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Development and Compositional Analysis of Protein Enriched Soybean-Pea-Wheat Flour Blended Cookies

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ABSTRACT

Bakery products are made from different types of flours and those made by using composite flour have many fold advantages and they are considered as carriers of nutrition. Biscuits and cookies are most popular bakery products because of their convenience, ready to eat nature and long shelf life. In this study, different experiments were conducted to enhance the nutritional value of wheat based cookies. The cookies were prepared by using different concentrations of soybean, pea and wheat flour. Six different combinations of three flours used for making the cookies were, C_1 (95% wheat flour+5% soybean flour), C_2 (95% wheat flour+5% pea flour), C_3 (90% wheat flour+10% soybean flour) C_4 (95% wheat flour+10% pea flour), C_5 (85% wheat flour+15% soybean flour) and C_6 (95% wheat flour+15% pea flour). Among all the six combinations, C_1 showed good acceptance as per 9 point hedonic scale, while as, C_5 had highest protein and total dietary fiber. Additionally, the combinations of pea and wheat flour (C_4 and C_6) showed fewer acceptances as per 9 point hedonic scale. The higher nutritional value of the cookies prepared by combining more than one flour will have a positive health effect. From our results, it can be concluded that incorporation of different cereal (i.e., wheat flour, soya flour, pea flour) will enrich the nutritional value of the cookies.

Key words: Bakery products, cookies, dietary fiber, fortification, protein enrichment

INTRODUCTION

Bakery industry is one of the largest food industries all over the world. Biscuits and cookies are most popular bakery products because of their convenience, ready to eat nature and long shelf life. Bakery products are made from different types of flours and those made using composite flour have many fold advantages and they are looked upon as carriers of nutrition (Sindhuja *et al*., 2005). Increasing urbanization is a leading cause of changing the food habits of populations and preferences are often given to convenient foods like cookies, breads, biscuits and other baked products (Oyewole *et al*., 1996). Bakery products are becoming increasingly popular worldwide due to their unique taste and easy availability at a reasonable cost. For example, cookies have become the most popular and versatile snack foods and is widely being consumed to satisfy the occasional 'pangs' of hunger and are considered an integral part of the diet. Additionally, consumers have been looking for food ingredients that are more natural and healthy. Cookies are consumed extensively all over the world as a snack food and on a large scale in developing countries where protein and

caloric malnutrition are prevalent (Chinma and Gernah, 2007). The demand of bakery products is increasing at high rate globally. India is a developing country with the large segment of the population depending on wheat as staple foods and the 25% of the wheat is used for the preparation of the baked food (Kamaljit *et al*., 2010). Soft wheat is the grain of choice for making cookies. However, production of good quality soft wheat is very limited and unevenly distributed globally. Moreover, refined wheat flour is low in protein and is deficient in essential amino acids such as lysine and certain other useful food components like dietary fiber (Baljeet *et al*., 2014). Therefore, compositing wheat flour with the locally available grains other than wheat and root crops has been reported to be desirable (Oyarekua and Adeyeye, 2009). Most of bakery products are used as a source for incorporation of different nutritionally rich ingredients for their diversification (Hooda and Jood, 2005; Sudha *et al*., 2007). Soybean (*Glycine max*) a species of legumes widely grown for its edible bean which contain a significant amount of protein, phytic acid, alpha-linoleic acid and the isoflavone(genistein and daidzein). Soybean contains about 48-50% proteins and these are unique among plant proteins by virtue of their relatively high biological value and presence of essential amino acid lysine, which is found in limited amounts in most of the cereals (Riaz, 1999; Ahluwalia and Kaur, 2001). It is also reported that the amino acids composition of soy proteins meets or exceeds human requirements (Siddiqui *et al*., 2003). Pea flour is a good source of protein, dietary fiber, starch and iron. The role of dietary fiber in controlling chronic disorders like diverticulitis, bowel cancer, cardiovascular disease, diabetes, constipation etc has been well documented. Protein deficiency is a major dietary problem faced by the people worldwide, particularly the under developed and developing countries (Kamaljit *et al*., 2010). This approach not only promotes development of diversified and nutrient rich bakery products but also reduces over exploitation and excessive use of wheat for making bakery products. Thus, the objective of this study was to incorporate Soybean Flour (SF) and Pea Flour (PF) in to Wheat Flour (WF) to develop protein and dietary fiber enriched cookies and assess their quality characteristics.

