

Development and Compositional Analysis of Protein Rich Soyabean-maize Flour Blended Cookies

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Abstract

Bakery products are mainly prepared from wheat as its main ingredient. The present study was designed to blend soy flour and maize flour as a source of protein and fibre replacing refined flour to make protein rich cookies. Soyabean is limiting in sulphur amino acid methionine but higher in lysine, isoflavones and protein while maize protein is deficient in lysine and tryptophan and rich in methionine. Thereby blending soy and maize flour nutritional quality can be improved. Cookies were prepared by blending soy flour (SF) with maize flour (MF) from 0 to 100% levels using traditional creamery method. Cookies were evaluated for physico-chemical, functional and sensory quality parameters. Combinations of MF/SF significantly improved ($p < 0.05$) the nutrient contents of the blends when compared to MF alone. The cookie containing maximum level of SF have high content of protein, crude fibre, ash and fat while the cookie containing maximum level of MF have high content of carbohydrate. The cookies with 10% soya flour and 90% maize flour scored maximum for all the sensory quality attributes. The use of soy flour/maize flour blends for cookie preparation is an advantage in a non traditional wheat producing country and in improving nutritional quality too.

Keywords: Maize flour; Soyabean flour; Blends; Chemical composition; Cookies

Introduction

The demand of bakery products is increasing at the rate of 10.07% per annum. India is a developing country with large segment of population depending on wheat as staple foods and 25% of wheat is used in the preparation of baked foods. Due to changing life style, the people have started demanding ready to cook or ready to serve convenience foods. More and more women are seeking employment to supplement the family income and they find less time for cooking and therefore demand ready to serve foods. Baked products are considered as excellent vehicle for fortification, value addition and feeding at mass scale. Baked products are the most important sources of dietary fibre in the total food consumption [1]. Protein deficiency is a major dietary problem facing the world today, particularly the underdeveloped and developing countries. Protein rich cookies can be prepared from composite flours such as wheat flour fortified with soy, cottonseed, peanut or corn germ flours [2]. The present study was designed to incorporate soy flour and maize flour as a source of protein and fibre. Gupta and Singh [3] used wheat flour and quality protein maize based biscuits prepared with and without processed defatted maize germ cake supplementation and compared with wheat flour based biscuits as standard. Population of many undeveloped countries faced the problem of malnutrition due to deficiencies of protein and calories. The use of protein-calorie sources of vegetable origin has been proposed a possible solution to this problem. Proteins which have adequate nutritional value and form part of the regular diet of the people would be possible candidates for the purpose. In this regard, soybean has been used in various foods to mitigate the shortage of protein supplies. However, soybean is limiting in sulphur amino acid methionine but high in lysine [4]. Soybean (*Glycine max*) a species of legume, widely grown for its edible bean which contain significant amounts of protein, phytic acid, alpha-Linolenic acid, and the isoflavones-genistein and daidzein. Soybean contains about 48 to 50% proteins. Upon germination of the soybean, the protein will be digested, and the released amino acids will be transported to locations of seedling growth. Legume proteins, such as soy and pulses, belong

to the globulin family of seed storage proteins called leguminins and vicilins, or in the case of soybeans, glycinin and beta-conglycinin. Grains contain a third type of storage protein called Gluten or "prolamines." Soy proteins are unique among plant proteins by virtue of their relatively high biological value and presence of essential lysine which is a limiting amino acid in most of the cereals [5,6]. Soybeans also contain biologically active or metabolic proteins such as enzymes, trypsin inhibitors, hemagglutinins, and cysteine proteases very similar to papain. The soy cotyledon storage proteins are important for human nutrition. Soybeans are processed into three kinds of modern protein-rich products soy flour, soy concentrate, and soy isolate. Soy protein contains phytoestrogens, which bind to estrogen receptors in the body. Some studies suggest that high levels of phytoestrogens may increase the risk of certain forms of cancer, while other studies contradict this finding and suggest these compounds may decrease the risk of cancer. They are the seeds of some leguminous plants which are also called wonder food as they are low in fat and absorb the flavor of spices and herbs making them tasty to eat. Beans and legumes contain all the important nutrients that have been recognized recently in preventing heart disease, cancer and obesity [7]. Besides having carbohydrates and fiber, they are the richest source of proteins. Pulses give an alternative source of proteins without fat for the non-vegetarians where as for the vegetarians it is the only source of proteins. Commonly used pulses are green gram, bengal gram soybeans and kidney beans. Soya proteins may interact with other soya components such as minerals, phytic acid, ascorbic acid, and fiber. Soy has been successfully incorporated

