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Review article

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A traditional food: *Köfter* (*Köftür*), A grape-based central Anatolian dessert

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Abstract

Grape (*Vitis vinifera*) is a widely cultivated and highly consumed agricultural product around the world. Owing to their high content of sugars, vitamins, minerals, and antioxidants, they hold an important place in human nutrition. In addition to being consumed raw or dried, due to their perishable nature, grapes are processed into various fruit-based products to extend their shelf life and make them available for consumption throughout the year. *Köfter (köftür)* is a traditional Turkish product prepared using grape juice, wheat flour, and starch. In Central Anatolia, particularly in provinces such as Nevşehir (Cappadocia) and Niğde, *köfter* is one of the most consumed snacks, especially during the winter months, and has a tradition of widespread production and consumption. *Köfter* is made by boiling grape juice obtained from high-yielding white grapes, adding wheat flour and starch, cooking the mixture to form a gel-like structure, and then spreading it onto trays to dry in the sun for several days. The dried *köfters* are stored in special containers produced from clay, allowing their surfaces to be coated with a thin layer of crystallized sugar. With its high nutritional value and energy-boosting properties, *köfter* offers a healthy snack alternative. Its unique texture and flavor make it an important product in Türkiye's cultural heritage. This review article was written to help conduct new research, preserve the traditional value of *köfter* in Turkish cuisine, and introduce it to more people.

Keywords: Grape, Snack, Traditional food, Köfter

1 Introduction

Grape (*Vitis vinifera)* is one of the oldest fruits in the World, an agricultural product which has a wide production area all over the World and has a high economic and nutritional value [1, 2]. Countries such as China, the USA, Chile, Iran, Iran, South Africa and Türkiye are among the leading countries in grape cultivation in recent years [3]. Türkiye ranked fourth among these countries in 2022 and agriculture of grape is very important for the Turkish economy [3]. Although grape production in Türkiye varies by year, it was 4,100,000 tons in 2019, 4,208,908 tons in 2020, 3,670,000 tons in 2021, 4,165,000 tons in 2022 and 3,400,000 tons in 2023 [4]. Grapes are composed of water, sugars, minerals, organic acids, nitrogenous compounds, aromatic substances, enzymes, vitamins, and phenolic compounds [5].

The primary sugars in grapes are glucose and fructose, which are important in human nutrition due to their ability to diffuse directly into the bloodstream. Additionally, grapes are rich in essential minerals such as potassium (K), calcium (Ca), phosphorus (P), sodium (Na), iron (Fe), and magnesium (Mg). Grapes predominantly contain two major acids: tartaric acid and malic acid, which together constitute 70-90% of the total acids in the fruit. Among the nitrogenous compounds present, glutamic acid, arginine, threonine, and proline collectively constitute 85% of the amino acids found in grapes. When examining the vitamin content of fresh grapes, it is seen that they are rich in inositol and thiamine (B_1). Additionally, it contains pantothenic acid (B_5), niacin, pyridoxine (B_6), biotin, folic acid, and small amounts of riboflavin (B_2) [5]. Grapes are rich in phenolic compounds such as catechins, gallic acid, myricetin, quercetin, kaempferol, and coumaric acid, along with anthocyanins and other flavonoids. These bioactive compounds contribute to various health benefits, including antioxidants, cardioprotective, anticancer, anti-inflammatory, and antiallergenic effects. The presence of these compounds highlights the potential of grapes to support human health and prevent chronic diseases, emphasizing their importance in a balanced diet [2]. Table, wine and dried grapes are produced according to the type of consumption [4]. Grape is a fruit that can be perishable quickly and its nutritional value decreases after storage, so its shelf life is extended by processing into different products [1]. For this purpose, in addition to being consumed fresh in season, it is processed into beverages such as wine, fruit juice, molasses and dried form. In addition, traditional foods such as pestil (bastık), kesme (tarhana), sausage (köme), saruç, hardaliye, ravanda, çullama, samsa, ilende, pepeçura, grape pickles and *köfter* are produced, which allow grapes to be consumed all year round [6].

