DUAL FORTIFICATION OF COMMON SALT – TECHNOLOGICAL HURDLES AND WAY AHEAD

B. Sivakumar
Director, National Institute of Nutrition (ICMR), Hyderabad,

Iron deficiency anemia (IDA), Iodine deficiency disorders (IDD) and vitamin A deficiency have been identified as the major public health problems in our country[1]. Fortification of common salt with iron has been developed by the National Institute of Nutrition (NIN) as a public health strategy for the control of IDA on the lines of iodization of salt for the effective control of IDD[2]. However, with the advent of universal iodization of edible salt as a National policy in 1988, NIN undertook research studies aimed at development and testing of double fortified salt (DFS) containing iodine and iron for reducing the deficiencies of both these micronutrients[3]. In view of their antagonistic chemical properties, the incorporation of iron and iodine in salt requires a stabilizer. NIN developed a DFS formulation using sodium hexametaphosphate (SHMP) as a stabilizer. SHMP is intended to protect iodine and prevent the interaction between the iron and iodine and also with the other constituents of the salt. The stability, bioavailability and acceptability of DFS were determined and found to be good[3]. The Micronutrient Initiative (MI) in Canada[4] and a company in Chennai with the trade name of the salt "Nutrisalt"[5] have developed two other formulations of DFS, in which physical separation of iodine was achieved by barrier methods. Parallel to these developments, studies were continued at NIN to explore other formulations. On the suggestion and support from the International Life Sciences Institute (ILSI, Washinton D.C.), NIN also tested other DFS formulations containing sodium ferric EDTA as a source of iron along with Iodine and also SHMP and EDTA as promoters of iron absorption[6]. Some formulations were identified as promising second-generation preparations. DFS containing encapsulated iron salt was found to have good stability characteristics and iron bioavailability, even with powdered common crystal salt. Working with powdered common salt reduces the cost of salt but increases the cost of iron incorporation, so that at the final product level there may not be any major difference in cost between these different approaches.

The NIN also carried out extensive studies on the safety and impact of its DFS (both experimental and community situations) on both iron and iodine statuses[1]. Trials of large-scale production, operational feasibility of distribution and acceptability in the community have been repeatedly demonstrated with the NIN DFS

Table 1: Comparative Physico-Chemical Features of different DFS Formulations

Characteristics	NIN Formulation	MI Formulation	Nutrisalt
Clinical constituents	30-40 ppm I, KIO_3 or KI Ferrous sulphate SHMP Stabilizer and promoter	50 ppm I, KI– Ferrous fumarate Encapsulation of iodine by dextrin	30 ppm I, KIO_3 Iron salt Barrier
Stability	Stable up to 9 months	Stable for 12 months.	Report claims good stability.
Acceptability	Fullfledged acceptability described	Not acceptable with some foods	Report claims good acceptability and stability during cooking.
Bioavailability of iron and iodine	Demonstrated. (Iron absorption 6.1%) Urinary iodine increased like with in IS.	Demonstrated. Iron absorption variable 13.5%. Urinary iodine equal to IS	Not reported
Pilot scale/ plant scale production tested	Plant scale production	Not tested	Not known

Table 2: Comparative bio-impact features of different DFS formulae

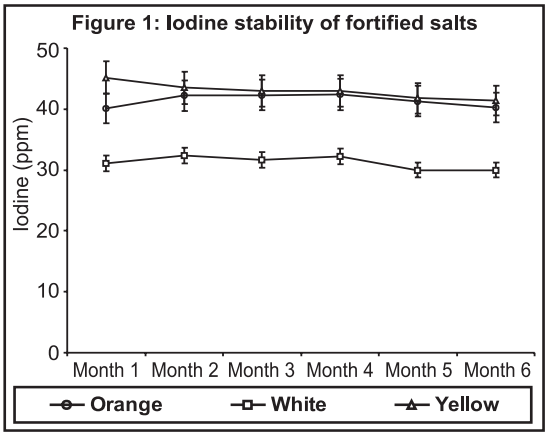
Study populations	Tribal villages in (AP) single blind, placebo Residential school children, Hyd. Double blind, placebo	Mothers and children in Ghana, double blind, placebo	Tea estate labourers, Valpari, South India Double blind, placebo
Deworming treatment	No treatment	No treatment	Simultaneously de-wormed.
Stability of iodine at the location	Done	Done	Data not given
Impact on iron and iodine status	Goitre prevalence decreased and urinary iodine improved. Iron status benefited only in some groups of the tribals. Benefited residential school children both in iron status and iodine status. The impact on iron status was mainly on control of anaemia.	Maintain good iodine levels in children and mothers. Children showed small reduction in prevalence of anaemia with DFS while the prevalence of anaemia increased in controls. Mothers too showed improvement with DFS, though the anaemia prevalence at baseline was not comparable to control.	Benefited only in females. De-worming is an important requisite for response.
Cost	About Rs. 4.50/kg	Worked out	Worked out (Rs. 4.50/kg)
Productivity	Not worked out	Not Worked out	Measured Plucking of tea leaves
Safety issues, if any, due to components	Safety of SHMP evaluated in rats as well as in children	Perhaps issues are not involved	Not known, if any safety issues are involved

(Table 1). Limited studies dealing with the acceptability and impact were reported on the other two formulations. The MI formulation, though stable, developed an unacceptable colour with some recipes[4]. No detailed studies are available on the organoleptic properties of Nutrisalt. Both the NIN and MI formulations demonstrated a limited, but significant impact on both iron and iodine statuses of different population groups. Nutrisalt was found to have an impact on iron status (as measured by an increase in blood hemoglobin) at a lower probability than the other formulations of DFS[5] (Table 2).

It has to be understood that the impact of DFS on hemoglobin increase will not be very striking since providing iron through DFS is a preventive measure and not a therapeutic one. However, it is a sustainable method of doubling iron intake of one billion plus population for several decades.

In one of the ongoing multicentric evaluation studies of DFS, some centers reported variation in the stability of iron. After reviewing all the available evidence, the Expert Committee appointed by the Indian Council of Medical Research (ICMR) on DFS, felt that the NIN DFS has shown consistent beneficial effect both on iodine and iron statuses, but felt that the stability of iodine needs to be reconfirmed before it is considered for introduction in the national program. As with other iodized salts, the stability of iodine in DFS is better when prepared with a better quality powdered crystal salt or refined salt and not with crude crystal salt. When salt has high initial moisture content or when the relative humidity of storage conditions is high, the stability was observed to be poor. In the multi-centric trials conducted by the ICMR and the subsequent studies conducted by NIN, the titrimetric method of iodine estimation with sulfuric acid was found to be unsuitable for some preparations of DFS. A suitable modification of the method resulted in finding the stability to be excellent (Figure 1). There was little loss in iodine even after 6 months under programme conditions and also in high humidity. This aspect was independently validated by outside experts finally clearing the doubts on the stability of iodine from the NIN DFS. Being conscious of the national hopes and stakes in DFS on the one side and realizing the responsibilities and the reputation of NIN on the other side, NIN has patiently built up the

scientific support to reach their goal. The untiring scientific efforts of Dr. B.S.Narasinga Rao and many scientists and staff members of NIN and the initial thrust provided by Dr. Gopalan in its formative years, with the strong support of the ICMR, and the healthy criticism and encouragement provided by the scientific community in the country, formed the foundation stones on which DFS was built. Now, it is imperative that the benefits of the DFS-technology should reach the people without further delay.



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