



Preparation of Alcoholic Beverages by Tribal Communities in the Indian Himalayan Region: A Review on Traditional and Ethnic Consideration

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The Indian Himalayan Region (IHR) is the center of the diverse food culture comprising fermented and non-fermented ethnic foods and alcoholic beverages. Diverse tribal communities in IHR (Uttarakhand, Himachal Pradesh, Jammu and Kashmir, Ladakh, Sikkim, Assam, Arunachal Pradesh, Manipur, Meghalaya, and Tripura) have been long known for their rich culture and food habits. Having strong ritual importance among the ethnic people of the IHR, alcoholic beverages are being consumed in various cultural, social, and religious events for ages. Consumption of in-house prepared alcoholic beverage is the socio-cultural tradition in India as well as across the globe. The processes and ingredients involved in alcoholic beverage preparations vary with raw material availability in different regions. The majority of the fermented drinks are cereal-based with a significant proportion of various plants and fruits as the main raw material, making a beverage more unique in taste. Some plant ingredients used for traditional alcoholic beverages have potential nutraceutical as well as therapeutic properties that are well documented. These properties could constitute an additional economic value for traditional alcoholic beverages commercialization, which, in turn, could promote the local rural economy. Until now, such beverages have only received marginal attention by ethnobotanists and few studies concern traditional fermented beverages in the IHR. In this view, the current review focused on preparation, diversity, cultural, and economic significance and health benefits of ethnic beverages used by tribal communities in the IHR.

Keywords: alcoholic beverages, socio-cultural tradition, fermented drinks, indigenous people, Indian Himalayan Region

INTRODUCTION

The Indian Himalayan Region (IHR) is host to the world's highest ecosystems, which includes Jammu and Kashmir, Ladakh, Himachal Pradesh, Uttarakhand, Sikkim, Darjeeling hills, Arunachal Pradesh, and some hilly regions of northern Assam (Tamang, 2001; Nehal, 2013). The ethnic tribes of IHR, living in high-altitude areas, are known for their traditional knowledge and complex life system all over the world. They are unique, due to their geographical condition, food preference, and lifestyle (Tamang, 2010a). Being a distinctive component, uses and preparations of alcoholic

beverages among the tribal communities have been a part of traditional knowledge for thousands of years (McGovern, 2009; Dutfield, 2010; Egea et al., 2015).

Fermentation of beverages is a 5000-year-old tradition in India. Soma is the most talked about and most mysterious of the Indian beverages. The entire 9th Mandala in Rig-Veda (1700 BC) is dedicated to Soma and it is elevated to the position of moon Goddess (<https://www.arishtam.com/indian-traditional-beverages/home-brew-tutorials/> accessed on October 24, 2020). The preparation of the ethnic beverages using the fermentation process by the tribal people of India is well known and documented by several workers (Kumar and Rao, 2007; Rivera et al., 2012a,b). It is reported that more than 350 types of major traditional beverages are prepared using indigenous knowledge. These homemade beverages, prepared informally at the local or family level, are region-specific and prepared manually by mixing old starter culture with the raw material (Tamang, 2020). The World Health Organization (WHO, 2014) has also reported the importance of traditional beverages in cultural and social events. It is important to mention that these traditional alcoholic beverages also contain extract of plant parts and a good source of minerals and bioactive compounds beneficial for health (Darby, 1979; Campbell-Platt, 1994; Steinkraus, 1996; Tamang and Fleet, 2009).

Although traditional alcoholic beverages are an important part of the cultural and social life of tribal communities, these beverages received minor attention from researchers and ethnobotanists so far especially in India. Several ethnobotanical studies on traditional alcoholic beverages used by the tribal communities have been published, but the details of ingredients, preparation methods, cultural significances, etc. have not been explored properly (Kishor et al., 2013; Nath et al., 2019). It is also observed that the investigation based on ethnobotanical field surveys, social and cultural engagements, and possible nutraceutical values are substantially lacking in IHR. Therefore, this review has been focused on the preparation and cultural significance of traditional alcoholic beverages in the IHR.

MATERIALS AND METHODS

In the present comprehensive review, an extensive database on various aspects of traditional alcoholic beverages in the IHR was searched using the most relevant search engines. For the compilation of the review, online original research articles, review articles, book chapters, published books, conference proceedings, and reports available on authentic and reputable scientific search engines like ScienceDirect (www.sciencedirect.com), PubMed (<https://pubmed.ncbi.nlm.nih.gov/>), Scopus (<https://www.scopus.com>), National Library of Medicine (<https://www.nlm.nih.gov/>), Google Scholar (<https://scholar.google.com/>), and Web of Science (<https://webofknowledge.com>) were searched. The literature was searched for alcoholic beverages in the IHR using keywords like indigenous beverages, Himalayan beverages, traditional beverages, ethnic beverages, starter culture, substrates etc.

A detailed bibliographic search was made using 83 references from 1974 until 2020 in the present review.

DIVERSITY AND PREPARATION OF TRADITIONAL ALCOHOLIC BEVERAGES

There are a variety of traditional alcoholic beverages, commonly or lesser known (Chhang, Judima, Jann, Chakti, Angoori, Daru, etc.), that are produced by tribes of IHR using fruits, cereals, grains, etc. as raw material (Tamang, 2001). Based on the used raw materials and preparation methods, these beverages can be classified into various types such as rice and cereal wine, palm wine, distilled spirit, and distilled alcoholic beverages (Bluhm, 1995; Thakur et al., 2004; Franz et al., 2011). Traditional alcohol brewing is a home-based industry run by tribal women using indigenous knowledge of the fermentation process. Tribes of the high-altitude Himalayan region have developed their own cultures for the preparation of fermentation-based alcoholic beverages using the available natural resources in the region (Roy et al., 2004). The preparation of traditional beverages is not only a means of livelihood in the hill regions but also an important household-cum-societal drink associated with religious ceremonies (Sharma and Mazumdar, 1980). As listed in **Table 1**, quite a few indigenous beverages are known by different local names for their unique taste, aroma, and process of preparation. However, all tribes across the Himalayan region mostly share a similar method, which is cooking of raw material, drying, and incorporation of starter culture, fermentation, and the extraction of the final product.