MATERIALS AND METHODS

Procurement of raw material: The raw materials wheat flour (*Triticum aestivum*), soybean (*Glycine max*), pea (*Pisum sativum*) sugars, butter and palmolein oil were obtained from the local market of New Delhi (India). The grinding of soya beans and dried peas were done to a uniform particle size by using Lumix grinder. The ground material was sieved (using 60 mesh size sieve) to obtain uniform particle size and stored in airtight clean containers for further use. Wheat flours were also purchased from local market and sieved to mesh 60 to get uniform particle size, sealed and stored in air tight container for further use.

Preparation and treatment of cookies: Cookies were prepared with some modification according to the method given in AACC (2000). For the preparation of cookies different composition of wheat flour, soybean flour and pea flour were used as mentioned in Table 1.

Table 1: Different combination of wheat, soybean and pea flour used for preparation of cookies

Treatments	Wheat flour (%)	Soybean flour (%)	Pea flour (%)
Control	100	0	0
C_1	95	5	0
C_2	95	0	5
C_3	90	10	0
C_4	90	0	10
C_5	85	15	0
C_6	85	0	15

Flow chart of cookies:

Physiochemical studies

Sensory evaluation: Cookies were evaluated for overall acceptability (color, flavor, taste texture and overall acceptability) and was carried out as per 9 point Hedonic scale, by the help of ten semi trained judges.

Microbiological analysis: Microbiological quality (Total Plate Count (TPC), yeast and mold, coliform, *E. coli*, *S. aureus*, *B. cereus* and *Salmonella*) of the products were investigated by ISO (International Organization for Standardization) methods ISO: 4833-2003, ISO: 21527-(2)2008, ISO: 4832-2006, ISO: 16649-(1) 2001, ISO: 6888-(1) 1999, ISO: 7932-2004 and ISO: 6579-2004, respectively.

Proximate analysis: Moisture, ash and fat content were determined according to AOAC (2000) methods. Protein content was determined according to IS: 7219-1973 (Kjeldahl method) using factor 6.25, dietary fiber was determined by AOAC 985.29 and carbohydrate by difference method.

Peroxide value and acid value: To assess the development of rancidity in the finished product, peroxide value and acid value was determined as per the procedure mention in (IS: 548 (1)-1964) for 90 days at 30 days interval.

RESULTS AND DISCUSSION

Proximate analysis of raw material: Soya flour had highest protein, fat and ash content, while pea flour had highest percentage of Total Dietary Fiber (TDF) and moisture content, while wheat flour is having highest carbohydrate content as described in Table 2.

Sensory analysis: Figure 1 summarizes the results for the sensory evaluation and overall acceptability of the different cookies. The sensory evaluation was carried out as per 9 point Hedonic scale. The sensory attributes that were taken into consideration include color, taste, flavor, texture and overall acceptability. These values are the mean of ten readings. Among the 6 fortified cookies C_1 had the highest overall acceptability, compared to control. Sensory score for cookies C_1 and C_2 were comparable to the control. Overall acceptance scored highest in cookies with 5-10% pea and soya flours. The same results were obtained by Banureka and Mahendran (2009). While C_4 had good color and taste, while C_3 had good texture, but due to high content of pea flour, the flavor of C_4 was beany. That renders the overall acceptability.

Table 2: Proximate composition of raw material

	Ingredients		
Parameters	Wheat flour	Soya flour	Pea flour
Moisture (%)	10.52±0.12	6.29±0.09	14.69±0.17
Ash (%)	0.61±0.02	4.58±0.06	1.83±0.09
Fat (%)	0.93±0.34	19.94±0.22	1.27±0.26
Protein (%) (N*6.25)	10.04±0.19	38.09±0.32	18.35±0.23
Carbohydrate (%)	77.90±0.17	31.10±0.17	63.86±0.19
Total dietary fiber (%)	9.63±0.12	11.05±0.12	23.50±0.12

