Egyptian Journal of Nutrition
Official journal of the Egyptian Nutrition Society
Print ISSN: 1687-1235
Online ISSN: 2090-2514
Vol. 40 (1): 24 –47 (2025)
DOI 10.21608/enj.2025.417742
https://ejn.journals.ekb.eg/

Development of Nutritious Gluten-Free and Sugar-Free Cookies Enriched with Natural Sweeteners for Children

Azza S. Abdel-Ghany

Food Science Department (Rural Home Economics), Faculty of Agriculture, Zagazig University, Zagazig, Egypt.

ABSTRACT

A gluten-free diet is necessary for people with celiac disease. So, this study aimed to develop nutritious, gluten-free cookies without refined sugar for children by combining rice, oat, and peanut flours with natural sweeteners such as honey, treacle, dates, raisins, and sweet potato. The developed cookies were evaluated for their chemical composition, mineral content, physical properties, texture, color, and sensory attributes. Results demonstrated that blending rice flour with oat and peanut flours significantly increased protein (10.43-10.97%) and fat content (22.24-22.91%) compared to the control cookies (100% rice flour). The inclusion of oat and peanut flours also improved fiber content (up to 2.86%) and raised energy values to 475.94 Kcal/100g. Treacle and sweet potato-based cookies showed elevated iron (3.70 mg/100g) and magnesium (104.44 mg/100g) levels, while raisins (C5) enhanced zinc levels (1.31 mg/100g). Physical properties, such as diameter and spread ratio, varied with ingredient composition. Texture analysis revealed that cookies with oat and peanut flour were firmer, with hardness values up to 26.31 N, and displayed greater resilience compared to the control. Sensory evaluation indicated that sweet potato and honey-based cookies scored highest in texture and overall acceptability, though traditional sugar-based cookies remained most preferred. Overall, the findings underscore that gluten-free cookies formulated with alternative flours and natural sweeteners can serve as a nutrient-rich, energy-dense snack for children, effectively addressing protein and mineral deficiencies. This research provides a viable approach to enhancing the nutritional profile of gluten-free products without compromising sensory quality, offering a promising solution for children with dietary restrictions

Keywords: Gluten-free cookies, Sugar, Honey, Dates, Raisins, Sweet potato, Textural profile, Sensory properties

*Received:**11-2-2025*** ***Accepted:17-2-2025*** ***Published:issue(1)-2025***

INTRODUCTION

Celiac disease is a chronic autoimmune disorder that affects the digestive system, triggered by the ingestion of gluten, a protein found in wheat, barley, and rye. When individuals with celiac disease consume gluten, their immune system responds by attacking the small intestine, specifically targeting the villi, small finger-like projections that line the intestine and promote nutrient absorption. This immune response leads to inflammation and damage to the intestinal lining, resulting in malabsorption of nutrients and a variety of gastrointestinal and systemic symptoms **(Singh *et al*., 2018b, and Caio *et al.*, 2019)**. The increasing prevalence of gluten-related disorders has driven demand for gluten-free alternatives, necessitating the development of products that are both safe and nutritionally adequate while maintaining desirable sensory and textural properties. Gluten plays a critical role in the structure and texture of many baked goods by providing elasticity, cohesiveness, and moisture retention **(Shewry & Hey, 2015, and Zheng *et al*., 2023).**

Gluten-free cookies, in particular, present a unique challenge in product development because of their low nutritional value due to their lack of protein, some minerals and fiber. Also, its reliance on gluten for texture, structure, and mouthfeel. So, traditional gluten-free cookies often exhibit inferior quality attributes, such as crumbly texture, reduced shelf life, and poor sensory acceptance, compared to their gluten-containing counterparts **(Gallagher *et al*., 2004, Vici *et al.*, 2016, and Hosseini *et al*., 2018)**. To address these limitations, researchers have explored the use of alternative flours and nutrient-dense ingredients, such as peanut and oat flours, which not only enhance the nutritional profile but also improve the physio-chemical and textural properties of gluten-free cookies. Peanuts, rich in protein, healthy fats, and micronutrients, and oats, known for their soluble fiber and mild flavor, have emerged as promising ingredients for gluten-free formulations **(Bonku & Yu, 2020, and Dauda *et al*., 2024).** Additionally, oats contain beta-glucans, which have been associated with cholesterol-lowering and prebiotic effects **(Wang and Jian, 2022)**.

In parallel with the replacement of gluten-containing flours, the substitution of refined sugars with natural sweeteners has gained attention due to the growing consumer demand for healthier, low-glycemic-index foods. Natural sweeteners, such as honey, maple syrup, and stevia, offer potential benefits, including improved nutritional content, enhanced flavor profiles, and reduced caloric density (**Singh *et al*., 2020 and Arshad *et al*, 2022**). However, the impact of these substitutions on the physio-chemical, textural, and sensory properties of gluten-free cookies remains an area of active investigation **(Mancebo *et al*. 2015*)***. For instance, the hygroscopic nature of natural sweeteners can influence dough rheology, baking performance, and final product texture (**Mariotti and Alamprese, 2012**).

Therefore, gluten-free products must be formulated in a way to balance health benefits with desirable sensory attributes, thus addressing the growing demand for high-quality gluten-free foods. That not only meet the dietary needs of individuals with gluten intolerance but also appeal to a broader consumer base seeking healthier and more nutritious snack options. So, the aim of the study was to develop nutritious, gluten-free cookies without refined sugar for children, as a functional food with high nutritional value. Also, investigate the effects of this substitution on the physio-chemical, textural, and sensory properties of gluten-free cookies.

MATERIALS AND METHODS

Materials

Rice flour, oat flour, peanut seeds, sugar, bee honey, treacle, dates, raisins, sweet potato, egg, butter, sunflower oil, whole fat milk powder, vanilla, salt, and baking powder were bought from a local market in Minya Al-Qamh Center, Sharkia Governorate, Egypt. All chemicals were purchased from El Gomhouria Company in Zagazig City, Egypt.

Methods

Preparation of peanut flour, mashed sweet potato, dates and raisins

Peanut seeds were roasted in an oven at 150°C for 20 min, then cooled, peeled, and ground in a grinder to fine powder. The obtained peanut flour was sieved and stored until use according to **Singh and Arivuchudar (2018)**. Sweet potato was cleaned and washed well with tap water to remove all the soil, then dried with a towel and steamed for 30 min under atmospheric pressure using a domestic steamer. The steamed sweet potato was mashed and cooled at room temperature **(Zhang *et al*., 2023b)**. The dates and raisins were cleaned, then ground by a grinder. The all-prepared materials were kept in sealed glass containers at 25± 2 C° until using it.

Preparation of gluten-free cookies

Cookie formulations were shown in Table (1). All cookie treatments were manufactured according to the method of **Abd El- Salam *et al*. (2023)** with some modifications. The ingredients required for the preparation of cookies were weighed accurately. Rice, oat and peanut flours were mixed at ratios of 40:40:20%, respectively. The butter was beaten in a deep bowl for one minute, then the powdered sugar or sweetener was added and continued beating for another minute until light and fluffy. After that, the eggs, vanilla, and powdered milk were added, then continued beating well for 30 seconds. The rice flour or a mixture of rice, oats, peanut flours, and baking powder were added and mixed well. The dough was cut into small pieces, each weighing 30 grams, and shaped into cookie circles using a cookie cutter, then placed on a baking tray lined with parchment paper. Bake in a preheated oven at 170°C for 15 min. After baking the cookies were cooled at room temperature and packed in airtight polyethylene bags for further studies.

Table (1): Cookies formulations

Ingredients (g)	Free-gluten cookies treatments						
	C0	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**
Rice flour	550	220	220	220	220	220	220
Oat flour	-	220	220	220	220	220	220
Peanut flour		110	110	110	110	110	110
Sugar	150	150	-	-	-	-	-
Bee honey	-	-	150	-	30	30	30
Treacle	-	-	-	150	-	-	-
Dates paste	-	-	-	-	120	-	-
Raisins paste	-	-	-	-	-	120	-
Mashed sweet potato	-	-	-	-	-	-	120
Butter	175	175	175	175	175	175	175
Eggs	60	60	60	60	60	60	60
Skimmed milk powder	20	20	20	20	20	20	20
Baking powder	5	5	5	5	5	5	5
Vanilla	5	5	5	5	5	5	5

Determination of chemical composition of raw materials and cookies

Moisture, crude protein, crude fat, ash and crude fiber contents were determined according to **AOAC (2007)** standard methods. Total carbohydrate was estimated by the difference. The total calorie value (Kcal) of the cookie samples was estimated according to **James (1995)** as follows: Total calories = [(Protein + carbohydrate)4+ (9×fat)]. Reducing and non-reducing sugars were determined according to the method of **Holme and Pech (1983)**. Minerals (calcium, magnesium, iron, zinc, and copper) were determined and calculated on a dry weight basis by the method of **Nation and Robinson (1971).** The samples were analyzed by atomic absorption (Varian-Spectr AA 220) in the National Research Center, Dokki, Egypt.

Evaluation of nutritional value of gluten-free cookies

The consumed grams of cookies to cover the daily requirements (GDR) of energy (1800 kcal), protein (34 g), and iron (8 mg) for male children aged 9-13 years were calculated by using **RDA (1989)**. Also, percent satisfaction (P.S.%) for those parameters after consuming 100g of cookies was calculated.

Physical properties of gluten-free cookies

Weight (g), diameter (cm), thickness (cm), and spread ratio were determined as described by **AACC (2000).**

Texture analysis of gluten-free cookies

Texture profile (hardness, adhesiveness, and resilience) of cookies was analyzed in Food Technology Institute, Ministry of Agriculture, Cairo, Egypt, using Brookfield, CT3-10 kg, with 1% of load sensitivity, equipped with 10 kg load cell, Fixture TA-JTPB, Probe TA7. The test was done as follows: test type compression, target 6.0 mm, trigger load 3.00 N, and test speed 3.00 mm/s **(AOAC, 2005)**.

Color measurement of gluten-free cookies

The three spectral readings of color as lightness (dark to light), redness (reddish to greenish), and yellowness (yellowish to bluish) were gauged to all treatments of cookies by a Hunter colorimeter (Color Flex EZ, USA). Three readings were taken for each color and each type of sample, according to **Pathare *et al*. (2013).**

Sensory evaluation of gluten-free cookies

Sensory evaluation was done by 12 trained panelists of staff members of the Department of Food Science, Agriculture Faculty, Zagazig University. Panelists were asked to rate each sensory attribute of the cookies (color, taste, flavor, texture and overall acceptability) on a nine-point hedonic scale, according to **Bandeira *et al*. (2020).**

Statistical Analysis

All the data were collected in triplicates and the results were expressed as the mean ± SD using the SPSS Statistics program Version 20. To compare samples, one-way variance (ANOVA) and LSD test were used. The charts were created using Microsoft Excel.

