9000 YEARS OLD TURKISH TRADITIONAL BEVERAGE: BOZA

Abstract

Boza successfully navigated to the Caucasus region and ventured into Asia using the networks of Mediterranean merchants. The Turkish population was aware of the widespread distribution of boza. According to historical records, boza production was seen throughout the Seljuk era. Specifically, a kind of boza made from barley or millet was called "Bekni." The populace consumed this type of boza and preserved it in jugs. Boza, an indigenous fermented beverage derived from cereals, is prepared using a combination of millet, maize, rice, and wheat. The substance has a distinct flavor profile that combines sweetness and sourness, accompanied by a pale yellow hue and an odor reminiscent of acidity and alcohol. Boza is a traditional beverage that is often enjoyed in Turkey, Bulgaria, and several other countries in the Balkan region. Boza is a beverage made by the fermentation of whole grains or flour. This phenomenon has garnered substantial attention and interest in several nations, including Turkey, Kazakhstan, Kyrgyzstan, Albania, Bulgaria, Macedonia, Montenegro, Bosnia and Herzegovina, select Middle Eastern countries like Iran and Iraq, as well as specific areas within Romania and Serbia. In Turkish culinary traditions, it is common to provide this particular meal with roasted chickpeas (leblebi) and cinnamon as accompaniments. The beverage's triumph may be ascribed to its alluring taste, flavor, and nutrition.This research provides a comprehensive analysis of the manufacturing processes, product qualities, storage, and health consequences associated with boza.

Keywords: cereal beverage, fermentation, boza, health benefits, manufacturing processes

Author

Prof. Dr. Seval Sevgi Kırdar
Department of Food Processing
Burdur Mehmet Akif Ersoy University,
Burdur Food Agriculture and Livestock Vocational School,
Burdur, Türkiye
skirdar@mehmetakif.edu.tr

I. INTRODUCTION

Consumers' lives have seen significant transformations in recent years. They are expected to continue evolving due to several factors, such as globalization, economic development, food science and technology advancements, individual lifestyle preferences, and religious constraints [1–3]. Regarding consumer behavior in the context of consumption, sensory acceptability remains consumers' primary criterion of choice [4–6]. This criterion is heavily influenced by cultural backgrounds and prior sensory exposure to a particular food product [7, 8].

Globally, empirical data unequivocally demonstrate the increasing prevalence of functional beverage intake [9], attributable to their nutritional composition, practical packaging and design, simple portability and storage, and long-lasting stability on shelves [10]. Functional drinks may be categorized into many types, including dairy-based, fruit- and vegetable-based, legume-based, coffee-based, or tea-based. The functional characteristics of these drinks cater to various requirements and ways of living, such as enhancing energy levels, combating the effects of aging, alleviating weariness and stress, or even targeting certain disorders [11].

The potential exists for the intake of these drinks to mitigate the adverse health and economic consequences associated with inadequate dietary patterns. Furthermore, one of the primary advantages associated with cereal-based drinks is their suitability for consumption by those adhering to vegetarian, vegan, and lactose-intolerant diets [12].

Producing cereal-based fermented beverages involves fermenting cereals like maize, wheat, rice, oats, or a combination of these. These beverages are mostly utilized as substitutes for milk or soy beverages. Individuals who exhibit allergies or intolerances towards dairy and/or soy products or who consciously choose not to consume dairy products due to moral or health considerations generally exhibit a preference for cereal-based beverages. A variety of cereal-based fermented beverages are manufactured globally, and they can be categorized according to the raw materials employed or the type of fermentation employed throughout the manufacturing process. Several traditional beverages are consumed in different countries.The beverage known as bassoi was referred to by the Turks residing in Middle Asia.Additionally, analogous beverages are manufactured in East European countries (Braga or brascha), the Balkans (busa), and Egypt (bouza) . In Nigeria, examples include obiolor, ogi, pito, and skete. Saudi Arabia has a beverage called sorbia, while Ethiopia has borde. Uganda's traditional beverage is bushera, and in Mexico, it is called pozol [13-19].

Boza is consumed in Turkey, Bulgaria, and other Balkan countries. Boza is a cereal-based beverage derived through the process of fermenting entire grains or flour. This phenomenon has gained significant popularity in several countries, including Turkey, Kazakhstan, Kyrgyzstan, Albania, Bulgaria, Macedonia, Montenegro, Bosnia and Herzegovina,some of Middle East countries such as Iran and Iraq, and certain regions of Romania and Serbia. The Turkish term "Boza" etymology can be traced back to its Persian counterpart, "buze," which denotes the grain millet[20,21].

Boza is a culturally crucial Turkish beverage that is created by the process of yeast and lactic acid fermentation. It uses various components including millet, boiling maize,

wheat, rice semolina, or flour.Boza may also be produced by combining any of the grains above kinds. The substance under consideration is a colloid suspension with a high viscosity and a pale yellow hue. Depending on its acid level, it can be categorized as sweet or sour boza. The conventional variety of boza is renowned for its characteristic sour flavor. The flavor profile of boza is contingent upon the specific constituents employed in its formulation and the procedural techniques employed during its manufacturing. The stimulating properties of lactic acid facilitate the use of boza throughout the summer. However, the elevated temperatures during this season lead to the rapid proliferation of native microorganisms, resulting in significant alterations in sensory characteristics. Therefore, boza is typically ingested during the winter season. In Turkey, it is customary to serve this dish accompanied by roasted chickpeas (leblebi) and cinnamon. The drink's success can be attributed to its appealing taste, flavor, and nutritional characteristics. Boza production in Turkey encompasses both handmade and industrial methods [22].

II. THE BOZA OF ETYMOLOGY

The origin of the word boza, whose history dates back nine thousand years, comes from the word "bûza/bûze", which means a kind of thick and sour drink made from rice and millet flour in Persian [23]. Bûze also means millet. Buza in Arabic appears as boza in Bulgarian, Croatian, Hungarian, Serbian, and Albanian languages; bozas in Greek; and boza or bosa in English[24]. Boza is transferred to Romanian, Contemporary Greek, English and Russian, Polish, Czech, French, German and Spanish and Portuguese as bozan, bozas, buza, or bosa, buza, bousa or bosan, busa and boza, respectively [25,26].

Etymological dictionaries explain that the word boza was not used in the Turkish language before the 13th century, but rather as a drink made from ground millet. The words "begni/bekni" and "buhsu-m/buksu-n/yuksu-n" are used in Turkish, and these words are translated into foreign languages as "beer". The word "begni" was first encountered in the 7th-century Chinese encyclopedia. Uyghurs use the same word for beer or boza. In Divanu Lugati't-Türk, "begni" is defined directly as boza. Towards the end of the 13th century, it was used as "maize must" in the dictionary of Ibn Mühenna and as "maize wine, boza" in the Persian dictionaries of the Middle Ages following this century [27]. In Russian etymology, the word boza does not exist in other Slavic languages, but in Ukrainian and Belarusian, buzà means "lightly intoxicating drink". Boza, also known as "buza" in some languages, is known to be used with the meaning of "fresh beer", "self-boiling drink," or "a special drink made of millet kvass" [28]. All beverages, including wine learned and bought from China, are obtained from grain in a geography foreign to grapes, and millet is mentioned as the first grain used in their production. It is the origin product of the explanation that boza should be made from millet for the "best quality and taste", which is referred to as a "traditional Turkish drink" in the literature [13, 29, 30].

Boza, which is obtained from millet, which is defined as "a type of grain, millet" in dictionaries, is described as "a bitter, sour, sharp, and sometimes slightly intoxicating drink made from germinated millet". While the first work in which the word Boza is mentioned in food and beverage books was written in the name of Aydınoğlu Umur Bey in the 14th century, the oldest sources on how to make it point to the first half of the 15th century. In this period, the addition of rice boza to wheat, honey, and boza yeast is mentioned, and barley boza is made with the addition of barley tallow, wheat flour, and honey. It is known that boza

is made in Egypt by soaking barley in an earthen bowl with some water or burying it in the ground until it germinates. After adding the brewer's sourdough yeast to the barley, which is crushed and made into dough, the loaves are given to the oven in such a way that only the outer layer is cooked. The uncooked inner part is removed, mixed with water, and left for fermentation. When the resulting liquid is pressed and filtered, boza becomes ready to drink. The alcohol content of boza, which is consumed like beer in Egypt, is up to 7% [13, 27].

Boza, a beverage originating from Central Asia and afterward transferred to Anatolia and Europe via migratory movements, is often recognized as a Turkish drink. However, it is noteworthy that several European nations have also embraced boza and included it into their cultural fabric, designating it as a national beverage [13, 31, 32]. Boza is consumed in Turkey, Albania, and Romania, but defined boza as a Bulgarian drink [21]. Boza is a Turkish drink by origin and formed a part of the city's culture and economy during the development period of the Ottoman Empire [33]. It is known that boza was discovered and produced in Asia and spread to other countries through migration [32].

