Optimization of Wheat Flour and Defatted Soya Flour Blend for Production of Quality Chapatti

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Abstract: This study examined the effects of soya flour substitutions at various proportions with wheat flour and evaluated the chapatti quality. Six types of formulations of flour for preparation of chapatti were prepared with soya flour & wheat flour ranging from 0%, 5%, 10%, 15%, 20%, and 100%. These flour were analyzed for physicochemical properties and chapatti made from these flours were evaluated for physical (Puffed height), textural, and organoleptic attributes. The supplementation of soya flour in wheat flour resulted in a significant increase in protein, crude fiber, ash contents of the flour. The puffed height were found to be higher in 10% soya flour blend chapatti 5.3 mm, as compared to other blends 5.2 mm (0%) 4.8 (5%) 4.6 (15%) 4.7 (20%) Textural measurement showed that hardness of chapatti decreased with the addition of soya flour. Sensory data indicated that the soya flour substitutions chapattis with up to 10% were acceptable.

Index Terms- Soya flour; Wheat flour; Chapatti; Puffed height; Hardness.

Introduction

Protein Malnutrition is widely recognized as a major health problem in worldwide due to Cereal-based dietary pattern. The quality of protein of the cereal-based diet can be improved by fortifications and it is suggested to meet the recommended dietary allowances of infants, preschool children, teenager girls, pregnant women, low-cost supplementary foods. Protein malnutrition may manifest as either marasmus, a wasting disease due to lack of protein and overall calories, or kwashiorkor, which presents with generalized edema due to primary protein malnutrition. The use of protein-calorie sources of vegetables or other origins as a supplementation on daily diet has been proposed a possible solution to this problem.

According to Mashayekh, et al. (2008), to determine the sensory and rheological properties of bread fortified with soya flour, defatted soy flour was blended with wheat flour at 3%, 7% & 12%. This study found that bread obtained with defatted soybean flour incorporated with wheat flour, has got most preference as compared to others. The ash and protein contents of wheat–soy bread blends increased compared with others.

When we mixed wheat flour with water, visco-elastic dough is formed. Because of this unique characteristic, we can process wheat flour into a variety of food products such as biscuit, bread, chapatti and pasta, etc (Pomeranz, 1989; Wrigley and Beitz, 1988).

Chapattis are the most widespread unleavened plane breads in India and almost it is consumed during every meal of the day in some parts of India. The two main quality parameters for Chapattis are softness and flexibility (Murthy and Austi, 1963). For chapatti making, dough is prepared by hand mixing of flour with an optimum amount of water. Take 60-100g of the dough & rounded between the palms and sheeted manually into a shape of disk, 2-3mm thick using a wooden rolling pin. It is then immediately baked on a preheated iron plate (tawa) at a temperature of 230°C for about 1 minute on each side (Sindhu et al., 1988). As Chapattis are little thin, they are susceptible to loss of moisture also stalling after baking. Therefore, they are mainly prepared fresh at the time of eating.

The Indian Market Research Bureau (IMRB) conducted a Consumer survey across seven major cities of India for the protein consumption in diet of adults. The IMRB Researchers interviewed 1,260 respondents including males and females (non-pregnant and lactating mothers) between the age group of 30-55 years. In this survey 59% of the sample size was non-vegetarian. 90% registered a protein deficiency in their meal plan, which has also indicated that over 80 per cent of Indian diets are protein deficient. This shows that most of the masses of the country are not getting the right adequate amount of proteins required in their respective diet. The findings of this survey reveal that 91 % of the vegetarians are having higher protein deficiency as compared to 85 per cent of their non-vegetarian counterparts. It was also found that in the north zone of the country about 98 per cent of the respondents were not aware of the ideal protein requirement for an average adult (56g per day for men & 46g per day for women.).

