



BIOCHEMICAL COMPOSITION AND NUTRITIONAL PROFILING OF TRADITIONAL FERMENTED BEVERAGES FROM INDIGENOUS COMMUNITIES OF ASSAM

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ABSTRACT

Traditional beverages play a pivotal role in the sociocultural life of the indigenous tribes of Northeast India. This study presents a comparative biochemical and nutritional analysis of traditional fermented beverages prepared by three indigenous tribes of Assam Rabha, Mising, and Tiwa. The analysis revealed that the carbohydrate content was highest in Zu of the Tiwa tribe ($31.1 \pm 0.06\%$), followed by Apong of the Mising tribe ($25.9 \pm 0.72\%$), and lowest in Jonga of the Rabha tribe ($24 \pm 0.73\%$). The protein content was comparatively similar across the beverages, with values of $10.7 \pm 1.17\%$ for Zu, $10.6 \pm 3.34\%$ for Apong, and $10.6 \pm 0.30\%$ for Jonga. Fat content was found to be highest in Jonga ($1.20 \pm 0.76\%$) and Apong ($1.16 \pm 0.66\%$), whereas the lowest was recorded in Zu ($0.76 \pm 0.11\%$). The estimated nutritive value was highest in Zu (174.04 kcal/100 ml), followed by Apong (156.44 kcal/100 ml), with the lowest in Jonga (149.20 kcal/100 ml). The study is significant as traditional beverages hold an integral place in the cultural practices of the indigenous tribes of Assam and contribute to human health and well-being. Further research in this area may facilitate the identification of essential bioactive components, which could be utilized in the development of novel therapeutic compounds.

Keywords: Assam, Biochemical, Indigenous tribes, Nutritional, Significance, Traditional beverage.

INTRODUCTION

Rice beer is a traditional alcoholic beverage that plays a major role in the sociocultural lives of people in Northeast India (Bhuyan *et al.*, 2014). The indigenous tribes consume traditional beverages mostly often since they are believed to have health benefits. These products are similar to *Shaosingju* and *Laochao* of China, *Sake* of Japan, *Chongju* and *Takju* of Korea, *Brembali*, *Tape-Ketan* and *Tapuy* of Indonesia, *Khaomak* of Thailand and *Tapaipululul* of Malaysia (Bora *et al.*, 2017). The beverage is prepared traditionally, where rice serves as the major component. Rice is mixed with yeast derived from plant parts and is allowed to ferment. The fermentation process then helps yield traditional beverages. This beverage serves as an important component of the sociocultural life of indigenous tribes, where it symbolizes hospitality and is also regarded as a medium of exchange. It is connected to religious

rituals and is even considered a medium that brings peace to the surrounding environment (Cheng *et al.*, 1964).

All the indigenous tribes of northeastern India practice their own traditional way of making beverages with different tastes and flavours. The reason might be due to the plant parts used in the preparation of the starter cake, which ultimately leads to the whole fermentation process. Although these traditional products play an integral role in the socioeconomic life of people and hold great cultural significance, they have not been well documented to date. Hence, this study is important for the proper documentation of indigenous practices that hold great cultural significance among indigenous tribes. Detailed studies on the medicinal value of these traditional products might provide valuable information and would prove advantageous in the use of these products on a broader scale.

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MATERIALS AND METHODS

Study area

The study was carried out from June 2022 to June 2023. Rice-based fermented beverage samples *Jonga* (Rabha), *Apong* (Mising) and *Zu* (Tiwa) were collected from the Goalpara district of Assam (Figure 1). The samples were transported under controlled conditions to the Department

of Zoology, B. Borooah College, Guwahati, for subsequent analyses. To minimize variability in nutrient composition due to storage duration, all biochemical and nutritional assessments were conducted on the 20th day post-fermentation. Strict precautions were taken during collection and transportation to ensure sample integrity and freshness.