PREPARATION OF STARTER CULTURE

The majority of the alcoholic beverages are prepared from cereals, mostly rice (46%) followed by millets (17%), barley (12%), wheat (10%), maize (10%), and sorghum (5%), as mentioned in **Supplementary Figure 1**. The raw materials for different beverages are used as a substrate for the growth of microorganisms such as yeasts, molds, and bacteria (Dung et al., 2006; Nath et al., 2019). The microbial starter culture is prepared through grinding the rice and local herbs and plant parts followed by mixing and preparing starter cake in some places whereas some communities prefer to use it in powdered form (Tsuyoshi et al., 2005). The details of medicinal plants used for the preparation of starter culture are presented in **Table 2**. There are a variety of starters used by the tribes of IHR to prepare alcoholic beverages. Keem is a starter cake used to prepare an alcoholic beverage popularly known as Soor in Garhwal Himalaya of Uttarakhand state (India). It is prepared using *Cannabis sativa* and *Sapindus mukorossi*, including 40 other herbs (Rana et al., 2004; Sekar and Mariappan, 2007). Balam is a wheat-based starter used to prepare Jaan and Daru. It is made by the Bhotiya community of high-altitude regions of Uttarakhand Himalaya. During the preparation of Balam, roasted wheat flour as a substrate is mixed with various herbs and spices such as *Cinnamomum zeylanicum*, *Amomum subulatum*, *Piper longum*, *Ficus religiosa*, and wild chillies (Das and Pandey,

TABLE 1 | Description of ethnic alcoholic beverages and their use in the Himalayan Region.

State	Tribes/Community/Region	Ethnic Beverages	Substrate	Starter/Microbes	Health Benefits	References
Laddakh	Bhoto community in Leh, Nubra valley	<i>Chhang/Lugri</i>	Barley	<i>Phab (Yeast)</i>	Treatment of arthritis, joint pain	Targais et al., 2012; Angmo and Bhalla, 2014
Himachal Pradesh	Lahaul and Spiti, Kinnaur region	<i>Chhang</i>	Wheat	<i>Phab (Yeast)</i>	Protection against cold	Kanwar et al., 2011
	Kinnaur region	<i>Lugari</i>	Rice	<i>Phab (Yeast)</i>	Protection against cold	Savitri and Bhalla, 2019
	Kangra region	<i>Lugdi</i>	Rice	<i>Phab</i>	Rich in protein and phenolic compounds	Kumar et al., 2019
	Lahaul and Spiti, Kinnaur region	<i>Aara</i>	Barley	<i>Phab (Yeast)</i>	Protection against cold	Savitri and Bhalla, 2007
	Kullu, Kangra, Mandi region	<i>Sura, Sur</i>	Finger millet	<i>Dhaeli or Dhehli</i>	Rich in Vitamin B	Thakur et al., 2004; Joshi et al., 2015
	Kinnaur region	<i>Angoori</i>	Grapes	<i>Phab</i>	Protection against cold	Thakur et al., 2004; Savitri and Bhalla, 2019
	Kinnaur region	<i>Chulli</i>	Wild apricot	<i>Phab</i>		
	Kinnaur region	<i>Behmi</i>	Apple	<i>Phab</i>		
	Kinnaur region	<i>Ara/Arak</i>	Apple, barley, pear	<i>Phab</i>		
	Shimla and Kullu region	<i>Chakti/Jhol</i>	Jaggery	<i>Phab</i>		
Uttarakhand	Bhotiya tribes in Johar valley	<i>Jaan</i>	Rice	<i>Balam (Yeast)</i>	Treatment of fever, dysentery, cough and cold, stomach ailments	Sekar and Mariappan, 2007; Kishor et al., 2013
	Bhotiya tribes in Johar valley	<i>Kacchi</i>	Barley	<i>Balam (Yeast)</i>	Cholera, treating weakness of cattle	Kishor et al., 2013
	Jaunsari community in Tons valley	<i>Soor</i>	Barley	<i>Keem</i>	Protection against cold	Sekar and Mariappan, 2007
	Bhotiya tribes in Johar valley	<i>Daru</i>	Rice, jaggery	<i>Balam (Yeast)</i>	Protection against cold	Roy et al., 2004; Sekar and Mariappan, 2007
Sikkim and Darjeeling	All tribes	<i>Jnards</i>	Finger millet	<i>Murcha (Bacteria and Yeast)</i>	Protection against cold	Tamang et al., 1988; Sekar and Mariappan, 2007
	Gorkha, Bhutia, Lepcha, Monpa tribes	<i>Kodo ka jaanr</i>	Finger millet	<i>Chyang</i>		Chetia and Borgohain, 2020
	Gorkha tribes	<i>Poko</i>	Rice	<i>Manapu</i>		
	All tribes	<i>Chhayang</i>	Finger millet/barley	<i>Yeast, Lacto acid bacillus</i>		Tamang, 2010b
	Gorkha tribes	<i>Baati jhar</i>	Finger millet	<i>Marcha</i>		Chetia and Borgohain, 2020
	Nepalese, Tibetan community	<i>Chhaang</i>	Finger millet	<i>Marcha</i>		Nath et al., 2019
Lepcha, Bhutiyi and Nepali community	<i>Rokshi</i>	Maize	<i>Mold and Yeast</i>		Sekar and Mariappan, 2007	

(Continued)

