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Effect of defatted soybean flour on physico-chemical, mineral and sensory quality attributes of *Chapati*

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SUMMARY :

Present work have been undertaken to formulate and evaluate the qualities of defatted soybean flour based *Chapati*. The *Chapati* is made up of blending of wheat flour and different proportion of defatted soybean flour. Four treatments were used with sample code T_0, T_1, T_2 and T_3 *i.e.* 0, 20, 30 and 40 per cent substitution of defatted soybean flour. The prepared *Chapati* was evaluated for its sensory acceptability using 9 point hedonic scale. It was found that treatment T_2 containing 30 per cent defatted soybean flour got the highest score as compared to other treatments. Hence, this proportion of flours was used for further study. Physical analysis of *Chapati* revealed that weight of sample T_0, T_1, T_2 and T_3 was observed 38.4, 40.6, 41.7 and 42.9 g, respectively. Thicknesses of *Chapaties* were also increased from 2.3 to 2.8 mm with increasing levels of defatted soybean flour with decrease in diameter from 19 to 17.5 cm. Ash contents of sample T_0, T_1, T_2 and T_3 were 1.38, 2.32, 2.72 and 3.14 per cent, respectively. The fat contents of sample T_0, T_1, T_2 and T_3 were 1.90, 2.66, 3.12 and 3.53 per cent, respectively. The protein contents of sample T_0, T_1, T_2 and T_3 were 10.06, 19.68, 23.62 and 27.56 per cent, respectively. The fibre contents of sample T_0, T_1, T_2 and T_3 were 1.50, 2.35, 2.60 and 2.85 per cent, respectively. The carbohydrate content of sample T_0, T_1, T_2 and T_3 were 56.94, 43.03, 36.88 and 30.76 per cent, respectively. The calcium, phosphorus, manganese, iron and zinc contents of control sample were 48.67, 349.22, 2.71, 7.77 and 2.23 mg/100 g, respectively. The calcium, phosphorus, manganese, iron and zinc contents of sample (T_2) were 109.36, 443.20, 2.77, 15.6 and 1.99 mg/100 g, respectively. It was concluded that the *Chapati* sample T_2 containing 70 per cent whole wheat flour and 30 per cent defatted soybean flour was most desirable in terms of sensory and nutritional quality profile.

KEY WORDS :Defatted soybean flour, Wheat flour, Protein, Minerals

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Protein Energy Malnutrition (PEM) continues to be the major nutritional problem resulting from under nutrition that affects children in most of the developing world. The most recent estimates show that more than one billion people worldwide are undernourished (FAO, 2009). Protein malnutrition is a serious problem in

India due to cereal based dietary pattern. This is reflected by the fact that the prevalence of under-weight children in India is among the highest in the world and is nearly doubles that of Sub-Saharan Africa. Food and Agricultural Organization suggested that to meet the recommended dietary allowances of infants, pre-school children, adolescent girls, pregnant and lactating women, low cost supplementary foods could be processed domestically by simple, inexpensive processing technology. Therefore various preparations based on cereal-pulse combination are of paramount important to improve the protein quality of Indian diet. Due to the high cost of proteins of animal origin and their inaccessibility by the poorer section of the population, the grain legume assumes significance as a cheap and concentrated source of proteins in Indian diets. Different food grain founds good source of protein among that soybean is most important, because of content of high amount of protein about 40 per cent.

Soybean is derived from seeds *Glycine max* (L.) merr of family - *Legumiodae* or *Fabaceae*. Taxonomically, the soybean belongs to the order, *Fabales*, the family, *Fabaceae*, the subfamily, *Faboidae* and the genus *Glycine*. The seeds are nearly spherical in shape with an average seed weight of 120-180 mg. Soybean is known as the "Golden bean" or the super legume of the twentieth century. Because of contain of good proportion of oil more than 20 per cent soybean also categorized as oilseed. It represents an excellent source of unsaturated fatty acids, high quality proteins and fibre. Soybean contains very small amount of saturated fatty acid but do not contain any Trans fatty acid. Kadam *et al.* (2012) stated that Legumes have been known as "a poor man's meat". Soy is nature's richest source of proteins. The protein content of most beans averages 20-25 per cent, but soybean contains about 40 per cent protein. The proteins present in soy meet the amino acid needs of body, both for adults and children. Generally legumes proteins are deficient in essential sulfurated amino acid methionine. However, soy protein contains enough of this important amino acid to meet adult needs. Protein in just 250 g of soybean is equivalent to protein in 3 litres of milk or 1 kg of meat or twenty four eggs. But it is the quality of soy protein that is most remarkable. Health professionals consider soy protein as superior protein compared to a lot of vegetable proteins and at par with egg and milk protein.

