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RESEARCH ARTICLE :

Development of low gluten cookies from pearl millet

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SUMMARY : Cookies/Biscuit is India's largest industry amongst food industries, with an estimated production of 70, 000 tonnes and cost of three thousand billions US Dollar. Biscuit along with bread forms major baked food accounting to over 30% and 50% respectively of total bakery products produced in the country. The present investigation was undertaken on the utilization of alternate flours sorghum (Sorghum vulgare)/pearl millet (*Pennisetum glaucum*) for the preparation of gluten free cookies as compared to conventional wheat (T*riticum aestivum*) flour cookies. The cookies with pearl millet and soy flour combination had higher fat, protein, ash and calorific values as compared to control cookies. The maximum sensory overall acceptability scores were found for cookies prepared from combination of pearl millet and soy flour followed by pearl millet and control cookies. Soy based cookies were developed by incorporation of millet (pearl millet) flour at 25, 50, 75 and 85% level for increasing protein content of cookie and utilization of millet. When millet flour was fortified with soy flour it gives high level of protein of 12.60% of cookie.Fat content increased from 19.12% for control cookies to 17.57 % for 100% incorporation mixed based cookies. The chief raw materials for production of these products are refined wheat flour, Table sugar, shortening, milk solids and leavening agents. The optimization of levels of ingredients shows optimum value of ingredients for cookies to be sugar 18g, fat 16g, baking powder, 0.3g, and water 12-13ml respectively.

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KEY WORDS :
Soyabean (*Glycine max*), Pearl millet (*Pennisetum glaucum),* Rich protein, Other nutrients, Low gluten cookie

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BACKGROUND AND OBJECTIVES

Cookies are most popular and widely consumed processed food in India and worldwide. The biscuit industry has been growing at an average rate of 15% during the past 3 years and thisis expected to be maintaining in coming years (IBMA, 2010). Cookies or Biscuit consumption per capita in India is 2.1 kg, compared to more than 10 kg in the USA, UK andWest European countries and above 4.25 kg in South-east Asian countries, e.g. Singapore, Hong Kong, Thailand, Indonesia, etc. China has per capita consumption of 1.90kg, while in the case of Japan it is estimatedat 7.5kg (Serivastava, 2009).They are high in carbohydrates, fat and calorie but low in fibre, vitamin, and mineral which make it unhealthy for daily use. Because of its acceptability in all age group, longer shelf

life, better taste. Soybean is an excellent source of protein contains 35-45% with all essential amino acids required for proper growth and maintenance of body. They are among the low cost processed food in the country when compared to Indian sweet meats, salted snacks items. Among these, bakery products cookies are very much preferred by children and adults.Study carried out by Shakuntale b. Masum, 2008 found that enrichment of defatted soya flour upto 20% improves the nutritional quality of bakery products like biscuit, bread muffins without affecting its taste, textural and overall acceptability of product. Cookies differ from other baked products like bread and cakes because of their low moisture content which ensures that they are free from microbial spoilage and confer a long shelf life of the product (Wade, 1988). Indian industrial scenario indicates that Bakery may be considered as the largest industry among other food industries in India with an annual turnover of Rs.7500 crores (Kamaliya and Subhash, 2003). The present growth rate of bakery industry is around 12% per annum. Bakery products are increasingly becoming popular in India as indicated by over 2.5 fold increase in their production during the last two decades (Puranik, 2003). Bakery industry is the one of the largest food industries in India with an annual turnover about Rs 3000 billion in the beginning of para 7500 crores. The per capita consumption of cookies in India is 2.1 kg, compared to more than 10 kg in the USA, UK and West European countries and above 4.25 kg in South-east Asian countries, e.g. Singapore, Hong Kong, Thailand, Indonesia, etc.

