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The Use of the Hıngedan (*Ferula pseudalliacea*) in the Production of Functional Gluten-Free Biscuits

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Abstract

In our study, gluten-free biscuits were produced to treat celiac disease using *F. pseudalliacae Rech. f.* plant at 5%, 10%, and 15% ratios. The physical, chemical, and sensory properties of the created biscuits were examined. In the research analyses, as the addition ratio of *F. pseudalliacea* increased, the diameter values varied between 30.90 to 61.59 mm, and thickness ranged from 13.42 to 13.83 mm. A decrease in cooking loss, textural properties, L* and b* values was observed, while an increase was determined in moisture, spread ratio, specific volume, and a* values. In the sensory analysis, data results of the biscuits presented to the panellists indicated that, in terms of overall liking, the product with 5% *F. pseudalliacae* addition received the closest preference to the control group, suggesting that the 5% *F. pseudalliacae*-supplemented biscuit did not have a negative impact as stated by the panelists. Based on the evaluations and analyses, the substitution of *F. pseudalliacae* in gluten-free biscuit production was seen as an important result in terms of offering an alternative and acceptability.

Keywords: Functional food, Celiac disease, Cookie, *Ferula pseuadalliacae,* Gluten

Glutensiz Bisküvi Üretiminde Hıngedan (*Ferula pseudalliacea*) Kullanımı

Öz

Çalışmamızda halk arasında çölyak hastalığında tedavi amaçlı tüketilen *F. pseudalliacae Rech. f.* bitkisi %5, %10, %15 oranlarında kullanılarak glutensiz bisküvi üretimi gerçekleştirilmiştir. Oluşturulan bisküvilerin fiziksel, kimyasal ve duyusal özellikleri incelenmiştir. Araştırma analizlerinde *F. pseudalliacea* ilave oranı arttıkça çap değerleri 30.90-61.59 mm, kalınlık 13.42-13.83 mm arasında değişmiştir. Pişme kaybı, tekstürel özellikleri, L* ve b* değerlerinde azalmalar gözlenmiş olup, nem, yayılma oranı, spesifik hacim ve a* değerlerinde artış olduğu belirlenmiştir. Duyusal analizde panelistlere sunulan bisküvilerin veri sonuçlarında genel beğeni olarak kontrol grubuna en yakın beğeniyi %5 oranında *F. pseudalliacae* ilaveli ürün alarak *F. pseudalliacae* %5 katkılı bisküvide olumsuz bir etki yaratmadığı panelistler tarafından belirtilmiştir. Değerlendirme ve analizler sonucunda *F. pseudalliacae* ikamesinin

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glutensiz bisküvi üretiminde alternatif olarak kullanılması ve kabul edilebilirliği önemli bir sonuç olarak görülmüştür.

Anahtar Kelimeler: Fonksiyonel gıda, Çölyak hastalığı, Bisküvi, *Ferula pseudalliacae*, Gluten

1. INTRODUCTION

Cereals and products in people's daily nutrition routines can cause certain ailments in individuals with sensitivity. Prolamins such as gliadin, secalin and hordein, which are sub-fractions of gluten proteins, can trigger certain ailments in people with gluten sensitivity after consumption. It has been stated that gluten proteins, which does not show absorption in the digestive system, has a toxic effect on the basis of these diseases [1]. Figure 1 shows the classification of gluten-related diseases.