TABLE 1 | Continued

State	Tribes/Community/Region	Ethnic Beverages	Substrate	Starter/Microbes	Health Benefits	References
Arunachal Pradesh	All tribes	<i>Jhara</i>	Various plants	<i>Ranu Dabai</i>	Protection against cold	Tiwari and Mahanta, 2007; Chetia and Borgohain, 2020
	Monpa, Apatani, Nishi tribes	<i>Apong</i>	Rice	<i>Ipo</i>		
	Monpa, Apatani, Nishi tribes	<i>Ennog</i>	Black rice	<i>Ipoh</i>		Shrivastava et al., 2012
	All tribes	<i>Madua</i>	Finger millet	-		
	All tribes	<i>Apong</i>	Rice	<i>Khamtip (fermented mixture)</i>		
	Monpa tribes	<i>Themsing</i>	Finger millet	-		
	Karbi tribes	<i>Bankhe-kham</i>	Tapioca (<i>Mannihot esculenta</i>) a tuber	<i>Khamtip (fermented mixture)</i>		
	Karbi tribes	<i>Shhang or Ccharo-kham</i>	Barley	<i>Khamtip (fermented mixture)</i>		
	Adi, Nyshing, and Mishmi tribes	<i>Opo</i>	Rice	<i>Pee</i>		Shrivastava et al., 2012; Nath et al., 2019
	Monpa tribes	<i>Mingri, Lohpani, Bhang chang</i>	Finger millet, rice, maize, or barley	<i>Pham</i>		
	Hill miri tribes	<i>Mingri</i>	<i>Rice</i>	<i>Bokha</i>		Nath et al., 2019
	Apatani tribes	<i>Opo</i>	<i>Rice</i>	<i>Chu</i>		
	Monpa, Miji, Mishmi tribes	<i>Rakshi</i>	Finger millets, rice, barley grains	<i>Ipoh</i>		Shrivastava et al., 2012; Nath et al., 2019
	Deuri and Khampuri tribes	<i>Poka</i>	Cereals	<i>Si-ye</i>		Nath et al., 2019
	Singpho tribes	<i>Rice bear*</i>	Cereals	<i>Chho</i>		
	Nyshing tribes	<i>Rice bear*</i>	Cereals	<i>Paa</i>		
	Tagin tribe tribes	<i>Rice bear*</i>	Cereals	<i>Phab</i>		
	Lisu or Yobin tribes	<i>Rice bear*</i>	Cereals	<i>Aje</i>		
	Sulung tribes	<i>Rice bear*</i>	Cereals	<i>Epop</i>		Nath et al., 2019
	Nocte tribes	<i>Rice bear*</i>	Cereals	<i>Pee</i>		
Thangsa tribes	<i>Apong</i>	Cereals	<i>Ipoh</i>			
Adi Galos tribes	<i>Kala-apang, Ennog</i>	Rice	<i>Kshai</i>			
Monpa, Apatani, Nishi tribes	<i>Pona</i>	Rice	<i>Ipoh</i>		Chetia and Borgohain, 2020	
Adi Galos tribes	<i>Opo</i>	Rice	<i>Siyeh</i>			

(Continued)

TABLE 1 | Continued

State	Tribes/Community/Region	Ethnic Beverages	Substrate	Starter/Microbes	Health Benefits	Reference	
Assam	Mishings tribes	<i>Apong</i>	Rice	<i>Ipoh, Apop-pith</i>	Protection against cold	Tiwari and Mahanta, 2007; Kardong et al., 2012; Bhuyan and Baishya, 2013; Handique and Deka, 2016; Chetia and Borgohain, 2020	
	Ahom tribes	<i>Haj pani or Koloh pani or Xajpani</i>	Bora rice	<i>Vekur pitha</i>		Chakrabarty et al., 2009; Das and Deka, 2012; Handique and Deka, 2016, Bhuyan and Baishya, 2013; Chetia and Borgohain, 2020	
	Zemenaga tribes	<i>Dekuijao</i>	Sproutd rice grain	<i>Saccharomyces cerevisiae</i>	Chakrabarty et al., 2009; Das and Deka, 2012		
	Dimasa tribes	<i>Judina</i>	Rice	<i>Humao</i>	Deka and Sharma, 2010; Bhuyan and Baishya, 2013; Chetia and Borgohain, 2020		
	Rabha tribes	<i>Jonga Mod, Chako/phab</i>	Rice	<i>Bakhor, Surachi or Phap</i>			
	Sonowal tribes	<i>Rohi</i>	Rice	<i>Saoul pitha</i>			
	Deori tribes		<i>Sujen</i>	Rice	<i>Mod-pitha, Perokkushi</i>	Bhuyan and Baishya, 2013	Deori et al., 2007, Nath et al., 2019, Chetia and Borgohain, 2020
		Bodo tribes	<i>Jou bishi/Jumai</i>	Rice	<i>Angkur, Amao</i>		Bhuyan and Baishya, 2013; Chetia and Borgohain, 2020
Karbi tribes		<i>Hor-Alank, Horlang</i>	Rice	<i>Thap</i>	Teron, 2006, Bhuyan and Baishya, 2013; Chetia and Borgohain, 2020		
Manipur	Tankhul tribes	<i>Yu angouba</i>	Sticky rice	<i>Hamei</i>	Beneficial like milk	Devi and Kumar, 2012	
	Meitei tribes	<i>Atingba/Yu</i>	Rice	<i>Hamei</i>		Chetia and Borgohain, 2020	
	Tankhul tribes	<i>Atingba</i>	Rice	<i>Ham</i>	Protection against cold	Jeyaram et al., 2009; Devi and Kumar, 2012	
	Sherdukpen tribes	<i>Rice bear*</i>	Cereals	<i>Paa</i>		Nath et al., 2019	
Naga tribes	<i>Banana wine</i>	Ripe banana	-		Devi and Kumar, 2012		
Meghalaya	Pnar/Jaintias, Khasis tribes	<i>Kiad</i>	Red rice	<i>Thiat (Yeast)</i>		Samati and Begum, 2007; Chetia and Borgohain, 2020	

(Continued)

TABLE 1 | Continued

State	Tribes/Community/Region	Ethnic Beverages	Substrate	Starter/Microbes	Health Benefits	References
Nagaland	Garo tribes	Chu	Rice	Wansi		Chetia and Borgohain, 2020
	Angami tribes	Litchumasu/Peyazu, Zutho	Sprouted, glutinous rice	Piazu/Yei, Piazu		Das and Deka, 2012; Chetia and Borgohain, 2020
	Dimasa Kacharis	Zudima	Rice	Humao		Chetia and Borgohain, 2020
		Naga tribes	Zutho/Jadjiang, Duizou	Rice	Grist, Khekhri	
	Tripura	Kaiait tribes	Chuwak	Rice	Chuwan	Protection against cold
Jamatia tribes		Chuwak	Rice	Chuwan		
Debbarna tribes		Chuwak	Rice	Chuwan		
Molsom tribes		Rakju	Rice	Chuwan		
Tripuris tribes		Langi/Chuwak	Rice	Chuwan		Chetia and Borgohain, 2020

*The local name of the particular traditional alcoholic beverage is not available; thus, the common name is provided.

