

# Nepalese Homebrewed Alcoholic Beverages: Types, Ingredients, and Ethanol Concentration from a Nation Wide Survey

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## ABSTRACT

**Background:** Despite the enormous public health problems related to traditional alcohol consumption practice in Nepal, this area has been ignored and the information at the national level is limited. Thus this study is designed to explore the readily available commonly practiced Nepalese homebrewed alcoholic beverages, the ingredients used and alcohol strength (ethanol concentration).

**Methods:** This study was carried out as a part of ongoing household survey on “Alcohol consumption practice among married women of reproductive age in Nepal”. A total of 284 homebrewed alcoholic beverage (distilled 175, non-distilled:109) samples were collected from the 16 survey districts of Nepal during the period of April to August, 2013. Ethanol percentage was tested in research lab by using standard procedure.

**Results:** Readily available homebrewed alcoholic beverages in practice were mainly of two types “Distilled” (local Raksi) and “Non-distilled” (Jand, Chhyang, Tumba). Rice, wheat, barley, millet, maize, fruits, and pure sugar were the commonly used ingredients to prepare alcohol. Ethanol concentration in homebrewed alcohol was 14.0% (IQR: 10.0-19.0) ranging from 3% to 40% for distilled, and 5.2% (IQR: 3.5-9.8) ranging from 1% to 18.9% for non-distilled. A significant difference ( $P < 0.05$ ) was found in alcohol strength by residence, development regions, types of alcohol, and the ingredients used.

**Conclusions:** The median concentration of ethanol in readily available home brewed alcoholic beverages in Nepal was more than the strength of factory produced beer. The alcohol strength varies across their types, ingredients used, residence and regions.

**Keywords:** Cross-sectional study; home brewed alcohol; nepal.

## INTRODUCTION

Alcohol, chemically known as ethanol, causes several health, economic and social consequences across the world.<sup>1,2</sup> Alcohol is not an ordinary commodity as it is commonly viewed; it requires research and public attention.<sup>3</sup> The global report stated that 5.9% of all deaths worldwide in 2012 were attributed to alcohol consumption and it

caused a loss of 139 million Disability-Adjusted Life Years (DALYs) or 5.1% of the global burden of diseases and injury.<sup>4</sup> Alcohol adversely effect the fetus when pregnant women drink.<sup>5</sup>

As Homebrewed alcoholic beverages (HBAB) are cheaper, they are more likely to be consumed by the people from poorer segment of the society

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in Asia and Africa.<sup>6,7-9</sup> These beverages are poorly monitored with no control over the production, licensing and selling.<sup>2,10</sup> There are varying ethanol concentrations in HBAB around the world. It was 22-45%, 6-11% and 2-3% in India, Uganda and Ghana. respectively.<sup>6,11</sup>

In India and Nepal, several indigenous HBAB are traditionally prepared and consumed since ancient times. They prepare HBAB from locally available grain, fruits and herbs for family use and commercial purpose.<sup>8,12-15</sup> Alcohol use is encouraged during childbirth as pain relief and breastfeeding mothers to increase milk production. A quarter of women in the Eastern nepal and 31.4% of mothers of stunting/underweight children consumed alcohol during pregnancy.<sup>16,17</sup>

Despite the enormous public health problems related to HBAB in Nepal, this area has been ignored by researchers and policy makers and the information is limited. Thus present study intended to provide value of ethanol concentration in Nepalese HBAB which may help national health policy and plan.

## METHODS

This study was a part of an ongoing cross-sectional study on “alcohol consumption practice among married women of reproductive age in Nepal”. A nationally representative household survey was carried out between April and August, 2013. Out of the 75 districts in the country, 16 were selected to represent the three ecological belts (Mountain, Hill and Terai) and the five development regions of Nepal. From the selected districts, 86 Village Development Committees (VDCs) and 14 Municipalities were selected based on the Probability Proportional to Size (PPS) sampling method. For the cross sectional study, 3 wards were selected using simple random sampling followed by 30 households within each ward using systematic random sampling. However, for the alcohol samples, after acquiring information from local key informants 1 sample each of the available variety of alcohol sample in the selected VDC was collected from among the selected households.

