Micronutrient Initiative

COMPARATIVE ACCEPTABILITY STUDIES ON ROLLER-MILLED WHEAT FLOUR FORTIFIED WITH THREE DIFFERENT IRON FORTIFICANTS IN PAKISTAN

F Mahmood[1], A Zeb[1] and NA Khan[2]
[1]Nuclear Institute for Food and Agriculture (NIFA), Peshawar, Pakistan and [2]Micronutrient Initiative, Pakistan

BACKGROUND

Anemia affects 30% of children under five and 50% of women of child bearing age in Pakistan and thus constitutes a serious public health problem and a significant constraint to the social and economic development of its population (National Nutrition Survey 2001-02). Wheat flour is considered to be an ideal vehicle for iron fortification in Pakistan, as the daily per capita wheat flour consumption in the country (269 g) is among the highest in the world. Universal fortification of wheat flour with iron and folic acid could, therefore, reduce iron deficiency anemia in children from 30% to 10% and in women of reproductive age from 50% to 18%, and reduce the occurrence of neural tube defects by 50%. Therefore a National Wheat Flour Fortification program began in 2004, which aims to achieve universal fortification of wheat flour by the year 2013. During the first 3 years of implementation the program will develop monitoring guidelines, strengthen the program management capacity of the public and the private sectors, and design effective advocacy and communication activities.

AIM

To compare consumer acceptance of unfortified wheat flour (control) with that of wheat flour fortified with 1.5 ppm folic acid and one of the following iron fortification alternatives: a) 30 parts per million (ppm) of iron as ferrous sulfate (FS); b) 20-ppm iron as Ferrous Sulfate + EDTA (FSE); and c) 60 ppm elemental iron as reduced iron (EI).

METHODS

A four-week one-way consumer-blind, randomized study was conducted, involving 44 volunteer families (352 individuals) divided into four groups of eleven families each. The flours were produced at a local mill from a single batch of wheat and compliance with fortification specifications verified by an external laboratory. The iron compounds were purchased directly from the manufacturers and handled according to the manufacturer's recommendations (storage time, temperature, relative humidity). Freshly prepared flour was provided to participating families within 30 days after production. The groups were given the four different flours in different order (Group 1 = Control – FSE - EI and FS; Group 2 = FS – EI - Control and FSE; Group 3 = EI – FS - FSE and Control; Group 4 = FSE – Control - FS and EI) for a period of one week each in color tagged bags of 20 kg capacity **(Figures 1 and 2)**. The choice of preparing products from the flour was left to the volunteer families. At the end of the week the filled questionnaire was retrieved and flour for the next week (specified for that week and group) along with Part-B of the questionnaire for the coming week were distributed. This practice was repeated for 4 weeks, so that each group of volunteer families consumed all the 4 flour types, without knowing the sequence of the fortificants, and gave their opinion by filling the Proforma. Responses were recorded in terms of 18 qualitative parameters, arising from as many questions contained in the given standard questionnaire.

RESULTS

Apparent wheat flour consumption was not different across groups or flour types (overall mean +/- SD). Overall there was no statistically significant difference in preference between the various kinds of flour with respect to the unfortified control ($p>0.05$) **(Figures 3 and 4)**. The four flours were not different in taste to the consumers to disqualify any of the fortificants for general use on this basis. Non significant trends were noted regarding a slight preference for FS flour over the other fortified flours (95.45 for FS against 95.23 for FSE and 95.00 for EI flours). In questions on the preparatory qualities of flour, the FS fortified flour came out ahead as well.

CONCLUSIONS

The study shows that at the iron fortification levels used iron-fortified wheat flour were indistinguishable from the control flour to consumers under the storage, use, and turn-over time described for this study.

The study provides a good base for initiating a nationwide flour fortification program in Pakistan.

Further studies on the stability of the different iron fortificants and flour combinations should be carried out under normal market conditions of storage, transportation, and food preparation.

ACKNOWLEDGEMENTS

The authors would like to express their appreciation to the Nutrition Section of the Planning Division, Government of Pakistan, for coordinating the research project.

RANDOMIZED BLOCK DESIGN: ALLOCATION OF TREATMENT BY WEEK AND FAMILY GROUPS

Week	Group 1	Group 2	Group 3	Group 4
1	Control	FS	EI	FSE
2	FSE	EI	FS	Control
3	EI	Control	FSE	FS
4	FS	FSE	Control	EI

Fig. 1

TAGGING SCHEME FOR CONTROL AND 3 TYPES OF FORTIFIED FLOUR

Color of the Tag	Type of flour	Fortificant	Fortification level
White	Unfortified - Control		
Green	Fortified with Ferrous Sulfate (FS)	Ferrous Sulfate Folic Acid	30 ppm 1.5ppm
Yellow	Fortified with Ferrous Sulfate and EDTA (FSE)	Ferrous Sulfate EDTA Folic Acid	20ppm 20ppm 1.5ppm
Red	Fortified with Elemental Iron (EI)	Reduced Iron Folic Acid	60 ppm 1.5 ppm

Fig. 2

ORGANOLEPTIC EVALUATION - CHAPATIES

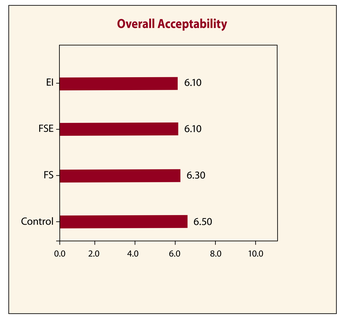

Fig. 3

ORGANOLEPTIC EVALUATION - NAN

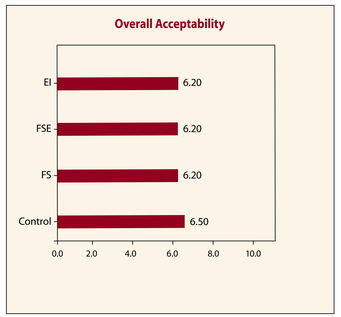

Fig. 4

ROTIS PREPARED FROM FORTIFIED AND UNFORTIFIED FLOUR