

## Formulation and Nutritional Evaluation of Gluten Free Cookies Incorporated with Sunflower Seed Flour

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(Received: February 5, 2023; Accepted: March 14, 2023)

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### ABSTRACT

This gluten-sensitive population with HLA-DQ2/8 genotype has immunological reaction to the gluten protein present in wheat, rye or triticale posing symptomatic damage to the villies of small intestine. The present study was carried out with the objective of production of gluten free cookies by substituting wheat flour with sunflower seed flour and brown rice flour along with peanut butter and jaggery. The produced cookies were evaluated for chemical and sensory characteristics. The results indicated that cookies made through brown rice flour and sunflower seed flour can be consumed safely by celiac patient. The cookies made from 30% sunflower seed flour and 35% brown rice flour had non- significant difference with the control cookies. The total plate count method and sensory characteristics showed that the developed cookies can be stored for 30 days successfully without significant deterioration in organoleptic characteristics. The cookies containing brown rice flour and sunflower seeds flour were considered best for providing sufficient amount of nutrition to children as well as to adults for celiac disease.

**Key words:** Brown rice flour, sunflower seeds flour, nutritional analysis, sensory characteristics, composite flour

### INTRODUCTION

To prevent celiac disease, consumer preferences are shifting from wheat-based products and toward whole-grain or gluten-free diets. Celiac disease is an autoimmune disorder in which the immune system reacts to gluten in an inappropriate way. It is caused by a reaction to gliadin, a protein (gluten protein) present in wheat. Gluten-free products have now become popular as people are more aware of celiac disease (Rai *et al.*, 2014).

Brown rice flour is full of nutrients that are beneficial for health. Brown rice flour consumption lowers the incidence of diabetes (type 2), heart disease and cancer, and these beneficial health effects are connected to bioactive substances found in bran rice grain such as antioxidants, polyphenols, minerals, vitamins and dietary fibre (Belorio *et al.*, 2019). Sunflower seeds (*Helianthus annuus* L.) are whole sunflower grains and one of the world's three most extensively cultivated oil plants. Sunflower seeds are high in critical amino

acids (lysine, methionine, cystine and tryptophan), minerals, proteins, vitamin B and antioxidants enhancing the product's appeal as a human food (Grasso *et al.*, 2019). The health benefits of sunflowers include blood pressure and diabetes control, skin protection, cholesterol reduction, and other activities. Sunflower contains minerals and phytochemicals like dietary fibre, manganese, vitamins, tocopherols, phytosterols, triterpene glycosides and alpha-tocopherol. Sunflower extracts are a source of antibacterial, anti-inflammatory, anticancer, and antioxidant substances (Adelek and Babalola, 2020). Jaggery derived from sugarcane is an unrefined traditional sugar and considered as a healthy sugar and is popular for its therapeutic effects due to its mineral richness and vitamins found in sugarcane juice. Magnesium-like minerals found in jaggery aid to enhance the human neurological system, relax body muscles, relieve weariness and protect blood vessels. It also functions as an antioxidant having the ability to remove free

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radicals from the body. Jaggery includes potassium and a small quantity of sodium and iron (Deotale *et al.*, 2019).

Baked goods are becoming more popular as a result of their accessibility, suitability for snacks and shelf-life. Cookies are the most popular baked products with low moisture content and having a long shelf life making them a useful source of energy for children, teenagers and adults. Because of their taste, flavour and ease of digestion, cookies play a vital part in the snacking.

## MATERIALS AND METHODS

The present study was conducted to develop gluten free cookies mixed with sunflower seed and brown rice flour and to analyze their nutritional quality. The study was conducted at the Nutrition and Dietetics Research Laboratory, Faculty of Allied Health Sciences, SGT University, Gurugram, Haryana.

The experiment consisted of four treatments:  $T_0$  (control) made by 100% wheat flour,  $T_1$  45% brown rice flour and 20% sunflower seed flour,  $T_2$  40% brown rice flour and 25% sunflower seed flour and  $T_3$  35% brown rice flour and 30% sunflower seed flour. 15% peanut butter and 15% jaggery powder were common in all treatments.

Cookie dough was prepared from wheat flour (control) and gluten free from the combination of brown rice flour and sunflower seed flour (experimental samples) along with jaggery powder and peanut butter. All the ingredients in standardized amount were mixed to form dough. Dough was divided into 15 g portions and shaped into small round balls and placed and flattened in greased cookie sheets. Sesame seeds were sprinkled on the top of cookies and baked in pre-heated oven to 350 °F for 20 min.