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in various products including chicken-meat analogs, cereals, pasta, and imitation bacon bites, but its use in bakery products (especially bread) has been limited because of unacceptable sensory and textural properties. Wheat is the main ingredient of baked goods. Attempts have been made to substitute wheat with other flours such as cowpea [8-10], amaranth grain [11,12] and African bread fruit [13]. Similarly, mixtures of wheat flours such as millet/pigeon pea [14], cowpea/maize [15] and cowpea/plantain [9] have been evaluated. The use of such non-glutinous composite flours in cookies preparation reduces the textural strength of cookies where such strength is dependent upon approximate levels of gluten development. This is because in contrast with the bread, the gluten network in cookies is to be slightly cohesive without been to elastic [16]. Maize (*Zea mays*) a major source of carbohydrates, protein, vitamin B, vitamin A (yellow maize) and minerals. Diets that rely heavily on corn may require the consumption of complementary foods to supplement its deficiency in certain amino acids and vitamins. It is deficient in lysine and tryptophan [4]. Maize is a major source of starch. Cornstarch (maize flour) is a major ingredient in home cooking and in many industrialized food products. Cookies are small, flat dessert treats, commonly formed into a circular shape. They constitute an important component of the diet. They could provide an excellent means of improving nutritional quality through incorporation of vegetable protein. Therefore by supplementing the wheat flour with good quality soy protein, nutritional quality of blend can be improved. Moreover, to enhance the utilization of soybean in the daily diet of people, it is highly desirable to develop novel and value added food products of soybean. The objective of the present study was to optimize the ingredients for cookies and to determine the nutritional properties of the soybean flour/maize flour blends and to evaluate the performance of the blends in cookies.

Material and Method

Present study was carried out in 2011 at Centre of Food Technology, University of Allahabad, Allahabad, U.P., and India. Soybean (glycine max), Maize (*zea mays*) used for this investigation were purchased from the local market. All required ingredients used for cookie production like margarine, beaten whole egg, sucrose, baking powder were purchased from local market of Allahabad, India. All the chemicals used in analysis were of (analytical reagent) AR grade obtained from Centre of Food Technology.

Flour blending

The soya flour at 10,20,30,40,50,60,70,80,90% levels was blended with maize flour on replacement basis i.e. SF:MF 100:0, 90:10, 80:20, 70:30, 60:40, 50:50, 40:60, 30:70, 20:80, 10:90, 0:100 in a laboratory food processor for 5 min. The flour blends were packed in HDPE bags, heat sealed and stored in a refrigerator for future use.

Cookie production

Cookies were prepared as described by Akapapunam and Darbe [17]. The basic formulation was 49.5% wheat flour, 20% margarine, 10% beaten whole egg, 20% sucrose and 0.5% baking powder. The dry ingredients were weighted and mixed manually. Margarine was added and rubbed thoroughly for uniformity in blending. Egg was added and the dough was thoroughly kneaded manually in a clean stainless steel bowl for 5 min. The dough was rolled on a sheathing board to uniform thickness (3.5 cm) and cut out using a round scorn cutter to a diameter of 2.5 cm. The cut dough were baked in greased pans at 160°C for 15 min in an oven and cooled at room temperature for 1 hour, and packed

in HDPE for further analysis (Figure 1). Ten cookies were baked in each treatment (flour or flour mix). Cookies were also prepared from 100% SF and 100% MF which were included for comparison.

Evaluation of functional properties of the flour

Bulk density was determined as described by Okaka [18]. Water and oil absorption capacities of flour as is basis were determined at room temperature [19].

Chemical composition and physical evaluation of cookies

The crude protein, fat, crude fibre, moisture and ash were determined as described by Sosulski et al. [19]. Cookie diameter and height were measured with a vernier caliper. Weights were determined using a digital top loading balance. Cookie spread ratio was calculated as D/H. The average values of 3 replicate determinations were reported.

Sensory evaluation

Wheat cookie (100% wheat) served as control and 100% soyabean and maize products were included for comparison. The cookie samples were evaluated for color, flavour, crispiness, mouth feel and overall acceptability on a 9-point hedonic scale.