Boza is a traditional Turkish beverage prepared by fermenting millet, cooked maize, wheat, rice semolina, or flour with yeast and lactic acid. Boza can also be created by combining any of the cereals mentioned earlier. Depending on its acid content, it is a highly viscous, pale yellow colloid suspension that can be classified as either sweet or acidic boza. The traditional boza is known for its acidic flavor. The flavor of boza depends on the ingredients used and the cooking procedure. The refreshing effect of lactic acid allows boza to be consumed during the summer; however, the high temperatures during that season cause rapid development of indigenous microflora and, as a result, dramatic changes in sensorial attributes [22]. Therefore, boza is commonly ingested during the winter. In Turkey, it is served with roasted chickpea leblebi and cinnamon. The beverage's prevalence is due to its delicious flavor and nutritional value.

Boza is produced both artisanally and industrially in Turkey.In contemporary times, boza, a traditional beverage traditionally sold by street vendors in large metal containers during chilly winter nights or crafted by small-scale boza producers for regular use, has seen a shift towards production in modern companies with substantial commercial capabilities. Appropriate packaging for storage and transportation has facilitated the availability of brown bears in a fresh, hygienic, and secure manner on retail shelves. These bears are delivered using refrigerated vans[34].

III. HISTORICAL OF BOZA

Boza is thought to have first appeared in Anatolia and Mesopotamia (8000-9000 BC), known as the Fertile Crescent region.When the archaeological findings are examined, a fermented beverage similar to boza is mentioned in Akkadian and Sumerian texts[35]. Greek historian Xenophon, Boza, BC. He stated that it was made in 400 BC in Eastern Anatolia and was stored in clay pots buried under the ground [36]. It is stated that the Boza was spread by the Turks from the Fertile Crescent region to the Caucasus and then to Central Asia. The dissemination of boza throughout many geographical regions is indicative of the Ottoman Empire's influence on the recipe's transmission to the nations under their dominion[37].

Boza is being manufactured on a large scale in several nations around the Balkan Peninsula, with production quantities reaching hundreds of tons. The commencement of industrial manufacture may be traced back to 1876, when Haji Sadiq established a specialized shop called Vefa in Istanbul. This was then followed by the establishment of Ömür Bozacısı in Bursa, Karakedi Bozacısı in Eskişehir, and Akman Boza in Ankara. The prominent Boza enterprises in Bulgaria are Bomax of Haskovo, Gribash, located in Peshtera, Harmonica, and Radomirska Boza, located in Radomir. These firms specialize in Boza, a traditional rye, millet, or einkorn beverage. A commemorative monument was erected in Radomir, serving as a tribute to the Bulgarian beverage called Boza. This unique monument pays homage to a street seller specializing in selling Boza, making it the only monument in the world. Boza, a traditional fermented beverage, was created by the Pacara Company in Tirana, Albania. In Skopje, Macedonia, the renowned Akman was responsible for its production. Additionally, in Thessaloniki, Greece, the specialist confectionary Hatzis, established in 1908, also produced Boza [38].

The first theory for the discovery of boza is in the direction of Anatolia and Gobeklitepe, which are the ancestors of wheat, grain cultivation, and agriculture in human history. They are also the ancestors of bread and beer, and therefore of boza. Six large cooking pots with 160 liters of liquid capacity in which gray-black sticky residue traces, which are the traces of calcium oxalate that emerged during the soaking and fermenting of the grain discovered in the Gobeklitepe excavation area, are considered indicators of the early agricultural period related to the production and consumption of fermented grain beverages for Gobeklitepe and Anatolia by the researchers[39, 40]. In this view, which defends that the source of boza is Mesopotamia, it is stated that its spread took place on the course of Sumer, Anatolia, Egypt, Africa, Asia, China, Iran, Afghanistan, Caucasus, and then the Balkans [41]. According to the other theory, boza is the traditional drink of the Turks. The most important data supporting the theory is that while boza was produced and consumed according to its current low alcohol state (1%) in the geographies where Turks live, the alcohol ratio of the beer produced in Sumer is quite high compared to boza[42- 44].

In the scientific data that Sait Maden added to the preface of his Epic of Gilgamesh translation, Central Asia was flooded as far as Eastern Anatolia due to the glacier melting during the Great Flood. The Turks who were living there came to Mesopotamia and started a civilization, and they carried the tastes they consumed, agricultural and grain culture, to Mesopotamia [45]. In the light of historical data, it is not clear which civilization has been discovered before and from whom to whom it is transferred, but boza has managed to become one of the cultural ambassador flavors of today without spoiling its traditional recipe by transferring it from culture to culture, especially in geographies where Turkish populations live [46].

Since the seriousness of written transmission and written record tradition in Anatolia was rarely seen outside the Hittite period, especially in the Turkish population, the transference continues through verbal (stories, poems, epics and sayings), written sources about boza are often encountered in periods when recording was once again important [47]. The written work in which boza has been featured for the first time was written in the 14th century and the principles of its preparation were written in the 15th century, and the production of boza obtained from wheat as well as rice and barley boza was described in the 232 work [27].

According to the expressions of Evliya Çelebi (17th century), it is known that two different bozas, sour and sweet, were produced in the Ottoman Empire. While sour boza is a drink close to the traditional beer recipe, high in alcohol, and has been banned by ulama at various times due to its intoxicating nature, sweet boza is a drink obtained by lactic acid fermentation before the alcohol rate rises, and it is a drink that people of all ages enjoy. Besides the community, Matbah-ı Amire records show that boza was frequently preferred by the Sultan and Statesmen; boza expenses are also found in the kitchen records of the Prince Sanjaks [27, 48].

Boza experienced its golden age during the Ottoman period. There were boza houses in almost every neighbourhood and it was even said to be one of Fatih Sultan Mehmet's favourite drinks. During the II. Selim period (1524 – 1574), it was banned for a while, because in some boza houses, it was rested for a few months in order to be turned into alcohol. In the 17th century, IV. Sultan Mehmed (1648-1687) banned alcoholic beverages, including boza, and closed all boza shops. This ban returned many times during the history of the Ottoman Empire, but permissions were always given for its remaking.According to the information in Seyahatname, there were 300 boza houses in Istanbul in 1635; there were also boza houses in Ankara, Bursa, Erzurum, Kirikkale, Edirne, Tosya, Rumelia, Crimea, and Egypt, and it has been a beverage preferred by the locals in many provinces in summer and winter [49]. Along with the banned taverns during the reign of Sultan Murat IV (17th century), boza makers increased their sour boza production and started to produce intoxicating boza like opium boza. It is understood that, as a result of this change, which was reflected in Turkish with the expression "the şıra producer's witness is the boza producer" (which expresses the meaning of "the blind leading the blind"), wine was produced with the name of şıra and beer with the name of boza. When the boza houses ceased to be a place of chitchat and took on the atmosphere of a pub, the sale of sweet boza turned into street sales (Figure 1), and the boza culture evolved into a culture of street flavors [33,50].

Hacı Sadık Bey, who immigrated to Istanbul from Prizren during the heavy immigration to the Ottoman Empire in 1870 after the War, experimented with a new technique instead of the juicy, brown and sourish boza produced, by producing yellowish, thick and sweetish boza. Since it has been deteriorated after a while because of storing in oak barrels, He has been able to preserve its flavor by preserving the boza in marble cubes. By establishing the world's first official boza trade house in 1876 with the brand name Vefa Bozacısı, he standardized the boza and the members of the same family brought the boza to industrial production in 1918. The recipe for the boza culture that has existed since the Republic Period is this standard recipe belonging to Hacı Sadık Bey. The reasons why the people love boza: Besides its taste, boza is a nutritious, easily accessible and cheap beverage that can be produced from all kinds of grains [46, 51].

IV. BOZAHANELER (BOZA HOUSE)

The first bozahane appeared in Ottoman urban life in the 15th century, serving as the location for both the manufacture and selling of boza. A workshop is also known as a bozahane, which is a group of Ottoman artisansIn the 15th century, apart from certain areas of Ottoman society such as mosques, bazaars, or lodges, another place emerged where they could spend time, have social experiences, have a good time, and express their opinions. It is probable that bozahanes existed in the Ottoman Empire at a time when coffee was not yet

known. Because the names of six bozahanes are mentioned in the Bursa kadı registers of 1482, The first coffeehouses in the Ottoman Empire were opened in Tahtakale in 1554 [52].

The most defining feature of boza is that it was known as sour or sweet in Ottoman society. According to the state's fatwa on the subject, sweet boza is not haram, but sour boza is haram and bad for people, demonstrating the significance of boza in Ottoman geography residents' lifestyles[53].

