



ISSN (E): 2277- 7695  
ISSN (P): 2349-8242  
NAAS Rating: 5.23  
TPI 2022; SP-11(2): 370-375  
© 2022 TPI  
[www.thepharmajournal.com](http://www.thepharmajournal.com)  
Received: 25-12-2021  
Accepted: 27-01-2022

#### Laky Khatun

Ph.D. Scholar, Department of Food Engineering & Technology, Central Institute of Technology Kokrajhar, Deemed to be University, MoE, Govt. of India, Kokrajhar, Assam, India

#### Subhajit Ray

Associate Professor, Department of Food Engineering & Technology, Central Institute of Technology Kokrajhar, Deemed to be University, MoE, Govt. of India, Kokrajhar, Assam, India

#### Corresponding Author

#### Laky Khatun

Ph.D. Scholar, Department of Food Engineering & Technology, Central Institute of Technology Kokrajhar, Deemed to be University, MoE, Govt. of India, Kokrajhar, Assam, India

## A comprehensive review on rice based fermented food and beverages in North East India

Laky Khatun and Subhajit Ray

### Abstract

In the North eastern region of India rice is the cardinal food grains and prime source of nutritional energy and nourishment. Fermented beverages of the north East India is an inevitable part of tribal life style attached culturally and with religious point of view and use for its therapeutical and nutritional value. The tribal in the north Eastern region have the conventional way of preparing of fermented product and beverages since long ago. The current paper is a relative assessment on the strait of preparing fermented rice base food and beverages by some popular tribes in North Easter region. The modus operandi they resort for the preparation of various sorts of fermented product are analogous but there is peculiarity in the starter culture preparation, they use various aboriginal plant species locally available and rice varieties as substrate resulting variation in taste and flavour. The review deals with the importance of consumption and to encourage entrepreneurs to developed in large scale production and commercialization.

**Keywords:** North Eastern region, traditional fermented product, alcoholic beverages, starter culture, nutritional characteristics

### Introduction

North East India is a part within the Eastern Himalayas and Purvanchal Himalayas. The Purvanchal Himalayas covering a area of 108,229 km square and it consist with the hills of Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura [1]. Rice is Northeast India's major food grains and the local population's primary source of nutritional energy and nourishment. It is high in minerals like phosphorous, potassium, magnesium as well as dietary fibre and vitamin B like thiamin, riboflavin and niacin [2]. Fermented food had long been popular in India. Fermented dishes made from local crops and other incredibly common popular biological resources in the North east region of India. Rural women of this region use various wild plant and non-vegetarian food [3]. Preparation of food by different communities are unique and different due to availability of food materials and also due to the geographical location, environmental factors etc. Fermentation is one of the oldest and most economical methods of preserving the quality and safety of foods, thereby enhancing the nutritional quality [4]. Fermentation also helps in proliferation of digestibility, breakdown of complex carbohydrates into simpler one, improves bioavailability essential amino acid, vitamins, and minerals, and alters the whole quality, taste and aroma of the food. [5]. Green Revolution in Eastern India (BGREI) during 2010-11 increased the production and productivity of rice from 96.7 million tonnes and 2202kg/hacter in 2007-08 to 106.31 million tonnes and 2393kg/hacter respectively in 2011-12 [6]. Rice based fermentation can be either acidic or alcoholic or both at the same time. At the beginning the procedure starts with pre treatment of rice grains, such as soaking, grinding and boiling which loosens the starch structure and dilutes the antinutrient components. During some food preparation after soaking it stimulates to germination process and activates the hydrolytic enzyme which relieve the rigidity of starch through endo and exo cleaving pathways. Microbial fermentation produces carbon di oxide and other gases in batter which makes it spongy. The degree of fermentation is determined by time, which influences the texture, taste, appearance and aroma of the food [7]. Fermented rice beer contains a variety of beneficial components, including Maltooligosaccharides, such as maltotetrose, maltotriose and maltose are low calorie which inhibit the growth of intestinal pathogenic microbes and are very nutritious for newborns [8]. Fermented product can be made spontaneously or with the addition of a starting culture containing effective microorganism which transform the substrates into edible products that are traditional in terms of ethnicity and social standing residents [9].

