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Quality characteristics of rusk prepared from soybean and oat based composite flour

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Present work have been undertaken to formulate and evaluate the qualities of composite flour based rusk incorporation with soybean and oat flour. The rusk is prepared from replacement with wheat flour. Five treatments were used with sample code T_0 (100:00:00), T_1 (90:05:05), T_2 (80:10:10), T_3 (70:15:15) and T_4 (60:20:20) *i.e.* 0, 5-5, 10-10, 15-15 and 20-20 per cent replacement of soybean and oat flour with wheat flour. The prepared composite flour based rusk was evaluated for its sensory acceptability using 9 point hedonic scale. It was found that treatment T_2 containing 10-10 per cent soybean and oat got the highest score as compared to other treatments. Hence, this proportion was used for further study of nutritional analysis and it's found better result in protein, fat, carbohydrate and fibre. It was concluded that from the research composite flour based rusk sample T_2 containing 80 per cent wheat and 20-20 per cent soybean and oat flour was most desirable in terms of sensory and nutritional quality profile.

Key Words : Composite flour, Protein, Soybean, Sensory evaluation, Rusk

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INTRODUCTION

India is a developing country with a large segment of population depending upon wheat, rice and maize as staple food which provide calories and proteins. Traditionally only wheat has been used as a whole wheat meal (*Atta*) in production of *Chapattis*, paratha and poori where as refined flour (*Maida*) finds great application in manufacture of bakery foods like bread and cookies.75 per cent wheat is produced as whole wheat flour and only 25 per cent is used in preparation of bakery goods.

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The main aim for the development of composite flour baked food was to meet the increasing demand of healthy diet. The composite flour products feature a combination of grains such as wheat, oat, barley, maize, rice, flax, soybean etc. and provide opportunity for snack manufacturers to develop products within an imaginative appearance, featuring new texture and colour with a beneficial nutritional profile. The use composite flours are well established in other food sectors particularly bakery and breakfast cereals. They make a positive contribution to the taste and texture of products and consumer readily accept the health benefits. Composite flour products can contribute to a healthy digestive system, help in weight control, reduce the risk of diabetes reduce the risk of cardiac failures. There was a need to quantify the different levels of various grains for development of baked products (Malik *et al.,* 2015). Bread may be described as a fermented confectionary

product produced mainly from wheat flour, water, yeast and salt by a series of process involving mixing, kneading, proofing, shaping and baking. Rusk is made from bread or rusk is hard dry twice baked bread (Joel *et al.*,2011).

Composite flour as a mixture of flours, starches and other ingredients intended to replace wheat flour totally or partially in bakery and pastry products. The use of composite flours had a few benefits for developing countries: The saving of hard currency, promotion of high-yielding, native plant species, a better supply of protein for human nutrition and better overall use of domestic agriculture production composite flour is considered advantageous in developing countries as it reduces the importation of wheat flour and encourages the use of locally grown crops as flour Thus, several developing countries have to take the initiation of programmes to evaluate the feasibility of alternative locally available flours as a substitute for wheat flour.

Wheat is a good source of calories and other nutrients but its protein is of lower nutritional quality when compared to milk, soyabean, pea and lupin proteins as its protein is deficient in essential amino acids such as lysine and threonine (Joel *et al.,* 2011).

Besides that, the wheat is also used for production of alcoholic and other drinks, as well as cattle food production. However, the wheat is mostly used for flour production, thus, the biggest problem of missing food is solved by using it. Wheat, as well as other corns presents the cheapest source of energy and calories (Husejin *et al.*,2009).

Wheat is an important part of manufacture of bakery goods because it has the inherited property to form dough and retain gases. However, the protein content of wheat varies from as low as 8 to 15 per cent. Flour is fine powder made from cereals or other starch based produce. Wheat flour with different cereal flour used in production of bakery goods such as cookies, bread and cake. Incorporation of composite flour into wheat flour for bakery goods production is expected to produce effect in the functional properties of the blended samples (Peter *et al.,* 2012).

