NBUJPS
NBU Journal of Plant Sciences

ISSN No. 0974-6927
Vol. 16 (2024), pp. 01-09

Review Article

A comprehensive review of the diversity of ethnic fermented beverages and their therapeutic effectiveness

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Abstract

The widespread practice of preserving food through natural fermentation has ancient origins, rooted in the ancestral wisdom of tribal communities. Ethnic foods and beverages are culinary offerings deeply connected to the heritage and culture of specific ethnic groups, utilizing their knowledge of locally sourced plant and animal ingredients. The diverse array of tribal communities spread across various geographical regions. Among these communities, alcoholic beverages are particularly popular. The ancestral practice of natural fermentation as a preservation technique has endured through the indigenous knowledge passed down within these tribes. These mildly alcoholic, sweet-flavored beverages are often considered more as food than drink due to their high calorie content, vitamins, and beneficial lactic acid bacteria and yeast. Traditionally, these alcoholic beverages are cereal-based, using substrates such as rice, wheat, maize, or ragi, depending on the local habitat of the tribal population, although fruits and vegetables are also used to make ethnic brew. For generations, these beverages have been integral to cultural, social, and religious events. However, many traditional ethnic practices have been overlooked, resulting in insufficient documentation for scientific analysis. This study aims to address this gap by conducting a scientific examination of various fermented beverages consumed by several parts of Asian countries areas inhabited by different communities.

Article info

Received **12 August 2025**
Revised **22 November 2025**
Accepted **25 November 2025**

Keywords: Ethnic knowledge, Fermentation, Starter culture, Traditional practices

DOI: ***https://doi.org/10.55734/nbujps.2024.v16i01.001***

Introduction

Since ancient times, natural fermentation has been a traditional technique of food preservation. This age-old method owes its existence to the rich ancestral knowledge passed down through generations, especially within tribal communities (Tamang, 2010). While many of these traditional practices have faded into obscurity, leaving little documented evidence for scientific scrutiny, the roots of natural fermentation can be traced back to our distant ancestors. These communities relied on fermentation to ensure food stability and longevity, showcasing their ingenuity (Tamang, 2020). Preserved through oral traditions and practical knowledge, these practices have endured over time.

Across the globe, diverse socio-linguistic groups have rich historical traditions of using various plant materials in the ancient art of fermentation, resulting in a wide array of distinctive beverages. This cultural tapestry weaves a fascinating narrative of how humanity's linguistic and social diversity has converged with the natural world, creating a spectrum of libations that reflect the unique tastes and traditions of each community.

Food and beverages are integral to every community, shaping and reflecting the unique ethnic identity of a society. The fundamental aspects of human lifestyle—where we live, what we wear, and how we nourish ourselves—are influenced by geographical features, climatic conditions, and other environmental factors. Natural products have taken precedence over chemically engineered compounds

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in food, medicine, and human health (Marin et al., 2017). The excessive use of synthetic drugs, chemical preservatives, and fertilizers has harmed human health and the environment. Given these challenges, there is a pressing need to explore novel, non-toxic, and environmentally friendly compounds to improve human well-being. Historically, probiotics, along with their metabolites and prebiotics, have been considered viable alternatives for addressing various infectious and non-infectious diseases.

Unfortunately, many traditional methods have been overlooked, leading to inadequate documentation for scientific analysis. The depth of these indigenous practices often remains hidden, ready to be uncovered and explored. Therefore, the primary goal of this study is to compile ethnic knowledge and explore its potential facets.

Natural methodology for preservation

Decontamination methods such as pasteurization, thermal heat processing, appreciation, and sterilization decrease the microbial content in food items, thereby extending their shelf life (Chiozzi et al., 2022). Additionally, chemical additives like nitrites, sulfites, and organic acids such as sorbic acid and propionic acid are commonly used for preservation to inhibit microbial growth. Conversely, using modern techniques for food preservation often compromises the food's organoleptic properties and nutritional availability.