Köfter is one of the grape-based traditional products produced especially in Central Anatolian provinces such as Nevşehir (Cappadocia) and Niğde [7]. This dessert, which has recently been consumed as a snack, is known by different names in different regions and districts and is generally called *köfter* in Niğde and its surroundings, and *köftür* in the Nevşehir Cappadocia region [8].

This dessert also transcends being merely a food item and serves as a significant symbol reflecting the region's agricultural efforts, social solidarity, and cultural identity. Shaped by geographical, religious, and national influences, *köfter* highlights the essence of Central Anatolian cuisine with its use of local ingredients and traditional preparation

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methods. *Köfter* is also presented as a cultural heritage product during festivals and special occasions, ensuring its transmission to future generations. Within the scope of gastronomy tourism, *köfter* attracts tourists' attention, contributing to the economic development of local communities while introducing the authentic culinary experience of Central Anatolia to the world. As such, it becomes an integral part of the intangible cultural heritage of the region [9].

In the production of *köfter*, grape juice obtained from high-yielding, light-coloured grapes is typically used as the raw material. Additionally, molasses soil (pekmez toprağı), flour, starch, and optionally eggs are used in the production of *köfter* [10].

Köfter production typically begins in the autumn season usually in September-October, which is the ripening period of grapesis consumed throughout the winter [1]. Due to its high nutritional value, significant caloric content, and unique flavor, this traditional product holds great importance for Türkiye [7]. For this reason, it has recently become a snack that can be eaten not only in winter but throughout the year. While there are a few small-scale factories producing throughout the country, it is generally a product produced in homes with traditional production [6].

The primary aim of this study is to review existing research on *köfter*, a traditional fruit-based product, and to highlight the unique characteristics and cultural significance of this product. By focusing on its production methods, nutritional value, and role in regional cuisine, this study seeks to draw attention to *köfter* as an important component of traditional food heritage.

2 Production process of *köfter*

Figure 1 presents the flowchart of *köfter* production. While the production steps are identical in both traditional and industrial methods, the processes are carried out differently in practice.

2.1 Industrial köfter production process

In the industrial production process of *köfter*, firstly the grapes are washed, and then destemming, crushing, and filtering are carried out using screw presses to obtain grape juice (must, şıra) (Figure 2). The resulting grape juice (must, şıra) is transferred to a tank for clarification and acidity reduction, where 5% grape molasses soil (pekmez soil) is added and it is left overnight (Figure 3). Pekmez soil is a type of soil with high calcium carbonate content, used to neutralize the acidity of grape juice. It is found in various regions with differing compositions and is characterized by its white or nearly white colour [11, 12].

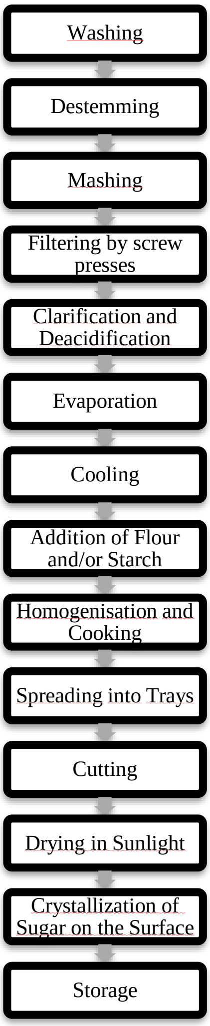

Figure 1. Production prosess of *köfter* [6]