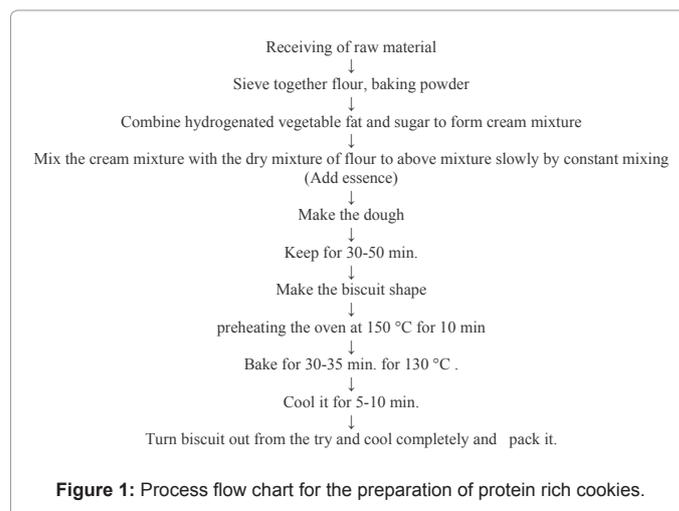


Figure 1: Process flow chart for the preparation of protein rich cookies.

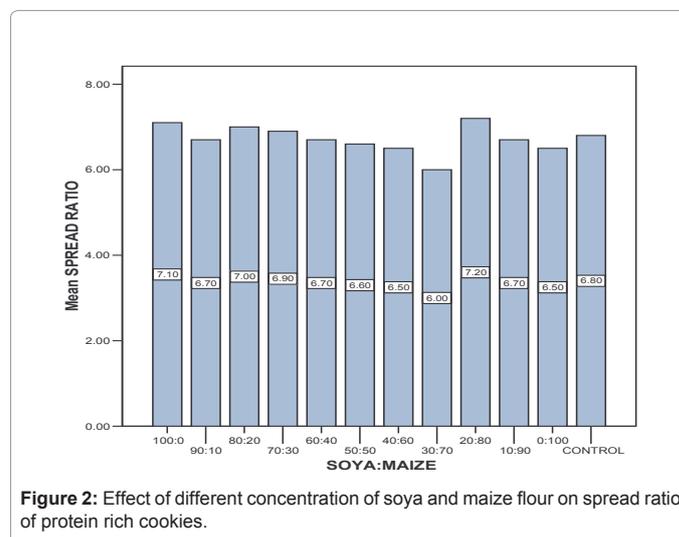


Figure 2: Effect of different concentration of soya and maize flour on spread ratio of protein rich cookies.

Statistical analysis

Data were analyzed by analysis of variance using SPSS software. Mean differences were determined by least significant difference test at $p < 0.05$.