Soybean (*Glycine max*), a species of legume, a miracle bean, is an excellent health food and it contains good quality protein but only minimal saturated fat, 21 per cent carbohydrates and sufficient amounts of minerals and vitamins. Moreover, most of the oilseeds contain 40–50 per cent oil, where as soybean contains about 18 per cent of oil. Amino acid profile of soy protein is excellent amongst plant proteins. Hence, it is superior to other plant proteins as it contains most of the essential amino acids except methionine (FAO, 1970), which is abundant in cereals and it is the most economical source of dietary protein. Soy protein directly lowers serum cholesterol levels. Soybean proteins include all the essential amino acids that are important for health. Soybean protein is about four times of wheat, six times of rice grain and it is also rich in Ca, P and Vitamins A, B, C and D. Fortified cereal with soy protein, especially when mixed with proper ratio, is one of the best sources of protein. Soybean flour has been used to improve protein quality and shelf-life of bread. Also, some studies have shown that adding soy flour (0.5%) to GF flour improves the quality of the bread (Maryam *et al.,* 2016).

Oat belongs to the family *Poaceae* and genus *Avena*. Oats are harvested with their hulls on them (Hoseney, 1994). Among cereals, oats are unique for their high protein as well as lipid contents. Oat is a perfect source of soluble dietary fibre β-glucan, a non-starchy polysaccharide available in the cell walls of the aleurone layer in bran. The most important beneficial effects of ß-glucan are their contribution to a lowering of serum blood cholesterol as well as moderating blood glucose in diabetics. Oats have received increased interest in human foods due to the dietary benefits associated with β-glucans. Oat products incorporated into bread may decrease its volume; however, they improve the structure of crumb together with taste, aroma and nutritive value of the final product. Oats are an excellent food for lowering cholesterol and reducing risk of heart disease because of the high soluble fibre content.

In addition to this it is also rich source of amino acid, B vitamins and many minerals. Oats have numerous uses in food most commonly they are rolled or crushed into oatmeal or into fine oat flour. Thought, oatmeal is chiefly eaten as porridge (Vijaykumar *et al.,* 2013). Present investigation formulated for development of composite flour based rusk on sensory, sensory and physico-chemical quality of rusk.

METHODOLOGY

Material:

Good quality wheat, soybean and oat flour, sugar, salt, yeast, shortening, milk powder were procured from local market of Basmath.

Chemicals:

All the chemicals used in this investigation were of analytical grade procured from standard suppliers. They were obtained from Department of Agricultural engineering, Maharashtra Institute of technology Aurangabad.

Packaging material:

Packaging material *i.e*. HDPE (High Density Polyethylene) was purchased from local market of Basmath.

Methods:

Procedure of functional analysis:

Water absorption capacity:

The method described by Adebowale *et al*. (2012) was used for determining the water absorption capacity (WAC). Sample of 1g was weighed into clean pre-weighed dried centrifuge tube and mixed with 10 ml distilled water with occasional stirring for 1 h. The dispersion was centrifuged at 3000 rpm for 15 min. After centrifuging, the supernatant was decanted and the tube with the sediment was weighed after removal of the adhering drops of water. The weight of water (g) retained in the sample was reported as WAC.

$$WAC = \frac{W_3 - W_2}{W_1}$$

W_1 = Weight of sample

W_2 = Weight of empty tube

W_3 = weight of tube after centrifugation.

pH dtermination:

The PH of the samples was measured with a PH meter. 10 g of each sample collected especially were homogenized in 50 ml of distilled water. The resulting suspensions were decanted and their PH determined using PH meter already standardized with buffer solutions of pH 4.0 and 7.0.

