

## An overview of traditional rice beer of North-east India: ethnic preparation, challenges and prospects

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Fermented drinks are always found to be connected with the culture and existence of the ethnic tribes throughout the world. Traditional rice beer of North-east India is an indispensable part of tribal life style attached culturally and religiously with them. There are more than 150 major tribes in Northeast India and almost all are having a traditional way of preparing rice beer from time immemorial. The present paper is a comparative review on the methods of preparing rice beer by some popular tribes of Northeastern India. The methodology they use is found to be unique in many senses from rest of the world. The uniqueness not only lies in the starter culture preparation, which is the prime source of yeast but also in the other ingredients like indigenous plant species and rice varieties used as substrate resulting variation in taste and aroma. Almost all the traditional rice beer has unique soothing taste, aroma, colour and nutritional as well as therapeutic values having significant role in their socio cultural lives. In the present scenario the tradition is fading and facing lots of challenges. But, still the traditional rice beer has got lots of scope for its scientific up-gradation and commercialization.

**Keywords:** Alcoholic beverage, Ethnic tribes, North-east India, Traditional brewing, Yeast

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The North-east India can be physiographically categorized into North-east hills, Brahmaputra and Barak valley plains and Eastern Himalayas. This region is having very remarkable climate with mostly humid, sub-tropical with hot summer. Moreover, it also has severe monsoons and mild winter<sup>1</sup>. This region is consisting of eight different states namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. The North-east India is inhabited by many ethnic tribes having diverse customs and lifestyles with difference in their preparation and consumption of fermented rice beer<sup>2</sup>. The occurrence of ethnic rice beer preparation and its varieties in consumption might have emerged due to varied climatic conditions and utilization of locally available natural resources<sup>3</sup>. Each tribe has their own age old traditional rituals and believes and they follow the same while preparing the starter cultures and fermentation of rice beer. The methodology of starter cake preparation and time of incubation for batch culture of rice beer are significantly different among the tribes. However, it varies from one week to three months. There is variation not only in preparation but

also in the serving procedure and serving protocol. Moreover, variations are also been observed even in serving bowls and dishes for consuming the rice beer tradition wise (bamboo receptacle, bamboo pipe, mud utensils, banana leaf etc).

The processes of preparation of rice beer begin with the making of starter culture for fermentation. Starter culture are traditionally made and preserved in a semi sterilized medium. Usually a gluten ground rice of local variety mixed with a number of plant parts having medicinal properties to make the starter cake<sup>2</sup>. The methodologies of fermentation followed by different tribes of these areas are not similar in many respects. Local rice varieties used as substrate for the preparation of starter cakes along with some local plant and ingredients owes different appearance, taste and aroma along with medicinal properties<sup>4</sup>. The starter cakes are the source of amyolytic enzymes, starch degrading moulds, lactic acid bacteria and alcohol producing yeasts<sup>5</sup>. Several microbes have been isolated like *Mucor circinelloides*, *Rhus chinensis*, *Saccharomycopsis fibuligera*, *Saccharomycopsis capsularis* and *Pichia burtonii* having amyolytic properties. Many ethanol producing bacteria also have been isolated like

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*Saccharomyces bayanus*, *Corchorus glabrata* and *Pichia anomala*<sup>6,7</sup> along with lactic acid bacteria like- *Lactobacillus plantarum*, *Lactobacillus brevis* and *Pediococcus pentosaceus*<sup>8</sup>.

### Preparation of rice beer in different Northeast India at a glance

**Arunachal Pradesh:** The state of Arunachal Pradesh was established on February 1987, having 20 districts, the land area of the state is 83,743 km<sup>2</sup> and having 110 local ethnic communities<sup>9</sup>. Geographically, this is the largest state among all the North-eastern states of India. The people native to the state traces their origins from the Tibeto-Burman people. The climatic condition is humid and subtropical with sufficient rainfall. Kala-Apang is a traditional alcoholic beverage prepared by Adi Galos tribe of Arunachal Pradesh. The starter culture is known as Kshai. For preparing Apang, first they burnt the rice husk till it become black in color. Then boiled rice is spread on a bamboo mat called Peche and burnt rice husk is mixed with it in 1:1 ratio. Kshai powder is mixed with and put it in a big container covers with locally available oko leaves (*Phrynium pubinerve*) and kept it for 20 days for fermentation. Perpur, a bamboo made funnel is used for filtration and oko leaves is used as filter<sup>2</sup>.

Ennog is another traditional black rice beer prepared by almost every Adi Galo tribal household for regular use. Ennog is also used in religious ceremonies and festivals. It is often sold in local market. For Ennog preparation rice is cooked and mixed with burn husk and kept for 4-5 days for fermentation. After fermentation extract are consumed directly as black beer.

**Assam:** The state of Brahmaputra valley and hills and plains (Assam) established in 1972, having 32 districts and a total land area of 78,438 km<sup>2</sup> having two categories of tribal population, ST (Hills) and ST (Plains) together having approx more than 20 major tribes in total. Assam is the second largest state of North-eastern region of India. The geographical location and climatic conditions of this state supports the practice of traditional brewing among different ethnic groups of Assam. The procedure of preparation of rice beer and associated starter culture is almost same among different tribes, but the plant materials used to prepare starter culture is different. Some of the major tribes of Assam are Boro, Karbi, Deori, Ahom, Rabha, Mising and Sonowal<sup>10</sup>.

Jou bishi/Jumai, a rice beer prepare by Boro tribe of Assam. The starter culture which they used to prepare Jou is locally known as Angkur. First the rice is boiled and cooled and then kept for dried up. Angkur is added to it and kept it for whole night. The mixture is kept in an earthen pot after adding a little amount of water at least for 3 to 4 days for fermentation. After fermentation, the mass is mixed with water and filtered to get the liquor<sup>2</sup>.