Wheat (*Triticum aestivum* L.) is the major food produce among all the cereal crops. Wheat is a staple food of large segment of world population. Wheat is one among the different cereals grow all over the world. It is the basic raw material for bakery and household food products and needs to be pulverized into fine flour before preparing different end-products. The quality of flour determines its suitability for a particular product. generally wheat is processed into refined wheat flour in roller mills and becomes the basic raw material for production of bread, cakes, biscuits, cookies, crackers, breakfast cereals, noodles etc. Wheat is also processed into whole-wheat flour in chakki/plate mills and is used in the preparation of traditional flat breads like *Chapati*, *Puri*, *Tandoori roti* etc.

Chapaties which are unleavened flat breads made from whole wheat flour are served as the staple food in the Indian sub-continent. The word "*Chappathi*" is derived from Canada, origin "*Chappate thatti*" meaning "flattened round". *Chapaties* are one of the most favorite bread items in northern South Asia. *Chapati* is a form of roti or rotta (bread). The words are often used interchangeably. While roti or rotta refers to any flat unleavened bread, *Chapati* is a roti made of whole wheat flour and cooked on a tava (flat skillet). Some people also add salt and/or oil to the dough. Small portions of the dough are rolled out into discs. The rolled-out dough is thrown on the preheated dry skillet and cooked on both sides.

EXPERIMENTAL METHODS

Raw materials :

Good quality raw materials soybean (*Glycine max)* seed were procured from AICRP on soybean, VNMKV, Parbhani and local market of parbhani, Maharashtra. Wheat flour procured from local market of Parbhani.

Chemicals :

Chemicals used in this investigation were of analytical grade. They were obtained from Department of Food Trade and Business Management, Department of Food Chemistry and Nutrition, Department of Food and Industrial Microbiology, College of Food Technology, VNMKV Parbhani.

Packaging material :

Packaging material *i.e.* Aluminium foils and LDPE

pouches was purchased from Parbhani local market.

Physical characteristics of *Chapati* :

The diameter and thickness of the *Chapati* was measured by using digital verneir caliper (A.A.C.C., 2000). And weight of *Chapati* was taken by using weighing balance.

Chemical characteristics of *Chapati* :

Chemical characteristics like moisture, ash, fat, protein and fibre were analyzed as per the method given by A.O.A.C. (1990). For carbohydrate difference method were used.

Mineral analysis :

The minerals like calcium, phosphorus, manganese, iron and zinc were analyzed by method given by A.O.A.C (2005).

Sensory evaluation :

Sensory evaluation of *Chapati* were made through rating products on a 9 point Hedonic Scale with corresponding descriptive terms ranging from 9 'like extremely' to 1 'dislike extremely' (Connie and James, 2005).

EXPERIMENTAL FINDINGS AND ANALYSIS

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Effect of defatted soybean flour on physical characteristics of *Chapati* :

Physical analysis of *Chapati* is important from both consumers and manufacturers point of view. *Chapati* was analyzed for physical characteristics including weight, thickness and diameter and results are presented in Table 1.

The data from Table 1 reveals that weight, thickness and diameter for control *Chapati* (T_0) were 38.4g, 2.3 mm and 19 cm, respectively. It was found that increase in weight of *Chapati* from 38.4 to 42.9 g with increase in levels of defatted soybean flour. Treatment T_3 observed with highest weight among other treatments (42.9). Increase in weight of *Chapati* observed because of property of defatted soybean flour to absorb more water and retain it. There was increase in thickness from 2.3 to 2.8 mm, with increase in levels of defatted soybean flour in *Chapati*. Thickness of sample T_1 and T_2 found similar where as T_3 sample had highest thickness 2.8 mm. With increase in levels of defatted soybean flour there were decreases in diameter of *Chapati* from 19 to 17.5 cm.

Similar results were founded with Khaliduzzaman *et al*. (2010). He was prepared *Chapati* fortified with potato flour. Similar result also founded with Sulatana *et al*. (2014).