2007). Mana is a granular-type starter culture prepared from wheat flakes (Tamang, 2010a). Another ethnic starter is Ragi, which is prepared by rice or millet mixed with herbs and spices (Tamang, 2012). The mixture is mixed with water and 2–4% powder of old Ragi and mixed thoroughly. The prepared mixture is shaped into balls for fermentation (72 h at 23–25°C) in a humid environment. After sun drying, these starter balls are used to prepare alcoholic beverages (Saono et al., 1974). Koji is another starter made with steamed rice. It is a mold starter that is prepared until mycelium growth in the fermentation process (Lotong, 1985; Tamang, 2010b). Dhehli is a herbal mixed starter used to prepare Sur or Sura beverage in Himachal Pradesh, India. It is prepared from 36 fresh herbs such as *Pistacia integerrima*, *Solanum canthocamptid*, *Clitoria ternatea*, *Aegle marmelos*, *Viola cinerea*, and *C. sativa* collected from the forest by elderly people in an annual community effort (Thakur et al., 2004; Tamang, 2010a; Sharma, 2013; Joshi et al., 2015). The extract with plant biomass is added to roasted barley flour to prepare Dhehli (Thakur et al., 2004; Sharma, 2013). Phab is another traditional starter used in Ladakh and the hilly areas of Himachal Pradesh (Thakur et al., 2004; Tamang, 2010b). It is used to prepare Chhang. Phab is prepared using roasted barley with black pepper, dried ginger, crushed paddy, wild herbs, and earlier made Phab starter. Marcha is another known starter used in Darjeeling hills and Sikkim in India (Tamang et al., 1988, 2010; Dung et al., 2006; Bhuyan and Baishya, 2013). It is prepared by crushing soaked glutinous rice. Plant parts, e.g., *Plumbago zeylanica*, *Buddleja asiatica*, and *Vernonia cinerea*, along with old starter powder, were also added to it (Tamang et al., 1988; Thapa, 2002; Tsuyoshi et al., 2005). Hamei is a rice-based starter of northeast hilly areas of India. It is prepared by mixing *Albizia myriophylla* in soaked rice and a pinch of old Hamei (Jeyaram et al., 2009; Tamang, 2010b; Tamang et al., 2010).

PREPARATION OF SOME POPULAR ALCOHOLIC BEVERAGES

The preparation of alcoholic beverages is very common in tribal communities of IHR. They use different types of starters (described above) to prepare a variety of alcoholic beverages. Jann is a traditional beverage made from rice, wheat, jau, etc. (Roy et al., 2004). It is prepared and consumed by the Bhotiya community of Uttarakhand state in India. High-quality Jann is made from local millet koni (*Setaria italica*). The quality of Jann is judged by its taste (sweetness), smell, and strength. Generally, it is known for low alcohol concentration. The preparation of Jann is very common and prepared by the community efforts (Roy et al., 2004). Tribes of Uttarakhand and Himachal Pradesh (both are hill state of the IHR) also prepare a local alcoholic beverage Sur (30–40% alcohol) using cereals and fruits (Rana et al., 2004; Sharma, 2013). Tribes of these regions consume Sur to tolerate adverse climatic conditions. They also consume Sur at family functions and festivals. Chhang is a popular indigenous alcoholic beverage that is also called Jhol and Chakti. Tribes of Lahaul and Spiti, Kullu, and Kangra prepare this ethnic beverage by a solid-state fermentation process using the sherokh (huskless) variety of

TABLE 2 | List of plant species used to prepare some popular starter cultures in the Indian Himalayan Region.

