Production of Gluten-free Buckwheat Biscuit for Celiac Patients as Contribution to Gastronomy

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Abstract

All individuals in the community have the right to participate in social activities such as eating out, resting and having fun. However, it is a known fact that there are various obstacles regarding the participation and satisfaction of celiac patients in tourism activities. Tourists with chronic disease such as celiac tend to choose destinations and businesses based on their individual needs products. Due to nutritional disorders, tourists have different requests regarding food and beverage service. Celiac patients with gluten in tolerance can not go to their desired destination due to food and beverage restrictions and have serious difficulties in nutrition. Celiac patients experience difficulties in food selection and consumption in the selected destinations and accommodation in gastronomic terms. This study was conducted to increase the nutritional preferences of celiac patients and to contribute to gastronomic tourism. According to the findings of the study, buckwheat biscuits had higher weight and spread ratio than wheat biscuits. In sensory analysis findings, buckwheat biscuits containing 30% ground yellow poppy seed in buckwheat biscuits have a higher score. As a result, buckwheat biscuits containing ground yellow poppy seed are suitable and useful for celiac patients due to their high phenolic content.

Keywords: Celiac, Gluten, Gastronomy, Poppy Seed, Buckwheat Biscuit.

Gastronomiye Katkı Olarak Çölyak Hastaları için Glutensiz Karabuğday Bisküvisi Üretimi

Özet

Toplumdaki tüm bireyler dışarıda yemek yeme, dinlenme ve eğlenme gibi sosyal faaliyetlere katılma hakkına sahiptir. Ancak çölyak hastalarının turizm faaliyetlerine katılımı ve memnuniyeti konusunda çeşitli engeller olduğu bilinen bir gerçektir. Çölyak gibi kronik hastalığı olan turistler, hedefleri ve işletmeleri kendi bireysel ihtiyaçları ürünlerine göre seçme eğilimindedir. Beslenme bozuklukları nedeniyle turistlerin yiyecek ve içecek servisi konusunda farklı istekleri vardır. Gluten toleransı olan çölyak hastaları yiyecek ve içecek kısıtlamaları nedeniyle istedikleri yere gidemezler ve beslenmede ciddi zorluklar yaşarlar. Çölyak hastaları, seçilen hedeflerde ve konaklamalarda yemek seçimi ve tüketiminde gastronomik açıdan zorluklar yaşamaktadır. Bu çalışma çölyak hastalarının beslenme tercihlerini artırmak ve gastronomi turizmine katkı sağlamak amacıyla yapılmıştır. Araştırmanın bulgularına göre karabuğday bisküvilerinin, buğday bisküvilerine göre daha yüksek ağırlık ve yayılma oranı vardır. Duyusal analiz bulgularında karabuğday bisküvilerinde %30 öğütülmüş sarı haşhaş içeren karabuğday bisküvileri daha yüksek puana sahiptir. Sonuç olarak, öğütülmüş sarı haşhaş

tohumu içeren karabuğday bisküvileri, yüksek fenolik içerikleri nedeniyle çölyak hastaları için uygun ve faydalıdır.

Anahtar Kelimeler: Çölyak, Gluten, Gastronomi, Haşhaş Tohumu, Karabuğday Bisküvisi.

INTRODUCTION

The need to eat and drink is a physiological phenomenon in order to sustain a healthy life (Baysal, 2004; Okumuş et al., 2007: 254; Sarışık, 2019: 188). In the tourism sector, catering needs of people meet gastronomy tourism. Despite the changing face of gastronomy tourism in recent years, it has some limitations (Cohen ve Avieli, 2004). All individuals in the community have the right to participate in social activities such as eating out, resting and having fun. However, it is a known fact that there are various obstacles regarding the participation and satisfaction of individuals with disabilities in tourism activities (Germ and Schleien 1997: 23; Kutlu, 2019; Yaylı and Öztürk 2006: 88). It is observed that tourists who want to engage in tourism activities and have chronic disease such as celiac face various obstacles in hotels, restaurants and shopping centers (Kutlu, 2019; Tozlu, 2012) .Therefore, tourists with chronic illness tend to choose destinations and businesses according to their individual needs products (Buhalis, 2000). It is possible to provide the individuals with special circumstances to tourism and to support the organizations economically with gastronomic variety. According to Barney (1996), organizations become competitive only when they can use their sustainable resources to create a competitive advantage (Suna and Alvarez, 2019).. The most accurate approach to gaining competitive advantage is to understand how to attract and retain customers, so as to understand the factors that affect the customer purchasing behavior.

