https://dergipark.org.tr/tr/pub/food
OPEN ACCESS JOURNAL

ISSN 2667-5803

FHTI Journal of Food Health and Technology Innovations
September Vol 4, No 8 (2021)

DergiPark AKADEMİK
ASOS indeks

Proceeding Article

Use of Some Functional Flours for Development of Prebiotic Gluten-Free Cookies

Çelik Hekimoğlu Fulya[1], Gok İlkay[1] *

Abstract

In this study, five different gluten-free and prebiotic products were developed by using chickpea, dried beans, wheat, rice, buckwheat, and carob flours and some chemical and sensory analysis were examined. Cookies were evaluated by 70 untrained panelists in terms of sensory analysis with appearance, texture, smell, taste, general liking, and consumption criteria. The first three products, which were liked at the highest score were analyzed to determine their nutritional values like dietary fiber, energy, ash, carbohydrate, protein, moisture, fat, and starch amounts were investigated.

Among the products, chickpea flour cookies were determined as higher nutritional value and liked much more than other cookies. In case of sensory analysis, the least liked cookie was the rice flour cookie. As a result of the study, four tasty gluten free cookie was prepared with functional foods. They are suitable for general consumption preferences and can be an alternative to wheat flour cookies. It was observed that consumers tend to consume these alternative products. As a result, gluten-free and prebiotic products can be developed by functional foods and can be consumed with a high degree of liking.

Keywords: Functional food, Sensory analysis, Gluten-free, Prebiotic, Cookie

TÜBİTAK ULAKBİM

1Manisa Viticulture Research Institute, Republic of Türkiye Ministry of Agriculture and Forestry, 45125 Manisa, Türkiye
*corresponding author: fadimeates2@yahoo.com

1. Introduction

Functional foods, which are basic nutrients, have special components that have advantageous physiological effects that can benefit people in terms of health and reduce disease risks (Hasler, 2012; Siro et al., 2008). Although all foods can be considered functional, the term "functional foods" refers to a variety of foods that have certain common characteristics. Functional foods are biologically active ingredients that have the potential to reduce disease risk when consumed as part of a normal diet. These foods are beneficial to health above and beyond traditional nutritional value (Gok & Ulu, 2019). According to the European consensus document (Diplock et al., 1999), a food product is considered functional food if, beyond adequate nutritional effects, it improves one or more target functions in the body, reducing the risk of developing a disease.

Jonas and Beckmann (1998) have classified functional foods into two different categories as modification and enrichment. The modification involves the artificial regulation of genes by biotechnological methods to reduce harmful substances in food content or to increase the value of nutrients in food. Enrichment, on the other hand, involves the acquisition of new foods by adding essential nutrients that are or are not naturally present in food such as probiotic yogurt (Öncebe et al., 2019).

Prebiotics, a special dietary fiber, are known for their health benefits and reduction in cancer risk in humans, including increased bioavailability of minerals, modulation of the immune system, prevention of gastrointestinal (GI) infections, modification of inflammatory conditions, regulation of metabolic diseases (Roberfroid, 2010; Davani et al., 2019). They are not affected by heat, cold, acid, or time, provide a wide range of health benefits and feed the good bacteria that everyone has in their intestines. A prebiotic is a beneficial food item that affects the host by selectively stimulating growth or activity, or both of the limited number of bacterial species found in the colon (Nagpal, 2011). Known as a functional food, Kefir is a fermented milk product and a natural probiotic that consumes prebiotics. Kefir grains contain lactic acid bacteria, acetic acid bacteria, and yeasts (Karaca et al., 2018). Fermented foods such as pickles and functional foods containing compounds such as probiotics are also functional foods.

Celiac disease or gluten sensitive enteropathy is a chronic disorder of the small intestine caused by exposure to gluten in the genetically predisposed individuals (Man et al., 2014). It is characterized by a strong immune response to certain amino acid sequences found in the prolamin fractions of wheat, barley and rye (Hussein et al., 2012). When people with celiac disease eat foods or use products containing gluten, their immune system responds by damaging or destroying the intestinal villi leading to the malabsorption of nutrients, thus adversely affecting all systems of the body (Hussein et al.,2012). Intestinal symptoms can include diarrhea, abdominal cramping, pain and distention and untreated celiac disease may lead to vitamin and mineral deficiencies, osteoporosis and other extra intestinal problems. The gluten-free diet remains until now the only treatment for celiac disease. Gluten free diet has benefits such as the recovery of the villi of the small intestine and risk reduction of malignant complications (Man et al., 2014).

