

Review

Traditional Fermented Beverages as Drinks of the Future

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Abstract

Fermentation is a foundational process that has historically underpinned the development of global civilizations. By extending the shelf life of perishable ingredients while enhancing flavor, nutrition, and bioactive properties, fermentation has provided the food security necessary for societies to flourish. Traditionally, these processes utilized locally available raw materials—such as milk, cereals, fruits, and vegetables—to produce a diverse array of non-alcoholic, alcoholic, and functional foods. This review explores the evolution of prominent ancient fermentation products and the contemporary movement to revive their authentic sensory profiles, including unique aromas and textures. Furthermore, it examines the transition from traditional artisanal methods to modern industrial production, where the use of standardized starter cultures and precise process parameters ensures product uniformity for the global market while employing precision fermentation to improve traditional fermentation products. By bridging ancestral wisdom with modern food science, this review highlights the enduring relevance of fermentation in the current food landscape.

Keywords: fermentation; yeast; LAB; precision fermentation

1. Introduction

Fermentation is a foundational bioprocess that predates scientific understanding by millennia. While archeological evidence suggests humans have utilized fermentation to preserve raw materials for at least 9000 years [1], the underlying mechanisms remained a mystery until the pioneering work of scholars such as Leeuwenhoek, Pasteur, Buchner, Traube, and Katz.

Biochemically, fermentation is a metabolic strategy employed by microorganisms to acquire energy via substrate-level phosphorylation. Although it is less energetically efficient than oxidative phosphorylation—yielding only 2 molecules of ATP per glucose molecule compared to 36 in aerobic respiration—it is essential for regenerating NAD⁺, which is required to sustain glycolysis [2]. Fermentative processes are generally categorized as spontaneous (utilizing wild microorganisms) or induced (using specific starter cultures). They are further classified by their oxygen requirements— aerobic (e.g., acetic acid production) or anaerobic (e.g., alcoholic and lactic acid fermentation)—and their metabolic outputs. While homofermentative processes yield a single primary product, heterofermentative processes finish with a complex matrix of organic compounds. Notable examples include kefir and kombucha, where symbiotic cultures of bacteria and yeast (SCOBY) act synergistically to generate a diverse array of acids and ethanol.



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Historically, alcoholic fermentation was among the first bio-transformations mastered by humans, with evidence found in Neolithic Egyptian and Near Eastern winemaking vessels [1,3]. These beverages were often more nutritious and safer than local water sources and served various medicinal purposes, such as pain management [3]. For instance, Kumis, traditional fermented mare milk prepared by Kazakh nomads, was historically utilized to treat tuberculosis and gastrointestinal distress [4].

Today, fermented foods and beverages remain an integral part of the human diet, accounting for an estimated 5–40% of global food consumption. Through fermentation, raw materials undergo significant transformations in texture, nutritional value, aroma, and color, often resulting in enrichment with proteins and essential amino and fatty acids [5–9]. While alcoholic beverages like beer and wine have dominated Western history, contemporary shifts are now favoring low-alcohol (LAB) and non-alcoholic beverages (NABs) due to their health profiles and extended shelf life [10]. Even though alcohol acts as a preservative, today's preservation technologies and processes can help improve and extend the shelf life of low- and non-alcoholic beverages. These beverages are deeply rooted in global food cultures and are socially accepted for both habitual and ritual consumption. Recently, the global functional beverage market has experienced a significant shift characterized by a sharp deviation from synthetic, highly processed soft drinks toward culturally rooted, traditional alternatives. This movement is primarily driven by three converging macro-environmental factors: the “clean label” movement, heightened post-pandemic health awareness, and a growing consumer desire for brand authenticity and heritage. Younger consumers (Millennials and Gen Z) are actively driving this transition, seeking out beverages that function as holistic lifestyle tools rather than basic refreshments. This commercial emergence has transformed formerly localized or niche items—such as kombucha, kefir, ayran, and botanical or adaptogenic herbal infusions—into high-performing global commodities. This commercialization is frequently supported by sophisticated direct-to-consumer digital marketing and influencer-led narratives centered on wellness.

This review aims to provide a concise overview of traditional fermented foods, primarily focusing on European traditions while examining popular products from Asia, Africa, and the Americas. The classification of these foods will be based on their raw material substrates (e.g., cereal-based, fruit-based). Furthermore, while fermentation remains a vital preservation method, its expanded modern definition, which now encompasses the industrial production of enzymes, organic acids, and specialty pharmaceuticals such as vitamins employed in traditional fermentation processes, known as precision fermentation. According to Verma et al. [11], precision fermentation is an advanced process of traditional fermentation using genetically modified microorganisms, such as bacteria, fungi, or yeast, to yield a desired product. Precision fermentation is a novel idea that originates from cellular agriculture, an alternative production of products traditionally produced from animals. Cellular agriculture uses bioreactors instead of conventional livestock farming [12–14]. Thus, precision fermentation can be described as an advanced biotechnological method for producing specific food ingredients, such as enzymes, organic acids, proteins and fats [15–17]. The integrity of precision fermentation lies in cutting-edge techniques that enhance the efficiency of microorganisms by inserting desired genes and in producing high-value compounds with greater efficiency.

2. Traditional Fermented Milk-Based Beverages

It is improbable that early humans intentionally fermented milk. The fermentation process probably occurred in some forgotten pot full of milk, which was then discovered to be tasty and nutritious. As mentioned before, fermentation adds functional value to the raw material, changing its texture, smell, taste, and form (cheese). A wide spectrum of

beverages and foods can be made out of milk, and they are usually related to the lactic acid bacteria involved in the fermentation. Numerous milk-fermented products are known to be producible, but describing them all would here be quite difficult. Even though this section is dedicated to milk-fermented products, only some of them can be described in detail due to page limits. However, the selection is ensured to cover most European regions and some of the most famous products from other countries (Turkey, Egypt, etc.). Milk fermentation started in the Near East and spread to Southern and Eastern Europe [18], so most of the products are related to these parts of the world. Table 1 shows various milk-based traditional products. As there are many traditional milk-based beverages, this section describes only a few of them in detail.

Table 1. Various traditional milk-based products.

Name	Substrate	Microorganism	Country	Source
Acidophilus milk	Cow milk	<i>L. lactis lactis</i> , <i>L. lactis cremoris</i> , <i>L. lactis lactis</i> var. <i>diacetylactis</i> , <i>Leuconostoc</i> subsp., <i>L. acidophilus</i>	Eastern Europe, Mediterranean, Scandinavia	[19]
Tätmjölk	Cow milk	EPS *-forming lactococci (<i>Lactococcus lactis</i> , <i>Leuconostoc mesenteroides</i>)	Scandinavia	[19]
Surmjölk	Cow milk	<i>Lactococcus lactis</i> , <i>Leuconostoc mesenteroides</i> , <i>Lactobacillus</i> spp.	Sweden	[19]
Skyr	Goat milk	<i>Lactobaacillus</i> spp., <i>Streptococcus thermophilus</i> , <i>L. delbrueckii</i> subsp. <i>bulgaricus</i> , <i>Kluyveromyces marxianus</i> and <i>Saccharomyces cerevisiae</i>	Iceland	[20]
Prokish	Sheep milk	<i>L. bulgaricus</i>	Greece/Bulgaria (Trachia)	[21]
Laban	Milk	<i>Lactobacillus</i> spp.	Egypt	[22–24]
Žinčica	Sheep milk whey	Lactic acid bacteria: <i>L. casei</i> , <i>L. plantarum</i> , <i>Lactococcus lactis</i> and <i>Leuconostoc mesenteroides</i> .	Poland, Slovakia	[25]
Taette	Milk	<i>S. lactis</i> var. <i>taette</i>	Scandinavia	[26]
Kumiss	Raw mare's milk	<i>L. leichmannii</i> , <i>L. delbrueckii</i> subsp. <i>bulgaricus</i> , "Torula" spp.	Russia	[25]
Kefir	Milk	<i>Lactococcus lactis</i> , <i>L. delbrueckii</i> subsp. <i>bulgaricus</i> , "Torula" spp.	Southwestern Asia	[27,28]
Fermented Buttermilk	Buffalo milk	mesophilic lactic acid bacteria	Scandinavia, Russia	[29]

* EPS, exopolysaccharide-producing strains.

Laban is a traditional fermented product consumed in African, Middle Eastern, and Southeast Asian countries. It is similar to yogurt. Traditional production does not require starter cultures but relies on the spontaneous fermentation of milk (*Lactobacillus* spp.). Industrial production involves the application of a starter culture comprising *Streptococcus thermophilus*, *Lactobacillus acidophilus*, and *Lactobacillus delbrueckii* subsp. *bulgaricus* [22–24].