The sample size for this study was decided with the aim of collecting at least 3 samples of alcohol

of different or same variety from each sampling units on the basis of availability, local varieties and the willingness of household to provide HBAB. Out of the 300 estimated samples from 100 sampling units (86 VDCs and 14 Municipalities), ethanol concentration was measured in 284 samples as 16 sample were discarded because of the inadequate amount of collection. A similar study in rural Kenya also collected two types of traditional brew representing each selected sites to analyze alcohol content<sup>18</sup>.

Information on ingredients used and methods of preparation were obtained from the women in the identified household.

Formal approval was sought from the district health office and local authority. Written informed consent was taken from respondents prior to data collection. This study was approved by ethical review board of the Nepal Health Research Council.

Interviewers and supervisors with health background were recruited and trained on sampling techniques, use of questionnaires and alcohol sample collection. Laboratory expert and senior research officer from Department of Food Technology and Quality Control provided detail orientation on procedures of collection and transportation of alcohol sample to the laboratory.

The alcohol samples were collected in 200 ml airtight glass bottles and transferred to the laboratory within 1- 4 days of collection. The precautionary measures were considered by keeping samples in cold place, ensuring leakage and protection from sunlight, air tightening of bottle cover, proper labeling and timely transfer. Non-distilled alcohol samples were collected in bottles containing potassium meta bisulphate as a preservative chemical in the proportion of 350 ppm. The non-distilled samples were sent to the Astha Scientific Research Laboratory in Kathmandu and the distilled samples were tested in In-Reach laboratory in Kathmandu by a trained technician.

The alcohol concentration of the distillate was determined by measuring their densities using a special alcohol hydrometer also known as Gay-lussac % alcoholmeter, calibrated at 20°C with readings in percentage volume by volume (% v/v).<sup>19</sup>

The used glass jar was clean and dry having 250ml capacity. The alcoholmeter was slowly dipped into the liquid until it floated freely. The reading was taken at the level of the liquid surface and the concentration of distilled alcohol was recorded. Alcohol strength by standard density method was 24.22% while reading on the Gay lussac alcoholmeter was 26%. An error of minus 2.22% was adjusted in reporting.

The Alcohol content was determined by using Pycnometer method taking the specific gravity of distilled sample at 20°C. The Non-distilled liquors were distilled following the standard method as defined in Association of Official Analytical Chemists (AOAC) Official Method 942.06.<sup>20</sup> The distillate was then kept in water-bath to bring the temperature of the sample exactly at 20 °C. Calibrated thermometer was used for the precise measurement of temperature of the water bath. Samples were incubated in the water bath kept at 20°C water until the temperature equilibrium is achieved (approximately 30 minutes). The volume of the distillate was then prepared with the addition of distilled water at 20°C. Finally, the specific gravity of the alcoholic distillate was identified by taking the weight of certain volume of samples and the same volume of distilled water bath kept at 20 °C. The specific gravity of the sample was then determined by comparing the weight of the distillate against the weight of same volume of water and both are kept in 20°C. Then the alcohol strength of the sample (in % v/v) by volume was determined by comparing the specific gravity of the samples with the specific gravity and alcohol strength in chart.

Data recorded in a pre-coded entry sheet by the Lab Personnel at InREACH and Aastha Lab, were entered into Epi-data 3.1 and Statistical Package for Social Science (version 17.0) was used for the analysis. Descriptive statistics (percentage, median, IQR, range) was calculated to describe the major findings. Statistical significance of alcohol strength by independent variables was analyzed using Mann-Whitney U test (2 samples) and Kruskal-Wallis 1-way ANOVA (k samples) as the data did not follow normal distribution.

## RESULTS

Ethanol concentration of HBAB samples are presented in Table 1. Of the 284 samples analyzed 175 (61.6%) were distilled liquor called 'Local Raksi', and 109 (38.4%) were non-distilled types of HBAB that included three different sweet and sour varieties Jand (n=61), Chhyang (n=45), and Tongba (n=3).