This research on Optimization of Wheat Flour and Defatted Soya Flour Blend for Production of Quality Chapatti will undertake the optimization of blend prepared from wheat flour and soya flour and preparation of acceptable Chapattis. for that the objectives set were first to characterize the experimental wheat flour & Soya flour for its physico-chemical characteristics; Preparation and characterization of wheat- soya flour blends; Preparation of chapatti from prepared wheat- soya flour blends; and at last the quality evaluation of chapatti prepared from Wheat soya flour blends.

Material and Methods

2.1 Raw Material

Wheat Flour and Soya Flour has been procured from local market to prepare composite Chapattis.

2.2 Preparation of Blended Flour with Wheat Flour & Soya Flour

Blended flours is prepared by substituting the wheat flour with soya flour in the ratio of 100:0, 95:5, 90:10, 85:15, 80:20, 100:0 and the samples were marked as A, B, C, D, E and F, respectively.

2.3 Proximate Analysis of Wheat Flour & Soya Flour Blends

The proximate composition (i.e., moisture, fiber, protein, fat, carbohydrate etc.) was determined according to the standard analytical methods (FSSAI Manual of Method of analysis of food, cereal & cereal products, 2016).

2.4 Water absorption capacity (WAC)

Water absorption capacity was measured by the methods of Sosulski et. al (1976).

2.5 Chapattis formulation

Chapattis was prepared from wheat flour and soya flour according to Haridas Rao et. al (1986) with slight modifications. Chapatti dough was prepared by mixing 200 g flour and water equivalent to chapatti water absorption. The dough was rest for 10 min. The dough was then divided into pieces of 50 g each and hand sheeted to a thickness of 1.5 mm. The sheeted and cut dough was baked on a hot plate maintained at 215°C for 70s on side 1 and85 s for side 2. The chapatti was then transfer to a heated gas tandoor (370°C) in such a way that side was placed on the grill and heated for 10s.

2.6 Color measurement of Flours

The instrumental measurement of flour color was carried out with a colorimeter Minolta CM-3500D and the result were expressed in accordance with CIELAB system with reference to illuminate D65 and a visual angle of 10°. The measurements were performed through a 6.4-mm diameter diaphragm with an optical glass, placing the flour directly on the glass. By Dar et al. (2014) the color of samples will recorded in terms of:

L* (L*=0 [black] and L*=100 [white]),

a* (-a*= greenness and +a*= redness) and

b* (-b*= blueness and +b*= yellowness).

2.7 Puffed Height of chapatti

The height of chapatti was immediately measured re after puffing by Venire Calliper (Haridas Rao et al., 1986).

2.8 Texture Analysis

The textural property of chapatti was measured by using a texture analyzer (TA. XT Plus, Stable Micro Systems, UK). The conditions employ should be: pre-test speed= 5.0 mm, s-1, test speed=2.0 mm, s-1, post-test speed=10.0 mm, s-1, distance= 60.0 mm and trigger type= auto. Three chapatti strips (5 x 2.5 cm) from each chapatti was cut from the center part of chapatti. A chapatti strip was hold at the center of the two clamps. One clamp was attached to the platform while the other was attached to the moving arm of the texture analyzer. The clamps were allowed pulling the chapatti strip apart until it ruptured. The peak force (N), force requires to pull the Chapatti strip into two pieces and extensibility (mm) will record (Yadav et al., 2012).

2.9 Sensory Evaluation

Chapattis made from wheat flour and soya flour blends were subjected to sensory evaluation as shown in Table 5, using 20 semi-trained panelists. The Chapattis were evaluated for appearance, color, taste & aroma, mouth feel, texture, and overall acceptability. 9-point hedonic scale ranging from 9 (like extremely) to 1 (dislike extremely) using for rating. All panelists were regular consumers of Chapattis. Water at room temperature was used to rinse the mouth between evaluations.

2.10 Statistical Analysis

Data analysis was performed using SPSS version 15 and results were expressed as % and mean ± SD.