RESULTS AND DISCUSSION

Chemical composition of raw materials
Macronutrients

Table (2) provided the chemical composition of various raw materials used in the manufacture of gluten-free cookies. The moisture content was highest in sweet potatoes (78.22%) and lowest in peanuts (1.73%), while its content in rice and oat flours was 12.19, and 10.29%, respectively. Moisture content of bee honey, treacle, dates, and raisins were 13.92, 15.72, 15.20, and 18.19%, respectively. The lower moisture content of peanut powder compared to other raw materials is due to the moisture loss during the roasting process, and thus the chemical content of whole peanut powder increased. Accordingly, peanuts had the highest crude protein content (29.40%), making them an essential source of protein in gluten-free cookies, especially for individuals needing protein-rich alternatives **(Arya *et al*., 2016)**. The protein content of peanut powder was higher than that reported by **El-Labban (2022)**, and **Abbas *et al.* (2024)** at 25.00-27.12%, and 27.19%, respectively. Oat flour also contributes significantly to protein content (14.80%), with 1% more than estimated in the study by **Zaki *et al*. (2018)** (13.87%).

Bee honey and treacle have minimal protein content (0.39% and 0.22%, respectively), serving primarily as sweeteners. This result is consistent with the results of **El Sohaimy *et al*. (2015)** who found that the protein content of honey ranges from 0.17% to 0.47%, depending on the pollen source. Also, **Weeraratne and Ekanayake (2022)** stated that the protein content in treacle is 0.3%.

Peanuts are also the richest source of fat (50.10%). Oat flour (6.17%) also contributes to the fat content, while most other ingredients have minimal fat content. This content is close to what was estimated by **Adeiye *et al*. (2013), Abbas *et al.* (2024)** in roasted peanuts (52.38% and 54.67% respectively), and **Zaki *et al*. (2018)** in oat flour (6.85%).

Ash content was highest in raisins (2.82%) and dates (2.55%), followed by peanuts (2.46%) then oat flour (1.98%). While other ingredients such as rice flour, bee honey, treacle, and sweet potato contained 0.47, 0.18, 0.37, and 1.08% ash, respectively. In other studies, the ash content was found to be 1.5 -3.2% in raisins **(Maki and Yasin, 2023),** 1.96- 2.50% in dates **(Mohamed *et al*., 2014),** 3.49- 3.91 and 4.09% in raw and roasted peanuts **(Taha *et al*., 2019 and Adeiye *et al*., 2013,** respectively**)**, 1.69% in oat flour (**Zaki *et al*., 2018)**, 1.07% in honey (**El Sohaimy *et al*., 2015),** 1.17% in treacle ***(*Mosa *et al*., 2006*)***, and 0.62, 0.37 and 1.42% in raw, boiled and baked sweet potato **(Ogliari *et al*., 2020).**

Oat flour (6.43%), dates (5.11%), and raisins (4.52%) are significant sources of crude fiber. High fiber content is crucial for improving the digestive health benefits of gluten-free cookies, which can be lower in fiber (**Arslan *et al*., 2019).** The fiber content of oat flour in this study was lower than that determined in the study of **Rajput *et al*. (2024)** (13.33%) and **Abd El-Salam *et al*. (2024)** (7.69%). The fiber content in this study was higher than those obtained by **AL Juhaimi *et al*. (2014)** in seven varieties of dates which ranged between (1.91-3.90%), and lower than those obtained by **Parvin *et al*. (2015)** (6.05- 6.90%). This result is matched with **Maki and Yasin (2023)** who stated that the fiber content of raisins ranged from 1.5 to 4.6%, and lower than 10.85% determined by **Salam and Kashif (2021).**

The results indicate that bee honey (85.51%) and treacle (83.69%) have the highest carbohydrate content, which is consistent with their composition of sugars. The rice flour (78.05%) and oat flour (60.33%) are the primary sources of complex carbohydrates. The moderate carbohydrate content of oat flour, along with its dietary fiber, makes it a valuable ingredient in functional food applications **(Rasane *et al*., 2015)**. Peanuts, being lower in carbohydrates (12.41%), offer a balance by contributing more protein and fat **(Arya *et al*., 2016)**.

Also, Table (2) showed that reducing sugars are highest in bee honey (75.84%), consistent with its high fructose and glucose content (**Bogdanov *et al*., 2008**). This finding was aligned with **El Sohaimy *et al*. (2015)** who mentioned that reducing sugars were the predominant sugars in Saudi (72.36%), Egyptian (69.84%) and Yemeni (64.21%) honey. Dates and raisins also have high reducing sugar content (61.67% and 66.51%, respectively), as reported by **Al-Farsi *et al*. (2005), Ramadan *et al*. (2018), and Venkatram *et al*. (2017).** While treacle has a high non-reducing sugar content (43.12%), primarily due to its sucrose content, consistent with studies on treacle (***(*Mosa *et al*., 2006**). Ingredients like rice flour (0.57%) and oat flour (0.86%) have significantly lower levels of reducing and non-reducing sugars, consistent with findings by **Lavanya and Pinky (2019)** who stated that reducing and non-reducing sugars in rice flour were 0.12- 0.55%, and 1.0-1.89%, respectively.

Table (2): Chemical composition of raw materials used for manufacture of gluten-free cookies

Parameters (%)	Rice flour	Oat flour	Pea nut	Bee honey	Treacle	Dates	Raisins	Sweet potato
Moisture	12.19± 0.22	10.29± 0.19	1.73± 0.01	13.92± 0.15	15.72± 0.24	15.20± 0.27	18.19± 0.33	78.22± 1.44
Crude protein	8.40± 0.32	14.80± 0.56	29.40± 1.24	0.39± 0.01	0.22± 0.01	2.19± 0.11	2.40± 0.09	2.60± 0.10
Crude fat	0.53± 0.01	6.17± 0.17	50.10± 1.51	-	-	1.27± 0.02	1.38± 0.10	0.29± 0.01
Ash	0.47± 0.01	1.98± 0.02	2.46± 0.02	0.18± 0.001	0.37± 0.002	2.55± 0.03	2.82± 0.03	1.08± 0.01
Crude fiber	0.36± 0.03	6.43± 0.11	3.90± 0.59	-	-	5.11± 0.23	4.52± 0.12	3.41± 0.70
Carbohydrates	78.05± 0.59	60.33± 0.66	12.41± 2.19	85.51± 0.16	83.69± 0.25	73.68± 0.58	70.69± 0.43	14.4± 0.87
Reducing sugars	0.57± 0.06	0.86± 0.03	0.89± 0.01	75.84± 1.21	19.63± 0.36	61.67± 2.04	66.51± 2.17	9.23± 0.67
Non-reducing sugars	1.18± 0.02	0.64± 0.04	3.57± 0.15	2.59± 0.23	43.12± 1.30	9.46± 0.16	2.23± 0.07	5.64±0.11

Minerals

Fig. (1 and 2) provide data on mineral content (Ca, Mg, Fe, Zn, Cu) of the raw materials used in gluten-free cookie production. Treacle (66 mg) and oat flour (53.6 mg) are the richest sources of calcium among the listed ingredients. This aligns with studies showing that molasses (treacle) and whole grains like oats are good sources of calcium, especially for individuals who avoid dairy products **(El Asri & Farag, 2023 and Abd El-Salam *et al.*, 2024).** On the other hand, bee honey (3.64 mg) has the lowest calcium content, which is expected as honey is primarily a source of sugars and has minimal mineral content **(Bogdanov *et al*., 2008).** The calcium content in peanuts (47 mg) and sweet potatoes (38.5 mg) is consistent with **Ortiz and Martirosyan (2025)** who reported similar values.

Oat flour (213 mg) and sweet potato (131 mg) are the top sources of magnesium. oats are known for their high magnesium content, which supports cardiovascular health and muscle function **(DiNicolantonio *et al*., 2018)**. Bee honey (0.97 mg) again has the lowest magnesium content, as it is not a significant source of minerals. The magnesium content in rice flour (112 mg) and peanuts (107.6 mg) is consistent with studies highlighting the role of whole grains and nuts in providing dietary magnesium **(Volpe, 2013).**

From Fig. (2), it is clear that Oat flour (7.2 mg) has the highest iron content, followed by treacle (3.76 mg). Oats are known for their iron-rich profile due to their whole-grain nature and minimal processing **(Rasane *et al*., 2015)**. It is also noted that the iron content of oat flour in this study was higher than that (2.8 mg) determined by **Alemayehu *et al*. (2021),** and lower than that **(**13.76 mg) in the **Youssef *et al*. (2016)** study**.** Raisins (1.04 mg) and sweet potatoes (1.86 mg) have relatively low iron levels. This aligns with studies showing that dried fruits like raisins lose some iron during processing **(Khiari *et al*., 2018)**. Peanuts (3.62 mg) also show slightly lower iron than United States Department of Agriculture (USDA) reported values (~4.6 mg), possibly due to varietal or processing differences **(Ortiz and Martirosyan, 2025)**.

Peanuts (4.46 mg) were the richest source of zinc, followed by raisins (2.04 mg). This confirms that nuts such as peanuts are well-documented as excellent zinc sources **(Singh *et al*., 2018a)**. This was in line with studies of **Asibuo *et al*. (2008), El-Labban (2022), Maki & Yasin (2023),** and **Niketh and Keshamma (2024)** who indicated that the zinc content in peanut and raisin varieties ranges from 3.0 to 6.5, 1.05 to 2.42 mg/ 100 g, respectively. Sweet potato (0.25 mg) and bee honey (0.28 mg) had negligible zinc. This is consistent with their low mineral profiles, as honey is primarily sugar, and sweet potatoes are carbohydrate-focused **(Bogdanov *et al*., 2008 and García-Martínez *et al*., 2024).**

Peanuts (0.79 mg) and oat flour (0.75 mg) were the top copper sources, confirming what is known about legumes and whole grains as sources of copper in the diet **(Ramírez-Ojeda *et al*., 2018)**. Bee honey (0.16 mg) and treacle (0.17 mg) had minimal copper, reflecting their low mineral density.