The median ethanol concentration in total aggregated samples was 10.7% (IQR: 7, 16) in which 14.0% (IQR: 10, 19) was for distilled (Local Raksi), and 5.2% (IQR: 4, 10) for non-distilled (Jand, Chhyang and Tongba). Local Raksi was the strongest of all.

**Table 1. Alcohol concentration (%) in 284 samples of Home Brewed Alcoholic Beverage by types and local Nepalese name.**

Beverage			Alcohol concentration (% v/v)	
Types	Local Name	No. (%)	Median (IQR)	Total Range
	Total Samples	284 (100)	10.7 (7, 16)	1 - 40
Distilled	Local Raksi (Ayela, tharra)	175 (61.6)	14(10, 19)	3 - 40
Non-distilled	Total non-distilled	109 (38.4)	5.2 (3.6, 9.8)	1 - 18.9
	- Jand	61	5.2 (3.4, 11.1)	1 - 18.9
	- Chhyang	45	5.4 (3.6, 9.6)	1 - 17.1
	- Tongba	3	3.5 (2.8, 5.6)	2.1 - 7.7

By development regions, 95 (33.5%) samples were from central region followed by eastern region 62 (21.8%), western region and far-western region 46 (16.2%), and mid-western region 35 (12.3%), respectively (Table 2). The western and far-western regions had the highest median ethanol concentration for distilled (16.0%). Although the median concentration of HBAB was 11.0% in central and 9% in Mid-western region, the highest range of 40% was found in both places. Regarding non-distilled types, HBAB from western region (8.8%) had the highest strength followed by mid-western region (8.1%).

The alcohol strength by ecological belt, location and ingredients used to prepare HBAB is shown in Table 3. No significant difference was found in median alcohol strength of HBAB across all three ecological belts of Nepal. However, there was a

substantial difference in alcohol strength by the location (urban/rural) and ingredients used to prepare HBAB. The ethanol concentration of HBAB from urban location (18.0%) was significantly higher than those from rural areas (13.0%) for distilled type (p value= 0.001).

**Table 2. Alcohol Concentration (%) in Home Brewed Alcoholic Beverage by Development Regions.**

Development Region	Distilled (N=175)				Non Distilled (N= 109)			
	No	Median (IQR)	Range (% v/v)	P Value	No	Median (IQR)	Range (% v/v)	P Value
Eastern	42	15 (12,18)	6-30	0.005	20	3.7 (2.8,5.6)	2.1-15.3	0.063
Central	51	11 (9.5,22)	3-40		44	5.2 (3.5,8.1)	1.0-14.8	
Western	31	16 (13,20.5)	8-29		15	8.8 (3.1,11.6)	2.1-14.8	
Mid-Western	20	9 (8.8,14)	5-40		15	8.1 (4.8,14.7)	2.1-18.9	
Far-Western	31	16 (13,19)	6-32		15	7.1 (3.9,9.7)	3.1-17.1	

Cereals (maize, wheat, millet, rice, and barley), fruits (plum, apple, grape, banana, strawberry, and apricot) and sugar products (Jaggery, Sugar) were the commonly used ingredients for the production of HBAB. Out of 284 samples, 208 (73.2%) were produced with cereals as the main ingredients; and second most common ingredient used was sugar in both types of alcoholic products. Non-distilled alcoholic beverages were produced more commonly from the cereals. Distilled HBAB of mixed ingredients had the highest concentration ( $M=19.0\%$ ,  $IQR: 17.0-27.0$ ) followed by fruits produced ( $M=15.2\%$ ,  $IQR: 14.0-16.2$ ).