It has emerged that businesses need to make new arrangements (Kutlu, 2019; Tozlu, 2012). It is seen that tourists coming to our country in recent years have paid more attention to destination preferences due to their special health conditions. Customers are becoming more interested in getting detailed information about what they can eat at destinations (Kivela & Crotts, 2005, p. 42; Suna & Alvarez, 2019). Tourists have different requests for food and beverage service due to nutritional disorders. Celiac patients with gluten intolerance cannot go to their desired destination due to food and drink restrictions and have serious problems with nutrition (Dalgic, et al., 2011; Kutlu, 2019; Lindfors et al., 2019). In order to maintain a gluten-free diet, patients can easily consume foods such as gluten-free milk, meat, vegetables and fruits, but instead of foods made with cereal flour, such as gluten-containing bread and pasta, they can consume foods made with industry-specific gluten-free flour (Goddard and Gillett, 2006; Losowsky, 2008 Kutlu, 2019). Gluten-free bakery products are among the special foods called "gluten-free foods" produced for celiac patients. These include naturally gluten-free rice, corn and soy flour, and biscuit products prepared from guar or amarant (https://ankara.baskenthastaneleri.com/brosur/pdf/COLYAK_HASTALIGINDA_BESLENME.pdf). Specially produced gluten-free nutrients contain carbohydrates and therefore high calorie content, as they contain less nutrients such as protein, fiber, iron and folic acid, niacin, thiamine and riboflavin (El Khoury, 2018; Kutlu, 2019). Although it seems difficult to live, it can be corrected by completely removing gluten-containing foods from the diet (Merdolvd., 1999). It is the limitations in food selection and consumption in the destinations and accommodation selected for celiac patients. It has been observed in the literature reviews that there are not enough studies on gluten-free foods. This study was carried out in order to increase food preferences by contributing to gastronomy tourism by facilitating destination choices of celiac patients, contributing to the elimination of this deficit and supporting future researches.

Celiac disease is caused by an individual's susceptibility to the gliadin protein of wheat gluten and prolamins of barley and rye (Denery-Papini et al. 1999). The ingestion of food containing

these proteins causes the destruction of the villous structure of the small intestine and leads to malabsorption of important nutrients such as iron, calcium and vitamins. The treatment for celiac disease is a lifelong adherence to a gluten free diet (Feighery 1999).

Buckwheat (*Fagopyrum esculentum*) is a pseudocereal and can be used in formulation of glüten-free products by celiac patients (Kaur et al. 2015). Steadman et al. (2001) reported that buckwheat has starch (65-75%), protein (10-12.5%), lipid (4.7%), minerals (K, P, Mg) and vitamins (B1, B2). Buckwheat proteins consist of globulins (up to 50%) and albumin (25%) (Choi et al. 2006). Buckwheat has also various phenolic compounds (rutin, quercetin, kaempferol, vitexin, orientin, quercetin, isovitexin, isoorientin) with antioxidant activity (Cai et al. 2004). Sensoy et al. (2006) observed a higher total phenolic content for buckwheat flour (10.47 mg/g) than that for white flour (1.79 mg/g). Szawara-Nowak et al (2016) investigated the effects of buckwheat flour on total phenolic content of dark or white wheat bread and reported that total phenolic content of dark wheat flour (1.8mg rutin equivalent/g) was higher than that of white wheat flour (0.38mg rutin equivalent/g) and increasing level of buckwheat flour in bread caused an increase of total phenolic content. Zelinski et al. (2017) studied functional properties of gluten free muffins made from buckwheat flour and compared with control gluten free muffin made from corn flour and reported that gluten free muffins made from buckwheat flour showed higher total phenolic content (24.48-26.28mg gallic acid equivalent/g) than control muffin (21.06mg gallic acid equivalent/g). Jan et al. (2015) researched antioxidant properties of cookies made from wheat flour blended with buckwheat flour at different levels (0, 20, 40, 60, 80, 100%) and reported that buckwheat cookie (100% buckwheat flour) showed higher antioxidant properties than control cookie (100% wheat flour).