In our country, is between one thousand to 1 percent prevalence of celiac disease 3, while it is estimated celiac from 250 thousand to 750 thousand in Turkey but considering that diagnosis to 10 percent is expected that patients diagnosed between 25 thousand to 75 thousand. Undiagnosed patients are the invisible part of the iceberg. Our Ministry of Health Information According to the data obtained from the

system according to the region in the number of diagnosed celiac disease in Turkey distribution but follows for 2017 along with 2019 in May as of our country Celiacs number is 68123 (Aydoğdu et al., 2005)

The development of a gluten-free alternative product for consumers with gluten intolerance is a subject of research all over the world. Increasing the variety of gluten-free products with the increase of gluten-sensitive individuals is of great importance as it will positively affect both the economic and social comfort of the people (Benjamin et al., 2018). Besides, it is of great importance to make gluten-free products functional by increasing their nutritional value (Hosseini et al., 2018). In this study, it was aimed to develop prebiotic products with four different gluten-free and one gluten-containing functional foods as a control, and to make both sensory and nutritional value analyzes of the developed products (Güngör, 2019).

2. Materials and Methods

2.1. Material Production

Five different cookie recipes were created by using four gluten-free (chickpea flour, dried bean flour, rice flour, buckwheat flour, carob flour, teff flour) and one gluten-containing flour (wheat flour) and their both sensory and nutritional analyzes were made. In order to prepare the cookies the following materials has been purchased from local market: chickpea flour, dried bean flour, rice flour, buckwheat flour, carob flour, teff flour, wheat flour, butter, oil, eggs, powdered sugar, baking powder, vanilla, wheat starch, amaranth flour, rose water. The recipes of cookies is given in *Table 1*.

Butter, powdered sugar, vanilla, baking powder were used as fixed materials in different proportions in each recipe due to the difficulty in making and shaping of flours, except for wheat flour, because of their gluten-free nature.

2.2. Sensory analysis

Sensory evaluation of cookies was applied to the group of 70 untrained panelists. Evaluation focused on overall sensory quality of cookies based on appearance, texture, smell, taste, and general consumption criteria with a hedonic scale of five points from “dislike extremely” to “like extremely”. The cookies presented to the panelists were numbered randomly with three-digit codes. Evaluation form were used to analyze sensory parameters. After evaluation were completed, the averaged data were tabulated. It aims that the taster can evaluate without prejudice and without being affected by the ranking. The prepared cookies (Chickpea flour cookie-NK, Dried bean flour cookie-KK, Wheat flour cookie-BK, Rice flour cookie-PK, Buckwheat and Carob cookie- KVK) were shaped in the same molds and quantities. The sensory characteristics of the samples were tested in the laboratory using the Organoleptic instrument, with the related product notice analysis method of the Turkish Standards and Turkish Food Codex regulations.

2.3. Proximate analysis of cookies

The first three products (BK 3.56; NK 3.36 and KVK 3.21) with highest mean value in the general liking criterion were determined their proximate composition was analyzed by AOAC (2005) official method of analysis. Highest scored three cookies analyzed for: moisture content by drying oven device, fat by Soxhlet solvent extraction method, protein by micro-Kjeldahl method (N x 6.25), and ash content by dry ashing method. The dietary Fiber (%) contained in the samples was determined by using the spectrophotometric device; Energy (%) was determined by the analysis method (FAO Food and Nutrition, 2003); Starch amount (%) were determined. Three replications of experiment were performed and mean value of each parameter with standard deviation were calculated.

2.4. Statistical analysis

Statistical analysis of the evaluation results of the sensory was carried out by the SPSS software, version 17.0. The conformity of the variables to normal distribution was examined with the Kolmogorov Smirnov test. Mean, standard deviation, and median values were utilized in presenting descriptive analyzes. The Mann-Whitney U Test was employed when evaluating non-parametric variables between two groups, and the Kruskal Wallis test was employed when evaluating variables between more than two groups. The cases where the p-value was less than 0.05 were considered statistically significant. The results of the food analysis and the statistical analysis were discussed together, and the panelists' evaluations and the health characteristics of the foods were compared (Olcay A, 2014).

3. Study Results and Discussion

The preferences characteristics of cookies identified with sensory tests in terms of appearance, texture, smell, taste, general liking, and product consumption. A total of 70 people, 35 males and 35 females, participated in this study. 27 people were under 30 years old, 38 people were between 30-50 and 5 people were over 50 *(Figure 2)*.

Scores given for appearance, texture, smell, taste, product consumption *(Table 2),* and general liking *(Figure 3)* were compared by gender; it was determined with Mann Whitney U Test that there was no significant difference between males and females.

Samples were compared for Appearance, Texture, Smell, Taste, General liking, and Consumption. No significant difference was found in terms of appearance and smell between samples. It was observed that there was a significant difference between the samples in terms of texture, taste, general liking, and consumption. Posthoc analysis results performed in terms of taste, the score of the PK sample was lower than BK and KVK samples.

When looking at the general liking scores, the score of the BK sample was higher than the KK, PK, and KVK samples. In terms of consumption scores, the score of the NK sample was higher than the scores of the KK, PK, and KVK samples. Similarly, the score of the BK sample was higher than the scores of the KK, PK, and KVK samples *(Figure 4)*.