Reports suggested that the remarkable antimicrobial properties inherent in essential oils and bioactive compounds are found in various plant parts such as flowers, bark, seeds, roots, fruits, and leaves. These natural elements have demonstrated the capacity to preserve food naturally. When combined with microorganisms, the synergistic effects of these herbs have shown profoundly positive impacts on human health, even contributing to disease prevention and treatment. The term "ethno-microbiology" is now fundamental in food microbiology. It encompasses traditional fermentation techniques that involve the conservation and crude sub-culturing of essential microbiota using back-sloping methods by indigenous communities for centuries.

More than 80% of the inhabitants in India and Africa consume cereal-based food products for their daily consumption (Das et al). Traditional fermented drinks are mainly made from cereal-based products like rice, wheat, millet, and maize, although various fruits, vegetables, and other plant parts are also sometimes used in fermentation. In the development of human civilization, food fermentation has played a crucial role by utilizing indigenous knowledge. Local cereal grains are used for fermentation, and the variation comes from the starter culture, which is cultivated locally with different herbs. The starter culture initiates the fermentation process, containing numerous microorganisms that alter the biochemical and sensory properties of the raw materials. This culture improves the taste and nutritional value of the ultimate products, making them extensively accepted socially and culturally.

Types of fermented beverages

Though numerous ethnic groups have a large variety of fermented drinks, but a general scheme of planning can be presented as a) choice of raw material as a substrate, b) treating of the raw material with sun-drying, washing, and boiling, c) introduction of starter culture made up of rice and locally grown several herbs d) Purification of the fermented product f) post purification processing (Watson, 1993). Numerous kinds of alcoholic beverages are available, such as:

- Non-distilled alcoholic beverages using amylolytic starter culture such as fermented millet-based alcohol locally known as *kodo ko jhaar* (Thapa and Tamang), fermented finger millet brew of Toto tribe of North Bengal (Bhattacharjee et al. 2021), fermented rice-based drink locally known as *bhaati jhaar* (Tamang et al., 2016), rice-based drink makgeolli(fermented rice) is available in Korea (Jung et al., 2012).
- Non-distilled or filtered alcoholic drinks using amylolytic starter culture, such as, e.g., sakéof Japan (Kotaka et al., 2008).
- Distilled alcoholic beverages using amylolytic starter cultures, such as Jou a rice-based distilled drink used by the Bodo tribe in Assam and West Bengal (Deka et al., 2017) and chokot, a distilled drink from the Rabha community in India (Bhattacharjee et al., 2023).
- Alcoholic drink, Tej, is produced from honey in Ethiopia (Fentie et al., 2020).
- Alcoholic drinks are made from the germination of cereals such as sorgram, maize, etc. “Bantu” beer of South Africa and the pito of Nigeria (Ekundayo., 1969).
- Wines and Ciders are the fermented drinks prepared from fruits deprived of distillation.

- Fermented fruit and cereals are recognized as whisky and bandy.

Fermented drinks of the Asian tribal community

India is a country rich in diverse cultures and traditions, with its wide collection of traditional foods and drinks. Beverages have garnered significant attention due to their nutritional benefits and potential to improve various diseases. Ethnic cultures in India have an enthralling tradition of producing ethnic liquors, deeply rooted in the indigenous knowledge passed down through generations. Each tribal group has uniquely developed distinct varieties of these beverages, showcasing their traditional heritage (Bhattacharjee et al., 2021).

Ethnic beverages can be grouped in the following way:

- Fruit-based fermented beverages (Wine, Cider, Perry, etc.).
- Brewed drinks (Beer and sakes)
- Distilled brews (Spirits, liquor, Brandies, etc.)

Additionally, several ethnic alcoholic beverages are available in every country. Every ethnic community has different fermented drinks, while the inoculation they use differs from community to community. Inoculation of the amylolytic starter culture plays a significant source of starting the fermentation process.

Amylolytic starter cultures are commonly derived from cultivating filamentous fungi and yeasts on raw or cooked cereals (Tamang, 2016). As far back as 4000 BC, these mixed amylolytic starters may trace their origins(Lee, 1984). The earliest written reference to a Chinese amylolytic starter known as "chu" resembles the Himalayan "marcha" (Tamang, 2010).

In Asian countries, the traditionally prepared starter culture is categorised into three major categories to convert starch to simple sugar into alcohol and organic acids (Tamang & Fleet, 2009).