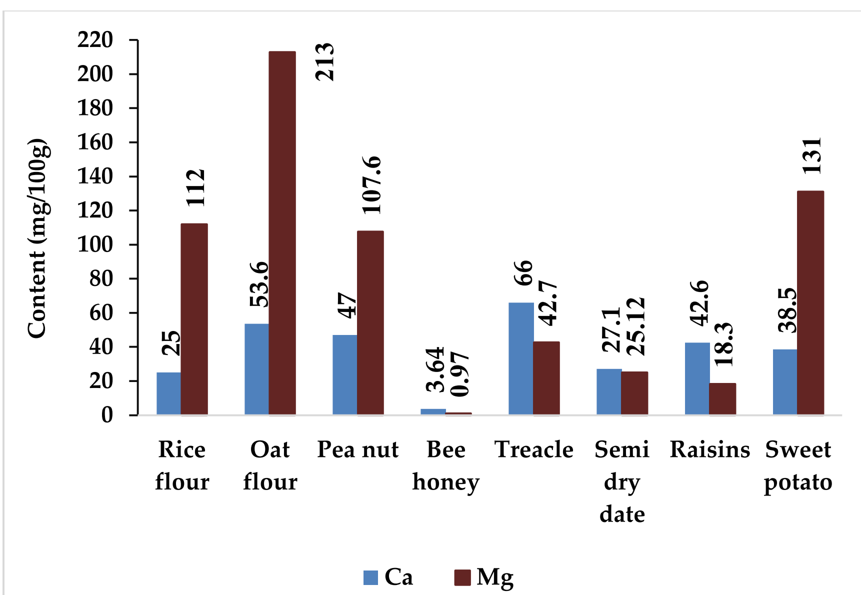

Fig. (1): Ca and Mg content of raw materials used in gluten-free cookie production

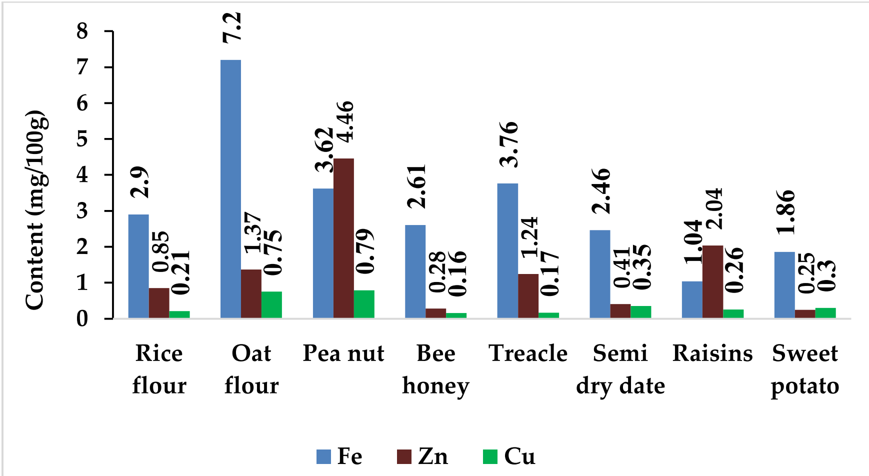

Fig. (2): Fe, Zn, and Cu content of raw materials used in gluten-free cookie production

Chemical composition of gluten-free cookies

Macronutrients

Table (3) shows a comprehensive analysis of the chemical composition of seven gluten-free cookie formulations (C0 to C6). The results revealed significant nutritional improvements when rice flour was blended with oat flour, peanut flour, and natural sweeteners (honey, treacle, dates, raisins, or sweet potato). The moisture content ranged from 5.56% in C1 to 10.47% in C6. C6 had the highest moisture content, while C1 had the lowest. The control cookies (C0) contained 6.51% moisture. High moisture in C6 is due to the high moisture content of the added sweet potato paste. Compared to the control (C0: 100% rice flour + sugar), treatments C1–C6 exhibited higher protein (10.43–10.97% vs. 7.09% in C0) and fat content (22.24–22.91% vs. 15.63% in C0), attributed to the inclusion of protein- and lipid-rich peanut flour **(Ortiz and Martirosyan, 2025)**, consistent with studies highlighting the role of peanut flours in enhancing gluten-free products of protein and fat content **(Abbas *et al*., 2024)**. Similar results were reported by **Singh and Arivuchudar (2018)**, where peanut-based formulations increased protein content in gluten-free products.

C5 (raisins) and C4 (dates) followed by C6 (sweet potato) had the highest ash content, while C0 had the lowest. Higher ash in C1–C6 (1.22–1.64%) vs. C0 (0.54%) reflects mineral contributions from oats, peanuts, and natural sweeteners (e.g., treacle, dates). Similar trends were noted in gluten-free cookies by **Paucean *et al*. (2016), Susman *et al*. (2021), and Abbas *et al*. (2024)**. Crude fiber content increases from 0.33% in C0 to 2.86% in C5.C4 (dates) and C5 (raisins) had the highest fiber (2.79–2.86%), aligning with findings that dried fruits boost dietary fiber **(Amin *et al*., 2019)**. The higher fiber content in C1 to C6 adds a functional aspect to the cookies.

Carbohydrates decreased in C1–C6 (52.64–58.52% vs. 69.90% in C0) due to sugar replacement with fiber-rich ingredients and an increase in protein and fat content. Energy values varied significantly, C1 was the highest energy (475.94 Kcal/100g) and C0 was the lowest (448.59 Kcal/100g). The energy content increased by adding the peanut flour rich in fats and proteins, as well as, sweeteners rich in sugars. The higher energy values in C1 to C6 provide a more satiating and energy-dense snack. Energy values align with gluten-free cookies reported by **Rai *et al*. (2014)** (439- 480 Kcal/100g).

C2 (honey: 9.87%), C5 (raisins: 8.80%), and C4 (dates: 8.25%) had the highest reducing sugar content, consistent with honey's fructose/glucose content and dried fruits' natural sugars than other sweeteners used **(Bogdanov *et al*., 2008 and El Sohaimy *et al*., 2015)**. C0 (sugar: 10.34%) and C1 (sugar: 10.56%) had the highest content of non-reducing sugars, while C2–C6 (natural sweeteners) showed lower values due to sugar substitution. These results were consistent with studies by **Singh & Arivuchudar (2018), Amin *et al*. (2019), Abotaleb &Arafa (2021), and Silva-Paz *et al*. (2024)** who demonstrated that blended flours and natural sweeteners enhance the nutritional profile of gluten-free cookies. Natural sweeteners add natural sugars to bakery products, which can positively influence consumer acceptability due to their health benefits and taste **(Arshad *et al*., 2022)**.

Table (3): Chemical composition of gluten-free cookies treatments

Parameters	Gluten-free cookies treatments						
	C0	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**
Moisture %	6.51± 0.10^{e}	5.56± 0.08^{f}	8.94± 0.14^{b}	6.62± 0.10^{e}	7.32± 0.11^{d}	7.94± 0.15^{c}	10.47± 0.18^{a}
Crude protein %	7.09± 0.26^{d}	10.43± 0.35^{c}	10.64± 0.08^{abc}	10.50± 0.12^{bc}	10.92± 0.23^{a}	10.97± 0.17^{a}	10.83± 0.25^{ab}
Crude fat %	15.63± 0.38^{b}	22.24± 0.68^{a}	22.30± 0.75^{a}	22.48± 0.74^{a}	22.85± 0.72^{a}	22.91± 0.49^{a}	22.40± 0.71a
Ash %	0.54± 0.01^{e}	1.22± 0.08^{d}	1.30± 0.03^{cd}	1.37± 0.02^{cd}	1.53± 0.13^{ab}	1.64± 0.09^{a}	1.45± 0.15^{bc}
Crude fiber %	0.33± 0.03^{d}	2.03± 0.07^{c}	2.02± 0.05^{c}	2.04± 0.01^{c}	2.79± 0.13^{a}	2.86± 0.15^{a}	2.21± 0.04^{b}
Carbohydrates %	69.90± 0.24^{a}	58.52± 1.12^{b}	54.80± 0.74^{d}	57.00± 0.69^{c}	54.58± 0.85^{d}	53.69± 0.45^{de}	52.64± 0.94^{e}
Energy (Kcal/100g)	448.59± 1.65^{e}	475.94± 3.02^{a}	462.43± 4.01^{c}	472.28± 3.42^{ab}	467.68± 4.03^{bc}	464.79± 3.25^{c}	455.46± 2.07^{d}
Reducing sugars %	0.13± 0.01^{f}	0.29± 0.04^{f}	9.87± 0.23^{a}	2.64± 0.15^{d}	8.25± 0.11^{c}	8.80± 0.26^{b}	1.41± 0.10^{e}
Non-reducing sugars %	10.34± 0.39^{a}	10.56± 0.13^{a}	0.97± 0.01^{e}	6.54±0.10^{b}	1.88± 0.02^{c}	0.89± 0.03^{e}	1.36± 0.07^{d}

Different letters (a, b, c, etc.) in the same row indicate significant differences between the treatments.
C0 = 100 % rice flour + sugar
C1 = 40% rice flour + 40% oat flour + 20% peanut flour + sugar
C2 = 40% rice flour + 40% oat flour + 20% peanut flour + bee honey
C3 = 40% rice flour + 40% oat flour + 20% peanut flour + treacle
C4 = 40% rice flour + 40% oat flour + 20% peanut flour + dates
C5 = 40% rice flour + 40% oat flour + 20% peanut flour + raisins
C6 = 40% rice flour + 40% oat flour + 20% peanut flour + sweet potato

Minerals

The gluten-free cookie formulations in Fig. (3) demonstrated that calcium (Ca) and magnesium (Mg) content in C1 to C6 were significantly higher compared to the control (C0, 100% rice flour), with C3 (treacle) showing the highest Ca (40.46 mg) and C6 (sweet potato) the highest Mg (104.44 mg). The Ca increase in C3 correlates with treacle richness in minerals. Similarly, the notable Mg in C6 stems from sweet potato's magnesium contribution. Also, Fig. (4) shows that C3 had the highest iron content at 3.70 mg/100g, this was attributed to treacle which is a good source of iron. C0 had the lowest iron content at 1.94 mg/100g, reflecting the minimal contribution from its basic composition, and the absence of iron-rich additives. C0 had the lowest zinc content at 0.51 mg/100g, but C5 (raisins) showed the highest zinc content at 1.31 mg/100g, indicating raisins can enhance zinc levels in cookies. The control formulation (C0) contained the least copper (0.15 mg/100g), aligning with its simpler ingredient profile. C4

(0.36 mg/100g) followed by C5 and C6 (0.32 mg/100g) shows the highest copper content. This elevation aligned with previous studies indicating that using oat and peanut flour in Gluten-free products enhances their mineral content **(Singh & Arivuchudar, 2018, and Ortiz & Martirosyan, 2025**). Also, **Filipčev *et al*., (2012)** found that replacing honey with blackstrap molasses in biscuits led to an increase in mineral content, especially calcium and iron. Furthermore, this study was consistent with findings that oat flour, peanut, date, and sweet potato enhance mineral profiles in fortified foods **(El-Zainy *et al*., 2010, Suleman *et al*., 2023, Abd El-Salam *et al*., 2024, Elkatry *et al*., 2024, and Hamood *et al*., 2024).**