Poppy (*Papaver somniferum*) is cultivated as an annual crop (Ozcan and Atalay 2006). According to scientific classification, Papaver somniferum L. is belonging to the Papaveraceae family of Rhoedales team. Poppy is cultivated in Turkey, India, Australia, France, Spain and Hungary. Turkey and India are accepted as traditional poppy producers in the World. The cultivated area of poppy in Turkey is 45% of the total cultivated area in the World. Some of poppy seed production (approximately 20000 tonnes for 1 year) is exported from Turkey to other countries. Poppy has seed and a capsule. Seed contains 45-54% oil and 20-30 % protein. Seed is used in bakery products after grinding (TGB, 2016). Ozcan and Atalay (2006) reported that potassium, phosphorus, magnesium, calcium, iron and sodium were found in poppy seed. Ryan et al. (2007) reported that ferulic acid, gadoleic acid, arachidic acid, linolenic acid, palmitic acid, linoleic acid, oleic acid, stearic acid, palmitoleic acid and palmitic acid were found in poppy seed. Maden & Yalcin (2017) researched the effect of storage at 15-20°C for different times (0-60 days) on free fatty acid amount, peroxide value and iodide number of White poppy seed, yellow poppy seed and gray poppy seed fats and reported that these values increased with increasing of storage time, but these changes were found as little. Yalcin & Maden (2017) evaluated the quality characteristics of noodles containing ground yellow poppy seed. For production of the noodles, Kunduru-1149 and Altındas-95 wheat flours and ground yellow poppy seed (5 % and 10 %) were used. It was reported that noodles made from Kunduru-1149 wheat flour had higher quality characteristics than noodles made from Altıntas-95 wheat flour and ground yellow poppy seed caused darker color. Total phenolic content of noodles including 10% ground yellow poppy seed was higher compared to that of other noodles. Yalçın (2018a) reported that crackers including 30% ground yellow poppy seed had higher total phenolic content compared to other samples. Yalcin (2017) used ground yellow poppy seed at different levels (0, 25, 50, 75, 100 % of fat). It was reported that the spread ratio was increased with addition of ground yellow poppy seed. Total phenolic content increased with increasing levels of ground yellow poppy seed.

It is known that there isn't any study about using buckwheat flour and ground yellow poppy seed in biscuits. Gluten free biscuits including ground yellow poppy seed and buckwheat flour in different ratios were prepared and physical characteristics, color properties, total phenolic content and sensory scores of gluten free biscuits were compared with those of wheat biscuit, in this study.

MATERIALS AND METHODS

Materials

Soft wheat flour was obtained from industry. Buckwheat grain and ingredients corn syrup, defatted milk powder, corn syrup, shortening, sugar, brown sugar, sodium bi carbonate, ammonium bi carbonate, salt were purchased from the market. Ground yellow poppy seed (Afyon) was purchased from the producer. Buckwheat grains (China) were ground into flour by grinder (Bosch, Germany) and sifted through 212 µm sieve. Protein content, mineral (potassium) and phenolic compounds of buckwheat flour were determined according to AACC approved methods (AACC, 2000), the method reported by Gopalani et al. (2007) and the HPLC method reported by Caponio et al. (1999), respectively. Fat content of ground yellow poppy seed was analyzed with the AOAC method (1990).