Hor-Alank is a traditional rice beer of Karbi tribe of Assam. They prepare Hor-Alank by fermenting cooked rice and are mixed with locally prepared yeast cake powder called Thap. The distilled Hor-Alank is called Hor-Arak. The starter culture Thap is traditionally prepared by using leaves of Marthu (*Croton joufra Roxb.*) and water-soaked rice. Leaves of locally available plants like *Amomum corynostachyum* Wall, *Acacia pennata* Willd are also used in the preparation of starter culture. Cooked rice is spread on bamboo mat (Antar), cooling and mixed with adequate amount of powdered starter cake (Thap) and stored in Tebuk (pot) or Pho-le (cooking utensil). The mixture is then kept for fermentation for three days in summer and four days in winter. An adequate amount of water is added with fermented mass and allowed to remain for one more night (act of addition of water is called Hor Kangthur). Next day Hor arak (alcohol) is distilled from it<sup>11</sup>.

Sujen, a rice beer is prepared by Deori tribe and the starter culture they used is known as Mod-pitha. Mod-pitha is prepared by mixing rice powder with different powdered plant parts (Table 1) and an amount of previously made old Mod-pitha is added to it which acts as an inoculant. Cooked rice is mixed with powdered Mod pitha and spread on a bamboo mat and covered with banana leaves overnight. Next day the mixture is poured to a sterilized earthen pot (Koloh) and the mouth of the pot is wrapped tightly with a banana leaves and kept for fermentation for 3-4 days in summer and 1 week in winter. Meya (a profuse whitish froth) formed after fermentation. Sujen is filtered for consumption after adding water in to it<sup>12</sup>.

Jonga Mod, a rice beer prepared by Rabha tribe of Goalpara district of Assam. Starter culture for preparing Jonga mod is known as Bakhor, Surachi or Phap. Paste of soaked rice is mixed with some dry powdered plant species (Table 1) and an amount of old powdered rice cake is also mixed as inoculants into the mixture before preparing the cake. For preparation of Jonga mod rice is cooked and mixed

Table 1 — List of some indigenous plant species used to prepare rice beer by different tribes of Northeast India.

State	Tribe	Rice Beer	Starter culture	Plant used to prepare the Starter culture	Reference
Assam	Ahom	Sajpani & Laopani	Vekur pitha	<i>Centella asiatica</i> <i>Cinnamonum bejolghota</i> <i>Cissampelos pareira</i> <i>Cledendrum 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 <i>et al.</i> 2013
	Boro	Jou bishi	Angkur	<i>Clerodendrum viscosum</i> <i>Oryza sativa</i> <i>Scoparia dulcis</i> <i>Xanthium strumarium</i>	Bhuyan <i>et al.</i> 2013
	Deori	Sujen	Mod pitha	<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 sp.</i> <i>Desmodium sp.</i> <i>Desmodium pulchellum</i> <i>Equisetum sp.</i> <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 sp.</i> <i>Saccharam 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 <i>et al.</i> 2007
	Karbi	Hor	Thap	<i>Croton joufra</i> <i>Amomum corynostachyum</i> <i>Acacia pennata</i>	R Tendon, 2006

(contd.)

Table 1 — List of some indigenous plant species used to prepare rice beer by different tribes of Northeast India. (*contd.*)

State	Tribe	Rice Beer	Starter culture	Plant used to prepare the Starter culture	Reference
	Mising	Apong	Apop pitha	<i>Adhatoda vasica</i> <i>Actinodaphne obovata</i> <i>Costus speciosus</i> <i>Centella asiatica</i> <i>Hydrocotyl rotundifolia</i> <i>Lygodium japonicum</i> <i>Melothrea heterophylla</i> <i>Naravelia zeylavica</i> <i>Piper longum</i> <i>Piper nigrum</i> <i>Phogocanthus thyrsoiflorus</i> <i>Pteridium sp</i> <i>Scoparia dulcis</i> <i>Selaginella sp</i> <i>Swertia chirata</i> <i>Zanthoxylum hemiltonian</i>	Kardong <i>et al.</i> 2012
	Rabha	Junga Mod	Bakhor, Surachi or Phap.	<i>Ananas comosus</i> <i>Artocarpus heterophyllus</i> <i>Calotropis gigantean</i> <i>Capcicum 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>	Deka & Sharma 2010
	Sonowal	Rohi	Saoul pitha	<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 <i>et al.</i> 2013
Arunachal Pradesh	Thangsa	Apong	Ipoh	<i>Scoparia dulcis</i> Linn. <i>Leucas lanata</i> Benth	Shrivastava <i>et al.</i> 2008
	Adi, Nyshing & Mishmi	Opo	Pee	<i>Clerodendrum indicum</i> Linn. <i>Cissampelos pareira</i> Linn.	Shrivastava <i>et al.</i> 2008
	Monpa	Bunk chung/ bhang chang	Pham	<i>Solanum khasianum</i>	Shrivastava <i>et al.</i> 2008
	Deuri and Khampuri	Poka	Si-ye	<i>Leucas aspera</i> Spreng <i>Piper betle</i> Linn	Bora <i>et al.</i> 2012
	Apatani	Opo	Chu	<i>Solanum khasianum</i>	Shrivastava <i>et al.</i> 2008
	Miji	Rakshi	Ipoh	<i>Artocarpus lakoocha</i> Roxb. <i>Mangifera indica</i> Linn.	Shrivastava <i>et al.</i> 2008
	Hill miri	Mingri	Bokha	<i>Cinnamomum glanduliferum</i> Meissn <i>Solanum nigrum</i> Linn.	Shrivastava <i>et al.</i> 2008
	Nocte		Pee	<i>Piper betle</i> Linn	Shrivastava <i>et al.</i> 2008
	Singpho		Chho	<i>Piper longum</i> Linn <i>Scoparia dulcis</i> Linn	Shrivastava <i>et al.</i> 2008
	Sulung		Epop	<i>Veronia cinerea</i> Less <i>Amomum aromaticum</i> Roxb	Shrivastava <i>et al.</i> 2008

(*contd.*)

Table 1 — List of some indigenous plant species used to prepare rice beer by different tribes of Northeast India. (contd.)