State (Tribe/Region)	Tribes/Community/Region	Starter/Microbes	Medicinal Herbs	References
Ladakh	Bhoto community	<i>Phab</i> (Yeast)	<i>Artemisia</i> sp.	Angmo and Bhalla, 2014
Himachal Pradesh	Lahul and Spiti, Kannaur, Kangra region	<i>Phab</i> (Yeast)	<i>Artemisia</i> sp.	
	Mandi region	<i>Dhaeli</i> or <i>Dhehli</i>	<i>Varbascum thapsus</i> , <i>Bistorta amplexicaule</i> , <i>Viburnum grandifolia</i> , <i>Impatiens recemosa/sulcata</i> , <i>Arisaema</i> sp., <i>Arisaema tortuosum</i> , <i>Ajuga brevifolia</i> , <i>Ajuga bractiosa</i> , <i>Viola canescens</i> , <i>Morus seratta</i> , <i>Cuscuta europiana</i> , <i>Cannabis sativa</i> , <i>Solanum pseudocapsium</i>	Joshi et al., 2015
	Kullu region	<i>Dhaeli</i> or <i>Dhehli</i>	<i>Varbascum thapsus</i> , <i>Bupleurum lanceolatum</i> / <i>Valeriana jatamansi</i> , <i>Cannabis sativa</i>	
	Kangra region	<i>Dhaeli</i> or <i>Dhehli</i>	<i>Swertia chirayata</i> , <i>Selinum tenuifolium</i> , <i>Silene griffithii</i> , <i>Polygonum allatum</i> , <i>Polygonum</i> sp., <i>Centella asiatica</i> , <i>Picrorhiza kurrooa</i> , <i>Varbascum thapsu</i>	
	Lug valley of Kullu region	<i>Dhaeli</i> or <i>Dhehli</i>	<i>Pistacia integerima</i> , <i>Solanum xanthocarpum</i> , <i>Clitoria ternatea</i> , <i>Aegel marmelos</i> , <i>Viola cinerea</i> , <i>Cannabis sativa</i> , <i>Trachyspermum copticum</i> , <i>Micromeria biflora</i> , <i>Spiranthes australis</i> , <i>Saussurea</i> sp., <i>Bupleurum lanceolatum</i> , <i>Drosera lunata</i> , <i>Salvia</i> sp., <i>Arisaema helleborifolium</i> , <i>Fragaria</i> sp.	Thakur et al., 2004
Uttarakhand	Bhotiya tribes	<i>Balam</i> (Yeast)	<i>Cinnamomum zeylanicum</i> , <i>Ammomum subulatum</i> , <i>Piper longum</i> , <i>Ficus religiosa</i>	Das and Pandey, 2007; Sekar and Mariappan, 2007
	Janusari community	<i>Keem</i>	<i>Cannabis sativa</i> , <i>Sapindus mukorossi</i> , <i>Melia azedarach</i> , <i>Zanthoxylum armatum</i> , <i>Leucas lanata</i> , <i>Dicliptera roxburghiana</i>	Sekar and Mariappan, 2007
Sikkim and Darjeeling	Nepalese, Tibetan, Gorkha community	<i>Marcha</i>	<i>Plumbago zeylanica</i> , <i>Buddleja asiatica</i> , <i>Vernonia cinerea</i> , <i>Zingiber officinale</i>	Tamang et al., 2012; Nath et al., 2019
	All tribes	<i>Ranu Dabai</i>	<i>Coccinia grandis</i> , <i>Vernonia cinerea</i> , <i>Clerodendrum viscosum</i> , <i>Plumbago zeylanica</i> , <i>Stephania japonica</i> , <i>Stephania glabra</i> , <i>Oroxylum indicum</i> , <i>Mussaenda roxburghii</i> , <i>Scoparia dulcis</i> , <i>Rauwolfia serpentina</i> , <i>Artocarpus heterophyllus</i> , <i>Wattakaka volubilis</i>	Sekar and Mariappan, 2007
Arunachal Pradesh	All tribes	<i>Ipoh</i>	<i>Cinnamomum glanduliferum</i> , <i>Cissampelos pareira</i> , <i>Cynadon dactylon</i> , <i>Leucas aspera</i> , <i>Lygodium salicifolium</i> , <i>Piper betle</i> , <i>Scoparia dulcis</i> , <i>Veronica cinera</i>	Greeshma et al., 2006
	Adi, Nyshing, and Mishmi tribes	<i>Pee</i>	<i>Clerodendrum indicum</i> , <i>Cissampelos</i>	Nath et al., 2019
	Monpa tribes	<i>Pham</i>	<i>Solanum khasianum</i>	
	Hill miri tribes	<i>Bokha</i>	<i>Cinnamomum glanduliferum</i> , <i>Solanum nigrum</i>	
	Apatani tribes	<i>Chu</i>	<i>Solanum khasianum</i>	
	Thangsa tribes	<i>Ipoh</i>	<i>Scoparia dulcis</i> , <i>Leucas lanata</i>	
	Deuri and Khampuri tribes	<i>Si-ye</i>	<i>Leucas aspera</i> , <i>Piper betle</i>	
	Singpho tribes	<i>Chho</i>	<i>Piper longum</i> , <i>Scoparia dulcis</i>	
	Nyshing tribes	<i>Paa</i>	<i>Cissampelos pareira</i> , <i>Clerodendron viscosum</i>	
	Tagin tribes	<i>Phab</i>	<i>Cinnamomum glanduliferum</i>	
	Lisu or Yobin tribes	<i>Aje</i>	<i>Albizia myriophylla</i>	
	Sulung tribes	<i>Epop</i>	<i>Veronia cinerea</i> , <i>Amomum aromaticum</i>	
	Nocte tribes	<i>Pee</i>	<i>Piper betle</i>	
	Miji tribes	<i>Ipoh</i>	<i>Artocarpus lakoocha</i> , <i>Mangifera indica</i>	
	Assam	Mishing tribes	<i>Ipoh</i>	<i>Scoparia dulcis</i> , <i>Amblovenatum opulentum</i> , <i>Justicia adhatoda</i> , <i>Zanthoxylum nitidum</i> , <i>Phlogacanthus thyrsiflorus</i> , <i>Centella asiatica</i> , <i>Andrographis paniculata</i> , <i>Cheilocostus speciosus</i> , <i>Piper nigrum</i> , <i>Selaginella</i> sp., <i>Piper longum</i> , <i>Naravelia zeylanica</i> , <i>Solena amplexicaulis</i>

(Continued)

