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DEVELOPMENT OF MINERALS ENRICHED BROWN FLOUR BY UTILIZING WHEAT MILLING BY-PRODUCTS

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ABSTRACT

Brown flour was developed by incorporating different proportions of wheat bran i.e. 0, 5, 10, 15 and 20% into the residual flour (milling by-product of pizza flour). Each treatment of brown flour, wheat bran and whole wheat flour was subjected for proximate composition and iron content. The highest iron content was observed in wheat bran i.e. 64.6 mg/Kg where as iron content in different treatments of brown flour ranged from 16.8 to 29.2 mg/Kg. Chapaties prepared from the respective flour samples were further evaluated for various chemical and sensory attributes. The brown flour prepared by the addition of 10% bran showed better performance and was quite comparable with whole wheat flour regarding the proximate and sensory attributes like color, flavor, texture, taste, folding ability, chewing ability and appearance. Moreover the same sample (T_3) had better iron content than whole wheat flour. Chapaties prepared by brown flour with 10% followed by 15% bran were of best quality and quite comparable with chapaties prepared from whole wheat flour.

Key words: Brown flour, wheat bran, residual flour, proximate composition, iron content, chapati, sensory attributes.

INTRODUCTION

Pizza Hut, Pakistan a fast food restaurant was importing wheat flour from Australia for the production of pizza dough and spending considerable foreign exchange over it. In 1998 research work carried out by the Institute of Food Science & Technology and identified one of the Pakistani wheat varieties which met the standard specifications set by Pizza Hut, International. Presently pizza manufacturer are preparing pizza using flour of the identified local wheat variety at an extraction rate of 55% resulting in 15% bran and 30% residual flour as by-products. This high rate of by-products is a barrier in the way of earning maximum profit. Brown flour may be defined as any flour in which wheat bran is added back (Cheetham, 1988). This addition of wheat bran facilitates the consumer with extra nutrients and minerals and reduces the prevalence of protein caloric malnutrition and low fiber disorders. Moreover, Kent and Evers (1994) pointed out that according to the Bread and Flour Regulations 1984, brown flour must have a minimum crude fiber content of 0.6% on dry basis as compared to 0.25% fiber content of white flour. The Canadian report concluded that there are three or possibly four specific physiological benefits of different types of dietary fiber: regulating colonic function, normalizing serum lipid level, attenuating the postprandial glucose response and perhaps weight loss by suppressing appetite (Anon. 1985).This suggests that brown flour is a rich source of dietary fiber and can be consumed to acquire the nutritional and physiological benefits associated with the consumption of high dietary fiber food. Whereas, the residual flour which is a milling by-product of pizza flour contained low level of fiber and consumption of such diet has been known to cause non-infectious diseases, such as diverticulosis, atherosclerosis, and colonic cancer as reported by Jeltema *et al.* (1983).

Nutrients are generally found in the highest concentration in the germ or embryo and in the aleurone cells surrounding the starchy endosperm. Aleurone cells are rich source of minerals, many of B vitamins and proteins. Significant quantities of minerals and vitamins are lost when whole wheat is milled to produce white flour because the outer layers of bran are removed along with aleurone cells and germ. Data compiled by Food and Agriculture Organization revealed that 72-75% extraction flour contains from as little as 20% to about 60% of the total B vitamin originally present in whole wheat flour (Anon. 1970). The aleurone cells, a component of bran, contain about 60% of the total minerals in the wheat kernel. Mineral contents (mg/kg) of bran are Fe (74-103), Zn (56-141), Cu (8.4-16.2), Mn (72-144) and Se (0.10-0.75), (Burk and Solomons, 1985) and (Turnlund, 1982). The endosperm contains less than 5% of the Thiamine and more than 40% of Pantothenic acid. The aleurone layer contains 32% of Thiamine and more than 80% of the Niacin

(Keagy *et al*, 1980). In general, the protein content of wheat is greatest in germ, followed by middlings, bran, whole wheat flour, and white flour in decreasing order (Kulp *et al*, 1980). Brown flour may be used in order to get the extra nutrients as compared to white flour or flour with low wheat fiber. The mandate of present project was to utilize the milling by-products of pizza flour and to figure out the most suitable treatment of brown flour for further commercialization.

MATERIAL AND METHODS

Procurement of Samples

Samples of wheat by-products including wheat bran and residual flour were obtained from Sunny Flour Mills, Lahore. Whole wheat flour was collected from the local market.

Grinding of Wheat Bran

Wheat bran was ground into fine flour in an electric grinder.

Incorporation of Bran into Flour

Bran was incorporated into the Residual flour at the rate of 0, 5, 10, 15, and 20% and was blended thoroughly. Different treatments of brown flour were made as given in Table I.

Table I. Different treatments of brown flours

Treatments	Residual flour (%)	Bran (%)	Whole wheat Flour (%)
T_1	100	0	0
T_2	95	5	0
T_3	90	10	0
T_4	85	15	0
T_5	80	20	0
T_6	0	0	100

T_6 : Whole wheat flour was used as control.