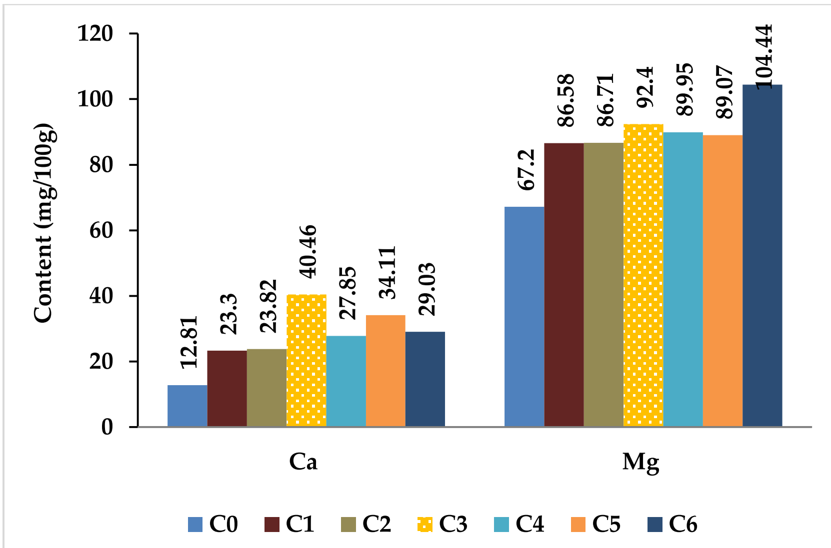

Fig. (3): Ca and Mg content of gluten-free cookie treatments

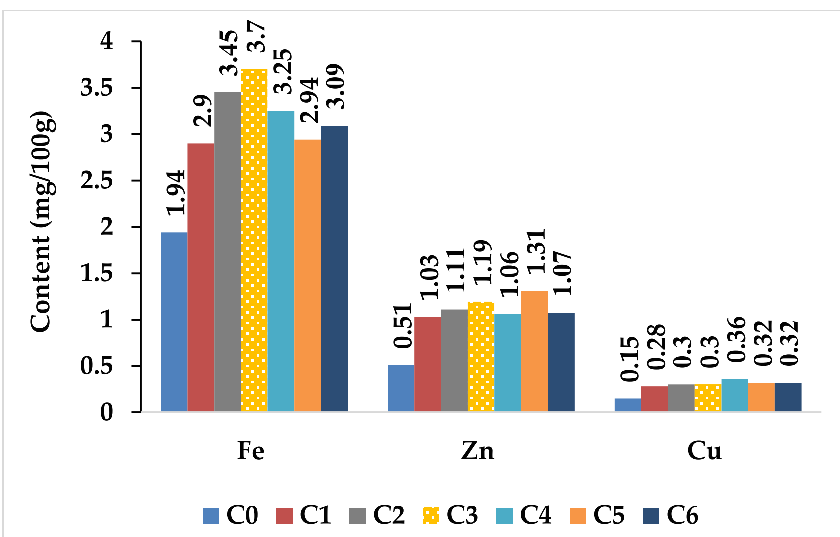

Fig. (4): Fe, Zn, and Cu content of gluten-free cookie treatments

GDR and P.S.% of the gluten-free cookies

Table (4) presents GDR and P.S.% for energy, protein, and iron (Fe) of the different gluten-free cookie treatments. The GDR for energy ranged from 378.21g (C1) to 401.26g (C0), with significant differences between treatments. C1, which includes sugar, oat, and peanut flours, had the lowest energy GDR and the highest percent satisfaction (26.44%). Conversely, C0, which is 100% rice flour with sugar, required the highest consumption to meet daily energy needs (401.26g) and had the lowest satisfaction percentage (24.92%). This indicated that the combination of oat and peanut flours decreased the GDR and increased the P.S.% of the cookies, as is evident when comparing the other treatments (C2, C3, C4, C5, and C6) to C0.

GDR for protein ranged from 309.98g (C5) to 479.96g (C0), with C0 having the lowest percent satisfaction (20.85%) and C5 the highest (32.26%). The use of different sweeteners, such as honey (C2) and treacle (C3), did not significantly affect the protein GDR as much as the base flour composition did. This was due to the high protein content in peanut flour, which significantly improved the protein satisfaction percentages **(Arya *et al*., 2016)**. These results aligned with findings of **Abd-Rabou (2017)** who enriched rice flour in gluten-free biscuits with chickpea flour and found P.S.% /100g of protein for children (3-6 years) increased, while the GDR decreased with increasing chickpea flour ratio.

For iron, GDR varied between 216.24g (C3) and 412.49g (C0). The highest percent satisfaction for iron was in C3 (46.25%), which included treacle, known for its iron content. This was consistent with research linking molasses uses to enhanced iron content in fortified foods **(FilIpčev *et al*., 2012)**. C0 had the lowest satisfaction percentage (24.25%), indicating that the alternative sweeteners like treacle (C3), bee honey (C2), and dates (C4) contribute more significantly to iron content than sugar alone. These findings were consistent with the studies that confirmed that fortifying gluten-free products with nutritional additives rich in protein and minerals enhances their nutritional value, addressing deficiencies common in rice flour-based formulations **(Ogunbusola *et al*., 2020, and Susman *et al*., 2021)**.

Table (4): The consumed grams to cover the daily requirements (GDR) and Percent satisfaction (P.S.%) of gluten-free cookies treatments

Treatments	Energy		Protein		Fe	
	GDR	P.S.%	GDR	P.S.%	GDR	P.S.%
C0	401.26± 1.47^{a}	24.92± 0.09^{e}	479.96± 17.12^{a}	20.85± 0.76^{d}	412.49± 8.51^{a}	24.25± 0.50^{f}
C 1	378.21± 2.40^{e}	26.44± 0.17^{a}	326.12± 10.93^{b}	30.69± 1.03^{c}	275.72± 8.60^{b}	36.29± 1.13^{e}
C 2	389.27± 3.38^{c}	25.69± 0.22^{c}	319.66± 2.34^{bc}	31.28± 0.23^{abc}	232.01± 6.73^{e}	43.13± 1.25^{b}
C 3	381.15± 2.76^{de}	26.24± 0.19^{ab}	323.84± 3.70^{bc}	30.88± 0.35^{bc}	216.24± 2.92^{f}	46.25± 0.63^{a}
C 4	384.90± 3.32^{cd}	25.98± 0.22^{bc}	311.45± 6.56^{bc}	32.12± 0.68^{a}	245.97± 4.91^{d}	40.67± 0.81^{c}
C 5	387.29± 2.71^{c}	25.82± 0.18^{c}	309.98± 4.74^{c}	32.26± 0.49^{a}	272.16± 4.63^{b}	36.75± 0.63^{e}
C 6	395.21± 1.79^{b}	25.30± 0.11^{d}	313.96± 7.26^{bc}	31.86± 0.74^{ab}	258.90± 0.84^{c}	38.63± 0.13^{d}

Different letters (a, b, c, etc.) in the same column indicate significant differences between the treatments.
C0 = 100 % rice flour + sugar
C1 = 40% rice flour + 40% oat flour + 20% peanut flour + sugar
C2 = 40% rice flour + 40% oat flour + 20% peanut flour + bee honey
C3 = 40% rice flour + 40% oat flour + 20% peanut flour + treacle
C4 = 40% rice flour + 40% oat flour + 20% peanut flour + dates
C5 = 40% rice flour + 40% oat flour + 20% peanut flour + raisins
C6 = 40% rice flour + 40% oat flour + 20% peanut flour + sweet potato

Physical properties of gluten-free cookies

The physical properties analysis of gluten-free cookies (Table 5) reveals that the cookies weight varies slightly among treatments, with C5 (raisins) having the highest weight (27.31g) followed by C2 (26.97g) then C4 (26.70g), and C0 (26.47g). While C3 and C6 had the lowest weight (25.70 and 25.77g). Treatment C0 (sugar) exhibited the largest diameter (5.92 cm), indicating that sugar promotes more spreading during baking **(Pareyt *et al*., 2009)**, Also it might be due to the increase the hydrophilic sites of the starch granules of the gluten-free flours leading to moisture absorption and subsequent diameter increase **(Akubor *et al*., 2023)**. In contrast, C5 (raisins) had the smallest diameter (5.23 cm), suggesting that raisins might restrict spreading due to their viscous nature **(Lewicki and Spiess, 1995)**. There were no significant differences between C2, C4, and C6 in diameter, as well as between C1 and C2.

Thickness measurements showed that C1 had the thickest cookies (2.05 cm), followed by C5 and C6 (1.86 and 1.85 cm, respectively), while C0 and C4 had the thinnest (1.72 cm and 1.70 cm, respectively). The spread ratio was an essential parameter indicating the balance between diameter and thickness. There were significant differences among the treatments. C0 had the highest spread ratio (3.45%), indicating a flatter cookie, while C1 had the lowest (2.65%), suggesting a thicker, less spread-out cookie. This was consistent with the thickest measurement observed in C1. Whereas, the spread ratio in other treatments (C2, C3, C4, C5, and C6) was higher than that in C1, and lower compared with C0. This could be due to the viscosity of the used ingredients, where the spread ratio is reduced with increasing dough viscosity **(Peter-Ikechukwu *et al*., 2020)**. These results are in agreement with **Salem *et al*. (2019)** who found a significant decrease in the spread ratio values of biscuits containing composite flours like rice, taro, and soybeans compared with biscuits containing 100% rice flour. Also, **Omran and Hussien (2015)** observed that the diameter and spread ratio reduced for cookies containing rice flour and (mashed or flour) sweet potato compared to cookies with 100% rice flour. **FilIpčev *et al*. (2012)** did not found any effect of replacing honey with 20% molasses on the spread ratio of biscuits. But, **Adeboye and Bamgbose (2015)** pointed out that increasing the percentage of sugar replacement with honey led to reduced thickness and increased spread ratio of cookies. **Amin *et al*. (2019)** observed non-significant decreases in thickness and spread ratio and significant decreases in diameter by increasing the percentage of sugar replacement with date powder for cookies. Similar results were observed by **Abotaleb and Arafa (2021)** who found that cookies containing 100 % oat flour had the highest thickness and lowest spread ratio. We conclude from the above that the difference in physical properties may be attributed to the different effects of the ingredients used in cookies manufacturing such as gluten-free composite flours, sweeteners, its viscosity, and its moisture, protein and fiber content.