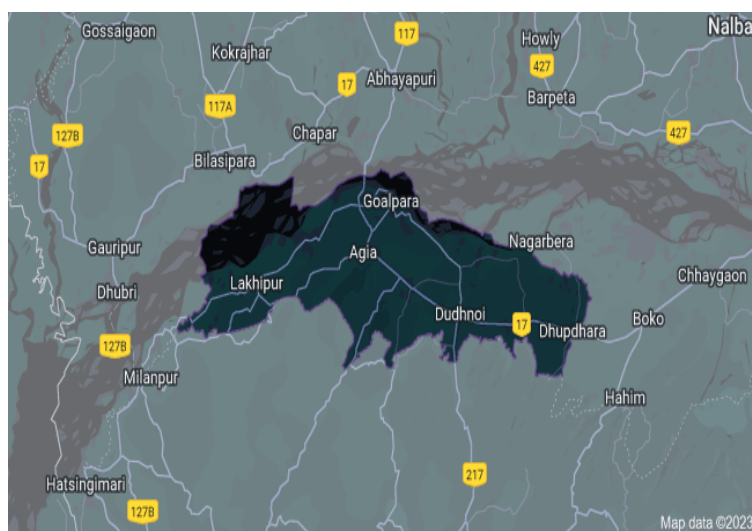


Figure 1. Maps of the study area: Goalpara (<https://maps.app.goo.gl/WxEDWyiFHYYGJXNhk9>).

Surveys were conducted in villages and local markets of the Goalpara district to obtain authentic samples directly from tribal practitioners. The study design was quantitatively standardized to ensure reproducibility and reliability of the results.

Traditional beverages

The traditional rice-based fermented beverage of the Rabha tribe, known as *Jonga Mod* continues to be widely prepared and consumed in the Goalpara district of Assam. The fermentation process begins with the preparation of a starter culture made from locally available plants, such as *Scoparia dulcis* (locally called *Bakhor* or *Phap*) (Figure 2), which are mixed with soaked rice and powdered residues of previously prepared rice cakes.

Cooked rice is combined with this mixture and placed in an earthen pitcher (*Jonga*), which is further encased in a bamboo-netted cylindrical structure (*Janthi*). The vessel is sealed with banana leaves, gently warmed near a fire, and stored in dark conditions to allow fermentation for 4–5 days during summer and 7–8 days during winter. The final product, a white yellow rice beer, is then extracted (Figure 4). The Mising community prepares *Apong*, their traditional beverage, using a starter culture called *Apoppitha*. This culture is made by blending soaked rice grains with different medicinal and aromatic plant parts, which are ground, shaped into oval cakes, and dried. Cooked rice is

then cooled, inoculated with *Apoppitha*, and placed in an earthen pot sealed with banana leaves. The pot is smoked over a bamboo frame placed on a hearth until the surface turns black, a process that enhances flavor and microbial activity. After 4–5 days, the fermented product is diluted with water and filtered to obtain the beverage (Figure 3). The Tiwa tribe prepares *Zu* by crushing rice and mixing it with indigenous plants such as *Justicia betonica* (locally known as *Horu Bahaka*). The mixture is fermented for approximately one week at room temperature. The fermented rice mass is then diluted with water and filtered through a clean cloth to produce the final beverage (Figure 5).

Nutritional analysis

Standard AOAC methods were followed for nutritional analysis (AOAC, 2006).

Estimation of protein

The estimation of protein content was carried out via Lowry's method (Lowry *et al.*, 1951). The method developed by Lowry *et al.* is sensitive enough to yield a moderately constant value and hence largely follows. The optical density reading was taken at 660 nm with a spectrophotometer (Perkin Elmer Lambda 25), and the reading value was put in the standard graph.

The carbohydrate

Carbohydrate ratio was estimated via the Anthrone method. Carbohydrates exist as free sugars and polysaccharides. The basic units of carbohydrates are monosaccharides, which cannot be split by hydrolysis into simpler sugars. The carbohydrate content can be measured by hydrolysing polysaccharides into simple sugars via acid hydrolysis and estimating the resulting monosaccharide. In the estimation process, readings were taken at 630 nm via a spectrophotometer (Perkin Elmer Lambda 25), and a standard graph was generated.

Estimation of fat

The estimation of fat content was performed by adding 4 ml of diethyl ether to 1 ml of solution, placing it in a funnel, shaking it properly and maintaining it for 24 hrs.

The sample was then extracted and weighed. The fat content was calculated via the following formula:

$$\text{Fat\%} = \frac{\text{Original weight of the sample} - \text{Weight of the sample after extraction}}{\text{Original weight of the sample}} \times 100$$

Nutritive value

The nutritive value was determined via the following formula:

$$\text{Nutritive value} = 4 \times \text{percentage of protein} + 9 \times \text{percentage of fat} + 4 \times \text{percentage of carbohydrate.}$$

pH value

The pH value was estimated via a pH meter.



Figure 2. Starter Culture Cake of *Jonga* (Rabha).



Figure 3. Filtration process of *Apong* (Mising) using *Tum* (bamboo basket).