State	Tribe	Rice Beer	Starter culture	Plant used to prepare the Starter culture	Reference
	Nyshing		Paa	<i>Cissampelos pareira</i> Linn <i>Clerodendron viscosum</i> Vent	Shrivastava <i>et al.</i> 2008
	Tagin tribe		Phab	<i>Cinnamomum glanduliferum</i> Meissn	Shrivastava <i>et al.</i> 2008
	Lisu or Yobin		Aje	<i>Albizia myriophylla</i> Benth	Shrivastava <i>et al.</i> 2008
Manipur	Sherdukpen		Paa	<i>Buddleia macrostachya</i> Benth <i>Plumbago zeylanica</i> Linn	Shrivastava <i>et al.</i> 2008
Meghalaya	Pnar	Kaid	Thiat	<i>Amomum aromaticum</i> <i>Musa paradisiaca</i>	Samati <i>et al.</i> 2007
	Garos	Bitchi			
	Khasi	U-Phandieng			Tanti <i>et al.</i> 2010
Nagaland	Naga	Zutho/ Ijadijang	Grist		Teramoto <i>et al.</i> 2002; Deka <i>et al.</i> 2010
	Angami	Litchumasu/ Peyazu	Piazu/ Yei		Das <i>et al.</i> 2012
Sikkim	Gorkha	Baati jhar	Marcha	<i>Plumbago zeylanica</i> <i>Buddleja asiatica</i> <i>Vernonia cinerea</i> <i>Zingiber officinale</i>	Tamang <i>et al.</i> 2012
	<u>Nepalese and Tibetan</u> people	Chhaang	Marcha	<i>Plumbago zeylanica</i> <i>Buddleja asiatica</i> <i>Vernonia cinerea</i> <i>Zingiber officinale</i>	Tamang <i>et al.</i> 2006
Tripura	Kalai	Chuwak	Chuwan	<i>Artocarpus heterophyllus</i> Lam. <i>Dysoxylum blume</i> <i>Litsea monopetala</i> (Wall) Seem <i>Moringa oleifera</i> Lam <i>Saccharum officinarum</i> L.	Ghosh <i>et al.</i> 2016
	Jamatia	Chuwak		<i>Ananas comosus</i> Mill <i>Casearia aculeate</i> Jacq <i>Dysoxylum</i> Blume <i>Markhamia stipulata</i> (Wall) Seem.	
	Debbarma	Chuwak		<i>Allophyllus serrarus</i> Kurz. <i>Ananas comosus</i> Mill <i>Aporusa diocia</i> (Roxb.) Muell <i>Combretum indicum</i> (L) DeFilipps <i>Cirtus sinensis</i> (L) Osbeck <i>Markhamia stipulata</i> (Wall) Seem.	
	Molsom	Rakju		<i>Artocarpus heterophyllus</i> Lam <i>Litsea monopetala</i> (Roxb.) Pers. <i>Markhamia stipulata</i> (Wall.) Seem <i>Nyctanthes arbor-tristis</i> L	

with the powdered rice cake, the final mixture is placed inside the Jonga (an earthen pitcher) and outside the Janthi (a special type of cylinder made of

bamboo net, which is placed inside the Jonga). Jonga is then warmed in fire after sealed the open area with banana leaf and kept at dark place (4-5 days in

summer and 7-8 days in winter). Rice beer is collected from Janthi where beer get accumulated using a receptacle made of dried shell of matured fruit of *Lagenaria siceraria* Standl. Again fermentation process is preceded for second time by adding adequate amount of water and rice cake, after 3-4 days rice beer is extracted and distilled through a traditional process using earthen or metallic pitcher-like pots placing one over another<sup>13</sup>.

Sajpani is prepared by Ahom tribe and the starter culture which they are used to prepare the rice beer is known as Vekur pitha. The traditional farmers of rural Ahom are been employing the techniques of preparing the Vekur pitha since centuries as part of their culture, where leaves of few wild plant species (Table 1) are used with rice powder as additive ingredients which act as medium for yeast growth<sup>14</sup>. Firstly, the Bora rice (sticky variety) is cooked and spread on plain bamboo plate, which is left often for 1 h. The cooled and dried rice is then mixed with powdered Vekur pitha which acts as fermenting agent, which is poured into a clay pot known as Kalah and kept in dark for 4-5 days. After 4-5 days of fermentation the concentrated alcoholic juices are collected through filtration process by using series of vessels<sup>15</sup>.

Apong is prepared by the Mising tribe and the starter culture of Apong is Apop pitha. For preparing Apop pitha, rice gains are soaked in water for 3-4 h. Different plant ingredients are washed properly and grinded together. Small amount of powdered old Apop pitha is added to it and the mixture is made oval shaped ball and allowed to dry. Cooked rice is cooled and mixed with Apop pitha is placed in an earthen pot. Earthen pot is sealed with banana leaves and smoked by placing it on bamboo frame assembled over the fire place until the pot turns blackish, after 4-5 days. Fermented mass is mixed with a small amount of water and filtered to get Apong<sup>16</sup>.

Rohi is prepared by Sonowal tribe of Assam and the starter culture of Rohi is known as Saoul pitha. Saoul pitha is prepared using rice gains which are saturated overnight in water. Several wild plant species are used as ingredients are washed properly mixed with powdered old Saoul pitha and grinded together to make the dough which is finally made into small balls and are then placed on banana leaves to dry for 3-5 days. For preparing rice beer (Rohi) half cooked rice is allowed to cool and produced Saoul pitha (starter culture) is added to it and mixed properly. The mixture is then kept in an earthen pot

covered with banana leaves for 3-4 days for fermentation. Finally, the Rohi is extracted from the fermented mass<sup>15</sup>.