Posthoc analysis was conducted to examine whether there was any difference between the samples in texture, taste, general liking, and consumption *(Table 3)*. In terms of texture, the score of the NK sample was higher than the other 4 samples. In terms of taste, the score of the PK sample was lower than the BK and KVK samples. When looking at the general liking scores, the score of the BK sample was higher than the KK, PK, and KVK samples. In terms of consumption scores, the score of the NK sample was higher than the others. Similarly, the score of the BK sample was higher than the scores of KK, PK, and KVK samples.

When the samples were analyzed in themselves with the Spearman Correlation Test, there was a same directional correlation between "smell" and "appearance", between "taste" and "appearance and smell", between "general liking" and "appearance, smell, and taste", between "consumption" and "appearance", between "taste" and "general liking" in the NK sample. In the KK sample, there was a same directional correlation between "smell" and "appearance", between “taste" and "appearance and smell", between "general liking" and "appearance and taste", between "consumption" and "taste and general liking". In the BK sample, there was a same directional correlation between "smell" and "texture", between "taste" and "texture and smell", between "general liking" and "texture, smell, and taste", between "consumption" and "appearance, texture, taste, and general liking". In the PK sample, there was a same directional correlation between "smell" and "texture",

between "taste" and "smell", between "general liking" and "appearance, smell, and taste", between "consumption" and "texture, smell, taste, and general liking". In the KVK sample, there was a same directional correlation between "smell" and "appearance and texture", between "taste" and "appearance, texture and smell", between "general liking" and "taste", between "consumption" and "general liking" *(Table 4)*.

As a result of the food analysis evaluation of the top three products (BK 3.56; NK 3.36 and KVK 3.21) in the general liking criterion, Buckwheat and Carob Cookies had a dietary fiber rate of 2.20%, Chickpea flour cookies had 7.20%, wheat flour cookies had 1%. When looking at the energy level results of the samples, BK wheat flour cookies had the highest ratio (520.46 kcal/100g). As a result of food analysis, it was determined that the highest ash percentage was found in chickpea flour cookies with 1.30%. The highest rate in terms of carbohydrate levels was 63.83% in KVK - Buckwheat and Carob flour cookies.

Chickpea flour, buckwheat, and carob flour, three of the gluten-free flours used in the study, are the flours for which protein levels were not expected to be high due to their structure. The food analysis result supported this study. The highest protein percentage was in wheat flour cookies with 8.48. As a result of the analysis, the highest humidity was in Buckwheat - Carob cookie with 8.48%. Butter was used in similar proportions in all recipes. However, the amount of material varies according to the consistency of the cookies. For this reason, chickpea flour (27.85%) and wheat flour (27.46) cookies, in which a significant difference between fat percentages was not found, required similar fat content in terms of consistency. Buckwheat and carob cookies (19.32%) on the other hand, came to its proper consistency with less amount of butter because of the binding characteristics of the carob.

Starch constitutes the majority of wheat flour with 71%. As a result of the analysis, the starch amount of the wheat flour cookie was the highest with 40.3%, per the quality of the flour used *(Table 5)*.

4. Conclusion

Within the scope of the study, five different cookie recipes were created and analyzed by combining four gluten-free and one gluten-containing flour with functional foods. According to the analysis results, the sample with the highest dietary fiber rate was NK chickpea flour cookie with 7.20%. The lowest dietary fiber was in wheat flour cookies with 1%. BK Wheat flour cookie was found to contain higher starch with 40.3% than the other two samples. Wheat flour cookies again have the highest rate in energy analysis. Food analysis results gave expected results depending on whether the flours used contain gluten or not. Although there was no significant difference between the used fat and sugar rates, some flours need more fat to obtain consistency due to their structure. The fat percentage criterion in the analysis, therefore, did not give a meaningful result. In terms of carbohydrate content, a 63.83% result was seen in wheat flour cookies. However, the percentages in the other two cookies did not differ greatly in terms of carbohydrates.

The majority of panelists preferred BK wheat flour cookie, which is a widely known recipe in terms of appearance, taste, general liking, and consumption, while they preferred NK chickpea flour cookie in terms of smell and texture. The scores given by 35 males, and 35 females participating in the study for appearance, texture, smell, taste, general liking, and product consumption were compared; it was observed that there was no significant difference between males and females.

In terms of consumption scores, NK was higher than the other three cookies made with gluten-free flour. When the sensory analysis results of cookies prepared

with functional foods and gluten-free products were examined, it was seen that they could be preferred by most of the panelists.

When the factors affecting the purchasing decisions of today's functional food consumers were examined, they were seen to be the factors such as the taste of the functional product, the brand reputation of the product, the level of education of the consumer, avoiding giving confusing and difficult information about the product, emphasizing the health benefits of the product, carrying out promotional and tasting studies about the product, choosing the most suitable markets for the target consumer group (Sevilmiş, 2008).