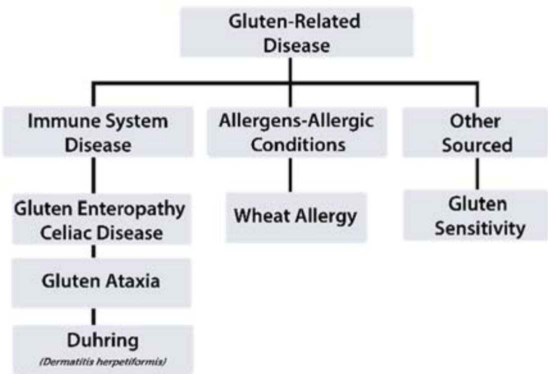

Figure 1. Classification of gluten-related diseases [2]

Celiac disease is diagnosed with many findings which consists of reasons such as allergic conditions in breast milk intake, intake of gluten-containing foods at meals, excess daily amount of these products and malnutrition in eating habits; it is a disease characterized by hereditary and environmental interaction in the umma system [3]. The only treatment method to be applied to sick people with Celiac disease, which has no treatment yet, is the application of a gluten-free diet with gluten deficiency in the foods taken. Sick individuals who follow a gluten-free diet are in search of gluten-free products that will not cause autoimmune damage [4]. In products created with gluten-containing raw materials, visco-elastic structure and desired texture and volume can be obtained in dough making. However, in products containing gluten-free raw materials in their formulation, the product’s expected appearance and desired textural properties cannot be obtained due to the absence of gluten. To compensate for the gluten deficiency, starch, hydrocolloids and functional components are added as auxiliary components in the products [5,6]. Brands in the market are trying to develop products for celiac patients, gluten sensitivity or individuals who make gluten-free nutrition a life [7]. Generally, in developed functional products, gluten cannot be reduced to zero. For this reason, the maximum gluten content in the product is 20 ppm which is the determined and acceptable ratio [8]. Upon the functional food development of manufacturers, the content of products such as cakes, biscuits, wafers and cookies are created from gluten-free mixtures. By definition; sugar, edible salt, vegetable oils, raising agents, eggs, whey and milk powder, additives in the weight and content permitted by the legislation, starches obtained from different grains are mixed and a certain amount of water is added to it, shapes are formed from the dough rested for a while, cooked at a certain temperature and cooled, and then the bakery product consumed after 'double cooking' and 'becoit'. The functional product developed from the words is defined as biscuits [9]. All foodstuffs whose contents have been fortified, enriched, processed or improved have been used as functional foods beyond benefiting from basic nutrients.

Functional foods are known as functional because they provide nutritional availability and have multiple physiological effects [10]. Many scientists argue that foods on the market are fortified with some special nutrients before processing and, therefore should be considered functional foods [11]. About 2500 years ago, Hippocrates described the relationship between nutrition and human health with the phrase "Let your medicine be your food and your food be your medicine". If we look at today, it has been observed that consumers tend to functional foods and food supplements due to the increase in diseases related to the heart, circulatory system obesity.

It is observed that functional foods provide additional health benefits to the consumer rather than providing nutrients [12]. The plant called Hıngedan-Hegedan (*Ferula pseudalliacea*), edible in the region where it grows, has medicinal properties and aromatic composition, is a wild endemic species with a physical height of 50 cm and curly leaves. In the study conducted by Artuş, it was determined as a result of the analyzes that the hıngedan plant has high bioactivity [13]. In the study conducted by Dastan et. al., in addition to the antiplasmodial and antibacterial properties of *Ferula pseudalliacea*, coumarin obtained from the isolated content of root extracts is a living natural antibacterial agent for the food and pharmaceutical industry [14], and Dastan et. al. found that the plant may be useful in the food and pharmaceutical industry as an antibacterial and antioxidant substance in the analysis of oils obtained from certain parts of this plant [15]. The study aims to use the *Ferula pseudalliacea* plant as a treatment for Celiac disease among people and to use it in the content of gluten-free flour mixtures in different proportions in the functional product to be created, and to benefit both with different tastes and nutritional properties, since it does not contain gluten, this mixture provides a new product advantage for celiac patients. It is thought that the content of the mixture will be highly preferred due to its nutritional and some medicinal properties. Hıngedan grass is a plant that is in demand by the public because of its high nutritional value. The fact that hıngedan has not yet been mixed with any product in the literature and used increases its original value. The study aims to provide a new functional food to the product range by developing a gluten-free biscuit with gluten-free Hıngedan (*Ferula pseudalliacea*) that celiac patients can easily consume.