Biscuit Production

Biscuits were produced according to the AACC method (2000) with some modifications (Baking temperature was 200°C replaced by 205°C). Ground yellow poppy seed and buckwheat flour (<212µm) were mixed in three different ratios, 10:90 (PB1), 20:80 (PB2) and 30:70 (PB3) for the production of biscuits. Control biscuit (C) was produced from wheat flour (40g). Buckwheat flour, ground yellow poppy seed and ingredients including defatted milk powder (0.4 g), sugar (12.8 g), corn syrup (0.6 g), brown sugar (4 g), shortening (16 g), sodium bi carbonate (0.4 g), ammonium bi carbonate (0.2 g) and salt (0.5 g) were mixed and baked according to the method by Yalcin (2018b).

Weight and Geometry of Biscuits

Weight, diameter, thickness and spread ratio of biscuits was determined according to the method reported by Yalcin (2018b).

Color Properties of Biscuits

Biscuits were ground with a grinder (Bosch, Germany). The color values (L*, a*, b*) of ground biscuits (<500µm) were performed by using a X-rite Ci6x portable spectrophotometer (USA).

Total Phenolic Content in Biscuits

Extraction and determination of total content in biscuits were analyzed according to Awika et al. (2004) and Li et al. (2007). Total phenolic content value of samples was expressed as mg GAE (gallic acid equivalent)/g (d.b.).

Sensory Analysis

Sensory analysis was applied to biscuits. Sensory panel contains 10 trained panelists. The hedonic test with 5 point scale ranged from 1 (dislike extremely) to 5 (like extremely) described by Ahmed et al. (2014) with some modifications. The biscuits were evaluated for structure, shape, fracture, appearance, flavor, chewiness and overall acceptance.

Statistical Analysis

One way ANOVA and Duncan tests (SPSS 15) were used to determine significance among values of means.

RESULTS AND DISCUSSION

Characteristics of the Base Materials

The protein content of buckwheat was found as 10.8% (dw). Potassium content of buckwheat was 7.441mg/g sample (dw). This result was higher than the result of study reported by Steadman et al. (2001). Steadman et al. (2001) reported that potassium content of buckwheat was found as 5.650mg/g dw. Phenolic compounds of buckwheat flour (dw) were gallic acid (22.21µg/g), chlorogenic acid (0.74µg/g), 4-hydroxybenzoic acid (25.59µg/g), 2,5-dihydroxybenzoic acid (4.76µg/g), vanillic acid (11.69µg/g), caffeic acid (81.82 µg/g), p-coumaric acid (0.54µg/g), ferulic acid (0.15µg/g), ellagic acid (4.21µg/g), cinnamic acid (6.33µg/g), rutin (8.05µg/g), apigenin (2.44µg/g) and catechin (4.64µg/g). Ground yellow poppy seed had 53.7% oil content.

Quality Characteristics of Biscuits

The weight, diameter, thickness and spread ratio values of biscuits are given in Table 1. Difference in ground yellow poppy seed level in buckwheat biscuit caused a significant change in quality characteristics of buckwheat biscuits($p<0.05$).

Significantly higher weights were observed for buckwheat biscuits in comparison to wheat biscuit. The weight of buckwheat biscuits decreased with increase in content of ground yellow poppy seed in biscuits. Higher weights for biscuits prepared from buckwheat flour as compared to biscuits prepared from wheat flour were also observed by Kaur et al. (2015).

Biscuits (PB2 and PB3) had significantly higher diameter than wheat biscuit (C). Diameter of biscuit (PB1) was found similar to wheat biscuit. W Thickness of biscuit decreased from 14.5 mm to 9.6 mm when ground yellow poppy seed level increased biscuits. Buckwheat biscuits had a significantly lower thickness than wheat biscuits.

Spread ratio of biscuits, which is an important quality parameter, increased when ground yellow poppy seed level in biscuits. Buckwheat biscuits gave a significantly higher spread ratio in comparison to the wheat biscuit. The spread ratio of biscuit (PB3) was found to be the highest (6.69). Spread ratio of biscuits increased due to increasing oil content of biscuit dough with addition of ground yellow poppy seed. Yalçın (2018b) used ground poppy seed types in biscuit formulation. Biscuits including 20% ground yellow poppy seed had higher spread ratio than biscuit including 20% ground white poppy seeds and gray poppy seeds.