Bulk density:

50 g flour sample was put into a 100 ml measuring cylinder. The cylinder was tapped several times on a laboratory bench to a constant volume. The volume of sample is recorded.

$$\text{Bulk density (g/ml)} = \frac{\text{Weight of sample}}{\text{Volume of sample after tapping}}$$

Dispersiability determination :

Standard method was used for determining dispersiability (Kulkarni *et al*., 1991). Sample of 10g was dispersed in distilled water in a 100 ml measuring cylinder and distilled water was added upto 50 ml mark. The mixture was stirred vigorously and allowed to settle for 3 h. The volume of settled particles was noted and percentage dispersiability was calculated as follows:

Dispersibility (%)= (50-Volume of settled particle) 50x 100

Water holding capacity:

The functional properties *viz.*, water holding capacity and oil absorption capacity were determined based on standard procedures. For estimating the water holding capacity the procedure mentioned by Gould *et al.* (1989) was adopted with little modification. One gram of the flour sample (dried) was weighed into a centrifugal tube, made up with 10 ml distilled water. This was kept in a bench top centrifuge (Kubota 5100 Bench Top Centrifuge, Fujioka, Japan) and rotated at 3500 rpm for 15 min. The supernatant was removed and the hydrated sample was weighed. WAC was found from the following formula:

$$\text{Water holding capacity} = \frac{W_1 - W_2}{100} \text{ x Weight of sample taken}$$

Procedure of physico-chemical analysis:

Moisture content:

Moisture was estimated by weighing accurately 5g of ground sample and subjected to oven drying at 1100C for 4h. It was again weighed after cooling in desiccators until the constant weight was obtained. The resultant loss in weight was calculated as moisture content (AOAC, 1998).

$$MC = \frac{W_2 - W}{W_1 - W} \text{ x } 100$$

where,

W= Weight of empty Petridish

W_1 = Weight of Petridish with sample before drying

W_2 = Weight of Petridish with sample after drying to constant weight

Crude fat:

5g ground sample was weighed accurately to thimble and defatted with the petroleum ether in Soxhlet apparatus for 6-8 hours at 800C. The resultant ether was evaporated and lipid content was calculated (AOAC, 1998).

$$\text{Fat (\%)} = \frac{W_2 - W_1}{W} \times 100$$

where,
W_2= Weight of flask with oil (g)
W_1= Weight of empty flask (g)
W=Weight of initial sample (g).

Crude protein:

Protein was determined by Micro-kjeldhal method (AOAC,1998) using 0.5g of ground sample by digesting the same with concentrated H_2SO_4 containing catalyst mixture for 3-4 hours at 100^0C. It was then distilled with 40 per cent of NaOH and liberated ammonia was trapped in per cent of boric acid and then it was titrated with 0.1N HCL using mixed indicator (Methyl red: Bromocresol green; 1:5). The per cent percentage was estimated in the sample using multiplying factor 6.25.

$$\text{Nitrogen \%} = \frac{[(\text{Sampletitre} - \text{blanktitre}) \times \text{Normality of HCL} \times 14 \times 100]}{[(\text{Weight of sample} \times 100)]}$$

Protein %= Nitrogen% ×6.25

Ash:

The total ash content was determined by the method cited by Ranganna (1995). The sample was taken in a previously weighed silica crucible. The ash content was determined by ashing the sample at 550°C for 6 hours in muffle furnace.

$$\text{Ash (\%)} = \frac{\text{Weight before ashing} - \text{Weight after ashing}}{\text{Weight of sample}} \times 100$$

Crude fibre:

The fibre content of was sample determined by the method cited by Ranganna (1995). The crude fibre is an organic residue remained after sample is digested with conc. acid and alkali. Weighed amount of dried and fat free sample was taken and digested with 0.225 N (1.25%) Sulphuric acid and 0.313 N (1.25 %) sodium hydroxide alkali for 30 minutes each and then washed with water. The sample was neutralized with dilute acid and filtered through muslin cloth. The sample was then washed with alcohol and hot water and dried in a hot air oven with asbestos at 110°C temperature till constant weight. The loss in a weight of sample was measured.

$$\text{Fibre (\%)} = \frac{\text{Initial wt.} - \text{Loss in weight of sample}}{\text{Initial weight of sample}} \times 100$$

Carbohydrates:

Carbohydrate was calculated by difference by using following formula (Ranganna, 1986).

Carbohydrate % = 100- (% Moisture + % Ash +% Fat +% Protein)

Preparation of composite flour:

Composite flour utilized in the preparation of oat and soybean flour rusk was prepared by blending proportion of oats and soybean flour with wheat flour in the following blends to standardize the formulation of composite flour rusk.