TABLE 2 | Continued

State (Tribe/Region)	Tribes/Community/Region	Starter/Microbes	Medicinal Herbs	References
	Karbi tribes	<i>Thap</i>	<i>Croton joufra</i> , <i>Amomum corynostachyum</i> , <i>Acacia pennata</i> , <i>Artocarpus heterophyllu</i> , <i>Oryza sativa</i> , <i>Phlogacanthus thyrsoiflorus</i> , <i>Solanum torvum</i>	Teron, 2006; Bhuyan and Baishya, 2013
	Ahom tribes	<i>Vekur paitha</i>	<i>Centella asiatica</i> , <i>Cinnamomum bejolghota</i> , <i>Cissampelos pareira</i> , <i>Clerodendrum viscosum</i> , <i>Croton caudatus</i> , <i>Hydrocotyle sibthorpioides</i> , <i>Lygodium flexuosum</i> , <i>Naravelia zeylanica</i> , <i>Oryza sativa</i> , <i>Pteridium aquilinum</i> , <i>Piper nigrum</i> , <i>Sida rhombifolia</i> , <i>Smilax perfoliata</i>	Bhuyan and Baishya, 2013
	Mishing tribes	<i>Apop-pitha</i>	<i>Ananas comosus</i> , <i>Artocarpus heterophyllus</i> , <i>Adhatoda vasica</i> , <i>Actinodaphne obovata</i> , <i>Cinnamomum tamala</i> , <i>Costus speciosus</i> , <i>Centella asiatica</i> , <i>Drymeria cordata</i> , <i>Hydrocotyl rotundifolia</i> , <i>Hydrocotyle sibthorpioides</i> , <i>Lygodium flexuosum</i> , <i>Lygodium japonicum</i> , <i>Melothrea heterophylla</i> , <i>Naravelia zeylavica</i> , <i>Oldenlandia corymbosa</i> , <i>Oryza sativa</i> , <i>Piper longum</i> , <i>Piper nigrum</i> , <i>Phogocanthus thyrsoiflorus</i> , <i>Pteridium aquilinum</i> , <i>Scoparia dulcis</i> , <i>Selaginella</i> sp., <i>Swertia chirata</i> , <i>Saccharum officinarum</i> , <i>Vitex negundo</i> , <i>Zanthoxylum hemiltonian</i>	Kardong et al., 2012
	Rabha tribes	<i>Bakhor</i> , <i>Surachi</i> or <i>Phap</i>	<i>Ananas comosus</i> , <i>Artocarpus heterophyllus</i> , <i>Calotropis gigantean</i> , <i>Capsicum frutescens</i> , <i>Cleodendrum viscosum</i> , <i>Dennstaedtia scabra</i> , <i>Ochthochloa coracana</i> , <i>Plumbago indica</i> , <i>Saccharum officinarum</i> , <i>Scoparia dulcis</i> , <i>Sida rhombifolia</i>	Deka and Sharma, 2010; Bhuyan and Baishya, 2013
	Bodo tribes	<i>Angkur</i>	<i>Clerodendrum viscosum</i> , <i>Oryza sativa</i> , <i>Scoparia dulcis</i> , <i>Xanthium strumarium</i>	Bhuyan and Baishya, 2013
	Sonowal tribes	<i>Saoul pitha</i>	<i>Centella asiatica</i> , <i>Clerodendrum viscosum</i> , <i>Corchorus olitorius</i> , <i>Naravelia zeylanica</i> , <i>Oryza sativa</i> , <i>Pteridium aquilinum</i> , <i>Sida rhombifolia</i>	Bhuyan and Baishya, 2013
	Deori tribes	<i>Mod Pitha</i>	<i>Allium sativum</i> , <i>Artocarpus hererophyllus</i> , <i>Ananus comosus</i> , <i>Alpinia malaccensis</i> , <i>Alternanthera sessilis</i> , <i>Capsicum annum</i> , <i>Cinnamomum bejolghota</i> , <i>Centella asiatica</i> , <i>Coffea bengalensis</i> , <i>Costus speciosus</i> , <i>Cyprus</i> sp., <i>Desmodium</i> sp., <i>Desmodium pulchellum</i> , <i>Equisetum</i> sp., <i>Lygodium flexuosum</i> , <i>Melastoma malabathricum</i> , <i>Mussaenda roxburghii</i> , <i>Myxopyrum smilacifolium</i> , <i>Naravelia zeylanica</i> , <i>Oryza sativa</i> , <i>Psidium guajava</i> , <i>Pothos scandens</i> , <i>Pteridium aquilinum</i> , <i>Pycnarrhena pleniflora</i> , <i>Rubus</i> sp., <i>Saccharum officinarum</i> , <i>Selaginella semicordata</i> , <i>Scoparia dulcis</i> , <i>Solanum torvum</i> , <i>Thunbergia grandiflora</i> , <i>Zanthoxylum oxyphyllum</i> , <i>Zingiber officinale</i>	Deori et al., 2007
Manipur	Tankhul tribes	<i>Hamei</i>	<i>Albizia myriophylla</i>	Jeyaram et al., 2009
	Sherdukpen tribes	<i>Paa</i>	<i>Buddleia macrostachya</i> , <i>Plumbago zeylanica</i>	Nath et al., 2019
Meghalaya	Pnar tribes	<i>Thiat</i>	<i>Amomum aromaticum</i> , <i>Musa paradisiaca</i>	Samati and Begum, 2007
Tripura	Kalai tribes	<i>Chuwan</i>	<i>Dysoxylum blume</i> , <i>Litsea monopetala</i> , <i>Moringa oleifera</i> , <i>Saccharum officinarum</i>	Ghosh et al., 2016
	Jamatia tribes	<i>Chuwan</i>	<i>Ananas comosus</i> , <i>Casearia aculeate</i> , <i>Dysoxylum</i> , <i>Markhamia stipulate</i>	
	Debbarma tribes	<i>Chuwan</i>	<i>Allophyllus serrarus</i> , <i>Ananas comosus</i> , <i>Aporusa diocia</i> , <i>Combretum indicum</i> , <i>Cirtus sinensis</i> , <i>Markhamia stipulate</i>	
	Molsom tribes	<i>Chuwan</i>	<i>Artocarpus heterophyllus</i> , <i>Litsea monopetala</i> , <i>Markhamia stipulate</i> , <i>Nyctanthes arbor-tristis</i>	

barley locally called grim (Thakur et al., 2004; Targais et al., 2012). It is presented to visitors, priests, and even deities during every social gathering like childbirth, marriage, or other celebrations. Chhang is known to provide energy and refreshment (Targais et al., 2012). All these alcoholic beverages are prepared by women tribes at the family level. After preparation, beverages are carefully tested and evaluated by older ladies of the family or community.

FERMENTATION

Fermentation is a microbiological process. The knowledge of microbial activities or fermentation is hardly recognized by indigenous people. Fermentation takes place when raw materials are mixed with starter culture and kept in a closed container. Starter cultures are nothing but inoculums containing microorganisms that are required to initiate the fermentation process. A schematic diagram has been presented (**Supplementary Figure 2**) to show the fermentation steps involved in ethanol production from cereal grains and microorganisms associated with it. These microorganisms could be present in the environment, raw materials, or the utensils used to prepare the drink. The selection of the microorganism depends on adaptation to the substrate and the fermentation conditions (Tamang, 1998). Many research groups indicated that the fermentation process varies from 5 to 25 days based on the flavor, taste, temperature, and alcohol content (Kanwar et al., 2011; Tamang et al., 2015; Chetia and Borgohain, 2020). The fermentation processes are used to prepare alcoholic beverages in the Himalayan region, which experiences low temperatures; therefore, resilient microorganisms capable of surviving and performing fermentation at low temperature are used for the preparation of foods and/or beverages.

