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Quality assessment of different iron fortified wheat flours

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Abstract: The study was carried out to evaluate the quality and level of fortificant i.e. iron in eight fortified wheat flour samples collected/procured from different sources. The samples were analyzed for their proximate composition and iron content. The results showed that almost all samples contain appreciable amount of essential nutrients. The maximum content of moisture, carbohydrate, crude protein, crude fat, crude fiber and ash recorded in these samples was (11.47%, 78.74 %, 11.36%, 2.30%, 2.37% and 1.53%) with a minimum content (5.46 %, 72.73 %, 9.13%, 1.43%, 1.12% and 1.28%) respectively. Maximum concentration of micro mineral (Fe) observed was (7.2 mg/100g) with a minimum concentration (3.2 mg/100g) respectively. On the basis of proximate composition it can be concluded from the study that wheat flours used for iron fortification were of good quality while level of iron predicted that homogenous mixing of fortificant to the flour must be ensured at the time of addition also consumption of fortified flour could provide a reasonable daily recommended amount of iron for normal body functioning.

Keywords: Wheat flour, food fortification, iron, proximate composition, anemia.
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INTRODUCTION

Food fortification has been defined as the addition of one or more essential nutrients to a food, whether or not it is normally contained in the food, for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients in the population or specific population groups[1].

Iron is a component of several tissue enzymes, such as cytochromes that are critical for energy production, and enzymes involved in the immune system. Essential for growth, brain development and for physical activity, iron is a key to strength, energy and work. Iron deficiency (ID) and iron deficiency anemia (IDA) are major nutrition problems around the whole world with impact on new born infant mortality, physical and mental growth retardation of children, reduction of productivity of adults and susceptibility to infectious diseases[2,3]. In the World Health Report 2002 ('Reducing Risks, Promoting Healthy Life') nutritional iron deficiency was identified as one of the 10 leading risk factors for disease, disability and death in the world today, with an impact greater than that of either zinc or vitamin A deficiency[4]. An estimated two billion people are affected, most of whom live in developing countries[5].

This situation is no different for Pakistan; most of the population is facing serious deficiency of Fe. In the past the main strategy to control Iron Deficiency Anemia (IDA) in pregnant women had been via supplementation. Realizing the low acceptance of iron tablets by pregnant women and the very limited impact of this strategy, the Government of Pakistan (GoP) in its Ninth Five Year plan[2] had promoted the control of this nutritional problem through a mixture of strategies, i.e., fortification, supplementation and food diversification. It has been suggested by GoP to initiate Programme of fortifying wheat flour with iron. Before recommending Atta as the best choice for iron fortification, it has decided by (GoP) to plan a national project in order to test the feasibility and efficacy of iron fortification in wheat flour 'Atta'. Ahmad and Bilal summarizes information regarding various fortificants that are being used for the control of IDA world over along with some information on a variety of foods that have been used for iron fortification ranging from flours to spices and liquids.

Wheat *(Triticum aestivum* L.) is the most important staple food crop. It is a major source of food for large section of population of the world and is supplying about 73% of the calories and protein of the average diet[6]. Flour is used as a recipe ingredient in many baked products[4]. Wheat flour is a good vehicle for delivering additional iron in Pakistan because it is so widely consumed and because iron can be added with no effect on product quality or appearance and at very low cost. And also the bioavailability of iron is several times greater than other staples such as maize and rice[5].

Since iron is a mineral it will not diminish during production, storage or baking. With regard to iron fortification, wheat flour (Atta) is by all means the ideal food because it is commonly consumed in the country. The present study was designed with a view to investigate the quality parameters plus level of iron in the fortified wheat flour samples.

MATERIALS AND METHODS

Samples of iron fortified flour were collected/procured from different sources. The proximate composition and iron contents were determined according to the standard recommended methods.

Proximate composition

Proximate composition includes moisture, crude protein, ether extract, crude fiber, ash, and Nitrogen free extract. Moisture was determined by oven dehydration method at 105°C up to the constant weight. Crude protein was determined by using Kjeldhal method, crude fat was determined by ether extraction method using soxhlet apparatus. Crude fiber was determined by acid digestion and alkali digestion method. Ash content was determined in muffle furnace at 550°c for 6 hours. For all these determinations powdered and oven dried sample were used in triplicate in accordance with standard procedures[15]. Nitrogen free extract (NFE) was calculated by difference.

