



Exploring Some Traditional Fermented Dairy Beverages of Global Importance: A Review

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10.18805/ajdfr.DR-2248

ABSTRACT

Milk based functional foods are the common part of people's diets in the modern world. People have been preparing these dairy products through different processes for many generations. For this, fermentation is one of the most commonly used method. Peoples in certain parts of the world include such fermented dairy products into their main diet. Certain drinks are representative of a nation's culture and are appropriate for the climate in that country. Their distinct texture, unique production technique and other organoleptic aspects are some of their special qualities. Typically, these drinks are made for domestic consumption and are not widely known outside of their community. Thus, we are going to discuss about such beverages, their manufacture procedure, microorganisms and their geographic origin in this review study.

Key words: Country, Fermented dairy products, Health benefits, Microbes, Traditional beverages.

Beverages are the liquids that are prepared by processing base material generally through fermentation process. Thirst satisfaction was an absolute purpose behind their preparation. Among all those beverages there was a variety of beverages that have their origin in the dairy industries. Those beverages had more health benefits than normal ones. As they have benefits of both natural composition and milk also. Milk from varied species has something better than others that adds more to their health benefits. Even a geographical area has some impact on animal milk composition (Beja-Pereira *et al.*, 2003).

Many of those beverages were representative of their geographic origin, like Ayran in Iran, Koumiss in Mongolia, etc. Ingredients used and the preparation method of every beverage were different which shows their uniqueness. preparation process of those products mostly included fermentation. It is a natural process that adds flavour and several health benefits to the final product. This process is conducted with the help of fermenting microbes. This process exerts various beneficial effects like increased mineral and proteins utilization, improving palatability, gut health, immunity, etc. (Marsh *et al.*, 2014).

The microbes present in different traditional beverages which are combinedly show the desired effects. Some common beneficial microbial species were found in different beverages those are like *Lactobacillus*, *Bifidobacterium* and Probiotic bacteria's, etc. (Yerlikaya, 2014).

As beverage companies work to differentiate their products, milk and milk-derived substances can be used with a range of traditional beverages to help them profit from the nutritional and functional advantages of these ingredients.

Kefir

It is a fermented product prepared from sheep, cow, goat, or camel milk having slight acidic taste and aroma, quite

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How to cite this article: Rani, P., Kanetkar, P., Bakshi, S., Binchhar, B., Yadav, S.P., Pankaj and Paswan, V.K. (2025). Exploring Some Traditional Fermented Dairy Beverages of Global Importance: A Review. Asian Journal of Dairy and Food Research. 1-9. doi: 10.18805/ajdfr.DR-2248.

Submitted: 21-06-2024 **Accepted:** 18-01-2025 **Online:** 26-02-2025

high viscosity and composed of air bubbles (Fig 1). In Turkish, kefir means "feels good". It has originated from the tribal communities in the northern Caucasus Mountain area of eastern Europe, although so many countries consume it including Russia, Ukraine, China, Italy, Brazil, Romania, Mexico, etc (Fig 2). Kefir was usually prepared in sheep skin bags and kefir grains were the fermenting units (Yilmaz *et al.*, 2022; Ahmed *et al.*, 2013). Kefir's starter includes lactic-(LAB) and acetic-acid (AAB) bacteria, *lactobacilli*, *Streptococcus*, *leuconostoc*, yeast, etc. This rich probiotic content makes it a "Natural complex probiotic". Here bacteria and yeasts are present in a symbiotic combination (Yilmaz *et al.*, 2022; Guzel-seydim *et al.*, 2010).

In different studies, commercially produced and home-made Kefir's samples were analyzed for their microbial composition. There were about 66 different microbes including 41 LAB, 13 AAB, 11 non-LAB/AAB, 16 yeast and 2 fungi were identified. During this fermentation process, *Lactococcus* and *lactobacillus* spp. dominate's at start and at end, resp. (Yilmaz *et al.*, 2022). Two types of fermentation take place during preparation viz., Alcoholic and Lactic acid fermentation. The natural refreshing effect of home-made kefir is due to combined fermentation by LAB and yeast (Guzl-seymid *et al.*, 2010).