- The traditional back-sloping method includes sub-culturing to reserve crucial microbiota, with yeasts, molds, and bacteria. These are formulated with various plant parts and rice cakes to create amylolytic starter. In Southeast Asia and the Himalayan regions of India, Nepal, Bhutan, and China for centuries, such starters have been used for making fermented liquor (Tamang & Fleet, 2009). These ethnic starter cultures have regional names: Bhakhor, ranu, dhabi, marcha in India; bubod in the Philippines; chiu/chu in China and Taiwan; and loogpang in Thailand (Tamang, 1996; Dung et al., 2007).

- *Aspergillus oryzae* and *A. sojae* is employed in Japan, as a starter known as "koji" to make several alcoholic beverages, for example, saké. This procedure is utilised in the production of non-alcoholic fermented soybean products like miso and shoyu (Tamang et al., 2016).

- Whole-wheat flour and its associated microbes are assorted with moisture and moulded into solid cakes. These tablets are then reared to favour the growth of explicit beneficial microorganisms. Accordingly, they are engaged to inoculate significant numbers of starchy substances, which undergo fermentation to produce malt. This starter mixture includes yeasts and filamentous moulds that are utilized for alcohol production in China.

In South Asia and states of the Indian Himalayan Range, microbial inocula, in the form of dry powders or hard balls known as starters, are used to carry out the fermentation process (Kumari et al., 2016). Indigenous alcoholic beverages, produced by many tribes using fruits, cereals, grains, etc. are fermented with the aid of these starter cakes.

Some of the fermented drink and their starter culture from India

Jou is a mild rice-based alcoholic beverage prepared by the Deori and Bodo communities of Assam using an amylolytic starter culture called *Amou*. It exhibits antioxidant properties, a moderately low pH, and balanced protein and carbohydrate content, with *Amylomyces rouxii* and *Rhizopus oryzae* identified as the dominant microbes involved in fermentation (Deka et al., 2018).

Pachwai

is a rice wine popular in the eastern regions of India, produced using Bakhar as a foundational culture. This culture includes *Rhizopus* sp., *Mucor* sp., and at least one variety of yeast (Hutchinson & Ram-Ayyar, 1925). In the preparation process, ginger and various plant materials are dried, ground, and then blended with rice flour.

Atingba

is an ethnic rice brew made by the Meitei communities in Manipur, using the amylolytic starter culture hamei (Jeyaram et al., 2009). Hamei is crucial for creating alcoholic beverages from glutinous rice, imparting a unique flavor and aroma.

Table 1. Some Traditional alcoholic beverages and starters are used in the Himalayan states of India.