Result & Discussion

3.1 Proximate Composition

The Proximate composition of wheat soya flour blends mention in Table 3.1.There is no significant differences observed in the moisture content of different wheat soya flour blends. Moisture of Product is important to shelf-life, wrapping and general acceptability (Haridas Rao et al, 1986). The crude protein content of the wheat soya flour blends ranged between 53.19% to 11.64%. The crude protein content was found to be highest in blend no E due to the high protein content in Soya seed. The fat content of wheat soya flour blend from this study was found between 1.43% to 1.84%. The differences in fat content are due to different composition of soya flour. High fat diet contributes significantly to the energy requirement for humans. High fat flours are also best for flavor enhancers and useful in improving tastiness of foods in which it is amalgamated as reported by Aiyesanmi et. al (1996). Gluten content of wheat soya flour blend from this study was found between 6.74% and 9.23%. The gluten content was found to be highest in blend A It is because of the maximum percentage of wheat flour. The crude fiber content of the Wheat soya flour blends samples showed a percentage increase in the range of 1.54% to 3.37% as the wheat flour was substituted with soya flour. Crude fiber most probable from the bran of the whole wheat flour represents variable portion of dietary fiber and includes mostly the lignin, cellulose and hemicelluloses components (Islam et al., 2007). The increased fiber content of the soya wheat flour blends has several health benefits. In studies, it is accepted that dietary fiber shows an important role in the prevention of several diseases such as cancer and diabetes cardiovascular diseases, diverticulosis, irritable colon, (Slavin, 2005).

The value of water absorption for wheat soya flour blends were ranged from 71.2% to 75.5%. The water absorption values increase in blends with incorporation of soya flour from 5% to 20%. This increase might be due to more retention of water by soya flour in blends. The water absorption value of soya flour was high because of high amount of crude fiber in soya flour. The variation might be due to the varietal difference, agro climatic condition and method of determination.

Alcoholic Acidity of wheat soya flour blends were ranged from 0.024% to 0.539%, increase in alcoholic acidity in blends due to substitution of soya flour. The acidity of flour is an important indicator of its freshness. The fats and phosphatides (lecithin) are separated enzymatically amid capacity of the flour. This breakdown is quickened by a high water, high temperatures and a high level of extraction (Freund and Kim, 2006). Higher alcoholic corrosiveness is a pointer of higher acridity of the germ oil in the flour. According to FSS Regulations, alcoholic acridity in wheat flour will not be in excess of 0.18% by weight; according to Indian Standard, it will not be in excess of 0.1%.

3.2 Color Analysis of Soya Wheat flour Blends

Tables 3.2 shows the results of determination of L,* a* and b* values of the color of the Wheat-Soya Flour blends. From the result it was noticed that the red (a) value decreased from +4.30 to +3.96, the lowest a pigment in Wheat- Soya Flour blends have been measured in blend F and the highest in blend no A. With the increase of soya flour share in wheat flour from 0% to 100% the level of yellow pigment (b) considerably increases, highest in soya wheat flour blend no E and lowest in soya wheat flour blend no1 while there was no such more difference in L(lightness) value in all blend. These changes in color because of the 'Maillard reactions' which takes place between reducing sugars and amino acids during the heating process (Chevallier et al., 2000) colour measurements of food products help an important role as it is one of the characteristics which have direct effect on the initial acceptance and liking of consumers towards the novel food products developed.

3.3 Puffed Height

Puffed Height of chapattis prepared from five soya wheat blends are shown in Table 3.3. The results showed that the puffed height of chapattis varied from 4.7 cms. (Blend no 5) to 5.2 cms. (Blend no 3). Fig 4.3 shows chapatti puffed height verses water absorption of Wheat-soya flour blends. The higher puffed height is said to be due to higher water absorption of flour, which helps in generating sufficient steam for puffing the chapatti (Haridas Rao et al, 1986). Earlier it was noted that Wheat soya Blend no 1 had relatively lower water absorption compared to other blends. It is possible that, similar to bread, where gas retention properties are governed by the visco-elastic gluten matrix, resulting in higher loaf volume, the chapatti dough should have a gluten mess which is capable of holding more steam resulting in higher puffed height.