Kefir grains are the small cauliflower floret of 10-30 mm in length, white to whitish yellow colour, clustered body and stored up to a year. Nowadays, kefir grains are used in cheese making due to the diversity of strains present in them and their characteristics show that it is suitable for brine-ripened cheeses (Kourkoutas *et al.*, 2006; Guzel-seydim *et al.*, 2010). Non-dairy origin of kefir grains is consisting of yeasts (*Candida*, *Saccharomyces*, *Kluyveromyces*) and LAB (*Leuconostoc*, *Lactococcus*, *Lactobacillus*) (Azizi *et al.*, 2021). Increasing biomass with fermentation process makes its easy recovery (Gorek and Tramek, 2007). Subbalakshmi *et al.* (2023) used kefir grains for the preparation of probiotic drink by using double fermentation process.

It helps to inhibit lactose intolerance, reduce cholesterol, etc. Kefir prepared from goat milk inhibits angiotensin-converting enzymes. Rich in protein and calcium, could alter the mucosal immunity, improve cell viability, immunoglobulins secretion, etc. (Vinderola *et al.*, 2005). It also has some biological activities like anti-hypertensive, improving gut health, anti-carcinogenic, superoxide radicals scavenging and type a1 diabetes by stimulating insulin secretion, anti-microbial, anti-inflammatory and antioxidative, etc. Also, can used for baby feeding as it provides disease resistance and weight gaining (Ahmed *et al.*, 2013; Azizi *et al.*, 2021).

Kefir have an exopolysaccharide component known as 'Kefiran', an edible polymer. It is a branched polymer produced mainly by *Lactobacillus kefiranofaciens*, contains approximately equal amount of D-galactose and D-glucose in chain, soluble in water and on drying it weighted more than 50% of overall weight of product. Its popularity is because of its rheological properties, biocompatibility, biodegradability, user safety, gelling, preservative, stabilizing effect, antimicrobial, antitumor and wound healing. (Ahmed *et al.*, 2013; Moradi and Kalanpour, 2019).

Lassi

In India, lassi has been prepared from old ages (2.6 million years ago). This Punjab-originated drink is an important part of diet during summer season as dessert (Fig 2). It's a thick, creamy, sweetish, rich-in-flavour dairy beverage, high in calorie count that is usually prepared from buffalo (Fig 1). Some taste enhancers (condiments, fruits, or spices) could be added depends on consumers

preference. Some cultures are added like *Lactic streptococci* in whole or partially skimmed milk. Chemical acidification (paneer whey) is preferred due to some challenges for culture maintenance. But a product by this process have low sensory score as the consistency gets lower. Using reconstituted milk with lactic acid culture, 20% water and 20% sugar gives the best result (Nair and Thompkinson, 2008; Zohra *et al.*, 2016).

It could be salted (Indian subcontinent) or sweet (India and Pakistan). For making sweet lassi some natural sweeteners like honey, maple syrup, molasses, stevia, etc. are used. Salted lassi is prepared by mixing curd/yogurt, salt and other ingredients. Bhang lassi (cannabis incorporated) is immensely popular during Holi, an Indian festival. Other herbs, such as cilantro, or spices, such as cumin or black pepper, etc. (Chawla and Sivakumar, 2017; Saha *et al.*, 2021). Other products like 'Googh' in Iran and Lebanon, 'Lben' in Morocco, 'Susa' and 'Maziwa La' in Kenya, 'yoghurt smoothies' in America have an identical taste as lassi (Sudheendra *et al.*, 2018).