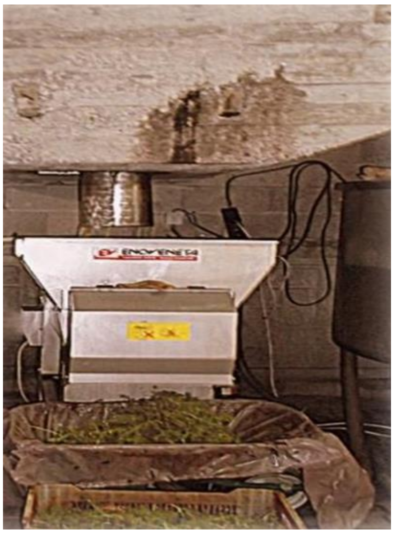

Figure 2. Pressing [6]

Figure 3. Clarification and deacidification tank [6]

Following clarification and acidity reduction, the juice is evaporated under vacuum conditions at 1 atm pressure and 65°C to 38 Brix. (Figure 4). After evaporation, the juice is cooled to 20–25°C to prepare for the addition of flour and/or starch (Figure 5). Flour and/or starch, amounting to 10% of the juice volume, are added, and the mixture is homogenized using a mixer. The mixture is strained to prevent lump formation. Sometimes flour can be used alone in production, sometimes it is used together. If *köfter* is made using only starch, it is softer than those made with flour alone. However, if *köfter* is made using equal amounts of both, a higher quality product can be obtained [6].

Figure 4. Evaporation with a bull-type evaporator [6]

Figure 5. Addition of flour and starch [6]

The homogenized mixture is transferred to containers in an open athmosphere and cooked at 90–93°C. After cooking, the mixture reaches a gel consistency and is spreaded manually onto trays moistened with grape juice (Figure 6). When the *köfter* have cooled and reached a suitable consistency, they are cut into square-shaped slices by hand using a knife (Figure 7). The shaped pieces are then spreaded evenly on racks to undergo the drying process, which lasts approximately four days (Figure 8). To ensure uniform drying, the pieces are flipped every two days.

Figure 6. Spreading into trays [6]

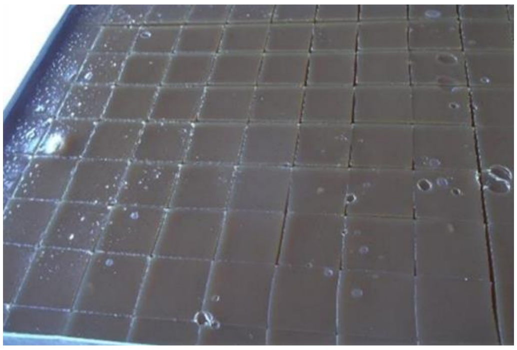

Figure 7. Cutting into squares [6]

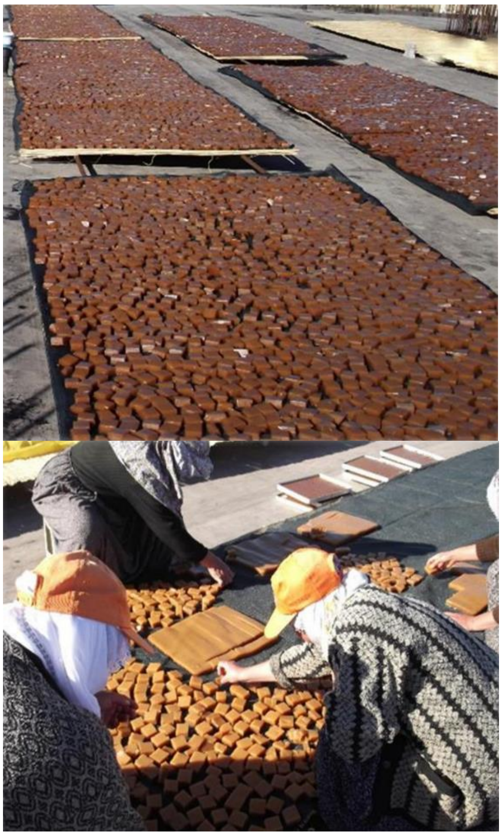

Figure 8. Drying [6]

At the end of the drying process, the surface of the *köfter* pieces is covered with breathable muslin cloth and left in the open air (Figure 9). This resting period allows a crystallized sugar layer on the surface of the *köfter* which gives its natural form, marking the final stage of production. Once this crystallization is complete, the *köfter* is ready for consumption (Figure 10) [6].