Evliya Çelebi states in his "Travelbook" that in the seventeenth century, there were approximately 300 boza shops in Istanbul and that there were 1000 employees. However, with the spread of coffee and coffee houses towards the end of the seventeenth century, boza lost its popularity, Sometimes lanterns were lit in the boza shops of old Istanbul. This lit lantern indicated that the boza season (September 15 to May 15) had arrived [54].

The fact that boza is among the primary beverages has enabled bozahanes to maintain their existence as a social place where people go frequently even today. Vefa Bozacisi in Istanbul and Karakedi Bozacisi in Eskişehir can be given as examples of the most important public spaces that have ensured the transportation of boza as a cultural heritage until today [51].

Boza, which is the ancient drink of the Turks, still maintains its place among the drinks preferred, especially in the winter months. The most important element that ensures the continuity of this culture is Vefa Bozacisi, which is famous for the boza shops of Istanbul and became a brand by taking the name of the district. Hacı Sadık Bey, who came to Istanbul from Prizren in 1870, founded Vefa Bozacı. He brought the boza-making profession in Prizren with him to Istanbul. He turned the boza business, which he initially continued as a mobile, into a stable state with his brother Hacı İbrahim Bey and opened a shop in the Vefa district. Thus, a historical fidelity spoiler has emerged[27, 51].

Akman Boza in Ankara, on the other hand, is another company with a historical background in which boza has been produced in Turkey since the 1920s. The family, whose founders were of Balkan origin, migrated from Skopje to Bursa and then to Ankara. The Akman family, which has three generations, started this business with the production of boza and must, and it appears as a place that continues to exist in Ankara until today [27, 51].

Another popular boza shop today is Karakedi Bozaçiler (Figure 2) in Eskişehir. Both the production and sale of boza are carried out in this workshop. In addition, boza is prepared in a way that can be eaten with a spoon. Apart from bozahanes, there are also places where boza is stored and sold in plastic packages. Ice cream shops, dessert shops, or various markets are among the places that sell boza. It can be thought that plastic packaging is preferred because it is comfortable to carry and, at the same time, the product can be more economical [27].

Providing coolness in the summer and warmth in the winter, boza appears as a meal for the poor and soldiers at first. So, it is recorded in the records that even Bozacı was recruited to the army during the expeditions. The fact that boza can be made from almost any kind of grain makes it one of the most consumed foods in times of famine. A price comparison made in 1640 gives us information about the ease of accessibility of boza under

the economic conditions of the period. According to this comparison; while 280 dirhams (898 gr) of sweet boza were sold for one coin, only 80 dirhams (256 gr) of plain rice pilaf could be bought for the same amount of money in the same period [49].

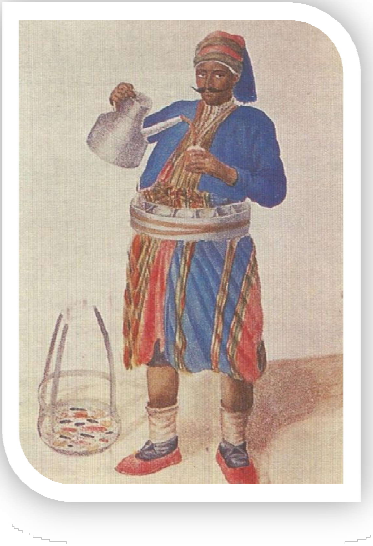

Figure 1: Boza Seller [27]

Figure 2 : Branded Boza Workshops

V. BOZA PRODUCTION

Boza comprises several different grains, with the millet-flour-based kind having the best quality and taste. The Albanian Boza type is characterized by its predominant use of maize as the principal component, setting it apart from Boza produced in other regions. On the other hand, countries such as Turkey, Bulgaria, and Macedonia often use bulgur, millet, barley, chickpea, or rice semolina/flour as the principal constituents in the production of boza. The nutritional composition of cereal grains is greatly influenced by the particular species and the prevailing environmental conditions under which they are grown. From a technical standpoint, the primary constituents of wheat proteins consist of gliadins and glutenins, which exhibit insolubility in water and form a composite known as gluten. Furthermore, carbohydrates, cellulose, and lipids are other noteworthy components. The chemical composition of boza, which is mainly obtained from wheat grains, is characterized by proteins (12.6%), carbohydrates (67.8%), lipids (1.6%), minerals (1.7%), and water (15.5%) [38].

Boza combines milled cereals or flours, including corn, barley, rye, wheat, millet, and rice. Leblebi flour has a strong prospect as a viable substitute for conventional wheat, rice, or maize flour. Nevertheless, it is essential to acknowledge that the sensory properties of boza are negatively impacted when grain flours are entirely replaced in its manufacturing. The chemical composition of the grains often used in the production of boza is shown in Table 1 [55].

Table 1. Chemical Composition of Grains Commonly Used for Boza Production

	Composition (%)			
Grain	Carbohydrates	Proteins	Fat	Dietary fibre
Wheat	71.2	12.6	1.5	12.2
Maize	18.7	3.3	1.4	2.0
Millet	72.8	11.0	4.2	8.5
Barley	77.7	9.9	1.2	15.6
Rye	60.7	8.8	1.7	13.2
Rice	80.0	7.1	0.7	1.3
Leblebi[3]	41.1-47.4	21.7-23.4	2.6	13.9-17.6

The process of boza manufacturing may be briefly outlined as follows: (i) initial preparation of the raw ingredients, (ii) boiling the mixture, (iii) subsequent chilling and filtering, (iv) addition of sugar, and (v)initiation of fermentation (Figure 3)[21].

1. **Preparation of the Raw Materials:** The first step in the process involves the preparation of the raw materials. As previously stated, millet, wheat, bulgur, maize, and rice are viable raw materials for the manufacturing of boza. The chosen grain or cereals undergo a process of cleaning to eliminate any unwanted substances. Subsequently, they are fragmented into pieces of semolina-like size and subjected to a sifting procedure to separate the hull and bran components. In some regions, the flours derived from these grains are also favored. The other parts required for the preparation of boza are granulated

sugar, potable water, and yeast, which may be sourced from a previous boza batch or fermented bread dough [13, 56,57].

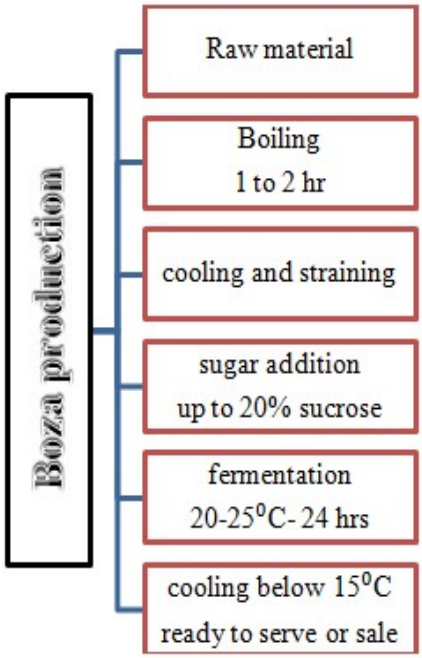

Figure 3: Boza Production Cheme

2. **Boiling:** The combination of sieved grains is subjected to boiling in a solution containing 4-6 times its volume of water (w/v) while continuously stirring. The boiling process utilizes stainless-steel boilers with varying capacities adjusted according to daily production requirements. The mixture undergoes water absorption throughout the process of boiling, necessitating the periodic addition of hot water until the boiling process is completed. The boiling process is halted after a uniform pulp is achieved, often within 1-2 hours, contingent upon the boiling temperature and the nature of the raw material [13, 56,57].

3. **Cooling and Straining:** It is recommended to let the pulp cool overnight after the boiling process. Cooling is expedited in some manufacturing facilities by the use of marble containers. The cooled pulp is diluted with water at a ratio of 2-2.5 and mixed continuously. Subsequently, the mixture is filtered into wooden barrels. The substance that has undergone the process of sieving is referred to as "sugarless raw boza," while the solid component that has not been drained is used as feed for animals [13, 56,57].

4. **Sugar Addition:** Based on the regulations outlined in Turkish Food Regulations, it is stipulated that boza must possess a minimum saccharose content of 15% in the form of granulated sugar. To optimize the fermentation process, it is common practice to include a maximum of 20% sugar in the initial composition of raw boza. In contrast to the prevailing approach seen in several other culinary traditions, the use of malt is absent in the traditional methods employed in Turkish food preparation[13, 56,57].