In this study, four new products prepared with different gluten-free flours and enriched with functional foods were developed, which are suitable for general consumption habits and can be an alternative to NK wheat flour cookies, which the majority are accustomed to. It was observed that these cookies prepared with different flours attract the attention of consumers and that consumers tend to consume these different products.

The study has shown that if people gain awareness and find consumption opportunities, the widespread use of functional and gluten-free foods, the production of alternative products, and the idea that these foods are not medicines but only a supplementary element to healthy nutrition will be adopted.

Only 10% of those who do not use functional products say that they can use these products if they are informed, and 52% of them say that they would not use these products even if they are informed. This 10% section, on the other hand, prefers to be informed mostly by the opinions of experts. Since the contradictory news about these products in media channels causes people to be insecure about them, the statements made by the experts on the subject are more effective in guiding the consumers.

Due to the high prices of such foods and the lack of a widespread understanding of their usage and places in Turkey, it is thought that increasing the alternatives on this subject would be beneficial. A study on functional foods has shown that the level of use of these foods has increased significantly. Participants were asked "how often do you use functional foods" and their answers are as follows: 10.4% stated that they use it every day, 20.8% once a week, 24.7% 2-3 days a week, 13.0% once a month, and 23.1% rarely. As can be understood, 55.9% of functional food consumers consume functional products at least once a week (Karaağaç, 2010).

At the 6th Meeting of the International Scientific Association of Probiotics and Prebiotics (ISAPP) in 2008, the definition of "diet prebiotics" was defined as substances that benefit the gastrointestinal microbiota. With this definition, it has been reported that prebiotics is useful not only in the colon but also in many places such as the oral cavity and the urogenital system (Valcheva et al., 2016). With the production/consumption of functional foods together with probiotic microorganisms and prebiotic substances, it is possible to strengthen the defense mechanism of the body and reduce the risk of disease and health problems (Green et al., 2020).

In this study, it was seen that gluten-free and prebiotic products could be developed with functional foods, and it was concluded that they could be consumed with a high degree of liking by consumers, and it is thought that these and similar products will become widespread with similar studies.

REFERENCES

Hussein, A. M. S., Hegazy, N.A., Ibrahim, T.A.A. (2012). Production and Evaluation of Gluten-Free Cakes, Australian Journal of Basic and Applied Sciences, 6(12): 482-491.

AOAC Official Method 930.15 (2005) Official Methods of Analysis of AOAC INTERNATIONAL, 18th Ed., AOAC INTERNATIONAL, Gaithersburg, MD.

Man, S., Paucean, A., Muste, S. (2014). Preparation and Quality Evaluation of Gluten-Free Biscuits. Bulletin of University of Agricultural Sciences and Veterinary Medicine.71(1) : 39-44.

Aydoğdu, S., Tümgör, G. (2005). Çölyak Hastalığı. Güncel Pediatri. 2:47-53.

Niland, B., & Cash, B. D. (2018). Health Benefits and Adverse Effects of a Gluten-Free Diet in Non-Celiac Disease Patients. Gastroenterology & hepatology, 14(2), 82–91.

Davani-Davari, D., Negahdaripour, M., Karimzadeh, I., Seifan, M., Mohkam, M., Masoumi, S. J., Berenjian, A., & Ghasemi, Y. (2019). Prebiotics: Definition, Types, Sources, Mechanisms, and Clinical Applications. Foods (Basel, Switzerland), 8(3), 92.

Diplock, A., Aggett, P., Aggett, M., Bornet, E., Fern, E. & Roberfroid, M. (1999). Scientific Concepts of Functional Foods in Europe: Consensus Document. British Journal of Nutrition(81), 1-27.

FAO. (2003). Food Energy – Methods of analysis and conversion factors. In Report of a technical workshop. FAO Food and Nutrition Paper 77. Rome: FAO.

Green, M., Arora, K., & Prakash, S. (2020). Microbial Medicine: Prebiotic and Probiotic Functional Foods to Target Obesity and Metabolic Syndrome. International journal of molecular sciences, 21(8), 2890. www.doi.org/10.3390/ijms21082890.

Güngör, G. (2019). Glutensiz granola üretimi ve zerdaçal (Curcuma longa L.) ve mahlep (Prunus mahaleb L.) ilavesinin antioksidan özelliklere etkisi. Yayınlanmamış yüksek lisans tezi. Bursa Uludağ Üniversitesi. Fen Bilimleri Enstitüsü.

Hasler, C. M. (2002). Functional Foods: Benefits, Concerns and Challenges—A Position Paper from the American Council on Science and Health. The Journal of Nutrition, 132(12), 3772–3781.

Hosseini, S. M., Soltanizadeh, N., Mirmoghtadaee, P., Banavand, P., Mirmoghtadaie, L., & Shojaee-Aliabadi, S. (2018). Gluten-free products in celiac disease: Nutritional and technological challenges and solutions. Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences, 23, 109.

Gok, İlkay & Ulu, Efe. (2019). Functional foods in Turkey: marketing, consumer awareness and regulatory aspects. Nutrition & Food Science. 49 (4), 668-686.