Result and Discussion

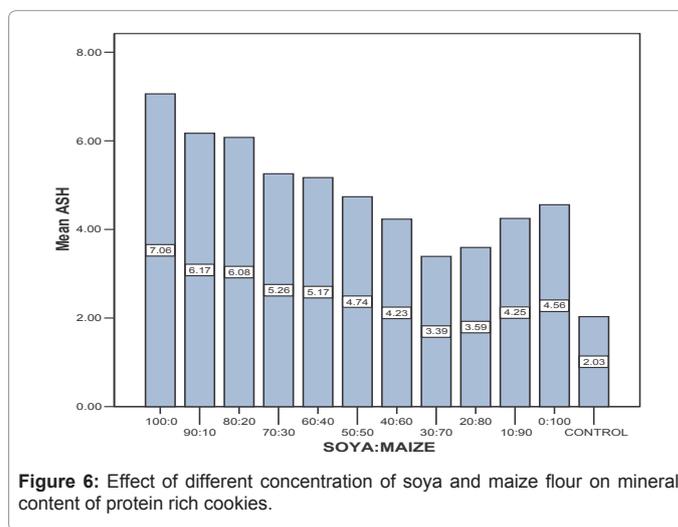
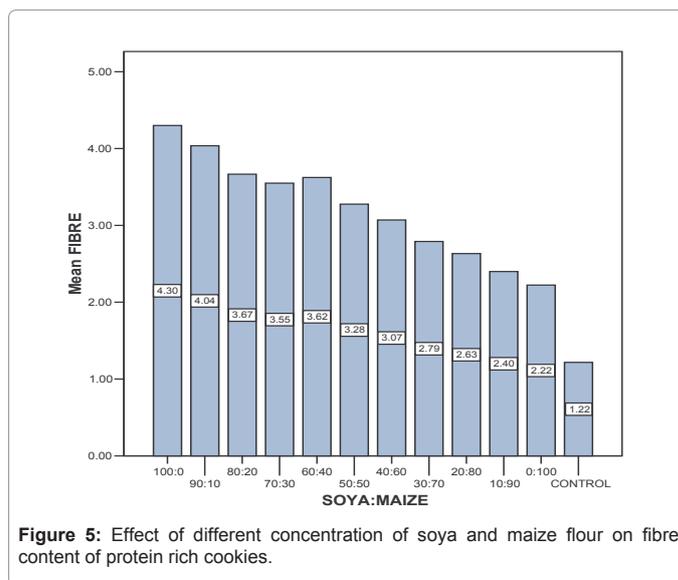
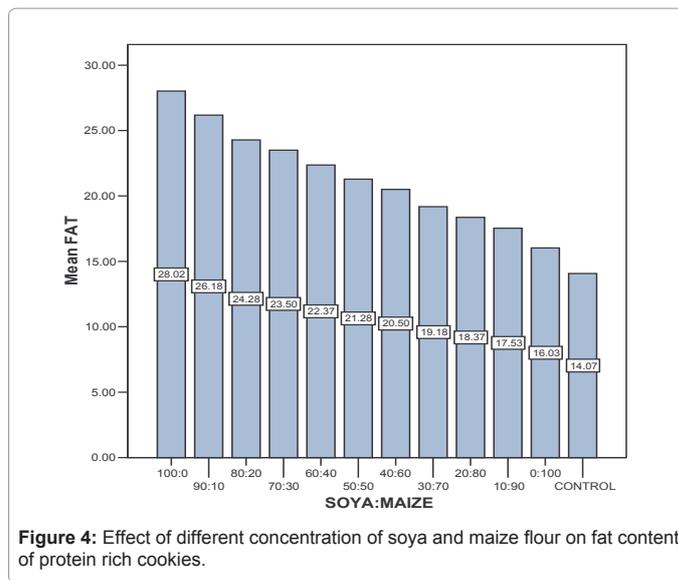
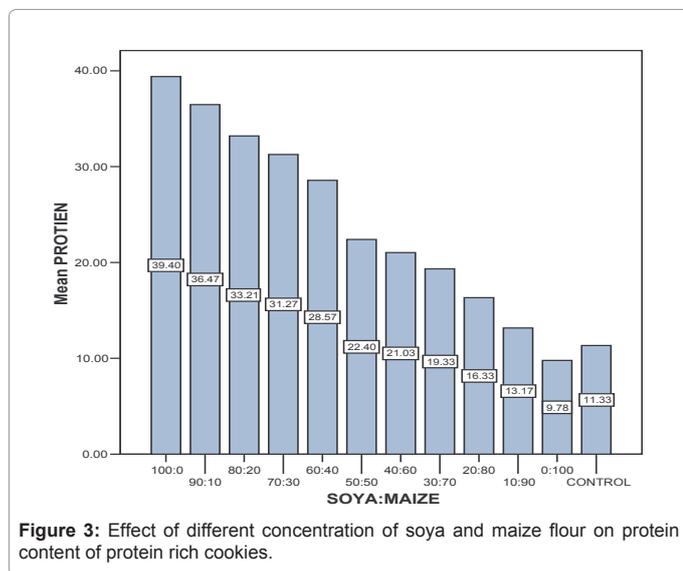
The proximate composition (%) of refined wheat flour, soya flour and maize flour used to prepare cookies was given in (Table 1).