Figure 9. Storing for their surface is covered with a layer of crystalline sugar [6]

Figure 10. Final appearance [6]

2.2 *Traditional köfter production method*

In the traditional method of *köfter* production, the process begins with washing the grapes and separating them from their stems. The grapes are then crushed, and the juice is filtered through a muslin cloth to remove any residues.

To clarify and reduce acidity, 5% of grape molasses soil (pekmez soil) is added to the juice, which is left to settle for one day. After a day, the clear grape juice is collected and boiled in a container in the open air to evaporate the liquid (Figure 11). Once the juice reaches the consistency of molasses, a mixture of flour and starch is added at a ratio of one to nine. This addition is done gradually, with continuous mixing to achieve a homogeneous mixture. The cooking process continues until the raw flour taste is completely eliminated and the mixture is transformed into a gel-like structure [6].

The cooked mixture is spreaded into metal or wooden trays lined with a thin layer of juice, approximately 2 cm thick, and allowed to rest for a short time to facilitate cutting. As it cools, the *köfter* begins to solidify and begins to become suitable for slicing, it is cut into square-shaped or sometimes diamond shaped pieces. A thin muslin cloth is placed over the pieces, and they are dried in sunlight for about four days (Figure 12). After drying, the *köfter* is placed in special containers produced with clay (pots) and covered with breathable muslin cloths (Figure 13). Inside pots, the *köfter* develops a thin sugar film on its surface, which crystallizes over time, forming a protective sugar layer. The product is stored in these containers until it reaches its final form [6].

Figure 11. Boiling in containers in open air [13]

Figure 12. Drying in sunlight [13]

Figure 13. Storing into pots for their surface is covered with a layer of crystalline sugar [13]

3 General composition of *köfter*

In the literature, several studies have been conducted on the chemical composition of *köfter*, as reported in various sources. The data obtained from these studies provide comprehensive details on the maximum and minimum values of the components under different conditions. A summary of these values is presented in Table 1.

Table 1. Composition of *Köfter*

Compounds	Minimum	Maximum	References
Total solids (%)	79.17	82.17	[10]
Ash (%)	0.77	0.79	[1]
a_w	0.762	0.782	[1]
Moisture (%)	33.83	34,09	[1]
Titratable acidity (%)	0.04	0.08	[10]
Reducing sugar (%)	40.70	47.30	[10]
pH	5.37	6.09	[1], [14]
L*	23.93	38.60	[14], [15]
a*	1.12	14.22	[15]
b*	2.5	21.59	[15]
HMF (mg/kg)	2.42±0.09	11.67±0.20	[10]
Total phenolics (mg gallic acid equivalent/100g)	381.65±101.53	488.71±49.68	[10]
Antioxidant capacity (µmol trolox/g)	3268.38±42.05	3552.17±26.93	[6], [10]
Na (mg/kg)	243.00±49.52	1089.67±391.23	[10]
Mg (mg/kg)	278.67±61.07	393.33±63.62	[10]
Ca (mg/kg)	1116.00±258.92	1480.00±195.82	[10]
K (mg/kg)	7037±984,91	10247.67±344.28	[10]
Fe (mg/kg)	6.02±0.48	9.47±0.31	[10]

4 Studies on *köfter*

Traditionally, wheat flour and/or wheat starch are used as thickening agentin the production of *köfter* [6]. However, wheat, due to its gluten content, can cause intolerance and lead to celiac disease in many individuals [16]. The genetic condition triggered by the consumption of gluten-containing foods is defined as gluten intolerance or celiac disease [16]. This disease persists throughout an individual's lifetime and affects the autoimmune system [17]. In addition to causing gastrointestinal disorders by affecting the epithelial tissue of the small intestine, it can also lead to various systemic reactions throughout the body [17].