Jonas, M. S., & Beckmann, S. C. (1998). Functional foods: Consumer perceptions in Denmark and England. Aarhus School of Business, MAPP Centre.

Karaağaç, S. (2010). Tüketicilerin Fonksiyonel Gıdaları Kullanmaya Ve Ödemeye Razı Olduğu Miktarı Etkileyen Faktörler: Antalya İli Örneği. Yüksek Lisans Tezi.

Karaca, Y., Gün, I., Seydim, A.C. & Guzel-Seydim, Z.B. (2018), "Production and quality of kefir cultured butter", Mljekarstvo, Vol. 68 No. 1, pp. 64-72.

Nagpal, R. K. A. (2011). Synbiotic effects of various prebiotics on in vitro activities of probiotic Lactobacilli. Ecol. Food Nutrition (50(1)), 63-68.

Olcay, A. & Akçi, Y. (2014). Adıyaman ve Gaziantepte yaşayan insanların fast -food işletmel erini tercih nedenlerinin faktörler itibariyle ortaya konmasına yönelik bir uygulama. Yönetim ve Ekonomi Araştırmaları Dergisi, 0(24), 158 - 181.

Öncebe, S. & Demircan, V. (2019). Tüketicilerin Fonksiyonel Gıda Tüketimini Etkileyen Faktörler. Akademik Gıda. 497-507. 10.24323/akademik-gida.667263.

Roberfroid, M. H. L. (2010). Prebiotic concept: definition, metabolic and health benefits. Br J Nutr (104), 1-63.

Sevilmiş, G. (2008). Bazı Fonksiyonel Gıdalarda Tüketici Kararları ve Bunları Etkileyen Faktörlerin Belirlenmesi Üzerine Bir Araştırma. Yüksek Lisans Tezi.

Siro, I., Kápolna, E., Kápolna, B. & Lugasi, A. (2008), "Functional food: product development, marketing and consumer acceptance-A review", Appetite, Vol. 51 No. 3, pp. 456-467.

T.C. Gıda, Tarım ve Hayvancılık Bakanlığı, Gıda ve Kontrol Genel Müdürlüğü. (2011) Türk Gıda Kodeksi Etiketleme Yönetmeliği. Erişim: http://www.resmigazete.gov.tr/eskiler/2011/12/20111229M3-7.htm Erişim tarihi: 21 Ağustos 2020.

Valcheva, R. & Dieleman, L. (2016). Prebiotics: Definition and Protective Mechanisms. Best Practice & Research Clinical Gastroenterology. 30. 10.1016/j.bpg.2016.02.008.

Table 1. The recipes of cookies

Chickpea Flour Cookie	500 g chickpea flour, 150 g butter, 200 g powdered sugar, 2 tablespoon rose water, 1 teaspoon cardamom, 200 ml oil, 1 table spoon amaranth flour, 5 g sugared vanilla, 1 teaspoon baking powder
Dried Beans Flour Cookie	250 g dried beans flour, 120 g butter, 200 g powdered sugar, 2 eggs, 1 table spoon amaranth flour, 5 g sugared vanilla,1 teaspoon baking powder
Wheat Flour Cookie	500 g wheat flour, 250 g butter, 100 ml oil, 4 tablespoon wheat starch, 200 g powdered sugar, 5 g sugared vanilla,1 teaspoon baking powder
Rice Flour Cookie	300 g rice flour, 125 g butter, 200 g powdered sugar, 2 eggs, 2 tablespoon rose water, 1 table spoon amaranth flour, 5 g sugared vanilla, 1 teaspoon baking powder
Buckwheat and Carob Flour Cookie	200 g buckwheat flour, 2 tablespoon butter, 2 tablespoon carob flour, 2 tablespoon teff flour, 2 table spoon powdered sugar, 1 egg, 5 g sugared vanilla, 1 teaspoon baking powder