Pearl millet (*Pennisetum glaucum)*is an important coarse cerealcrop in western India (Gujarat, Rajasthan and Haryana). In 2011, 46%of pearl millet produced was used for food, 37.5% for cattle feed, 7.7% for poultry feed, 8.8% for alcohol industry and as low as 0.4% for seed purpose. Pearl milletis a food that supplies a major proportion of calories and protein to large segments of populations in the semi-arid tropical regions of Africa and Asia (O'Kennedy *et al.,* 2006). Millet is a gluten-free and low-cost cereal (approximately 40% lower than the price of corn), which is resistant to drought and nutrient-poor soils (Gomes *et al.,* 2008). In 2011, the global millet production was about 27.5 million tonnes (Food and Agriculture Organization, 2015). Countries in Africa and Asia produced 56% and 41% of the total world production, respectively (Shahidi and Chandrasekara, 2013). Millet is a superior cereal with regard to nutritional quality and presents several health benefits (Krishnan *et al.*, 2011).). Moreover, millet is a potent source of antioxidants, due to its phenolic content (Dykes and Rooney, 2006; Shahidi and Chandrasekara, 2013) and is a staple food substitute for celiac patients who require gluten-free cereal (Shahidi and Chandrasekara, 2013).

RESOURCES AND METHODS

Refined wheat flour, pearl millet flour, soya flour and various ingredients such as sodium bicarbonate, ammonium bicarbonate, vegetable oil, sugar, baking powder, vanilla essence, liquid glucose and salt were purchased from the local market. All the chemicals used in present investigation were of standard analytical grades from BDH (India), E-Merck Sarabhai, M. (Guaranteed) and glassware used in the present investigation was of Qualigens, Bombay and Borosil, respectively.

Preparation of blends :

RWF= Refined Wheat flour, PMF= Pearl Millet flour, SF= Soybean flour.

Table A : Different combination of wheat, pearl millet and soybean flours

Sr. No.	Treatments	Symbol
1.	100% RWF + 0% PMF + 0% SF	C_0
2.	65% RWF + 25% PMF + 10% SF	C_1
3.	45% RWF + 50% PMF + 5% SF	C_2
4.	20% RWF + 75% PMF + 5% SF	C_3
5.	10% RWF + 85% PMF + 5% SF	C_4

Preparation of low gluten cookies :

Sweet cookies from white flour (control) and blends (composite of, sugar, fat, baking powder and water) were prepared using the traditional creamery method as described by Whitley (1970). Following general formula has been used for product preparation. The required quantity of sugar, fat and flavour (vanilla) was creamed well. To this, well mixed blends of remaining ingredients were added along with a required amount of water. The contents were mixed further for 2 min. to make dough of desired consistency. Using a wooden rolling pin, dough was rolled into a sheet of uniform thickness of approximately 5mm. Then cookies were cut into round

shape pieces and placed on greased tray. The tray was kept in baking oven at 300^{0}C for 3-4 min.

Following ingredients were taken to make cookies per 100 g blend.

Ingredients quantity :

Wheat flour or blend	64 g
Sugar	18 g
Vegetable oil	16 g
Glucose	1 g
Ammonium bicarbonate	0.5 g
Common salt	0.4 g
Baking powder	0.3 g
Sodium bicarbonate	0.2 g
Vanilla	0.025 g
Water	10-12 ml

Sensory evaluation of low gluten cookies :

The sensory evaluation of cookies was done by panel of 10 judges as described by Amerine *et al.* (1967) on 9 point hedonic scale.

The ratings were given on the different sensory attributes like appearance, colour, taste, texture, flavour, and overall acceptability as per the hedonic rating mentioned below:

Like extremely- 9, Like Very much-8, Like Moderately-7, Like Slightly-6, Neither like nor Dislike-5, Dislike Slightly- 4, Dislike Moderately- 3, Dislike Very much -2, Dislike extremely-1.

Proximate composition of low gluten cookies

The proximate composition of cookies *viz.*, moisture, fat, protein, carbohydrate, crude, fiber, and ash content were determined in different products made from different ratio of wheat, pearl millet and soya flour. It was estimated by hydrolysis method as described in AOAC (1984).