Advantages of lassi consumption are skin improvement, probiotic source, immunity booster, weight management, bone strength, bloating prevention, maintain cardiac health, etc. High consumption rate, nutrition values and absorption process make it reliable fortification product. Have wise effects on growth, morbidity and cognition. It contains both essential and non-essential amino acids, calcium (0.6%) and phosphorous (0.04%) at low quantity, has lower acidity than fruit juices, probiotic bacteria control intestinal infection and lactose digestion, lowers blood pressure and cholesterol and its functionality could be enhanced by adding probiotic and herbal extracts (Chawla and Sivakumar, 2017; Maji *et al.*, 2020). In blood plasma, LDL and cholesterol level starts to decrease with increase in content of dietary fibre. Beetroot and mango incorporation in it increases its vitamin A content to three and five percentage resp. with high consumer acceptance and turmeric, ginger and carrot enhances its anti-oxidative effect (Nair and Thompkinson, 2008; Chawla and Sivakumar, 2017; Maji *et al.*, 2020).

Ayran

It is a designated official drink (non-alcoholic beverage) of Turkey as it holds its culture and tradition. Ayran is a part of festivals, where it is offered during sporting events, concerts and folk dance. The traditional method of preparation is the adding water and salt in yogurt and mixing till foaming (Fig 1). In some areas, yoghurt dilution with 30-50% water with 1% salt has preferred (Koksoy and Kilic, 2004). *Lactobacillus delbrueckii* ssp. *bulgaricus* and *Streptococcus thermophilus* are added to standardized milk (8% Total Solid) for ayran preparation. Homogenization and pasteurization are also used for preparation (Altay, 2017). Its name changes in different countries like *Doogh* in Iran and Afghanistan, *Laban ayran* in Syria and Lebanon, *Shinna* in Iraq, *Eyran* in Azerbaijan, *Tan* in Armenia, *Ayrani* in Cyprus

and *Moru* (spiced buttermilk) in India etc (Fig 2). Its simple method of preparation and high nutritional value make it incredibly special. In Turkey, it is available in high-fat, low-fat and no-fat types, but all of them tastes similar. Home-made ayran also has different varieties like Spicer ayran, with the addition of hot pepper and different herbs and vegetables. Susurluk ayran, made in Susurluk district in Balikesir state and it is most popular in Turkey. Taste and foaming are the differential characters for them (Baruzzi *et al.*, 2016; Sarmadi *et al.*, 2022).

Ayran is used for the preparation of cold soups like 'Tarator' and 'Cacik' by adding cucumbers, salt, dill and olive oil. Depending upon fat content, it behaves like pseudoplastic or thixotropic fluid, whereas some research demonstrated it as a Newtonian fluid (Kosky and Kilic, 2003; Ahmed *et al.*, 2013; Sarmadi *et al.*, 2022). Rheological instability is the main problem for its elevated level of production. A culture containing *Streptococcus thermophilus* to produce exopolysaccharide has a positive/negative effect on the viscosity and texture (Yilmaz *et al.*, 2015). Low initial pH than carbonated soft drinks like Sprite, Cappy and Coca-Cola and its elevation after consumption makes it good for dental health. It contains more calcium, sodium and phosphorus (Sener *et al.*, 2013). It shows an inhibitory action against *Staphylococcus aureus*, *E. coli* and putrefactive aerobic bacteria and their anti-cancerous properties, protect DNA damage, high gut absorption rate, colonel bioavailability, high phenolic content (could increase by encapsulating herbs). A complete sleep cycle

is especially important for a normal lifestyle (Grishina *et al.*, 2011; Altay, 2017).

Ryazhenka

Ryazhenka is a Russian dairy beverage immensely popular in their local market. Some literatures claimed to have its origin in Ukraine, afterwards gain popularity in Russia (Fig 2). It's a non-alcoholic beverage having creamy consistency, faint brown colour, caramel-like taste and roasty-sweet flavour (Fig 1). This flavour is because of furfuryl alcohol formed during baking. High ketone content gives fruity flavour to it. Its preparation by using baked milk (90-95°C for 3-5 hr.) is its distinguishing feature. Fermentation done with *Lactobacillus bulgaricus* and *Streptococcus thermophilus* containing starter. As per Russian rules, if milk heated for less than three hours, isn't considered as ryazhenka; it is for developing characteristic colour and taste. Varenets, the original Russian product is akin to ryazhenka, but the heating protocol (97±2°C for 40-80 min.) and the use of only *Streptococcus thermophilus* in varenets makes the difference. Its organoleptic properties and positive health effects makes it popular in Chinese market (Moiseenko *et al.*, 2021; Aidarbekova and Aider, 2022).