During fermentation changing circumstances help to activate the enzymes already present, and adjusting the pH which improve the function of certain enzymes, such as amylases, proteases, hemicellulases and phytases. Together with microbial metabolites and enzyme altered the technological and nutritional effects of fermented cereal foods [10]. During fermentation enzymatic conversion of insoluble polysaccharides to ethanol occur and due to which larger rise in ethanol concentration as compared to the comparable drop in carbohydrate content [11]. In comparison with other rice

beer in North east India, the JOU rice beer has high alcohol contents [27].

### Types of Fermented Food and Beverages

Traditional fermented foods and beverages are primarily made with rice and other cereals. All of these fermented foods, however have different quantities and cooking methods depending on places [9]. Some of the fermented product made by rice are represented by Table-1.

**Table 1:** Different Fermented Products with Their Starter Culture

Fermented product	Type	Raw materials used	Community	Starter culture	Reference
Poita Bhat	Fermented cereal based breakfast	Left over cooked rice	Assamese	-	[2]
Judima or Zo	Alcoholic beverage	Rice bark of thempra ( <i>Accacia pennata</i> ), leaves of <i>piper betle</i> , and leaves or twigs part of <i>Buddleja asiatica</i> and <i>Hedyotis scandens</i>	Dimasakacharis	Humao	[12]
Jou	Rice beer	Whole twig of <i>Scoparia dulcis</i> L. plant, leaves of <i>Musa paradisiaca</i> L., <i>Artocarpus heterophyllus</i> Lamk., <i>Ananas comosus</i> (L.) Merr., <i>Clerodendron infortunetun</i> L. and bark of <i>Plumbago zeylanica</i> L. and fruits of <i>Capsicum annum</i> L	Boro	Amao	[13]
Chako or Choko	Rice beer	<i>Ananas Comosus</i> (L.) leaves, <i>Artocarpus heterophyllus</i> Lam., <i>Calotropis gigantea</i> (L.) leaves, <i>Capsicum frutescens</i> (L.) fruits, <i>Cleodendrum viscosum</i> Vent. Leaves, roots of <i>Plumbago indica</i> , leaves of <i>Saccharum officinarum</i> (L.) and shoots of <i>Scoparia dulcis</i> L. and cooked rice and rice	Rabha	Bakhor/Phap	[14]
Selroti	Rice based bread	Rice, sugar, butter, wheat flour and other spices/condiments like Cardamom, Cloves, Cocconut, Fennel, Nutmeg and Cinnamon and also use Honey or unripe banana or baking powder	Nepalese	-	[16]
Poko	Traditional alcoholic beverage	Cooked rice, black pepper	Nepalese	Murcha	[17]
Hor or Alank	Traditional rice beer	Rice and leaves of marthu ( <i>Croton joufra</i> )	Karbi	Thap	[18]
Zutho	Traditional alcoholic beverage	Rice grains and unhulled rice grains	Naga	-	[3]
Bhati Jaanr	Rice based beverage	roots of <i>plumbago zeylanica</i> , leaves of <i>Buddleja asiatica</i> , flowers of <i>Vernonia cinerea</i> , ginger, red dry chilli	Gorkha	Marcha	[1]
Sujen	Fermented rice beer	Plants like <i>Artocarpus heterophyllus</i> , <i>Cinnamomum bejolghota</i> , <i>Costus speciosus</i> , <i>Desmodium pulchellum</i> , <i>Coffea bengalensis</i> , <i>Cyperus species</i> , <i>Lygodium flexuosum</i> , <i>Melastoma malabathricum</i>	Deori	Mod Pitha	[13, 19]
Apong	Rice beer	Different plant leaves such as <i>Cenilla asiatica</i> , <i>Hydrocotyle sibthorpiodes</i> , <i>Oldenlandia Corymbosa</i> , <i>Saccharum officinarum</i> , <i>Clerodendrum viscosum</i> , <i>Cyclosorus exlensa</i> , <i>scoparia dulcis</i> , <i>Drymeria cordata</i> , <i>Ananas comosus</i> , <i>Capsicum annum</i> , and <i>Lygodium flexuosum</i> , boiled rice and soaked rice	Assamese	Aopa Pitha	[20, 22]
Chubitchi	Traditional rice beer	Achetra ( <i>Plumbago zeylanica</i> L), Somaki ( <i>Clerodendrum cordatum</i> ) and Sarath ( <i>Thelypteris clarkei</i> ) and chillies	Garo	Wanti	[28]
Ennog	Black rice beer	Rice and some available plants <i>Veronia cinerea</i> Less and <i>Clerodendron viscosum</i>	Monapa, Nishi	Ipoh	[20, 29]
Xaj Pani	Fermented rice beer	Polished rice	AHOMS	Vekur Pitha	[28]
Kiad	Rice beer	Polished rice	Khasis/Jaintias	Thiat	[28]
Atinga	Rice beer	Polished rice	Manipuri	Meitei	[28]