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

Proximate composition of low gluten cookies :

The nutrient content of the pearl millet baked cookies is presented in Table 1. The pearl millet baked in cokies (C_2) had highest contents *viz.*, moisture (4.32%), protein (11.98%), fat (18.20%), carbohydrate (65.58%), ash (1.22%) and crude fibre (.30%) content than control. Highly significant difference was noted for moisture, carbohydrate**,** crude fibre, fat, ash and protein content at 5% level (P=0.05) in treatment.

Sensory attributes of low gluten cookies :

The acceptability of cookies were evaluated by their

Table 1 : Proximate composition of low gluten cookies

Treatments	Moisture (%)	Protein (%)	Fat (%)	Carbohydrate (%)	Ash (%)	Crude fibre (%)
C_0	4.25	11.04	17.57	65.20	0.81	0.19
C_1	4.30	12.60	19.12	62.18	1.25	0.55
C_2	4.32	11.98	18.20	65.58	1.22	0.30
C_3	4.34	11.75	18.00	64.46	1.23	0.20
C_4	4.30	11.74	17.80	64.75	1.21	0.22
S.E.±	0.043	0.012	0.029	0.024	0.012	0.019
C.D. (P=0.05)	0.136	0.038	0.092	0.076	0.039	0.026

Table 2 : Sensory evaluation of low gluten cookies

Treatments	Sensory attributes				
	Colour and appearance	Taste	Flavour	Texture	Overall acceptability
C_0 (Control)	8.25	8.20	7.40	7.35	7.80
C_1	8.50	8.60	8.55	8.50	8.54
C_2	8.80	8.85	8.70	8.75	8.78
C_3	7.70	7.80	7.50	8.20	7.80
C_4	7.14	7.60	7.30	7.81	7.46
S.E. ±	0.045	0.063	0.093	0.044	0.056
C.D. (P=0.05)	0.143	0.200	0.294	0.140	0.176

different sensory quality characteristics *viz.*, colour and appearance, taste, flavour, texture, and overall acceptability of the developed products on 9 point hedonic scale. The mean score values of different sensory characters have been tabulated in Table 2.

Utilization of low gluten cookies in food products is an area of current interest because of nutritional awareness of consumer and changing demographics. The nutritive value of foods particularly baked products like cookies can be improved by fortification. Cookies thus, made can be used effectively for feeding the diabetic and diseased peoples. Cookies can be easily fortified with low gluten and fat free substances to produce convenient food of high quality. This chapter deals with the justification of the findings obtained in the experiments. The results have been explained with the help of reported values of various parameters given by different researchers and they are discussed as under.

The overall acceptability was determined on the basis of quality scores obtained from the evaluation of color, flavor, and texture of the cookies. The mean regarding overall acceptability of cookies are shown in table 4 revealed that the overall acceptability of C_2 (45% wheat flour, 50% pearl millet and 5% soy flour) was highest score of 8.78 followed by other treatments. All the treatments showed significant relationship among themselves. The present findings can be supported by reported results of Shukla (1997) and Kamaliya and Subhash (2003). The chemical composition is highest of C_2 (45% wheat flour, 50% pearl millet and 5% soy flour) treatment followed by other treatments. The chemical composition of cookies is in conformity with the findings obtained by Sathe *et al*. (1981), France (1988), Semwal *et al*. (1996) and Swamy *et al*.(2003).

Conclusion :

On the basis of obtained results, gluten free flours combinations could be used to produce good quality cookies with acceptable sensory qualities. These cookies are advantageous for people suffering from gluten intolerance and low income groups. Pearl millet flour as a replacement for refined wheat flour in the preparation of cookies was effective in enhancing its nutritional and sensory attributes. Nutritive value of the cookies improved in terms of protein, ash and fibre. On the basis of overall acceptability of cookies from mixed flour were found to have higher overall quality compared to control.

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