Table (5): Physical properties of gluten-free cookies treatments

Treatments	Weight (g)	Diameter (cm)	Thickness (cm)	Spread ratio (%)
C0	26.47± 0.89[abc]	5.92± 0.02[a]	1.72± 0.02[e]	3.45± 0.04[a]
C 1	26.40± 0.73[bc]	5.42± 0.03[d]	2.05± 0.03[a]	2.65± 0.02[f]
C 2	26.97± 0.38[ab]	5.47± 0.04[cd]	1.76± 0.02[d]	3.10± 0.01[c]
C 3	25.70± 0.42[c]	5.77± 0.07[b]	1.80± 0.02[c]	3.20± 0.05[b]
C 4	26.70± 0.39[ab]	5.50± 0.02[c]	1.70± 0.01[e]	3.24± 0.03[b]
C 5	27.31± 0.11[a]	5.23± 0.03[e]	1.86± 0.01[b]	2.81± 0.03[e]
C 6	25.77± 0.23[c]	5.51± 0.06[c]	1.85± 0.02[b]	2.98± 0.04[d]

Different letters (a, b, c, etc.) in the same column indicate significant differences between the treatments.
C0 = 100 % rice flour + sugar
C1 = 40% rice flour + 40% oat flour + 20% peanut flour + sugar
C2 = 40% rice flour + 40% oat flour + 20% peanut flour + bee honey
C3 = 40% rice flour + 40% oat flour + 20% peanut flour + treacle
C4 = 40% rice flour + 40% oat flour + 20% peanut flour + dates
C5 = 40% rice flour + 40% oat flour + 20% peanut flour + raisins
C6 = 40% rice flour + 40% oat flour + 20% peanut flour + sweet potato

Texture profile of gluten-free cookies

Hardness is an important quality parameter which means the maximum force is required to be achieved after increasing the trigger force until the cookie breaks into two pieces **Shokry (2024)**. The texture profile analysis of gluten-free cookies revealed a significant difference in hardness, adhesiveness, and resilience across various treatments, demonstrating the substantial influence of ingredient variations on the textural properties of cookies (Table 6). Hardness increased in all treatments containing oat and peanut flours, and it was highest in C1 (26.31 N) and C4 (25.70 N). This increase in hardness may be attributed to the incorporation of oat and peanut flours in C1, which have been shown to contribute to firmer textures due to their higher protein and fiber content **(Sandhu *et al*., 2018, Nugraheni *et al*., 2019, and Abotaleb & Arafa, 2021)**. The control cookies (C0, 12.22 N), made solely from rice flour and sugar, exhibited the lowest hardness, they were softer, likely due to the absence of a robust protein network, consistent with findings that rice flour-based products lack structural integrity without composite flours **(Zhang *et al*., 2023a)**. Treatments with C2, C3, C4, and C6 also show lower hardness than C1 but are still firmer than the control, suggesting that the use of different sweeteners impacts the textural characteristics, likely due to their varying moisture-retention capabilities and sugar compositions **(Kawai *et al*., 2014)**. Also, the liquid sweeteners can reduce crispness, because of the moisture retention softening the matrix **(Struck *et al*., 2014). Omran and Hussien (2015)** exposed that the reduction in hardness values of sweet potato cookies may be attributable to sweet potato nature which is hydrophilic, hence, absorbing excessive moisture, and also to starch gelatinization.

Adhesiveness was significantly higher in C1 (0.700 mJ) compared to other treatments, indicating that the combination of oat and peanut flour led to more cohesive dough. This is a result of strong bonding and adherence between protein and starch. Where, the protein content of peanut and oat flour was the highest, while its content in rice flour was the lowest (Table 2) **(Altındağ *et al*., 2015)**. Additionally, the high adhesiveness in C1 could be due to the hygroscopic nature of sugar, which affects the dough's binding properties (**Gallagher *et al*., 2004**). The control (C0) and other treatments like C3 (0.009 mJ) and C6 (0.008 mJ) show much lower adhesiveness. This may be due to the use of treacle and sweet potato may introduce additional water content, reducing adhesiveness **(Pareyt and Delcour, 2008).**

Resilience, which measures the cookie's ability to recover its shape after deformation, shows less variation but is highest in treatments C1, C2, and C4 (0.04-0.05) compared to C0 (0.01). These results imply that the inclusion of oat and peanut flour, along with different sweeteners like honey and dates, enhances the resilience of the cookies. This may be due to the presence of fibers and proteins in these ingredients likely enhancing the dough's recovery capacity **(Mancebo *et al*., 2015)**. Conversely, the control's low resilience (0.01) suggests a weaker structural matrix, consistent with previous findings that rice flour forms a less elastic network **(Zhang *et al*., 2023a)**. These results were consistent with studies that reported that gluten-free formulations containing rice flour were less hardness than formulations that contained rice flour with other flours **(Susman *et al*., 2021 and Yee *et al*., 2024).** In generally, there are many factors that affect the hardness of bakery products, including flour quality, dough moisture, emulsifiers and enzymes, baking conditions, type and amount of added ingredients, and flour protein content and quality **(Salem *et al*., 2019**).

Table (6): Texture profile analysis of gluten-free cookies treatments

Treatments	Hardness (N)	Adhesiveness (mJ)	Resilience
C0	12.22± 0.09^{g}	0.005± 0.001^{c}	0.01± 0.01^{b}
C 1	26.31± 0.13^{a}	0.700± 0.100^{a}	0.04±0.01^{a}
C 2	21.43± 0.22^{d}	0.300± 0.100^{b}	0.04±0.01^{a}
C 3	18.92± 0.10^{e}	0.009± 0.001^{c}	0.02±0.01^{b}
C 4	25.70± 0.28^{b}	0.300± 0.100^{b}	0.05± 0.01^{a}
C 5	23.43± 0.15^{c}	0.233± 0.060^{b}	0.01±0.01^{b}
C 6	15.36± 0.12^{f}	0.008± 0.002^{c}	0.02± 0.01^{b}

Different letters (a, b, c, etc.) in the same column indicate significant differences between the treatments.
C0 = 100 % rice flour + sugar
C1 = 40% rice flour + 40% oat flour + 20% peanut flour + sugar
C2 = 40% rice flour + 40% oat flour + 20% peanut flour + bee honey
C3 = 40% rice flour + 40% oat flour + 20% peanut flour + treacle
C4 = 40% rice flour + 40% oat flour + 20% peanut flour + dates
C5 = 40% rice flour + 40% oat flour + 20% peanut flour + raisins
C6 = 40% rice flour + 40% oat flour + 20% peanut flour + sweet potato

Color attributes of gluten-free cookies

The color attributes of gluten-free cookies are essential in influencing consumer acceptance. The data presented in Table (7) demonstrate how different formulations affect the cookies' visual appeal. Treatment C0 (100% rice flour + sugar) exhibited the highest lightness value (69.61), indicating a lighter color. In contrast, the treatments (C1 to C6) containing oat or peanut flour and alternative sweeteners contributed to a darker color, this attributed to the natural pigmentations of these added ingredients. The redness parameter varied significantly across treatments. Treatments C3 and C6, which included treacle and sweet potato, showed the highest redness values (9.16 and 10.01, respectively), contributing to a more reddish hue in the cookies. This can be attributed to the natural colors of the added ingredients and the Maillard reaction browning products between protein and reducing sugar during baking, especially with the high protein content **(Salem *et al*., 2019)**. In contrast, C0 exhibited the lowest redness (3.77), reflecting the use of only rice flour and sugar. The yellowness values were highest for

C0 (26.86) likely due to the simple composition of rice flour and sugar. there were significant differences between C6 (25.09) and other treatments (C0, C4, and C5), which had the second highest yellowness values, this is due to the orange color of used sweet potato. No significant differences in the yellowness values were found between C3, C4 and C5, which may result from the darker pigmentation introduced by treacle, date, and raisins. This may be because the speed at which the Maillard reaction occurs varies depending on the type of sugar **(Silva-Paz *et al*., 2024)**. These results are very consistent with **Zaki *et al*. (2018), Abotaleb & Arafa (2021), and Dauda *et al*. (2024).** In addition, **FilIpčev *et al*. (2012)** who pointed out that replacing honey with molasses resulted in darker biscuits, compared to biscuits made with honey, which had a more vibrant color. Also, **Akhobakoh *et al*., (2022)** found that substituting sugar with date powder in cookies led to significant increase in the darkening color.

Table (7): Color attributes of gluten-free cookies treatments

Treatments	*L**	*a**	*b**
C0	69.61± 0.97[a]	3.77± 0.06[d]	26.86± 0.44[a]
C 1	61.14± 0.50[b]	5.82± 1.23[c]	24.84± 0.78[bc]
C 2	57.39± 0.82[c]	7.03± 0.35[bc]	24.71± 0.14[bc]
C 3	52.09± 2.44[ef]	9.16± 1.06[a]	24.27± 0.40[bcd]
C 4	55.60± 1.03[cd]	6.98± 0.74[bc]	23.94± 0.17[cd]
C 5	54.30± 1.44[de]	7.75± 0.44[b]	23.37± 0.91[d]
C 6	50.60± 0.61[f]	10.01± 0.14[a]	25.09± 0.27[b]

*L**: (Lightness), *a**: (redness), *b**: (yellowness),
Different letters (a, b, c, etc.) in the same column indicate significant differences between the treatments.
C0 = 100 % rice flour + sugar
C1 = 40% rice flour + 40% oat flour + 20% peanut flour + sugar
C2 = 40% rice flour + 40% oat flour + 20% peanut flour + bee honey
C3 = 40% rice flour + 40% oat flour + 20% peanut flour + treacle
C4 = 40% rice flour + 40% oat flour + 20% peanut flour + dates
C5 = 40% rice flour + 40% oat flour + 20% peanut flour + raisins
C6 = 40% rice flour + 40% oat flour + 20% peanut flour + sweet potato

Sensory evaluation of gluten-free cookies

The sensory evaluation results for gluten-free cookies indicate distinct variations in sensory properties across different treatments (Table 8 and Fig. 4). Treatment C0 achieved the highest score (8.64), suggesting that traditional ingredients offer a more visually appealing product. Conversely, treatments C4 and C5, incorporating dates and raisins respectively, received the lowest appearance scores, potentially due to the darker and less uniform appearance imparted by these ingredients.

Treatments C2 and C6, which include honey and sweet potato, scored highest in color (8.29), indicating that these natural sweeteners may enhance the visual appeal of the cookies. Also, the results showed that participants preferred the light brown color in samples C1, C2, C5, and C6, which could be attributed to the addition of oat and peanut flours as well as to the Maillard reaction. On the other hand, C3 scored lowest in color (7.57), possibly due to the brownish tint introduced by treacle.

All treatments received high scores for aroma, with no significant differences, indicating that the inclusion of various flours and sweeteners did not adversely affect the cookies' aroma. This could be due to the vanilla added during manufacturing. This suggests that the aroma of gluten-free cookies can be maintained by adding vanilla or some other aromatic compounds.