### Process Conditions and Manufacturing Process

Rice samples cook and left for cooling followed by addition of water and then allow to ferment for 12 hrs and another way the left over cooked rice used to ferment with water for whole night during the preparation of Poita bhat [2]. The glutinous

rice after soaking in water it grinded along with dry bark of *Acacia pennata* and added little quantity of water drops and make it into a paste which is subsequently fashioned into rice cake and then the old rice cake powder spread of the new cake or Humao. In the 2<sup>nd</sup> step cooked rice allowed to cool and

mixing of Humao powder and kept in a large aluminium pots or earthen pot which is covered with jute gunny bags. After completion of fermentation a yellowish juice will come out and then diluted with water and filtered for consumption [23]. Cooked rice spread out on a bamboo mat and allowed to reduce the temperature upto that when one can handle with bare hand and then addition of 2-3 pieces of Amao is pulverised and combined with cooked rice. After 24 hrs it transfer to a aluminium Hadi and added some quantity of drinking water and it keeps for fermentation. The juice which collects after 2-3 days of fermentation is known as Joubidwi, after distillation of Joubidwi by traditional distillation set up jougwan is produce. The juice collects after 2-3 months later then it is known as Joufinai [11]. In the first process of making bakhor rice cake, the rice grains are ground into flour, and the above mentioned in (table 1) plant components are combined with the flour to form a small spherical paste, which is then dried. After it combines the cooked rice with the particular bakhor powder. Janthi a cylindrical bamboo net put inside the Jonga (a earthen pitcher) and the mixture kept inside the Jonga and outside the Janthi. The mouth of Janthi cover with banana leaves and sealed. It keeps in dark for ferment in dark place upto 4-5 days in summer and 7-8 days in winter. The final choko or jonga mod collects from the inside of Janthi [15]. Selroti is made by sorting, washing and soaking a local type of rice attey in cold water overnight or 4-8 hours at room temperature. The unwanted water drained from the rice and it grind into powderd form or flour. The rice flour put together with wheat flour, sugar, butter, coconut, baking powder and other condiments. For the softening of dough a little amount of milk or water added and keep for ferment for 2-4 hours during summer and 6-8 hours during winter. The batter transfer to hot oil for fry in a ring shape by using spatula [19]. The murcha which used for the preparation of alcoholic beverage Poko prepare using rice flour and millet grains. Grinded millet grain and flour mix together with murcha seed and Manawasha, a flower of a wild plant as a source of yeast and 5% black pepper and then blend into a paste to prepare a cake. It placed on straw and covered with straw and allow to ferment at 30-33 c for 5-7 days and dried under sun light [20]. The traditional method for the making process of poko, the rice after whole night soaking it cooked into sticky rice and then after cooling the murcha powder spread over the rice and stirred thoroughly and transfer to an earthen pot. The leaves and straw used to plug the mouth of the pot and tied by the muslin cloth. Then it allow to ferment at room temperature upto 2-3 days during summer and 5 days during winter. During the fermenting process it mixed every day. Lastly the rice turns into a creamy white soft and juicy [17]. In the fermenting process of HOR quantity of rice cooked and laid over a bamboo mat called Antar. The cooked rice is broken up into small pieces or tiny grains, then set aside to chill. A sufficient amount of powdered Thap fully combined with the rice and kept in a tabuk (pot) for three days in summer and upto 4 days in winter to ferment. A hole is made at the centre where hengru (cylindrical sieve made from bamboo splits) is put for the collection of beer and Horlank is retrieved with Lankjak means a gourd shell. The remaining fermented rice excluding the beer is called Bechurang [18]. The polish rice grains are steeped in water about 2 hours and drained off the excess water then followed by air dry. The rice grains ground into flour. On the other hand the unhulled rice grains soaked in water for the germination upto 3-4 days. After germination it is dried under sun light and ground. Mixing together the