Slow heating of milk helps to produce prebiotic lactulose. Lactulose helps bacteria to grow in GI tract, inhibition of pathogens, blood insulin and glucose level maintenance, etc. In Russian primary schools, ryazhenka has been included in the diet after the COVID-19 pandemic (Wang *et al.*, 2022; Miroshnikova, 2022). It has remarkably



Fig 1: Pictures of different fermented beverages.

high antioxidant energy than kefir and yogurt. Also contains various twenty-six fatty-acids, fourteen volatile organic compounds (VOCs) including ketones and aromatic alcohol in small quantities. VOCs are responsible for different flavours, butanoic and nonanoic acid for dairy butter, ethyl methyl carbonate for fruity-sweet flavours, etc. (Moiseenko *et al.*, 2021).

Koumiss

A Mongolian fermented beverage prepared by using unpasteurized mare (female horse) milk and sometimes jennet (female donkey) milk (Kanetkar *et al.*, 2023) (Fig 2). In Magnolia, it is known as "cege" and it was one of their 'Eight treasures'. Its history is incredibly old as it was extremely popular in the "Han Yuan Dynasty" from around 202BC to 202AD. Its preparation has been done by natural fermentation and in barrels and containers made up of wood (Yang *et al.*, 2022) (Fig 1). The name of this beverage is supposed to have come from a river named "Kuma," in the Asian grassland. It has several names like 'chigo, chige, arrag' in Russia and Kazakhstan. Koumiss culture is consisting primarily of *L. bulgaricus*, *L. plantarum* and *L. helveticus* (Afzaal *et al.*, 2021). Fermentation processes are the same as in kefir, both Alcohol and Lactic acid fermentation takes place. On an average a decent quantity (per 100 ml) of calcium (76 mg), sodium (13 mg), magnesium (6 mg), Phosphorous (43 mg) and a small concentration of Iron, Zinc and magnesium has also found. The alcohol content is at a low level, approx. 2%. Alcohol content can classify koumiss as weak (1%), moderate (1.8%) and strong (1.8-2.3%). Depending upon their acidity (lactic acid content) they differentiate as strong (3.3-3.6), moderate (3.9-4.5) and light (4.5-5). The micro-organisms that involved are also different, such as Lactic acid bacteria

are in strong, *Lactobacillus* bacteria are in moderate and *Streptococcus thermophilus* and *Streptococcus cremoris* for light koumiss (Danova *et al.*, 2005; Ishii *et al.*, 2014; Afzaal *et al.*, 2021; Shaikh *et al.*, 2021).

Easy digestion and absorption enhance its demand. It is the first beverage used for dietary therapy because of its rich pharmacological effects. "Koumiss therapy" which is done to increase appetite, gastric secretions and improve digestion has gained popularity not only in China but also in Russia, Kazakhstan, Mongolia and Kyrgyzstan (Li *et al.*, 2022). Improving blood formation and supply, alertness, kidney functions, immune system and endocrine glands (Danova *et al.*, 2005). 21 compounds in Koumiss decrease crypt depth and increases intestinal villi length production of lymphocyte cells and improve immunity (Li *et al.*, 2022). It contains all essential amino acids, whereas proline, lysine, valine, tyrosine and leucine are in vital quantity. Biological compounds that were present in koumiss have antagonistic effects against few pathogens (Afzaal *et al.*, 2021).