Treatments C0 and C6 achieved the highest texture scores (8.86 and 8.71, respectively), suggesting that traditional sugar and sweet potato help create a desirable cookie texture. Treatments C2, C3, C4, and C5 received lower texture scores, indicating that the type of sweetener influences the texture, with treacle and dried fruits possibly contributing to a denser or chewier texture.

Treatment C0 and C1 had the highest sweetness score (8.29), followed by C2 then C5, with no significant differences. While, treatment C6 (sweet potato) had the lowest score (7.00), suggesting that while natural sweeteners contribute to sweetness, they may not match the sweetness intensity of sugar.

The flavor scores showed that C0 (8.71) and C6 (8.43) were most favored. The use of sweet potato in C6 provided a unique flavor profile that was well-received. Treatment C3 (treacle) scored the lowest in flavor (7.86), possibly due to the distinct and perhaps overpowering taste of treacle.

Treatment C0 received the highest overall acceptability score (8.86), followed by C1 (8.57), then C6 (8.43), and C2 (8.29) indicating that the formulation with sugar, sweet potato, or bee honey is most preferred. While, treatment C4 had the lowest overall acceptability (7.29). In general, mixing rice flour with oat and peanut flour had no significant effect on the sensory properties of the resulting cookies. Although the use of sugar in gluten-free cookies is preferred for its sensory properties, alternative natural sweeteners such as honey, treacle, dried fruits, and sweet potatoes can also produce acceptable results with distinct benefits. These results align with **Mohammed (2017)** who proved that there was no significant difference in overall acceptability between rice flour cookies and that made by replacing 20 and 40% of rice flour with lupine flour. In another study by **Bolarinwa *et al*. (2019),** cookies made with rice flour and potato starch in a 3:1 ratio received the highest scores for texture and overall acceptability. Also, **Wang and Wu (2022)** reported that adding peanut or soybean flour to rice flour improved the taste, flavor, texture, and appearance of the cookies. The cookies made from 95% oat flour and 5% wheat flour received the highest scores in sensory evaluation and were most acceptable **(Dauda *et al*., 2024)**.

FilIpčev *et al*. (2012) found that replacing honey with molasses led to reduce the appearance scores and general acceptability and increased the flavor intensity of the biscuits. Also, **Iftikhar *et al.* (2015)** demonstrated that the sensory quality of cookies was not affected by the addition of date paste up to 15%, but cookies containing 20% date paste obtained the lowest scores in texture, color and flavor. In contrast, **Akhobakoh *et al*., (2022)** found that the sensory quality scores of biscuits made with potato flour and replacing sugar with date powder were lower than the control. The control sample was sweeter than the other treatments. On the other hand, **Abd El- Salam *et al*. (2023)** found that cookies made with only rice flour had lower scores in taste, texture, and appearance compared to cookies containing rice, quinoa flours, and papaya powder.

Table (8): Sensory properties of gluten-free cookies treatments

Treatments	Appearance	Color	Aroma	Texture	Sweetness	Flavor	Overall acceptability
C0	8.64± 0.48[a]	8.00± 0.82[ab]	8.57± 0.79[a]	8.86± 0.38[a]	8.29± 0.49[a]	8.71± 0.49[a]	8.86± 0.38[a]
C 1	8.57± 0.79[a]	8.14± 0.69[ab]	8.71±0.49[a]	8.57±0.53[ab]	8.29± 1.11[a]	8.57± 0.79[ab]	8.57± 0.53[a]
C 2	7.86± 0.38[bc]	8.29± 0.49[a]	8.57± 0.53[a]	7.86±0.69[c]	8.14± 1.07[a]	8.43± 0.98[ab]	8.29± 0.76[ab]
C 3	7.71± 0.76[bc]	7.57± 0.79[b]	8.29±0.99[a]	8.00± 0.58[bc]	7.86± 0.69[ab]	7.86± 0.69[b]	7.86± 0.38[bc]
C 4	7.43± 0.45[c]	7. 86± 0.69[ab]	8.64± 0.63[a]	7.71± 0.76[c]	7.71± 0.49[ab]	8.29± 0.70[ab]	7.29± 0.49[c]
C 5	7.57± 0.53[c]	8.00± 0.58[ab]	8.57± 0.79[a]	7.86± 0.38[c]	8.14± 0.69[a]	8.29± 0.76[ab]	7.86± 0.69[bc]
C 6	8.29± 0.49[ab]	8.29± 0.49[a]	8.71± 0.76[a]	8.71±0.49[a]	7.00± 0.82[b]	8.43± 0.79[ab]	8.43± 0.79[ab]

Different letters (a, b, c, etc.) in the same column indicate significant differences between the treatments.

C0 = 100 % rice flour + sugar
C1 = 40% rice flour + 40% oat flour + 20% peanut flour + sugar
C2 = 40% rice flour + 40% oat flour + 20% peanut flour + bee honey
C3 = 40% rice flour + 40% oat flour + 20% peanut flour + treacle
C4 = 40% rice flour + 40% oat flour + 20% peanut flour + dates
C5 = 40% rice flour + 40% oat flour + 20% peanut flour + raisins
C6 = 40% rice flour + 40% oat flour + 20% peanut flour + sweet potato

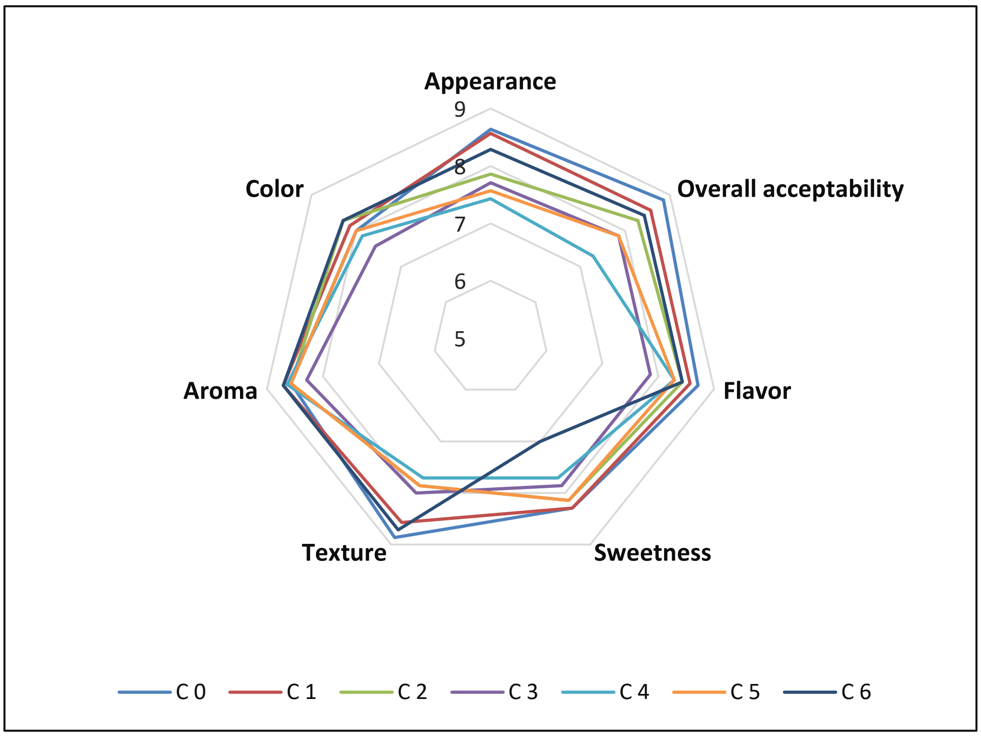

Fig. (4): Web chart for mean sensory evaluation scores of gluten-free cookie treatments

CONCLUSION

The study demonstrated that blending rice flour with oat flour, peanut flour, and natural sweeteners significantly enhanced the nutritional profile of gluten-free cookies, with increased protein, fiber, and mineral content, while reducing carbohydrate levels. The inclusion of ingredients like treacle, dates, raisins, and sweet potato improved iron, calcium, and magnesium levels, addressing common deficiencies in gluten-free products. Also, this study highlighted the potential of gluten-free cookies to meet daily nutritional requirements, particularly for energy, protein, and iron, with formulations containing peanut flour and treacle showing the highest satisfaction percentages. Physical properties such as diameter and spread ratio varied based on ingredient composition, with natural sweeteners influencing texture and color. The use of oat and peanut flours contributed to firmer textures and higher resilience, while natural sweeteners like treacle and dates added functional benefits. Sensory evaluation revealed that traditional sugar and sweet potato-based cookies were most preferred, but formulations with honey, and dried fruits also achieved acceptable sensory scores. Overall, this study suggests the potential of producing gluten-free cookies nutritionally enriched and sensorially appealing by incorporating composite flours and natural sweeteners, to address common dietary deficiencies in popular gluten-free bakery products. It also offers a viable and healthier alternative to conventional sugar-laden snacks for individuals, especially for children, with gluten intolerance or dietary restrictions.

REFERENCES

AACC (2000). Approved methods of the American Association of cereal chemists (10^{th} ed.). St. Paul, MN: The American Association of Cereal Chemist, Inc.

Abbas, M.S.; Abbas, M.M.M. and Saleh, S.A.A. (2024). Evaluation of healthy pan bread enriched with sesame, peanut and sun flower seeds. Egypt. J. Chem., 67(5): 89-108.

Abd El- Salam, A.M.A; Hussien, H.A. and Abdulla, M.F.M. (2023). Preparing gluten-free cookies for children from quinoa and papaya powder. Food Technol. Res. J., 2(2): 135-144.

Abd El-Salam, A.M.A.; Mohamed, E.S. and Hussien, H.A. (2024). Chemical, sensory and quality evaluation of cupcakes with wheat flour, oat flour and strawberry powder. Food Technol. Res. J., 4(1): 64-72.

Abd-Rabou, E.A.E.A. (2017). Effect of enriched gluten free biscuits with chickpea Flour or kareish cheese on chemical, nutritional value, physical and sensory properties. Alex. J. Agric. Sci., 62(1): 93-101.

Abotaleb, H.M. and Arafa, R.M. (2021) Quality characteristics of gluten-free cookies prepared from oat and unripe banana flour blends. Egypt. J. Food. Sci., 49(2): 187-198.

Adeboye, A.S. and Bamgbose, A. (2015). Effect of honey on selected physical and sensory properties of cookies from cassava-wheat composite flour. J. Food Process. Technol., 6(7): 1000459.

Adeiye, O.A.; Gbadamosi, S.O. and Taiwo, A.K. (2013). Effects of some processing factors on the characteristics of stored groundnut milk extract. African J. Food Sci., 7(6): 134-142.

Akhobakoh, M., Zing, Z.B., Ngatchou, A., Mbassi, J.E.G. and Nchanji, E.B. (2022). Potato (*Solanum tuberosum* L.) flour enriched with date palm fruit (*Phoenix dactylifera* L.) powder and bean milk for cookies production. Agric. Sci., 13: 973-988.

