

Development of Gluten Free Coconut Cookies by Using Corn Flour and Coconut for Celiac Patients

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Abstract

Gluten intolerance affects approximately 1% of the world population and continuously increasing due to the underestimation as the condition is often left undiagnosed. The only treatment for people with gluten allergy is their use of gluten free diet. Therefore, there is much important need to develop gluten free products which are more nutritious and economical as well. The present study was undertaken on the utilization of alternate flours (corn flour, maize), for the preparation of gluten free cookies made with coconut and corn flour as compared to conventionally made wheat flour cookies. Different concentrations of corn flour were used with coconut concentrations such as 0%, 20%, 30% and 40% to increase its nutritional value. The physicochemical parameters, sensory qualities and functional properties of flours/cookies were studied and compared with control cookies. The blend of maize and coconut crushed had best pasting qualities. The control cookies showed weak texture and binding but T2 (30% coconut concentration) was analyzed the best one from all the treatments. The maximum sensory evaluation acceptability scores were found for T2 cookies. These gluten free cookies will be used by celiac patients who are gluten intolerant. Celiac disease is caused due to gluten indigestibility. This project will explore the use of corn flour and coconut powder to produce such cookies. Once developed successfully, the final product will be commercialized in Pakistan, where to the best of our knowledge no such product is being manufactured locally.

Keywords: Gluten free Cookies; Coconut cookies; Corn flour; Celiac patients diet; High nutritional value.

Abbreviations: CD: Celiac disease; TPC: Total plate count; AOAC: American association of analytical chemists.

Introduction

Cereal based biscuits/Cookies and breakfast cereals are products which are important energy source for human nutrition. In many countries, they have a wide range of options

for enjoying longer and lower-cost snacks, and they are baked products with three main ingredients: flour, sugar and oils, mixed with other small ingredients to develop Cookie Dough [1].

Snack comfort consumption has recently increased in developing countries due to rapid life and socio economic changes. Therefore, cookies are one of the most desirable Snacks in these countries. Cookies are balanced, hard, and edible foods based on basic ingredients such as wheat, eggs, and sugars that have a longer shelf life, are more convenient, less expensive, and can serve as nutrient transport agents. Commercial cookies are usually made with flour. However, consumer interests shift from wheat-based flour to wheat-based or gluten-free foods to prevent gluten intolerance [2].

Wheat is major world's food crop and it is our staple food. Major portion of gluten is obtained from wheat. A wheat kernel have 8-15% of total protein (85-90% is gluten and other is albumin/globulin). Gluten protein present in the seed is not water soluble but can be extracted by different methods in ethanol [3].

Flour is replaced by coconut flour to a certain extent to maintain the nutritional quality of food, maintain adequate levels of nutrients correct or prevents specific nutritional deficiencies in residents or groups at risk of deficiency improve nutritional values and perform certain technical measures [4].

Gluten is the main protein which is present in wheat. Gluten has further components such as gliadin and glutenin. It is a complex mixture of hundreds of related but different proteins, such as gliadin and glutenin. Similar proteins which are present as secalin in rye, hordein in barley, and avenin in oats and are collectively called gluten. The objective was to discuss the biochemical and functional properties of the gluten proteins, including structure, sources, and dietary intakes [5].

The average daily gluten intake in the Western diet is thought to be 5–20 g/day and has been implicated in several disorders. Gluten containing grains (wheat, rye, barley, and oats) are important staple foods. Gluten is among the most complex protein networks and plays a key role in determining the rheological dough properties [6].

Gluten is the main storage protein of wheat grains and also found in barley, wheat and rye. Gluten is a compound mixture of interrelated different proteins such as gliadin and glutenin in wheat. Similarly these storage proteins present in rye as horde in in barley and avenins in oats [7].

Gluten is a heat resistant protein acts as a binding agent and commonly used as additive in food manufacturing to improve moisture retention, flavor and taste. Gliadin contains peptides structures which are highly resistant to pancreatic, gastric and intestinal digestion in gastrointestinal tract [8].

Average daily intake of gluten is recommended as 5-20 g/day, but gluten intolerance and ingestion is a main problem for some peoples who cannot digest gluten, they are named as celiac patients [9].

The most common chronic gastrointestinal disorder occurs in the world is celiac. Only 1-3% of the total Pakistan and whole world is affected by this disease. It is assessed that 90% of these individuals remain undiagnosed [10].

In January 2007 FDA anticipated the rule for the labeling of gluten and gluten free products. According to this rule, it was decided that it is mandatory to mention gluten free term on the label and its quantity which is less than 20 ppm [11].

The first deliberation in the preparation of gluten free product includes the elimination of any food or food ingredients which contains gluten, as celiac disease is activated by the digestion of gluten or its protein fraction *i.e.* gliadins in wheat, horde in barley, secalins in rye and avenins in oats [12].

