NUTRITIONAL, PHYSICAL AND SENSORY EVALUATION OF COOKIES BASED ON BLENDS OF SOY AND PEARL MILLETS (BAJRA) FLOUR

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Abstract

Present consumer favours mixed grain bakery products like cookies, breads and biscuits. Several researches have been done to meet the consumer demand. In the present study, refined wheat flour was replaced by 25% and 50% incorporation of pearl millet flour and soy flour. Pear millets and soy flour are gluten-free in nature and have beneficial nutraceutical properties. According to previous studies it was found that pearl millets proves to be an excellent source of micronutrients such as zinc, iron. The proximate principle of pearl millets and soy flour were compared with that of refined wheat flour and thereafter, cookies were prepared using different proportions of pearl millets and soy flour and proximate, physical characteristics, sensory studies and microbial evaluation were done. Cookies prepared with 50% each of pearl millet and soy flour showed better overall acceptability. They had a better baked aroma, were crisp and highly palatable. They scored better in terms of nutritive value for carbohydrates, fat, proteins, calcium, iron and phosphorus (P<0.05). From all the sample study it was observed that gluten-free cookies were having higher nutritional value when compared with control sample of cookies. The results indicate that pearl millets and soy flour cookies were a better option with enhanced nutritional quality, physical characteristics and sensory attributes. This study leads to development of new product in the baking industry as cookies

1. INTRODUCTION

Today, people focus more on healthy nutrition. Baking is one method that utilizes less fat. Among baked products cookies are acceptable among all age groups, especially children. Cookies hold a significant place in baking industries due to its taste, texture and aroma. They have a good shelf life and the major ingredient used in preparation are refined wheat flour, starch and sugar. Refined wheat flour is gluten free but low in nutrient, and hence cookies prepared from refined wheat flour are low in protein and mineral content (McSweeney, 2016; Kaushik J. S, 2011). Therefore, there is a need to find better option to make cookies still a nutritional product.

Pearl Millets

Pearl millet is the most widely grown millet in semi-arid regions. In pearl millet the starch content of the grain varies from 62.8 to 70.5%, soluble sugar 1.2 to 2.6% and amylose 21.9 to 28.8% [Ed Gopalan, 2003]. In pearl millets insoluble dietary fiber is present and the α-amylase activity is 8 to 15 times greater in pearl millet than in wheat [Iren, 2004]. Pearl millets contains almost 9 to 13% protein, but to a large extent variation of 6 to 21% of protein content have also been observed (Saldivar, 2003). Bajra or pearl millets comprises of several essential micro nutrients that are needed by the body (Ed Gopalan and Deosthale. NIN, 2003).

The total mineral content in pearl millets is 2.3 mg/100g which is quite high as compared to other commonly consumed cereals. It is also rich in several other vitamins like B-vitamins, potassium, phosphorous, magnesium, iron, zinc, copper and manganese. (Adeola O, 1994) Though pearl millets are nutritious, they are under-utilized in several countries, due to lack of knowledge, non- availability, method to use

and how to consume. (Obilana A.B., 2004; Olatungi O., 1982).

Pearl millets contain good amount of iron, calcium, high fat and zinc; hence it is naturally comparable and superior to many of major cereals due to its high value of energy and protein. (Fasasi O.S., 2009; Anu S.S., 2006; Malik M., 2002).

Several researches for replacing wheat flour with pearl millets have been conducted. The researches show that 100% pearl millets cookies were graded low in sensory study. They had hard gray colored cookies (Badi S.M., 1975). Semi-refining of bajra or pearl millets leads to reduction in level of phytate and improved bio-accessibility of several minerals such as iron, calcium (Florence S.P., 2011). However, mixing pearl millet flour with some other flour can lead to better acceptability. By keeping this in mind, an attempt was made to find one millet or cereal flour to blend with pearl millets flour.

Soyabean

Soybean (Glycine max), a species of legume, a miracle bean, is an excellent health food and it contains 43.2% good quality protein but only some amount of saturated fat, 21% carbohydrates and quite plenty amount of minerals and vitamins (Gopalan C., 1999). However, most of the oilseeds contain 40–50% oil, whereas soybean contains about 18% of oil (American Soybean Association 2004). An early meta-analysis concluded that soy protein lowered LDL cholesterol by 12.9% (Anderson J.W., 1995). It is also apparent that the ethanol-acetone extract of soy flour produces changes in serum cholesterol, particularly in the LDL fraction (Balmir F1., 1996)

With all this background, the study was aimed to develop nutritional cookies using blends of pearl millets and soy flour.

