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Optimization and Quality Evaluation of the Cookies Developed from Composite Dehulled Sesame Seed FlourBlend

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Abstract
Defatted sesame seed flour replaced millet flour at 30, 40, and 50% and was used to prepare biscuits. Protein content of the biscuits was significantly ($p \leq 0.05$) increased by replacement with sesame seed flour. Millet flour biscuits were heavier than those from the blends. Diameters and weights of biscuits were reduced and thicknesses and spread factors were increased with increasing level of sesame replacement. Sensory evaluation results showed that the biscuits were highly rated for flavour and crispiness but considered poor in colour.
Keywords: *Cookies, Dehulled Sesame Seed, Flour Blend*

1. Introduction

Cookies are ready to eat, convenient and inexpensive snack prepared from unpalatable dough which is transformed into easily digestible, light, porous appetizing product by application of heat. Consumption of cereal foods like biscuits and cookies are very popular especially among pre-school and school children. The principal ingredients are wheat flour, fat, sugar, water while optional ingredients are milk, salt, flavouring agent, aerating agent and other food additives. The quality of cookies or biscuits is governed by nature and quantity of ingredients used. Physical characteristics, organoleptic properties, and nutritional quality of cookies vary with different composite flour and percentage of additive used. Several authors have investigated on the effect of ingredients in dough and formula balance on structure of final product and also showed correlation between raw material characteristics and product quality *(Abboud et.al; 1999)*. Cookies vary in protein, fat, carbohydrate content which affects the final quality of the product.

Cookies are a rich source of fat, protein and carbohydrate; hence they provide energy and are also a good source of minerals *(Kure et. al; 1998).* Cookies can be served with soft drinks, tea or taken as snack between various meals. Composite flour can be used for preparation of cookies and can be described as a mixture of various flours obtained from root, tuber, cereals, legumes and oilseed with or without wheat flour.

World protein requirement is still a highlighted issue with concerns about protein malnutrition and food security. In developing countries like, India where protein intake is less than RDA, therefore development of high protein foods is important for malnourished population. There is constant need for cheaper and non-conventional sources of protein to improve traditional proteins by either substituting or replacing. Oilseed protein is one of the best alternatives. The protein content of the oilseed depends on variety and origin of seeds.

Sesame seed (Sesamum indicum L.) is known as "**Queen of oilseed crops"** due to its high yield of oil and good quality. The word "sesame" is derived from Latin word meaning Sesamum meaning seed or fruit of sesame plant.

Dehulled sesame seeds contain 19-31% of protein but no antitrypsin compounds *(Kinsella and Mohite 1985*). Cookies usually have low protein efficiency ratio however protein fortified cookies carry nutrients in concentrated form and complement to foods low in essential amino acids. High protein cookies can be prepared with soy flour, cottonseed, peanut etc. Sesame protein is low in lysine (2.7%) but it has a high level of methionine (3.2%) which is often deficient in plant proteins *(Johnson et al. 1979)*. The sesame seed protein can be used

effectively for fortification of traditional wheat protein for preparation of protein rich cookies. Enrichment of cereal-based foods with other protein sources such as oil seeds and legumes has received considerable importance because of amino acid composition.

Sesame seeds are rich in mono-unsaturated fatty acid, oleic acid, which comprises of up to 50% of fatty acids in them. Oleic acid helps in lowering LDL or "bad cholesterol" and increases HDL or "good cholesterol" in the blood. Also mono-unsaturated fats may help to prevent coronary artery disease, and stroke by favouring healthy serum lipid profile. They are valuable sources of dietary protein with fine quality amino acids which are essential for growth of children. Sesame seeds also contain many health benefiting compounds such as **sesamol** (3,4-methylene-dioxyphenol), sesaminol**,** furyl-methanthiol, guajacol, phenylethanthiol and furaneol, vinylguacol, and decadienal. Sesame seeds are rich sources of vitamin E, vitamin A, riboflavin and B-complex vitamins such as niacin, folic acid, thiamin (vitamin B1), pyridoxine (vitamin B6).

The objective of the study was to optimize the composite flour blend for the cookies and perform quality evaluation of the cookies and study the shelf life of the optimized cookie.

2. Materials and Methods

2.1 Procurement and preparation of ingredients

Refined wheat flour, sesame seeds, invert sugar syrup, refined oil, skimmed milk powder, maltodextrin, potassium sorbate and granulated sugar was procured from Soufflet Malt India Pvt Ltd., Alwar, Rajasthan. The flavours and baking powder was purchased from the local market of Alwar, Rajasthan.