**Manipur:** The state of Manipur is established in 1972 having 9 districts and a total land area of 22,327 km<sup>2</sup> having 33 recognized ST communities<sup>17</sup>. This state is bounded by Assam, Mizoram and Nagaland in west, south and north respectively and in east by international border of Burma. The ethnic tribe of Manipur has been preparing fermented rice beer from the time immemorial. 'Yu' is a traditional rice beer prepared by Meithei communities of Manipur. They use Hamei as starter culture. The powdered mass of pre-soaked rice (Yam) mixed with solution of filtrate dried bark of Yanglee (*Albizia myriophylla*) to prepare elliptical or flattened mass called Hamei. It is then placed over paddy husk or paddy straw and used only when alcoholic smell start coming from it. For the preparation of Yu, 5-6 kg of rice is cooked and placed in Phoura/Yangkok (earthen pot) and cooled under the dim light. Powdered Hamei is mixed with cooled rice and kept for fermentation by covering mouth with clean cloth. The pot is kept in sunlight for 3-4 days in summer. Whereas, in winter, the mixture is kept in a bamboo basket wrapped internally with various leaves and exposed directly in sunlight for 5-6 days for fermentation. After fermentation, the liquid is filtered adding water to it<sup>18</sup>.

**Meghalaya:** The state of Meghalaya is established in 1972 having 11 districts and total land area of 22,429 km<sup>2</sup> having 5 major tribes (Garo, Hajong, Khasi, Pnar and Tiwa or Lalung). The state is mountainous, with extend of valley and flat terrains. Kiad is traditional liquor and is prepared mostly by Pnar tribe of Meghalaya state. The methodology of preparation of Kiad consists of two parts including Thiat (yeast cake) preparation and Kiad brewing. Kiad is prepared by mixing of 4-5 kg of Kho-so (a local red rice) with Um-pohliw (spring water). It is then cooked in a vessel (Khiaw-heh) and taken out from the vessel after cooling. One or two balls of starter culture (Thiat cakes) are powdered and mixed with the cooled rice. The mixture is then placed in a Shang (cone shaped basket), which is externally covered with That (cloth) and kept for 2-3 days for fermentation. The fermented mixture is called Jyndem, from which yellowish white color beer locally known as Sadhiar is extracted. Kiad is prepared after distillation of fermented Jyndem in a

special layer of metallic vessels. Lower part is filled with mixture, upper part is filled with cooled water and middle part is kept hallow. Vapors are collected in middle part and get condensed to form liquid which is known as Kiad<sup>19</sup>.

**Nagaland:** The state of Nagaland is established in 1963, having 11 districts and a total land area of 16,579 km<sup>2</sup> having more than 35 tribal communities<sup>20</sup>. It has evergreen tropical and the sub-tropical forests having monsoon climate with high humidity levels. Zutho is a traditional rice beer is prepared by Naga tribes of Nagaland. The starter culture for Zutho is known as Grist. For preparation of Grist, unhulled glutinous rice grains are soaked in water for 3 days and drained and then allowed to germinate for 3-4 days in summer and for 1 week in winter. After growth the seeds are air dried and are pondered in mortar and pestle forming Grist. For preparing of Zutho, boiling water is mixed with rice powder and allowed to cool followed by mixing of one handful of the grist in summer time and two handfuls in winter. Fermentation is done in a wooden vessel for 2-3 days during summer and 6-7 days during winter. The raw extract Zutseh could be drink directly as strong beverage or some amount of water is added to it and strained through a bamboo basket which is called Zutho<sup>21</sup>.

**Sikkim:** The state of Sikkim (27.3300° N, 88.6200° E) established in 1975 having 4 districts and total land area of 7,096 km<sup>2</sup> having 3 major tribes (Lepcha, Bhutias and Nepalese)<sup>22</sup>. The state of Sikkim is characterized by mountainous terrain. Many ethnic tribes prepare and consume traditional alcoholic beverages known as Chhaang. Chhaang is prepare and consumed by Nepalese and Tibetan people, usually it served cold/normal temperature during summer. In winter, it is served as piping-hot in brass bowls or wooden mugs. Chhaang is prepared from cooked rice and mixed with Marcha (a ball-like amylolytic starter) and is kept left for fermentation for 2-3 days. Initially, this potion is called *Glum* and after fermentation, water is added and filtered for consumption.

Bhaati jaanr is a sweet tasted mild alcoholic traditional rice beer usually consumed in rural area of Darjeeling hills and Sikkim<sup>22</sup>. The starter culture of Bhaati jaanr is called Marcha prepared by mixture of different plant particles. For preparation of Bhaati jaanr, the glutinous rice is cooked about 15 min and cooled by spreading it on bamboo mat.

The powdered Marcha is mixed well with the cooled rice and kept in an earthen pot for saccharification<sup>7,8</sup>. The pot is then covered and kept for fermentation for 2-3 days during summer and 7-8 days during winter. The fermented mass is then turn into thick mass by stirring with the help of wooden hand-driven or bamboo made stirrer for direct consumption. It is sometime stored in earthen Crock for a week or more to get yellowish-white supernatant called Nigaar. Nigaar is consumed directly with or without the adding of water<sup>23</sup>.

**Tripura:** The state of Tripura (23.8400° N, 91.2800° E) established in 1972 having 8 districts and total land area of 10,491.69 km<sup>2</sup> having 12 major tribes (Chakma, Chaimal, Garo, Halam, Jamatia, Kuki, Lusai, Mog, Noatia, Reang Tripuri and Uchai). Several ethnic tribe practices preparation and consumption of indigenous rice beer from ancient time in Tripura. The methodology of preparing alcoholic beverage is almost same, but the plants materials used to prepare the starter culture differ from tribe to tribe. The tribal community prepares rice beer (Chuwak) regularly at home for their consumption following almost similar traditional process. During the preparation of Chuwak, the rice is cooked and cooled by spreading over a mat. The starter culture cake (Chuan beleb) is mixed with the cooled rice in a suitable amount and placed in a container called Batikasla which is covered by banana leaf and clean cloth. The mixture is then kept for fermentation for 3 days. Water is added on it and kept for another 2 days. Un-distilled raw beer is extracted from the mixture for consumption. For distillation, the fermented mass is heated up and the vapour is collected in a container called Batibakhrak which is placed over the Batikasla. The vapour from Batibakhrak is cooled and collected in another container for consumption as distilled beer called Chuwak<sup>24</sup>.

