
Double Fortification of Salt with Iron and Iodine

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Malnutrition

- “Pathological state resulting from relative or absolute deficiency of one or more essential nutrients”

(Hawkesworth, 2009)

Micronutrient Malnutrition

- Loss of 1.5 million lives per year

(Fiedler, 2009)

- Common among the children

(Caulfield *et al.*, 2006)

Malnutrition in Pakistan

- Very high level of malnutrition
- Annual GDP loss: 3-4%

(USSCN, 2008)

- Undernourished: 24 %
- 37.5 million people

(FAO, 2008)

Objectives

- To improve the status of Iron and Iodine our population
- To improve the Iron and Iodine status specifically in target groups

Recommended Daily Allowance (RDA) for Iron

Age group	RDA (mg/day)
0-6 months	0.27
7-12 months	11
1-8 years	7-10
9-13 years	8
14-18 years (males)	15
14-18 years (females)	18

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19-50 years (males)	8
19-50 years (females)	18
Over 50 years	8
Pregnant women (of all age)	27
Lactating women (14-18 years)	10
Lactating women (over 19 years)	9

(Paul *et al.*, 2004)

Recommended Daily Allowance for Iodine

Age group	RDA ($\mu\text{g}/\text{day}$)
0-6 months	110
7-12 months	130
1-8 years	90
9-18 years	120
19 and over	150
Pregnant women	220
Lactating women	290

(Paul *et al.*, 2004)

Iodine

- Important for thyroid function
- Iodine deficiency may results
 - Impaired cognitive development
 - Hypothyroidism
 - Congenital abnormalities
 - Cretinism
 - Goiter

(WHO and UNICEF, 2007)

Iron

- Important for
 - Oxygen transport
 - Transport medium for electron
 - Part of enzymes

- Deficiency may result in
 - Anemia
 - Impaired cognitive performance
 - Increased maternal and child mortality

(Brownlie, 2002)

Salt Fortification

Salt is selected for fortification because

- Large scale consumption
- Regular consumption
- Constant amount
- Not related to socio-economic status

(Caulfield *et al.*, 2006)

Methods of Salt Fortification

- Spray mixing
- Dry mixing

(Ranganathan, 2007)

Criteria for Fortificant Compound

- No discoloration
- No segregation
- No added flavor or odor
- Nutritionally available
- Economically feasible

(Andersson *et al.*, 2008)

Iodine Compounds

- Potassium iodide
- Potassium iodate
- Calcium iodate

(Diosady, 2002)

Iron Compounds

- Ferrous ascorbate
- Ferrous fumarate
- Ferrous succinate
- Ferrous gluconate
- Ferrous sulfate.7H₂O
- Ferrous sulfate
- Ferric pyrophosphate

(Hurrell, 2002; Swain *et al.*, 2003)

Stabilizing Compound

- Sodium hexametaphosphate
- Sodium acid sulphate
- Orthophosphoric acid

(Diosady, 2002)

Problems in Stability

- Bioavailable form of iron: ferrous
- Ferrous oxidize to ferric
- Oxidation is accelerated by
 - ✓ Alkaline conditions
 - ✓ Oxidizing agents
 - ✓ High humidity
 - ✓ High temperature

(Diosady, 2002)

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Oxidation results in

- Low bioavailability
- Poor taste
- Unacceptable discoloration
- Loss of iodine

(Diosady, 2002)

Solution

Microencapsulation

(Yao *et al.*, 2010)

Product Analysis

- Iron determination

Atomic absorption spectrometry

- Iodine concentration

Sandell-kolthoff method

(Andersson *et al.*, 2008)

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- Moisture

Gravimetric method

- Color

Colorimetric

(Andersson *et al.*, 2008)

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Thank You!