya pradesh	5	Fortified milk (All), DFS (All)	DFS (All)	DFS (20 districts), fortified rice (1 district)
Kerala	6	Fortified rice (4 districts), fortified milk (All – pipeline)	Fortified rice (1 district) (3 districts – pipeline)	Fortified wheat flour (All in NPS and NPNS), fortified rice (Pipeline)
Chandigarah	6	DFS (1 district), fortified oil (1 district)	Fortified milk (All)	Fortified rice (pipeline)
Karnadaka	7	DFS (6 districts) Fortified oil (All districts), fortified rice (4 districts – pipeline)	DFS (4 districts – pipeline)	Fortified rice (4 districts)
Bihar	8	DFS (2 districts)	DFS (6 districts)	
Haryana	8	Fortified oil (All), fortified milk (All), fortified wheat flour (6 districts)	Fortified oil (All), fortified wheat flour (6 districts), DFS (All –pipeline)	Fortified oil (All), fortified wheat flour (5 districts)
Maharashtra	9	DFS (2 districts), fortified wheat flour (2 districts), fortified oil (2 districts)	-	Fortified rice (1 district)
West Bengal	10	-	-	Fortified wheat flour (All)

States	Rank	MDM (Mid-day meal scheme)	ICDS (Integrated Child Development Services)	PDS (Public Distribution System)
Telangana	11	Fortified rice (1 district), fortified oil (4 districts), DFS (4 districts)	Fortified rice (1 district), DFS (2 districts), fortified oil (2 districts)	-
Himachal Pradesh	12	Fortified edible oil (All)	Fortified edible oil (All), DFS (All)	Fortified oil (All), fortified wheat flour (All), DFS (All)
Tripura	12	Fortified rice (All-pipeline), DFS (1 district), fortified oil (1 district)	Fortified rice (All-pipeline)	-
Odisha	13	Fortified rice (2 districts, 14 districts –pipeline), DFS (4 districts), fortified oil (4 districts)	-	Fortified rice (1 district – pipeline)
Rajasthan	14	Fortified wheat flour (1 districts), DFS (9 districts)	Fortified oil (All), DFS (As per availability), fortified wheat flour (2 districts)	-
New Delhi	15	Fortified oil (All), DFS(All)	-	-
Goa	17	Fortified oil (All), DFS (All)	-	Fortified rice (pipeline), fortified wheat flour (pipeline)
Chhattigrah	18	Fortified wheat flour (All), fortified rice (All)	Fortified rice (All), fortified wheat flour (All)	
Andaman and Nicobar	18		-	Fortified wheat flour (All)

Source (FFRC, 2021) (DFS –Double Fortified Salt, NPS- Non Priority Subsidy, NPNS-Non Priority Non Subsidy)

6.5 Government Supported Fortification Programmes:

6.5.1 Mid-Day Meal Scheme (MDM):

The Mid Day Meal (MDM) Scheme aims at improving nutritional levels among children studying in government, local body, and government-aided schools up to 8th class. As per norms, primary school children are provided 100 grams of grains (rice or wheat flour) daily and upper primary school children are provided 150 grams of grains daily, as part of a hot cooked meal served at school. The government allocates 2.16 million MT of food grains (wheat and rice) to feed 118.5 million children every year.

6.5.2 Integrated Child Development Services (ICDS):

Supplementary Nutrition (SN) supplied under ICDS Scheme is of two types for different beneficiaries, i.e., pregnant women, lactating mothers, and children aged 6 months to 3 years receive a Take Home Ration (THR); children aged 3 to 6 years receive a hot cooked meal. Supplementary nutrition served to the beneficiaries is to be prepared as per the National Food Security Act, 2013 which provides food security to the people.

6.5.3 Public Distribution System (PDS):

Public Distribution System (PDS) is the key channel of the government's food security system in India, reaching 67 percent of the population and implemented through the Ministry of Consumer Affairs, Food & Public Distribution, and Department of Food & Public Distribution.

The present food basket of PDS includes wheat, rice, sugar, and kerosene. Many states/UTs also permit sale of food items such as pulses, edible oils, iodized salt, spices, etc. through PDS outlets.

Under NFSA (National Food Security Act) 2013, beneficiaries are classified as AAY (Antyodaya Anna Yojana) or PHH (Priority Households /Non AAY) and get rice at INR 3 per kg, and wheat at INR 2 per kg. Antyodaya Anna Yojana beneficiaries are entitled to 35 kg per family per month; PHH beneficiaries are entitled to 5 kg per person per month[4]

6.5.4 SABLA: A Scheme for Adolescent Girls:

SABLA is a centrally sponsored scheme for all-round development of 11 to 18 years old adolescent girls. The scheme has a special focus on all out-of-school adolescent girls and is implemented using ICDS. The Anganwadi Centres (AWCs) are the focal point for the delivery of the services for 205 districts selected from all state governments/UTs, covering 1 crore beneficiaries. The nutrition component of the scheme aims at improving the health and nutritional status of these girls by provision of supplementary nutrition in the form of both THR (Take home ration) and HCM (Hot cooked meal). Inclusion of fortified staple foods here would be an ideal intervention to address micronutrient malnutrition at the right stage, i.e., among adolescent girls before they go on to be mothers[4]