Kefir is considered one of the oldest fermented milk-based beverages. It can be produced from any type of milk (goat, sheep, cow, camel, buffalo) and kefir grains [29,30]. Today, even milk substitutes, such as soy, rice, and coconut milk, can be used as a raw material for kefir production. In Turkish, keyif refers to a "good feeling", which it evokes upon consumption [31]. This is a traditional product of the shepherds in the Caucasus Mountains [19], but its production and consumption are mainly based in Eastern European countries, especially the Balkan–Caucasus region and Russia. Despite its strong association with Eastern European countries, it is currently gaining popularity in Japan, the United States, the Middle East,

and Africa [29]. The type and quality of milk and the interactivity among yeasts and lactic acid bacteria significantly affect sensory and textural properties of kefir [31]. In general, kefir is a slightly carbonated, foamy, and viscous beverage, creamy and sour. It has a small amount of alcohol and a yeasty aroma due to the yeasts present in kefir grains. The color of kefir is white-yellowish [30,32]. Kefir is easily digestible and valued for its nutritional value and commonly carries (per 100 g) 3.0–3.4 g of protein, 1.5 g of fat, and 2.0–3.5 g of lactose [33,34]. The fermentation process aids the increase in vitamins and amino acids in the final product [35]. The alcohol content is usually <2% and <0.3% for Turkish kefir. Kefir grains are immersed into milk and left at room temperature to ferment for 18–24 h; after the fermentation, the grains are separated and can be reused, and the product can be consumed [36]. Kefir grains can be purchased and mixed with sugar and various fruit juices.

Kefir grains represent a symbiosis between many different genera of bacteria, yeast, and fungi. Bacteria comprise the majority of the microflora of kefir grains, consisting of 83–90% lactic acid bacteria and acetic acid bacteria. Additional microorganisms are lactose-fermenting and non-lactose-fermenting yeasts (10–17%), belonging to *Naumovozyma*, *Kluyveromyces*, and *Kazachstania* and fungi such as *Geotrichum candidum*. All of these organisms intertwine between kefir, a polysaccharide matrix, which is the building block of the kefir grains [19,35,36]. The kefir grains can be easily filtered out after fermentation, and can be used multiple times for future batches.

Kefir milk differs in microbiota from kefir grains. *Actinomycetes*, *Bacteroidetes*, *Firmicutes*, and *Proteobacteria* have been identified in kefir, while only *Bacteroides* has been found in kefir milk [37]. The bacteria involved in the production of kefir are mainly *Lactococcus*, *Lactobacillus*, *Leuconostoc*, and *Acetobacter*, with *Lactobacillus* constituting the main microorganisms in kefir grains, and the genera *Lactococcus* and *Leuconostoc* being principal in kefir milk. The genus *Acetobacter* is not always detected, indicating that this genus is not obligatory for the fermentation process. *Bifidobacteria* have been found only in a small number of kefir grains. Many lactic acid bacteria present in kefir grains, such as *L. acidophilus*, *L. helveticus*, *L. casei*, *Pediococcus dextrinicus*, and *P. acidilactici*, are recognized as probiotics, thus making kefir a probiotic product as well [9,38]. Common metabolic products of kefir fermentation are lactic acid, produced by lactic acid bacteria, and ethanol and carbon dioxide, produced by yeasts, but they can also be a result of a heterofermentative metabolism of lactic acid bacteria. The carbon dioxide content increases during fermentation with a decrease in pH. The indigenous kefir usually contains 0.65 g–1.33 g/L of CO₂ [38]. Organic molecules, such as acetaldehyde, diacetyl, and acetoin, have been detected in lower amounts [19].

Ayran is another dairy drink created from cow's milk. It is kindred to yogurt but contains salt [31,35]. Ayran is common in various Eastern countries, Turkey, Bulgaria, Macedonia, Kazakhstan, Kyrgyzstan, and Azerbaijan, where it can be found under various names, including ayrani in Cyprus, jugurt/eyran in Turkey, dhalle in Albania, ayryan in Bulgaria, and ariani in Greece [39]. This beverage is characterized by its low viscosity and good digestibility. Due to its light consistency, it is preferred during the summer months [31,35]. Traditional preparation methods involve mixing yogurt with water (30–50%) and salt (0.5–1%) [31], while the modern process involves adding starter cultures consisting of *Streptococcus thermophilus* and *Lactobacillus delbrueckii* subsp. *bulgaricus* to a standardized batch of milk to produce yogurt [31]. The indigenous microbial population comprises lactic acid bacteria such as *Lactobacillus delbrueckii* subsp. *bulgaricus* and *Streptococcus thermophilus*, but in lower amounts than in industrially produced ayran.

Fermented buttermilk is popular all over the world. This low-alcoholic fermented beverage is often produced from cow's milk, but it can be made from buffalo's milk as well [29,32]. Buttermilk is a byproduct of butter production, and this is why it is popular worldwide. In Russia and Bulgaria, it is called urgutnik and is produced from sheep's milk;

it is also called clabber in Ireland, kirnupiima in parts of Scandinavia and Finland, and savanyutez in Hungary, all made from sheep's milk as well [19]. Indigenous fermented buttermilk differs from Bulgarian buttermilk or acidophilus milk, and industrial buttermilk is now produced using starter cultures. It is a liquid product with very low viscosity. It can be yellowish in color [19] and have a pronounced sour taste. It is often used for cooking and baking. Indigenous fermented buttermilk is produced immediately after churning milk or cream as part of the butter-making process [19]. Fermentation is enabled by mesophilic lactic acid bacteria [31], and the starter culture is similar to Nordic surmjölk [19]. Buttermilk fermentation is conducted at 17–22 °C [40].

Tätmjölk is a fermented beverage produced using a starter including exopolysaccharide (EPS)-forming lactococci. This beverage is indigenous in the northern parts of Scandinavia, Finland, Norway, and Sweden [19,41]. Tätmjölk is characterized by an extremely viscous consistency, a very mild acid taste, and low syneresis [42]. The starter, called tätte, is made of tätmjölk, selected for its good properties. If tätte fails to ferment the milk, it is replaced with another sample from the neighbor. Tätte is preserved for the following season by soaking a piece of linen cloth in the tätte and then leaving it to dry out. This method appears to be extremely useful practical, facilitating the propagation of this microbial culture all over the world. If the tätte is lost, butterwort (*Pinguicula vulgaris*) leaves can be added to the milk and incubated at 17–20 °C until coagulation occurs [42]. This process is repeated many times until the appropriate fermented milk is produced. Fermentation occurs in wooden barrels or similar vessels kept in a cellar at 17–20 °C. Coagulation usually occurs overnight or the next day, and the product is stored for several days or months, depending on oxygen availability. Therefore, tätmjölk produced and stored in tight barrels could have an extended shelf-life, which decreases with the availability of oxygen. Yeast is a contaminant in this process, and in the case of contamination, a certain share of lactose would ferment to ethanol. Tätmjölk produced in this manner could last for several months, with about 60% of the lactose being fermented to lactic acid, ethanol, and carbon dioxide [43].

Surmjölk is also a Nordic fermented milk known best in the southern and western parts, including the Faroe Islands [41]. It has a mild acid taste but is richer in flavor than tätmjölk. Its indigenous starter culture usually includes good-quality surmjölk, which is added to the milk and fermented at 18–22 °C for 12–14 h. Afterwards, the product can be stored at low temperatures for several days or months. For a longer storage period, the milk has to be heat-treated before fermentation and then stored in tight barrels, same as tätmjölk.

Filbunke is another milk beverage modification prepared using tätmjölk or surmjölk starter culture. Milk is fermented in portion-sized wooden bowls. During fermentation, the fat globules rise to the surface, forming a layer of cream. The product looks like gelatinized milk, which is eaten with a spoon. Filbunke has a white layer of fungi (*Geotrichum candidum*) on the surface, and may contain lactose-fermenting yeasts. Today, filbunke production is limited, and the product is not easily available on the market.

Skyr is produced as follows: Heated milk (90–100 °C) is cooled to 40 °C. After cooling, it is mixed with rennet and starter culture (mostly thermophilic lactic acid bacteria) to encourage fermentation. Filtrated skyr can be used as a starter culture as well. To stimulate the growth of thermophilic lactic acid bacteria, mesophilic acid-tolerant bacteria, fungi and yeasts, milk is concentrated fivefold and the pH of the product is taken below 4.0 [44,45]. As a byproduct of filtration, skyr whey is traditionally used for the production of pickled products and blood and liver sausages [46].

3. Traditional Fermented Cereal-Based Beverages

Boza, in general, is a beverage made from different cereals, such as millet or maize, but wheat, rice, rye, oat, and barley can also be used [47,48]. According to Leatherman

and Wilster [49], the name boza is actually a Persian word for millet. It has been traced to 8000–9000 years ago and is considered one of the first fermented beverages made by humans [48]. Turkey, countries in the Balkan Peninsula, Southern Russia, the Middle East, and Northern Persia are traditional countries in which boza is drunk [31,44,50]. Analogous beverages are consumed in different countries, such as braga or brascha, a drink enjoyed in Eastern European countries; busa, consumed in the Balkans with the addition of cocoa to the standard boza recipe; and bouza in Egypt [48]. According to different authors, boza can be served with different additions, and in Turkey, boza is consumed with cinnamon and roasted chickpeas [48,51]. This viscous beverage has the form of a colloidal suspension, with a slight sour or sweet taste (conditioned with the acid content), a sour-alcoholic odor, and a pale yellow or light to dark beige color, depending on the cereal used for production [31,48]. As many raw materials and additions can be used for production, it is difficult to standardize boza. The use of different cereals alongside spontaneous fermentation results in different degrees of fermentation and viscosity [31]. Depending on the aforementioned conditions (fermentation, cereal, and additions used in the production), boza contains low alcohol content, up to 1.5% [35,52]. Boza production begins with the preparation of raw materials, followed by boiling, after which the mash is cooled and strained. After straining, sugar is added and left for fermentation [48], which can be natural or stimulated with the addition of previously fermented boza. Indigenous inoculum involves lactic acid fermentation by lactic acid bacteria and alcoholic fermentation by yeasts. Microbial varieties found in boza are composed of different species, such as *Lactobacillus plantarum*, *Lb. acidophilus*, *Lb. fermentum*, *Leuconostoc mesenteroides*, and *Ln. brevis*, and yeasts (*Saccharomyces cerevisiae*, *Candida tropicalis*, *Geotrichum candidum*) [52–54]. Thus, boza can be regarded as a source of probiotic bacteria, such as *Lb. plantarum*, *Lb. paracasei*, *Lb. Rhamnosus*, and *Lb. Pentosus* [31].