Iron determination

For Fe determination 0.5g of each sample was wet digested with HNO_3: $HClO_4$ (2:1) for 2-3 hrs on heating mantle[3]. Digested samples were filtered through 0.45 µm pore size millipore filter and volume was made to 100 ml with distilled water. Concentration of Fe was determined on Hitachi Zeeman Japan Z-8000, Atomic Absorption Spectrophotometer equipped with standard hallow cathode lamps as radiation source and air acetylene flames.

RESULTS AND DISCUSSION

The data related to proximate composition of flour samples of wheat have been presented in Table 1. The data in Table 1 showed that the moisture (%) level was in the range of 5.46% to 11.47% which was well below the allowed level. Accurate measurement of moisture content is very difficult. Water in food items exists in three different forms i.e. bound form (water of crystallization or as hydrate), adsorbed water (physically bound as a monolayer to the surface of the food constituents) and bulk or free water (separate constituents). The free water is loss by evaporation. Moisture values include other volatile matter such as essential oils, traces of volatile acids and amines. Moisture flour>13% is liable to attack by microorganisms, mites and insects. Highest moisture content is mainly responsible for microbial spoilage and hence we can't store flour for long time. Hence from the standpoint of moisture contents the flours were of good quality having values well below the maximum limit[13]. The ash content was in the range of 1.28% to 1.53%. Wheat ash is mostly present in bran as compare to wheat flour. It is interesting to note that the ash content gradually increases with an increase in iron content that might be due to the addition of fortificant.

Maximum content of crude protein investigated was 11.36% while minimum amount found was 9.13%. Similarly, the crude fat content investigated was in the range of 1.43% to 2.30%. Fiber, which is known to promote softer stools with increased frequency and regularity of elimination, was found in the range of 1.12% to 2.37%.

The data related to amount of iron in eight flour samples of wheat have been presented in Table 2. Maximum concentration of Fe observed was 7.2 mg/100g with a minimum concentration of 3.2 mg/100g respectively.

Table 1: Proximate composition of different wheat flours samples

Parameters (%)	Lab. Code of samples							
	1	2	3	4	5	6	7	8
Moisture	8.57±0.26	9.03±0.17	10.5±0.24	5.46±0.78	7.36±0.45	9.74±0.56	11.47±0.23	10.51±0.22
Ash	1.50±0.09	1.28±.07	1.31±0.03	1.50±0.05	1.35±0.07	1.44±0.03	1.50±0.02	1.53±0.04
Crude protein	10.47±0.09	10.45±0.08	11.28±0.09	10.64±0.14	9.13±0.17	11.36±0.06	10.59±0.17	10.34±0.15
Crude fat	1.56±0.03	2.09±0.04	1.70±0.02	1.89±0.05	2.18±0.02	2.30±0.02	1.52±0.04	1.43±0.03
Crude fiber	2.13±0.07	1.62±0.04	1.80±0.07	1.92±0.05	1.99±0.05	2.37±0.03	1.12±0.09	1.23±0.09
NFE	75.77±0.26	75.50±0.29	73.44±0.32	78.74±0.45	77.81±0.35	72.73±0.33	73.86±0.23	75.14±0.24

Values are mean of triplicate determinations±SD

Table 2: Iron content of different wheat flours samples

Parameters (mg/100g)	Lab. Code of samples							
	1	2	3	4	5	6	7	8
Fe	*5.2 ±0.02	4.8 ±0.04	4.4 ±0.09	5.2 ±0.03	3.2 ±0.08	5.6 ±0.07	6.8 ±0.04	7.2 ±0.07

Values are mean of triplicate determinations±SD

The average iron content i.e. 5.3 mg/100g suggest that an intake of 300 g whole wheat flour/day/person can take about 15.9 mg/day of Fe with respect to the daily intake of 14-28 mg/day recommended[7] as well as 18 mg/day recommended by RDA[8] is comparable.

Many countries have adopted the mandatory or voluntary iron fortification of wheat flour. The levels of iron fortification commonly used in developed countries are 6.5 mg/100 g in Sweden, 4.4 mg/100 g in USA and 1.65 mg/100 g in the UK[16-17].

Flour fortification with iron and other nutrients has been practiced in many countries. However, flour fortification with iron remains an important issue in regard to absorption and efficacy. Addition of fortificant like Fe to whole wheat flour is a positive food safety approach to combat iron deficiency but it is suggested to evaluate the existing wheat varieties not only for quality parameters but also for Fe contents before launching iron fortification programme on large scale. Furthermore, homogenous mixing of fortificant must be ensured in order to have a uniform level of fortificant in the flour. It is suggested to collect and collate more data from controlled studies on iron fortification before launching any type of fortification programme on national level.

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