#### **An overview of phytochemical components and medicinal properties of locally made rice beer**

Diverse plants have been reported from different localities associated with the preparation of starter cultures by the different tribes of North-east India like *Albizia myriophylla* by the *Maitais* of Manipur<sup>18</sup>, *Amomum aromaticum* by the *Jaintias* of Meghalaya<sup>19</sup>, *Plumbago zeylanica*, *Buddleja asiatica*, *Vernonia cinerea* and *Zingiber officinale* from Sikkim<sup>7</sup>, *Glycyrrhiza glabra* by the *Dimasas* in Assam<sup>25</sup>, *Ananas comosus*, *Artocarpus heterophyllus*, *Calotropis gigantea*, *Capsicum frutescens* etc. by

the *Rabha* community of Assam<sup>13</sup>, etc. Fig. 1. The phytochemical components of these plant species either alone and/or in combination, have remarkable therapeutic potential in curing various diseases and abnormalities<sup>26</sup>. It is believed from the decade that the rice beer have tremendous impact on the health care system and provide better

health benefits by preventing and treating physiological disorders and gastrointestinal diseases. The rice beer was found to be effective against insomnia, headache, body ache and inflammation of body parts, diarrhea and urinary problems, expelling worms and as a treatment of cholera<sup>13,19</sup>.



Source: www.google.com





Fig. 1 — Photographs of Plants used in preparation of rice beer by different tribes of Northeast India

Researchers from various parts of North East India like Tripura University Department of Microbiology, College of Home Science's department of food and nutrition Jorhat, Assam Agricultural University and the Tamil Nadu-based Indian Institute of Crop Processing Technology have found nutritional as well as antioxidant activity in rice beer samples in the laboratory. The compounds are responsible like phenolic acids, polyphenols and flavonoids, etc. are known to inhibit the oxidative mechanism which are responsible for many disorders and diseases in humans such as infections, diabetes, arthritis, cardiovascular diseases, cancer, Alzheimer's diseases, AIDS, etc.

Method of preparation of rice beer differs not only region wise or state wise but even among the tribes within the same state. The indigenous knowledge for preparing alcohol is pass-on from one generation to next generation and plays very crucial roles in sociocultural setup which is well evident in their social gatherings, marriage rituals, festivals and condolences<sup>2,4</sup>. As traditional rice beer possesses good

nutritional and medicinal values, it may be beneficial for health related disorders of the consumers. The manufacturing units for rice beer preparations are traditionally designed which results in the compromised quality and standard. Therefore, it has got substantial scope of reorientation with scientific input with better manufacturing possibility for increasing its shelf life. Increase in shelf life may upsurge its potential for commercialization with added nutritional values and health benefits.

The traditional rice beer of North-east India has been documented and studied by different authors in the recent years. Teramoto *et al.* 2002 collected the fermented rice beer Zutho prepared by Naga tribe of Kohima district in Nagaland. After biochemical and microbial characterization they reported *Saccharomyces cerevisiae* as the main yeast in Zutho. They estimated the percentage of volatile ester, ethanol, higher alcohol such as ethyl-acetate, 3-methyl butanol using gas chromatography. Further, they analyzed the rice beer and found it to have an aroma similar to Japanese sake and also suggested that the

Zutho made with sprouted rice grain in Nagaland is a traditional form similar to European beers made with malt and Asian alcoholic beverages made with microbial starter such as Koji.

The starter culture Thap which is used by the Karbi tribe to prepare rice beer Hor is a potential yeast medium since immemorial. Teron, 2006 studied an age old tradition of Karbi tribe of Assam to preparation and consumption of fermented rice beer Hor-Alank. He also reported the preparation of starter culture Thap contains yeast to carry out the fermentation. Thap is traditionally prepared from leaves of Marthu (*Croton joufra*) and water soaked rice. To the sticky powdered rice mass some amount of previously prepared old yeast cake called Thap Aphi is mixed, and the mixture is made into round-flat cakes. The leaves of Ku-eng (*Amomum corynostachyum* Wall.) and bark of Therma (*Acacia pennata* Walld.) are used as substitutes for *C. joufra*.

Singh *et al.* 2006 documented 12 different plant species used to prepare the rice cake Hamei and tried to find out the uses of 12 plant species belonging to the 12 families, their medicinal properties used as ingredients to prepare the Yu, a traditional alcoholic beverage by Meitei communities of Manipur. Different types of traditional beer viz. Andro, Sekmai, Phayeng, Jiribam, Bishenpur and Tengnoupal are prepared using similar ingredients and methods except size, shape and covering during the fermentation. They also reported the medicinal use of Yu (Table 1) and its preparation. They concluded that the medicinal knowledge of Yu along with the 12 plant species will be useful lead for phytochemist and pharmacologist for further study.

Saikia *et al.* 2007 tried to describe the ethnobotany and taxonomy of traditional rice varieties and beverage processing techniques along with other plant materials used by Tai Ahom of North Lakhimpur district. The fermented rice beer of Ahom tribe is commonly known as sajpani and laopani. It has been also observed that the fermented rice beer is highly aromatic, sweet and with property of hallucination. Sajpani/Lopani is taken as energy booster during physical labour and other important ceremonial occasions of family and the society. Finally they concluded that the indigenous rice brewing system among the Ahom is scientific, time tested, eco-friendly and sustainable for health. They also found that the rice varieties which are used in the fermentation of rice beer are a source of phyto-medicine.