Physical parameters

The physical parameters of cookies prepared by varying soya flour (SF) and maize flour (MF) from 0 to 100% without the use of refined wheat flour (maida) are presented in (Table 2). It was observed that no significant difference in diameter and height of cookies was obtained, with increasing proportion of MF. It was observed that the weight of cookies gradually decreased from 16.3 to 4.9 with increasing proportion of SF because the total solid content in SF was higher than MF as seen from composition of MF & SF. The spread ratio of cookies decreased significantly from 7.1 to 6.7 with increasing level of MF (Table 1, Figure 2). Reduced spread ratio of cookies were attributed to the fact that composite flours of maize and soy apparently form aggregates with increased number of hydrophilic sites available for competing, for the limited free water in cookies dough [21,22]. Similar results were observed by Sathe et al. [23].

Chemical parameters

The chemical composition of cookies regarding moisture, ash, crude fat, crude protein, crude fiber and carbohydrate are presented in (Table 3). With the increase in MF level in cookies, there was decrease in proteins, fat, crude fiber and ash content and increase in carbohydrate content. The protein content of cookies decreased from 39.3 to 9.9% with increasing MF in cookies from 0 to 100% (Figure 3). The protein of MF blended cookies was significantly higher than that of control. The fat, crude fiber and ash contents decreased from 28 to 16%, from 4.3 to 2.2% and from 7.09 to 4.59% (Figure 4-6) respectively, thus being significantly lower in cookies prepared from MF. The moisture content was not changed significantly as MF increased



in the blends. The carbohydrate content of cookies was found to be significantly increased from 20.5 to 64.51% with increasing levels of MF in cookies. The increased carbohydrate content in cookies might be due to their higher contents in MF than reported increased protein content in crackers prepared by replacing wheat flour with soy flour [24]. They reported that the high protein content was associated with the water binding properties of soy flour. The data regarding changes in protein contents presented in (Table 3) shows that the protein content as increased from 11.3 to 39.3% in 100% SF cookie as compared to control, but the protein content was decreased from 11.3 to 9.9% in 100% MF cookie as compared to control. In formulation 10SF:90MF the protein content also increased from 11.3 to 13.1% as compared to control. However, the ash and crude fiber and fat contents in cookies were increased with increasing amount of MF to 100% as compared to control. It was clear from (Table 1) that the cookie containing maximum level of SF have high content of protein, crude fibre, ash and fat while the cookie containing maximum level of MF have high content of carbohydrate.

Sensory evaluation

The data about sensory evaluation of cookies from SF and MF are presented in (Table 4). The data revealed that cookies with 10% SF and 90%MF obtained highest scores of color (7.6), flavor (7.9), mouth feel (8) and overall acceptability (8) as compared to other samples. It was observed that, the score of color (9), was higher in control sample. However, the cookies with 10% SF and 90% MF were better with respect to flavor, crispiness, overall acceptability and mouth feel. Thus on overall acceptability score of cookies with 10% SF and 90% MF was considered as standardized and used for further studies. A SF cookie has lower sensory scores than MF cookies. Sathe et al. [23] reported similar results after replacing refined wheat flour with soy and groundnut flours at 15% level to prepare protein enriched crackers. The standardized and the maximal scored cookies for overall acceptability has the calorific value of 450.4 Kcal/100 g which is slightly higher than that of control i.e. 445 Kcal/100g. 100%SF has increased calorific value (491.2) as compared with control. Onweluz and Iwezu [25] reported increase in calories of biscuits prepared from blends of wheat-soy flour and cassava-soy flour.

S.No	Particulars	Refined wheat flour	Soya flour	Maize flour
1	Moisture	11.5	6.2	8.7
2	Protein	12.2	43.2	6.0
3	Fat	1.9	0.9	4.8
4	Ash	1.0	1.0	1.3
5	Crude fiber	0.30	5.49	0.45
6	Carbohydrate	73.0	43.3	78.8

Table 1: Nutritional properties of refined, soya and maize flour.

Particulars	Soya flour: Maize flour											Control
	100:0	90:10	80:20	70:30	60:40	50:50	40:60	30:70	20:80	10:90	0:100	
Weight g	12.28	11.6	11.4	11.3	7.9	7.0	6.9	6.3	6	5.9	4.9	7.10
Height, %	4.9	5.2	5	5.2	5	5.2	5	5	5	5	5	5.10
Diameter, cm	3.5	3.5	3.5	3.3	3.5	3.3	3.5	3.6	3.3	3.4	3.4	3.50
Spread ratio	7.1	6.7	7	6.9	6.7	6.6	6.7	7.2	6.6	6.8	6.7	6.80
WAC, %	217	197	196	193	192	190	185	183	180	177	197	151.00
OAC, %	119	119	116	132	133	134	139	147	200	210	120	169.97
BD, g/cm ³	0.61	0.65	0.67	0.68	0.69	0.70	0.72	0.73	0.81	0.84	0.72	0.73

Table 2: Physical Evaluation of cookies prepared from soybean flour (SF), maize flour (MF) and their blends.