flour and unhulled grains flour in the ratio of 10:3 and make a past by addition of boiling water then allowed to chill in room temperature upto 4-5 days. The fermentation process completed after 4-5 days. The name of the first fermented product in its purest form is called 'Thoutshe' and after dilution it is known as Zutho which is the final product. [3]. The glutinous rice steeped in water for 8-10 hrs and ground into flour. The wild herbs and the spices previously mentioned above in (table 1) are added and also the mother culture which is old marcha. By adding some amount of water the mixture makes into a paste and kneaded into a flat cake and dried. [1]. During the preparation of bhati jaanr this marcha powder mixed with glutinous cooked rice. After mixing it placed into an earthen pot and allowed to saccharification for 1-2 days. During saccharification a sweet aroma dispatched. The jar is made air tight after saccharification and fermented for 2-3 days in the summer and in winter upto 7-8 days. By stirring the fermented bhati jaanr make into a thick paste mass and consume directly. After the proper fermentation is complete it is sometimes preserved for a week or longer in a earthenware crock to produce nigaar which is yellowish white supernatant liquor and it is collected at the bottom of the vessel and consumes straight with or without water [24]. The first process is preparing of Mod pitha. The plants parts mention above (table-1) are dried in sun and the soaked rice grinded into fine powder. There are a couple of old pitha added to the mixture, water also added to form a sticky paste and and it transfer into a small spherical shaped pitha. Then it hanged on Dhua sang above the fire place upto 7 days until it becomes hard. Next the brewing process for Sujen, the rice husk, water mixed with rice to cook and after cooking the powder of Mod pitha added to it and mix thoroughly. Fronds of *Pteridium aquilinum* spread over the mixture and covered with banana leaves and it shift to the container called Koloh for fermentation process for 3-4 days. After fermentation it filtered by sakoni and it is ready to consume [19]. All the leaves mentioned on (table-1) are cleaned and dried before use. Then the soaked rice mixed with the leaves and ground into powder. The mixture made into a paste by adding water and assemble into ball shaped cake known as Aopo pitha. The powder of Aopo pitha added to the boiled rice after cool and the mixture put together in a killing (earthen pot) covering the mouth with banana leaves. After 5 days of fermentation little water is added to the product and filtered it to consume. [22]. another is Poro Apong which is also known as Saimod in saimod along with boiled rice ash also used [24]. Chubitchi made by cooked menil (glutinous rice) both the polished and unpolished mixing with wanti powder. Wanti is a starter culture prepare using rice, medicinal herbs mentioned on (table-1) and chillis. After proper mixing it made out into flattened oval cakes and then sun dried. The cooked Menil cooked rice after cooling mixed well with appropriate wanti and put together into a earthen pot with a bamboo sieve inside of the pot. The open mouth tied with banana leaves and clean cloth then it kept to ferment for a week at a room temperature in summer [28]. During the making process of Ipoh the dried rice flour and the powder of seeds and bark of *veronia cinerea* Less and *Clerodendron viscosum* Vent are mixed which made into a paste and it assemble into a oval shaped cakes and then dried. Next for the preparation of Ennog the paddy husk allowed to burn until it became black in colour in a vessel and then mixed with the cool boiled rice followed by spreading Ipoh cake powder then it transfer to a conical bamboo basket