Table 1. Physical Parameters of Biscuit

Ratio of ground yellow poppy seed and buckwheat flour	Weight (g)	Diameter (mm)	Thickness (mm)	Spread ratio (D/T)
Control	17.8 ± 0.2^{d}	59.4 ± 0.6^{c}	14.5 ± 0.3^{a}	4.10 ± 0.04^{d}
10:90	18.9 ± 0.0^{a}	60.2 ± 0.2^{c}	12.2 ± 0.2^{b}	4.95 ± 0.07^{c}
20:80	18.6 ± 0.1^{b}	61.4 ± 0.5^{b}	10.6 ± 0.4^{c}	5.82 ± 0.24^{b}
30:70	18.3 ± 0.0^{c}	63.9 ± 0.3^{a}	9.6 ± 0.2^{d}	6.69 ± 0.18^{a}

Values are means ± standard deviation of two replicates
Values marked by the same letter in each column are not statistically different ($p<0.05$).

Color Properties of Ground Biscuits

Color properties (L*, a*, b*) of biscuits are given in Table 2. L* color values (lightness) of buckwheat biscuits were significantly lower than that of wheat biscuits. Higher a* color (redness) and b* color (yellowness) values were observed for buckwheat biscuits compared to

those of wheat biscuits. L* color value of buckwheat biscuits decreased, while a* and b* color values when ground yellow poppy seed level was increased.

Table 2. Color values of biscuit

Ratio of ground yellow poppy seed and buckwheat flour	L*	a*	b*
Control	71.14±0.05[a]	12.34±0.05[d]	30.54±0.23[d]
10:90	57.18±0.02[b]	15.65±0.03[c]	31.00±0.01[c]
20:80	51.16±0.08[c]	17.20±0.01[b]	32.20±0.05[b]
30:70	47.17±0.08[d]	18.91±0.03[a]	33.06±0.06[a]

Values are the mean ± standard deviation of two replicates.
Values marked by the same letter in each column are not statistically different ($p<0.05$).

Total phenolic content of biscuits

Figure 1 shows total phenolic content of biscuits. Total phenolic contents of buckwheat biscuits were significantly higher than that of wheat biscuit. The total phenolic content of buckwheat biscuits increased from 2.37 mg gallic acid equivalent/g sample to 2.64 mg gallic acid equivalent/g sample with increasing level of buckwheat flour in biscuits. Higher total phenolic content was reported by Filipčev et al. (2011) for ginger nut cookies including buckwheat flour (30%, 40%, 50%).