Values are given as Mean±Standard Deviation

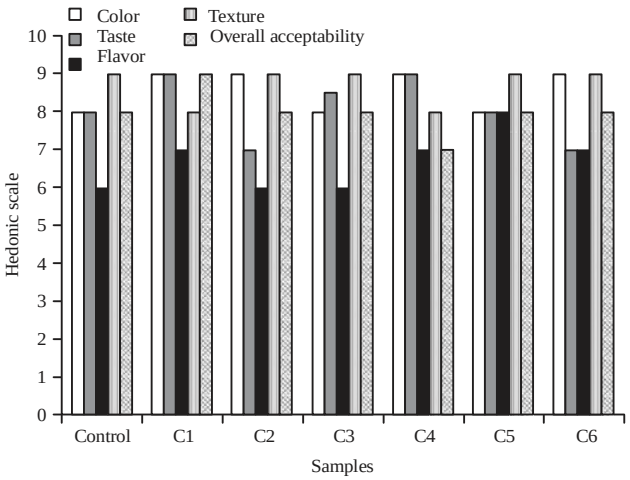

Fig. 1: Effect of treatment on sensory attributes of the cookies

Table 3: Microbiological analysis of control and treated sample

Parameters	Control	C_1	C_2	C_3	C_4	C_5	C_6
TPC (CFU g^{-1})	90±0.6	93±0.5	140±0.20	100±0.43	130±0.19	80±0.7	90±0.5
Yeast and mold (CFU g^{-1})	3.9±0.12	20±0.12	3.3±0.12	2.6±0.12	3.9±0.12	2.9±0.12	4.8±0.12
Coliform (CFU g^{-1})	2.6±0.12	3.2±0.12	3.4±0.12	2.7±0.12	3.7±0.12	1.7±0.12	3.4±0.12
E. coli (CFU g^{-1})	1.4±0.12	1.1±0.12	1.3±0.12	1.0±0.12	1.2±0.12	1.1±0.12	1.5±0.12
S. aureus (CFU g^{-1})	2.4±0.12	3.1±0.12	1.9±0.12	2.7±0.12	2.0±0.12	2.4±0.12	3.1±0.12
B. cereus (CFU g^{-1})	1.9±0.12	2.0±0.12	2.5±0.12	1.9±0.12	2.6±0.12	1.8±0.12	2.5±0.12
Salmonella/25 g	Absent	Absent	Absent	Absent	Absent	Absent	Absent

Values are given as Mean±Standard deviation, TPC: Total plate count

Table 4: Nutritional values of the cookies samples

Parameter	Control	C_1	C_2	C_3	C_4	C_5	C_6
Moisture (%)	5.11±0.12	5.52±0.12	5.91±0.12	5.60±0.12	5.97±0.12	5.71±0.12	6.05±0.12
Ash (%)	1.45±0.12	1.57±0.12	1.65±0.12	1.68±0.12	1.70±0.12	1.77±0.12	1.78±0.12
Fat (%)	28.99±0.12	32.06±0.12	31.15±0.12	32.70±0.12	31.55±0.12	33.49±0.12	32.09±0.12
Protein (%)	6.81±0.12	7.46±0.12	6.99±0.12	8.31±0.12	7.43±0.12	9.79±0.12	7.99±0.12
Carbohydrate (%)	57.64±0.12	53.39±0.12	54.30±0.12	51.70±0.12	53.35±0.12	49.24±0.12	52.09±0.12
Energy (kcal/100 g)	518.71±0.00	531.94±0.00	525.51±0.00	534.34±0.00	527.07±0.00	537.53±0.00	529.13±0.00
Total dietary fiber (%)	9.73±0.12	10.09±0.12	10.17±0.12	11.68±0.12	11.51±0.12	13.28±0.12	13.71±0.12

Values are given as Mean±Standard deviation

Microbiological studies: The results obtained from the microbial quality investigated are shown in Table 3. The results obtained for the TPC were low in all cookies. Among all sample C_2 had the highest TPC (140 CFU g^{-1}). Yeast and mold count were also negligible (<10 CFU g^{-1}) in all sample except C_1 had (20 CFU g^{-1}). Rest of the parameters (coliform, *E. coli*, *S. aureus*, *B. cereus*) were also investigated for all the sample and had microbial count less than 10 CFU g^{-1}, while *Salmonella* was absent in all of the sample. This eliminates the possibility of any contamination in different cookies samples, which is pointer to good production and handling practices. This could be also due dry nature of the cookies samples as reported by Ezeama (2007).