bound with leaves of ekkam (*Phryium capitulum* wild). Then the whole basket covered with leaves and allowed to ferment for 3 days. After emerging a strong alcoholic smell the mixture transferred to a U shaped bamboo basket with a lining of leaves. To ensure proper sealing a wooden material or a piece and stone keeps upon it. After 10 days it completed the fermentation process and it is ready to filtrate into fresh beer Ennog<sup>[20]</sup>.

### Nutritional and Physicochemical Characteristics of Fermented Food and Beverages

In cereals and pulse based food phytic acid decreases due to fermentation. After study pH and Phytic acid also decrease during fermentation of Poita bhat pH from 6.8 to 5.39. Minerals contents increases during fermentation like Fe, Mg, Ca and Zn. Highest quantity of Mg is present in Poita Bhat then followed by Ca.(2).pH is slightly acidic ( $4.4 \pm 0.1$ ) and titrable acidity is ( $0.45 \pm 0.01$ ). The total carbohydrate present is  $32.43 \pm 2.7$  mg/ml, protein and free amino acid contents are  $0.97 \pm 0.18$  mg/ml and  $3.21 \pm 0.21$  mg/ml respectively<sup>[23]</sup>. The carbohydrate contents decrease with time of fermentation and

due to increasing the time of preservation that means highest carbohydrate in Joubidwi. Ethanol content increase with storage time after 24 hrs ethanol content is  $43.42 \pm 0.57$  and after 15 months of storage  $127.85 \pm 0.08$  in Joufinai. Protein and flavonoid contents increase gradually with the storage time. Joufinai has highest protein and flavonoid content<sup>[11]</sup>. Fermented foods have high energy content in comparison to the raw ingredients. The moisture content, reducing sugar, fat and carbohydrate increases in selroti batter after fermentation. The pH of batter is  $5.8 \pm 0.4$ , titrable acidity, moisture, total sugar, fats, are  $0.08 \pm 0.01$ ,  $42.5 \pm 0.6$ ,  $2.1 \pm 0.5$ ,  $69.2 \pm 4.4$  and  $0.8 \pm 0.08$  respectively. Protein and carbohydrate quantity are  $5.7 \pm 0.5$  and  $91.3 \pm 0.6$ . The energy value of selroti batter is  $410.3 \pm 0.5$  (kcal/100gm DM)<sup>[21]</sup>. The biochemical changes occur during poko fermentation, the pH decrease from 4.3 to 3.0 but the acidity increase upto 1.7% LA. The reducing sugar and total sugar quantity is highest on the 2nd and 3rd day of fermentation ranged 14.4 to 15.6% and 14.6 to 18.2% respectively. The alcohol quantity increases according to the fermentation period range 0.5- 4.0%<sup>[17]</sup>.