Dehulling of seeds was done by soaking 200 grams of sesame seeds in 500 ml seeds were dried at 40^0C in hot air oven for 24 hours and powdered.

2.2. Formulation and evaluation of functional composite flour

Different combinations of refined wheat flour and sesame seed powder (SSP) were prepared as shown in Table no. 1 and were evaluated for various functional properties.

Various flour blends used in preparation of cookies

Table No. 1. Formulation of flour blends

Sample Code	Refined Wheat Flour (%)	Sesame Seed Powder (%)
Control	100	0
Sample A	90	10
Sample B	80	20
Sample C	70	30
Sample D	60	40

Following functional properties were analysed for all the various blends of the formulated flours:

Table No. 2. Methods for analysis of Functional properties of flour blends

Functional Property	**Refrence**
Sedimentation Value	Sediment shaker machine
Water absorption capacity	Sosulski et al.1976
Oil absorption capacity	Sosulski et al. 1976
Gluten Content	AACC Standard Method 38-10.01
Bulk density	Okaka and Potter 1977

Reference methods used for function properties determination

2.3 Preparation and evaluation of cookie dough

Cookie dough were prepared using formulated blends, fat, baking powder, invert sugar syrup, skimmed milk powder, granulated sugar.

Table No. 3. Recipe of cookie

Ingredient	**Amount (%) w/w**
Flour Blend	45
Sugar	30
Refined oil	13

Baking Powder	1.2
Water	5
Skimmed milk powder	0.8
Invert sugar solution	3
NI flavour TIL	0.3

The water was heated up to 40ºC and potassium sorbate was dissolved in it. The sugar was creamed with fat using electric beater at medium speed till light and fluffy. Flour along with all remaining ingredients was added to the creamed mixture along with flavour and water and mixed together to form dough. The dough was kneaded and allowed to rest for 15 minutes at 3-4^{0}C.After the resting period the dough was evaluated for weight, height, pH, moisture and acidity.

Table No. 4. Method of dough evaluation

Property	Method
Dough weight	Electronic weighing balance
Dough height	Centimetre scale
Dough Ph	pH meter
Dough Moisture	AACC Standard Method 38-10.01

2.4. Preparation and physical analysis of cookies

10 representative samples were analysed from each formulation prepared dough was rolled into uniform thickness of 0.8 mm and cut into circles of 4 cm diameter. The cookies were baked at 170^{0}C for 20 minutes Cookies diameter and thickness were determined using Vernier calliper, while cookies weight was determined using an electronic weighing balance. Spread ratio was calculated by the formula given by McWatters et al.; 2003. The density and volume of cookies were calculated on basis of weight, height and diameter. The colour of the cookie was assessed using a Hunter-Lab colorimeter (Optical Sensor, Hunter Associates Laboratory Inc., Reston VA, USA).

2.5. Optimization of cookie

The cookies were stored in properly sealed HDPE pouches for sensory evaluation carried out for optimization of the recipe. The cookies were optimized based on nine-point Hedonic scale was used with 1 = dislike extremely, 5 = neither like nor dislike, and 9 = like extremely (Ihekoronye and Ngoddy, 1985) twenty-four hours after preparation of the cookies.

2.6. Proximate analysis of cookie

Methods used for calculating proximate analysis is shown in the table below

Table No 5. Methods for Nutrient analysis of the cookies

Nutrient	Method	Refrences
Moisture	AOAC Method	AOAC (1984)
Protein	Kjeldhal Method	AOAC (1984)
Fat	Soxhlet Method	AOAC (1984)
Ash	AOAC 923.03	AOAC (1995)
Crude Fibre	AOAC Method	AOAC (1984)
Carbohydrate	Substitution Method	Osborne & Voogt (1978)
Energy	Atwater Method	Yusuf H (1981)

Methods and references used for nutrient analysis

2.7. Shelf life studies

Shelf life studies were carried out for the optimized recipe stored in properly sealed HDPE laminate pouches. The cookies were evaluated for total of 21days. For the first 7 days it was evaluated on daily basis, for remaining 14 days it was evaluated alternatively by the panel members on 9 point hedonic scale were instructed to evaluate appearance, colour, taste, texture, flavour, crispness, and general acceptability of the cookies.Breakage percentage and chipping percentage of various blended cookies were examined manually by taking 10 cookies and counting the number of broken and chipped cookies.

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2.8. Statistical Analysis

All measurements were made in triplicate for each sample. Statistical analysis was carried out using statistical tool IBM SPSS Statistics version 20 and significance was accepted at $p \leq 0.05$. A one-way analysis of variance (ANOVA) and test Duncan ($p = 0.05$) was used to establish the significance of differences among the mean values, the results were expressed as mean and standard deviation.