2. MATERIALS AND METHOD

2.1. Materials

The materials used in the study, rice flour (Başak Gıda- Konya), corn starch (Başak Gıda, Konya), granulated sugar (Bor Şeker, Niğde), shortening (Sana Dough- Istanbul), vanillin (Baghdad-Ankara), baking powder (Metro Chef- Adana), salt (Billur Iodized Salt, Istanbul) were obtained from local companies in Adana, and hıngedan was generally found in all rural areas of the Hakkari region, but the most dense was supplied from the countryside of Marinüs (Kavaklı) Village. The water used as a component during production was provided from the mains water of Çukurova University Balcalı Campus. Guar gam (Ricol, Asr Kimya-Istanbul) and SSL (Artı Gıda Kimya-Istanbul) are used.

2.2. Method

Gluten-free biscuits with hıngedans for celiac patients were produced in Çukurova University, Faculty of Engineering, Department of Food Engineering, Grain Processing Technology Laboratory. The control group was formed by adding the ingredients (rice flour, corn starch, granulated sugar, shortening, vanillin, baking powder, salt, emulsifier, gum) to the mixing chamber in the amounts shown in Table 1. Due to the distinctive strong smell and taste of the hıngedan plant, in preliminary trials, it was determined that adding the plant to biscuits at 5%, 10%, and 15% ratios would be the most suitable amounts in terms of palatability. The hıngedan plant was collected from mountainous lands in Van-Hakkari provinces in May 2022, dried under sunlight for a period of 1 week, and stored in a dry place (+4 ^{o}C) without light. The preserved hingedan plant was milled for 30 seconds using a Spice-Herb Grinder brand laboratory grinder with a capacity of 3500 W and 1250 gr.

Table 1. Biscuit dough ingredient quantities (g)

Biscuit constituent components	Control (gr)	5% Hıngedan(gr)	10% Hıngedan(gr)	15% Hıngedan(gr)
Rice flour	21.09	21.09	21.09	21.09
Cornstarch	21.09	21.09	21.09	21.09
Granulated sugar	25.31	25.31	25.31	25.31
Margarine	16.87	16.87	16.87	16.87
Vanillin	0.84	0.84	0.84	0.84
Baking powder	0.63	0.63	0.63	0.63
Salt	0.42	0.42	0.42	0.42
SSL	0.21	0.21	0.21	0.21
Guar gum	0.84	0.84	0.84	0.84
Hıngedan	0	2.10	4.2	6.32
Water	12.65	12.65	12.65	12.65

The components were added to the mixing chamber of the 'Kitchen Aid' Artisan brand 4.8 L capacity mixing machine and the dough-making process was carried out by mixing for 1 minute in the 1st cycle, 4 minutes in the 2nd cycle and a total of 5 minutes. As the addition rate of the ingingenuous grass increases, the dough cannot be shaped and clumps are observed. After resting the dough at +4 ºC for 10 minutes, 200 gr balls were made and a smooth and inclined surface was formed with the help of rollers based on AACC method 10-54.01, and then 3 different formulations with 1 control group and 2 iterations were developed by forming a shape with 6 cm wide cookie molds. It was baked in 'FIMAK' brand 'EKF' a 60.80' model oven for 22 minutes with a lower temperature of 150 ºC and an upper temperature of 200 ºC. The biscuits obtained were left to cool for 1 hour and then analyzed.

2.2.1. Analysis of Biscuits

2.2.1.1. Weight and Cooking Loss

Measurements were recorded by weighing the biscuits on a precision scale before and after baking. The dough weight (A) and post-baking biscuit weight (B) of the six recorded biscuits were measured and formulated as A-B\A. These ratios were averaged.