Kiselo mlyako

Local Indo-European peoples (Thracians) lived in Bulgaria were used to consume a beverage having grainy texture and sour taste during nomadic times as a staple food and it was similar to today's kiselo mlyako (Fig 2). Beverage contain fermenting bacteria *Lactobacillus bulgaricus* and *Streptococcus salivarius* subsp. *thermophilus*. Milk from cows, buffalo, sheep, or goats could be used for its preparation (Nancheva, 2019). People in Bulgaria treat kiselo mlyako as a symbol of nationalism like, rose oil and Bulgaria's Jews' rescue after IWW (Cohen, 2019). The characteristic attributes are smooth texture, pleasant sour flavour and thick consistency and its composition is

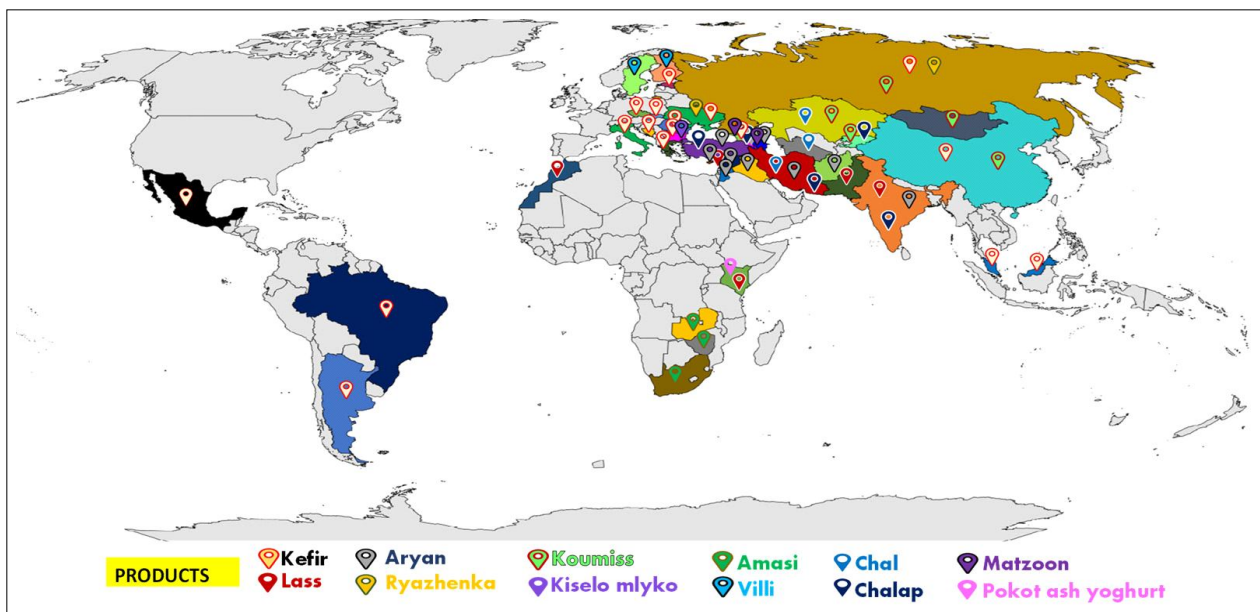


Fig 2: Map representing different countries where the respective beverages are consumed.

wonderfully comfortable to the climate of Bulgaria (Fig 1). Rapid fermentation of it helps in extending its shelf-life by inhibiting pathogens and saprophytic micro-organisms (Tumbariski *et al.*, 2021). Space foods are need to have longer shelf-life, balanced nutrition and harmless at zero gravity. In 1965, the Skylab mission was carried out by NASA and Kiselo mlyako was in their menu (Shukla, 2020).

Being a reliable source of health-promoting bacteria, it has so many health benefits like reducing pathogens, controlling infection, boosting immunity, anti-cancerous, improve GI tract, heart problems, pregnancy issues and many more. The probiotic effect of *Lactobacillus bulgaricus* showed its colonies in intestine. Different strains of this bacteria could protect against the lead toxicity, hypolipidemia, free radicle scavenging, *etc.* Higher proteolytic activity of the strains gives oligopeptides which are responsible for rapid mineral absorption and probiotic effects (Oyeniran *et al.*, 2020; Tumbariski *et al.*, 2021).