3.4 Texture profile analysis of Chapattis

Objective measurement of texture of chapatti showed the cutting force for chapatti ranged from 5.31N to11.17N (Table 3.4). Chapattis made from whole wheat flour had higher cutting force values compared to chapattis made from other blends. Austin and Ram (1971) reported that good quality chapattis should give minimum resistance to tearing. Haridas Rao et al (1986) reported that chapattis made from flour with high protein content were chewy with high tearing resistance and vice versa. In the present study, it

was observed that blend A, which has relatively less protein content (11.64 %), required significantly higher cutting force The blend no E which had relatively higher protein content, required lower cutting force. Thus, the results indicate that total protein content alone may not influence the cutting force of chapattis, instead protein composition and other parameters may have a role in chapatti quality.

3.4 Sensory characteristics

Sensory evaluation scores of chapattis are shown in Table 3.5. Chapattis prepared from wheat soya blend no B and wheat soya blend no C had very appealing whitish brown color. On the other hand, color of chapattis made from wheat varieties wheat soya blend no D and wheat soya blend no E was relatively darker. Chapattis made from varieties wheat soya blend no A were not as dark as the latter two varieties.

On the other hand, chapattis made from wheat soya blend no A were very fragile giving average scores. Sensory scores for the wheat soya blend no C was higher. However, unlike in bread, where softer bread generally gets higher score, it is not very easy to evaluate the required cutting or tearing strength in a highly acceptable chapatti. It is desired that chapatti should not be too fragile with easy to tear properties, but it should offer some resistance to tearing as well as chewing.

Chapattis made from wheat varieties wheat soya blend no 2 & wheat soya blend no C were very pliable. Leelavathi et al (1986) explained that higher water absorption capacity of flour renders chapattis soft and pliable. However, in relative terms the wheat soya blend no C, even though had the highest water absorption, produced chapattis that were relatively less pliable. Highest sensory scores for taste and aroma were recorded for the wheat soya blends no C. These chapattis had wholesome sweetish aftertaste (Table 3.5). The wheat soya blend no E recorded significantly lower score for taste due to their beany taste. This blend had relatively lower score in appearance & texture.

Conclusion

Chapatti is the main traditional staple food consumed by majority of the population in the Indian subcontinent and is also widely consumed in UK, and other countries, particularly by the Asian ethnic community. In India, different wheat varieties are produced, however, not all varieties are suitable for chapatti preparation. The chapatti quality is influenced by the contents of protein, protein characteristics and damaged starch. The use of unsuitable whole wheat flour for chapatti preparation affects quality of the product resulting in a tough or fragile, non-pliable and undesirable chapatti. In this study, wheat flour was replaced with soya flour at different levels that is 0 % (Blend A), 5% (Blend B), 10% Blend C), 15% (Blend D) and 20% (Blend E), 100% (Blend F). Soya-Wheat flour blends were evaluated for their physico-chemical properties and chapatti making properties. Of these, blend B & blend C highly acceptable chapattis on the basis of aroma, texture, mouth feel & overall acceptability score given by sensory panelist compare with Blend D & Blend E(Less acceptable). Blend B & Blend C was closely followed by those, prepared from blend A. The total protein content in these blends ranged from 11.64 to 21.04%. The total protein content did not show any correlation to the puffed height or overall scores of the chapattis. Few studies indicate that having protein content of 9.5 to 10.5% was found to be more suitable for chapatti preparation. Though, no such relation was observed in this study. As per the FSSAI regulations of Protein rich (paushtik) Atta means, the product obtained by mixing wheat Atta with groundnut flour "or soya flour", or a combination of both". Can extent of 10.0 per cent of flour. Cereals products are the major source of protein in Indian food, which has a lower quality of protein as compared to other vegetable and visceral proteins. Soybean is one of the nature's wonderful nutritional gifts as opulent protein source. The research study was conducted to evaluate the quality characteristics of soy enriched wheat flour which could be used as a protein supplemented or in house use as food in the form of chapatti. Protein Energy Malnutrition (PEM) of the world population can be reduced through the development of protein rich Atta in this way. This study has demonstrated that chapatti with soy flour substitution; up to 10% were nutritionally superior to that of the whole wheat flour chapatti. Although soya flour substitution, up to 5% nutritionally near to the, organoleptically they are close to each other. The findings of the present study may help in developing commercial processing technology for effective utilization of wheat flour as nutrition point of view.