Effect of defatted soybean flour on chemical parameters of *Chapati :*

The chemical composition of *Chapati* regarding moisture, ash, crude fat, crude protein, crude fibre and carbohydrate are presented in Table 2.

The Table 2 reveals that with the increase in defatted soybean flour at different level in *Chapati* there was significant increase in protein, ash, crude fat, crude fibre and moisture content and decrease in carbohydrate content. The moisture content was increased from 28.22 per cent to 32.16 per cent because of high moisture retention capacity of defatted soybean flour than wheat flour. The protein content and fat content of *Chapati* increased from 10.06 to 27.56 per cent and 1.90 to 3.53 per cent, respectively, with increasing formulation of defatted soybean flour in *Chapati* from 20 to 40 per cent.

Table 1 : Effect of different level of defatted soybean flour on physical characteristics of *Chapati*

Treatments	Weight (g)	Thickness (mm)	Diameter (cm)
T_0	38.4	2.3	19
T_1	40.6	2.7	18
T_2	41.7	2.7	18
T_3	42.9	2.8	17.5
Mean	40.9	2.62	18.12
S.E±	0.402	0.154	0.389
C.D. (P=0.05)	0.856	0.328	0.829

*Each value an average of three determinations

The protein content of *Chapati* blended with defatted soybean flour was significantly higher than that of control *Chapati*. The crude fibre and ash contents increased from 1.50 to 2.85 per cent and 1.38 to 3.14 per cent, respectively, thus being significantly higher in *Chapati* prepared from defatted soybean compared to that of control.

Increase in protein, crude fat, crude fibre and ash content of *Chapati* supplemented with defatted soybean flour might be due to their appreciably higher contents in defatted soybean flour than wheat flour. The carbohydrate content of *Chapati* was found to be significantly decreased from 56.94 to 30.76 per cent with increasing levels of defatted soybean flour in *Chapati*. The lowered carbohydrate content in *Chapati* might be due to their lower contents in defatted soybean flour than wheat flour.

Sathe *et al*. (1981) reported that increased protein content in crackers prepared by replacing wheat flour with soy flour. They reported that the high protein content was associated with the water binding properties of soy flour. Barnwal *et al*. (2013) prepared biscuits incorporated with de oiled maize germ cake, and reported increased in protein, fat, ash, crude fibre with increase in proportion of de oiled cake flour. Kumar *et al*. (2010) developed Soy based biscuits by incorporation of millet (kodo and kutki) flour at 70, 80, 90 and 100 per cent level for increasing protein content, and reported that with increase in soy flour significantly increase in protein and fat content.

Sensory evaluation of *Chapati :*

Organoleptic characteristics are pivotal in judging the suitability of product as consumer point of view. In order to study the effect defatted soybean flour fortification on sensorial quality characteristics, different random trials with wide range of fortification levels has been taken following the unorganized sensorial evaluation. It was observed that *Chapati* containing more than 45 per cent of defatted soybean flour fortification were not acceptable by panel members. Hence, for further optimization of defatted soybean flour fortification level

Table 2 : Effect of different level of defatted soybean flour on chemical characteristics of *Chapati*

Sample	Moisture (%)	Ash (%)	Crude fat (%)	Protein (%)	Fibre (%)	Carbohydrate (%)
T_0	28.22	1.38	1.90	10.06	1.50	56.94
T_1	29.94	2.32	2.66	19.68	2.35	43.03
T_2	31.06	2.72	3.12	23.62	2.60	36.88
T_3	32.16	3.14	3.53	27.56	2.85	30.76
S.E.±	0.312	0.290	0.286	0.295	0.324	0.311
C.D. (P=0.05)	0.664	0.615	0.609	0.628	0.689	0.663

*Each value an average of three determinations

Table 3 : Effect of different levels of defatted soybean flour on sensory characteristics of *Chapati*

Treatments	Colour and appearance	Flavour	Taste	Texture	Overall acceptability
T_0	8.00	8.10	7.80	8.00	7.97
T_1	7.80	8.10	7.80	7.80	7.87
T_2	7.90	8.20	7.90	8.70	8.17
T_3	7.00	7.60	6.80	7.40	7.20
Mean	7.67	8.00	7.57	7.97	7.80
S.E.±	0.411	0.306	0.406	0.328	0.365
C.D. (P=0.05)	0.874	0.651	0.864	0.699	0.777

*Each value an average of three determinations

Table 4 : Effect of different level of defatted soybean flour on mineral composition of *Chpati* (T_2)