Table A : Formulation of flour for rusk preparation

Treatments	Composition of flour (%)		
	Wheat	Soybean	Oat
T_0	100	00	00
T_1	90	05	05
T_2	80	10	10
T_3	70	15	15
T_4	60	20	20

Preparation of rusk:

Rusk is hard dry twice baked bread. Bread is an ideal functional product, since it is an important part of our daily diet. Bread is consumed in large quantity in world in different types and forms depending upon cultural habits Bread is usually made from wheat flour dough that is cultured with yeast, allowed to rise and finally baked in an oven.

Ingredients	Quantity (g/ml)
Flour	100
Sugar	6
water	65
Salt	2
Yeast	3
Cardamom	1
Milk powder	5
Shortening	4

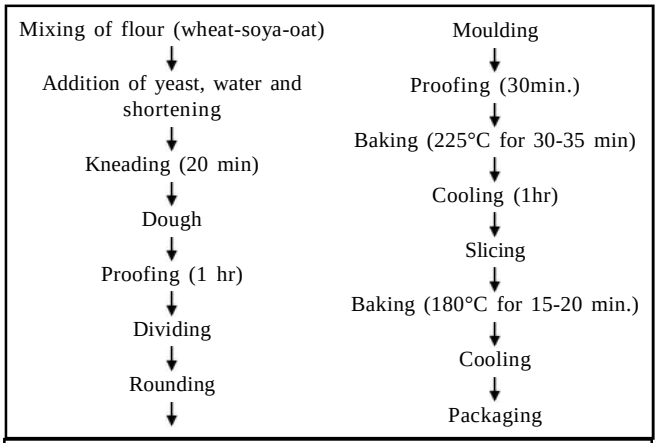

Fig. A : Flow chart for preparation of rusk

OBSERVATIONS AND ASSESSMENT

Functional properties and proximate composition of wheat, oat and soybean flour used for the experiment is Table 1 to 2.

The moisture content of wheat flour was slightly higher that of the composite blend flour. This may be due to higher temperature employed during drying of grains. Oat and soybean flour contains higher fat, fibre, ash. The higher fibre content was due to presence of few oat and soybean bran particles present in flour Table 3.

where,

T_0= Composite flour based rusk prepared from 0 per cent addition

T_1= Composite flour based rusk prepared from 05-05 per cent addition of soybean and oat flour

T_2 = Composite flour based rusk prepared from 10-10 per cent addition of soybean and oat flour

T_3 = Composite flour based rusk prepared from 15-15 per cent addition of soybean and oat flour

T_4 = Composite flour based rusk prepared from 20-20 per cent addition of soybean and oat flour.

Moisture content:

It can be seen from the above graph that moisture content increase with decreased in oats and soybean flour content in the composite flour based rusk. The results show that rusk with 20- 20 per cent oat and soybean flour had the highest moisture content while rusk with 0 per cent oat and soybean flour had low moisture content.

Ash content:

Ash content in a food substance indicates inorganic remains when the organic matter has been burnt away. High ash content was observed in rusk with 20-20 per cent oat and soybean flour followed by rusk with 15-15 per cent oat soybean flour and, while minimum ash content was observed in rusk with 0 per cent oat and soybean flour.

Protein:

Rusk with 20-20 per cent oat and soybean flour contain higher protein while 0 per cent oat and soybean flour or control lower amount of protein. The increase in protein content could be due to increase in the proportion of oat and soybean flour.

Fat:

High fat was observed in rusk containing 20-20 per cent oat and soybean flour. The increase in fat content in the final product with increase in percentage level of oat and soybean flour.