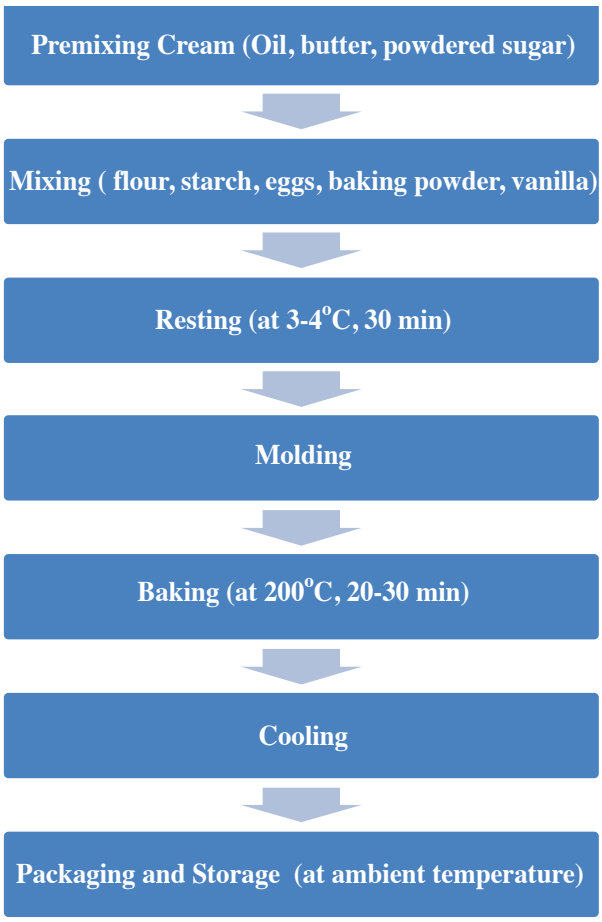

Fig. 1. Flow chart for cookies preparation

		Gender of the panelist				
		Male		Female		P
		Mean	±SD	Mean	±SD	
Appearance	NK	3.66	±1.00	3.49	±1.27	0.689
	KK	3.49	±1.09	3.77	±1.06	0.273
	BK	3.97	±0.86	4.03	±0.86	0.855
	PK	3.86	±0.91	4.00	±0.77	0.617
	KVK	3.77	±1.03	3.91	±0.89	0.627
Texture	NK	3.74	±1.09	3.89	±1.08	0.559
	KK	3.37	±1.06	2.97	±1.10	0.113
	BK	2.57	±0.92	2.83	±0.98	0.216
	PK	2.46	±0.95	2.63	±1.00	0.562
	KVK	2.94	±1.16	3.31	±1.08	0.129
Smell	NK	3.40	±0.81	3.57	±1.04	0.382
	KK	3.46	±1.04	3.49	±0.85	0.877
	BK	3.37	±0.97	3.49	±0.85	0.573
	PK	3.09	±0.98	3.14	±0.88	0.592
	KVK	3.43	±1.01	3.46	±1.09	0.897
Product Consumption	NK	3.31	±0.93	3.26	±1.29	0.942
	KK	2.71	±0.89	2.57	±0.98	0.619
	BK	3.37	±1.09	3.66	±1.14	0.264
	PK	2.89	±1.02	2.89	±0.90	0.812
	KVK	2.69	±1.05	2.97	±1.07	0.288

Table 2. The scores of appearance, texture, smell, taste, general liking, and product consumption by gender

	NK-KK	**NK-BK**	**NK-PK**	**NK-KVK**	**KK-BK**	**KK-PK**	**KK-KVK**	**BK-PK**	**BK-KVK**	**PK-KVK**
Texture	<0.001	<0.001	<0.001	<0.001	0.006	<0.001	0.761	0.363	0.015	0.002
Taste	0.545	0.053	0.268	0.405	0.242	0.092	0.933	0.002	0.248	0.043
General liking	0.173	0.351	0.091	0.287	0.020	0.768	0.514	0.008	0.041	0.347
Consumption	<0.001	0.252	0.014	0.014	<0.001	0.161	0.269	<0.001	<0.001	0.868

Table 3. Posthoc analysis results

	Texture	Smell	Taste	General liking	Consumption
NK					
Appearance	-0.096[c]	0.322[a]	0.239[b]	0.321[a]	0.335[a]
Texture		0.024[c]	0.225[c]	0.150[c]	-0.085[c]
Smell			0.254[b]	0.283[b]	0.215[c]
Taste				0.699[a]	0.346[a]
General liking					0.385[a]
KK					
Appearance	-0.044[c]	0.292[b]	0.430[a]	0.348[a]	0.117[c]
Texture		-0.043[c]	-0.016[c]	0.064[c]	0.218[c]
Smell			0.374[a]	0.201[c]	0.174[c]
Taste				0.643[a]	0.301[b]
General liking					0.527[a]
BK					
Appearance	0.094[c]	-0.062[c]	0.120[c]	0.199[c]	0.340[a]
Texture		0.264[b]	0.271[b]	0.286[b]	0.280[b]
Smell			0.441[a]	0.361[a]	0.196[c]
Taste				0.788[a]	0.415[a]
General liking					0.400[a]
PK					
Appearance	0.041[c]	0.052[c]	0.174[c]	0.247[b]	0.096[c]
Texture		0.307[a]	0.166[c]	0.230[c]	0.321[a]
Smell			0.339[a]	0.293[b]	0.270[b]
Taste				0.703[a]	0.322[a]
General liking					0.481[a]
KVK					
Appearance	0.232[c]	0.311[a]	0.304[b]	0.234[c]	-0.009[c]
Texture		0.333[a]	0.371[a]	0.187[c]	0.077[c]
Smell			0.591[a]	0.146[c]	0.107[c]
Taste				0.343[a]	0.148[c]
General liking					0.655[a]