Proximate Analysis of Flours

Brown flour samples, wheat bran, residual flour and whole wheat flour were analyzed for moisture, crude protein, crude fat, crude fiber and total ash contents by following their respective procedures described in AACC (2000).

Iron Determination

Iron content of the different treatments was determined by using Atomic Absorption Spectrophotometer according to the method described by AOAC (1990).

Chapati Preparation

Chapaties from brown flours were prepared according to the method described by Rehman *et al.* (1996).

Analysis of Chapatti

Proximate analysis

Chapaties prepared from all treatments were analyzed for moisture, crude protein, crude fat, crude fiber and total ash contents according to the methods of AACC (2000).

Iron Determination

Iron contents of each chapatti were determined by using Atomic Absorption Spectrophotometer according to the method described by AOAC (1990).

Sensory Evaluation

Each chapati sample was evaluated by a panel of judges for various sensory attributes color, flavor, taste, texture, chewing ability, folding ability and appearance by following instructions given by Land and Shephered (1988).

Statistical Analysis

The data thus collected was analyzed statistically by following techniques described by Steel *et al.* (1997).

RESULTS AND DISCUSSIONS

Proximate composition of different flours

The chemical composition of wheat bran, residual flour, different brown flours and whole wheat flours were significantly different from each other. The wheat bran was reported to contain the highest amounts of crude protein, fat, fiber and ash with mean values of 15.75, 3.77, 10.38 and 4.18%, respectively (Table 2). The proximate composition of different flours has been explored in Table 3. The minimum and the maximum values of above mentioned nutrients in different treatments of brown flours (T_2 to T_5) ranged from 11.35 to 12.49% for protein, 2.08 to 2.45% for fat, 0.95 to 2.51% for fiber and 1.40 to 1.89% for total ash. The nutrients were found to increase with the increase in the bran proportion in the flour. The mean values for (T_6) whole wheat flour were 11.28 % for crude protein, 1.83 % crude fat, 1.70% crude fiber and 1.72% total ash. Taking into account the chemical composition, the results of brown flour treatment T_3 (10% bran) were closer and even slightly better than whole wheat flour. The residual flour contained lowest protein (10.94%), fat (1.91%), fiber (0.42%) and ash (1.2%).

Table.2. Chemical composition of wheat bran

Parameter	Quantity
Moisture	9.67 %
Protein	15.75 %
Fat	3.77 %
Fiber	10.38 %
Ash	4.18 %
Iron	64.6 mg/Kg

Table.3. Chemical composition of different flours

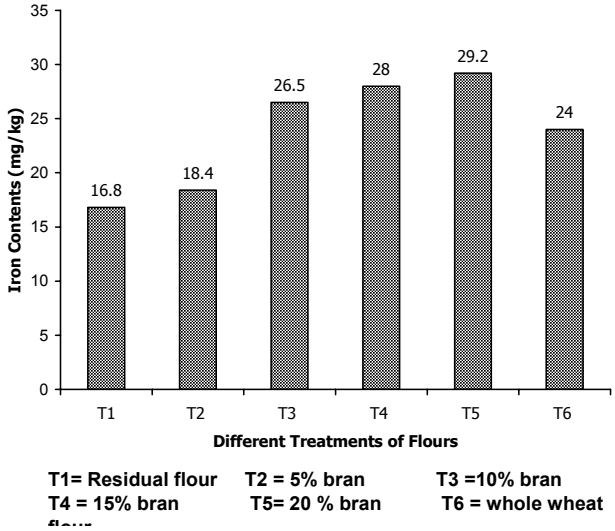
Treatments	Moisture %	Protein %	Fat %	Fiber %	Ash %	Iron mg/Kg
T_1	10.99 a	10.94 e	1.91 c	0.42 e	1.25 d	16.80 f
T_2	10.74 b	11.35 cd	2.08 b	0.95 d	1.40 c	18.40 e
T_3	10.67 b	11.47 c	2.13 b	1.75 c	1.73 b	26.50 c
T_4	10.69 b	11.88 b	2.30 a	2.00 b	1.79 ab	28.00 b
T_5	10.32 c	12.49 a	2.45 a	2.51 a	1.89 a	29.20 a
T_6	7.26 d	11.28 d	1.83 c	1.70 c	1.72 b	24.00 d

Iron contents

Iron content varied significantly among bran, brown flours, whole wheat flour and the residual flour (Table 3). The iron content was found significantly higher in wheat bran due to presence of aleurone cells, a component of bran and it possess 60 % of the total minerals in the wheat kernel. The iron content was found to differ significantly among different flour treatments. The iron content among brown flours varied from 18.4 to 29.20 mg/Kg. Significantly the highest iron content 29.20mg/Kg was found in brown flour (T_5) containing 20 % bran followed by T_4, T_3 and T_2 containing 28.0, 26.50 and 18.40 mg/Kg, respectively. The least iron content 16.8 mg/Kg was found in T_1 (residual flour) because it contained the negligible quantity of bran where as the whole wheat flour contained 24.0 mg iron per Kg of the flour.