Another beverage produced from cereals is called kvass [47,55], which is usually made from rye or barley malt, rye flour, and even stale rye bread [54]. Juniper berries (*Juniperus communis* L.) and raisins are common additions to kvass [55,56]. An indigenous beverage from Russia, mint kvass, is made from stale dark rye bread with the addition of water, sugar, dried yeast, fresh mint leaves (or lemon zest or honey), and raisins. The alcohol content of kvass usually does not exceed 1%. Since it contains CO₂, it is a sparkling drink that can be sweet or sour and golden-brown in color [47,54]. To produce kvass, stale sourdough bread or malt can be used as raw material [54]. Kvass production is similar to beer production; the starch should be broken down to simpler sugars in order for yeast to convert it to alcohol and CO₂. Mint kvass production involves several stages, similar to those for boza: raw material collection, oven drying (if needed), boiling, cooling and straining, sugar addition, and fermentation. Under domestic conditions, inoculation can be performed by adding mother sourdough for fermentation, but when produced in industry, a starter is used, and the final product is pasteurized. Kvass has a versatile microbiota usually comprising live yeast cells and lactic acid bacteria [47]. Microorganisms conducting fermentation are mostly lactic acid bacteria (*Lactobacillus casei*, *Leuconostoc mesenteroides*) and yeast (*Saccharomyces cerevisiae*) [47,54].

Saké is a beverage originating from Japan. Unlike the aforementioned beverages, saké contains high levels of alcohol, usually over 15%. Saké production involves two types of fermentation: solid-state fermentation preparing koji rice using fungal spores of *Aspergillus oryzae*, and submerged fermentation of the prepared rice using *Saccharomyces cerevisiae*. The first step is to wash the polished rice, which is then steeped in water. Then, the rice is subjected to steaming for 30–60 min and then cooled and mixed with koji—the rice previously inoculated with *A. oryzae*—and water. After the koji, rice, and water have been mixed, the selected yeast starter culture for alcoholic fermentation is added. Fermentation is usually performed in open tanks at about 10–15 °C. After fermentation, the solid parts

(rice) have to be separated from the liquid (moromi) to obtain clear saké, which is left to settle and then re-filtered, pasteurized, blended, and diluted with water before bottling [57]. There are different grades of sake, and the most skillful brewers use highly polished rice, wherein the fermentation lasts for 25–30 days at 9–11 °C for 25–30 days. This product is called ginjoshu [58]. Spoilage microorganisms usually belong to genus *Lactobacillus*, homofermentative bacteria tolerant to higher levels of ethanol and acid [59]. Some authors have reported strains of *Aspergillus oryzae* for saké production on an industrial scale [60–62]. In addition to *A. oryzae*, sake is rich in *Fructilactobacillus fructivorans* and *Lactobacillus homohiochi* [63]. *Lactobacillus* provides sake with a sour, aromatic character.

Chicha is a clear, yellowish alcoholic beverage prepared from maize. This beverage is an indigenous drink of the indigenous peoples of the Andes in countries such as Ecuador, Brazil, Peru, Bolivia, Colombia, and Argentina [64]. Traditional production depends on human saliva as the source of amylase, which converts starch to fermentable sugars. The use of saliva can be combined with the malting of maize. Today, chewing is not obligatory since malted maize is available on the market [65]. The main microorganisms identified in chicha belong to the genera *Enterococcus*, *Lactococcus*, *Streptococcus*, *Weissella*, *Leuconostoc*, *Lactobacillus*, and *Saccharomyces* [66].

Pozol is a Mexican fermented maize product. It is made by boiling maize in lime water to aid the swelling and ease the removal of the outer grain layer. This procedure is called “nixtamalization.” The boiled maize grains are then dehulled, washed, and ground into wet flour, which is then shaped into semi-cylindrical balls. These balls get wrapped in polythene or banana leaves and are left to natural fermentation, which lasts 2–5 days. Fungal and bacterial microbiota develop during this time, and the pH value decreases to 3.5–4.0. An acidic flavor is developed. The pozol balls are then suspended in water with the addition of salt, sugar, etc. The main microorganisms found in pozol balls are LAB (*Leuconostoc mesenteroides*, *Lactobacillus plantarum*, *L. confusus*, *L. lactis*, and *L. raffinolactis*), yeasts, and the filamentous fungus *Geotrichum candidum* [67].

Kaffir beer is known in South Africa [68], and merissa is popular in Sudan [69]. Kaffir beer is an indigenous drink usually made in rural areas, but today, a modern industrial process is used to prepare this beverage [68,70]. Even though the sorghum grains are subjected to malting, starch still has to be broken down using fungal enzymes [71]. This type of beer is not hopped and has a sour flavor. In South Africa, it is associated with nutrition and social importance.

Merissa production relies on three important phases, but the product’s quality highly depends on the brewer’s skills. Merissa is also nutritious and has a great influence on traditional Sudanese belief systems. Another Sudanese beverage is kanyu-moro, obtained by fermenting sesame seeds. As it does not have high alcohol levels, it is a preferred drink of women [69].

4. Traditional Fermented Fruit-Based Beverages

Even though there are numerous fruit-based beverages all over the world, this review can mention only a few.

Hardaliye is a low-alcohol, sour, fermented fruit-based drink. Its main ingredients are red grape juice and crushed black mustard seeds, but other flavoring components can be added, such as cherry pulp and leaves [72,73]. Industrial-scale production aims to ensure a longer storage time, and thus, the addition of benzoic acid is allowed. This beverage is indigenous to Thrace, which is now southeastern Bulgaria (Northern Thrace), northeastern Greece (Western Thrace), and the European part of Turkey (East Thrace) [74]. Its color is dependent on the grape variety and process conditions. Homemade production involves the pressing of the raw materials (fruits), which are then left at room temperature to ferment

for 5–10 days. Lactobacilli and unknown fungal species are predominant microorganisms in hardaliya [45], including *L. paracasei* subsp. *paracasei*, *L. casei* subsp. *pseudoplantarum*, *L. brevis*, *L. pontis*, *L. acetotolerans*, *L. San Francisco*, and *L. vaccinostercus* [75].

Gilaburu juice is another traditional Turkish low-alcohol fermented drink made of gilaburu, the European cranberry bush (*Viburnum opulus* L.), and water. The European cranberry bush is a red fruit with a tart taste that can be found in Kayseri. The tartness can be avoided by adding sugar, but the juice itself has a lot of acetic acid, which adds a sour sensation. Traditionally, this drink is prepared by soaking fruits in water and leaving them in a dark place at room temperature. Fermentation takes 3–4 months [75,76], during which a synergistic effect of lactic acid bacteria is noticed. Several bacterial species are commonly found in gilaburu juice, including *L. plantarum*, *L. casei*, *L. brevis*, *L. hordei*, *L. buchneri*, *L. parabuchneri* and *L. harbinensis*, *Leuconostoc mesenteroides*, and *L. pseudomesenteroides* [77].

5. Traditional Fermented Beverages Produced with Different Plants

Salgam is a non-alcoholic fermented beverage made from black or purple carrots (*Daucus carota*), turnips (*Brassica rapa*), bulgur wheat flour, sourdough, salt, and water [78]. Kanji, an Indian beverage, is produced via indigenous fermentation of carrots with the addition of salt and spices such as chili or mustard seeds. Such beverages are rich in color due to the extracted anthocyanins from black carrots [35]. Salgam is a traditional beverage indigenous to Turkey. This is mainly produced in households, and very little of it is produced for commercial purposes [79]. Salgam is a red and sour beverage [80]. The microbial population found in fermented salgam is mainly related to lactic acid bacteria, including *L. plantarum*, *L. brevis* and *L. paracasei* subsp. *paracasei*, and even yeast species such as *S. cerevisiae* [81,82].

Sauerkraut juice is a byproduct of cabbage fermentation. Its main ingredients are cabbage, salt, and water. This is a popular drink in Germany, Ukraine, the Balkan area, and Black Sea regions [55,56]. It is obtained after the fermentation of cabbage via pressing, which empowers different microorganisms such as lactic acid bacteria, including *L. mesenteroides*, *L. brevis*, *L. sakei*, and *L. plantarum* [8,83].