Materials and Methods

Procurement of Materials

Whole Maize grains were obtained from the local store then it was taken to grinding mill to get its flour [13]. Other ingredients such as sugar, butter, milk powder and coconut crushed were purchased from well profile store with its high quality methods proximate composition of whole rice flour and coconut flour. Gluten free cookies were made by using corn flour as alternative of wheat flour and different concentrations of coconut crushed such as (0%, 20%, 30%, and 40%) are used to judge its nutritional value and textural properties. Following chemical characteristics were determined by these methods; Determination of moisture content is carried out by the No-44 15.02 mentioned in the protocols of AOAC (2006). Methods mentioned in AOAC (2006) with the reference number 940.26 were used as a benchmark in carrying out the ashing calculation for cookies. Reference no 920.29 of AOAC standards (2006) were used as the helping guidelines to determine the fat content of cookies. The method number 920.152 of AOAC (2006) was used as a standard protocol for operating kjeldhal apparatus. Estimation of fiber was determined out by the instructions given in procedure number 962.09 of AOAC (2006). Texture analysis was carried out by the method stated by Eckert (2018) with minor modifications. Texture parameters for cookies were determined instrumentally by compression test using TA.XT Plus Texture Analyzer with a 50 N load cell. TPC was carried out

according to the procedure no. 42-11 of AACC (1999). Gluten free cookies preparation of raw material. Gluten free cookies were made by using corn flour as alternative of wheat flour and different concentrations of coconut crushed such as (0%, 20%, 30%, and 40%) are used to judge its nutritional value and textural properties. All the ingredients were weighed according to set required quantity. Corn flour was taken and sieved with 22 mesh size sieving size net. Then crushed coconut was taken and it was mixed with corn flour then these both were grinded in grinder. Sugar, butter, egg, milk powder and salt was taken and weighed [14-23].

Kneading of dough

First of all sugar and butter were taken in bowl and beated for 5 minutes with manual beater to get their homogenous material, then egg, salt and milk powder were added and mixed for 2 minutes. At the end corn flour and coconut powder were added and mixed for 3 minutes. The dough was obtained and stored in refrigerator for 1 hour. There were four different concentrations of corn flour and coconut used, so all the treatments for gluten free cookies were mixed in the same way. Kneaded dough shown in Figure 1.



Figure 1: Kneaded dough.

Sheeting of the dough

Dough was removed from the refrigerator after getting chilled. Sheet was made on the table and dusting of flour was done on the surface Figure 2.



Figure 2: Sheeting of dough for cookie.

Molding

After sheeting of the dough, molding was done with the help of specific dye as shown in figure Figure 3 and 4.



Figure 3: Molding of cookies in different shape.

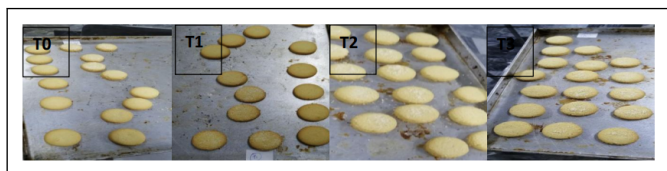


Figure 4: T0 (cookies with 0% coconut concentration), T1 (cookies with 20% coconut concentration), T2 (cookies with 30% coconut concentration), T3 (cookies with 40% coconut concentration).

Baking

After molding, cookies were baked in the deck oven at 160°C for 12 minutes and then cooled for 30 minutes.

Treatments	Ash	Moisture	Fat	Protein	Water activity
T(0)	0.040 ± 0.004	4.100±0.200	5 ± 0.51	5.000 ± 1.035	0.430±0.030
T(1)	0.041 ± 0.003	5.067 ± 0.153	7 ± 0.55	5.667 ± 2.517	0.453 ± 0.029
T(2)	0.038 ± 0.002	4.610 ± 0.101	8 ± 0.56	6.333 ± 2.887	0.457 ± 0.031
T(3)	0.029 ± 0.005	4.067 ± 0.208	7.33± 0.57	6.667 ± 0.577	0.447 ± 0.050

Table 1: Proximate analysis of gluten free cookies.

The range of moisture content varies from 4.067% to 5.067%. The maximum amount of moisture (5.067%) was seen in cookies and minimum value was (4.067%) observed in Different treatments of coconut cookies. The range of Ash content varies from 0.029% to 0.040%. The maximum amount of Ash (0.040%) was seen in cookies and minimum value was (0.029%) observed in different treatments of coconut cookies. The range of Fat content varies from 5% to 8%. The maximum amount of Fat (8%) was seen in cookies and minimum value was (5%) observed in Different treatments of coconut cookies.

Sensory evaluation of cookies

The organoleptic properties of cookies were analyzed through hedonic scale testing keeping in view the appearance, aroma, texture, impact on taste buds while quantifying the overall acceptability. These comparisons were further extended by addition of different proportion of Coconut crushed concentrations in cookies. This diversified proportion appeared to significantly differentiate all these characters and addition. Coconut crushed up to 30% was found to be most suitable in overall acceptability of cookies. And this very ratio appeared compatible in many sensory attributes while compensating the nutritional profile of final product. The judges evaluated the cookies samples for their color, appearance, taste, texture, after taste and overall acceptability. Sensory scores of the various judges were given on hedonic scale [24-27].