5. **Fermentation:** In order to initiate the fermentation process, it is recommended to use a starter culture consisting of Boza from a prior batch with an approximate concentration of 2–3 percent. The concoction is allowed to undergo fermentation inside oak barrels. The proportion of the beginning culture is contingent upon the specific season and temperature during its production. The combination that has been infected is subjected to incubation at a temperature range of 15 to 25.8 °C for about 24 hours before its readiness for use. During the process of boza fermentation, it is seen that two distinct forms of fermentation take place concurrently. One process during alcohol fermentation is the production of carbon dioxide bubbles, which subsequently increase volume. The second process, known as lactic acid fermentation, produces lactic acid, which imparts boza with its acidic properties. The wooden barrels should not be filled due to the volume expansion during fermentation. It is recommended that the boza, created in this manner, be devoured to avoid excessive sourness. Cold storage is often used in practical applications to slow down the fermentation process, hence prolonging the shelf-life of boza. During the first manufacturing of boza for the season, a starting culture consisting of either sourdough or yogurt is used as a substitute due to the unavailability of boza at that time. As a fermentation agent, sourdough produces more acidity than when inoculated with a prior batch of boza because of its lower viscosity. When yogurt is chosen as the preferred option, it results in a thick and highly acidic product with a distinct flavor that can be identified[13, 56,57].

6. **The Preservation and Service of Boza:** The preservation conditions of boza have considerable significance due to its inclusion of fermented and food-grade microorganisms. If boza is not stored correctly, it should not be exposed to the elements. It is recommended to place this mixture in a refrigerated environment promptly and consume it within 2-3 days. It is advisable to store boza in a sanitary glass container before proceeding with its commercial distribution. According to MEGEP [58], consuming boza expeditiously throughout the bottling process is recommended due to the ongoing fermentation process. In the past, boza, a beverage typically presented in cups, was traditionally accompanied by a little garnish of ginger. However, contemporary practices have shifted, and it is now commonly served with cinnamon and yellow chickpeas. In certain instances, individuals may express a desire to utilize honey to enhance a substance's sweetness (Figure 4) [58]. Typically, boza is consumed by individuals in Turkey throughout the winter season. In Bulgaria, Boza is also favored throughout the summer months [38].

Figure 4: Boza

VI. COMPOSITION AND NUTRITIVE VALUE OF BOZA

The chemical composition of boza exhibits variability as a result of the components employed during its production and the conditions under which it is processed. According to Turkish Boza Standard [59], boza is "A product prepared by cooking millet, rice, wheat, corn, and similar cereals cleaned of foreign materials by adding drinking water to one or more of the crushed or flours and subjecting them to alcohol and lactic acid fermentations in accordance with its technique by adding white sugar.". The first fermentation that takes place in Boza fermentation is alcohol fermentation, which providesthe development of yeast and the release of carbon dioxide, which is seen toswell. The second fermentation is the lactic acid fermentation carried out by thelactic acid bacteria that shape the acidic structure ofboza.

Based on the established criteria outlined in Turkish Standards, boza is expected to possess specific attributes. These include a uniform and consistent appearance, devoid of any visible grain husk, with a light or dark cream color. Boza should also exhibit a dense texture, distinctive taste, and aroma. In terms of composition, the minimum requirements for total dry matter and total sugar (in the form of saccharose) are 20% and 10%, respectively. Additionally, the ethyl alcohol content in sour and sweet boza should not exceed 2% by volume. As determined by lactic acid, the acceptable range for total titratable acidity is 0.2-0.5% for sweet boza and 0.5-1.0% for sour boza(Table 2) [59].

In contrast, the permissible levels of volatile acidity, specifically acetic acid, in sweet boza are up to 0.1%, while in sour boza, it is up to 0.2% (5). The average composition of boza is presented in Table 1. The permissible limit for coliform bacteria in boza is ten colony-forming units per gram (cfu/g), while the acceptable threshold for molds is 20 cfu/g. The presence of fecal coliforms, Salmonella, and Staphylococcus aureus is deemed unacceptable according to the specifications outlined in TS 9778 [59].

Table 2. Composition of Boza

Components	**Value**
Dry mater	Min. 20%(m/m)
Total sugar	Min. 10% (m/m)
Etil alcohol	Max. 2% (m/m)
Ash	Max. 0.2%(m/m)
Total acidity	Sour boza 0.2-0.5 %(m/m) Asit boza 0.5-1.0% (m/m)
Uçucu asitlik	Sour boza 0.1 %(m/m) Asit boza 0.2 % (m/m)

Boza is a source of, protein, carbohydrate, fibre and vitamins, including thiamine, riboflavin, pyridoxine and niacin [13,38].Table 3 shows the average composition of Turkish Boza.

Table.3. Composition of Boza [26, 31]

Components	**Average(%)**
Energy	240 kcal
Dry Matter	26.3
Soluble matter	19.10
Insoluble matter	7.2
Invert sugar	6.2
Total sugar	15.1
Dextrine	1.0
Nitrogenous matter	1.23
Ash	0.15
Raw fiber	0.02
Crude oil	0.25
Acidity	0.3-0.5
Volatile acidity	0.04-0.13
Alcohol	<0.6
Vitamins	**Average(mg/100g DM)**
Thiamine(B1)	0.19-0.25
Riboflavin (B2)	19.10
Pyridoxine (B6)	0.32-0.36
Nicotinamid	0.51-0.60

The selection of raw materials employed in the production of boza significantly influences the chemical composition of this beverage. According to Akpinar-Bayizit et al. [22], the presence and composition of raw materials have an impact on the availability and quantity of carbohydrates that can serve as main fermentation substrates, as well as nitrogen sources and growth factors for microbial activity. The qualities of the final product are further influenced by operations such as size reduction, heating, and cooling [60].

Boza is a beverage characterized by its high viscosity and low alcohol content, offering a delightful sweetness and subtle acidity. Its color ranges from creamy white and beige to a light brownish hue. The composition of the substance under consideration includes approximately 0.50-1.61% protein, around 12.3% carbohydrate (with 8–12% sugar content), and a moisture content ranging from 75% to 85% [29, 61]. As per the statements provided by the manufacturers (Bomax, Ömür Bozasi), the end products they produce consist of a range of 8–57.5% carbs, 0.5–3.5% proteins, 0.4–0.5% fats, 29 mg of calcium, 1.3 mg of iron, 95 mg of phosphorus, and 1 mg of zinc, as well as vitamins such as thiamin, riboflavin, and niacin. According to a study conducted by Çelik et al. [55], boza that is made solely with leblebi (yellow chickpea) flour has elevated levels of protein (8.46%) and minerals such as calcium (268.1 ppm), potassium (525.3 ppm), phosphorus (199.2 ppm), zinc (3.13 ppm), and manganese (1.14 ppm). Additionally, this type of boza contains a lower amount of sugar (0.05%). Various types of acids, including oxalic, lactic, pyruvic, acetic, and malic acids, were detected in different samples of Boza. Citric acid was observed in Boza made from rice and maize, whereas orotic acid was detected in Boza made from rice, maize, and millet [22].

The duration of fermentation is an additional significant variable that influences the pH level and acidity of boza. An increase in fermentation duration leads to a decrease in pH and an increase in acidity, specifically in relation to lactic acid. In their study, Hancioglu and Karapinar [20] documented a decrease in the pH levels of the boza samples, which declined from 6.13 to 3.48. Additionally, they observed an increase in the total titratable acidity of the samples, which rose from 0.02 to 0.27 mmol/g. Furthermore, the alcohol content of the boza samples exhibited an increase, escalating from 0.02% to 0.79%.

According to a study by Hayta et al.[62], Turkish boza's pH gradually drops from 5.8 to 3.5 over the course of 24 hours during the fermentation process. The duration of fermentation also exerts an influence on yeast-mediated alcohol generation. Extended fermentation durations result in increased alcohol concentrations. However, it is worth noting that the typical alcohol content range of conventional Turkish boza falls within 0.03% to 0.39% w/v, as reported by Kose and Yucel[63]. Based on the pertinent national rules, it is stipulated that a beverage is classified as a nonalcoholic beverage if its ethyl alcohol content is below 5 g/L [64].

The temperature at which fermentation occurs is a significant determinant of the chemical composition of the end product. Gotcheva et al. [21] investigated the effects of various temperatures (4°C, 25°C, and 30°C) on the fermentation process of boza. The glucose concentration at the beginning of the fermentation process was 1.73 g/L. Subsequently, after 24 hours of fermentation at temperatures of 30°C, 25°C, and 4°C, the glucose concentrations grew to 17.4 g/L, 13.8 g/L, and 2.6 g/L, respectively. The greatest temperature resulted in the most intensive starch hydrolysis, which can be attributed to the accelerated growth of microflora. The initial concentration of free amino nitrogen was measured to be 20.3 mg/L. Subsequently, this concentration was seen to fall to 7.3, 7.9, and 18.6 mg/L at the conclusion of fermentation at temperatures of 30°C, 25°C, and 4°C, respectively. The study reported that the greatest level of microbial activity was recorded at a temperature of 30°C. The pH value of the solution decreased from an initial value of 5.0 to 3.4, observed at either 25°C or 30°C. Minimal alterations in pH were noted during the fermentation process conducted at a temperature of 4°C.