Figure 4. *Jonga* (Rabha)



Figure 5. *Zu* (Tiwa)

RESULTS AND DISCUSSION

In the present study, the nutritional contents of all three traditional fermented beverages (Table 1) from the Rabha, Tiwa and Mising tribes were estimated. All the experiments were conducted in triplicate and the analyses were conducted. Biochemical analyses of these beverages revealed relatively high levels of carbohydrates, consistent with the starch-rich substrate of rice. Among the samples, carbohydrate content was highest in *Zu* (Tiwa), then *Apong* (Mising), with modest values, and the lowest content occurred in *Jonga* (Rabha). The presence of residual sugars, due to incomplete fermentation, accounts for the

elevated carbohydrate concentrations observed in the final products. Carbohydrates represent the primary macronutrient in these beverages, serving as a major source of energy and supporting essential physiological functions in the human body. Protein content was recorded at $10.7 \pm 1.17\%$, $10.6 \pm 3.34\%$ and $10.6 \pm 0.3\%$ for *Zu*, *Apong* and *Jonga*, respectively. Proteins are essential biomolecules for living organism with diverse biological functions, including immune defence, as antibodies represent specialized proteins that neutralize pathogenic microorganisms such as bacteria and viruses (Deka *et al*, 2010).

Table 1. Nutritional Composition of traditional rice beverages.

Samples	Protein%	Carbohydrate%	Fat%
<i>Jonga</i> (Rabha)	10.6 ± 0.3	24 ± 0.73	1.2 ± 0.76
<i>Zu</i> (Tiwa)	10.7 ± 1.17	31.1 ± 0.64	0.76 ± 0.11
<i>Apong</i> (Mising)	10.6 ± 3.34	25.9 ± 0.72	1.16 ± 0.66

*Values are the means of three replicates.

Table 2. Nutritive values of traditional rice beverages.

Samples	Nutritive values
<i>Jonga</i> (Rabha)	149.2 kcal/100 ml
<i>Zu</i> (Tiwa)	174.04 kcal/100 ml
<i>Apong</i> (Mising)	156.44 kcal/100 ml

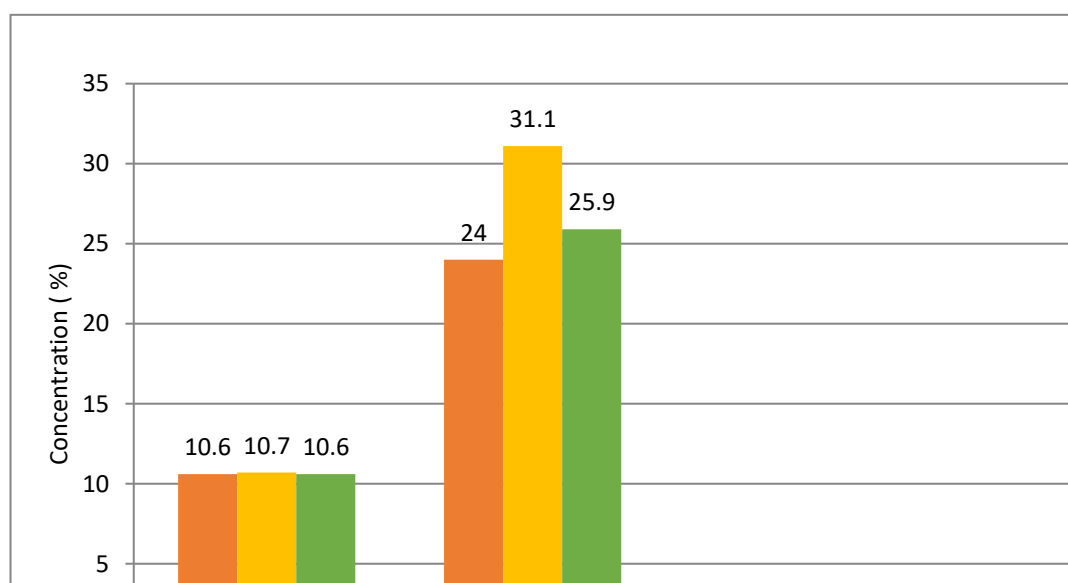


Figure 6. Graphical comparison of nutrient composition of *Jonga*, *Zu* and *Apong*.