State	Tribe	Beverage	Substrate	Starter	Reference
Ladakh and Himachal Pradesh	-	Chhang	Barley or Rice	Phabs	Angmo & Bhalla, 2014
Uttarakhand	Bhotiya	Chhang	Barley or Rice	Balma	Bhardwaj *et al.*, 2016
Himachal Pradesh	-	Sura	Millet	Dhehli	Thakur & Bhalla, 2004
		Chhang or Lugri	Barley or Rice	Phab	
		Daru	Jaggery from Sugercane (*Acacia nilotica* is added for flavour)	Phab	
		Chulli	Wild apricots	Phab	
		Angoori	Grapes	Phab	
West Bengal	Santhals,Oraons, Mundas	Haria or Jhara	Rice	Bakhar or Ranu Dabai	Ghosh & Das, 2004
	Toto	Eu	Finger millet	Moi/moa	Bhattacharjee *et. al.* 2021
Assam	Bodo	Jou Bishi	Rice	Angkur	Bhuyan & Baishya, 2013
		Zu	Rice	Emao	Tanti *et al.*, 2010
	Karbi	Horlang	Rice	Thap	Bhuyan & Baishya, 2013
		Arak	Rice	Thap	Tanti *et al.*, 2010
	Ahom	Haj or Koloh Pani	Rice	Vekur Pitha	Bhuyan & Baishya, 2013
	Deori	Sujen	Rice	Mod Pitha	
	Rabha	Jonga or Kecha Mod	Rice	Surachi or Phap	
	Mising	Apong	Rice	Apop Pitha	
	Kachari	Rohi	Rice	Saoul Pitha	
	Adivasi	Haria	Rice	Dabai	Tanti *et al.*, 2010
	Dimasa	Zu	Rice	Hamao	
Manipur	Meithei	Atingba	Glutinous Rice	Hamei	Jeyaram *et al.*, 2009
Meghalaya	Pnar	Kaid	Rice	Thiat	Nath *et al.*, 2019
	Khasi	U Phandieng	Rice	-	Tanti *et al.*, 2010
Arunachal Pradesh	Monpa	Bunk chung/ bhang chang	Rice	Pham	Nath *et al.*, 2019
	Thangsa	Apong	Rice	Ipoh	
	Adi, Nyshing & Mishmi	Opo	Rice	Pee	
	Deuri and Khampuri	Poka	Rice	Si-ye	
	Apatani	Opo	Rice	Chu	
	Miji	Rakshi	Rice	Ipoh	
	Hill miri	Mingri	Rice	Bokha	
Sikkim	Gorkha, Bhutia, Lepcha, Monpa	Kodo Ko Jaanr or Chyang or Chee	Finger millet	Marcha	Tamang *et al.*, 1988
	Gorkha	Bhaati Jaanr	Rice	Marcha	
Nagaland	Mao Naga	Zutho	Rice	Khekhrii or Grist	Tamang *et al.*, 2012
	Angami	Peyazu	Glutinous rice	Yei	Tanti *et al.*, 2010
Tripura	Debbarma, Jamatia, Koloi, Molsom	Gora Bwtwk	Rice	Chuwan Beleb	Ghosh *et al.*, 2016

The yeast communities in hamei were identified through biochemical characterization and molecular techniques, revealing species such as *Saccharomyces cerevisiae*, *Pichia anomala*, *Trichosporon* sp., *Candida tropicalis*, and others (Jeyaram et al., 2009).

Zutho

is a rice fermented mild alcoholic drink among the Mao community in Nagaland with local starter culture known as amylolytic starter, khekhrii (Teramoto et al., 2002).

chhang, jau chhang and sura

are the fermented beverages of Himachal Pradesh, where Phab and dheli are used as ethnic amylolytic starters (Tamang et al., 2016). These beverages are shown the dominance of LAB strains in their starter culture.

Starter culture used in different brew

The starter culture preparation varies from region to region, which involves the use of food crops, spices or herbs of a particular region (Angmo & Bhalla, 2014). The variety of regional plants used in these starter cultures aid in the colonisation of microorganisms needed for the fermentation of the substrate, as well as adds medicinal properties to the beverage. Some of the known starter culture is listed below:

Phabs

Phabs is prepared with roasted husked barley grain flour. This flour is mixed with wheat flour and kneaded into dough. The dough is rolled into small tablets and placed between layers of shrub Artemisia sp. (burnak). Then the tablets are left to ferment for 2-3 days (Angmo & Bhalla, 2014). Phabs are used to prepare many traditional beverages.

Balma

For balma preparation, the dough is prepared with *Triticum aestivum*, *Fagopyrum esculentum, F. tataricum* or *Hordeum vulgare* flour. Leaves of herbs like *Inula cuspidata*, *Micromeria biflora*, *Origanum vulgare*, *Thymus linearis* and roots of *Rubus* sp. are mixed in the dough. The dough tablets are then left for fermentation between the layers of leaves of *Cupressus torulosa*, *Cannabis sativa* and/or *Pinus roxburghii* (Bhardwaj et al., 2016).

Dhehli

Dhehli preparation is an annual community effort in Himachal Pradesh. Herbs are crushed and added to sattu (flour of roasted barley). This mixture is kneaded roughly and put in wooden moulds to give brick shape (Thakur & Bhalla, 2004).

Bakhar or ranu dabai

All freshly collected plants are chopped and ground. Then powdered rice and old Bakhar is mixed with the paste. After removing woody and husky parts, the paste is made into tablets of different size. These tablets are placed between layers of straw and kept in a basket for incubation. When ready, these are used to prepare Haria, a fermented rice beer (Ghosh & Das, 2004).