Boza is a fermented beverage with a notably high viscosity, thus making an examination of its rheological qualities pertinent. Genc et al. [65] carried out a study to determine a correlation between the rheological characteristics of boza and the results of its sensory analysis. The observed behavior of the product demonstrated characteristics of a non-Newtonian fluid, as evidenced by a decrease in apparent viscosity measurements with an accompanying rise in shear rate. The behavior in question was further elucidated through the use of a power law function, which revealed its characteristic of being pseudo-plastic in nature.

Guven [66] conducted an analysis of the chemical composition of boza produced using mixtures of millet and maize. The dry matter content of the sample was found to be 23.7%. Additionally, the total sugar content was determined to be 11.6%, while the protein content was measured to be 0.9%. The ash content was found to be 0.16%, and the oil content was determined to be 0.27%. Evliya [31] documented the compositional values of boza produced from combinations of bulgur, maize, and wheat in a ratio of 6:2:2, and millet, maize, and wheat in a ratio of 4:3:1, respectively, as stated below: The dry matter content ranges from 27.46% to 29.17% and 25.20% to 27.90% for the two samples. The protein content ranges from 1.22% to 2.00% and 1.14% to 1.93% for the respective samples. The total sugar content ranges from 16.16% to 19.20% and 17.10% to 18.15% for the two samples. Lastly, the ash content ranges from 0.81% to 0.93% and 0.12% to 0.18% for the respective samples.

Boza can be manufactured utilizing many grains and other starch-rich plants, such as potatoes. In their study, Ustun and Evren [67] investigated the sensory, chemical, and physical characteristics of bozas manufactured using various ingredients such as bulgur, bread, millet, potato, rice, maize, and wheat. The bozas were prepared by incorporating 15% or 25% sugar into the respective mixtures. The composition of the sample was determined to have the following characteristics: soluble dry matter ranged from 11.5% to 26.8%, total dry matter ranged from 14.49% to 28.03%, ash content ranged from 0.057% to 0.158%, total sugar content ranged from 7.33% to 21.89%, starch content ranged from 0.15% to 7.37%, protein content ranged from 0.477% to 1.012%, fiber content ranged from 0.019% to 0.75%, alcohol content ranged from 0.138% to 0.525%, acidity (expressed as lactic acid) ranged from 0.242% to 0.448%, pH ranged from 2.93 to 3.72, and volatile acidity (expressed as acetic acid) ranged from 0.0048% to 0.0324%.

The biogenic amine content of boza was examined by Yegin and Uren [54]. All boza samples were found to contain putrescine, spermidine, and tyramine, which are three out of the 11 biogenic amines that were investigated. Tyramine emerged as the predominant biogenic amine. The tyramine levels observed in the boza samples ranged from 13 to 65 mg/kg. The biogenic amine concentrations in the boza samples ranged from 25 to 69 mg/kg. The maximum permitted limits found that the levels of biogenic amines found in Turkish boza were within acceptable ranges.

According to the Turkish Standards Institute[59], sweet boza contains 0.2-0.5% acid. In Evliya Çelebi's Seyahatname, sweet boza is a white, thick consistency boza made from Tekirdağ millet that even the ulema drink. Sour boza contains 0.5-1.0% acid. Again, according to Evliya Çelebi, this boza is called "Islambol Boza", which is mostly made by Tatars and Gypsies, drunk by janissaries, levents, porters, and high in alcohol and acidity.

Uylaşer et al. [32] collected boza samples from 17 different patisseries in Bursa with a dry matter content of 18.99-25.70% (average 22.62%), invert sugar 0.1-1.92% (average 0.5%), sucrose 9.35-15.76% (mean 12.78), total sugar 10.64-16.05 (mean 13.29), sugar-free dry matter 4.112-11.76% (mean 8.84)) raw ash 0.07 -0.17% (average 0.12%), protein 0.27-0.56% (average 0.45%) and acidity (as lactic acid) 0.18-0.34% (average 0.26%). Alcohol was not detected in any of the samples.Yegin [54] determined that in 10 different boza samples, the dry matter was in the range of 15.32 ± 0.10-31.12% ± 0.14, the pH values were in the range of 3.16-3.96, and the protein content was between 0.50 ± 0-0.99 ± 0.02.Akpinar et al. [22] determined the highest total acidity value in wheat boza of 0.61% ±0.07 and the lowest total acidity value of 0.32 ±0.04% in millet boza in their study. While the pH value of the boza samples was in the range of 3.43–3.86, the alcohol content of the wheat boza was found to be lower by 0.46% ±0.04.

According to the results of chemical analysis by Yavuz [68], the dry matter content in boza is 23.40%, total sugar is 16.60%, protein is 1.38%; total acidity is 0.92%, ethanol is 0.42%, and ash content is 09.33%. The pH was found to be 3.30. Meriç [69] examined the chemical composition of 27 boza produced in the Thrace region and found the dry matter values between 5.57% and 29.82%, with an average value of 20.61%; pH values are between 3.11-4.59, with average values of 3.72; the acidity values in terms of lactic acid were between 0.13-0.47, and the average value was determined to be 0.28.

In Berktaş's [70] study, the dry matter determination results for boza produced from different raw materials were determined in the range of 24.48–28.16. The pH values of boza produced with 2% yeast using different raw materials after 24 hours of fermentation ranged from 3.78±0.03 to 4.16±0.04.

In the research conducted by Tortum [71] on the chemical components of boza samples, the dry matter ratio was found to be between 22.78% and 36.01%, with an average value of 29.39%. In the acidity analysis, it was between 0.17 and 0.22% in terms of lactic acid, and the average value was determined to be 0.19.

There needs to be more research about the taxonomic classification of the microorganisms responsible for boza fermentation. Hancıoğlu and Karapınar [20] studied the composition of lactic acid bacteria and yeasts. They identified various lactic acid bacteria species, including *Leuconostoc paramesenteroides* (25.6%), *Lactobacillus sanfrancisco* (21.9%), *Leuconostoc mesenteroides* subsp. *mesenteroides* (18.6%), *Lactobacillus coryniformis* (9.1%), *Lactobacillus confusus* (7.8%), *Leuconostoc mesenteroides* subsp. *dextranicum* (7.3%), *Lactobacillus fermentum* (6.5%), and *Leuconostoc oenos* (3.7%). Additionally, they found the presence of Saccharomyces uvarum (83.0%) and Saccharomyces cerevisiae (17.0%) among the yeast species. Following a 24-hour fermentation process, the concentration of lactic acid bacteria in boza rose from 7.6 x 10^6 per mL to 4.6 x 10^8 per mL. Additionally, it has been documented that the yeast concentration in boza increased from 2.25 x 10^5 per mL to 8.1 x 10^6 per mL.

The microbiological properties of boza were analyzed in the study of 15 boza samples collected from four different provinces of Turkey (Isparta, Antalya, Istanbul and Ankara) by

Yasin Tuncer et al. [72]. The total mesophilic aerobic bacteria (TMAB) count of the boza samples ranged from 2.4 x 10^7 to 3.2 x 10^8 cfu/mL, with an average of 1.2 x 10^8 cfu/mL; lactic acid bacteria (LAB) counts ranged from 2.1 x 10^7 to 2.9 x 10^8 cfu/mL, with an average of 9.3 x 10^7 cfu/mL; yeast-mold count was found to be between 4.7 x 10^5 and 5.4 x 10^6 cfu/mL, with an average of 1.9 x 10^6 cfu/mL. It was determined that only one of the boza samples had coliform bacteria at the level of 1.1 x 10^2 cfu/mL.

In the mycoflora of boza consumed in Bulgaria, *Lactobacillus plantarum* (24.0%), *Lactobacillus acidophilus* (23.0%) and *Lactobacillus fermentum* are dominant; It is also stated that *Lactobacillus coprophilus* (11.0%), *Lactobacillus brevis* (15.0%), *Leuconostoc raffinolactis* (9.0%) and *Leuconostoc mesenteroides* are also present at lower rates. It is stated that *Saccharomyces cerevisiae* constitutes 47.0% of the yeast flora of Bulgarian boza [21,73].

VII. BOZA'S SHELF LIFE

Boza is a culturally significant fermented beverage that is traditionally consumed during both the winter and summer seasons. Its consumption is attributed to the cooling properties associated with the presence of lactic acid.However, at high temperatures, yeast and acetic acid bacteria multiply rapidly, causing changes in the sensory properties of boza [7, 69]. Boza has a shelf life of 15 days and can be consumed at every stage of fermentation until the pH value drops below 3.5 [10].Boza has a 1- to 2-week shelf life when kept at +4°C, after which the product loses usability due to an increase in acidity. Boza made with probiotic starter culture has a documented shelf life of 12 days at +4°C [65].