Fibre:

The mean for fibre content of oat and soybean flour fortified rusk showed that fibre content increased

Table 1 : Functional properties

Parameter	Wheat flour	Soybean flour	Oat flour
WAC (%)	155± 3.0	257.67±1.53	137.67±1.15
WHC (g/g)	1.51± .011	2.73±0.48	1.83±0.27
Disperciability (%)	23.36± 1.15	20.83±1.04	14.33±1.53
Bulk density(g/ml)	0.50± 0.06	0.53±0.10	0.39±0.03
pH	6.33±0.03	6.54±0.04	5.67±0.05

*Each value is an average of three determinations

Table 2 : Proximate composition of flour

Parameter (%)	Wheat flour	Soybean flour	Oat flour
Moisture	7.66±0.3	7.33±0.5	6.33±0.5
Fat	2.08±0.2	20.48±0.4	6.5±0.5
Protein	10.69±01	34.76±0.2	14.78±0.1
Crude fibre	1.74±0.4	2.43±0.4	4.04±0.1
Ash	1.87±0.2	3.19±0.3	1.9±0.1
Carbohydrates	73.93±0.8	34.90±0.2	62.68±0.6

*Each value is an average of three determinations

with the increase in different level of oat and soybean flour.

Carbohydrate:

Carbohydrate content decreased with increase in different level of oats and soybean composition in flour. Rusk with 0 per cent oat and soybean flour contain more carbohydrate.

Sensory evaluation of composite flour based rusk:

The sensorial quality characteristics of composite flour based rusk play a vital role in attracting consumers to purchase the product. Consumer judges composite flour based rusk quality on the basis of its sensory parameters such as colour, flavour, texture, taste, overall acceptability etc. Sensorial evaluation was done using 9 point hedonic scale. The rusk were evaluated with respect to colour, flavour, taste, texture, appearance and overall acceptability. The sensory score resulted that there was an increase in sensory score with the addition of oat and soybean flour improved flavour, taste, texture, appearance, overall acceptability of the final product.

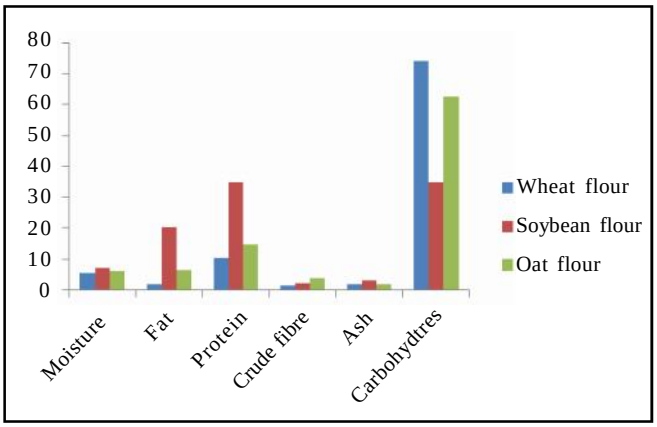

Fig. 1: Proximate composition of flour

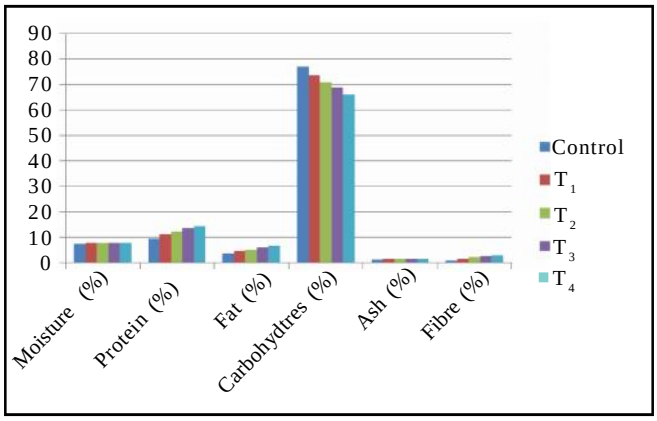

Fig. 2: Effect of composite flour on physico-chemical characteristics of rusk

Table 3: Effect of Composite flour on physico-chemical characteristics of rusk

Sample	Chemical parameters (%)					
	Moisture	Protein	Fat	Carbohydrates	Ash	Fibre
T_0	7.24	9.64	3.82	76.89	1.53	1.2
T_1	7.63	11.45	4.69	73.59	1.60	1.84
T_2	7.76	12.53	5.21	70.83	1.64	2.32
T_3	7.83	13.86	6.09	68.57	1.62	2.74
T_4	7.96	14.57	6.93	65.82	1.70	3.19
S.E.±	0.032	0.028	0.035	0.022	0.049	0.047
C.D. (P=0.05)	0.103	0.089	0.110	0.072	0.158	0.151