3. Results and Discussion

3.1 Analyses of functional properties of blends

Functional properties of control and the various proportions of flour blends used for preparation of cookies are tabulated in Table No. 6.

TableNo.6. Functional properties of various blends used for cookie preparations

Parameter / Blends	Sedimentation Value (Sv)	Water absorption capacity (%)	Oil absorption capacity (%)	Wet Gluten (%)	Dry Gluten (%)	Bulk density (g/ml)
Control	30.27±0.512[a]	144±2.097[a]	146±1.414[a]	30.27±0.51[a]	9.34±0.35[a]	0.733±0.005[a]
Sample A	39.28±0.893[b]	149.44±1.87[b]	150.3±0.48[b]	29.28±0.89[b]	8.44±0.31[b]	0.76±0.007[b]
Sample B	27.27±0.232[c]	152.54±2.54[c]	153.70±0.483[c]	27.27±0.23[c]	7.90±0.0.69[c]	0.79±0.006
Sample C	26.30±0.221[d]	163±1.636[d]	157.40±0.69[d]	26.30±0.22[d]	7.57±0.206[d]	0.83±0.007[d]
Sample D	24.89±0.895[e]	172.90±2.07[e]	162.30±0.48[e]	24.89±0.89[e]	7.24±0.77[e]	0.87±0.006[e]

All values are means ± standard deviation (SD)
Columns are significant at ($p \leq 0.05$)z

3.2. Evaluation of dough properties

Table 7. Evaluation of dough properties

Parameter / Blends	Dough weight(gm)	Dough height(cm)	pH	Moisture (%)
Control	160.43±0.208[a]	6.77±0.060[a]	8.02±0.01[a]	10.03±0.158[a]
Sample A	163.08±0.020[b]	6.46±0.089[b]	8.83±0.015[b]	10.43±0.228[b]
Sample B	165.56±0.439[c]	6.46±0.089[c]	8.88±0.008[c]	10.81±0.022[c]
Sample C	167.20±0.161[d]	6.20±0.070[d]	8.91±0.008[d]	11.13±0.038[d]
Sample D	168.57±0.443[e]	5.90±0.122[e]	9.1±0.455[e]	11.44±0.082[e]

All values are means ± standard deviation (SD)
Columns are significant at ($p \leq 0.05$)

3.3. Physical analysis of the developed cookies

Table No.8.Physical parameters of developed cookies

Parameter / Cookies	Weight(gm)	Diameter(cm)	Thickness(mm)	Spread ratio	Density(g/cm³)
Control	6.90±0.005[a]	4.4±0.00[a]	2.1[a]	1[a]	0.208±0.004[a]
Sample A	7.78±0.020[b]	4.6±0.00[b]	1.95±0.005[b]	2.3±0.20[b]	0.211±0.003[b]
Sample B	8.25±0.044[c]	4.77±0.044[c]	1.91±0.005[c]	2.5±0.018[c]	0.190±0.001[c]
Sample C	8.92±0.015[d]	4.83±0.016[d]	1.80±0.004[d]	2.67±0.289[d]	0.184±0.005[d]
Sample D	9.45±0.034[e]	5.2±0.051[e]	1.7[e]	3.1±0.005[e]	0.181±0.007[e]

All values are means ± standard deviation (SD)
Columns are significant at ($p \leq 0.05$)

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3.4 Cookies Colour

Table9.Color analysis of control cookie and optimized cookies

Parameter / Values	Control	Sample A	Sample B	Sample C	Sample D
L*	55.07±0.015[a]	54.87±0.026[b]	54.10±0.152[c]	52.17±0.017[d]	50.92±0.014[e]
a*	5.11±0.011[a]	6.03±0.031[b]	6.93±0.032[c]	7.72±0.11[d]	8.5±0.7[e]
B*	21.44±0.035[a]	20.61±0.052[b]	21.06±0.03[c]	25.03±0.11[d]	25.13±0.153[e]

All values are means ± standard deviation (SD)
Columns are significant at ($p \leq 0.05$)

3.5. Sensory analysis of all the prepared cookies

Table10.Sensory analysis of all the prepared cookies

Samples / Parameter	Sample A	Sample B	Sample C	Sample D
Colour	7	7	7	8
Flavour	6	7	7	8
Texture	7	7	7	8
Crispness	5	6	7	8
Taste	6	7	7	8
Overall Acceptability	6	7	7	8

