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, C1 (95% wheat flour+5% soybean flour), C2 (95% wheat flour+5% pea flour), C3 (90% wheat flour+10% soybean flour), C4 (95% wheat flour+10% pea flour), C5 (85% wheat flour+15% soybean flour) and C6 (95% wheat flour+15% pea flour). Among all the six combinations, C1 showed good acceptance as per 9 point hedonic scale, while as, C5 had highest protein and total dietary fiber. Additionally, the combinations of pea and wheat flour (C4 and C6) 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 rates 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) into 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.

| 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           |
Weighed all ingredients

Creaming of sweeteners (sucralose) and shortening for 10 min

Mix flour and other ingredients for 3 min in mixer

Kneading

Resting of dough for 30 min

Cutting of dough in small parts

Molded in desired shapes

Placed in greased trays

Baked in preheated oven (178°C for 25 min)

Cool cookies for 5-10 min

Take out from the tray and cool completely and pack

Cookies

Sensory analysis

Microbiological analysis

Nutritional analysis

Stability studies
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 C1 had the highest overall acceptability, compared to control. Sensory score for cookies C1 and C2 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 C4 had good color and taste, while C3 had good texture, but due to high content of pea flour, the flavor of C4 was beany. That renders the overall acceptability.

| 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
Asian J. Clin. Nutr., 7 (3): 76-83, 2015

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

Table 3: Microbiological analysis of control and treated sample

| Parameters            | Control | C1  | C2  | C3  | C4  | C5  | C6  |
|-----------------------|---------|-----|-----|-----|-----|-----|-----|
| 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 | C1  | C2  | C3  | C4  | C5  | C6  |
|----------------------|---------|-----|-----|-----|-----|-----|-----|
| 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 C2 had the highest TPC (140 CFU g⁻¹). Yeast and mold count were also negligible (<10 CFU g⁻¹) in all sample except C1 had (20 CFU g⁻¹). Rest of the parameters (coli form, 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
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.

REFERENCES

AACC., 2000. Approved Laboratory Methods. Americans Association of Cereal Chemists, Minnesota, USA.

AOAC., 2000. Association of Official Analytical Chemists of Official Methods of Analysis. 17th Edn., AOAC International, Washington, DC., USA., ISBN-13: 978-093558467-7.

Ahluwalia, P. and A. Kaur, 2001. Studies on use of isabgol (Psyllium mucilloid) husk in atta for chapati making. J. Food Sci. Technol., 38: 75-78.

Akhtar, S., F.M. Anjum, S.U. Rehman, M.A. Sheikh and K. Farzana, 2008. Effect of fortification on physico-chemical and microbiological stability of whole wheat flour. Food Chem., 110: 113-119.

Baljeet, S.Y., B.Y. Ritika and K. Reena, 2014. Effect of incorporation of carrot pomace powder and germinated chickpea flour on the quality characteristics of biscuits. Int. Food Res. J., 21: 217-222.

Banureka, V.D. and T. Mahendran, 2009. Formulation of wheat-soybean biscuits and their quality characteristics. Trop. Agric. Res. Extension, 12: 62-66.

Chinma, C.E. and D.I. Gernah, 2007. Physicochemical and sensory properties of cookies produced from cassava/soyabean/mango composite flours. J. Food Technol., 5: 256-260.

Elleuch, M., D. Bedigian, O. Roiseux, S. Besbes, C. Blecker and H. Attia, 2011. Dietary fibre and fibre-rich by-products of food processing: Characterisation, technological functionality and commercial applications: A review. Food Chem., 124: 411-421.

Ezeama, C.F., 2007. Food Microbiology: Fundamentals and Applications. Natural Prints Ltd., Lagos, Nigeria.

Handa, C., S. Goomer and A. Siddhu, 2012. Physicochemical properties and sensory evaluation of fructoligosaccharide enriched cookies. J. Food Sci. Technol., 49: 192-199.

Hooda, S. and S. Jood, 2005. Organoleptic and nutritional evaluation of wheat biscuits supplemented with untreated and treated fenugreek flour. Food Chem., 90: 427-435.

Kamaljit, K., S. Baljeet and K. Amarjeet, 2010. Preparation of bakery products by incorporating pea flour as a functional ingredient. Am. J. Food Technol., 5: 130-135.

Oyarekua, M.A. and E.I. Adeyeye, 2009. Comparative evaluation of the nutritional quality, functional properties and amino acid profile of co-fermented maize/cowpea and sorghum/cowpea Ogi as infant complementary food. Asian J. Clin. Nutr., 1: 31-39.

Oyewole, O.B., L.O. Sanni and M.A. Ogunjobi, 1996. Production of biscuits using cassava flour. Nig. Food J., 14: 24-29.
Reddy, S.R., 2004. Agronomy of Field Crops: Soy-Beans. Kalyani Publishers, Ludhiana, India, pp: 143-513.
Riaz, M.N., 1999. Soybean as functional food. Cereal Food World, 44: 88-92.
Siddiqui, N.R., Mehmood-ul-Hassan, S. Raza, T. Hameed and S. Khalil, 2003. Sensory and physical evaluation of biscuits supplemented with soy flour. Pak. J. Food Sci., 13: 45-48.
Sindhuja, A., M.L. Sudha and A. Rahim, 2005. Effect of incorporation of amaranth flour on the quality of cookies. Eur. Food Res. Technol., 221: 597-601.
Sudha, M.L., R. Vetrimali and K. Leelavathi, 2007. Influence of fibre from different cereals on the rheological characteristics of wheat flour dough and on biscuit quality. Food. Chem., 100: 1365-1370.
Ugwuona, F.U., 2009. Chemical and sensory evaluation of soy-fortified cassava-wheat biscuit. J. Trop. Agric. Food Environ. Exten., 8: 55-59.