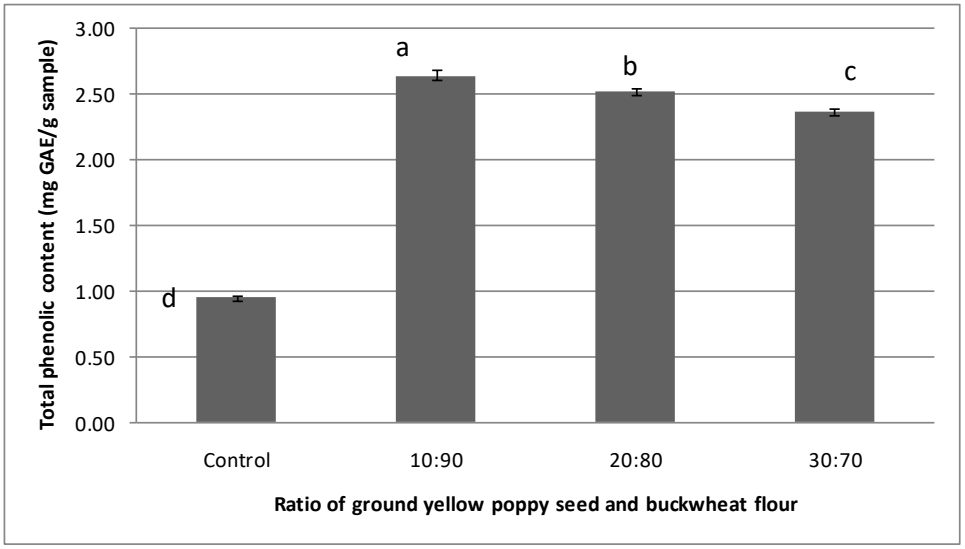

Figure 1. Total phenolic content of biscuit samples

Sensory Profile of Biscuits

The mean sensory acceptance scores for appearance, shape, flavor, structure, fracture, chewiness and overall acceptance of biscuits are shown in Figure 2. Biscuits including 10% ground yellow poppy seed had the lowest scores. Control biscuit had the highest score. The best biscuit among buckwheat biscuits was biscuit including 30% ground yellow poppy seed. All biscuits had desired scores (above 3).

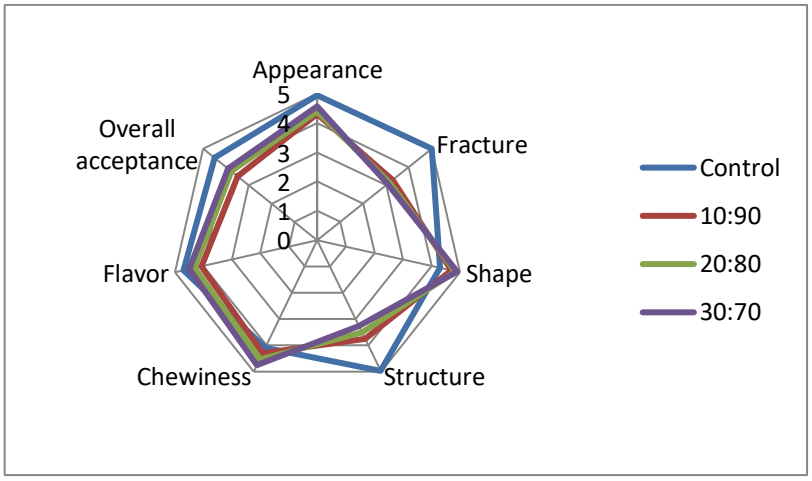

Figure 2. Sensory profile of biscuit samples

CONCLUSION

Celiac patients with gluten in tolerance can not go to their desired destination due to food and drink restrictions and have serious problems with nutrition. In this study it was conducted to increase the nutritional preferences of celiac patients and contribute to gastronomic tourism. Quality characteristics (weight, diameter, thickness, spread rate), color values (L *, a *, b *) and the sensory profile of buckwheat biscuits with ground yellow poppy seed were compared with the same values of wheat biscuit (control biscuits made from wheat flour do not contain ground yellow poppy seed). According to the findings of the study, buckwheat biscuits had higher weight and spread rate than wheat biscuits. Buckwheat biscuits have lower L * color values and higher a * and b * color values compared to wheat biscuits. Total phenolic content of buckwheat biscuits is higher than wheat biscuits. In the sensory analysis findings, it was found that buckwheat biscuit containing 30% ground yellow poppy seed had a highest score among buckwheat biscuits. According to these results, the best biscuit was biscuit containing 30% ground yellow poppy seed. Based on these results, it can be concluded that gluten-free biscuits, including buckwheat flour and ground yellow poppy seed, have antioxidant activity, which has a high phenolic content, which ensures the protection of living tissues from various diseases. This result suggests that buckwheat biscuits, including ground yellow poppy seeds, may be healthier than wheat biscuits. It is recommended that more studies should be carried out, awareness activities such as world celiac day in hotels should be organized within the score of gastronomy tourism without berries, special ovens, which produces gluten free bread should be opened and gluten free dining stands should be established in hotel restaurants to increase the nutritional preferences of celiac patients and to participate of celiac patients to gastronomy tourism.

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