In recent years, the production of gluten-free foods using alternative components has gained attention. For this purpose, Alaşalvar and Erinç [15] used potato and corn starch as an alternative to wheat flour and wheat starch used in the production of *köfter* and examined the texture and colour properties of the products, which are important quality parameters for food products. For the study, *köfter* samples with different formulations were produced. The formulations included 100 g of grape molasses, 50 ml of pure water, and 15 g of one of the following: wheat flour, wheat starch, corn starch, or potato starch. The results of the colour analysis indicated that the use of different starches in *köfter* production significantly influenced the colour properties. Among the colour parameters, L* (lightness) value, which is the value expressing brightness, was highest in potato starch and lowest in corn starch. There was no statistically significant difference between the L* values of wheat flour and potato starch. The a* value shows the (redness-greenness) properties of the samples. The highest value was observed in wheat flour, followed by potato starch, wheat starch, and corn starch. The b* (yellowness-blueness) valuewas found to be highest for the sample produced with wheat flour, and lowest for the sample produced withcorn starch. According to the results of colour analysis, it was determined that usage of potato starch instead of wheat flour does not create a significant difference in colour quality.

In the study, the textural properties of *köfter* such as hardness, elasticity, stickiness, internal stickiness, gumminess, chewiness, and springiness were used to evaluate. The change in starch type in *köfter* formulations had a statistically significant impact on the textural properties of the samples. For the value of hardness, highest to lowest values were observed for the samples produced with wheat starch, corn starch, wheat flour, and potato starch, respectively. However, no statistically significant difference was found between the samples produced with wheat flour and potato starch. The elasticity values of *köfter* samples containing wheat starch and corn starch were found to be similar, while potato starch used in the sample reduced the elasticity. Gumminess values increased in the samples produced with wheat and corn starch, while that value decreased in the samples containing potato starch. Chewiness and elasticity parameters of the samples showed close responses for this parameter. It was observed that the use of potato starch increased the stickiness of the samples. Hardness, chewiness, and elasticity values were highest in *köfter* samples produced with wheat starch. This result is attributed to the interaction of other components in wheat flour forming complexes with starch or trapping the water required for gelatinization. Alaşalvar and Erinç [15] concluded that, in terms of colour properties, potato starch provided brightness and redness levels similar to wheat flour. From a textural perspective, the parameters of hardness and elasticity for the samples produced with corn starch were found to be close to wheat flour.

Becerikli and Başoğlu [10] investigated the effects of starch and egg addition on the quality parameters, physicochemical and bioactive properties of *köfter* in their study. For this purpose, they used three different *köfter* samples: one containing only flour, one with a flour-starch mixture, and one with flour and egg. Becerikli and Başoğlu found no statistically significant differences in the dry matter content or pH values of the *köfter* samples. In the colour analysis, the L* value was highest in the sample containing flour-starch and lower in the sample containing flour-only. No statistically significant differences were observed for the a* and b* values. When titration acidity results were analyzed, the highest acidity was observed in the sample containing the flour-only, followed by the sample containing the flour-starch and the flour-egg, respectively. The highest reducing sugar content was observed in the sample containing the flour-starch, while the lowest value for that content was found in the sample containing the flour-only. This difference is believed to be related to the type and ripeness of the grapes used. HMF (hydroxymethylfurfural) analysis revealed the highest HMF content observed in the sample containing the flour-starch. However, despite variations in HMF levels among the samples, the differences were not statistically significant. In the total phenolic content analysis, the sample containing the flour-starch showed the highest total phenolic content, followed by the samples containing the flour-only and flour-egg. Conversely, the sample containing flour-only exhibited the highest antioxidant capacity, with no significant statistical differences observed between the other two samples. Mineral analysis revealed variations among the *köfter* samples, which were attributed to differences in raw materials and production conditions. The study highlights the nutritional importance of *köfter*, made from grape as its primary ingredient, due to its high mineral, antioxidant, and phenolic content. Additionally, its high sugar content makes it a calorie-dense and energy-rich food. As a traditional and unique product, further research on *köfter* is valuable for understanding its nutritional and cultural significance. Microbiological analyses (Total mesophilic aerobic bacteria, yeasts, and coliform bacteria) in *köfter* samples did not yield measurable results. The absence of microbial growth in the samples is believed to be due to the high sugar and dry matter content present in the *köfter* [10].