Amasi

A South African beverage prepared at a household by unpasteurized full cream cow milk mostly in the tribal area. "Zulu and Xhosa" tribes have a fairy tale named 'ntsomi' it's about the magical bird, where they represent amasi as a magical drink (Scheub, 1970). People of "Sotho" group call it 'Mafi' and in Zimbabwe, it is 'Sethem', 'hodzekoi', or 'mukaka wakakora' (Fig 2). Amasi represents the cultural and socio-economic values of native peoples. They consume it with 'Phuto', a crumbled pap from maize flour. Natural fermentation of Amasi takes place in a pre-smoked skin bag or a pre-smoked calabash (wooden bucket) (Fig 1). The previous batch Amasi is used for fermentation. It is conducted directly under sunlight for 2-3 days until it tastes acidic. Nowadays, *Lactococcus lactis*, *Leuconostoc mesenteroides* subsp. *cremoris* and *L. lactis* subsp. *cremoris* are used for the fermentation process. 18 different yeasts and 282 bacteria were identified from amasi samples. Among all, *Saccharomyces cerevisiae* was most prevalent yeast followed by *Candida lusitanae* and *Candida colliculosa*. 194 out of 282 strains were LAB. 179 of all identified LAB were of *Lactococcus* spp. Amasi have high anti-oxidative potential, SFA and BCFA content, FA nutritional indices *etc.* as compare to kefir, ryazhenka and mahewu.

Amasi is also have a high mineral content (per 100 gm) as it is composed of Potassium (190 mg), Calcium (162 mg), Phosphorus (92.2 mg), Sodium (56.7 mg), Magnesium (14.3 mg) and vitamins like vit. A and B12 in decent amount (Osvik *et al.*, 2013; Moiseenko *et al.*, 2021; Maleke *et al.*, 2021).

Amasi is also very effective against food allergies, aeroallergen sensitization, asthma, rhinitis, dermatitis, *etc.* In rhinitis and Atopic dermatitis of 12-month-old children Amasi resulted 50% more effective. The Department of Health of South Africa under the "Road to Health" program, recommended Amasi as a weaning diet for 12 months old children. Consumption of Amasi regularly can result in delaying gut emptying and appetite control, *etc.* (Levin *et al.*, 2020; SAdoH, 2018).

Villi

It is a fermented beverage, popular in Nordic countries and is supposed to have its origin in Sweden or Finland (Fig 2). This beverage is consumed as a breakfast/snack along with cereals, fruits and/or muesli, but mixing cinnamon and sugar in it is a traditional way to have it (Fig 1). Its fermentation is carried out by mixing starter culture and mould. *Lactococcus lactis* subsp. *cremoris* produces phosphate-containing exopolysaccharides provide stickiness and ropy consistency with decreased syneresis. Those exopolysaccharides are composed of protein (3-47%), carbohydrate (29-85%) and Glucose: Galactose: Rhamnose (3:1:1) molar ratio, arabinose and mannose in low quantity (Ruas-Madiedo *et al.*, 2002; Tamime *et al.*, 2007; Luo and Deng, 2016; Li *et al.*, 2022).

Villi has a high count of symbiotic bacteria, mould and yeast and they act synergically to have better gut health (Luo and Deng, 2016). *Geotrichum candidum* is a pathogenic fungus but the strain (*Geotrichum candidum* LG-8) which is found in villi is found to have probiotic effects (Wu *et al.*, 2023). Regular consumption of villi can help to increase weight at a slower rate. An increase in the quantity of *Muribaculum* spp. for an effective carbohydrate metabolism in mouse gut (Chung *et al.*, 2020; Yamane *et al.*, 2021). EPS fraction is also effective on the adhesive properties of two probiotic bacteria *Bifidobacterium lactis* and *Lactobacillus rhamnosus* with intestinal mucosa. Such

Table 1: Chemical composition of fermented beverages.