2.2.1.2. Volume and Specific Volume

The volume analysis using rapeseed, which is based on the displacement method, was measured using six biscuits. The data obtained were divided by the number of samples and the volume of the biscuit was determined. The measurement of the specific volume was calculated by dividing the volume data by the weight data of the same samples [16].

2.2.1.3. Diameter, Thickness and Spread Ratio

AACC Standard Method No. in Biscuits: Based on 10-54, measurements were made with a 0.001 mm Mitutoyo, Minoto K-4 digital caliper. Measurements are made by measuring the diameter and thickness in mm; The spread rate was calculated by rationing the diameter (mm) value of the biscuits to the thickness (mm) value [17].

2.2.1.4. Color Analysis

Color analysis was recorded in the biscuit by determining the L*, a* and b* values with a Konica Minolta CM CR-400 model, 1.5 V (Japan) handheld color device. After baking, 3 points were determined from the outer surface of the biscuits, which were left to cool for 1 hour, and color measurement was made. Biscuit CIE color values are L*, a* and b* with 3 misses;

L*=100 (white), L*=0(Black) lightness-darkness of the biscuit,
a*=red (High positive), a*=green (High negative),
b*=yellow (high positive), b*=blue (high negative).
a* and b* values provide information about color size or position [18].

2.2.1.5. Moisture Analysis

In the biscuit samples, after resting for 1 hour after baking, the numbered containers were weighed by taking the tare of the numbered containers. The weighed samples were kept in an oven at 105 ºC for 24 hours to come to constant weighing. At the end of 24 hours, the samples were re-weighed and the weight loss of the biscuits was recorded and the moisture content (%) was calculated [17].

2.2.1.6. Texture Analysis

These analyzes are important in terms of the mechanical properties of the food, as information about consumer taste, sales, processing, transportation and storage of the product is given by determining the textural properties of the foods. After the biscuits were left to cool for 4 hours, the hardness (breaking force) was determined based on the AACC 74-09 method. The texture properties of the biscuit were determined by using the 3-point fracture method to determine the hardness (N) and brittleness (mm) values with the help of the TA-XT Plus Stable Micro Systems device [19].

2.2.1.7. Sensory Analysis

To determine the sensory properties and consumability of the gluten-free hıngedan biscuits produced, 45 panellists, 25 of whom are women and 20 are men, between the ages of 25-60 with the title of doctorate. The panellists were given a brief briefing on the hıngedan plant. Biscuits were randomly numbered with codes 136, 493, 572 and 613 and presented for evaluation under bright room conditions at the Sensory Analysis Laboratory of the Department of Food Engineering at Çukurova University. It was carried out by using to the hedonic test form by applying to the hedonic test form by evaluating a score from 1 to 5, 1 being very bad and 5 being very good, over 7 different parameters as hardness, crispness, color, surface appearance, taste, general taste and smell in biscuits (tA.

2.2.1.8. Statistical Analysis

The data obtained from the control groups and the biscuits with *F. pseudalliacae* additives were evaluated with the help of the SPPS 25.0 statistical program ($P<0.05$). Whether there was a significant difference between the groups was determined by ANOVA and TUKEY-DUNCAN comparison tests.

3. RESULTS AND DISCUSSION

In this study, it was aimed to produce biscuits suitable for the consumption of Celiac patients and individuals with gluten sensitivity by creating a gluten-free biscuit formulation and adding 5%, 10% and 15% *F. pseudalliacaea* plant to it. For this purpose, the moisture, physical, texture and sensory qualities of gluten-free biscuits with different proportions of *F. pseudalliacaea* were confirmed.