Kombucha, a Chinese drink, remains one of the most popular low-alcohol fermented beverages in the world [84,85]. Several types of tea can be used for the production of kombucha, such as black and green tea [86]. Kombucha is known for its combination of fizziness, sweetness, and sour taste [5,84]. Even though it was once a homemade beverage, global demand has led to a boom in commercial production. Its preparation is not complicated; tea leaves are added to boiling water and left to steep for 10 min. Then, some sugar is added and the tea is left to cool. SCOBY (symbiotic culture of bacteria and yeast), a gelatinous living mixture of different microorganisms, is then added to the prepared tea. Fermentation takes 1–8 weeks, depending on the intended sourness or sweetness of the beverage. Afterward, the SCOBY is removed from the surface and stored for future use [87]. Kombucha contains acetic acid, gluconic and glucuronic acids, ethanol, and glycerol [84,85,87–89], and the SCOBY contains lactic acid bacteria and yeasts, as well as acetic acid bacteria [88]. Examples of detected bacteria in the SCOBY include *Actinobacteria*, *Bacteroidetes*, *Deinococcus-Thermus*, *Firmicutes*, and *Proteobacteria*. *Proteobacteria* are the most abundant, with *Gluconacetobacter* being the dominant genus. The genus *Lactobacillus* is found as well, along with the genera *Leuconostoc*, *Enterococcus*, and *Allobaculum*. As for yeasts, *Zygosaccharomyces* is the dominant genus, but the genera *Pichia*, *Dekkera*, and *Kazachstania* can also be detected in the final product [47].

Ginger beer is another a low-alcohol fermented beverage [87]. It is made from ginger, lemon, sugar, and yeast, but various other ingredients can be added as well, such as baking powder, baker's yeast, juniper berries (*Juniperus communis*), licorice (*Glycyrrhiza glabra*), and chili (*Capsicum annuum*). Similarly, as with kombucha, this beverage was dominantly a

homemade drink, but global demand made it commercial. It is a non-alcoholic drink with a fizzy and sour taste [87]. It originates from England, where the first commercial production began in the mid-1700s. Fermentation is powered by lactic acid bacteria and yeasts [86]. *Lactobacillus*, *Leuconostoc*, *Bacillus*, *Staphylococcus*, *Candida*, and *Saccharomyces* are common genera found in ginger beer [90,91].

Sima is a drink indigenous to Finland. It is made from water, lemon, raisins, white and brown sugar, and dried ale or baker's yeast. It tastes sweet but is turbid. Its production involves the preparation of raw materials, boiling, cooling, straining, adding sugar, and fermentation.

Water kefir, or tibicos, is a low-alcohol, sucrose-based fermented beverage. It is prepared by adding water kefir grains (a symbiosis of bacteria and yeasts found in grains) into sucrose solution. Dried fruits (most commonly figs), lemon, or other similar adjuncts can be added [92,93]. Water kefir grains are left to ferment for 1 to 2 days at room temperature, resulting in a sour, cloudy, carbonated, straw-colored beverage [94]. Water kefir grains mainly consist of lactic acid bacteria, acetic acid bacteria, and yeasts. The main genera detected in grains are *Actinobacteria*, *Firmicutes*, and *Proteobacteria*. The genus *Zymomonas* was found in all samples, followed by *Lactobacillus*. *Leuconostoc* and *Acetobacter* and *Gluconacetobacter* were also found [37].

Pulque is a fermented alcoholic beverage made from agave juice (*Agave atrovirens* or *A. americana*). The microbiota designated for its fermentation is mainly made up of *L. plantarum*, a heterofermentative *Leuconostoc*, *Zymomonas mobilis*, and *S. cerevisiae*. Other yeasts include *C. parapsilosis*, *C. rugosa*, *C. rugopelliculosa*, *Debaryomyces carsonii*, *P. guilliermondii*, *P. membranifaciens*, and *Tolrulospora delbrueckii*. *Z. mobilis* is responsible for 45% of the conversion of glucose to ethanol (4–6% v/v in the final product) and carbon dioxide [94].

Palm wine is a well-known fermented beverage consumed in Asia, South America, and Africa. It is made from the palm sap of different indigenous palms, such as coconut palm (*Cocos nucifera*), oil palm (*Elaeis guineensis*), date palm (*Phoenix dactylifera*), kithul palm (*Caryota urens*), nipa palm (*Nypa fruticans*), ron palm (*Borassus aethiopum*), and raffia palm (*Raphia hookeri*) [95,96]. Palm sap is a clear, sweet, and colorless syrup containing 10–12% (w/v) sugar. The fermentation of palm wine occurs spontaneously, which causes problems with the stability and quality of the product. The process begins with the collection of sap by tapping the palm tree and leaving it for spontaneous fermentation. Wine contains nutritional components, such as sugars, proteins, amino acids, and vitamins [96].

6. Traditional Fermented Beverages Produced with Soybean

Miso is one of the most popular semisolid fermented foods. It is made from soybeans, rice, or barley, with the addition of salt. It originates from Japan [97]. Rice miso is prepared by mixing cooked soybeans with koji (steamed rice inoculated with *A. oryzae*), salt, and a small amount of water [98]. Miso in Japanese means “immature shoyu.” Its production is defined by Japan Agricultural Standards (JAS), which establish the obligatory use of steamed soybeans, salt, and miso koji. Miso koji is prepared from a single cereal or soybean (steamed rice, barley, or soybean) by adding a starter culture of *Aspergillus oryzae*. Rice miso, barley miso, and soybean miso can be prepared, and each type of miso is related to the corresponding type of koji. Red salty rice miso (akakei karakuti komemiso), at pH 5.0, contains 12–13 g/100 g of NaCl, 1.6–2.0 g/100 g of total nitrogen, 13–14 g/100 mL of total sugar, and 1.0 mL/100 g of alcohol [99]. Its production involves koji production (steamed rice is inoculated with a starter culture of *A. oryzae*) followed by the mixing of koji, steamed soybean, and salt, and finally, fermentation. Koji is obtained after 40 h of solid-state fermentation, when the fungus overgrows the rice, resulting in “rice koji.” Then, the koji is mixed with steamed soybean, salt, and water, and inoculated with *Zygosaccharomyces*

rouxii and/or *Candida versatilis*. Salt is again added to aid the fermentation and prevent contamination with undesirable microorganisms. Further fermentation of the mixture is continued for 3–12 months. The microbial flora is very similar to that of shoyu, but hydrolysis is much lower in miso than in shoyu, and the product is a solid paste. Thus, miso is much harder to sterilize or pasteurize in comparison to shoyu.

Shoyu or soy (soya) sauce is a fermented soybean liquid produced via fungal fermentation. This is a condiment indigenous to Asia, and many types of shoyu can be found in Japan. However, the principal product is called koikuchi-shoyu, a deep brown-colored shoyu, with a pH of 4.7. It contains 16.9 g/100 mL of NaCl content, 1.57 g/100 mL of total nitrogen, 3.0 g/100 mL of reducing sugar, and about 2–3 mL/100 mL of alcohol content [100]. Similarly to miso, shoyu is produced by first preparing the koji, followed by brine fermentation, and finally refinement. Steamed soybean and roasted wheat are inoculated with a starter culture of *A. oryzae* or *A. sojae*. Fermentation lasts 3–4 days, while the fungus overgrows the grain mixture. Brine is then added to aid the fermentation process provided by the halotolerant yeast *Z. rouxii*, *C. versatilis*, and lactic acid bacteria. Salt acts like a preservative, protecting the fermentation from undesirable microorganisms. Fermentation lasts 6–8 months. The final stages of the production are filtration and pasteurization (70–80 °C).

7. Precision Fermentation—Its Significance in Traditional Production

All of these fermentation processes are related to some kind of substrates produced or obtained from animals or plants, which require intensive farming and husbandry. This impacts the ecological aspect of the production of fermented products and, in some cases, the ethical justification. Further, the growing community of consumers (Millennials and Gen Z) willing to pay more for fermented products prepared in an eco-friendly fashion enables the application of novel methods to the production of fermented products. Precision fermentation is an emerging method of applied biotechnology. It comprises several stages, such as product purification, microbial strain, and process optimization techniques. The final product of precision fermentation is a specific ingredient, i.e., the target protein, enzyme, vitamin, and polysaccharide. This production is characterized by high precision and efficiency [17]. Traditional fermentation relies on the microorganisms indigenously found in fruits, vegetables, cereals, etc. In traditional fermentations, microorganisms grow and consume substrate to produce various products such as cheese, wine, beer, and sauerkraut, whereas precision fermentation results in the production of molecules of interest [101].

Using different techniques, with precision fermentation, various molecules, i.e., animal-originating proteins, can be produced without the animal. In other words, products such as animal-free dairy, eggs, collagen, meat alternatives, probiotics, and steviol glycosides can be synthesized using various microorganisms [102]. This method is considered a sustainable and ethical way of producing healthier food alternative [103] and offering a nutritional booster of plant-based proteins; it uses lower amounts of land and water, with a significant reduction in ecological parameters such as gas emissions, carbon footprint, and waste [102]. In addition, the growth of the human population pushes precision fermentation as a valued option for food production that can bridge the increasing dietary demands. Moreover, this method can diversify the range of proteins in the human diet. Precision fermentation is considered for the cost-effective production of different foods, including animal-free dairy and eggs, heme-based meat alternatives, bee-free honey, and bio-identical ingredients such as vanillin, omega-3 fatty acids, and vitamin B12 for sustainable nutrition [102–105]. Some of the prominent products are shown in Table 2.

Table 2. Prominent precision fermentation products worldwide [106].