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Table 3.1 Proximate Composition of Soya-Wheat flour Blends

Analysis	Blend No A	Blend No B	Blend No C	Blend No D	Blend No E	Blend No F
Moisture	8.91±0.21	8.96±0.23	8.89±0.19	8.91±0.32	9.08±0.28	9.44±0.27
Protein	11.64±0.34	13.46±0.42	15.89±0.48	16.17±0.56	21.04±0.66	53.19±0.68
Ash	1.29±0.05	1.43±0.04	1.68±0.06	1.95±0.06	2.33±0.07	6.61±0.09
Gluten	9.23±0.32	8.31±0.34	8.06±0.28	7.56±0.21	6.74±0.32	N/A
Insoluble Ash	0.0451±0.002	0.0412±0.003	0.0428±0.002	0.0518±0.003	0.0429±0.003	0.3666±0.004
Urease Activity	0.04±0.01	0.05±0.01	0.05±0.01	0.06±0.01	0.07±0.01	0.16±0.01
Alcoholic Acidity	0.024±0.002	0.058±0.002	0.084±0.003	0.113±0.001	0.1211±0.001	0.539±0.002
Fat	1.84±0.03	1.81±0.04	1.76±0.03	1.62±0.04	1.58±0.03	1.43±0.04
Crude Fibre	1.54±0.02	1.68±0.03	1.73±0.04	1.83±0.03	1.95±0.04	3.37±0.03
Water Absorption	73.2±0.01	72.2±0.02	75.5±0.02	71.2±0.04	73.2±0.04	-

Table 3.2 Color Analysis of Soya-Wheat flour Blends

Sample	L*	a*	b*
Blend No A	90.41±0.01	+4.30±0.01	+12.69±0.01
Blend No B	90.11±0.01	+4.24±0.02	+12.74±0.01
Blend No C	89.91±0.02	+4.17±0.01	+13.29±0.02
Blend No D	90.08±0.01	+4.09±0.02	+13.76±0.03
Blend No E	90.76±0.02	+4.02±0.01	+14.00±0.01
Blend No F	90.42±0.02	+3.96±0.01	+15.45±0.02

Table 3.3 Puffed Height of Soya Wheat Flour Chapatti

Sample	Puffed Height (In cms.)
Blend No A	5.2±0.2
Blend No B	4.8±0.3
Blend No C	5.3±0.2
Blend No D	4.6±0.3
Blend No E	4.7±0.2
Blend No F	N/A

Table 3.4 Texture Properties of Soya-Wheat Flour Composite Chapattis

Sample	Cutting Force (In N)
Blend No A	11.174±0.24
Blend No B	9.176±0.18
Blend No C	7.722±0.22
Blend No D	6.808±0.23
Blend No E	5.318±0.34
Blend No F	N/A

Table 3.5 Sensory Properties of Soya wheat Flour composite Chapattis

Sample	Appearance (10)	Color (10)	Taste & Aroma (10)	Mouth feel (10)	Texture (10)	Overall Quality (10)
Blend No A	7.2±0.2	8±0.4	7.4±0.4	7±0.4	7.1±0.4	7.3±0.1
Blend No B	7.7±0.3	7.7±0.6	7.3±0.5	7.6±0.5	7.2±0.3	7.6±0.1
Blend No C	7.7±0.2	8.1±0.4	7.5±0.3	7.88±0.6	7.88±0.6	7.7±0.1
Blend No D	7.1±0.3	7.5±0.6	7.1±0.2	7.3±0.3	7.3±0.4	7.3±0.1
Blend No E	6.8±0.4	6.9±0.5	6.1±0.3	6.5±0.4	6.5±0.5	6.8±0.2
Blend No F	N/A	N/A	N/A	N/A	N/A	N/A