Akubor, P.I.; Onogwu, O.C.; Okereke, G.O. and Damak, A.M.A. (2023). Production and quality evaluation of gluten free biscuits from maize and soybean flour blends. Eur. J. Nutr. Food. Saf., 15(8): 59-79.

Alemayehu, G.F.; Forsido, S.F.; Tola, Y.B.; Teshager, M.A.; Assegie, A.A. and Amare, E. (2021). Proximate, mineral and anti-nutrient compositions of oat grains (*Avena sativa*) cultivated in Ethiopia: implications for nutrition and mineral bioavailability. Heliyon, 7(8): e07722.

Al-Farsi, M.; Alasalvar, C.; Morris, A.; Baron, M. and Shahidi, F. (2005). Compositional and sensory characteristics of three native sun-dried date (*Phoenix dactylifera* L.) varieties grown in Oman. J. Agric. Food Chem., 53: 7586-7591.

AL Juhaimi, F., Ghafoor, K. and Özcan, M.M. (2014). Physicochemical properties and mineral contents of seven different date fruit (*Phoenix dactylifera* L.) varieties growing from Saudi Arabia Fahad. Environ. Monit. Assess., 186: 2165-2170.

Altındağ, G.; Certel, M.; Erem, F. and İlknur, K.Ü. (2015). Quality characteristics of gluten-free cookies made of buckwheat, corn, and rice flour with/without transglutaminase. Food Sci. Technol. Int., 21(3):213-220.

Amin, A.A.; El-kalyoubi, M.; El-Sharabasy, S.F. and Abdel-Fattah, A.A. (2019). Quality attributes of cookies fortified with date powder. Arab Univ. J. Agric. Sci., Ain Shams Univ., Cairo, Egypt, 27(5): 2539-2547,

AOAC (2005). Official Methods of Analysis of AOAC International, 17th ed.; AOAC International: Gaithersburg, MD.

AOAC (2007). Official method, of analysis of the asocial official analytical chemists, 18th edition, current through revision 2. (editors.Dr .William horwitz, Dr George, Latimer, jr.), whashington, USA.

Arshad, S.; Rehman, T.; Saif, S.; Rajoka, M.S.R.; Ranjha, M.M.A.N.; Hassoun, A.; Cropotova, J.; Trif, M.; Younas, A.; Aadil, R.M. (2022). Replacement of refined sugar by natural sweeteners: focus on potential health benefits. Heliyon, 8(9): e10711.

Arslan, M.; Rakha, A.; Xiaobo, Z. and Mahmood, M.A. (2019). Complimenting gluten free bakery products with dietary fiber: Opportunities and constraints. Trends in Food Sci. Technol., 83: 194-202.

Arya, S.S.; Salve, A.R. and Chauhan, S. (2016). Peanuts as functional food: a review. J. Food Sci. Technol., 53(1): 31-41.

Asibuo, J.Y.; Akromah, R.; Safo-Kantanka, O.; Adu-Dapaah, H.K.; Ohemeng-Dapaah, S. and Agyeman, A. (2008). Chemical composition of groundnut, *Arachis hypogaea* (L) landraces. Afr. J. Biotechnol., 7(13): 2203-2208.

Bandeira, Z.R.; Hunaldo, V.K.L.; Freitas, A.C.; Fontenele, M.A.; Santos, L.H.; Silva, S.S.; Clímaco, G.N.; Costa, J.R.M.; Gomes, P.R.B.; Lobato, J.S.M. (2020). Elaboration and physical-chemical, microbiological and sensorial characterization of sweet gluten-free cookies prepared with babassu mesocarp flour and rice flour. Res. Soc. Dev., 9(8): e178985646.

Bogdanov, S.; Jurendic, T.; Sieber, R. and Gallmann, P. (2008). Honey for nutrition and health: a review. J. Am. Coll. Nutr., 27(6): 677-689.

Bolarinwa, I.F.; Lim, P.T. and Muhammad, K. (2019). Quality of gluten-free cookies from germinated brown rice flour. Food Res., 3(3): 199-207.

Bonku, R. and Yu, J. (2020). Health aspects of peanuts as an outcome of its chemical composition. Food Sci. Hum. Wellness, 9: 21-30.

Caio, G.; Volta, U.; Sapone, A.; Leffler, D.A.; De Giorgio, R.; Catassi, C. and Fasano, A. (2019). Celiac disease: A comprehensive current review. BMC Med., 17(1): 142.

Dauda, A.O.; Babatunde, A.O.; Maiyaki-Ibrahim T.D. and Jimoh, A.Y. (2024). Evaluating quality attributes of cookies produced from oat and wheat flour blends. Ceylon J. Sci., 53(4): 609-617.

DiNicolantonio, J.J; Liu, J. and O'Keefe, J.H. (2018). Magnesium for the prevention and treatment of cardiovascular disease. Open Heart. 5(2): e000775.

El Asri, O. and Farag, M.A. (2023). The potential of molasses from different dietary sources in industrial applications: A source of functional compounds and health attributes, a comprehensive review. Food Bio. sci., 56: 103263.

Elkatry, H.O.; Almubarak, S.E.H.; Mohamed, H.I.; Ramadan, K.M.A.and Ahmed, A.R. (2024). The potential of using bisr date powder as a novel ingredient in biscuits made of wheat flour only or mixed with barley. Foods, 13(1940): 1-23.

El-Labban, A.A. (2022). Physicochemical characteristics of some new peanut varieties in Egypt. Egypt. J. Appl. Sci., 37 (9-10): 71-81.

El Sohaimy, S.A.; Masry, S.H.D. and Shehata, M.G. (2015). Physicochemical characteristics of honey from different origins. Ann. Agric. Sci., 60(2): 279- 287.

El-Zainy, A.R.; Shalaby, A.O.; Slo, A.A. and Foad, E.A. (2010). Effect of adding sweet petatoe flour to wheat flour on the properties of pan bread. J. Food and Dairy Sci., Mansoura Univ., 1(7): 387-396.

Filipčev, B.; Bodroža-Solarov, M.; Šimurina, O. and Cvetković, B. (2012). Use of sugar beet molasses in processing of gingerbread type biscuits: Effect on quality characteristics, nutritional profile, and bioavailability of calcium and iron. Acta Alimentaria, 41(4): 494-505.

Gallagher, E.; Gormley, T.R. and Arendt, E.K. (2004). Recent advances in the formulation of gluten-free cereal-based products. Trends in Food Sci. Technol., 5(3-4): 143-152.

García-Martínez, R.M.; Rodiles-López, J.O. and Martínez-Flores H.E. (2024). Nutritional value and antioxidant capacity of Mexican varieties of sweet potato (*Ipomoea batatas* L.) and physicochemical and sensory properties of extrudates. Pol. J. Food Nutr. Sci., 74(4): 376-386.

Hamood, A.A.; Mustafa, E.D. and Al-Janabi, M.I.A. (2024). Fortification of laboratory bread with oat flour and study of effect on sensory and nutritional characteristics, Euphrates J. Agric. Sci., 16 (3):213-221.

Holme, D.J. and Pech, H. (1983). Analytical Biochemistry, Longman Group Limited, England, 1st ed., pp. 305.

Hosseini, S.M.; Soltanizadeh, N.; Mirmoghtadaee, P.; Banavand, P.; Mirmoghtadaie, L. and Shojaee-Aliabadi, S. (2018). Gluten-free products in celiac disease: Nutritional and technological challenges and solutions. J. Res. Med. Sci., 23: 109.

Iftikhar, F.; Kumar, A. and Altaf, U. (2015). Development and quality evaluation of cookies fortified with date paste (*Phoenix dactylifera* L.). Int. J. Sci., Eng. Technol., 3(4): 975-978.

James, C.S. (1995). General food studies. In: Analytical Chemistry of Foods, Blachie Academic and Professional, London, New York, Tokyo, Chapter 6, p 135.

Kawai, K.; Toh, M. and Hagura, Y. (2014). Effect of sugar composition on the water sorption and softening properties of cookie. Food Chem., 145: 772-776.

Khiari, R.; Zemni, H. and Mihoubi, D. (2018): Raisin processing: physicochemical, nutritional and microbiological quality characteristics as affected by drying process. Food Rev. Int., 35(3):1-53.

Lavanya, A. and Pinky, B. (2019). Physical and nutritional quality evaluation of different rice varieties. Int. J. Curr. Microbiol. Appl. Sci., 8 (06): 1827-1834.

Lewicki, P.P. and Spiess, W.E.L. (1995). Rheological properties of raisins: Part I. Compression test. J. Food Eng., 24(3): 321-338.

Maki, R.R. and Yasin, S.S. (2023). A study of the chemical composition, vitamins and minerals of four varieties of raisins. 4th International Conference of Modern Technologies in Agricultural Sciences, IOP Conf. Series: Earth and Environmental Science 1262. 6 pages.

Mancebo, C.M.; Picón, J. and Gómez, M. (2015). Effect of flour properties on the quality characteristics of gluten free sugar-snap cookies. LWT - Food Sci. Technol., 64(1): 264-269.

Mariotti, M. and Alamprese, C. (2012). About the use of different sweeteners in baked goods. Influence on the mechanical and rheological properties of the doughs. LWT - Food Sci. Technol., 48(1): 9-15.

Mohamed, R.M.A.; Fageer, A.S.M.; Eltayeb, M.M. and Ahmed, I.A.M. (2014). Chemical composition, antioxidant capacity, and mineral extractability of Sudanese date palm (*Phoenix dactylifera* L.) fruits. Food Sci. Nutr., 2(5): 478-489.

Mohammed, A.T. (2017). Production of high nutritional value cookies from broken rice supplemented with sweet lupin flour. Egypt. J. Agric. Res., 95 (2): 755-767.

Mosa, Z.M.; Khourshied, A. and El-Talawy, F.M. (2006). Quality parameters in black honey samples processed in different regions in Egypt. Egypt T. Agric. Res., 84(1): 165-177.

Nation, J.L. and Robinson, F.A. (1971). Concentration of some major and trace elements in honey bee, royal jelly and pollen, determined by atomic absorption spectrophotometer. J. Apic. Res., 10(1): 35-43.

Niketh, S. and Keshamma, E. (2024). Study of the proximate and mineral composition of commercial raisin (*Vitis vinifera* L) varieties. Afr. J. Bio. Sci., 6(9): 3544-3552.

Nugraheni, M.; Sutopo, S.; Purwanti, S. And Handayani, T.H.W. (2019). Nutritional, physical and sensory properties of high protein gluten free cookies enriched with resistant starch type 3 of *Maranta arundinaceae* and flaxseed. Food Res., 3(6): 658-663.