* a:p<0.010 b: p 0.050 c: p 0.050

Table 4. The correlation of the scores given within the samples themselves

	Dietary fiber (%)	**Energy (kcal/ 100g)**	**Ash (%)**	**Carbohydrate (%)**	**Protein (%)**	**Moisture (%)**	**Fat (%)**	**Determination of starch amount (%)**
Chickpea flour cookies	7.20	492.45	1.30	54.99	5.46	3.20	27.85	20.4
Buckwheat and Carob cookies	2.20	450.36	0.88	63.83	5.29	8.48	19.32	35.7
Wheat flour cookie	1	520.46	0.50	59.85	8.48	2.71	27.46	40.3

Table 5. Food analysis results of the samples

Sample 244 **Sample 167** **Sample 984** **Sample 745** **Sample 307**

NK **KK** **BK** **PK** **KVK**

Figure 5. Photos of cookies made from 5 different flours

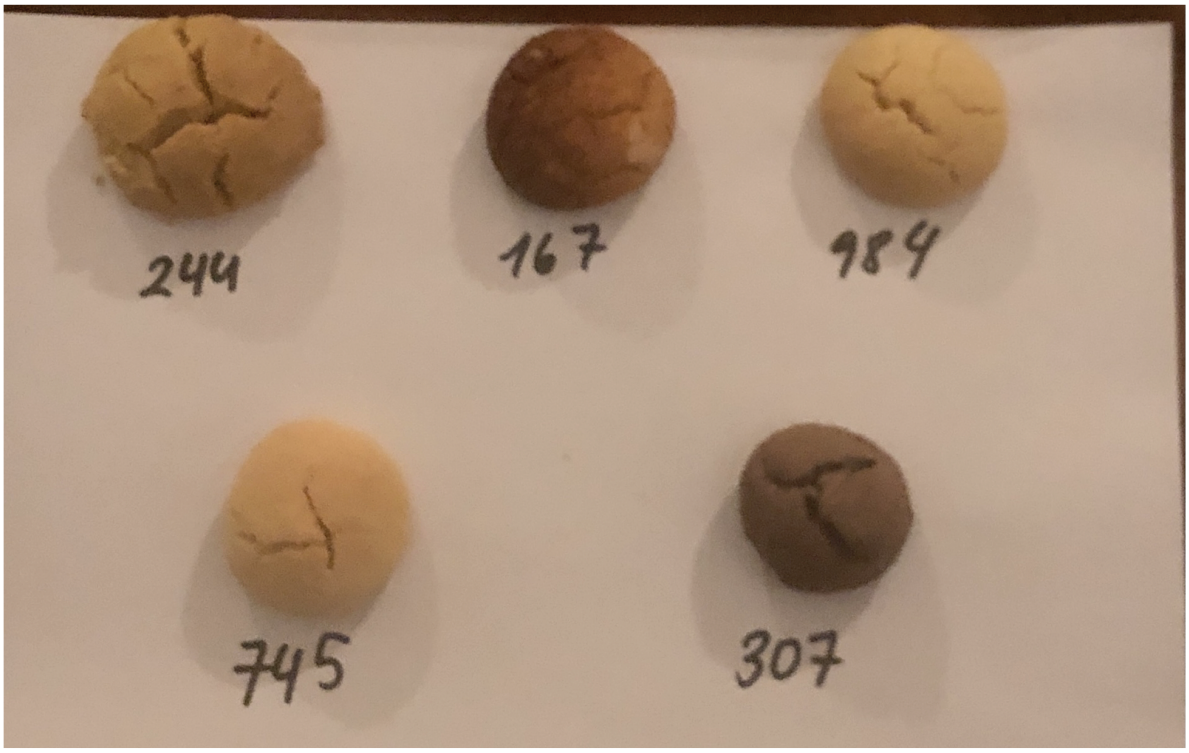

Figure 6. Samples of cookies (code : 244 – 167 – 984 – 745 – 307)