Angkur

For preparation of angkur, rise grains are soaked in water for few hours and then ground along with different herbs in a wooden mortar and pestle. This powder is used to prepare dough, which is then made into round cakes of 5cm diameter. These cakes are placed in between paddy straws after being overlaid with powdered angkur (Bhuyan & Baishya, 2013).

Emao

Emao is prepared from husked rice and leaves of *Atrocarpous integrifolia*. Also herbs like *Cledodendrum viscosum* and *Polygonum hydropiper* are added. This starter culture is used by Bodo community of Assam to prepare rice beer called Zu (Tanti et al., 2010).

Thap

Preparation of Thap is done using rice soaked for almost 1 day. Different herbs and soaked rice is ground together and made into dough by adding water. This dough is used to make flat cakes of 6cm diameter. The cakes are overlaid with powdered Thap and left in bamboo sieves to dry (Bhuyan & Baishya, 2013).

Vekur pitha

Rice grains are soaked overnight, and different plant parts are ground together for the preparation of Vekur pitha. This paste is made into oval-shaped balls and placed on banana leaves and allowed to dry. Vekur pitha is used by the Ahom community of Assam to prepare a rice beer called Haj (Bhuyan & Baishya, 2013).

Mod pitha

The different plant parts needed for starter cake are washed properly and ground together with the soaked rice grain and made into dough for Mod pitha preparation. The dough is made into round-shaped balls and placed in bamboo sieves for drying (Bhuyan & Baishya, 2013).

Saoul pitha

Saoul pitha is prepared from soaked rice ground with different plant parts needed for the starter cake. The paste is made into oval-shaped balls that are placed on a banana leaf and allowed to dry for 3-5 days (Bhuyan & Baishya, 2013).

Hamao

Hamao is a starter culture used by the Dimasa community of Assam for the preparation of rice beer Zu (Tanti et al., 2010). Traditionally, for the preparation of Hamao, sticky rice is soaked in water for 10-12 hours and then crushed with the bark of *Albizia myriophylla*. A small amount of previously prepared culture is added. The mixture is made into round or oval cakes and then sun-dried (Kumari et al., 2016).

Hamei

Hamei is traditionally prepared from crushed raw rice with bark of Yangli (*Albizia myriophylla*). The paste is pressed into round, flat cakes of about 2-7 cm diameter. The cakes are kept over rice husk in bamboo baskets for 2-3 days (Jeyaram et al., 2009).

Thiat

For the preparation of Thiat (natural) yeast, a handful of *Amomum aromaticum* leaves is sundried and ground into a powder. Then 1-2 kg of rice is soaked and also ground. Small, round Thiat cakes are made from these two powders along with Musa paradisiaca leaf paste. These cakes are then left to dry in bamboo baskets (Samati & Begum, 2007).

Ipoh

The Thangsa tribe of Arunachal Pradesh prepare Ipoh using Glutinous rice, leaves of *Scoparia dulcis* and *Leucas lanata*. All the ingredients are ground into a course paste and then mixed with 8-10 gm of old starter powder. The mixture is kept for fermentation for 2-3 days over fire place. This fermented mixture is made into flat cakes or biscuits and kept on bamboo mats for sun drying (Shrivastava et al., 2012).

Pham

For Pham preparation by the Monpa tribe, glutinous rice is washed and ground into a coarse paste along with some leaves of *Solanum khaianum* and some old starter culture. This greenish mixture is left for fermentation for two days and then made into small tablets. These tablets are then sun-dried and kept for future use (Shrivastava et al., 2012).

Marcha

For marcha preparation, glutinous and non-scented rice is soaked in water overnight. A few pieces of roots of *Plumbago zeylanica*, a few leaves of *Buddleja asiatica*, flowers of *Vernonia cinerea*, and spices such as ginger and chilli are blended. The paste is made into flattened cakes. Old marcha powder is sprinkled on the cakes and then wrapped in fern fronds. These are then placed on straw covered bamboo floor above the kitchen oven (Tamang et al., 2012).

Khekhrii or grist

For the preparation of Khekhrii, rice grains are germinated and then sundried. These dried, sprouted grains are powdered and used in rice beer preparation (Tamang et al., 2012).