The Bhotiya community in the Himalayan regions of Uttarakhand uses the wheat-based starter culture Balam, which is known to have as many as 32 microbial isolates. They are dominated by *Bacillus* (two species) and yeasts (*Saccharomycopsis fibuligera*, *Kluyveromyces marxianus*, *Saccharomyces* sp.; Das and Pandey, 2007; Kumari et al., 2016). Previous studies by a group of researchers reported many yeasts, molds, bacteria, and fungi, viz., *Saccharomyces cerevisiae*, *S. fibuligera*, *Wickerhamomyces anomalus*, *Candida glabrata*, *K. marxianus*, *Meyerozyma* sp., and *Pichia* sp., among yeasts, and molds like *Aspergillus penicillioides* and *Rhizopus oryzae*. These studies were performed using culture-dependent approaches and have drawbacks if estimating total microbial communities. Therefore, with the advancement in sequencing technologies, especially Next-Generation Sequencing, it has become possible to look into the complete microbial community composition. Recent high-throughput sequencing analysis of different fermented foods revealed the presence of bacterial community, which depict phyla Proteobacteria, Firmicutes, and Actinobacteria and genera *Leuconostoc*, *Lactobacillus*, *Acetobacter*, *Gluconacetobacter*, etc. Several studies also revealed the presence of fungal phyla Ascomycota and Zygomycota along with the genera *Saccharomyces*, *Zygosaccharomyces*, *Aspergillus*,

Aureobasidium, *Mucor*, *Candida*, etc., in traditional starter cultures (Thiat, Marcha, Phut, Humao, Chowan, etc.) used by indigenous people of the Indian Himalayas (Thakur et al., 2004; Sha et al., 2017).

During the preparation of the starter, microorganisms could be added in the form of old starter powder or may be present already in the raw material as indigenous microbiota. These microorganisms have been found beneficial for health (Tamang et al., 2015). The health benefits of *Saccharomyces* sp., *Lactobacillus*, and *Bacillus* are recently well documented and considered as potential probiotic candidates. Studies on the genes responsible for the probiotic properties have been performed on the starter cultures and fermented foods to document the role of microbes in probiotic properties in ethnic foods (Das and Pandey, 2007; Kumari et al., 2016; Syed et al., 2020; Elkhalfifa et al., 2021). Microorganisms present in these starter cultures are also known to be responsible for suppressing pathogenic population, carbohydrate metabolism, protein metabolism, etc. (Jani and Sharma, 2021). Additionally, microorganisms associated with these foods are also known for the production of several enzymes, flavoring substances, vitamins, etc., which are used in the fermentation industry for commercial purposes (Tamang et al., 2015).

CULTURAL SIGNIFICANCE OF ETHNIC BEVERAGES

Fermented foods and beverages have a strong connection with the socio-cultural lives of the various ethnic groups of the country. Traditional alcoholic beverages are not only a refreshing drink but also an integral part of the social and cultural occasions of the tribal communities in IHR in various ways (Tamang et al., 2010). These beverages are served in various functions such as wedding ceremonies, crop harvesting celebrations, offerings to traditional Gods, worshipping rituals, and death commemorations of loved ones to express togetherness, unity, joy, and sorrow. These beverages also related to the origin, habitat, religion, and overall life of tribes; therefore, they regard these ethnic beverages as their cultural heritage (Jeyaram et al., 2009; Ghosh et al., 2016). However, there is no such large-scale production unit or industry that can be seen based on a local alcoholic beverage in this region. It is only confined to each ethnic group or community of the respective state, especially women who are associated with preparing these beverages. New Year celebration and farm activities are one of the major events of tribes of Himachal Pradesh and Ladakh. They prepare Chhang, which is a traditional alcoholic beverage of Buddhists of Laddak (also described in the *Diversity and preparation of traditional alcoholic beverages* section). Judima is another traditional alcoholic beverage that is very intimately related to the ritual of Dimasa tribes. Freshly prepared Judima is offered to family gods and goddesses during religious occasions, marriage ceremonies, and festivals (Chakrabarty et al., 2009). Tribes also believe that a drop of Judima to a newborn baby will be helpful for good health and also protect the baby from any evil force (Chakrabarty et al., 2009).

Traditional alcoholic beverages consumed by the local tribes in the Himalayan region not only are related to rituals and occasions but also are known to provide increased nutrition such as proteins, vitamins, added minerals, phytochemicals, phytosterols, and dietary fibers to the consumer (Vijayendra and Halami, 2015). Tribal people used to drink these alcoholic beverages mostly in the morning before having breakfast, for health benefits. Alcoholic beverages have also discussed “Ayurveda” for their medicinal importance. Several workers have reported the health benefits of traditional alcoholic beverages such as rice beer, which has been found to be effective in diarrhea and urinary problems, headache, body ache, inflammation, worms treatment, etc. (Samati and Begum, 2007; Deka and Sharma, 2010).

In the tribal community, most of the people are very much hooked to rice beer and sometimes do not realize the harmful effects of these beverages. Tribes of IHR usually believe that traditional alcoholic beverages help reduce diseases and generate energy in the body to tolerate the very low temperature of hilly areas. Due to this belief, tribes drink alcoholic beverages very frequently (Seale et al., 2002). Tribes of IHR start alcohol consumption at an early age, mostly in the teenage years, and become addicted to alcohol. In most regions, beverage consumption is very common among all family members except infants. It is regularly consumed by all male members and elder women. Young male members (16–30 years) consume ~4–5 glasses per day. However, young women used to consume it at weekly intervals or during occasions (Shrivastava et al., 2012). Gradually, such young generation of tribes have become highly addicted to alcohol, and sometimes, this habit ruins their life and livelihood. It is well known and studied that consumption of traditional alcoholic beverages in small amounts is good for the health but frequent intake of alcohol badly affects the body and leads to health problems (Luu et al., 2014). According to Luu et al. (2014), the level of risk associated with traditional beverage varies from low-risk (family and neighbors) to high-risk (by an agent) distribution. Furthermore, dilution, adulteration, and waste release increase the chances of health risk, which is related to direct consumption as well as associated local air pollution, water pollution, and bad public behavior. Therefore, awareness programs for tribal people in India is a necessity of the current scenario.

