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Review Article

FOOD TO FOOD FORTIFICATION - A NOVEL APPROACH TO MITIGATE IRON DEFICIENCY ANEMIA

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ABSTRACT
Iron deficiency anemia is the most prevalent nutritional deficiency disorder affecting all age groups in the world. The latest preliminary estimate figures from WHO on the prevalence of iron deficiency anemia by age group and region show the highest prevalence is found in infants, children, adolescents, and women of childbearing age, especially pregnant women. The scale and magnitude of the problem has functional impact both physiologically and socioeconomically and require the urgent adoption of known and effective measures. Food-to-Food Fortification are often described as a sustainable food based strategy because this process empowers individuals and households to take ultimate responsibility over the quality of their diet through own-production of nutrient rich foods and informed consumption choices. Food-to-Food Fortification, which consists of selecting food combinations that promote non heme iron bioavailability by increasing the amount of enhancers of absorption or decreasing the amount of inhibitors of absorption present in a meal.

Keywords: *Anaemia, Prevalence, Food to Food Fortification, Bio Availability of Iron*

INTRODUCTION
Iron deficiency is the most common and widespread nutritional disorder in the world in industrialized and non- industrialized countries. It is the result of a long-term negative iron balance; in its more severe stages, iron deficiency causes anaemia.
The mean prevalence among specific population groups are estimated to be: pregnant women, infants and children aged 1–2 years-50%; preschool-aged children-25%; school children- 40%; adolescents, 30–55%; non-pregnant women, 35%. These average figures obscure the fact that iron deficiency and iron-deficiency anaemia are even more prevalent in some parts of the world, especially in the Indian subcontinent and in sub-Saharan Africa, where, for example, up to 90% of women become anaemic during pregnancy. Numerous research studies over the past years have carried out in different facets on anaemia, still it becomes an enigma and continues a major public health problem among community. Several attempts and technologies have followed by the researchers to reduce the prevalence of anaemia. One of the technology i.e., Fortification has been applying over the years for several foods to develop enriched food products.
A common problem with fortification is that other nutritional components in the food may lower the bioavailability of the fortified nutrient(s). In particular, with iron fortification, the inhibitory effect on iron bioavailability of food components such as phytic acid (the major phosphorus storage compound in grains). To overcome these inhibitory effects, more concentration on simple processing techniques while handing of foods is necessary. A few research studies on food to food fortification revealed that it is the ample technology to mitigate iron deficiency anaemia through increasing the bio availability of iron by following simple processing techniques at home and industrial level.

Food-based Strategies to Mitigate Iron Deficiency
Food-based strategies are often described as a sustainable approach because the process empowers individuals and households to take ultimate responsibility over the quality of their diet through own-production of nutrient rich foods and informed consumption choices. These strategies are said to be "the ideal long-term goal toward which society strives—provision of assurance of access to a nutritionally adequate diet achieved through diversity of food availability, wise consumer selection, proper preparation, and adequate feeding".

Table 1: A wide variety of interventions through food based strategies

S. No	Strategy	Process	Application
1.	To increase the production of micronutrient-rich foods	Agricultural Programs And Policies To Increase Commercial Production	Promotion of Home production of fruits and vegetables (home gardens), small livestock production and aquaculture (fishponds)
2.	To increase the intake of micronutrient-rich foods	Nutrition Education, Communication And Education Interventions Targeted at Specific Age Groups	Promotion of optimal breast-feeding and complementary feeding practices for infants and young children
3.	To increase the bioavailability of micronutrients	Home Processing Techniques Such As Fermentation or Germination, Preservation And Conservation Techniques Such As Solar Drying Or Production Of Leaf Concentrates	Extends the availability of seasonal fruits and vegetables throughout the year

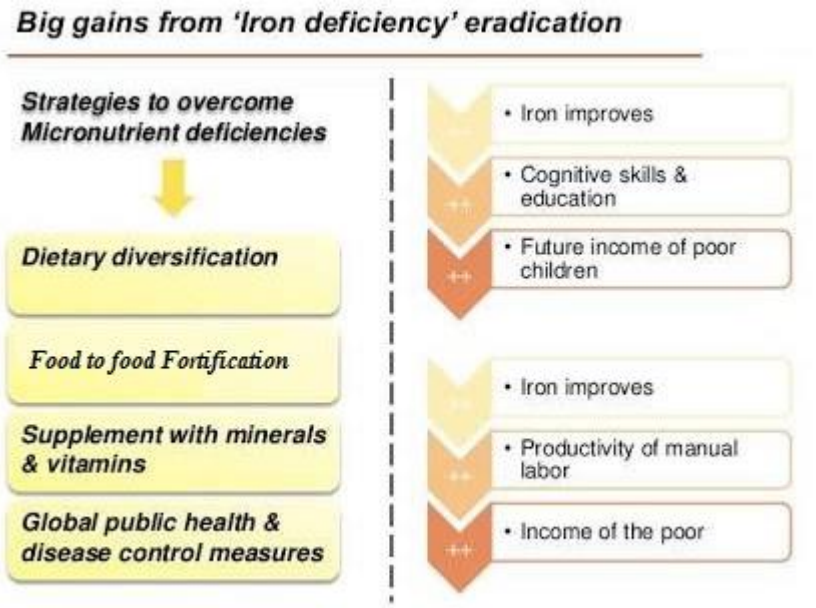

Figure 1: Strategies to overcome Iron Deficiency Eradication

Source: www.britanniacoin-bnf-mediabritanniainhealthnutrition

Simple Techniques to Improve Iron Bio Availability

Various home processing techniques can be used to either increase the bioavailability of micronutrients or to ensure their retention during preparation, cooking or other processing techniques. For nonheme iron, the most crucial issue is to increase its bioavailability and this can be achieved through