Yei

For preparation of yei, germinated rice grains are dried, ground and mixed with normal rice. These are then used to prepare 'Peyazu', an alcoholic beverage consumed by the Angami community of Nagaland (Tanti et al., 2010).

Chuwan beleb

For the preparation of chuwan beleb, rice is soaked for 2 hours and then ground into a fine paste. Other associated raw materials are dried, finely powdered, and sieved. A small amount of water is added to the mixture to make the dough. This dough is made into flat round cakes and sun-dried for future use in Gora Bwtwk preparation by the tribes of Tripura (Ghosh et al., 2016).

Biochemical properties of the fermented beverages

During fermentation, raw cereals or the substrates undergo broad biochemical changes facilitated by microorganisms. Research indicates that Haria, a rice-based drink, results from liquefaction, saccharification, and fermentation. This transformation involves aerobic bacteria, yeast, molds, lactic acid bacteria (LAB), and *Bifidobacteria* working together. Aerobic microorganisms initiate the process, allowing anaerobic yeasts and molds to flourish later.

LAB and *Bifidobacteria* are present from the start, likely presented by herbs in the starter culture. Two key enzymes, amylase and glucoamylase, break down the starch in cereals like rice, wheat, maize, and millet. Amylase converts amylose and amylopectin into dextrin, which glucoamylase then

breaks down into glucose (Das et al., 2018). This glucose fuels yeast-driven alcohol production.

The enzymes also produce water-soluble malto-oligomers, contributing to the beverage's clarity. (Das et al., 2018).

Medicinal properties of fermented beverages throughout the World

In developing and underdeveloped countries, malnutrition and poor health are significant challenges. In India, a major cereal producer, traditional cereal-based foods often fall short in addressing these issues due to high starch content, limited essential amino acids, and low mineral bioavailability (5-15%) caused by phytic acid and other antinutritional factors. However, fermented rice and cereal-based foods offer improved nutritional benefits and physiological advantages. Fermenting rice with other cereals, legumes, or herbs enhances amino acid and mineral profiles and therapeutic potential through complementary actions. Wet processing with mixed-culture microorganisms like lactic acid bacteria (LAB) and yeast further fortifies these foods with minerals and nutrients (Das et al., 2017).

The cereal-based beverage "Kounou" from Cameroon, Central Africa, boasts significant antioxidant potential and exceptional sensory attributes. This sorghum-fermented drink has low alcohol content and high nutritional value, containing carbohydrates, reducing sugars, proteins, amino acids, and ash. These qualities make it a popular meal replacement in northern Cameroon. Additionally, its high levels of flavonoids and polyphenols suggest potential health benefits from regular consumption (Bayoï et al., 2021).

Kombucha, a fermented tea beverage, has gained popularity recently due to its potential health benefits. While research is ongoing, kombucha is known to be a source of probiotics that support a healthy gut microbiome and aid digestion. The fermentation process produces enzymes and organic acids that enhance digestion. Kombucha also contains antioxidants like polyphenols, which neutralize harmful free radicals and reduce oxidative stress. Additionally, it helps detoxify the body and improve the immune system by modulating gut microbes (Villarreal-Soto et al., 2018).

Various types of rice beer consumed in Northeast India have been found to possess therapeutic values. Handia is effective against dysentery, diarrhea, amebiasis, acidity, and vomiting (Ghosh et al., 2013). Apong helps prevent kidney stones, while Jou aids in preventing jaundice and urinary disorders. Judima offers a range of benefits, including anti-inflammatory, anti-allergic, antioxidant, antibacterial, antifungal, antispasmodic, hepatoprotective, hypolipidemic, neuroprotective, hypotensive, anti-aging, and anti-diabetic properties. Zutho boosts the immune system, lowers blood insulin levels, prevents loss of appetite, reduces bad cholesterol, aids in wound healing, and prevents infection. Bhaati Jaanr is recommended for ailing individuals and postnatal women to regain physical strength (Roy, 2020). These fermented beverages not only improve nutrition but also contribute to the well-being of people in the region.