Category	Product/Ingredient	Target Molecule	Production Microorganism	Primary Use
Dairy	Whey and Casein Proteins	β -lactoglobulin Casein proteins (α , β , κ -casein)	Genetically modified yeast (<i>Trichoderma reesei</i> or <i>Pichia pastoris</i>) Genetically modified yeasts (<i>Pichia pastoris</i> or <i>Saccharomyces cerevisiae</i>)	Animal-free and lactose-free milk, ice cream, cream cheese, and protein powders Creating the stretch, melt, and structure required for plant-based cheeses (like Mozzarella)
Meat	Heme Protein (Leghemoglobin)	Soy Leghemoglobin	Engineered yeast (<i>Pichia pastoris</i>)	Replicating the distinct meaty flavor, bleeding appearance, and aroma in plant-based beef burgers
Eggs	Egg White Proteins (Ovalbumin)	Ovalbumin	Genetically modified fungus (<i>Trichoderma reesei</i>)	Egg-free baking binders, protein enrichment, and carbonated beverages without animal proteins
Sweeteners	Zero-Sugar, High-Intensity Natural Sweeteners	Steviol Glycosides/Brazzein, Allulose/Tagatose	Genetically modified fungus (<i>Trichoderma reesei</i>) Engineered baker's yeast (<i>Saccharomyces cerevisiae</i>)	Low-calorie soft drinks, teas, and confectionery
Structural proteins	Animal-Free Collagen	Collagen and elastin peptides	Genetically modified bacteria (<i>E. coli</i>) or yeast	Cruelty-free and vegan anti-aging skincare products, cosmetics, and ingestible nutraceuticals
Honey	Bee-Free Honey	Bee stomach enzymes (such as invertase, amylase, and glucose oxidase) Fructose/glucose matrices	<i>Aspergillus oryzae/niger</i> (Filamentous Fungi) <i>Bacillus subtilis</i> (or other engineered bacteria/yeasts)	Honey-like product

Another advantage of precision fermentation is that it can provide vitamins and protein synthesis without the use of antibiotics, hormones, or intensive livestock farming. This would surely help improve food safety and nutritional quality [107].

Precision fermentation uses genetically modified microorganisms (yeast, bacteria, or fungi) to produce molecules like proteins, fats, and other bioactive compounds [101]. The leading reasons for why precision fermentation has been increasing in popularity include its good production scalability, effective resource consumption, and potential for the production of a wide spectrum of molecules [108]. A downside is the public perception of uncertainties associated with genetically modified microbes [17,109]. Thus, traditional fermentation is still important in many cultures, especially in developing countries [17]. The selection of genes in microorganisms, plants, and animals to produce specific compounds in controlled bioreactors ensures high-purity products are obtained through advanced purification and by expanding their commercial use in food, cosmetics, and pharmaceuticals [110,111].

Rather than replacing traditional processing, PF is increasingly utilized in “hybrid formulations.” In these systems, a traditional fermented beverage matrix (such as a kombucha or water kefir base) serves as the vehicle for targeted, precision-fermented ingredients [112,113]. For instance, a traditional botanical tea base can be enriched with recombinant humanized lactoferrin or specific osteopontin proteins produced via PF. This hybrid approach allows manufacturers to preserve the revered “ancient wisdom” and complex organic acid profile of traditional fermentation while simultaneously fortifying

the beverage with high-purity, bio-designed therapeutic molecules. This effectively bridges the gap between clean-label heritage and modern clinical nutrition [114].

8. Why Traditional Drinks Are the “Way for the Future”

In short, there are several core reasons why these traditional products are becoming central to modern food consumption habits. Fermented foods are known to enhance health and add to bioactivity. Specifically, fermentation aids nutrition and upgrades bioactive properties. Modern consumers are shifting toward non-alcoholic (NAB) and low-alcoholic (LAB) beverages such as kefir and kombucha due to their superior health profiles compared to high-alcohol options. Food safety and shelf life are nowadays vital for the food industry [115]. Fermentation has been used for preservation, and these techniques remain a sustainable way to extend the shelf life of perishable raw materials (milk, cereals, fruits) without any chemical additives. At the same time, such preservation techniques preserve the nutritive compounds and probiotics. Many traditional drinks, such as boza and kefir, are recognized as rich sources of live probiotic bacteria (e.g., *Lactobacillus plantarum*), aligning with the global trend of functional “wellness” drinks [116,117].

Even though there are many benefits of consuming traditional fermented products, there are several hurdles that need to be considered. Namely, the transition from artisanal heritage to a global food market faces several significant “endangering” factors. The first factor is the loss of traditional knowledge, as over-reliance on commercial, mass-produced beverages has marginalized local practices, leading to the disappearance of authentic regional recipes. Standardization of products often distances the commercial products from the indigenous ones. Bridging artisanal and industrial production typically requires standardized starter cultures. While this ensures product uniformity for the global market, it can lead to the loss of unique, complex sensory profiles (aromas and textures) found in spontaneous, traditional fermentation. Another hurdle is the public perception of GMOs, which are often involved in precision fermentation. Public concern regarding “uncertainties associated with genetically modified microbes” remains a major hurdle for consumer acceptance. Generally popular drinks like kefir are well-documented and researched, but many local traditional beverages have not been sufficiently researched, leaving their full nutritional and commercial potential unknown.

However, the general acceptance of traditional products offers a bright perspective for the future through several points. For example, precision fermentation is the most emphasized “way for the future.” It involves using tailored microorganisms to produce specific high-value molecules (proteins, enzymes, vitamins) with extreme efficiency and productivity. In addition, it covers sustainability by lowering the consumption of land and water, reducing gas emissions and the overall carbon footprint. Another upside of precision fermentation is the production of animal-free food alternatives. It allows for the production of bio-identical dairy proteins (whey/casein) and egg whites without the need for intensive livestock farming. And lastly, the ability to customize and “improve” traditional products by ensuring high purity and targeted nutritional benefits [17].

To prevent the disappearance of traditional drinks, certain efforts to revive authentic sensory profiles by documenting local microbiota and fermentation ingredients must be implemented. In this way such drinks can be preserved as premium, “authentic” products for a global market. Furthermore, using precise process parameters to scale the production of these ancient drinks is necessary. By bridging “ancestral knowledge” with “modern food science,” the industry can produce functional traditional drinks that meet modern safety standards while maintaining their cultural identity and offering health benefits for the consumers.

9. Conclusions

Non-alcoholic and low-alcohol fermented beverages are very important for the human diet, offering numerous benefits for human health. This paper has described the considerable diversity of these beverages across Europe. Although the nutritional benefits of some beverages have been extensively researched and are well known, others are not sufficiently studied and their nutritional potential is unknown. Local preparation practices for these traditional beverages appear to be endangered by the over-reliance on commercially produced beverages that currently prevail, even in farming regions. The lack of knowledge transmitters and documentation regarding local microbiota, fermentation ingredients, and fermentation processes has resulted in the marginalization and, in some cases, even the disappearance of local fermented beverages. The growing interest in beverages with enhanced nutritional benefits has made some traditional milk-based drinks, such as kefir and ayran, widely available on the European market. With the development of science and technology, as well as increasing consumer awareness of healthy and sustainable nutrition, the future of (precision) fermented products seems more promising than ever.

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References

- McGovern, P.E.; Zhang, J.; Tang, J.; Zhang, T.; Hall, G.R.; Moreau, R.A.; Nuñez, A.; Butrym, E.D.; Richards, M.P.; Wang, C.; et al. Fermented beverages of pre- and proto-historic China. *Proc. Natl. Acad. Sci. USA* **2004**, *101*, 17593–17598. [[CrossRef](#)] [[PubMed](#)]
- Chojnacka, K. Fermentation Products. In *Chemical Engineering and Chemical Process Technology*; Pohorecki, R., Bridgwater, J., Molzahn, M., Gani, R., Gallegos, C., Eds.; EOLSS Publications: Oxford, UK, 2010; Volume 5.
- Marshall, E.; Mejia, D. Fermentation and sustainable livelihoods. In *Traditional Fermented Food and Beverages for Improved Livelihoods*, 1st ed.; Marshall, E., Ed.; FAO: Rome, Italy, 2011; pp. 15–27.
- Prajapati, J.B.; Nair, B.M. The history of fermented foods. In *Handbook of Fermented Functional Foods*, 2nd ed.; Farnworth, E.R., Ed.; CRC Press: Boca Raton, FL, USA, 2008; pp. 1–24.
- Tamang, J.P.; Kailasapathy, K. Tea, coffee and cacao. In *Fermented Foods and Beverages of the World*, 1st ed.; Tamang, J.P., Kailasapathy, K., Eds.; CRC Press, Taylor and Francis Group: New York, NY, USA, 2010; pp. 357–358.
- Batty, J.C.; Folkman, S.L. *Food Engineering Fundamentals*; John Wiley and Sons: New York, NY, USA, 2000.
- Stansbury, P.F.; Whitaker, A.; Hall, S.J. *Principles of Fermentation Technology*; Aditya Books: New Delhi, India, 1997.
- Sharma, R.; Garg, P.; Kumar, P.; Bhatia, S.K.; Kulshrestha, S. Microbial Fermentation and Its Role in Quality Improvement of Fermented Foods. *Fermentation* **2020**, *6*, 106. [[CrossRef](#)]
- Tamang, J.P.; Watanabe, K.; Holzapfel, W.H. Review: Diversity of Microorganisms in Global Fermented Foods and Beverages. *Front. Microbiol.* **2016**, *7*, 377. [[CrossRef](#)] [[PubMed](#)]
- Sökand, R.; Pieroni, A.; Biró, M. An ethnobotanical perspective on traditional fermented plant foods and beverages in Eastern Europe. *J. Ethnopharm.* **2015**, *170*, 284–296. [[CrossRef](#)]
- Verma, K.; Duhan, P.; Pal, D.; Verma, P.; Bansal, P. Precision fermentation for the next generation of food ingredients: Opportunities and challenges. *Future Foods* **2025**, *12*, 100750. [[CrossRef](#)]
- Mattick, C.S. Cellular Agriculture: The Coming Revolution in Food Production. *Bull. At. Sci.* **2018**, *74*, 32–35. [[CrossRef](#)]
- Stephens, N.; Di Silvio, L.; Dunsford, I.; Ellis, M.; Glencross, A.; Sexton, A. Bringing Cultured Meat to Market: Technical, Socio-Political, and Regulatory Challenges in Cellular Agriculture. *Trends Food Sci. Technol.* **2018**, *78*, 155–166. [[CrossRef](#)] [[PubMed](#)]