Products	Chemical composition							References
	Moisture (%)	Total solid (%)	Fat (%)	Solid not fat (%)	Protein (%)	Carbohydrate (%)	Ash (%)	
Kefir	89.5	10.5	0.3	10.2	3.4	6.0	0.7	Arslan, 2015
Lassi	96.2	3.8	0.8	3.0	1.29	1.21	0.5	Chawla and Sivakumar, 2017
Ayran	94	6.0	1.2	4.8	1.7	2.1	1.0	Zucchini and Dobson, 2011
Koumiss	95.3	4.7	1.7	3.0	2.2	0.5	0.3	Ishii <i>et al.</i> , 2014
Amasi	84.86	15.14	3.66	11.48	3.3	3.68	4.5	Maleke <i>et al.</i> , 2021
Chal	87.76	12.24	5.8	6.44	3.07	2.97	0.4	Salami <i>et al.</i> , 2016; Yam <i>et al.</i> , 2014
Matzoon	87.56	12.44	1.47	10.97	5.33	3.71	0.75	Kanetkar <i>et al.</i> , 2023

exopolysaccharides are studied to have health-promoting effects like Anti-tumour effect, cholesterol-reducing effect on both body and blood, immunity boosting effect, etc. (Ruas-Madiedo *et al.*, 2002; Patten and Laws, 2015).

Chal

Fermentation of camel milk with microbes by adding water in it and holding it in a skin bag at room temperature gives a sparkling product known as, Chal (Fig 1). It is popular in the Northern part of Iran, Turkmenistan and Kazakhstan (Muthukumaran *et al.*, 2022). It is generally consumed in the arid and desert zones of Kyzylkum and Karakum (Fig 2). The addition of water is depending on the season. Milk is diluted for 1:1 ratio (milk:water) in winter and monsoon, whereas 1:4 in summer (Konuspayeva *et al.*, 2023). If a culture used for fermentation is much sour, then a creamy layer starts to appear on the surface. It is an *Agar* and the remaining liquid is a Chal (Cherzekoy and Saporov, 2005). Probiotic strains of *Lactobacillus* and *Wieselia* are dominant in the starter culture of Chal (Yam *et al.*, 2015).

Traditionally, Chal is a very important part of the medicinal system of Iran. A major part of health benefits like antioxidants, wound healing, anti-cancerous, free radicle scavenging, anti-diabetic, hepatoprotective effects, anti-inflammatory, tuberculosis come from the base material and camel milk (Asresie and Adugna, 2014; Salwa and Lina, 2010; Mohammed and Alshaibani, 2021). Camel milk is composed of a high quantity of whey proteins (Immunoglobulins, Lactoferrin, Lactoperoxidase, Lysozyme), Vitamin B3 and C, Unsaturated fats, Calcium, Iron, antioxidative properties, etc. than bovine milk (Yadav *et al.*, 2015). Chal is rich in calcium (bounded to protein) which have more bio-availability than added calcium (Salami *et al.*, 2016). Camel milk is a potential source of probiotic bacterial strains like *Bifidobacterium*, *enterococcus*, *Lactobacillus*, etc. and some potential probiotic bacterial strains like *Lactobacillus plantarum*, *Lactobacillus hilgardii*, *Leuconostoc spp.*, etc. were isolated from Chal (Shori, 2017). Some probiotic yeasts like *Saccharomyces boulardii*, *Saccharomyces cerevisiae* and *Saccharomyces pastorianus* and some isolated yeasts like *Kluyveromyces lactis*, *K. marxianus*, *Isaatchenkia orientalis*, *Saccharomyces cerevisiae* and *Debaryomyces hansenii*, etc. shown health beneficial anti-cancerous, fungus and bacteria suppressing and anti-inflammatory properties (Yam *et al.*, 2014; Alkalbani *et al.*, 2022).