The starter culture for the mentioned fermented liquors includes locally available plants with significant medicinal properties. These plants, such as *Ananas comosus*, *Artocarpus heterophyllus* Lam., *Calotropis gigantea* (L), *Capsicum frutescens* L., *Clerodendrum viscosum* Vent., and others, are used in preparing starter cultures for rice beer production and possess antioxidant properties (Das et al., 2017). Their antioxidant activity and antimicrobial effects contribute to health benefits (Akash et al., 2020). Antioxidants inhibit the formation of free radicals produced by cells, which are associated with oxidative stress and various health issues like heart disease, cancer, and arthritis. (Huy et al., 2008).

The Harchur raksi (HR) is a lesser-known beverage consumed by the indigenous people residing in the high-altitude regions of the entire Himalayan range. The Harchur raksi is Raksi is a traditional brew prepared from cereals, fortified with a medicinal plant Harchur (*Viscum articulatum* Burm. f.) leaves. This brew has the antioxidant and anti-inflammatory activity (Bhattacharjee et al., 2023).

Conclusion

Food and beverages are integral to any region, defining its ethnicity, diversity in the agro-economy resources and variations in the geography and climate of the particular area. These factors not only characterise the region's heritage but also reflect the socio-cultural aspects of its communities. Fermentation through natural ethnic techniques is a backslapping criterion of several ethnic groups to revive their ethnomicrobial culture. Cereals serve as the principal food in many countries, and improving the shelf life of food through producing fermented beverages from low-grade grains promotes bio-sustainability. The ethnic communities residing in different regions possess extensive knowledge of integrating medicinal plants into diverse applications. An illustrative instance of this is the

utilisation of plants in the starter culture to prepare fermented beverages. Fermented drinks are used as refreshing drinks and have many ethnomedical values, reducing various ailments, including cough, dysentery, bronchitis, asthma, fever, liver problems, and hypertension. Moreover, fermented beverages derived from cereals, with negligible or minimal alcohol content, serve as a source of probiotic microflora, particularly beneficial for individuals with lactose intolerance. This kind of study will open a new door to preserving ethnic knowledge, ensuring that valuable ethnomicrobiota are not lost.

Author contributions

All the authors contributed to the manuscript writing and approved it.

Funding

Not applicable

Competing interests

All the authors do not have any competing interests

References

Angmo K, Bhalla TC (2014) Preparation of Phabs—an indigenous starter culture for production of traditional alcoholic beverage Chhang in Ladakh.

Bhattacharjee S, Kar P, Sarkar I, Sen A, Ghosh C (2021) Biochemical and microbial profiling establish “Eu” (a traditional fermented beverage of Toto people) as a probiotic health drink. *J Ethn Foods* 8:1–13

Bhattacharjee S, Sharma A, Lala M, Gupta P, Ghosh C, Sen A (2023) Efficacy of ‘Harchur raksi’, a traditional fermented beverage of high-altitude Darjeeling hills as an anti-inflammatory and antiviral remedy. *Vegetos*:1–9

Bhardwaj KN, Jain KK, Kumar S, Kuhad RC (2016) Microbiological analyses of traditional alcoholic beverage (Chhang) and its starter (Balma) prepared by Bhotiya tribe of Uttarakhand, India. *Indian J Microbiol* 56(1):28–34

Bayoï JR, Ndegoue SV, Etoa FX (2021) Traditional processing and quality attributes of “kounou”, a fermented indigenous cereal-based beverage from northern Cameroon. *J Agric Food Res* 6:100209

Bhuyan B, Baishya K (2013) Ethnomedicinal value of plants used in preparing traditional rice beer by tribes of Assam, India. *Drug Invent Today* 5(4):335–341

Das M, Kundu D, Singh J, Rastogi A, Banerjee R (2017) Physiology and biochemistry of indigenous tribal liquor Haria: a state of art. *Adv Biotechnol Microbiol* 6(2):1–5

Dung PM, Mancarella P, Toni F (2007) Computing ideal sceptical argumentation. *Artif Intell* 171(10–15):642–674

Deka D, Sarma GC (2010) Traditionally used herbs in the preparation of rice-beer by the Rabha tribe of Goalpara district, Assam.