14. Linder, T. Beyond agriculture—How microorganisms can revolutionize global food production. *ACS Food Sci. Technol.* **2023**, *3*, 1144–1152. [CrossRef]
15. Specht, L.; Crosser, N. State of the Industry Report. Fermentation: An Introduction to a Pillar of the Alternative Protein Industry. Available online: <https://gfi.org/wp-content/uploads/2022/05/INN-Fermentation-SOTIR-2020-0911.pdf> (accessed on 22 April 2024).
16. Boukid, F.; Ganeshan, S.; Wang, Y.; Tülbek, M.C.; Nickerson, M.T. Bioengineered enzymes and precision fermentation in the food industry. *Int. J. Mol. Sci.* **2023**, *24*, 10156. [CrossRef] [PubMed]
17. Teng, T.S.; Chin, Y.L.; Chai, K.F.; Chen, W.N. Fermentation for future food systems: Precision fermentation can complement the scope and applications of traditional fermentation. *EMBO Rep.* **2021**, *22*, e52680. [CrossRef] [PubMed]
18. Lee, C.H.; Ahn, J.; Son, H.S. Ethnic fermented foods of the world: An overview. *J. Ethn. Foods* **2024**, *11*, 39. [CrossRef]
19. Fondén, R.; Leporanta, K.; Svensson, U. Nordic/Scandinavian Fermented Milk Products. In *Fermented Milks*; Tamime, A., Ed.; Blackwell Science Ltd.: Hoboken, NJ, USA, 2006.
20. Þóra, V.; Reynisson, E.; Knocke, N.; Ólafsdóttir, A.; Sveinsson, Þ.E. 2011: Hefðbundið skyr: Samanburður á heimagerðu og verksmiðjuframleiddu skyrri—Forkönnun. Skýrsla Matís 09–11, 2011. In *Traditional Skyr. Preliminary Comparison of Homemade and Industrial Skyr: Matís Report*; Matís: Reykjavík, Iceland, 2011.
21. Chomakow, H. *The Dairy Industry in the Peoples Republic of Bulgaria*; Booklet; Agricultural Academy: Sofia, Bulgaria, 1973.
22. Bin Masalam, M.S.; Bahieldin, A.; Alharbi, M.G.; Al-Masaudi, S.; Al-Jaouni, S.K.; Harakeh, S.M.; Al-Hindi, R.R. Isolation, molecular characterization and probiotic potential of lactic acid bacteria in Saudi raw and fermented milk. *Evid.-Based Complement. Altern. Med.* **2018**, *2018*, 7970463. [CrossRef]
23. Béal, C.; Chammass, G. Production of Laban. In *Handbook of Animal-Based Fermented Food and Beverage Technology*, 2nd ed.; Hui, Y.H., Ed.; CRC Press, Taylor & Francis Group: Boca Raton, FL, USA, 2012; pp. 181–212.
24. Farnworth, E.R. *Handbook of Fermented Functional Foods*, 2nd ed.; Taylor & Francis: Boca Raton, FL, USA, 2008.
25. Kurmann, J.A.; Rašić, J.L.; Žinčica, M.K. *Encyclopedia of Fermented Fresh Milk Products: An International Inventory of Fermented Milk, Cream, Buttermilk, Whey, and Related Products*; Van Nostrand Reinhold: New York, NY, USA, 1992; pp. 322–323. ISBN 0-442-00869-4.
26. Jay, J.M. Fermentation and Fermented Dairy Products. In *Modern Food Microbiology*; Food Science Texts Series; Springer: Boston, MA, USA, 1998. [CrossRef]
27. Von Wiese, W. KeTM—Ein Sauermilcherzeugnis im Widerstreit zwischen Hersteller, Lebensmittelüberwachung und Verbraucher. *Dtsch. Milchwirtsch.* **1986**, *6*, 227–229.
28. Rosa, D.D.; Dias, M.M.S.; Grze’skowiak, Ł.M.; Reis, S.A.; Conceição, L.L.; Maria do Carmo, G.P. Milk Kefir: Nutritional, Microbiological and Health Benefits. *Nutr. Res. Rev.* **2017**, *30*, 82–96. [CrossRef] [PubMed]
29. Battock, M.; Azam-Ali, S. *Fermented Fruits and Vegetables: A Global Perspective*; FAO: Rome, Italy, 1998.
30. Tamang, J.P.; Samuel, D. Dietary cultures and antiquity of fermented foods and beverages. In *Fermented Foods and Beverages of the World*, 1st ed.; Tamang, J.P., Kailasapathy, K., Eds.; CRC Press, Taylor and Francis Group: New York, NY, USA, 2010; pp. 1–31.
31. Altay, F.; Karbancıoğlu-Güler, F.; Daskaya-Dikmen, C.; Heperkan, D. A review on traditional Turkish fermented non-alcoholic beverages: Microbiota, fermentation process and quality characteristics. *Int. J. Food Microbiol.* **2013**, *167*, 44–56. [CrossRef] [PubMed]
32. Panesar, P.S. Fermented dairy products: Starter cultures and potential nutritional benefits. *Food Nutr. Sci.* **2011**, *2*, 47. [CrossRef]
33. Wolfe, B.E.; Dutton, R.J. Fermented foods as experimentally tractable microbial ecosystems. *Cell* **2015**, *161*, 49–55. [CrossRef] [PubMed]
34. Melo, A.; Silva, M.A. Development of fermented and flavoured kefir milk. *BMC Proc.* **2014**, *8*, P15. [CrossRef]
35. Kabak, B.; Dobson, A.D. An introduction to the traditional fermented foods and beverages of Turkey. *Crit. Rev. Food Sci. Nutr.* **2011**, *51*, 248–260. [CrossRef] [PubMed]
36. Lopitz-Otsoa, F.; Rementeria, A.; Elguezabal, N.; Garaizar, J. Kefir: A symbiotic yeasts–bacteria community with alleged healthy capabilities. *Rev. Iberoam. Micol.* **2006**, *23*, 67–74. [CrossRef] [PubMed]
37. Marsh, A.J.; O’Sullivan, O.; Hill, C.; Ross, R.P.; Cotter, P.D. Sequencing-based analysis of the bacterial and fungal composition of kefir grains and milks from multiple sources. *PLoS ONE* **2013**, *8*, e69371. [CrossRef] [PubMed]
38. Clementi, F.; Gobbetti, M.; Rossi, J. Carbon dioxide synthesis by immobilized yeast cells in kefir production. *Milchwissenschaft* **1989**, *44*, 70–74.
39. Chandan, R.C. History and consumption trends. In *Manufacturing Yogurt and Fermented Milks*, 2nd ed.; Chandan, R.C., Kilara, A., Eds.; Blackwell Publishing Ltd.: Oxford, UK, 2013; pp. 3–16.
40. Mayo, B.; Ammor, M.S.; Delgado, S.; Alegria, A. Fermented milk products. In *Fermented Foods and Beverages of the World*, 1st ed.; Tamang, J.P., Kailasapathy, K., Eds.; CRC Press, Taylor and Francis Group: New York, NY, USA, 2010; pp. 263–283.
41. Larsson, I. *Tätmjölk, Tätgräs Surmjölk och Skyr Acta Universitatis Stockholmiensis, Stockholm Studies in Scandinavian Physiology*; New Series 18; Almqvist & Wicksell: Stockholm, Sweden, 1988.
42. Gisler, N. Beskrifning om tätmjölkens tillagning Kgl. In *Vetenskapsakademins Handlingar*; Kungliga Vetenskapsakademien: Stockholm, Sweden, 1749.