Treatments	Mineral content (mg/100 g)				
	Calcium	Phosphorus	Manganese	Iron	Zinc
T_0	48.67	349.22	2.71	7.77	2.23
T_2	109.36	443.20	2.77	15.6	1.99
S.E ±	0.245	0.249	0.021	0.007	0.004
C.D. (P=0.05)	0.521	0.531	0.045	0.015	0.010

*Each value an average of three determinations

in *Chapati*, organized trials were taken by incorporating different levels *viz*., 20, 30, and 40 per cent of defatted soybean flour. The data pertaining to organoleptic quality evaluation of prepared *Chapati* is presented in Table 3.

Colour is considered as one of the important consumer quality judging parameter in selection of food products. Attractive colour of product is a must have in fast moving consumer goods to appeal consumer for consumption. Data from Table 3 revealed that sample T_0 obtained higher score for colour *i.e.* (8.00) then sample T_2 obtained good score (7.90) for colour and appearance. With gradual increase in level of defatted soybean flour colour and appearance found to decrease hence sample T_3 scored (7.00).

Flavour being a combination of taste, smell and mouth feel, has large number of factors it. Sample T_2 obtained highest score for flavour *i.e.* (8.20) while sample T_3 obtained less score for flavour *i.e.* (7.60). The sample T_2 obtained maximum score for taste (7.90) whereas sample T_3 obtained fewer score for taste (6.80). When *Chapati* fortified more than 30 per cent by defatted soybean flour then taste of *Chapati* get affected.

Textural characteristics play a pivotal role in judging its consumer acceptability. It could be stated that textural characteristics of *Chapati* is basically function of moisture content. The sample T_2 founded good textural characteristics with obtaining highest score for texture *i.e.* (8.70), while sample T_3 obtained fewer score about (7.40). The sample T_2 obtained higher score for overall acceptability (8.17) as compared to control and other sample. However among other treatments T_2 was better and was mostly acceptable after T_0. Thus on overall acceptability score T_2 (30 % defatted soybean flour) was considered as standardized and used for further substitution.

Wani *et al*. (2016) reported similar results by fortifying Pulse flour upto 15 per cent in wheat flour to produce acceptable chapattis with comparable overall acceptability compared to whole wheat flour. Akhtar and Anjum (2007) reported that *Chapati* prepared from flour with elemental iron as iron fortification was not liked but remained acceptable for taste by the panel. Banureka and Mahendran (2009) reported that biscuit produced with soy flour substitution upto 25 per cent were nutritionally superior to that of the whole wheat flour biscuits. To obtain biscuits of high nutritional and organoleptic qualities, wheat flour could be substituted with 10 per cent of soy flour.

Mineral composition of *Chapati* :

Mineral content of soybean and defatted soybean flour is essential in justifying its food value. Calcium, iron, manganese, phosphorus and zinc are the minerals of interest in current study. Minerals play a key role in various physiological functions of the body especially in the building and regulation processes. The data pertaining to mineral content is presented in Table 4.

Result obtained from Table 4 showed that calcium, phosphorus, manganese, iron and zinc content of control *Chapati* was 48.67, 349.22, 2.71, 7.77 and 2.23 mg per 100 g, respectively. The calcium, phosphorus, manganese, iron and zinc content of *Chapati* fortified with defatted soybean flour (T_2) was 109.36, 443.20, 2.77, 15.6 and 1.99 mg per 100 g, respectively. It was found that with increasing levels of defatted soybean flour to *Chapati* mineral content of *Chapati* was increased. Whereas zinc content was reduced from 2.23 to 1.99 mg per 100 g. similar results were obtained with Waghray *et al*. (2011).

Alemayehu *et al*. (2016) reported that addition of nettle (*Urtica simensis*) leaves on wheat flour significantly ($p<0.05$) increased the amount of crude protein, ash, dietary fibre, Ca, Fe and Zn. Kadam *et al*. (2012) developed missi roti by using composite flour of wheat flour, chickpea and soybean flour with methi leaves and founded that increase in calcium, phosphorus and iron.

Conclusion :

Thus in light of scientific data of the present investigation, it may be concluded that soybean containing macro and micronutrients. Fortification of nutritionally rich legume flour with respect to total protein content and minerals (calcium, manganese, iron, phosphorus and zinc) will be effective in improvement of nutritional and organoleptic quality of *Chapati*.

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