Gerçekaslan and Aktaş [8] investigated changes in *köfter* quality parameters over a 3-month storage period. They conducted various analyses on *köfter* samples after one, two, and three months of storage, respectively. During the storage period, increases in water activity and colour quality parameters, represented by L*, a*, and b* values, were found to be significant. In contrast, moisture content and pH values decreased during storage. A notable reduction in pH and moisture content occurred in the first month, but no significant changes were observed in subsequent months. The surface of *köfter* samples developed a thin, sugary film during the first month, which likely helped retain moisture content beyond this period. This film, formed by sugar crystallization, was also responsible for the increase in colour parameters and water activity during storage. To assess textural changes, Gerçekaslan and Aktaş performed shearing and penetration tests. The hardness values of *köfter* increased during storage but showed no significant changes after the first month. Adhesiveness values decreased throughout the storage period.

In texture profile analysis, small differences were observed among the measured parameters during storage. These differences were statistically significant for springiness, gumminess, and chewiness, while hardness showed a significant increase only in the third month. Cohesiveness and resilience values decreased over time. The textural changes during storage were related to the retrogradation of starch used in *köfter* production. Retrogradation led to an increase in hardness and a decrease in adhesiveness. Although cohesiveness (representing the internal strength of bonds) and resilience (indicating the ability to recover shape) decreased, the product remained intact and elastic. The minor changes in springiness further confirmed this stability. Gerçekaslan and Aktaş [8] concluded that *köfter* maintained its structural integrity during storage. Despite changes in some quality and textural properties, the product's overall characteristics were preserved, highlighting its durability and stability as a traditional food product.

In another study, Aktaş and Gerçekaslan [1] utilized Differential Scanning Calorimetry to determine the sorption properties and glass transition temperature (Tg) of *köfter*. They identified the Tg of *köfter* as 24.5°C [1]. Foods with high solid content transition to a glassy state when amorphous components lose their structural integrity upon rapid cooling at Tg. This temperature represents the point at which a glassy structure forms. Tg is critical for defining processing methods, storage conditions, and shelf-life criteria for food products [18]. Recent research has reported Tg data for numerous food components, including sugars, polysaccharides, and proteins [19]. Additionally, Aktaş and Gerçekaslan [1] used Iglesias-Chirife and Peleg models to classify the sorption type of *köfter* as Type-III. This finding underscores the importance of storing *köfter* under conditions below 24.5°C to maintain its quality and stability. In another study [20], the effect of molasses concentration on the textural, pasting, and sensory properties of *köfter* was investigated by preparing and analyzing *köfter* samples containing different formulations of molasses and water. The samples were prepared with different molasses-water mixtures in the following concentrations: 75%-25%, 70%-30%, 60%-40%, 50%-50%, 30%-70%, and 25%-75%. The analysis revealed that the amount of water significantly influenced the pasting properties. The swelling ability increased up to the 50%-50% molasses-water concentration, meaning that adding more than 50% molasses decreased the swelling capacity of the starch. Additionally, the interaction between sugar, starch, and water increased the peak viscosity (PV) of the samples. As the molasses concentration increased, the sugar content also increased, enhancing the cohesion between starch granules. However, when the molasses content exceeded 50%, sugar penetration into starch granules hindered the interaction, leading to a decrease in viscosity. The interaction of sugar's hydroxyl groups with surrounding water molecules reduced and restricted the movement of water molecules. The trough viscosity (TV) of the starch paste was affected by the water concentration. As the water concentration decreased to 50%, the TV value increased, but when the water content surpassed 50%, the swelling capacity of starch granules increased, which led to a decrease in the TV value. As the molasses ratio increased, the high temperature and mechanical shear forces applied during Rapid Visco Analyzer (RVA) analysis caused the starch granules to lose their structure and integrity, resulting in a decrease in the breakdown viscosity (BV). The RVA is a device designed to simulate the cooking process of cereals by applying different temperature steps to the flour-water mixture and measuring the viscosity of the samples under controlled temperature and shear rate conditions [21, 22]. During RVA tests, the pasting process is observed in a starch or flour-water mixture subjected to heat and mixing [21, 22]. In this process, the starch granules swell, gelatinize and form a gel [22]. However, when the molasses ratio exceeded 50%, the BV value increased again. When the integrity of the granules weakened, starch showed less resistance. The blends with equal amounts of water and molasses demonstrated the ability to withstand more heat and stress [20].