Particulars	Soya flour: Maize flour											Control
	100:0	90:10	80:20	70:30	60:40	50:50	40:60	30:70	20:80	10:90	0:100	
Moisture	5.1	5.32	5.22	4.98	4.99	5.01	5.04	4.99	5.21	5.14	5.04	4.5
Fat	28	26	24.3	23.7	22.2	21.3	20.6	19.3	18.5	17.6	16	14.2
Protein	39.3	36.4	33.12	31	28.6	22.4	21.01	19.2	16.3	13.1	9.9	11.3
Ash	7.09	6.23	6.10	5.28	5.19	4.98	4.20	3.47	3.62	4.24	4.59	2
Crude fibre	4.30	4.1	3.9	3.8	3.6	3.3	3.1	2.9	2.6	2.4	2.2	1.2
Carbohydrate	20.51	26.05	33.2	35.05	39	46.31	49.1	53.04	56.3	59.9	64.5	68
Calories Kcal/100g	491.24	483.8	483.98	477.4	470.2	466.5	392.88	446.9	443.83	450.4	441.6	445

Table 3: Chemical composition of cookies prepared from soybean flour (SF), maize flour (MF) and their blends.

Particulars	Soya flour: Maize flour											Control
	100:0	90:10	80:20	70:30	60:40	50:50	40:60	30:70	20:80	10:90	0:100	
Colour	6.8	6.9	6.9	7.0	7	7.3	7.5	7.5	7.6	7.6	7.6	9
Flavour	5.77	5.80	5.83	6.01	6.53	6.63	6.97	6.97	7.20	7.9	7.0	7.57
Crispiness	6.0	6.10	6.47	6.56	6.58	7.30	7.37	7.73	7.80	7.8	8.10	7.60
Mouthfeel	5.50	6.10	6.20	6.3	6.9	7	7	7.5	7.5	8	7.2	7.83
Overall acceptability	5.53	5.90	6.07	6.10	6.20	6.48	7	7.5	7.5	8	7.2	7.87

Table 4: Sensory evaluation of cookies prepared from soybean flour (SF), maize flour (MF) and their blends.

Functional properties of flours

The SF produced 20% increase in water absorption capacity (WAC) over MF, probably due to the higher protein content of SF (Table 1). However, MF showed better ability to bind and retain oil than SF. The WAC of SF/MF blends increased while oil absorption capacity (OAC) decreased as the level of SF was increased. The presence of high level of fat in SF might have affected adversely the OAC of blends. SF/MF blends would be useful in bakery products where hydration to prove handling characteristics is recovered. The blends would also be useful in ground meat formulations, dough nuts, pancake where oil holding proper try is an important consideration. The bulk density of MF and SF are 0.72 and 0.61 g/cm respectively and increased from 0.64 to 0.84 g/cm for the blends. The bulk density of the blends increased significantly with the level of 3 MF. The low bulk density of all the flours would be an advantage in the formulation of complimentary foods. The bulk density of the flour could also be used to determine packaging requirement.

Conclusion

Substitution of maize flour with soy flour at levels of 0 to 100% resulted in notable increase in protein content, which could be nutritionally advantageous for the developing countries as protein malnutrition is the common problem and bakery products can be a good medium to solve this problem up to some extent, where many people can hardly afford high pertinacious foods because of the costs. Some of the functional properties of the maize-soy mixes obtained could be an advantage in industrial uses, such as the bulk density and water holding capacity. The MF cookies received higher ratings than SF cookies. Combinations of MF/SF significantly improved ($p < 0.05$) the nutrient contents of the blends when compared to MF alone. All constituents except carbohydrate increased with levels of SF. The ratio 10:90 (SF:MF) appeared optimum for the blended cookies. Soya and maize flour can be combined to produce acceptable cookies with a greatly improved nutritional quality. It is also of interest in child feeding program and for low income group. The use of soy flour/maize flour blends for cookie preparation is an advantage in a nontraditional wheat producing country also.