The samples of developed gluten free cookies prepared with different levels of sunflower seed flour and brown rice flour were evaluated for their sensory attributes three times by a panel of 15 members from Department of Nutrition and Dietetics, SGT University, Gurugram. The panellists were served the developed gluten free cookies with one control and different test samples. Control sample ( $T_0$ ) was prepared from ingredients used in the standardized recipe and test samples were prepared by using different levels of sunflower seed flour and



Fig. 1. Control cookie ( $T_0$ ) and gluten free cookies with different ratio of brown rice flour and sunflower seed flour ( $T_1$ ,  $T_2$  and  $T_3$ ).

brown rice flour. The samples were coded to avoid any bias. The panellists were requested to score the gluten free cookies for five sensory attributes i.e. appearance, colour, texture, taste and flavour and overall acceptability by using a score card. The acceptability of the formulated products was analyzed by using nine-point Hedonic scale. The final score for each attribute for each product was obtained by averaging the score of all the 15 panellists. In the present study, determination of various proximate nutrients (energy, protein, carbohydrate, total fat and sugar) of gluten free cookies was carried out by Equinox Center, R 65, TTC Rabale, Navi Mumbai.

Total energy content was determined by SOP - CHM - 29- 00 Formula.

The carbohydrate content was determined by SOP - CHM - 28-00 Formula.

The protein content was determined by FSSAI Manual - 3(8.7) 2016 Formula.

The total fat content was determined by FSSAI Manual - 3(14.5) 2016 Formula.

The sugar content was determined by FSSAI Manual - 5 (2.6) 2016 Formula.

The most acceptable formulated cookies and control cookies were stored in a polythene zipper bag (food grade, LD-PE, thickness 0.11 mm) at room temperature and stored for 30 days. The cookies were analyzed for sensory attributes (appearance, colour, texture, taste and flavour and overall acceptability) and viable count with total plate count method after 15 and 30 days of the product formulation. The sensory characteristics were again evaluated using 9-point Hedonic scale by panellists from the Department of Nutrition and Dietetics, FAHS, SGT University, Gurugram.

The data were collected and presented in the

results as mean and standard deviation. Two-way analysis of variance test by SPSS software was used for calculating the difference between the variable and t test was used for comparison between samples.

## RESULTS AND DISCUSSION

Among all formulated gluten free cookies, the data indicated that the  $T_3$  sample containing 35% brown rice flour and 30% sunflower seed flour had the highest overall acceptability 8.26 followed by sample  $T_0$  which contained 100% wheat flour;  $T_2$  containing 40% brown rice flour and 25% sunflower seed flour and  $T_1$  which contained 45% brown rice flour and 20% sunflower seed flour recording 8.00, 6.66 and 6.53, respectively (Table 1 and Fig. 1). 15% jaggery powder and 15% peanut butter were common in all four samples. It was concluded from t-test that there was no significant difference between  $T_0$  and  $T_3$  on the basis of appearance, colour, texture, overall acceptability and significant difference in taste and flavour. Panellists' recorded crunchy taste and nutty flavour which made it more palatable due to substitution of normal butter with peanut butter and sugar with jaggery powder. Thus, sample  $T_3$  was most preferred one.

The proximate composition was carried out between  $T_0$  (wheat flour) and  $T_3$  (30% sunflower seed flour and 35% brown rice flour) which was preferred the most out of the three formulated samples ( $T_1, T_2$  and  $T_3$ ). The average energy (kcal) content  $T_3$  (470.12±1.00 kcal/100 g) was higher than  $T_0$  (410.65±1.02 kcal/100 g). As the incorporation of sunflower seed flour improved the nutrient profile and the presence of unsaturated fat provided more than 20% of energy of the product (Table 2). The average carbohydrate content in  $T_0$  (66.22±0.90) was higher than  $T_3$  (51.51±1.02) as the incorporation of sunflower seed flour decreased the carbohydrate (Grasso *et al.*, 2019). The