(1) Home processes such as fermentation or germination; and

(2) Food-To-Food Fortification

Processing Methods at Home level

Nonheme iron from cereals or other plants is poorly absorbed because of the presence of inhibitors of iron absorption, particularly phytic acid. Various food-processing techniques, which have traditionally been used in meal preparation across countries in Africa, Asia, and Latin America, do exist to reduce the phytic acid content of plant-based staples. Some techniques such as fermentation, germination or malting

involve enzymatic hydrolysis of phytic acid, whereas other nonenzymatic methods such as thermal processing, soaking or milling can also reduce the concentration of phytic acid in some plant staples.

Enzymatic hydrolysis of phytic acid: Enzymatic hydrolysis of phytic acid in whole grain cereals and legumes can be achieved by soaking, germination or fermentation. These processes enhance the activity of endogenous or exogenous phytase (Lorenz, 1980; Chavan and Kadam, 1989).

Germination: Germination consists of soaking seeds in water in the dark, usually for up to 3 days, to promote sprouting.

During the germination process, phytase activity increases, causing the phytic acid to break down. Germination also reduces other antinutrients, including polyphenols and tannins. The amount of certain vitamins, including riboflavin, B-6 and vitamin C increases during germination, as well as the bioavailability of calcium, iron and zinc.

Malting: Malting is a technique that grinds and softens whole grains by soaking them in water until sprouting occurs. Drying and milling typically follow malting. Many cereal-based porridges are prepared by malting, a process that increases bioavailability of iron and zinc by reducing phytic acid levels.

Fermentation: Acid and alcoholic fermentation can be used for cereals, legumes or vegetables, to increase their nutritional value and improve their physical characteristics. Fermentation can be spontaneous (using the microorganisms that are naturally present in food), or started with an inoculation. Fermentation improves the bioavailability of minerals, such as iron and zinc, as a result of phytic acid hydrolysis.

Soaking is another technique to increase the amount of soluble iron. For example, soaking flour for 24 hours increases the amount of soluble iron by up to tenfold (Svanberg 1995). Under optimal pH conditions, soaking wheat or rye flour for 2 hours, completely hydrolyzed phytic acid.

Combining fermentation, soaking and germination techniques is also highly efficient in activating endogenous phytase enzymes to degrade phytic acid and to reduce, to some extent, the amount of polyphenols that inhibit nonheme iron absorption (Svanberg 1995). Sour dough leavening, for instance, can completely degrade phytic acid.

Nonenzymatic methods for reducing phytic acid content. Nonenzymatic methods, such as thermal processing, soaking and/or milling can also be used to reduce the phytic acid content of plant-based staples. Mild heat treatment reduces the phytic acid content of tubers but not cereals and legumes. Soaking can reduce the phytic acid content of certain legumes and cereals that contain water-soluble sodium or potassium phytate.

Gibson and collaborators initiated a community trial to combat iron, zinc and vitamin A deficiency in Malawi using an integrated approach that combines a variety of the strategies such as germination and malting (Gibson *et al.,* 1998).

Various food processing techniques and food combinations do have positive effects on increasing the bioavailability of nonheme iron, the effect of ascorbic acid to improve body iron stores has been tested in a few prospective studies summarized by Svanberg (1995). These experiments, however, used vitamin C supplements, as opposed to food sources of vitamin C, and thus are not considered food-based approaches.

There are various ways you can combat the effects of phytate. Eating foods rich in vitamin C with iron-rich food can help. Also, cooking can increase the amount of iron available (Viadel *et al.,* 2006; Bishnoi *et al.,* 1994).

Sprouting grains, seeds and pulses is another effective way of reducing phytate as it is released on germination. Studies show that germinating and dehusking can reduce phytate in rice and mung beans by 92 per cent (Marero *et al.,* 1991), and increase iron absorption from various grains and pulses by between 20 and 62 per cent (Hemalatha *et al.,* 2007).

Food to Food Fortification

Food-to-Food Fortification (or Dietary Combinations) strategies to improve iron nutrition consist of dietary modifications to either include in a meal foods that can promote the absorption of nonheme iron or to exclude foods that inhibit nonheme iron absorption.

Conclusion

Several nutritional and non- nutritional factors are responsible for the inception of Iron deficiency anaemia. Though several aspects contribute to the onset of anaemia, it can preclude through undertaking appropriate food based strategy in the proper time. Focusing on simple processing techniques with maximum nutrient retention at home and industrial level corrects this micronutrient deficiency. And also, Education about nutrition and nutrient bioavailability (Food to Food Fortification) while handling and processing of foods among community is the most important line of attack to combat the nutritional deficiencies suffering in the world.

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