2. MATERIALS AND METHODS

Ingredients: Pearl millets grains, refined wheat flour, soy flour were obtained from local market. Other ingredients like butter (amul butter), vanilla essence, skim milk powder and honey were procured from specific brand.

1. Cookies Formulation:

Pearl millet grains were roasted at 200ºC and whole flour was made by grinding. The flour was then sieved through a 44-mesh sieve to get semi- refined flour. Similarly, soybean was roasted and grinded and sieved to obtain soy flour.

The ingredients were used in specific proportion to make different samples of cookies. The samples were sheeted to 10mm thickness and cut in shape and baked for 20 minutes at 200º C in a pre-heated oven. (Nidhi Chopra, 2014) Then different samples were used for proximate composition, mineral content, physical characteristic, sensory and microbial analysis. Table 1 shows the formulation of different cookies.

Table 1. Formulation of different Cookies

Ingredient(gms)	C	T1	T2
Refined Wheat Flour	100	50	-
Pearl Millet Flour	-	25	50
Soy Flour	-	25	50
Fat	50	50	50
Honey	50	50	50
Vanilla Essence	2	2	2
Total	202	202	202

Procurement raw ingredients → Preparation of semi refined pearl millet and soy flour

Development of cookies

Sensory evaluation → 9 point Hedonic Scale

Physico-Chemical Analysis → Protein, Moisture, fat, ash, Cho, FE, Ca, P

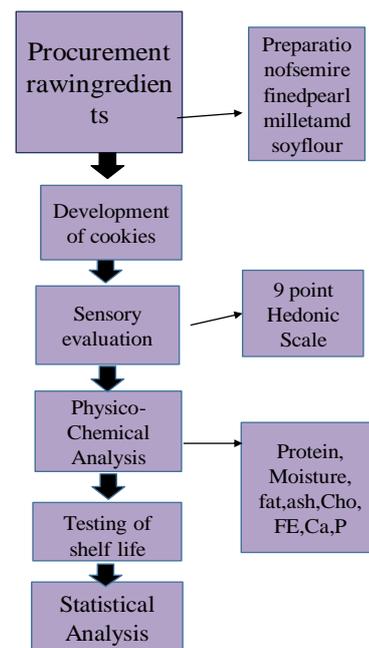Testing of shelf life

Statistical Analysis

Figure 1. Flow chart of the methodology used in study

1. Proximate analysis and mineral content: Protein (Kjeldahl method), Fat (Solvent Extraction), moisture, ash, iron, calcium and phosphorus were determined by standard method of AOAC 2000. (AOAC, 2000).

2. Physical characterization of samples: The physical parameters include weight, diameter (D), Thickness (T) and spread ratio (D/T). Diameter of samples was measured by placing six cookies edge to edge with the help of a scale rotating at 90° and again measuring the diameter of samples and then calculating mean value. Thickness was measured by placing six cookies on top of each other and taking mean thickness (cm). Spread ratio was calculated using the formula

Spread Ratio – Mean Diameter/Mean Thickness

3. Sensory Analysis:
A trained panel consisting of 25 members were used to conduct the sensory evaluation of the prepared sample, using 9-point hedonic scale. Sensory evaluation was conducted in a closed room with proper light and temperature maintained as 25°. Normal water was used as palate cleanser.

4. Microbial Analysis
Standard total plate count, score count, Coliform, yeast and mould count were performed on 0 and 30th day of storage period for all the samples.

5. Stastical Analysis:
ANOVA test and difference between mean were used to find the significant difference ($P<0.05$) using SPSS software (IBM). Sensory evaluation studies for each attribute such as color, texture, aroma etc. were depicted graphically.

3. RESULTS AND DISCUSSION

Proximate analysis
Native variety of pearl millets, grown in Gujarat and Rajasthan were used for the study. Basically, pearl millets is an winter crop, its seeds being grey in color, bold and round shaped without husk (Anon, 2010). This variety is commonly consumed by the rural masses of theses areas. It is considered to be highly nutritious and superior by local people. Soybean has good amount of proteins and contains beneficial bioactive compounds like mineral and fat-soluble vitamins. (Alabi, M. O., 2007). The comparison between proximate analysis of refined wheat flour, semi-refined pearl millet flour, refined soy flour is shown in table 2 Pearl millet flour scored high in comparison to other flour.

Table 2. Proximate analysis of different types of flours.