Ekundayo JA (1969) The production of pito, a Nigerian fermented beverage. *Int J Food Sci Technol* 4(3):217–225

Fentie EG, Emire SA, Demsash HD, Dadi DW, Shin JH (2020) Cereal- and fruit-based Ethiopian traditional fermented alcoholic beverages. *Foods* 9(12):1781

Ghosh C, Das AP (2004) Preparation of rice beer by tribal inhabitants of tea gardens in Terai, West Bengal.

Ghosh S, Rahaman L, Kaipeng DL, Deb D, Nath N, Tribedi P, Sharma BK (2016) Community-wise evaluation of rice beer prepared by ethnic tribes of Tripura. *J Ethn Foods* 3(4):251–256

Hutchinson CM, Ayyar CR (1915) Bakhar—the Indian rice beer ferment. *Imperial Dept of Agriculture in India*

Jeyaram K, Singh TA, Romi W, Devi AR, Singh WM, Dayanidhi H, et al. (2009) Traditional fermented foods of Manipur. *Indian J Tradit Knowl* 8(1):115–121

Kumari A, Pandey A, Ann A, Raj A, Gupta A, Chauhan A, et al. (2016) Indigenous alcoholic beverages of South Asia. In: *Indigenous Alcoholic Beverages of South Asia*. CRC Press, New York:501–566

Pham-Huy LA, He H, Pham-Huy C (2008) Free radicals, antioxidants in disease and health. *Int J Biomed Sci* 4(2):89

Nath N, Ghosh S, Rahaman L, Kaipeng DL, Sharma BK (2019) An overview of traditional rice beer of North-east India: ethnic preparation, challenges and prospects.

Roy A (2020) Traditional cereal-based alcoholic beverages of India: a rich source of unexplored microorganisms for potential health benefits. *IJBPAS* 9:791–802

Samati H, Begum SS (2007) Kiad—A popular local liquor of Pnar tribe of Jaintia Hills district, Meghalaya. *Indian J Tradit Knowl* 6(1):133–135

Shrivastava K, Greeshma AG, Srivastava B (2012) Biotechnology in tradition—A process technology of alcoholic beverages practiced by tribes of Arunachal Pradesh, NE India. *Indian J Tradit Knowl* 11(1):81–89

Tamang JP, Sarkar PK (1996) Microbiology of mesu, a traditional fermented bamboo shoot product. *Int J Food Microbiol* 29(1):49–58

Tanti B, Gurung L, Sarma HK, Buragohain AK (2010) Ethnobotany of starter cultures used in alcohol fermentation by ethnic tribes of Northeast India.

Tamang JP (2010) Diversity of fermented beverages and alcoholic drinks. In: *Fermented Foods and Beverages of the World*:85–125

Tamang JP, Fleet GH (2009) Yeast diversity in fermented foods and beverages. In: *Yeast Biotechnology: Diversity and Applications*:169–198

Tamang JP, Sarkar PK, Hesseltine CW (1988) Traditional fermented foods and beverages of Darjeeling and Sikkim—a review. *J Sci Food Agric* 44(4):375–385

Tamang JP, Tamang N, Thapa S, Dewan S, Tamang B, Yonzan H, et al. (2012) Microorganisms and nutritional value of ethnic fermented foods and alcoholic beverages of NE India.

Tamang JP, Thapa N, Bhalla TC, Savitri (2016) Ethnic fermented foods and beverages of India. In: *Ethnic Fermented Foods and Alcoholic Beverages of Asia*:17–72

Teramoto Y, Yoshida S, Ueda S (2002) Characteristics of rice beer (zutho) and a yeast isolated from the fermented product in Nagaland, India. *World J Microbiol Biotechnol* 18:813–816

Thakur N, Bhalla TC (2004) Characterization of traditional fermented foods and beverages of Himachal Pradesh.

Villarreal-Soto SA, Beaufort S, Bouajila J, Souchard JP, Taillandier P (2018) Understanding kombucha tea fermentation: a review. *J Food Sci* 83(3):580–588

Watson WE, Kumar K, Michaelsen LK (1993) Cultural diversity's impact on interaction process and performance: comparing homogeneous and diverse task groups. *Acad Manag J* 36(3):590–602.