Nutritional analysis: Table 4 and Fig. 2 show that the results of the chemical composition of the enriched cookies. Cookies with increased soy fortification were found to be nutritionally superior (have higher protein, fat and dietary values) compared to the control sample. The moisture content of the treated samples were increased with the fortification of the control sample. High moisture

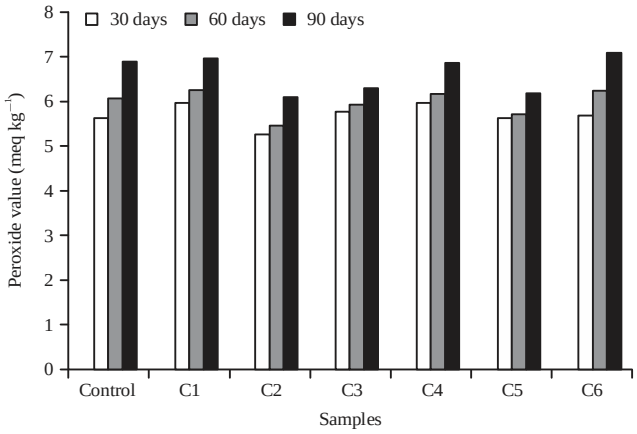

Fig. 2: Peroxide values v/s days

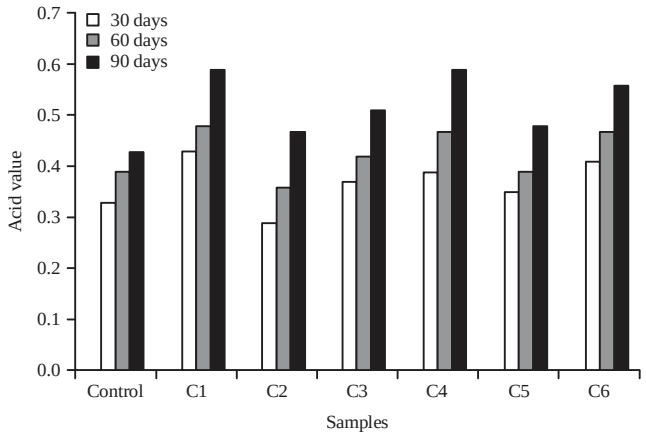

Fig. 3: Acid values v/s days

content has been associated with the short shelf life of the baked products, as they encourage microbial infiltration that lead to the spoilage (Ezeama, 2007; Akhtar *et al*., 2008; Elleuch *et al*., 2011). The ash content was also increased from 1.45-1.78% in the cookies produced from soy and pea flour substitution. Ash is an indication of mineral content of the foods and has been reported in several studies for the high content by supplementation with soy and pea flour. Increase in fat content in fortified cookies could be due to increased proportion of soya flour. This could be due to the fact that soya flour contained higher percentage of fat; Reddy (2004) reported that soy flour contained 20-24% of fat. The significant increase in protein content was due to the addition of soya flour and pea flour in the product because both are rich in proteins. One of the study conducted by Ugwuona (2009) found protein and fat content of biscuits increased with increasing soy fortifications. The incorporation of soya flour and pea flour in the cookies resulted in decrease in the carbohydrate content 51.09% as compared to the control 59.62% because both are rich in fiber. Energy value of these fortified cookies also increased.

Stability studies: Shelf life study for these cookies were carried out in which two parameters were selected and checked viz, peroxide value and acid value. The peroxide value and acid values were investigated after each 30 days till the 90 days. Figure 2 and 3 showed that, there were little

increase in peroxide value and acid value, because of the oxidation of oil. So, the cookies developed were stable and the further shelf life study is under process. These findings were in accordance with the study of Handa *et al*. (2012) (Fig. 2 and 3).

CONCLUSION

Based on these results and observations, it can be concluded that incorporation of different cereal (i.e., wheat flour, soya flour, pea flour) will enrich the nutritional value of the cookies. These types of baked products can go a long way in supplying the required quantities of dietary fiber and protein to various segments of our population and also the consumers demand on the nutritional importance of these fortified sugar free cookies would help enhance the acceptability of the product.

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