VIII. HEALTY EFFECTS OF BOZA CONSUMPTION

Boza is composed of proteins, carbs, fats, and various vitamins. Due to this characteristic, it is widely regarded as a highly nutritious beverage. Additionally, it contains a significant amount of lactic acid, which benefits the digestive system and the composition of intestinal microorganisms [38].

The presence of vitamins in boza confers benefits to both the neurological and digestive systems. Additionally, it facilitates the release of energy and promotes an increase in lactation. This is the reason why it is often advised for pregnant and lactating women, as well as athletes, to incorporate this beverage into their diet. Moreover, it enhances the body's resilience by fortifying it and alleviating fatigue. It also possesses therapeutic properties for treating influenza, common colds, and throat infections while exhibiting antitussive effects. Boza possesses significant nutritional value for individuals engaged in physical activity, as it encompasses essential vitamins such as A, C, E, and four variants of vitamin B. Moreover, its plant-based composition renders it particularly advantageous for vegetarians and vegans, serving as a commendable alternative to dairy-based beverages due to its vitamin-rich nature [13, 22, 38].

Boza has been identified as a potential contributor to various health advantages. These include its ability to regulate blood pressure, enhance colonic health, reduce plasma cholesterol levels, promote milk production in lactating women, facilitate digestion by augmenting gastric juice production, and stimulate the secretion of pancreatic and hepatic cells[10].

Petrova and Petrov [74] state that boza has been shown to provide many health benefits such as balancing blood pressure, enhancing milk manufacturing in lactating females and facilitating digestion. In addition, its cereal content, such as barley, oat, millet and others, helps reduce TG; thus, it lowers the chances of cardiovascular disease and paralysis [75].

In addition to the chemical properties of boza, research on its effects on health reveals that boza is an important source in terms of phenolic compounds and antioxidant activity. Boza whole grain cereals, which are raw materials, are very rich in phenolic substances. There are many studies showing that most phenolic compounds, such as phenolic acids and flavonoids, are found in grains. The main phenolic acids found in cereals; ferulic and pcoumaric acids, while the main flavonoids are anthocyanins [30-33]. Phenolic compounds have antioxidant properties and show a protective effect against degenerative diseases in which free radicals play a role, such as cancer and heart diseases [30, 76]. In another study investigating the antioxidant activity of some traditional soft drinks in Bosnia and Herzegovina, it was determined that traditionally prepared beverages had higher antioxidant activity values compared to commercial production. In the same study While the total phenolic content of the investigated boza samples was 273.15-210.59 mg TAE/L, the anthocyanidin content was found to be 956.04-1539.83 mg catechin/L [39].

Additionally, it is rich in iron, phosphorus, niacin, salt, and vitamins A, B1, B2, and E. The product above is a beverage with cancer-fighting properties, effectively inhibiting the development of carcinogenic compounds within the human body. Additionally, it serves to safeguard bone health and enhance its growth [13, 38, 39].

The angiotensin I-converting enzyme (ACE) is a crucial component in the physiological regulation of blood pressure and the balance of fluid and salt in the human body. ACE inhibitors are a group of chemicals that lower the activity of angiotensin-converting enzyme (ACE), which is a key part of how blood pressure is controlled. In a recent study that looked at the biochemistry of the ACE-inhibiting activity of protein hydrolysate and protein fractions from Boza, it was found that the ACE-inhibiting activity of Boza goes up by 3.5 times after it has been broken down in the stomach. After in vitro digestion of Boza, the different samples, such as Boza, protein hydrolysate, fractionated hydrolysates, and dialysates, contain a variety of bioactive chemicals that have different effects on ACE inhibition. Boza can be regarded as a favorable source of ACE-inhibitory peptides [77].

Cereal-based goods that include health-promoting properties have the potential to mitigate chronic ailments such as type 2 diabetes, cardiovascular illnesses, and specific forms of cancer through the adoption of a nutritious diet characterized by reduced fat intake and increased consumption of dietary fiber [78]. Dietary fiber is a broad term encompassing several types of carbohydrates obtained from plant cell walls that are not broken down by human digestive enzymes [79]. The consumption of [the food in question] has the potential to impact weight management, cholesterol levels, and diabetes, and has a role in the prevention of cardiovascular diseases such as diverticulitis, varicose veins, hiatus hernia, and colon cancer [80]. As per the American Association of Cereal Chemists, dietary fiber can be categorized into two main types: water-insoluble fiber (including cellulose, chitin, hemicellulose, hexoses, pentoses, lignin, xanthan gum, and resistant starch) and water-soluble fiber (such as beta-glucan and arabinoxylan, as well as oligosaccharides like galacto- and

fructo-oligosaccharides). The cereals utilized in the manufacturing of boza encompass both types of fibers[38].

According to Kandylis et al. [81], the natural prebiotic lactic acid bacteria (LAB) content of Boza is what gives it its second health-promoting benefit. The integration of probiotics, prebiotics, and synbiotics into food products yields numerous advantageous effects on human health. The potential benefits of consuming probiotics include various mechanisms such as pathogen interference, exclusion, and antagonism. Additionally, probiotics have been found to have immunostimulatory and immunomodulatory effects. Animal models have demonstrated anticarcinogenic and antimutagenic activities associated with probiotic consumption. Probiotics have also been shown to alleviate symptoms of lactose intolerance and promote vaginal and urinary tract health. Furthermore, there is evidence suggesting that probiotics can reduce blood pressure in individuals with hypertension. Probiotics have been found to decrease the incidence and duration of diarrhea, including antibiotic-associated diarrhea, Clostridium difficile infection, travelers' diarrhea, and rotaviral diarrhea. Lastly, probiotics contribute to the maintenance of mucosal integrity [82].

Boza, a fermented product derived from grains, falls within the category of functional beverages owing to the presence of probiotic microbes inherent in the grain's natural flora. In their study, Todorov et al. [83] conducted an investigation into the probiotic characteristics of lactic acid bacteria (LABs) derived from boza. Their findings revealed that boza exhibits a substantial abundance of LABs with probiotic potential. Furthermore, all strains isolated from boza shown the ability to endure simulated gastrointestinal conditions and exert pathogen-inhibiting effects through the production of bacteriocin. According to Birer [25], Boza is known to have a calming and invigorating impact. According to Arıcı and Dağlıoğlu[13], the presence of lactic acid in it contributes to its regulating impact on the digestive system and intestinal flora. Additionally, it has been shown that it exerts a beneficial influence on the functioning of the gastric glands [84].

IX. CONCLUSION

Boza is a beverage with significant nutritional value that can be traced back to ancient times. Boza, a traditional beverage with a strong and cherished consumption pattern in regions inhabited by Turks, particularly in the Balkans, is recognized as an intangible cultural heritage item. The preservation of boza, akin to coffee, as a cultural asset warrants attention. It is imperative to acknowledge the significance of promoting boza on a worldwide scale, a responsibility that falls upon the state, while concurrently providing support to traditional boza producers.The manufacturing of boza has a lengthy historical background and can be assessed as a non-dairy beverage with beneficial properties. This beverage possesses excellent nutritional value, rendering it easily digestible. It offers a pleasurable sensory experience through its taste and aroma, while also providing advantageous benefits to human well-being as a result of its probiotic microorganisms. The preservation mechanism observed in Boza through the utilization of lactic acid bacteria (LAB) is attributed to the antibacterial properties exhibited by bacteriocins and other metabolites synthesized by LAB.

Boza, a beverage that holds a significant position among our cereal-based fermented products, possesses notable nutritional properties and exerts positive health effects, including

probiotic, antimicrobial, and antioxidant properties. People of all ages, particularly children and young adults, readily consume it as a result.The widespread adoration for boza and the establishment of bozahanes as communal venues have facilitated the enduring presence of this cultural phenomenon in contemporary society. Vefa Bozacısı, deriving its name from the corresponding region, Akman Boza of Balkan origin in Ankara, and Karakedi Bozamaker in Eskişehir are among the workshops that facilitate the consumption of boza and contribute to the preservation of Bozahane tradition.Along with the more well-known addition of cinnamon and chickpeas, boza used to traditionally come with coconut, ginger, and cloves.