Parameter	Refined Wheat Flour	Pearl Millet Flour	Soy Flour
Moisture (%)	13.18 ± 0.01	11.21±0.23	3.7±0.02
Ash (%)	1.26 ± 0.02	2.05±0.02	9.7±0.02
Crude Fiber (%)	1.73 ± 0.02	2.07±0.01	10.2±0.11
Fat (%)	10.65 ± 0.01	5.14±0.15	15.2±0.01
Protein (%)	8.58 ± 0.02	10.97±0.08	42±0.02

All readings taken in triplicates at ($P<0.05$).

Table 3 shows proximate composition of cookies prepared from refined wheat flour (control) and two different samples (T1 and T2) respectively. Cookies with 50% Pearl millet flour (T2) had higher moisture content of 9.5 g compared to that of T1 cookies (10.8 g). (Archana, 2004) reported moisture content for pearl millet cookies was higher and ranged from 2.57-2.67%. Low moisture content may be attributed to the roasting of pearl millet prior to making of cookies. Cookies are low moisture baked products and high moisture results in a soggy and soft texture that decreases overall consumer acceptability (Chevallier, 2000). The fat content of the cookies ranged from 23 gm - 17 gm, lowest found in sample T2 with significant difference. The protein content of the cookies ranged from 7.87 gm-10.1 gm, with the highest recorded in sample T2 with 50% pearl millet and soy flour each. Pearl millets are known to have high good fat content in them. (Jain RK, 1997) Similarly replacing refined wheat flour with pearl millet and soy flour increased ash content from 0.48 to 5.4gms. The iron phosphorus and calcium levels of Sample T2 were higher in comparison to Control and sample T1 owing to the presence of more pearl millet flour.

Replacement of refined wheat flour with equal proportions of Pearl millet and soy flour in cookies significantly (p<0.05) increased the levels of iron, calcium and phosphorus from 2.7-5.83 mg, 18-42 mg and 121-310 mg respectively. (Bram P, 2008).

Table 3. Proximate Composition of all cookies

Composition	Refine Wheat Flour	T1	T2
Moisture (g)	$9.90^a \pm 0.29$	$10.8^b \pm 0.3$	$9.5^a \pm 0.8$
Proteins (g)	$7.87^a \pm 0.29$	$8.5^b \pm 0.7$	$10.1^c \pm 0.4$
Fat (g)	$23^a \pm 0.04a$	$19.4^b \pm 0.4$	$17.0^c \pm 0.1$
Ash (g)	$0.48^a \pm 0.02$	$1.3^b \pm 0.1$	$5.4^b \pm 0.2$
Carbohydrate*	74	75	75
Energy(K Cal)	348	374	382
Iron (mg)	$2.7^a \pm 0.5$	$4.06^b \pm 0.5$	$5.83^c \pm 0.5$
Calcium (mg)	$18^a \pm 2.0$	$38.6^b \pm 2.3$	$42.6^c \pm 6.0$
Phosphorus (mg)	$121^a \pm 10.0$	$270.0^b \pm 20.9$	$310.5^c \pm 6.9$

[ABC] *means on the same line without a common letter are significantly different at P < 0.05. (all samples at the same time).*

Physical Characteristics of Cookies

Presence of glutenin in flour influences the diameter of the cookies. However, in this study, gluten free, pearl millet cookies had a diameter of about 87mm (T1), 86.7 mm (T2) and were comparable with the diameter of control cookies (88 mm) (Table 4). There results were similar to sugar snap cookies prepared by adding gluten at various proportions (74-97 mm) (Adeola O, 1994).

Thickness of cookies with 25% and 50% incorporation of soy flour and pearl millet flour was similar to the control cookies ranging from 10.4-11.3 mm. Spread ratio is based on the values obtained for thickness and diameter of the cookies. The cookie spread ratio decreased with addition of pearl millet. The spread ratio of the control cookies (wheat flour) was 8.30 which decreased to 7.88 (T1) and 7.85 (T2). The cookies with equal proportion of pearl millet and soy flour had lighter and crisper texture compared to the control cookies. And cookies from 100% millet (gluten free) are generally not prepared as they are tough, hard, gritty and mealy in texture and taste. They also

lack spread and top surface cracks, which is a desirable attribute of cookies (Yousef MI, 2004). Similarly, in this study, cookies prepared from equal proportions of semi refined pearl millet and soy flour resulted in product that had crispy and crumby texture and were better acceptable by sensory panel members.