Ogliari, R.; Soares, J.M.; Teixeira, F.; Schwarz, K.; da Silva, K.A.; Schiessel, D.L. and Novello, D. (2020). Chemical, nutritional and sensory characterization of sweet potato submitted to different cooking methods. Inter. J. Res. - GRATHAALAYAH, 8(10): 147-156.

Ogunbusola, E.M.; Alabi, O.O.; Sanni, T.A.; Seidu, K.T., Oke, H.O. and Akinwale, O.R. (2020). Assessment of gluten-free cookies made from rice and soy protein isolate blends. J. Microbiol. Biotechnol. Food Sci., 9(5): 907-912.

Omran, A.A. and Hussien, H.A. (2015). Production and evaluation of Gluten-Free cookies from broken rice flour and sweet potato. Adv. Food Sci., 37(4): 184-191.

Ortiz, C. and Martirosyan, D.M. (2025). Bioactive compounds in peanuts (*Arachis hypogaea* L.): a review of their anti-inflammatory and antioxidant effects. Agric. Food Bioact. Compoun., 1(12): 1-18.

Pareyt, B. and Delcour, J.A. (2008). The role of wheat flour constituents, sugar, and fat in low moisture cereal based products: a review on sugar-snap cookies. Crit. Rev. Food Sci. Nutr., 48(9): 824-839.

Pareyt, B.; Talhaoui, F.; Kerckhofs, G.; Brijs, K.; Goesaert, H.; Wevers, M. and Delcour, J.A. (2009). The role of sugar and fat in sugar-snap cookies: Structural and textural properties. J. Food Eng., 90(3): 400-408.

Parvin, S.; Easmin, D.; Sheikh, A.; Biswas, M.; Sharma, S.C.D.; Jahan, G.S.; Islam, A.; Roy, N. and Shovon. M.S. (2015). Nutritional analysis of date fruits (*Phoenix dactylifera* L.) in perspective of Bangladesh. American J. Life Sci., 3(4): 274-278.

Pathare, P.B.; Opara, U.L. and Al-Said, F.A. (2013). Colour measurement and analysis in fresh and processed foods: A review. Food Bioprocess Technol., 6: 36-60.

Paucean, A.; Man, S.; Muste, S. and Pop, A. (2016). Development of gluten free cookies from rice and coconut flour blends. Bull. Univ. Agric. Sci. Vet. Med. Cluj-Napoca, Food Sci. Technol., 73(2):162-163.

Peter-Ikechukwu, I.; Kabuo, N.O.; Uzoukwu, A.E.; Chukwu, M.N. and Ogazi, C. (2020). Physical and organoleptic properties of cookies produced with date fruit pulp, toasted watermelon seed and wheat flour composite. Eur. J. Agric. Food Sci., 2(2): 1-5.

Rai, S.; Kaur, A. and Singh, B. (2014). Quality characteristics of gluten free cookies prepared from different flour combinations. J. Food Sci. Technol., 51(4):785-789.

Rajput, H.; Yadav, A.; Kumar, A.; Amit, and Kumar, S. (2024). Comparative analysis of biochemical, nutritional and sensory properties of whole wheat flour with oat flour, defatted soy flour and ground flaxseed. Afr. J. Bio. Sci., 6(Si2): 5477-5488.

Ramadan, B.R.; Mostafa, T.M.A. and Ied, W.A.M. (2018). Effect of drying methods on chemical composition, mineral and antioxidants of saidy date (*Phoenix dactylifera* L.) fruits residue. J. Food and Dairy Sci., Mansoura Univ., 9 (3): 127-132.

Ramírez-Ojeda, A.M.; Moreno-Rojas, R. and Cámara-Martos, F. (2018). Show more mineral and trace element content in legumes (lentils, chickpeas and beans): bioaccesibility and probabilistic assessment of the dietary intake. J. Food Composition and Anal., 73: 17-28.

Rasane, P.; Jha, A.; Sabikhi, L.; Kumar, A. and Unnikrishnan, V.S. (2015). Nutritional advantages of oats and opportunities for its processing as value added foods - a review. J. Food Sci. Techno., 52(2): 662-675.

RDA (1989). Recommended dietary allowance, food nutrition board, National Academy of science press, Washington. D.C. USA.

Salam, M.B.U. and Kashif, M. (2021). Proximate and mineral composition of solar dried raisins found in local market of Palosi, Peshawar. Int. J. Applied Chem. Biol. Sci., 2(5): 1-7.

Salem, M.E.; El-Zayet, F.M.; Rayan, A.M. and Shatta, A.A. (2019). Physicochemical properties and acceptability of gluten-free biscuits as affected by some cereals and tubers type. J. Food Sci., Suez Canal Univ., 6(1): 1-12.

Sandhu, R.S.; Kamboj, R. and Singh, B. (2018). Textural, color and sensory attributes of high fiber cookies supplemented with oatmeal flour. In IJCA: Proceedings on International Conference on Advanced Engineering and Technology, 4: 21-24.

Shewry, P.R. and Hey, S.J. (2015). The contribution of wheat to human diet and health. Food Energy Secur., 4(3): 178-202.

Shokry, A M. (2024). Characteristics estimation of gluten-free cookies using quinoa, millet and cassava flours as functional food. Middle East J. Agric. Res., 13(03): 628-642.

Silva-Paz, R.J.; Silva-Lizárraga, R.R.; Jamanca-Gonzales, N.C. and Eccoña-Sota, A. (2024). Evaluation of the physicochemical and sensory characteristics of gluten-free cookies. Front. Nutr. 10: 1304117.

Singh, A.L.; Sushmita, S.; Chaudhari, V. and Patel C. B. (2018a). The zinc content in peanut seed is governed by its size and calcium and phosphorus nutrition. 5th International Symposium on Zinc (Zinccrops2018) for "Improving crop production and human health", 5-7 Sept 2018 KU Leuven, Belgium. P 39.

Singh, P.; Arora, A.; Strand, T.A.; Leffler, D.A.; Catassi, C.; Green, P.H.; Kelly, C.P.; Ahuja, V. and Makharia, G.K. (2018b). Global prevalence of celiac disease: systematic review and meta-analysis. Clin. Gastroenterol. Hepatol., 16: 823-836.

Singh, P.; Ban, Y.G.; Kashyap, L.; Siraree, A. and Singh, J. (2020). Sugar and sugar substitutes: recent developments and future prospects. In: Mohan, N., Singh, P. (eds) Sugar and Sugar Derivatives: Changing Consumer Preferences. Springer, Singapore. pp 39-75.

Singh, R. and Arivuchudar, R. (2018). Formulation and evaluation of peanut flour incorporated cookies. Int. J. Food Sci. Nutr., 3(5): 56-59.

Struck, S.; Jaros, D.; Brennan, C.S. and Rohm, H. (2014). Sugar replacement in sweetened bakery goods. Int. J. Food Sci. Technol., 49: 1963-1976.

Suleman, D.; Bashir, S.; Shah, F.U.H.; Ikram, A.; Shahid, M.Z.; Tufail, T.; Khan, A.A.; Ahsan, F.; Ambreen, S.; Raza, A. and Mohamed, M.H. (2023). Nutritional and functional properties of cookies enriched with defatted peanut cake flour. Cogent Food Agric., 9(1): 2238408.

Susman, I.; Schimbator, M.; Culetu, A. and Popa. M.E. (2021). Formulation of Gluten-Free Cookies with Enhanced Quality and Nutritional Value. Bull. Univ. Agric. Sci. Vet. Med. Cluj-Napoca, Food Sci. Technol., 78(1): 106-114.

Taha, M.G.; Yousef, H.Y.M.; EL-Behery, S.A. and Mostafa, H. (2019). Fatty acids and chemical composition of peanut (*Arachis hypogaea* L.). Al-Azhar J. Agric. Res., 44(1): 119-127.

Venkatram, A.; Padmavathamma, A.S., Rao, B.S.; Sankar, A.S.; Manorama, K. and Vijaya, D. (2017). Influence of storage temperature on sugars, total soluble solids and acidity of raisins prepared from seedless varieties of grape (*Vitis vinifera* L). Int. J. Curr. Microbiol. App. Sci., 6(8): 2095-2102.

Vici, G.; Belli, L.; Biondi, M. and Polzonetti, V. (2016). Gluten free diet and nutrient deficiencies: A review. Clin. Nutr., 35(6): 1236-1241.

Volpe, S.L. (2013). Magnesium in disease prevention and overall health. Adv. Nutr., 4(3): 378S-383S.

Wang, S. and Wu, W. (2022). Effect of defatted soy and peanut flour obtained by newaqueous method on quality of gluten-free cookies. J. Food Process. Preserv. 46: e16390.

Wang, Y. and Jian, C. (2022). Sustainable plant-based ingredients as wheat flour substitutes in bread making. npj Sci. Food, 6(49): 1-16.

Weeraratne, P. and Ekanayake, S. (2022). Kithul (*Caryota urens*) treacle: A healthy natural sweetener? Ceylon Med. J., 67: 11-16.

Ye. L.; Zheng, W.; Li, X.; Han, W.; Shen, J.; Lin, Q.; Hou, L.; Liao, L. and Zeng, X. (2023). The Role of gluten in food products and dietary restriction: Exploring the potential for restoring immune tolerance. Foods, 12(22): 4179.

Yee, L.K.; Ibrahim, S.N.; Ronie, M.E.; Aziz, A.H.A.; Kobun, R.; Pindi, W.; Roslan, J.; Ridhwan, N.M.; Putra, N.R. and Mamat, H. (2024). Quality characteristics of cookies made with red rice flour composite flour. Akademik Gıda, 22(4): 253-261.

Youssef, M.K.E; Nassar, A.G.; EL-Fishawy, F.A. and Mostafa, M.A. (2016). Assessment of proximate chemical composition and nutritional status of wheat biscuits fortified with oat powder. Assiut J. Agric. Sci., 47(5): 83-94.

Zaki, H.M.; Elshawaf, A.M.; El-Makhzangy, A. and Hussein. A.M.S. (2018). Chemical, rheological and sensory properties of wheat- oat flour composite cakes and biscuits. J. Prod. Dev., 23(2): 287-306.

Zhang, X.; Wang, Z.; Wang, L.; Ou, X.; Huang, J. and Luan, G. (2023a). Structural support of zein network to rice flour gluten-free dough: Rheological, textural and thermal properties. Food Hydrocolloids, 141: 108721.

Zhang, Z.; Liu, B.; Liu, X.; Hu, W.; Zhang, C.; Guo, Y.; Wu, W. (2023b). Effects of steaming on sweet potato soluble dietary fiber: Content, structure, and Lactobacillus Proliferation in vitro. Foods, 12(8): 1620.