6.5.5 Welfare Institutions and Hostels:

A bouquet of schemes is provided under the Ministry of Social Justice to address the basic needs of the underprivileged and the elderly. These include welfare institutions taking care of the elderly under the Integrated Programme for Older Persons (IPOP) Scheme which was implemented in 1992. The scheme's major goal is to improve older people's quality of life by providing basic necessities such as shelter, food, medical treatment, and entertainment options, as well as encouraging productive and active ageing. Along with this, many hostels catering to backward classes also get their rations from PDS through FCI. At the national level, fortifying wheat flour and rice will help to improve the nutritional status of the older persons.[4]

6.6 Laws for Food Fortification:

In order to promote fortification as a means to address micronutrient deficiencies, The Food Safety and Standards Authority of India (FSSAI) has approved the provisional Food Safety and Standards (Fortification of Foods) Regulations, 2016, that includes provisions for fortification of wheat flour, rice, milk, edible oil and salt with vitamins and minerals, among several other things. The updated Food Safety and Standards (Fortification of Food) Regulations, 2016 state that the FSSAI may mandate fortification of any food article specified under the regulations from time to time, in consultation with stakeholders, on directions from the Government of India or recommendations from States/UTs. Under Food Safety and Standards (Prohibition and Restriction on Sales) Regulations, 2011, sale of only iodized salt is permitted for direct human consumption. Further, Food Safety and Standards (Food Product Standards and Food Additives) Regulations, 2011 provide that vanaspati shall contain synthetic Vitamin A. The level of fortificants added to the food items are furnished in Table 6.2. The Ministry of Women and Child Development and Ministry of Human Resource Development have advised the use of double fortified salt (iron and iodine), wheat flour (with iron, folic acid and vitamin B-12) and edible oil with (vitamin A and D) under their Schemes i.e. Integrated Child Development Scheme and Mid-day Meal Scheme. Food Fortification Resource Centre (FFRC) was developed by FSSAI in partnership with Tata Trusts and numerous international nutrition NGOs as a resource centre to promote large-scale food fortification and to promote and encourage food industries to adopt fortification as a norm.

6.7 Standards on Fortification:

6.7.1 General Principles:

Essential nutrients may be appropriately added to foods for the purpose of contributing to any of the following:

- Preventing or reducing the risk of, or correcting a demonstrated deficiency of one or more essential nutrients in the population or specific population group.
- Reducing the risk of, or correcting inadequate nutritional status of one or more essential nutrients in the population specific population group.
- Meeting requirements or recommended intake of one or more essential nutrients

- Maintaining or improving health
- Maintaining or improving the nutritional quality of foods.

Table 6.2: Level of Fortificants in Food Products

Sr. No	Food product	Component	Level of nutrients	Source of nutrients
1	**Double fortified salt**	Iodine content a) Manufacture level b) Distribution channel including retail level	 20-30 ppm 15-30 ppm	Potassium iodate
		Iron content (as Fe)	850-1100 ppm	Ferrous sulphate or ferrous fumarate
2	**Fortified oil**	Vitamin A	6 µg RE-9.9 µg/gm of oil	Retinyl acetate or retinyl palmitate
		Vitamin D	0.11 µg RE-0.16 µg per gram of oil	Cholecalciferol or ergocalciferol (from plant source
3	**Fortified milk**	Vitamin A	270 µg RE-450 µg RE	Retinyl acetate or retinyl palmitate
		Vitamin D	5 µg -7 µg	Cholecalciferol or ergocalciferol (from plant source
4	**Fortified wheat flour and rice**	Iron	28 mg – 42.5 mg	Ferrous citrate or ferrous lactate or ferrous sulphate or ferric pyrophosphate or electric iron or ferrous fumarate or ferrous BisGlycinate
		Or sodium iron (III)	14 mg - 21.25 mg	ethylene Diamine Tetra Acetate Trihydrate (Sodium Feredetate – NA Fe EDTA)
		Folic acid	75 µg - 125µg	-
		Vitamin B12	0.75 µg-1.25 µg	Cyanocobalamine or hydroxycobalamine

Source (FFRC, 2021)

All fortified food shall be packaged in a manner that takes into consideration the nature of the fortificant added and its effect on the shelf life of such food. Every package of fortified food shall carry the words "fortified with (Name of the fortificant)" and the logo, as specified in the schedule of these regulations, on the label. All other provisions under the Food Safety and Standards (Packaging and Labelling) Regulations, 2011, also apply to the fortified foods.

Every package of food, fortified with iron shall carry a statement "Not recommended for people with Thalassemia and people on low iron diet." After subregulation, the Department of Food Safety and Standards (fortification of foods) amended regulations pertaining to compliance with standards on micronutrient content in fortified foods in 2020. The fortification of vitamin A and vitamin D in packed refined edible vegetable oil weighing less than 15 kilograms must meet the level set in amended regulation.

In the case of packed toned, double toned, skimmed, or standardised milk, vitamin A and vitamin D must be fortified to the level provided in the specified clause in FSSAI regulation (FSSAI, 2020).

6.8 Conclusion:

Globally nutritional deficiencies are severe issue faced by the people. The major 4 programmes put forward by India include dietary diversification, food fortification, public health and food safety measures, in which food fortification was more beneficial. Food fortification will remain a significant tool for treating and preventing specific nutritional deficiencies, as well as promoting a broader overview of well-being in certain groups and possibly preventing some chronic diseases.

As a result, food fortification research and technology application will have a larger scope of compensating for insufficient nutrients in food. Technological and scientific problems include identifying and developing fortifying substances that will ensure product quality and bioavailability. To attain the country's aim of nutritional security, it is critical to raise nutrition awareness through constant monitoring of population nutritional status and prompt implementation and adjustment of policies.

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