Table 4. Physical Characteristics of the cookies

Parameters	C	T1	T1
Diameter (mm)	88.0b	87.0a	86.7a
Thickness (mm)	10.4a	10.6a	11.3a
Spread ratio (D/T)	8.30b	7.88a	7.85a
Spread factor	83.0b	78.8a	78.2a

mean in the same row followed by different superscripts differ significantly ($p \leq 0.05$).

Sensory evaluation:

Results of many researchers conducted on use of gluten-free cereal indicate that millets can easily be used to replace refined wheat flour. Millets exerts a beneficial influence on the sensory and nutritional quality of cookies. In the present study, controlled sample made of refined wheat flour was off-white in color and crisp in texture. However, it lacked in aroma and that reduced its overall quality (8.1). On the other hand, cookies made with 25% and 50% in cooperation of pearl millet flour were better acceptable. They had good color, vanilla-like aroma, baked cereal aroma and sweet taste. These qualities improved the overall acceptability of T1 (8.4) and T2 (9.2) sample. The results indicate that pearl millet cookies were better acceptable compared to control Fig 2. Graphical representation of sensory analysis, Fig 3 Cookies prepared out of different proportions.

Increased overall acceptability of pearl millets recipe was also studied where, depigmentation of pearl millet was carried (Archana, 2004). However, in this study dark color of the pearl millet cookies did not affect the acceptability of the samples. Studies show that substitution of soy flour with wheat flour leads in preparation

of good quality of cookies. (Tasnim Farzana, 2015).

It was also studied that if soy products are consumed on regular basis, it leads to delays in ageing process and also improves physical and mental ability, level of hemoglobin, memory power. (American Soybean Association, 2004)
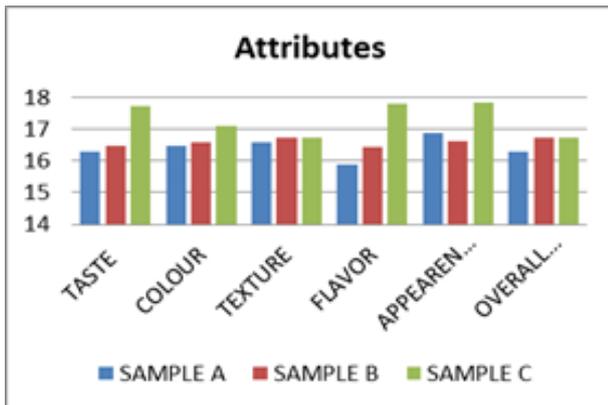

Fig 2. Graphical Representation of the sensory analysis of all three samples

Sample-1   *Sample-2*   *Sample-3*

Figure 3: Cookies prepared in different proportions

Microbial evaluation

No microbial growth (YMC and bacterial growth) was observed in any sample. This could be attributed to the fact that cookies were processed at high temperature at 200°C/20 min.

4. CONCLUSION

The main focus of this study was to develop nutritious cookies possessing several health benefits and bring a healthy option available for the consumers.

The cookies can be consumed by any individual whether they are diseased or healthy. These cookies are healthy and hence can be consumed by individual of any age group. This research was based on development of one such product that provides good nutritional and positive health effects on body. The main ingredients chosen for the development of

product were soy and bajra flour. Further the cookies were made in three different samples, in which one being the standard sample that was made only with wheat flour.

Sensory evaluation was done to check the overall acceptability by 50 panelists with the help of hedonic score card. This has several parameters like taste, appearance, color, texture and flavor. The results of the study demonstrate that the cookies made with blends of soy and bajra flour were acceptable more than the other two samples. They were also highest content of nutrients like energy, protein, iron, calcium, fiber etc. Pearl millets and Soy flour is proved to be a good replacement for refined flour in baking industries, in order to enhance nutritive quality. Nutritive values as calculated for all three samples, were best in cookies prepared with 50% each of bajra and soy flour. The absence of gluten in millet and soy flour did not affected the cookies quality much, and were almost similar to standard sample in appearance.

The T2 cookies were found to have higher overall acceptability as compared to other samples. The cookies had a long- lasting vanilla like smell combined with baked grain aroma.

Further crispy and crumby texture of cookies leads to enhance in sensory factors making it more palatable and acceptable. The studies show that both pearl millets and soy flour possess good potential to be used as cookies and also have high nutritive value as compared to other samples.

Pearl millet flour and soy flour as a replacement for refined wheat flour was effective in improving nutritional and sensory characteristics of the cookies. It can be concluded that mix grain cookies are better in comparison to 100% pearl millet cookies. Hence development and utilization of functional food is a step toward better nutrition. More studies should be conducted to investigate the possibility of use of pearl millet and soy flour as ingredients in other value-added food products.

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