Chalap

It's a non-alcoholic beverage produced by mixing 'Suzmo', carbonated water (80%) and salt. Sometimes Ayran is also used for chalap preparation because of its creamy consistency, high viscosity, high syneresis and slightly acidic taste (Fig 1). Chalap has been considered a national fermented beverage of Kyrgyzstan. In Kyrgyzstan, chalap is generally used during lunch in summer (Smanalieva *et al.*, 2022; Kubatbekova, 2016). 'Suzmo' is a traditional food of Kyrgyzstan. It's a semisolid and highly viscous dairy

product. Prepared by filtering Ayran by filtering cloth and the retentate is a 'Suzmo'. Quite like the 'Shrikhand' and also used in the preparation of kurut (Iskakova and Smanalieva, 2021). Concentrated *Suzmo* is diluted to prepare Chalap. It has similar texture to Dough (Iran), Ayran (Turkey), Than (Armenia) and Lassi (India) (Fig 2). Nowadays, modification of chalap whey-based products has been modified with better taste and health benefits (Smanalieva *et al.*, 2022). Modified and whey-based chalap are being prepared with better nutritive values and biological availability. Modified chalap are clear and without any sediment of protein residues (Smanalieva *et al.*, 2022).

Matzoon

Matzoon have an origin in Armenia whereas in Georgian it is popular as 'Matsoni' (Fig 2). They are the national food products of their respective countries. They are very important biogeographic fermented foods (Konuspayeva *et al.*, 2023). It is prepared by cow's milk and fermented using bacteria (*Bacillus/Streptococcus*) and yeasts (Fig 1). *Streptococcus thermophilus*, *Lactobacillus delbrueckii subsp. lactis*, *Lactobacillus delbrueckii subsp. bulgaricus* and *L. rhamnosus* are considered indigenous bacteria in Matzoon's starter culture. Because the fermentation process carried out at 42-45°C matzoon is known as 'Thermophilic Sour Milk'. It is used for 'Tan' preparation. It's a Caucasian fermented dairy product. Low shelf life (5-7 days) at refrigeration is the main issue in front of producers but, UV ray's treatment could extend it up to a month (Borcakli *et al.*, 2013; Konuspayeva *et al.*, 2023).

In Armenia and Georgia, it is prepared as a household beverage without preservatives and stabilizers addition. Georgian Ministry of Labour's Health and Social Affairs Department appeals to consume it as a complementary food for children's over 6 months (Quero *et al.*, 2014). Matzoon acts as a body cleaner, metabolism regulator, blood cholesterol, colitis and dysfunction of the intestine, neutralize drugs and some hormones (Chitchyan and Verdvan, 2021). In past, it was used for dermatitis, wound healing, cosmetics for skin and hair and as a potential food preservative (Chanishvili, 2012). The bacterial culture showed probiotic potential, high antibiotics, little salinity and bile juices resistance, anti-microbial, adhesion to intestinal cells etc. *Lactobacillus fermentum* resulted the lowest residual lactose than other bacteria present during fermentation which makes is in lactose intolerance (Macori and Cotter, 2018).

Pokot ash yogurt

It's a Kenyan fermented beverage prepared by using cow or goat milk, have an aromatic taste and bright grey colour (due to ash used for preparation) (Fig 1 and 2). 'Cromwo' is the name of that tree and it has disinfectant ability (Dansero *et al.*, 2012; Mattielli *et al.*, 2018). In local tribes, it is also known as 'Mala ya kienyeji or Kamabele kambou'. *Mala ya kienyeji* is local alcohol and is locally prepared in a home kitchen (Howland, 2016).

CONCLUSION

Fermented products of milk hold a place in human diet. The dairy products have employed fermentation for a long time in human society. The process of fermentation imparts a notable flavour and texture to the finished product. These fermented drinks are used by various cultures throughout the world because they are associated with their ethical, social and cultural values. Ethnic products' contents are rich in biological substances and their starting cultures are teeming with beneficial bacteria, they offer numerous health benefits. Therefore, learning about fermented dairy and food products is essential to understanding culture of society.

Disclaimers

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Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article. No funding or sponsorship influenced the design of the study, data collection, analysis, decision to publish, or preparation of the manuscript.

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