Table 2. Analyses conducted on the biscuit

Analysis	Control	5% Hıngedan	10% Hıngedan	15% Hıngedan
Moisture (%)	9,58	11,26	11,60	10,95
Diameter (mm)	61,55	60,90	61,48	61,59
Thickness (mm)	13,83	13,42	13,55	13,50
Spread rate	4.47	4.53	4.53	4.57
Baking Loss(%)	14,52	11,04	12,06	12,60
Spesific Volume Cm^3/gr)	1,84	2,35	2,46	2,21
Texture Hardness (N)	138,31	91,49	78,67	88,90
Texture Fragile (mm)	12,14	11,35	11,41	11,63
L*	73,35±20.04	61,00±0.58	56,00±0.60	52,66±0.75
a*	-0.90±0.35	-0.35±0.18	0.26±0.22	0.57±0.15
b*	20.16±1.09	18.75±0.43	17.00±0.37	15.52±0.24

3.1. Moisture

Chinma et. al., found that the moisture rates of the biscuits they produced by adding peanuts to germinated millet and bambara were found to be between 8.12-8.63 g; The high humidity levels have been attributed to the high-water absorption capacity of the proteins in the content of bambara peanuts [20]. Oliveira et. al., the moisture values of gluten-free biscuits obtained by adding a mixture of ―Guaranal and ―Catuabal plants, which are medicinal plants added to rice flour at a rate of 4%, were found to be 2.68% and 2.65% [21]. In our study, it was observed that the moisture content of the biscuit samples increased (Table 2). It was determined that the control group product had lower moisture content compared to the biscuits with *F. pseudalliacaea* added. This may be associated with the low water absorption capacity of biscuits with *F. pseudalliacaea*. According to the findings of the POST-HOC TUKEY HSD test, which was performed to determine which groups the difference was between the two groups, a statistically significant difference was found between the humidity values of K1 and B1 P=0.001, O1 P=0.000, and OB1 P=0.009.

3.2. Diameter

In his study on gluten-free biscuits, Kunt added buckwheat flour, chickpea flour, carob flour and transglutaminase and sodium alginate to the formulation to increase the nutritional value of the biscuit and to improve the structure of the biscuit [22]. The diameter values obtained from the samples varied between 60.20-64.30 (Table 2). It was observed that the biscuits obtained with the addition of transglutaminase to the formulation with chickpea flour gave the highest diameter value. In gluten-free biscuits, the addition of chickpea flour increased the biscuit diameter, while carob flour decreased it. Doğan produced gluten and gluten-free biscuits in which rhubarb was added at different ratios (0, 0.5, 1, 2). The diameter values of gluten biscuits varied between 56.49-58.15 mm, while the diameter values of gluten-free biscuits varied between 49.50-56.23 mm. It was determined that the diameter value decreased as the rhubarb content increased in gluten biscuits. It was thought that the diameter value decreased as the ratio increased due to the fiber content of the rhubarb plant. There was a difference in the diameter values of gluten-free biscuits, and this difference was explained to be due to the linear quadratic effect between rhubarb and gum [23]. In this study, it was observed that the diameter ratio decreased in biscuits to which *F. pseudalliacaea* was added at 5% and increased in biscuits to which *F. pseudalliacaea* was added at 10% and 15%. Analysis of variance was used to test whether there was a significant difference between the diameter averages of more than two samples.

3.3. Thickness

In the gluten-free biscuit study created for the consumption of celiac patients, biscuits were produced by adding 10, 20, 30 % almond flour and 25, 50 % stevia to the mixtures in which rice flour was used as 100%, 90, 80.7 0. The thickness values obtained as a result of the study analysis were recorded as 0.81-0.83-0.86 cm for biscuits with rice flour and stevia, 0.82-0.85-0.86 cm for biscuits with 10% almond flour and stevia, 0.83-0.85-0.97 cm for biscuits with 20% almond flour and stevia, and 0.84-0.86-0.98 cm for biscuits with 30% almond flour and stevia. t was observed that the biscuits with almond flour and stevia addition had the highest thickness ratio. It is thought that the increase in thickness values is related to the increase in bulk density of almond flour and stevia [24]. Singh et. al., observed a decrease in the thickness values of the biscuits with the substitution of water chestnut flour obtained at the end of many pretreatments at the rates of 50%, 60, 70, 80, 90% into the biscuit mixture [25], while in our study; the ratios of the thickness values of the biscuits ranged between 13.83-13.42 mm., shown that in Table 2. Accordingly, the highest average was 13.83 mm in the K1 group and the smallest average was 13.42 mm in the B1 group.