Figure 7. The first three products, which were liked at the highest score

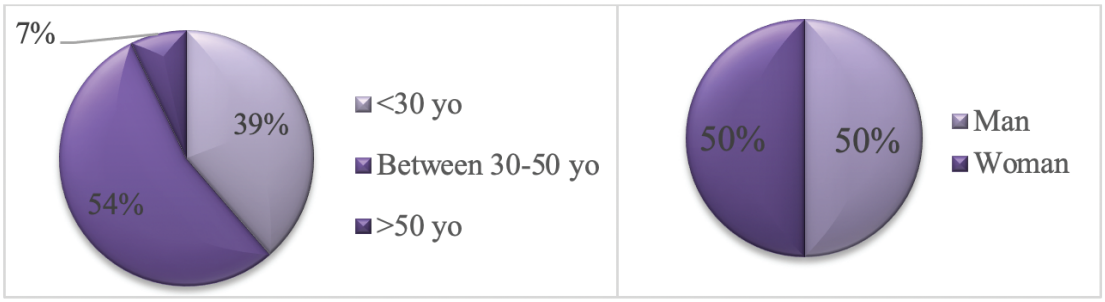

Figure 1. Gender and age rates of the panelists

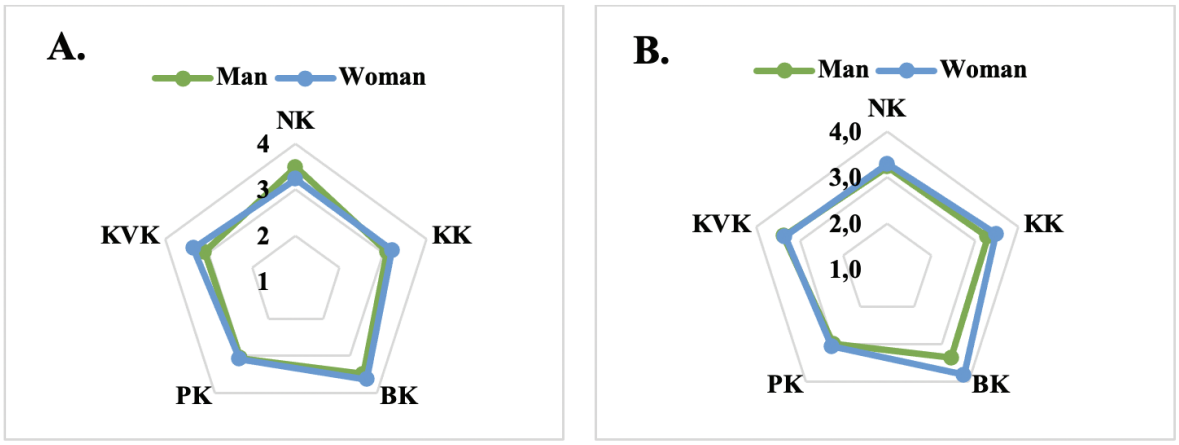

Figure 2. General liking (A.) and taste (B.) status of the panelists

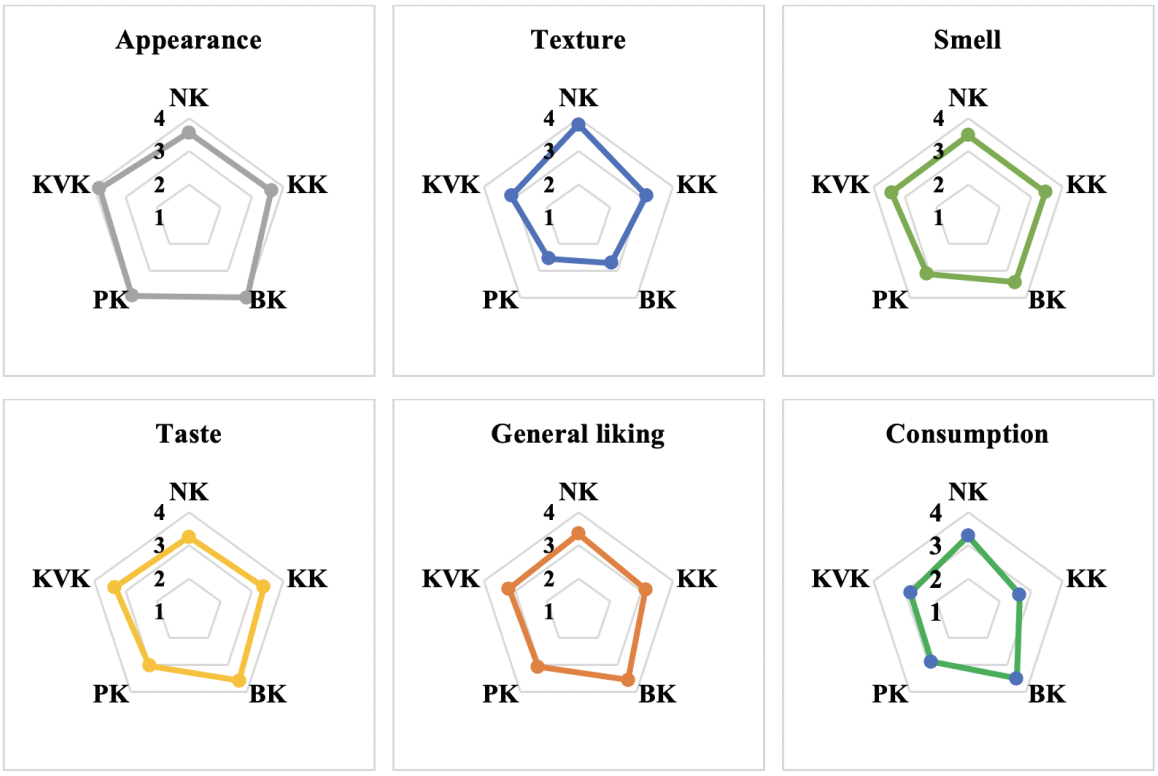

Figure 3. Samples' scores of appearance, texture, smell, taste, general liking, and product consumption