DISCUSSION AND PROSPECTS

The preparation and consumption of indigenous alcoholic drinks have been known for centuries. All tribal communities in the IHR prepare their specific beverage for livelihood. The local brews or traditional alcoholic beverages also play a very significant role in the cultural and traditional aspects of tribal people residing in a particular part of the country. Besides having tremendous nutritional properties, viz., proteins, carbohydrates, ash, crude fiber, and macro- and micronutrients, ethnic beverages also have many beneficial microflorae, which may exert health benefits such as probiotics, especially those that are consumed as an undistilled drink like rice beer (Tamang et al., 2012, 2015).

It is well known that tribes use many plant species that have medicinal properties to prepare traditional rice beer, which helps

to reduce the toxic effect of traditional drinks (Samati and Begum, 2007; Deka and Sharma, 2010). Tribes used these traditional beverages, e.g., rice beer, for treating fever, colds and cough, body ache, etc. Tribal women used these alcoholic beverages to treat menstruation problems (Darby, 1979; Campbell-Platt, 1994; Steinkraus, 1996; Samati and Begum, 2007; Tamang and Fleet, 2009; Deka and Sharma, 2010). Tribes collect medicinal plants directly from their natural habitat for the preparation of ethnic drinks. Due to uncontrolled collection from the natural habitat and rapid urbanization, these plant species (which are used in the preparation of traditional beverages) will be depleted. Therefore, the quality, taste, and medicinal properties of traditional drinks are compromised seriously. However, medicinal properties of traditional alcoholic beverages have been documented by several workers (Darby, 1979; Campbell-Platt, 1994; Steinkraus, 1996; Tamang and Fleet, 2009); until now, very limited studies have been carried out to establish the medicinal properties of traditional alcoholic beverages. Therefore, it is required to urgently carry out the work that elaborates the nutritional and medicinal aspects of traditional alcoholic beverages.

Documentation of the fermentation process and plant species used for the production of traditional alcoholic beverages is not adequately addressed by the scientific community. Only limited and fragmented pieces of literature are available regarding the production of traditional beverages, especially in the Himalayan region. The plant parts used by tribal communities and sanitary conditions during preparation regulate the quality of the starter culture, alcohol content, and overall quality of the drink (Basumatary et al., 2014; Nath et al., 2019). Sometimes, contamination or toxicities found in prepared drinks become lethal to the community, and due to the lack of knowledge about the facts, tribal people start blaming the person who was involved in the preparation of the beverage. It has also been reported that the indigenous microorganisms (yeast strains) involved in fermentation processes during the alcoholic beverage preparation lose their effectiveness due to the use of inorganically grown substrate, i.e., rice, over the polluted areas (Kumari et al., 2016). Therefore, scientific studies are required to urgently establish the knowledge about the microorganisms (potential isolates) used in the fermentation process of ethnic alcoholic beverages so that harvesting can be done effectively. Also, it should be noted that reduction in the manufacturing of ethnic alcoholic beverages for daily use has been observed due to economic and legal bindings. Moreover, due to lack of interest and ignorance of traditional values of the young generation, there is a constant decrease in traditional knowledge. This has created a gap leading to the lack of knowledgeable and experienced people among the tribal communities.

Scientific studies may be helpful to reveal some new scope for value addition in traditionally prepared alcoholic beverages, and of course, application of modern science could be incorporated for improvement, wherever it is required (Syed et al., 2021). It is necessary to also conserve traditional alcoholic beverages and culture. As already discussed, these alcoholic beverages are enriched with some nutritional and medicinal properties, and there is a scope of improvement and drug development using biotechnological, medicinal, and food and nutrition-based research that will

be helpful for the commercialization of traditional alcoholic beverages (Sekar and Mariappan, 2007).

CONCLUSION

The socio-cultural life in the IHR is associated with the people of various ethnic origins, languages, faith, and traditional practices. These ethnic origins and traditional practices give rise to some unique food habits such as fermented food and beverages. The tribal communities prepare these ethnic beverages by a fermentation process and consumed them in almost every family or social gatherings. Preparations of these alcoholic drinks are well mingled with the cultural and indigenous healthcare systems of these tribes. These alcoholic beverages are enriched with many nutritional components like vitamins and proteins. Phytochemical and ethnobotanical studies have also revealed that traditional alcoholic beverages have a medicinal property to cure various diseases and have healing capacity. Based on available literature, it can be concluded that traditional alcoholic beverages play a very important role in preserving the long-standing traditions of tribes. Therefore, documentation of traditional culture is a prime necessity, which will be a valid way to conserve the ancient heritage of traditional alcoholic beverages for the future. It will be helpful to transfer this knowledge or technique from one generation to another.

Furthermore, there is an urgent need to work on the value addition (nutritional value) of these ethnic beverages by research on method improvement, microorganisms selection, raw material improvement genetic improvement, etc., which may suggest the due market value of traditional alcoholic beverages and lead to their industrialization. Such initiatives might be advantageous for mankind and the economic sustainability of the tribal communities.

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AUTHOR CONTRIBUTIONS

BR and JR: manuscript design and final manuscript writing and revision. SP, PD, and JR: data collection. BR, SP, and PD: data analysis. BR, JR, and PD: data interpretation. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fsufs.2021.672411/full#supplementary-material>

Supplementary Figure 1 | Percentage of various cereals used by the tribal communities for the preparation of alcoholic beverages.

Supplementary Figure 2 | Schematic diagram depicting different stages of fermented beverage production.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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