3.4. Spread Ratio

Olawoye et. al., studied the effects of biscuit starch resistance, glycemic load and glycemic index depending on baking temperature and time by adding Cardaba banana flour to gluten-free cookie combination. The spread rates, calculated by dividing the width ratio of the cookies by the thickness ratio, varied between 5.46-6.23. It has been observed that the product with the highest spread rate in gluten-free biscuits that have undergone a certain temperature and duration of baking is formulated biscuits. Here, it is stated that the rate of spread varies depending on the starch in the Cardaba banana [26]. Olojede et. al., investigated the effect of sourdough in gluten-free bakery products by adding different starter cultures to acha flour-substituted gluten-free cookie dough. Used *F. fructivorans*, *C. glabrata*, *C. tropicalis* starter cultures are added to the cookie dough by making single, double, or triple mixtures. It was observed that the highest spread rate in the cookie dough was in the biscuit in which *F. fructivorans* culture was used alone, and the lowest spread rate was in the cookie obtained from the triple combination of *F. fructivorans*, *C. glabrata*, *C. tropicalis*. It has been stated that the variability of these values in the spread rate is due to the fermentation feature of sourdough [27]. Considering the spread rates of *F. pseudalliaca*-added gluten-free biscuits produced in our study, the group with the highest value was OB1 4.57 and the group with the smallest spread rate was K1 4.47. The results of the analysis of the spread rate obtained by adding *F. pseudalliacaea* grass, which was used at different rates in the study, to biscuit samples are as follows; The control group (K1) was 4.47, B1 was 4.53 with 5% *F. pseudalliacaea* content, O1 with 10% *F. pseudalliacaea* was 4.53, and 15% *F. pseudalliacaea* was 4.57 (Table 2).

3.5. Baking Loss

In a study, it was observed that as the addition rate of the hydrocolloid concentration added to gluten-free biscuits increased, the baking losses decreased. This situation in biscuits has been associated with an inverse correlation between moisture and cooking loss, and as the rate of hydrocolloid addition increases, the removal of free water is prevented and a decrease in baking losses occurs [2]. According to the data obtained from the gluten-free biscuits created in our study, the highest baking loss rate was 14.52% in the K1 group, while the lowest average was 11.04% in the B1 group.

3.6. Specific Volume

Maria et. al., aimed to investigate the function of proteins added to famous products on the rheological and quality properties. For this purpose, they created gluten-free cakes and biscuits. Biscuits were produced using different protein sources such as soy, casein, pea, and egg white protein. In the specific volume values of the biscuits obtained, it was observed that the specific volume ratios of biscuits created separately from soy, casein, and pea significantly increased, while this value did not change in the biscuit with added egg white. In the specific volume values of biscuits obtained by using soy, casein, pea and egg white protein as different protein sources; it was observed that the specific volume ratios of biscuits created separately from soy, casein and peas increased significantly, and this value did not change in biscuits with egg whites [28]. In our study, the specific volume values in gluten-free biscuits vary between 1.84 and 2.46 cm^3/gr. Accordingly, the O1 group with the highest specific volume average was recorded as 2.46 cm^3/gr, while the smallest mean was found to be 1.84 cm^3/gr in the K1 group. In a study, chocolate gluten-free biscuits were produced by using cassava starch, rice flour and soy flour instead of wheat flour. The specific volume analysis results of these samples were found to be in the range of 2.3-3.2 cm3/gr. The specific volume values of biscuits obtained from cassava and rice flour were lower than those obtained from soybean flour. This has been associated with a higher proportion of protein in the structure of soy flour than in the structure of other flours. It has been stated that flours containing high protein have larger volume products [29].