**Fig 1:** A-Selroti (16), B- zutho serving in bamboo cup (20), C- judima (7), D- Bhati jaanr (7), E- Zutho (7)

The acidity of zutho is 5.1ml and the pH is 3.6. Zutho contains 5.0% alcohol and the reducing sugar, total sugar are 6.3 mg/ml and 39.7 mg/ml. Ethyl acetate 285 mg/l.<sup>[26]</sup> The mean pH, titratable acidity expressed as percentage of

lactic acid and alcohol content of bhaati jaanr were 3.5, 0.24% and 5.9%, respectively. The moisture content of the product was higher in fermented product. No remarkable change was observed in the fat and protein contents of bhaati jaanr over

the substrate. The crude fiber content increased during fermentation. There was highest amount of phosphorous then followed by potassium. The total energy value is  $404.1 \pm 13.8$  (kcal 100g/g DM) [24].

### Sensory Properties

The dish poita Bhat is slightly sour in taste with soft texture [1]. Judima is a mild alcoholic beverage in liquid state and watery in colour with clear opacity [23]. Jou is light golden brown colour alcoholic drink with an attractive taste [13]. It is bitter in taste and the bitterness increases with storage time [11]. The rice beer Choko is reddish brown in colour like honey and it is strongly alcoholic but sweet in taste [15]. Selroti is a sweet, ring shape dish, people consume as a confectionary bread with Aludam, Simi- ko acchar and meat [16]. Poko is very sweet and less sour in taste with alcoholic and aromatic flavour [17]. Zutho is sour in taste with fruity aroma and had its unique aroma similar to the Japanese sake and sprouted sake [26]. Bhati Jaanr is a sweet flavoured and mild alcoholic beverage [24]. The rice beer Sujen is sweet in taste with a unique flavor [21].

### Conclusion

In North East India has a huge diversity of fermented food among the different tribes. Fermented foods made from fish, vegetables, fruits, meat, bamboo, milk, millets rice and other grains are common but rice based fermented food and beverages are particularly popular in North east, which can be considered as a functional food because of high nutrition and bioactive compound. As per traditional knowledge in north east India about the process and production of various fermented product, they have the great opportunity for development of various food industries associated with fermented product and various new product, quality assurance and increased promotion on a large scale.