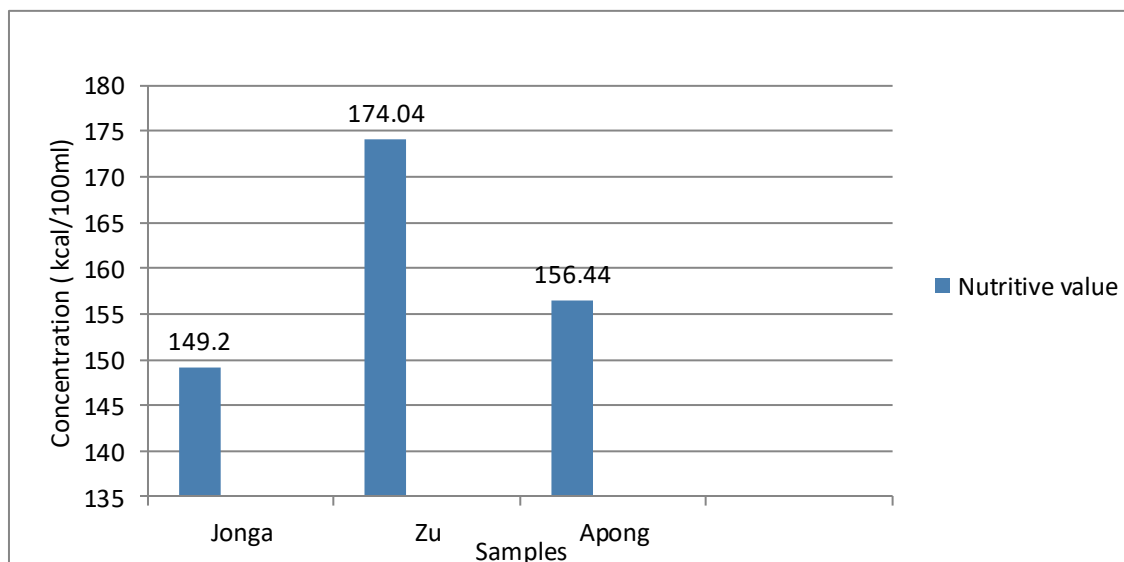


Figure 7. Graphical representation of nutritive value.

Fat content estimation indicated minimal levels across the three beverages, with *Jonga* (Rabha) and *Apong* (Mising) showing slightly higher values than *Zu* (Tiwa). Although quantitatively low, fats remain essential macronutrients, functioning as dense sources of energy (yielding more than twice the calories per gram compared to carbohydrates and proteins) and acting as energy reserves during periods of food scarcity or high metabolic demand. A comparative graphical representation of the nutritional composition of the beverages is provided in Figure. 6. Nutritive value estimation revealed that *Zu* exhibited the highest energy content, followed by *Apong*, while the lowest was recorded in *Jonga* (Figure. 7). Foods with high nutritive value are characterized by significant concentrations of essential nutrients—including proteins, carbohydrates, fats, vitamins, and minerals relative to their caloric contribution, thereby supporting optimal physiological functions and overall health. For comparative assessment, the results were evaluated against the Dimasa tribe's traditional beverage *Judima*, the first alcoholic beverage from Northeast India to be granted a Geographical Indication (GI) tag by the Geographical Indications Registry, Chennai. Previously reported values for *Judima* indicated a carbohydrate content of $18 \pm 1.8\%$ and protein content of $3.8 \pm 1.8\%$ (Sarmah *et al.*, 2022), both of which are comparatively lower than the levels recorded in *Jonga*, *Zu*, and *Apong*. Collectively, the findings confirm that the traditional rice-based beverages of Assam represent nutritionally rich formulations, particularly with respect to carbohydrates and proteins, while maintaining low fat content.

CONCLUSION

Traditional fermented beverages of Assam hold considerable importance for the indigenous communities,

functioning not only as dietary components but also as cultural symbols of identity and heritage. Documentation of these practices is critical, particularly in the context of globalization and modernization, which threaten the continuity of traditional knowledge systems. The present study contributes to this effort by characterizing the nutritional composition of selected beverages, demonstrating that they are rich sources of carbohydrates, proteins, and fats, thereby providing significant nutritive value. The analysis of nutritional composition also underscores their potential health benefits, as these beverages may serve as functional foods that support human well-being. Such findings highlight the relevance of traditional beverages beyond their cultural significance, positioning them as potential reservoirs of bioactive compounds. Future research employing standardized methodologies and advanced analytical approaches is essential to validate these observations and to identify novel bioactive constituents that could be harnessed for therapeutic applications.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest

ETHICS APPROVAL

Not applicable

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AI TOOL DECLARATION

The authors declares that no AI and related tools are used to write the scientific content of this manuscript.

DATA AVAILABILITY

Data will be available on request

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