During cooling, due to amylose retrogradation, the final viscosity (FV) increased as the molasses concentration increased. However, when the molasses concentration exceeded 60%, the FV value decreased because the sugar interacted with starch and prevented the alignment of starch chains. The setback viscosity (SV) decreased as the molasses concentration increased up to 50%. After exceeding 50% molasses, the SV value of the sample increased. High molasses concentrations accelerated retrogradation, and the increase in molasses concentration also extended the time required for starch granules to swell, which increased the pasting time and the stickiness temperature. The sensory properties of the samples were significantly influenced by the concentration of water and molasses. The most preferred sample was the one containing 60% water and 40% molasses, which also received the highest scores for colour, texture, taste, and odor. The sensory scores of samples with molasses concentrations between 75% and 40% were similar, while higher water concentrations (above 60%) negatively affected the sensory characteristics. This was likely due to the dilution of the sweet taste, which is undesirable in desserts. Therefore, the balance of water and molasses can be adjusted based on the desired sensory qualities, which directly affect consumer acceptance [20].

5 Conclusion

Grapes are one of the most widely cultivated fruits globally, holding substantial agricultural and economic importance. Due to their high sugar content, they are rich source of energy and calories. Additionally, their abundance in phenolic compounds, vitamins, and minerals makes them a highly nutritious food. These properties contribute positively to human health in various ways. Grapes are consumed extensively not only in fresh and dried forms but also as processed products. Besides their use in beverages such as wine, hardaliye, and molasses, grapes are transformed into numerous food items such as *köfter*, pestil, köme, and çullama, ensuring year-round consumption.

Köfter is a traditional product primarily produced in regions like Nevşehir (Cappadocia) and Niğde in Central Anatolia, Türkiye. It is made by boiling and evaporating grape juice with wheat flour and starch. The resulting mixture is spreaded into trays and dried. Once dried, the *köfter* is stored for a period to allow a thin layer of crystallized sugar to form on its surface, resulting in a long shelf-life. Due to its high caloric content, *köfter* serves as an energy-rich food, particularly consumed during the winter months. While traditionally made at home, *köfter* is also produced on an industrial scale. However, it is a unique Turkish taste, making it culturally significant for the country.

A review of the literature on *köfter* reveals a noticeable scarcity of studies on this product. Given its cultural heritage and unique value to Türkiye, there is a critical need to conduct more research on *köfter* and similar traditional products. Such efforts are essential to bringing these cultural significant taste into the global scientific and culinary literature. Therefore, further scientific studies on köfter are strongly encouraged to preserve and promote its cultural and nutritional importance.

Conflict of interest

The authors declare that there is no conflict of interest.

Similarity rate (iThenticate): 3 %

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