43. Olsen-Sopp, O. Taette, die urnordische Dauermilch und verwandte Milchsorten, sowie ihre Bedeutung für die Volksernährung. In *Centralblatt für Bakteriologie, Parasitenkunde und Infektionskrankheiten—Zweite II Abteilung*; Gustav Fischer: Jena, Germany, 1912; Volume 33, pp. 1–55.
44. Simonarson, G. Den isländska maträtten skyr—En tillverkningsmetod från sagotiden. *Nord. Mejeriindustri* **1987**, *4*, 174–176.
45. Magnússon, S. Skyr—Islandsk spesialitet med tradisjoner. *Mejeriposten* **1988**, *10*, 280–284.
46. Hilmarsson, E.; Arnadóttir, A.T. Nutritional effects of pickle fermentation of blood and liver sausages in skyr whey. In *Nutritional Impact of Food Processing*; Somogyi, J.C., Müller, H.R., Eds.; Karger: Basel, Germany, 1987; pp. 47–58.
47. Marsh, A.J.; Hill, C.; Ross, R.P. Fermented beverages with health-promoting potential: Past and future perspectives. *Trends Food Sci. Technol.* **2014**, *38*, 113–124. [\[CrossRef\]](#)
48. Arici, M.; Daglioglu, O. Boza: A lactic acid fermented cereal beverage as a traditional Turkish food. *Food Rev. Int.* **2002**, *18*, 39–48. [\[CrossRef\]](#)
49. Leatherman, C.; Wilster, G.H. Cultured buttermilk and acidophilus milk. *Stn. Tech. Bull.* **1944**, *5*, 3–12.
50. Blandino, A.; Al-Aseeri, M.; Pandiella, S.; Cantero, D.; Webb, C. Cereal-based fermented foods and beverages. *Food Res. Int.* **2003**, *36*, 527–543. [\[CrossRef\]](#)
51. Yeğin, S.; Üren, A. Biogenic amine content of boza: A traditional cereal-based, fermented Turkish beverage. *Food Chem.* **2008**, *111*, 983–987. [\[CrossRef\]](#)
52. Gotcheva, V.; Pandiella, S.S.; Angelov, A.; Roshkova, Z.; Webb, C. Monitoring the fermentation of the traditional Bulgarian beverage boza. *Int. J. Food Sci. Technol.* **2001**, *36*, 129–134. [\[CrossRef\]](#)
53. Prado, F.C.; Parada, J.L.; Pandey, A.; Soccol, C.R. Trends in non-dairy probiotic beverages. *Food Res. Int.* **2008**, *41*, 111–123. [\[CrossRef\]](#)
54. Dlusskaya, E.; Jänsch, A.; Schwab, C.; Gänzle, M.G. Microbial and chemical analysis of a kvass fermentation. *Eur. Food Res. Technol.* **2008**, *227*, 261–266.
55. Albuquerque, T.G.; Costa, H.S.; Sanches-Silva, A.; Santos, M.; Trichopoulou, A.; D’Antuono, F.; Alexieva, I.; Boyko, N.; Costea, C.; Fedosova, K.; et al. Traditional foods from the Black Sea region as a potential source of minerals. *J. Sci. Food Agric.* **2013**, *93*, 3535–3544. [\[CrossRef\]](#) [\[PubMed\]](#)
56. Costa, H.S.; Albuquerque, T.G.; Sanches-Silva, A.; Vasilopoulou, E.; Trichopoulou, A.; D’Antuono, L.F.; Alexieva, I.; Boyko, N.; Costea, C.; Fedosova, K.; et al. New nutritional composition data on selected traditional foods consumed in Black Sea Area countries. *J. Sci. Food Agric.* **2013**, *93*, 3524–3534. [\[CrossRef\]](#) [\[PubMed\]](#)
57. Yoshizawa, K.; Ishikawa, T. Industrialization of saké manufacture. In *Industrialization of Indigenous Fermented Foods*; Steinkrau, K.H., Ed.; Marcel Dekker: New York, NY, USA, 1989; Volume 3, pp. 127–168.
58. Kodama, K.; Saké, Y.K. *Economic Microbiology*; Rose, A.H., Ed.; Academic Press: New York, NY, USA, 1977; Volume 1, pp. 432–475.
59. Inoue, T.; Tanaka, J.; Mitsui, S. *Recent Advances in Japanese Brewing Technology*; Gordon and Breach Science Publishers: Tokyo, Japan, 1992; Volume 2.
60. Hirooka, K.; Yamamoto, Y.; Tsutsui, N.; Tanaka, T. Improved production of isoamyl acetate by a sake yeast mutant resistant to an isoprenoid analog and its dependence on alcohol acetyltransferase activity, but not on isoamyl alcohol production. *J. Biosci. Bioeng.* **2005**, *99*, 125–129. [\[CrossRef\]](#) [\[PubMed\]](#)
61. Kotaka, A.; Bando, H.; Kaya, M.; Kato-Murai, M.; Kuroda, K.; Sahara, H.; Hata, Y.; Kondo, A.; Ueda, M. Direct ethanol production from barley β -glucan by sake yeast displaying *Aspergillus oryzae* β -glucosidase and endoglucanase. *J. Biosci. Bioeng.* **2008**, *105*, 622–627. [\[CrossRef\]](#) [\[PubMed\]](#)
62. Hirasawa, T.; Yamada, K.; Nagahisa, K.; Dinh, T.N.; Furusawa, C.; Katakura, Y.; Shioya, S.; Shimizu, H. Proteomic analysis of responses to osmotic stress in laboratory and sake-brewing strains of *Saccharomyces cerevisiae*. *Process Biochem.* **2009**, *44*, 647–653. [\[CrossRef\]](#)
63. Terasaki, M.; Nishida, H. Bacterial DNA Diversity among Clear and Cloudy Sakes, and Sake-kasu. *Open Bioinform. J.* **2020**, *13*, 74–82. [\[CrossRef\]](#)
64. Escobar, A. The American Maize Beverage Chichi. Master’s Thesis, Cornell University, New York, NY, USA, 1977.
65. Hayashida, F.M. Ancient beer and modern brewers: Ethnoarchaeological observations of chicha production in two regions of the north coast of Peru. *J. Anthropol. Archaeol.* **2008**, *27*, 161–174. [\[CrossRef\]](#)
66. Bassi, D.; Orrù, L.; Vasquez, J.C.; Cocconcelli, P.S.; Fontana, C. Peruvian chicha: A Focus on the Microbial Populations of This Ancient Maize-Based Fermented Beverage. *Microorganisms* **2020**, *8*, 93. [\[CrossRef\]](#) [\[PubMed\]](#)
67. Nuraida, L.; Wachter, M.C.; Owens, J.D. Microbiology of pozol, a Mexican fermented maize dough. *World J. Microbiol. Biotechnol.* **1995**, *11*, 567–571. [\[CrossRef\]](#) [\[PubMed\]](#)
68. Odunfa, S.A. African fermented foods. In *Microbiology of Fermented Foods*; Wood, B.J.B., Ed.; Elsevier Applied Science: London, UK, 1985; Volume 2, pp. 155–191.
69. Dirar, H.A. *The Indigenous Fermented Foods of Sudan*; CAB International: Wallingford, UK, 1993.
70. Ridgely, B. African sorghum beer. *Zymurgy* **1994**, *17*, 28–30.