Deori *et al.* 2007, tried to find out the ethno botany of rice beer Sujan which is traditionally prepared by Deori tribe of Assam. They collected and documented the plant species used in preparation of Sujan. In their study they documented two different types of starter culture used by Deori tribe in the preparation of Sujan. They concluded that Sujan is good for health as it acts as a remedy for various common ailments which may be recognized to medicinal properties of plants species used (Table 1) in preparation of starter culture. They suggested to taking urgent effort to document and analyzing the quality of rice beer.

Samati *et al.* 2007, tried to find out the importance and uses of local rice beer Kiad prepare by Pnar tribe of Jaintia hill district, Meghalaya. They reported that the preparation of Kiad by Pnar ethnic tribe is mainly consisted into two parts, Thiat (natural yeast) preparation and Kiad brewing. They also documented the medicinal use of Sadhiar (raw non distilled beer) in urinary trouble and Kiad is used to cure dysentery. Finally, they concluded that the limited consumption of Kiad is beneficial for health and also acts as a remedy for various disorders and suggested that there is an urgent need to take effort to document, reserve and encourage the practice and tradition of tribal people.

Tanti *et al.* 2010, surveyed some remote villages of Assam, Mizoram, Nagaland, Meghalaya, Sikkim and Arunachal Pradesh and collected the starter culture used for fermentation of alcoholic beverages by several tribes. They documented the traditional knowledge of ethnic tribes for preparation of starter culture. They studied total 11 different starter cultures collected from different tribes and also documented the plant species (Table 1) used to prepare the starter culture. They observed that the different tribal communities of Northeast India used almost identical protocol for fermentation and finally concluded that the different plant species used in preparation of alcoholic beverages has significant epidemiological effect on human health.

Deka *et al.* 2010, tried to find out the ethno-medicinal value of rice beer and associated starter culture used in preparation of rice beer by Rabha tribe of Goalpara district, Assam. They documented the traditional use of herbs (Table 1) and rice used in the preparation of rice cake having high medicinal value in relieving headache, diarrhea, urinary problem etc. Finally they conclude that the preservation of indigenous knowledge on preparation of rice beer is

totally based on indigenous culture and health care system as per the need for the society but these days rice beer is brewed in a restricted manner without considering these needs.

Kardong *et al.* 2012, tried to find out the biochemical and nutritional aspects of Saimod, a homemade rice beer prepared by mixing burnt ash of rice husk with the cooked rice by Mising tribe of Assam, India. They documented the process of preparation of Saimod and the plant species use as ingredient (Table 1) and highlighted their medicinal values also. After biochemical analysis they listed the physiochemical properties, nutrient composition and enzymes present in Saimod. They also reported that Saimod is an acidic beverage and contains almost all metabolically important nutrients with the adequate amount of amylase enzyme. The authors finally concluded that the nutrients present in Saimod can provide energy besides its soothing effect and other medicinal properties to the consumer and also suggested that the unique preparation process involving the powder ashes of burnt rice husk/straw may be useful in developing new technology for sustainable maintenance of fermented rice beer.

Shrivastava *et al.* 2012, tried to find out the traditional process of alcoholic beverage preparation by 21 different tribes residing in 14 (out of 16) districts of Arunachal Pradesh, their consumption pattern and socio-cultural importance of traditional beverages. They documented the methodology of preparation and done the analysis of physical properties of 10 different beverages (Apong, Shhang, Bankhe-kham, Opo, Madua, Themsing, Rakhshi, Mingri, Lahpani and Bhangchang) used by different ethnic tribes of Arunachal Pradesh. They concluded that the tribes of Arunachal Pradesh used medicinal plants (Table 1) along with other natural products like rice, millet, barley, pant tubers in the preparation which results the rice beer as one of the rich sources of nutrition and health of the tribes.

Bhuyan *et al.* 2013, tried to find out the ethno medicinal value of various plant species (Table 1) associated with the preparation of traditional rice beer by different tribes of Assam, India. They enlisted the plant parts along with the different plant species used to prepare rice beer by the seven different rice beer varieties viz. Jou bishi, Horlang, Haj, Sujan, Jonga mod, Apong and Rohi by different tribes of Assam. They also documented the methodology of preparation of traditional rice beer and also observed

the preparation of starter cake. They mentioned the similarities in the methodologies of rice beer preparation by different tribes of Assam. The rice beer is consumed in many occasions, festivals, marriages and community gathering which give it special recognition. Finally, they suggested that as the plant species used in preparing rice beer has various medicinal properties, so the final product may reveal some important properties and beneficial effects of these traditional beverages which needs further detail study.

Bhuyan *et al.* 2014, tried to find out the biochemical properties and nutritional value of rice beer of Northeast India. They collected five different rice varieties and starter culture used in preparation of rice beer from Assam, Arunachal Pradesh and Nagaland. They analyzed the biochemical properties of starter culture as well as rice beer and documented the alcohol percentage, pH, total acidity, volatile acidity, crude protein and soluble protein content of rice beer. They also estimated the antioxidant properties of the rice beer. They finally concluded that the rice beer produced in Northeast India is nutritionally rich and have high therapeutic values. On the basis of evident antiradical activity they suggested the possibility of medicinal properties in rice beer.

Basumatary *et al.* 2014, tried to find out the biochemical properties of a traditional drink of Boro tribe of Assam called Jou. They analyzed the physicochemical and biochemical properties of Jou and documented various parameters such as s, color, state, taste, opacity, solid content, pH, amount of carbohydrate, reducing sugar, protein content, free amino acid, total acidity, volatile acidity and percentage of total alcohol content. After analysis they concluded that the fermentation and preparation of traditional rice beer is a process of enhancement of food with protein, amino acids and vitamin and the alcohol contents in Jou is higher as compare to local rice beer prepare by other tribes in Northeast India. They also suggested that the phytochemical analysis of the substrate used in preparation of rice beer might have beneficial impact on health as well as healing potential in curing various diseases.