REFERENCES

[1] M.V. Ignat, L.C. Salanță, O.L.Pop, C.R.Pop, M.Tofană, E.Mudura, A. Pasqualone, "Current functionality and potential improvements of non-alcoholic fermented cereal beverages". Foods, vol 9, 2020, pp.1031.
[2] L.C. Peyer, E. Zannini, E.K. Arendt, "Lactic acid bacteria as sensory biomodulators for fermented cereal-based beverages". Trends Food Science and Technology, vol 54, 2016,pp.17–25.
[3] L.C. Salant,ă, A. Uifălean, C.A. Iuga, M. Tofană, J. Cropotova, O.L. Pop, C.R. Pop, A.M. Rotar, M. Bautista-Ávila, C. Velázquez González, "Valuable Food Molecules with Potential Benefits for Human Health. In The Health Benefits of Foods—Current Knowledge and Further Development"; IntechOpen: London, UK, 2020.
[4] U.T.X. Phan, E. Chambers, "Application of an Eating Motivation Survey to Study Eating Occasions". Journal of Sensation Studies, vol 31, 2016, pp.114–123.
[5] U.T.X. Phan, E. Chambers, "Motivations for choosing various food groups based on individual foods". Appetite, vol 105, 2016, pp.204–211.
[6] U.T.X. Phan, E. Chambers, "Motivations for meal and snack times: Three approaches reveal similar constructs". Food Quality Preference, vol 68, 2018, pp.267–275.
[7] Q.J. Wang, L.A. Mielby, J.Y. Junge, A.S. Bertelsen, U. Kidmose, C. Spence, D.V. Byrne, "The role of intrinsic and extrinsic sensory factors in sweetness perception of food and beverages: A review". Foods, vol 8, 2019, pp.211.
[8] D. Chambers, U. Phan, S. Chanadang, C. Maughan, K. Sanchez, B. Di Donfrancesco, D. Gomez, F. Higa, H. Li, E.Chambers, "Motivations for Food Consumption during Specific Eating Occasions in Turkey". Foods, vol 5, 2016, pp.39.
[9] M.R. Corbo, A. Bevilacqua, L. Petruzzi, F.P. Casanova, M. Sinigaglia, "Functional Beverages: The Emerging Side of Functional Foods: Commercial Trends, Research, and Health Implications". Comprehensive Review Food Science and Food Safety, vol 13, 2014, pp.1192–1206.
[10] G. Ghoshal, S.K. Kansal, "The Emerging Trends in Functional and Medicinal Beverage Research and Its Health Implication". In Functional and Medicinal Beverages; Elsevier Inc.: Amsterdam, The Netherlands, 2019, ISBN 9780128163979.
[11] S. Sethi, S.K.Tyagi, R.K. Anurag, "Plant-based milk alternatives an emerging segment of functional beverages: A review". Journal of Food Science and Technology, vol 53, 2016, pp.3408–3423.
[12] A.G.T. Menezes, C.L.Ramos, D.R. Dias, R.F.Schwan, "Combination of probiotic yeast and lactic acid bacteria as starter culture to produce maize-based beverages". Food Research International, vol 111, 2018, pp.187–197.
[13] M. Arici, O. Daglioglu, "Boza: a lactic acid fermented cereal beverage as a traditional Turkish food". Food Reviews International vol 18, 2002, pp.39–48.
[14] G.O. Adegoke, A.K. Babalola "Characteristics of microorganisms of importance in the fermentation of fufu and ogi—two Nigerian foods". Journal of Applied Bacteriology, 65, 1998, pp.449–53.
[15] M.A.A. Gassem, "A microbiological study of Sobia: a fermented beverage in the Western province of Saudi Arabia". World Journal of Microbiology and Biotechnology, vol 18, 2002,pp.173–177.
[16] K. Abegaz, T. Langsrud, F.Beyene , J.A.Narvhus, "The effects of technological modifications on the fermentation of bode, an Ethiopian traditional fermented cereal beverage". Journal of Food Technology Africanvol 9, 2004, pp.3–12.
[17] C.M.B.K. Muianja, J.A.Narvhus, J.Treimo, T. Langsrud, "Isolation, characterization and identification of lactic acid bacteria from bushera: A Ugandan traditional fermented beverage". International Journal of Food Microbiology, vol80, 2003, pp.201–210.
[18] C. Wacher, A. Canas, E. Barzana, P. Lappe, M. Ulloa, J.D. Owens , " Microbiology of Indian and Mestizo pozol fermentations". Food Microbiology, vol 17, 2000, pp.251–256.

[19] S.R. Morcos, S.M. Hegazi, S.T. El-Damhoughy, " Fermented foods of common use in Egypt II. The chemical composition of bouza and its ingredients". Journal of Science Food Agriculure, vol24, 1973, pp.1157–1161.
[20] Ö. Hancıoğlu, M. Karapınar, "Microflora of Boza, A Traditional Fermented Turkish Beverage". International Journal of Food Microbiology, vol 35, 1997, pp.271–274.
[21] V.Gotcheva, S.S.Pandiella, A. Angelov, Z.Roshkova, C. Webb, "Monitoring the fermentation of the traditional Bulgarian beverage boza". International Journal of Food Science and Technology, vol 36, 2001, pp.129–134
[22] A. Akpinar-Bayizit, L. Yilmaz-Ersan,T. Ozcan, "Determination of Boza's organic acid composition as it is affected by raw material and fermentation". International Journal of Food Properties, vol 13,2010, pp. 648–656.
[23] C. Sâlephur, "Farsça Türkçe Genel Sözlük", Tebriz, 1381.
[24] Boza, "Türk Ansiklopedisi", MEB Yayınları, 1956-1976.
[25] S. Birer, "Boza yapımı ve özellikleri". Gıda, vol 12, 1987, pp.341-344.
[26] U. Yücel, S. Ötles, "Geleneksel Fermente İçeceğimiz Boza", Gıda, vol 5, 1998, pp. 36-38.
[27] A.N. Turan, (Ed.), "Acısıyla Tatlısıyla Boza", 2000, Turan, A.N., "Boza'yı Kurcalamak", Kültür ve Turizm Bakanlığı Yayınları, Ankara, 2007, pp.15-29.
[28] P.Y. Çernıhk, "Acısıyla Tatlısıyla Boza". T.C. Kültür ve Turizm Bakanlığı Yayınları,2000, pp.134.
[29] M. Zorba, Ö. Hancıoğlu, M. Genç, M. Karapınar, G. Ova, "The use of starter cultures in the fermentation of boza, a traditional Turkish beverage". Process Biochemistry, vol 38, 2003, pp.1405–1411.
[30] K. Guven, N. Benlıkaya, "Acid pH produced by lactic acid bacteria prevent the growth of *Bacillus cereus* in boza, a traditional fermented Turkish beverage", Journal of Food Safety, vol 25, 2005, pp. 98–10.
[31] B. Evliya, "A Traditional Turkish Fermented Drink Boza", Food Biotechology, vol 4, 1990, pp.478.
[32] V. Uylaşer, M. Korukluoğlu, D. Göçmen, "Bursa'da Satışa Sunulan Bozaların Bileşimi ve Kalitelerinin Araştırılması", Gıda Mühendisliği Kongresi, Gaziantep, 1998.
[33] Ü. Koç, "Klasik Dönem Osmanlı Ülkesinde Boza". T.C Kültür ve Turizm Bakanlığı Yayınları, Ankara, 2007.
[34] S.Atabay "Farklı Tahıl Çeşitlerinden Endüstriyel Olarak Üretilmiş Bozaların Fizikokimyasal Özelliklerinin Belirlenmesi". Van Yüzüncü Yıl Üniversitesi Master's thesis, pp74, 2003.
[35] D.A.Tóth, "Hungarian-Mesopotamian Dictionary" (HMD), 2001.
[36] S.D. Todorov, "Diversity of bacteriocinogenic lactic acid bacteria isolated from boza, a cereal-based fermented beverage from Bulgaria". Food Control, vol 21, 2010, pp.1011-1021.
[37] P.M. Isin, "*Bountiful Empire: A History of Ottoman Cuisine"*. Reaktion Books.pp.11-22, 2018.
[38] P. Petrova, K. Petrov, "Traditional cereal beverage boza fermentation technology, microbial content and healthy effects". In Fermented Foods, Part II (pp. 284-305). CRC Press, 2017.
[39] M. Heun, R. Schäfer-Pregl, D. Klawan, R. Castagna, M. Accerbi, B. Borghi, F.Salamini, "Site of Einkorn Wheat Domestication Identified by DNA Fingerprinting". Science, vol 278, 1997, pp. 1312–1314.
[40] P.E. McGovern, "Uncorking the Past. The Quest for Wine, Beer, and Other Alcoholic Beverages". Berkeley/Los Angeles/London: University of California Press, 2009.
[41] N. Kramer, "Tarih Sümer'de Başlar", Türk Tarih Kurumu Yayınları: X (11a).1995.
[42] C. Çakır, "Tarihi, Etimolojisi ve Edebiyatı ile Boza Kitab"ı, Türk Dünyası Araştırmaları Vakfı, İstanbul, 2019.
[43] M. Kaşgarlı "Divanu Lugati't – Türk", (Çeviren: Atalay, B.), Ankara: Alaadin Kıral Basımevi, 1941.
[44] C. Kaya, "Uygurca Altun Yaruk (Giriş, Metin ve Dizin)", Atatürk Kültür, Dil ve Tarih Yüksek Kurumu, Ankara: TDK Yayınları: 607, 1994.
[45] İ.M. Çığ, "Sümerlilerde Tufan Tufanda Türkler", Ankara: Kaynak Yayınları, 2008.
[46] B. Demirci, H. Ayvalı, H. Coda, A. Ünver, "Boza as a Gastronomic Value in Anatolia".Tourism and Hospitality Studies, Internationaler Verlag der Wissenschaften Berlin 2020, pp.229-238.
[47] İ. Görkem, "Dünden Bugüne Türk Sözel Edebiyatı: Değişim ve Dönüşüm", A.Ü. Türkiyat Araştırmaları Enstitüsü Dergisi, vol 39, 2009, pp. 411–422.
[48] İ. Selçuk, "Boza consumption in early-modern Istanbul as an energy drink and a mood-altering substance". Akademik İncelemeler Dergisi, vol 11, 2016, pp.61-81.
[49] M. Yerasimos, "500 Yıllık Osmanlı Mutfağı" (13. Baskı). İstanbul: Boyut Yayın Grubu, 2014.
[50] A. Ünsal, "Şıra, Boza ve Kimi Şerbetlere Dair, Acısıyla Tatlısıyla Boza". T.C Kültür ve Turizm Bakanlığı, Ankara, 2007.
[51] [51] E. İgüs, "Balkanlar'dan Anadolu'ya Boza ve Türleri ile Türkiye'deki Balkan Kökenli Bozacılar", Karabük Üniversitesi Sosyal Bilimler Dergisi, vol 6, 2016, pp. 101–111.