71. Platt, B.S. Biological ennoblement: Improvement of the nutritive value of foods and dietary regimens by biological agencies. *Food Technol.* **1964**, *18*, 68–76.
72. Coskun, F.; Arici, M. The effects of using different mustard seeds and starter cultures on some properties of hardaliye. *Ann. Microbiol.* **2006**, *56*, 335–337. [[CrossRef](#)]
73. Aydoğdu, H.; Yıldırım, S.; Halkman, A.K.; Durgun, T. A study on production and quality criteria of hardaliye; a traditional drink from Thrace region of Turkey. *GIDA J. Food* **2014**, *39*, 139–145.
74. Arici, M.; Coskun, F. Hardaliye: Fermented grape juice as a traditional Turkish beverage. *Food Microbiol.* **2001**, *18*, 417–421. [[CrossRef](#)]
75. Yilmaztekin, M.; Sislioglu, K. Changes in volatile compounds and some physicochemical properties of European cranberry bush (*Viburnum opulus* L.) during ripening through traditional fermentation. *J. Food Sci.* **2015**, *80*, C687–C694. [[CrossRef](#)] [[PubMed](#)]
76. Sonmez, N.; Alizadeh, H.A.A.; Öztürk, R.; Acar, A.I. Some physical properties of gilaburu seed. *Tarim. Bilim. Derg.* **2007**, *13*, 308–311. [[CrossRef](#)]
77. Sagdic, O.; Ozturk, I.; Yapar, N.; Yetim, H. Diversity and probiotic potentials of lactic acid bacteria isolated from gilaburu, a traditional Turkish fermented European cranberrybush (*Viburnum opulus* L.) fruit drink. *Food Res. Int.* **2014**, *64*, 537–545. [[CrossRef](#)] [[PubMed](#)]
78. Turker, N.; Aksay, S.; Ekiz, H.I. Effect of storage temperature on the stability of anthocyanins of a fermented black carrot (*Daucus carota* var. L.) beverage: Shalgam. *J. Agric. Food Chem.* **2004**, *52*, 3807–3813. [[CrossRef](#)] [[PubMed](#)]
79. Erten, H.; Tanguer, H.; Canbaş, A. A traditional Turkish lactic acid fermented beverage: Shalgam (salgam). *Food Rev. Int.* **2008**, *24*, 352–359. [[CrossRef](#)]
80. Incedayi, B.; Uylaşer, V.; Çopur, Ö.U. Traditional Turkish beverage shalgam: Manufacturing technique and nutritional value. *J. Food Agric. Environ.* **2008**, *6*, 31–34.
81. Tanguer, H.; Erten, H. Occurrence and growth of lactic acid bacteria species during the fermentation of shalgam (salgam), a traditional Turkish fermented beverage. *LWT Food Sci. Technol.* **2012**, *46*, 36–41. [[CrossRef](#)]
82. Arici, M. Microbiological and chemical properties of a drink called salgam. *Ernähr.-Umsch.* **2004**, *51*, 10–11.
83. Karovičová, J.; Kohajdová, Z. Lactic acid fermented vegetable juices. *Hortic. Sci.* **2003**, *30*, 152–158. [[CrossRef](#)]
84. Cvetković, D.; Markov, S.; Djurić, M.; Savić, D.; Velićanski, A. Specific interfacial area as a key variable in scaling-up kombucha fermentation. *J. Food Eng.* **2008**, *85*, 387–392. [[CrossRef](#)]
85. Blanc, P.J. Characterization of the tea fungus metabolites. *Biotechnol. Lett.* **1996**, *18*, 139–142. [[CrossRef](#)]
86. Reiss, J. Influence of different sugars on the metabolism of the tea fungus. *Lebensm. Unters. Forsch.* **1994**, *198*, 258–261. [[CrossRef](#)]
87. Dufresne, C.; Farnworth, E. Tea, kombucha, and health: A review. *Food Res. Int.* **2000**, *33*, 409–421. [[CrossRef](#)]
88. Nguyen, N.K.; Dong, N.T.; Nguyen, H.T.; Le, P.H. Lactic acid bacteria: Promising supplements for enhancing the biological activities of kombucha. *Springerplus* **2015**, *4*, 91. [[CrossRef](#)] [[PubMed](#)]
89. Liu, C.-H.; Hsu, W.-H.; Lee, F.-L.; Liao, C.-C. The Isolation and Identification of Microbes from a Fermented Tea Beverage, Haipao, and Their Interactions during Haipao Fermentation. *Food Microbiol.* **1996**, *13*, 407–415. [[CrossRef](#)]
90. Dookeran, M.M.; Baccus-Taylor, G.S.; Akingbala, J.O. Laboratory manufacture and comparison of ginger (*Zingiber officinale* Roscoe) beer quality. *J. Food Agric. Environ.* **2004**, *2*, 29–33.
91. Osuntogun, B.; Aboaba, O.O. Microbiological and physico-chemical evaluation of some non-alcoholic beverages. *Pak. J. Nutr.* **2004**, *3*, 188–192. [[CrossRef](#)]
92. Laureys, D.; De Vuyst, L. Microbial species diversity, community dynamics, and metabolite kinetics of water kefir fermentation. *Appl. Environ. Microbiol.* **2014**, *80*, 2564–2572. [[CrossRef](#)] [[PubMed](#)]
93. Gulitz, A.; Stadie, J.; Wenning, M.; Ehrmann, M.A.; Vogel, R.F. The microbial diversity of water kefir. *Int. J. Food Microbiol.* **2011**, *151*, 284–288. [[CrossRef](#)] [[PubMed](#)]
94. Nout, M.J.R. Traditional fermented products from Africa, Latin America and Asia. In *Yeasts in Food: Beneficial and Detrimental Aspects*; Boekhout, T., Robert, V., Eds.; B. Behr's Verlag GmbH & Co. KG: Hamburg, Germany, 2003; pp. 451–473.
95. Sambou, B.; Goudiaby, A.; Daouda, D.; Ervik, F.; Camara, M.C. Palm wine harvesting by the bassari threatens *Borassus aethiopum* populations in north-western Guinea. *Biodivers. Conserv.* **2002**, *11*, 1149–1161. [[CrossRef](#)]
96. Oluwole, O.; Kosoko, S.; Familola, O.; Ibironke, O.; Cheikyoussef, A.; Raheem, D.; Saraiva, A.; Raposo, A. Fermented traditional wine from palm trees: Microbial, nutritional attributes and health impacts. *Front. Food. Sci. Technol.* **2023**, *3*, 1225762. [[CrossRef](#)]
97. Mullin, W.J. Miso as a functional food. In *Asian Functional Food*; Shi, J., Ho, C.-T., Shahidi, F., Eds.; Taylor & Francis: New York, NY, USA, 2005; pp. 537–553.
98. Ebine, H. Industrialization of Japanese miso fermentation. In *Industrialization of Indigenous Fermented Foods*, 1st ed.; Steinkraus, K.H., Ed.; Marcel Dekker, Inc.: New York, NY, USA, 1989; pp. 89–126.
99. Yoshii, H. Miso. In *Encyclopedia of Brewing*, 2nd ed.; Noshiro, K., Yoshizawa, K., Kamata, K., Mizunuma, T., Tadenuma, M., Eds.; Asakura Shoten: Tokyo, Japan, 1991; pp. 441–469.
100. Mizunuma, T. Shoyu. In *Encyclopedia of Brewing*, 2nd ed.; Noshiro, K., Yoshizawa, K., Kamata, K., Mizunuma, T., Tadenuma, M., Eds.; Asakura Shoten: Tokyo, Japan, 1991; pp. 398–440.

101. Hilgendorf, K.; Wang, Y.; Miller, M.J.; Jin, Y.-S. Precision fermentation for improving the quality, flavor, safety, and sustainability of foods. *Curr. Opin. Biotechnol.* **2024**, *86*, 103084. [[CrossRef](#)] [[PubMed](#)]
102. Abbaspour, N. Fermentation's pivotal role in shaping the future of plant-based foods: An integrative review of fermentation processes and their impact on sensory and health benefits. *Appl. Food Res.* **2024**, *4*, 100468. [[CrossRef](#)]
103. Nath, S. Integration of microbial proteins into traditional food systems: Innovations, challenges, and future perspectives. *Food Rev. Int.* **2025**, *42*, 1532–1557. [[CrossRef](#)]
104. Rai, A.; Sharma, V.K.; Sharma, M.; Singh, S.M.; Singh, B.N.; Pandey, A.; Nguyen, Q.D.; Gupta, V.K. A global perspective on a new paradigm shift in bio-based meat alternatives for healthy diet. *Food Res. Int.* **2023**, *169*, 112935. [[CrossRef](#)] [[PubMed](#)]
105. Eastham, J.L.; Leman, A.R. Precision fermentation for food proteins: Ingredient innovations, bioprocess considerations, and outlook—a mini-review. *Curr. Opin. Food Sci.* **2024**, *58*, 101194. [[CrossRef](#)]
106. Available online: <https://gfi.org/wp-content/uploads/2022/04/2021-Fermentation-State-of-the-Industry-Report.pdf> (accessed on 3 April 2026).
107. Perwez, M.; Al Asheh, S. Valorization of agro-industrial waste through solid-state fermentation: Mini review. *Biotechnol. Rep.* **2025**, *45*, e00873. [[CrossRef](#)]
108. Chai, K.F.; Ng, K.R.; Samarasinghe, M.; Chen, W.N. Precision fermentation to advance fungal food fermentations. *Curr. Opin. Food Sci.* **2022**, *47*, 100881. [[CrossRef](#)]
109. Banovic, M.; Grunert, K.G. Consumer acceptance of precision fermentation technology: A cross-cultural study. *Innov. Food Sci. Emerg. Technol.* **2023**, *88*, 103435. [[CrossRef](#)]
110. Knychala, M.M.; Boing, L.A.; Ienczak, J.L.; Trichez, D.; Stambuk, B.U. Precision fermentation as an alternative to animal protein: a review. *Fermentation* **2024**, *10*, 315. [[CrossRef](#)]
111. Terefe, N.S. Recent developments in fermentation technology: Toward the next revolution in food production. *Food Eng. Innov. Across Food Supply Chain* **2022**, 89–106. [[CrossRef](#)]
112. Jahn, L.J.; Rekdal, V.M.; Sommer, M.O. Microbial foods for improving human and planetary health. *Cell* **2023**, *186*, 469–478. [[CrossRef](#)] [[PubMed](#)]
113. Banovic, M.; Asioli, D.; Sogari, G. Cross-cultural consumer valuation of precision fermentation milk: Effects of information, individual traits, and labelling preferences. *Food Qual. Prefer.* **2025**, *131*, 105570. [[CrossRef](#)]
114. Ghate, P.R.; Shende, P.; Bhagwat, K.; Sharma, R. Biotechnological advances in precision fermentation for novel food ingredients: Microbial platforms, process optimization, and food chemistry outcomes. *Microbiol. Arch. Int. J.* **2026**, *14*, 89–112.
115. Marco, M.L.; Heeney, D.; Binda, S.; Cifelli, C.J.; Cotter, P.D.; Foligné, B.; Gänzle, M.; Kort, R.; Pasin, G.; Pihlanto, A.; et al. Health benefits of fermented foods: Microbiota and beyond. *Curr. Opin. Biotechnol.* **2017**, *44*, 94–102. [[CrossRef](#)] [[PubMed](#)]
116. Berger, B.; Pridmore, R.D.; Barretto, C.; Delmas-Julien, F.; Schreiber, K.; Arigoni, F.; Brüssow, H. Similarity and differences in the *Lactobacillus acidophilus* group identified by polyphasic analysis and comparative genomics. *J. Bacteriol.* **2007**, *189*, 1311–1321. [[CrossRef](#)] [[PubMed](#)]
117. Ashraf, S.A.; Elkhaila, A.E.O.; Ahmad, M.F.; Patel, M.; Adnan, M.; Sulieman, A.M.E. Probiotic Fermented Foods and Health Promotion. In *African Fermented Food Products—New Trends*; Elhadi Sulieman, A.M., Adam Mariod, A., Eds.; Springer: Cham, Switzerland, 2022.

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