Tamang *et al.* 2012 mentioned in their research paper about the percentage of several nutritional components including carbohydrate, protein and other macromolecules in traditional rice beer (Bhaati jaar) of Sikkim. They concluded that because of high

caloric contents Bhaati jaar is consumed by local tribe those have poor health and tribal women after child birth for regain the strength.

Ghosh *et al.* 2017 focused on comparative study of preparation method and the nutritional features of local rice beer prepared by Debbarma, Jamatia, Koloj and Molsom tribes of Tripura. It has been found that almost thirteen different plant species (Table 1) mixed with soaked rice flour by these four tribes for preparation of starter cultures. They also reported that the physico-chemical properties rice beer prepared by different tribes varied within tribes with respect to moisture content, carbohydrate content, reducing sugar, alcohol percentage. In conclusion they added that with aging and prolonged fermentation the concentration of alcohol is increased. The plants reported in this study are also reported for having nutritional and medicinal benefits for the metabolic stability in humans.

### Challenges

Due to rapid urbanization the plants species used to prepare rice beer by the ethnic communities is dwindling due to loss of their natural habitats. These plants are added to control the intoxicating properties and to improve its quality and health boosting properties, but from last few decades due to non-availability of some of these plants the quality, taste and health boosting properties of the local beverages have been seriously compromised.

The indigenous yeast strains involved in effective fermentation processes by the local communities are also been losing its properties due to compromised quality of the substrate (rice) produced organically earlier but now are produced inorganically over the polluted areas and fields due to continuous synthetic inputs as fertilizers, pesticides and weedicides in agricultural practices. Moreover the production of traditional beer by the tribal communities are done under poor hygienic conditions without proper technical and scientific inputs, which results in short shelf life and poor quality product with low alcohol content<sup>27</sup>.

Now a day's rice beer is brewed in restricted manner for rituals and festivals only. Manufacturing for daily use has been reduced drastically due to legal and economic bindings<sup>13</sup>. Moreover, the traditional knowledge is reducing due to lack of interest and ignorance of the traditional values and believes in the young generation. This has created a gap leading to the absences of the experienced and knowledgeable

persons among the tribal communities. Documentation of the process of rice beer production and plant species used in preparation of starter cake is not sufficiently addressed by the scientific community. Very limited and fragmented literatures are available regarding the preparation and consumption of traditional rice beer of this region.

It has been reported that traditional rice beer prepared by several ethnic tribes are also used for treating fever, cold and cough, body ache, urinary tract infection and are also consumed to cure the menstruations problems among the tribal women<sup>18</sup>. Moreover, many plants species used to prepare the traditional rice beer have antioxidant properties which might be responsible for reducing the toxic effect from the traditional alcoholic beverages. Very limited studies have been done scientifically to establish the fact. Detail scientific studies are required which elaborates the nutritional and medicinal aspects of rice beer and may establish the fact.

### Future prospects

Scientific study may reveal some new scope for manufacturing some beautifying product from traditionally prepared rice beer. In Sekmai and Payeng village of Manipur tribal women use rice beer over their face and skin as beauty care product<sup>18</sup>. Sometimes some bacterial contamination or toxicities are also reported and due to the lack of knowledge about the facts, tribes are blaming the person who ever is preparing and are barred to prepare it in future. There is a urgent need of scientific studies and systematic knowledge about the microorganisms responsible for beer production, so that the fermentation process and the product harvest can be done effectively leading to improve the quality of beer and purification method through selection and development of potential isolates<sup>27</sup>.

The plants which are used to prepare the starter culture are also deeply associated with traditional believes and rituals. Rice beer owes some bioactive compounds which enriched the product with nutritional and medicinal properties. It has got sufficient scope for its improvement through interdisciplinary research involving researcher from different background like medical science, biotechnology, food and nutrition. Future research on rice beer may also have the scope for new drugs development and improved shelf- life for commercialization.

## Conclusion

Rice beer is a traditional alcoholic beverage prepared and consumed by almost all the ethnic tribes of North-east India. The beer prepared and consumed is enriched with proteins, vitamins, amino acids and several nutritional components. Phytochemical analysis and ethno botany of rice beer reveals that the plant parts used to prepare the rice beer have several medicinal values and are also reported to be used in traditional healing and in remedies against various diseases by several tribes. *Artocarpus hererophyllus*, *Centella asiatica*, *Piper sp.* and *Solanum sp.* are the most common plants used in preparation of rice beer in North east India. Rice beer and its preparation are well mingled with the culture and indigenous health care system. Documentation and preservation of indigenous knowledge of these tribes and their recipe of preparation of rice beer needs scientific input for increasing its shelf-life and value addition for its marketing and commercialization with increased acceptability by the common people. These may lead to a valid way to preserve rich ancient heritage of traditional rice beer preparation and its conservation for the future generation and the world. It also becomes more apparent and important as these days rice beer is brewed in a restricted manner and the traditional believes and customs are dwindling in young tribal generation. Scientific studies and detailed analysis of the indigenous rice beer of ethnic tribes may reveal some other important properties and might be beneficial for mankind and economical development of the tribal population of North-east India.