3.6. Proximate analysis of the optimized cookies

Table11.Proximate analysis of the optimized cookies

Parameter / Sample	Moisture (%)	Protein (%)	Ash (%)	Fat (%)	Fibre (%)	Carbohydrate (%)
Control Sample	6.54±0.05[a]	8.2±0.02[a]	0.29±0.017[a]	14.57±0.05[a]	0.41±0.01[a]	65.94±0.083[a]
Sample D	4.93±0.05[b]	16.8±0.03[b]	3.01±0.015[b]	24.15±0.06[b]	1.09±0.03[b]	47.93±0.095[b]

All values are means ± standard deviation (SD)
Columns are significant at ($p \leq 0.05$)

3.7 Energy

Table 12. Energy calculation of cookies

Sample	Energy(Kcal)
Control	422.69
Sample D	479.42

3.8. Shelf life studies
Table13.Shelf life studies

Day	Colour	Texture	Flavour	Crispness	Taste	Overall Acceptability	Chipping (%)	Breakage (%)
1	8	8	8	8	8	8	0	0
2	8	8	8	8	8	8	0	0
3	8	8	8	8	8	8	0	0
4	8	8	8	8	8	8	0	0
5	8	8	8	8	8	8	1	0
6	8	8	8	8	8	8	0	0
7	8	8	8	8	8	8	1	1
9	7	7	7	7	7	7	1	0
11	7	7	7	7	7	7	0	0
13	7	7	7	6	6	6	1	1
15	7	7	6	6	6	6	0	0
17	6	6	6	6	6	6	0	2
19	6	6	6	6	6	6	0	0
25	6	6	6	6	6	6	0	1
30	6	6	6	6	6	6	1	2

From the above given results, the table shows that for the first seven days the cookies had no significant changes in taste (8), colour (8), texture (8), Flavour (8), crispness (8) and overall acceptability (8). On 5^{th} day tit was observed that out of 5 cookies 1 was broken and on 7^{th} day 1 was broken and 1 chipped. Significant changes can be observed in terms of flavour (6), taste (6), Colour (6) texture (6) and overall acceptability (6) from 9^{th} day onwards till 30^{th} day. Breakage and chipping percentage varied between 0% to 1%. The sensory values of the shelf life studies reveal that the product is acceptable for 30 days as there is no significant difference seen in the sensory scores.

4. Summary and Conclusion

The sesame seeds were procured from the company‟s inventory and dehulled by soaking water for 45 minutes and by rubbing with hand. The dehulled seeds were dried at 40^0C in hot air oven for 24 hours and powdered. Five cookies samples were analysed for their functional properties of flour blends, their dough characteristics and physical analysis. Cookie made with 100% wheat flour was used as control. Cookies were optimized based on 9 point hedonic scale for father proximate analysis and shelf life studies.

The results obtained after evaluation of functional properties of flour blends, dough characteristics, physical and sensory evaluation of cookies, proximate and shelf life studies of the optimized cookies are as follows.

1. The sedimentation value (Sv) of flour blends has decreased from 30.27 Sv to 24.89 Sv.The minimum sedimentation value was found in sample D (24 Sv) and maximum in control (30.27Sv).There was significant difference observed in sedimentation value of the all the blends used.

2. The WAC was observed to be maximum in sample D (172%) followed by sample C (163%), sample B (152%), sample A (149%) and control (144%).

3. The OAC of sample D (162%) was found to be highest and lowest in sample A (146%), indicating that OAC varied with substitution.

4. In the present study we can see that the gluten content both wet and dry is reducing as the amount of sesame seed powder is increasing, sample D had 24.89 % on wet basis and 7.24% on dry basis which is significantly lower than the Control (100 % RWF) with 30.27 on wet basis and 9.33 % on dry.

5. The highest bulk density was observed for sample D (0.87 g/mL) and lowest for control (0.733 g/mL).

6. The dough weight was compared for all the 5 samples including the control. It was

observed that the dough weight increased as the substitution with sesame seed powder increased. The dough weight of sample D (168.57gm) was the highest

7. The dough of control sample (6.77 cm) had the highest height while dough of sample D had lowest height (5.9). There was no significant difference observed in dough‟s of sample A (6.46) and sample B (6.46).

8. pH of the dough of different samples were only slightly different varying between 8.83-9.1but significantly different from the control sample (8.02). The difference may be attributed to SSP substitution and mixing of the ingredients.

9. In terms of cookie weight, Sample D (9.45g) cookies were heavier than sample C(8.92g), sample B(8.25g), sample A(7.78g).

10. In terms of cookie diameter, The diameter of sample D was 5.2 mm while the control sample had lowest diameter of 4.2mm. The significant difference in the diameter may be due to level of substitution with SSP increasing the fat content in the cookies.

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