Results and Discussion

Statistical analysis

Each factor was implicated with apposite statistical approach to determine the significance level. ANOVA technique was applied to meet the compatibility. Therefore, the obtained results were checked at 5% level for better interpretation.

Proximate composition of cookies

Mean values with their standard deviation

The chemical composition and energy content of the cookies are summarized in Table 1.

The range of Protein content varies from 5.000% to 6.667%. The maximum amount of Protein (6.667%) was seen in cookies and minimum value was (5.000%) observed in different treatments of coconut cookies. The range of water activity varies from 0.430% to 0.457%. The maximum amount of water activity (0.457%) was seen in cookies and minimum value was (0.430%) observed in different treatments of coconut cookies.

All determinations were done in triplicate and the results were reported as average value with standard deviation (SD).

Sensory evaluation of protein gluten-free cookies

Mean values with their standard deviation

The range of Color/Appearance values varies from 7.5 ± 0.53 to 8.4 ± 0.52 . The maximum no of Color/Appearance ($8.4 \pm 0.52\%$) was seen in cookies and minimum value was ($7.5 \pm 0.53\%$) observed in Different evaluations of coconut cookies. The range of no of Taste/Flavor varies from 5.5 ± 0.53 to 8.4 ± 0.52 . The maximum no of Taste/Flavor ($8.4 \pm 0.52\%$) was seen in cookies and minimum value was (5.5 ± 0.53) observed in Different evaluations of coconut cookies. The range of no of Texture/Mouth feel varies from 5.1 ± 0.32 to 8.4 ± 0.52 . The maximum amount of Texture/Mouth feels ($8.4 \pm 0.52\%$) was seen in cookies and minimum value was ($5.1 \pm 0.32\%$) observed in Different evaluations of coconut cookies. The range of no after taste varies from 5.1 ± 0.57 to 7.8 ± 0.63 . The maximum no after taste ($7.8 \pm 0.63\%$) was seen in cookies and minimum value was (5.1 ± 0.57) observed in Different evaluations of coconut cookies. The range of no of Uniformity/Size varies from 7.7 ± 0.48 to 7.9 ± 0.32 . The maximum no of Uniformity/Size ($7.9 \pm 0.32\%$) was seen in cookies and minimum value was ($7.7 \pm 0.48\%$) observed in Different treatments of coconut cookies. The range of no of Overall Acceptability varies from 4.067 ± 0.21 to 8 ± 0.67 . The maximum no of Overall Acceptability ($8 \pm 0.67\%$) was seen in cookies and minimum value was (4.9 ± 0.57) observed in Different treatments of coconut cookies Figure 5.

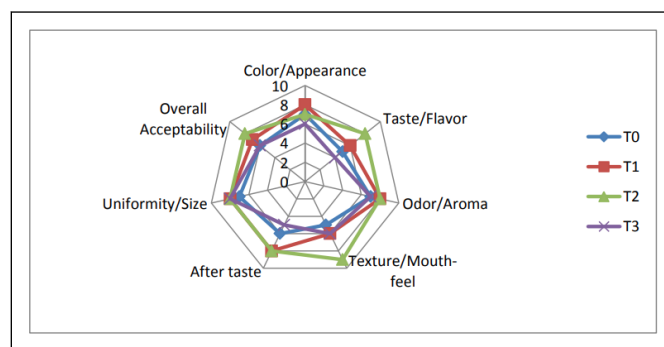


Figure 5: Graph of sensory evaluation.

Nutritional profile of cookies

Studies have shown that patient following a strict glutenfree diet often suffer from various nutrient deficiencies. Hallert described signs of vitamin deficit in celiac patients adhering to gluten-free diet. Ciacci showed that adults with celiac disease resulting a strict gluten free diet have meaningfully lower weight, body mass index, and fat and lean body mass than control subjects. Lohiniemi since gluten free cereal foods are made using refined gluten free flourier starch not enriched or fortified, so they are found to be rich in carbohydrates, proteins and fats. Moreno mechanical and sensory challenges have to be solved in preparing such foodstuffs, since dough without gluten has a weak structure, is technically hard to work and often has a low mouth feel. To enhance the nutritional value and mouth feel, coconut crushed was added with different concentration which gave it good texture and taste Table 2 [28-31].

Nutritional Facts	Per 100 gram	Per Serving (50 gm)	% Daily Value Per Serving
Calories (Kcal)	495	248	
Fat (g)	32.1	16	25
Sodium (mg)	2283	1142	48
Total Carbohydrates (g)	48	24	8
Sugar (g)	4.8	2	
Protein (g)	3	2	

Table 2: Nutritional profile of cookies.

Conclusions

Gluten free diet which is very helpful for the treatment of those people who are gluten intolerant and suffering from celiac disease. By avoiding gluten we can replace our food with different alternative flours which contains no gluten. Gluten free product can minimize the strength of celiac patients and make them healthy. These coconut free cookies that were made have high nutritional value and can be commercialized.

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