## References

- Jain SK, Kumar V & Saharia M, Analysis of rainfall and temperature trends in North East India. *International Journal of Climatology*, 33: 968–978 (2013) Published online 5 April 2012 in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/joc.3483.
- Das AJ & Deka SC, Mini Review -Fermented foods and beverages of the North-East India, *International Food Research Journal*, 19(2): 377-392 (2012).
- Roy B, Kala C P, Farooquee N A & Majila BS, Indigenous Fermented Food and Beverages: A Potential for Economic Development of the High Altitude Societies in Uttaranchal, *Journal of Human Ecology*, 15(1) (2004) 45-49.
- Tanti B, Gurung L, Sarma HK & Buragohain AK, Ethnobotany of starter cultures used in alcohol fermentation by few ethnic tribes of Northeast India, *Indian Journal of Traditional Knowledge*, Vol. 9(3) (2010) pp. 463-466.
- Dung NTP, Rombouts, FM & Nout MJR, Functionality of selected strains of moulds and yeasts from Vietnamese rice wine starter, *Food Microbiology*, 23 (2006) 331-340.
- Tamang JP & Sarkar P, Microflora of Murcha: an amyolytic fermentation starter, *Microbios*, 81(327) (1995) 1, 15-22.
- Tsuyoshi N, Fudou R, Yamanaka S, Kozaki M, Tamang N, Thapa S. & Tamang JP, Identification of yeast stains isolated from marcha in Sikkim, a microbial starter for amyolytic fermentation, *International Journal of Food Microbiology*, 99 (2) (2005) 135-146.
- Tamang JP & Thapa S, Fermentation dynamics during production of Bhaati Jaanr, a traditional fermented rice beverage of the eastern Himalayas, *Food Biotechnology*, 2006, 20:251–261.
- Srivastava RC, Folk medicine and traditional healers of Arunachal Pradesh in proceeding on traditional healing practices in Northeast India, published by NEIFM, Pasighat Arunachal Pradesh. 2008, 47-57.
- Bordoloi BN, Sharma Thakur GC & Saikia MC, Tribes of Assam Volume-I, II & III, published by Tribal research Institute of Assam, 1987-1991.
- Teron R, Hor, the traditional alcoholic beverage of Karbi tribe in Assam, *Natural Product Radiance*, Vol. 5(5) (2006) pp.377-381.
- Deori C, Begum SS & Mao AA, Ethnobotany of Sujen: A local rice beer of Deori tribe of Assam. *Indian Journal of Traditional Knowledge*, Vol. 6(1) (2007) pp. 121-125.
- Deka D & Sarma GC, Traditionally used herbs in the preparation of rice –beer by the Rabha tribe of Goalpara district, Assam, *Indian Journal of Traditional Knowledge*, Vol. 9(3) (2010) pp.459-462.
- Saikia B, Tag h & Das AK, Ethnobotany of foods and beverages among the rural farmers of Tai Ahom of North Lakhimpur district, Asom, *Indian Journal of Traditional Knowledge*, Vol 6(1) (2007) pp 126-132.
- Bhuyan B, Baishya K, Ethno medicinal value of various plants used in the preparation of traditional rice beer by different tribes of Assam, India, Copyright@2013, JPR Solutions, Published by Reed Elsevier India Pvt. Ltd. All rights reserve).
- Kardong D, Deori K, Sood K, Yadav RNS, Bora TC & Gogoi BK, Evaluation of Nutritional and biochemical aspects of Po:ro apong (Saimod) –A homemade alcoholic rice beverage of Missing tribe of Assam, India, *Indian Journal of Traditional Knowledge*, Vol.11 (3) (2012) pp.499-504.
- [https://manipur.gov.in/?page\\_id=3507](https://manipur.gov.in/?page_id=3507).
- Singh PK & Singh KI, Traditional alcoholic beverage, Yu of Meitei communities of Manipur, *Indian Journal of Traditional Knowledge*, Vol. 5(2) (2006) pp. 184-190.
- Samati H & Begam SS & Kiad, A popular local liquor of Pnar tribe of Jaintia hills district, Maghalaya, *Indian Journal of Traditional Knowledge*, Vol. 6(1) (2007) pp.133-135.
- Tohring SR, Violence and identify in Northeast India: Naga-Kuki conflict, (Mittal publication 2010), pp XV-XVII ISBN 978-81-8324-344-5.
- Teramoto Y, Yoshida S & Ueda S, Characteristics of a rice beer (Zutho) and a yeast isolated from the fermented product

- in Nagaland, India, *World journal of Microbiology & Biotechnology*, 18(2002) 813-816.
- 22 [http://sikkim.nic.in/sws/sikk\\_his.html](http://sikkim.nic.in/sws/sikk_his.html).
- 23 Tamang JP, Tmang N, Thapa S, Dewan S, Tamang B, Yonzan H, Rai AK, Chettri R, Chakraborty J & kharel N, Microorganisms and Nutritional value of Ethnic fermented foods and alcoholic beverages of North East Indi, *Indian Journal of Traditional Knowledge*, Vol. 11(1) (2012) pp 7-25.
- 24 Ghosh S, Rahaman L, Kaipeng DL, Deb D, Nath N, Tribedi P & Sharma BK, Community-wise evaluation of rice beer prepared by some ethnic tribes of Tripura, *Journal of Ethnic Foods*, 3 (2016) 251-256.
- 25 Chakrabarty J, Sharma GD & Tamang JP, Substrate utilisation in traditional fermentation technology practiced by tribes of North Cachar Hills district of Assam, *Assam University Journal of Science & Technology, Biological Sciences*, 4 (1): 2009; 66-72.
- 26 Prakash D, Dhakare R & Mishra A, Carotenoids: the phytochemicals of nutraceutical importance, *Indian Journal of Agricultural Biochemistry*, 17 (2004) 1-8.
- 27 Basumatary TK, Basumatary RT, Medhi S, Bose S & Begum RH, Biochemical analysis of Jou: a traditional drink of the Boro tribe of Assam and Northeast India, *IOSR Journal of Environmental Science. Toxicology and Food Technology*, (IOSR-JESTFT) e-ISSN: 2319-2402, p-ISSN: 2319-2399, Volume 8, Issue 7 Ver. I (2014), PP 99-103.
- 28 Shrivastava K, Greeshma A G & Srivastava B, Biotechnology in Tradition- A process technology of alcoholic beverages practiced by different tribes of Arunachal Pradesh, North East India, *Indian Journal of Traditional Knowledge*, Vol. 11(1) (2012) pp 81-89.
- 29 Bhuyan DJ, Barooah MS, Bora SS & Singaravadiel K, Biochemical and nutritional analysis of rice beer of North East India, *Indian Journal of Traditional Knowledge*, Vol. 13(1) (2014) pp.142-148.