References

- Hans GB, Steller W, Feldhelm W, Wisker E, Kulikowski W (1986) Dietary fibre and bread: Intake, enrichment, determination and influence on colonic function. *Cereal Food World* 31: 306-310.
- Tsen CC (1976) Regular and protein fortified cookies from composite flours. *Cereal Foods World* 21: 633-640.
- Gupta HO, Singh NN (2005) Preparation of wheat and quality protein maize based biscuits and their storage, protein quality and sensory evaluation. *Journal of Food Science and Technology* 42: 43-46.
- FAO (1970) Amino acid content of food and ecological data on protein. *Nutritional studies 24*. Food and agricultural organization of the united nations, Rome.
- Riaz MN (1999) Soybean as functional food. *Cereal FoodWorld* 44: 88-92.
- Kaur A, Ahluwalia P (2001) Studies on use of isabgol (Psyllium mucilloid) husk in atta for chapati making. *Journal Food Science Technology* 38: 75-78.
- Anderson JW, Ward K (1979) High carbohydrate, high fiber diets for insulin treated men with diabetes mellitus. *American Journal of Clinical Nutrition* 32: 2312-2321.
- Okaka JC, Isieh MI (1990) Development and quality evaluation of cowpea-wheat biscuits. *Nigerian Food Journal* 8: 56-62.
- Akubor PI, Adamolekun FA, Oba CO, Obari T (2003a) Functional properties and biscuit making potential of cowpea/plantain flour blends for cookie production. *Plant Food Human Nutrition* 58: 1-9.
- Akubor PI, Benye FN, Obiegbuna JE (2003b) Effects of cowpea supplementation on the functional and biscuit making properties of wheat flour. *Journal Sustainable Agriculture Environment* 5: 247-253.
- Adeyemi A, Adabiri BO, Afolabi OA, Oke OL (1992) Evaluation of some quality characteristics and baking potentials of amaranth flour. *Nigerian Food journal* 10: 8-15.
- Ayo JA (2001) The effect of amaranth grain flour on the quality of bread. *International Journal of Food Properties* 4: 341-351.
- Akubor PI, Badifu GIO (2004) Chemical composition, functional properties and baking potential of African breadfruit kernel and wheat flour blends. *International journal of food science technology* 39: 223-229.
- Eneche EH (1999) Biscuit making potential of millet/peigen pea flour blends. *Plant Food Human Nutrition* 54: 21-27.
- Akubor PI, Achi OK (2001) Functional properties and biscuit making potential of cowpea and maize flour blends. *Journal Manag Technology* 3: 220-225.
- Schober TJ, O'Brien CM, McCarthy D, Darnedde A, Arendt EK (2003) Influence of gluten-free flour mixes and fat powders on the quality of gluten-free biscuits. *Eur. Food Res. Technol* 5: 376-379.
- Akpanunam MA, Darbe JW (1994) Chemical composition and functional properties of blends of maize and bambara groundnut flours for cookie production. *Plant Food Human Nutrition* 46: 147-155.
- Okaka JC (1976) Functional and storage properties of cowpea-wheat flour blends in bread making. *J Food Sci Technol* 42: 822-833.
- Sosulski FW, Garratt MO, Slinkard AE (1976) Functional properties of ten legume flours. *Inst Food Science Technology Journal* 9: 66-69.
- AOAC (1990) Official methods of analysis (15th edn), Association of Official Analytical Chemists, Washington DC.
- Mc Watters KH (1978) Cookie baking properties of defatted peanut, soybean and field pea flours. *Cereal Chem* 55: 853-863.
- Yamazaki WT, Donelson JR, Kwolik WF (1977) Effects of flour composition on cookie diameter. *Cereal Chem* 54: 352-360.
- Sathe SK, Tamhane DV, Salunkhe DK (1981) Studies in saltine crackers. I. Composition and certain physico-chemical changes during baking. *Cereal Food World* 26: 404-406.
- Singh R, Singh G, Chauhan GS (1996) Effect of incorporation of defatted soy flour on quality of biscuits. *J of Food Sci Technol* 33: 355-357.
- Onweluzo JC, Iwezu EN (1998) Composition and characteristics of cassava-soybean and wheat-soybean biscuits. *J Food Sci Technol* 35: 128-131.