It is obvious from the results (Fig 1) that iron content increased significantly with progressive increase in bran proportion in the flour. The results for iron content in the present investigation are comparable with early findings reported by Davis *et al.* (1984) and Kirk and Sawyer (1999). It may be concluded that wheat bran is a good source of minerals and can be supplemented in wheat flour to uplift the mineral profile of the wheat flour. Since iron deficiency is one of the major problem especially more prevalent in children, pregnant and lactating women, therefore they may take extra bran in the form of brown flour in order to combat the existing dilemma.

Fig.1. Iron Contents of Different Treatments of Flours



Chapati analysis

Chemical analysis

The chapaties prepared from different treatments of flours were also subjected to chemical analysis as discussed in Table 4. The results regarding the chemical analysis were reported significant and in accordance with the particular flour from which that chapati was prepared.

Table.4. Chemical composition of chapaties from different flours

Treatments	Moisture %	Protein %	Fat %	Fiber %	Ash %	Iron mg/Kg
T_1	29.30 a	9.27 e	0.70 c	0.26 f	1.18 c	15.60 d
T_2	27.70 b	9.62 de	0.75 bc	0.78 e	1.33 b	16.50 d
T_3	24.40 d	9.91 cd	0.85 b	1.29 d	1.57 a	23.40 c
T_4	30.20 a	10.71 ab	0.87 b	1.68 b	1.62 a	25.80 b
T_5	25.60 c	10.88 a	1.13 a	2.20 a	1.67 a	27.60 a
T_6	26.07 c	10.25 bc	0.76 bc	1.47 c	1.56 a	22.40 c

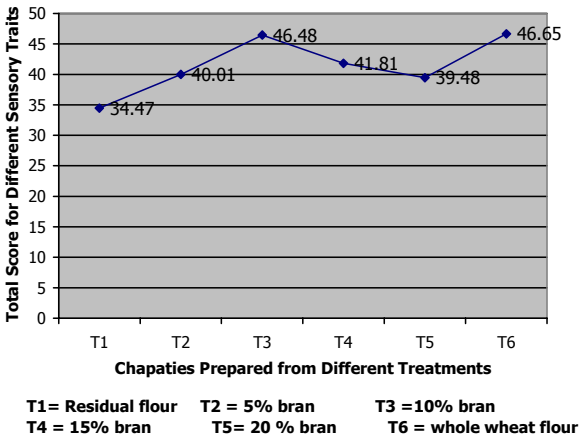
Sensory evaluation

The sensory evaluation of the chapaties prepared from different treatments of flour mentioned in Table 5 showed significant differences. The total pooled scores obtained by the various treatments of chapaties for color, flavor, taste, texture, chewing ability, folding ability and appearance were 34.47, 40.01, 46.48, 41.81, 39.48 and 46.65 for T_1, T_2, T_3, T_4, T_5 and T_6 respectively. These results revealed that chapaties from whole wheat flour were ranked at the top followed by the chapaties from T_3 containing 10% bran and T_4 containing 15% bran. These results delineated further that chapaties prepared from different flour were significantly affected by the various treatments (Fig 2). However, on the basis of scores assigned by the panel of trained judges to different sensory attributes, it is obvious that chapaties prepared from treatment T_3 of brown flour showed almost the same quality characteristics as that of whole wheat flour (T_6). This indicated a close resemblance of T_3 (containing 10% bran) with T_6 (whole wheat flour).

Table.5. Pooled data for sensory evaluation of chapaties

Treatments	Color	Flavor	Taste	Texture	Chewing ability	Folding ability	Appea rance	Total Score
T_1	6.33 ab	5.16 b	4.66 c	4.66 c	3.83 c	3.83 c	6.00 b	34.47
T_2	6.83 a	6.33 a	5.33 bc	5.33 bc	4.50 bc	4.83 bc	6.66 ab	40.01
T_3	7.00 a	6.50 a	5.66 b	6.33 ab	6.66 a	6.83 a	7.50 a	46.48
T_4	6.16 ab	6.00 a	5.83 b	5.66 bc	5.66 ab	6.00 ab	6.50 ab	41.81
T_5	5.50 b	6.00 a	5.33 bc	5.33 bc	5.33 ab	5.83 ab	6.16 b	39.48
T_6	6.50 a	6.66 a	7.00 a	6.83 a	6.33 a	6.33 a	7.00 ab	46.65

Fig.2. Pooled Data for Sensory Characteristics of Chapaties Prepared from Different Treatments of Flour



Conclusion

The present investigation revealed that concentration of crude protein, fat, fiber and minerals were higher in wheat bran and therefore, it must be utilized in diet to combat nutritional imbalance and mineral deficiency. Moreover, brown flour of treatments T_3 (10% bran) followed by T_4 (15% bran) showed better proximate composition and chapati making characteristics comparable with whole wheat flour. Therefore, the treatments T_3 of brown flour having 10% bran followed by T_4 with 15% bran are recommended for commercialization.

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