### References

1. Tamang JP, Tamang N, Thapa S, Dewan S, Tamang B, Yonzan H, *et al.* Microorganisms and nutritional value of ethnic fermented foods and alcoholic beverages of North East India. *Indian Journal of Traditional Knowledge*, 2012, 11(1)
2. Goswami G, Baruah H, Boro RC, Barooah M. Fermentation Reduces Anti-Nutritional Content and Increases Mineral Availability in Poita bhat. *Asian Journal of Chemistry*, 2016, 28(9).
3. Jamir B, Deb CR. Studies on some fermented foods and beverages of Nagaland, India. *International Journal of Fermented Foods*. 2014;3(2):127-138.
4. Chavan JK, Kadam SS, Beuchat LR. Nutritional improvement of cereals by fermentation. *Critical Reviews in Food Science & Nutrition*. 1989;28(5):349-400.
5. Sanlier N, Gokcen BB, Sezgin AC. Health benefits of fermented foods. *Critical reviews in food science and Nutrition*, 2017, 1-22
6. Khatkar BS, Chaudhary N, Dangi P. Production and consumption of grains: India, 2016.
7. Ray M, Ghosh K, Singh S, Mondal KC. Folk to functional: an explorative overview of rice-based fermented foods and beverages in India. *Journal of Ethnic Foods*. 2016;3(1):5-18.
8. Das G, Patra JK, Singdevsachan SK, Gouda S, Shin HS. Diversity of traditional and fermented foods of the Seven Sister states of India and their nutritional and nutraceutical potential: A review. *Frontiers in Life Science* 2016;9(4):292-312.
9. Rawat K, Kumari A, Kumar S, Kumar R, Gehlot R. Traditional fermented products of India. *Int J Curr Microbiol App Sci* 2018;7(4):1873-1883.
10. Singh AK, Rehal J, Kaur A, Jyot G. Enhancement of attributes of cereals by germination and fermentation: a review. *Critical Reviews in Food Science and Nutrition*. 2015;55(11):1575-1589.
11. Deka AK, Handique P, Deka DC. Antioxidant-activity and physicochemical indices of the rice beer used by the Bodo community in North-East India. *Journal of the American Society of Brewing Chemists*. 2018;76(2):112-116.
12. Chakrabarty J, Sharma GD, Tamang JP. Traditional technology and product characterization of some lesser-known ethnic fermented foods and beverages of North Cachar Hills District of Assam. *Indian Journal of Traditional Knowledge*, 2014, 13(4)
13. Basumatary TK, Basumatary RT, Medhi S, Bose S, Begum RS. Biochemical analysis of Jou: a traditional drink of the Boro tribe of Assam and North East India. *IOSR J of Envir Sci Toxi and Food Tech*. 2014;8:99-103.
14. Narzary Y, Brahma J, Brahma C, Das S. A study on indigenous fermented foods and beverages of Kokrajhar, Assam, India. *Journal of Ethnic foods*. 2016;3(4):284-291.
15. Deka D, Sarma GC. Traditionally used herbs in the preparation of rice-beer by the Rabha tribe of Goalpara district, Assam. *International Journal of Traditional Knowledge*, 2010, 9(3).
16. Yonzan H, Tamang JP. Indigenous knowledge of traditional processing of Selroti, a cereal-based ethnic fermented food of the Nepalis. *International Journal of Traditional Knowledge*, 2010, 9(2).
17. Shrestha H, Rati ER. Defined microbial starter formulation for the production of Poko—a traditional fermented food product of Nepal. *Food Biotechnology*, 2003;17(1):15-25.
18. Teron R. Hor, the traditional alcoholic beverage of Karbi tribe in Assam, 2006.
19. Deori C, Begum SS, Mao AA. Ethnobotany of Sujen- A local rice beer of Deori tribe of Assam. *International Journal of Traditional knowledge*, 2007, 6(1).
20. Das AJ, Deka SC, Miyaji T. Methodology of rice beer preparation and various plant materials used in starter culture preparation by some tribal communities of North-East India: A survey. *International Food Research Journal*. 2012;19(1):101.
21. Dahal NR, Karki TB, Swamylingappa B, Li QI, Gu G. Traditional foods and beverages of Nepal—a review. *Food Reviews International*. 2005;21(1):1-25.
22. Yonzan H, Tamang JP. Microbiology and nutritional value of selroti, an ethnic fermented cereal food of the Himalayas. *Food Biotechnology* 2010;24(3):227-247.
23. Arjun J, Verma AK, Prasad SB. Method of preparation and biochemical analysis of local tribal wine Judima: an indigenous alcohol used by Dimasa tribe of North Cachhar Hills District of Assam, India. *International Food Research Journal*, 2010, 21(2).
24. Prakash Tamang J, Thapa S. Fermentation dynamics during production of bhaati jaanr, a traditional fermented rice beverage of the Eastern Himalayas. *Food*

Biotechnology 2006;20(3):251-261

25. Pegu R, Gogoi J, Tamuli AK, Teron R. x Apong, an alcoholic beverage of cultural significance of the Mising community of Northeast India. *Global Journal of Interdisciplinary Social Sciences*. 2006;2(6):12-17.
26. 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 and Biotechnology*. 2002;18(9):813-816.
27. Nath N, Ghosh S, Rahaman L, Kaipeng DL, Sharma BK. An overview of traditional rice beer of North-east India: ethnic preparation, challenges and prospects. *International Journal of Traditional Knowledge*, 2019, 18(4).
28. Mishra BK, Hati S, Das S, Brahma J. Fermented Rice Beverage of Northeast India: A systematic review. *International Journal of Fermented Foods*. 2019;8(1):41-56
29. Das AJ, Deka SC. Fermented foods and beverages of the North-East India. *International Food Research Journal*. 2012;19(2):377.