*****Each value is an average of three determinations

Table 4 : Sensory evaluation of composite flour based rusk

Sample	Colour	Texture	Flavour	Taste	Overall acceptability
T_0	8	8	7.0	8.0	7.8
T_1	7.25	7.0	6.75	7.0	7.0
T_2	8.0	7.75	7.0	7.6	7.6
T_3	6.62	6.37	6.37	6.9	6.75
T_4	6.37	6.67	6.12	6.55	6.25
S.E.±	0.314	0.200	0.217	0.199	0.187
C.D. (P=0.05)	0.904	0.578	0.625	0.574	0.541

*****Each value is an average of three determinations

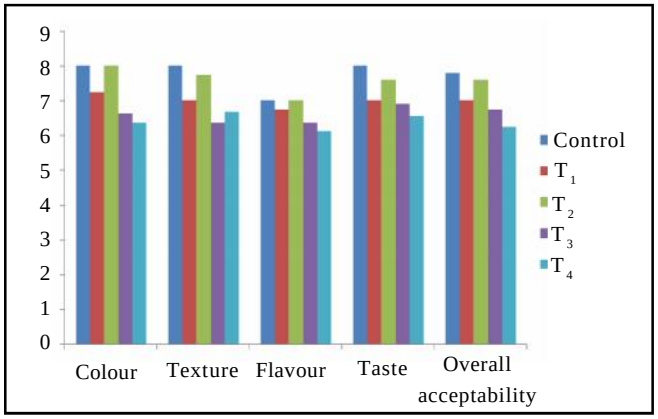

Fig. 3: Sensory evaluation of composite flour based rusk

where,

T_0= Composite flour based rusk prepared from 0 per cent addition

T_1= Composite flour based rusk prepared from 05-05 per cent addition of soybean and oat flour

T_2= Composite flour based rusk prepared from 10-10 per cent addition of soybean and oat flour

T_3 = Composite flour based rusk prepared from 15-15 per cent addition of soybean and oat flour

T_4= Composite flour based rusk prepared from 20-20 per cent addition of soybean and oat flour.

The data presented in table- for sensory evaluation of composite flour based rusk. Sensory evaluation is one of the best qualities deciding technique which involve perceptions of human senses. Colour, flavour, taste and overall acceptability are important quality deciding parameter for yoghurt.

Colour is first parameters which attract the consumer for the consumption of product. Colour decides its freshness and clarity. The colour value for control sample was 8.0 the sample T_2 got good scores for colour about 8.0. Colour values of rusk were changes with increase in proportion of oat and soybean flour. Flavour is combination of taste, aroma and mouth feel. It is one of the important qualities deciding parameter which play important role in judging the quality of freshness, suitability and acceptance. The flavour of rusk changes with changing the proportion of and oat and soybean sample T_2 scored highest for flavour. The taste of sample was decreased with increasing ratio of oat and soybean flour. The result of sensory evaluation concluded that sample T_2 was scored highest for all the parameters and it was acceptable.

Conclusion:

Thus, in the light of scientific data of the present investigation, it may be concluded that that oat and soybean flour can be used successfully in preparation of rusk at the replacement level of 5, 10,15 and 20 per cent levels without any undesirable changes in physical, chemical and organoleptic attributes of rusk. From this observation it was concluded that 10-10 per cent oat and soybean flour blend rusk was good quality and easy to handle as compared to 15-20 per cent oat and soybean flour rusk. And nutritional value are more closer to all proportion. Moreover, this finished product can be consumed by socio-economically poor and vulnerable groups of people. It is interesting to note that the incorporation of oat and soybean flour yielded rusk with better as compared to maida rusk. Oat and soybean flour not only improved the overall acceptability of the product but also improves the nutritive value of the product. Rusk is found to be the best. The findings of the present study may help in developing commercial processing technology for effective utilization of soy flour and oat flour especially in the manufacturing of bakery products.

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