**Table 2.** Nutrients composition of developed gluten free cookies

Nutrients/Treatments	$T_0$	$T_3$
Energy	410.65±1.02	470.12±1.00
Carbohydrates	66.22±0.90	51.51±1.02
Protein	11.28±0.94	13.24±0.91
Total fat	10.52±1.04	23.33±1.00
Sugar	9.37±0.60	9.25±0.45

average protein content in  $T_3$  (13.24±0.91) was higher than  $T_0$  (11.28±0.94). The addition of sunflower seed flour led to significant increment in protein content of the cookies. The sunflower seed protein was rich in essential amino acid like lysine, valine and improved the *in vitro* protein digestibility. Similar results were reported by Man *et al.* (2017). The average total fat content in  $T_3$  (23.33±1.00) was higher than  $T_0$  (10.52±1.04) as the addition of sunflower seed flour increased the total fat content. This increment was beneficial for human health because almost 90% of the sunflower seed fat was unsaturated fat (Man *et al.*, 2017). The average sugar content in  $T_0$  (9.37±0.60) was higher than  $T_3$  (9.25±0.45). As the incorporation of sunflower seed flour reduced the sugar level reducing the risk of type 2 diabetes. It helped masses in better control of blood sugar levels maintaining their health (Cheenam and Leena, 2016).

The control (100% wheat flour cookies) and formulated gluten free cookies (35% brown rice flour and 30% sunflower seed flour) were stored successfully for 30 days without significant difference in organoleptic characteristics (Table 3).

The total plate count of control wheat flour cookies varied from 3.03 to 3.45 log cfu/g from day 15 to day 30 (Table 4). The total plate count of  $T_3$  cookies ranged from 3.13 to 3.55 log cfu/g from day 15 to day 30. Various researchers found similar results for shelf life of value-added baked products. The shelf-life study on

**Table 1.** Sensory characteristics of gluten free cookies with different levels of brown rice flour and sunflower seed flour

Sample code	Sensory attributes				
	Appearance	Colour	Texture	Taste and flavour	Overall acceptability
$T_0$	7.26±0.70	7.33±0.89	7.2±0.67	7.20±0.67	8.00±0.65
$T_1$	6.73±0.79	6.80±0.77	6.13±0.51	7.00±0.84	6.53±0.63
$T_2$	6.26±0.71	6.73±0.79	6.60±0.91	6.73±0.79	6.66±0.61
$T_3$	7.40±0.73	7.20±0.67	7.33±0.86	7.80±0.94	8.26±0.70

**Table 3.** Sensory characteristics of developed cookies during storage

Level of incorporation	Storage (days)		
	15	30	C. D. (P≤0.05)
<b>Appearance</b>			
Control	7.11±0.55	7.06±0.63	0.46
T <sub>3</sub>	6.64±0.49	6.42±0.52	0.66
<b>Colour</b>			
Control	7.20±0.71	7.08±0.69	0.48
T <sub>3</sub>	6.76±0.61	6.71±0.63	0.62
<b>Texture</b>			
Control	7.11±0.67	7.08±0.70	0.47
T <sub>3</sub>	6.93±0.84	6.88±0.86	0.62
<b>Taste and flavour</b>			
Control	7.02±0.67	6.96±0.79	0.64
T <sub>3</sub>	6.93±0.84	6.88±0.79	0.71
<b>Overall acceptability</b>			
Control	7.94±0.65	7.88±0.63	0.38
T <sub>3</sub>	6.50±0.53	6.42±0.61	0.51

**Table 4.** Total plate count (log cfu/g) of developed cookies during storage

Level of incorporation	Storage (days)		
	15	30	C. D. (P≤0.05)
Control	3.03±0.13	3.45±0.15	0.19
T <sub>3</sub>	3.13±0.16	3.55±0.08	0.08

pineapple powder incorporated wheat flour biscuits reported to have the shelf-life of six weeks at the ambient conditions of average temperature at 30°C and 75-80% RH by Thivani *et al.* (2016). Duta *et al.* (2019) reported 3-month storage period of gluten free oat biscuits in different packaging materials.

## CONCLUSION

The different levels of brown rice flour and sunflower seed flour had a significant impact on organoleptic and nutritional properties of gluten free cookies. Brown rice flour and sunflower seed flour have a great importance in human nutrition with good amount of nutrients. The incorporation of sunflower seed flour increases the nutritional value of the cookies. The developed gluten free cookies with these flours, jaggery powder and peanuts butter were found to be good in energy, protein, carbs, total fat and sugar. Among the different combinations of test treatment used, treatment T<sub>3</sub> having 35% brown rice flour and 30% sunflower seed flour was best in terms of appearance, colour, texture, taste, flavour and overall acceptability. The shelf analysis study done on the formulated cookies proved that

this product could be stored up to 30 days without deterioration of organoleptic characteristics and microbial load. Thus, the gluten free cookies which have high content of energy, protein, carbs and fats can be preferred as a potential health cookie to enhance the nutritive quality of the diet for children, adolescents and people of old age and other population without compromising on the sensory attributes.

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