3.7. Hardness

The hardness values of gluten-free biscuits are shown in Table 2. Accordingly, the highest mean was recorded as 138.31 in the K1 groups, while the smallest mean was 78.67 in the O1 group. It was observed that the hardness rate decreased in the biscuits to which *F. pseudalliacaea* was added at the rate of 5% (B1) and 10% (O1), and the hardness values of the biscuits added at the rate of 15%

increased compared to the other two products added. Whether there was a significant difference between the hardness values of more than two samples was tested by analysis of variance. According to the findings of the analysis, a statistically significant difference was found between the hardness values of the samples. The decrease in the hardness value of the biscuits with the addition of gluten-free *F. pseudalliacaea* compared to the control group is thought to be the interactions that develop by creating a linear and quadratic effect with the other ingredients in the biscuit. Similar results were seen in the study conducted by Doğan [23].

3.8. Fragility

Oliveira et. al., almond flour created by partially removing the fat of the by-product obtained from the extraction of Brazilian almond oil was evaluated by adding it to the formulation of gluten-free biscuits. The hardness and fragility values of the composition were observed in the cookie prepared by substituting 75 gr of almond flour used in 100 gr of wheat flour. It has been reported that this is related to increased fat content, fiber and phenolics, and decreased in carbohydrate content in 64 biscuit mechanics by replacing almond flour with wheat flour [30]. In our study, the fragility analysis results obtained by adding *F. pseudalliacaea* grass, which was used in different proportions, to biscuit samples are as follows; The control group (K1) was 12.14, B1 with 5% *F. pseudalliacaea* was 11.35, O1 with 10% *F. pseudalliacaea* was 11.41, and OB1 with 15% *F. pseudalliacaea* was 11.63. It is thought that the decrease in fragility or bite force value in biscuits with the addition of gluten-free *F. pseudalliacaea* compared to the control group, and the inability of the margarine in the biscuit to bond with any gluten structure, reduce the fragility by creating a softer structure in the biscuit. Similar results were seen in the study by Laguna [31].

3.9. Sensory Properties

In food science, it is known that the concepts of smell, taste, and many other senses in food form the concept of flavor in the brain, and these mixed concepts formed in the brain provide impressions about food aroma, taste, and flavor [32]. In sensory analyses, consumers can form positive or negative opinions about the product based on the interaction of the final product with the sensory organs. In many academic studies, it has been determined that sensory interactions in consumers affect the perception of the product's sales and service. The appearance and aroma of the product before chewing, the hardness, softness, and mouthfeel during chewing are provided by sensory perception [33]. Although the gluten-free biscuits produced have superior health and nutritional features, they can sometimes be insufficient in sensory panels. Gluten-free substances can be harder, rougher and more difficult to chew in the mouth than gluten-containing equivalents [24]. In our study, although K136 received the highest score in the sensory evaluation of biscuits, the product adding of *F. pseudalliacaea* at a rate of 5% received scores close to the control (Table 3). Farzana et. al., observed similar tending results in biscuits enriched with buckwheat flour [34]. Gülhan, produced gluten-free cakes by adding 10%, 20% and 30% lentil flour to gluten-free cake recipes. A study was conducted to investigate these cakes' dough properties, quality and sensory properties. In general, when the cake samples were evaluated, all samples received acceptable scores. The results obtained from the gluten-free cake samples prepared with the addition of 30% lentil flour were close to the control sample. Her research has suggested that cakes made with 30% lentil flour may be an alternative source for people with gluten sensitivity [35]. Han et. al., conducted a study on the production of gluten-free cookies for celiac patients. The study experimented with biscuits using 6 different legume flours (green and red lentils, chickpeas, yellow peas, kidney beans and kidney beans). After physical and nutritional examination, they reported that the cookies they produced were similar to those commercially available on the market [36]. The findings show that legumes can be used in product formulations.