[52] F. Feyiz, "Osmanlı Şehir Mekânlarına Bir Örnek: Bozahaneler". Uluslararası Ekonomi Siyaset İnsan ve Toplum Bilimleri Dergisi, vol 4, 2021, pp.9.
[53] B.S. Ergüder, "Geleneksel İçeceğimiz Bozanın Tüketim potansiyeli Üzerine Bir Araştırma: İstanbul Örneği", Master's thesis, Okan Üniversitesi/ Sosyal Bilimler Enstitüsü, İstanbul, 2019.
[54] S. Yegin, M. Fernández-Lahore, "Boza: A traditional cereal-based, fermented Turkish beverage". pp. 533–542. *In*: Y.H. Hui and E. Özgül Evranuz (eds.). Handbook of Plant-Based Fermented Food and Beverage Technology. CRC Press, Florida, 2012.
[55] İ. Çelik, F. Işik, Y.Yilmaz, "Effect of roasted yellow chickpea (leblebi) flour addition on chemical, rheological and sensory properties of boza". Journal of Food Processing and Preservation, vol 40, 2016, pp.1400-1406.
[56] H.Tangüler, "Traditional Turkish fermented cereal based products: Tarhana, boza and chickpea bread". Turkish Journal of Agriculture-Food Science and Technology, vol 2, 2014, pp.144-149.
[57] C.E.Tamer, Ö.U. Çopur," Geleneksel bir içecegimiz: Boza". Geleneksel Gıdalar Sempozyumu Bildiri Kitabı, 2004, pp.85-89.
[58] MEGEP, "Yiyecek İçecek Hizmetleri Diğer Soğuk İçecekler ve Servisi". MEB Yayını, Ankara, 2006.
[59] TSE, "*Boza Standardı"*. TS 9778. Türk Standartları Enstitüsü, pp 1-6, Ankara, 1992.
[60] M.J.R. Nout, Y. Motarjemi, "Assessment of fermentation as a household technology for improving food safety: a joint FAO/WHO workshop". Food Control, vol 8, 1997, pp.221-226.
[61] S.Yegin, A. Üren, "Biogenic amine content of boza: A traditional cereal-based, fermented Turkish beverage", Food Chemıstry, vol.111, 2008, pp.983-987.
[62] M. Hayta, M.Alpaslan, E. Kose "The effect of fermentation on viscosity and protein solubility of boza, a traditional cereal-based Turkish beverage". Europen Food Research Technology, vol213, 2001, pp.335–337.
[63] E. Kose, U.Yucel, "Chemical composition of Boza". Journal of Food Technology, vol1, 2003, pp.191–193.
[64] Anonymous, "Regulations of non-alcoholic beverages". No: 98/24, Republic of Turkey, Ministry of Agriculture and Rural Affairs, General Directorate of Protection and Control Vision, 1998.
[65] M. Genc, M. Zorba, G. Ova, "Determination of rheological properties of boza by using physical and sensory analysis". Journal of Food Engineering, vol52, 2002, pp.95–8.
[66] S. Güven, "Bazı Geleneksel Gıdalarımızın İşlenmesi ve Teknoloji Geliştirmenin Önemi". Gıda Kontrol, Eğitim ve Araştırma Enstitüsü Tebliğ No:18., Çanakkale, 1982, pp. 223-235.
[67] N.S. Ustun, M. Evren, "Degişik Hammaddelerden Boza Üretimi ve Üretilen Bozaların Bileşimi". Ondokuzmayıs Üniversitesi Ziraat Fakültesi Dergisi, vol 13, 1998, pp. 95–106.
[68] M. Yavuz, "Bozanın Reolojik Karakterizasyonu". Master's thesis, İstanbul Teknik Üniversitesi, 2001.
[69] A. Meriç, "Trakya Bölgesinde Üretilen Bozaların Bazı Fizikokimyasal ve Mikrobiyolojik Özellikleri". Master's thesis, Namık Kemal Üniversitesi, 2010.
[70] İ. Berktaş, "Bozanın Farklı Hammaddeler Kullanılarak Üretilmesinin Fenolik İçeriğine Ve Kalitesine Etkisi". Master's thesis, İstanbul Teknik Üniversitesi, 2011.
[71] M.Y. Tortum, "Trakya Bölgesinde Üretilen Bozalardan Laktik Asit Bakterileri Ve Mayaların İzolasyonu ve Pcr Yöntemi İle Tanımlanması". Master's thesis, Namık Kemal Üniversitesi, 2018.
[72] Y. Tuncer, B. Özden, M.D. Avşaroğlu, "Bozanın Bazı Mikrobiyolojik Özelliklerinin ve Laktik Asit Bakterisi Zolatlarının Antibakteriyel Aktivitelerinin Belirlenmesi". Süleyman Demirel Üniversitesi Fen Bilimleri Enstitüsü Dergisi,vol 12,2008, pp.19-25.
[73] V. Gotcheva, S.S. Pandiella, A. Angelov, Z.G. Roshkova, C. Webb, "Microflora Identification of the Bulgarian Cereal-Based Fermented Beverage Boza". Process Biochemistry, vol 36, 2000, pp.127-130.
[74] P.M. Petrova, K.K. Petrov, "Antimicrobial activity of starch-degrading Lactobacillus strains isolated from boza". Biotechnology and Biotechnological Equipment, vol 25, 2011, pp.114-116.
[75] A. Yarış, "Turkish Traditional Fermented Plant-Products as Functional Food". Eurasian Journal of Food Science and Technology, vol 6, 2022, pp. 42-51.
[76] G. Baervald, "The origin of bread based beverages". Ge-treideMhel Brot, vol 42, 1998, pp. 335–338.
[77] A. Kancabaş, S. Karakaya, "Angiotensin- converting enzyme (ACE)-inhibitory activity of boza, a traditional fermented beverage". Journal of the Science of Food and Agriculture, vol 93, 2013, pp. 641-645
[78] H. Köksel, B. Cetiner, "Grain science and industry in Turkey: Past, present, and future". Cereal Foods World, vol 60, 2015, pp.90–96.
[79] D. Charalampopoulos, R. Wang, S.S. Pandella, C. Webb, "Application of cereals and cereal components in functional food: a review". International Journal of Food Microbiology, vol 79, 2002, pp. 131–141.

[80] F. Shahidi, P. Ambigaipalan, “Beverages fortified with omega-3 fatty acids, dietary fiber, minerals, and vitamins. pp. 801–813. *In*: F. Shahidi and C. Alasalvar (eds.). Handbook of functional beverages and human health”. Taylor and Francis Group LLC, UK, 2016.
[81] P. Kandylis, K. Pissaridi, A. Bekatorou, M. Kanellaki, A. Koutinas, “Dairy and non-dairy probiotic beverages”. Current Opinion in Food Science, vol 7, 2016, pp. 58–63.
[82] T.R. Klaenhammer, “Probiotic bacteria: today and tomorrow". Journal of Nutrition, vol 130, 2000, pp.415–416.
[83] S.D. Todorov, M. Botes, C. Guigas, U. Schillinger, I. Wiid, M.B. Wachsman, L.T.M. Dicks, “Boza, a natural source of probiotic lactic acid bacteria”. Journal of Applied Microbiology, vol 104, 2008, pp. 465-477.
[84] M.H. Pamir, “Boza Üzerinde Mikrobiyolojik ve Kimyasal Araştırmalar” PhD thesis, Ankara Üniversitesi, 1961.