Table 3. Sensory properties

Sample no	Number of samples	Hardness	Brittleness	Colour	Surface appearance	Taste	General likes	Odour
K136	12	3.92±1.3	3.67±1.37	4.00±1.65	4.42±0.99	4.17±1.11	4.33±0.88	4.17±1.52
B493	12	4.08±1.08	3.83±1.26	3.83±1.26	4.25±1.21	3.67±1.07	3.92±0.99	3.33±0.98
O572	12	3.83±1.26	3.50±1.44	4.00±0.85	4.08±1.37	3.25±0.96	3.50±1.31	3.00±0.95
OB613	12	3.67±1.67	3.42±1.62	3.50±1.24	3.75±1.13	2.83±1.52	3.00±1.27	2.42±0.90
Total	48	3.88±1.31	3.60±1.39	3.83±1.26	4.13±1.17	3.48±1.25	3.69±1.20	3.23±1.25

4. CONCLUSION

In our study, the distinctive smell and taste of *F. pseudalliacaea*, differing from the panellists' palate preferences, and the formation of a dark color in the product's appearance as the addition rate increased, have influenced the scores. The additional purpose of *F. pseudalliacaea* being commonly used in folk medicine for celiac disease and the product being prepared specifically for celiac patients should be considered. Notably, none of the panellists were celiac patients it was their first time tasting this plant. At the end of the study, the biscuit with a 5% addition rate received scores close to the control group, suggesting that a product with varying proportions of *F. pseudalliacaea*, achieved by reducing its levels and adding different ratios to the biscuit, could be developed for consumers based on taste and aroma preferences. In gluten-free biscuits made with the addition of *F. pseudalliacaea*, an increase in the *F. pseudalliacaea* addition rate was expected to increase in hardness values; however, a reverse correlation was observed, with this value decreasing with the addition rate. The highest hardness value was determined in the control group. The lowest brittleness value was observed in the biscuit with a 5% addition. One of the significant goals of our study is to produce gluten-free biscuits with the addition of *F. pseudalliacaea*, commonly used in folk medicine for the treatment of celiac disease, for celiac patients and individuals with gluten sensitivity. The aim is to enrich and offer these biscuits to the consumers at an acceptable level. In the production of the gluten-free biscuits developed in this study, raw materials without gluten were used, and the *F. pseudalliacaea* plant, which is used by many celiac patients for treatment purposes although not yet used as a medical treatment, was added. Biscuits that could be consumed by individuals with celiac disease and gluten sensitivity were produced. The products with 5% *F. pseudalliacaea* addition showed values close to the control group regarding overall acceptability, indicating that the product gained functional properties and could be produced with positive health attributes. Many species of the Ferula genus have been used by humans for years as food and for medicinal purposes. *Ferula orientalis* is used as a flavoring agent in pickles, *F. hermonisbois* as a food supplement with aphrodisiac properties, and *F. assa-foetida*l, derived from oleo-gum resin in Afghanistan, Iran, Nepal, India, and other Asian countries, is used as a spice. In Iran, where traditional medicine is prevalent, *F. assa-foetida* is used for the treatment of constipation, diarrhea, and abdominal pain. Similarly, it is indicated that underground and above-ground extracts of *F. gummosa, F. heuffelii*, and *F. communis* are used for preventing diarrhea, wound healing, coughs, asthma, muscle spasms, toothaches, gastric problems, and in the treatment of scorpion and snake bites [37]. Although the species *F. pseudalliacae* is used by the local people in the Hakkari region as a food supplement and to enhance the flavor of pickles, it is also used for the treatment of many diseases, especially celiac disease [38]. Taking all these into consideration, it is thought that investigating the medicinal properties of the Ferula plant in future studies and its use as an additional additive in functional foods will provide a significant contribution to the literature.

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