**Table 3. Alcohol Concentration (%) of Home Brewed Alcoholic Beverage by Ecological Belt, Location and Ingredients used.**

	Distilled (N=175)				Non Distilled (N= 109)			
	No	Median (IQR)	Range (% v/v)	P Value	No	Median (IQR)	Range (% v/v)	P Value
<b>By Ecological Belt</b>								
Mountain	33	13(10,20)	5-40	0.995	22	5.3 (3.6,9.4)	2.1-18.9	0.289
Hill	58	15 (9, 21.8)	3-40		44	4.4 (3.3,8.2)	1-14.8	
Terai	84	14.5 (11,18)	6-30		43	6.9 (3.5,12.9)	2.1-17.1	
<b>By Location</b>								
Urban/Semi-Urban	30	18 (15,25.8)	6-40	0.001	11	4.8 (3,8.1)	1-10.4	0.360
Rural	145	13 (10,18)	3-40		98	5.3 (3.5,9.8)	2.1-18.9	
<b>By Ingredients</b>								
Cereal	108	12.8 (10,18)	3-40	0.002	100	5.6 (3.5,9.9)	1-18.9	NA
Fruit	12	15.2 (14,16.2)	10-30		1	4.1	4.1-4.1	
Sugar	36	14 (10,18)	6-30		8	3.7 (3.3,4.5)	2.3-13.5	
Mixed	19	19 (17,27)	7-32		0	NA	NA	

NA: Not Applicable

## DISCUSSION

Common traditional HBAB found in Nepal are of two major types, distilled liquors and non-distilled fermented beverages from grains, fruits, and sugar. There are different local names for these beverages though they follow almost similar procedures for the preparation.

Present study found significantly differing alcohol strength for distilled and the non-distilled beverages. The distilled HBAB had more than two-times alcohol strength of total non-distilled 14.0%

( $IQR: 10.0-19.0$ ) versus 5.2% ( $IQR: 3.6-9.8$ ). Among non-distilled subtypes, *Chhyang* was the strongest (5.4%;  $IQR: 3.6-9.6$ ). In total, the strength ranged from 3% - 40% for distilled and from 1% - 18.9% for non-distilled types.

This was a surprising finding to the common expectations that these homebrewed alcoholic beverages were considered milder in alcohol strength than those of market available products. The median aggregated ethanol concentration (10.7%) for both distilled and non-distilled

beverages in current study was almost similar to the wine concentration (7%-12.9%) and two folds higher than the average beer concentration (4.5%) in US and Europe.<sup>21</sup> and higher than the strongest beer in Nepal (7.0%). Although, the median concentration for local Raksi (14.0%) was nearly 3 times lesser than that of average spirit concentrations of USA (41.1%).<sup>21</sup> the strength ranged up to the 40% high in some areas of Nepal. Similarly, Nepalese HBAB were stronger than in Uganda (6.0-11.0%), Ethiopia (2.0-4.0%), Egypt (3.8 to 4.2%) and Ghana (2.0-3.0%) and it was milder than that of Indian distilled home liquor 22.0- 45.0% and 34.0% Kenyan Chhangaa spirit.<sup>6</sup>

Among subtypes of non-distilled alcohol, the ethanol concentration of Jand (5.2%) in current study was similar to 5.9% of Rice Jand in India.<sup>14</sup> Whereas, the alcohol strength of Chhyang (median 5.4%) in our study was less than the 8.2% in India.<sup>12</sup> The difference in alcohol strengths of these traditional alcohol types, particularly Jand and Chhyang across Nepal and India may be due to the differences in maturation time that people in different locality prefer to have. In this study we collected the samples which were readily available at home and we did not ask details on the preparation process for individual sample. However, according to information collected, some of these HBAB were kept for more than 6 months to make it strong in alcoholic effect. People in the community believe longer the maturation stronger the effect.

All HBABs were produced with locally available ingredients like cereal (millet, rice, maize wheat, barley, buckwheat), fruit (apple, grapes, bananas, apricot, peach etc), sugar products (pure sugar, *Bheli*/Jaggery) and mixed products (combination of cereals, fruits or sugars; or all three types of ingredients). The *Local Raksi* is the distillate extracted from *Jand* while the '*Jand*', '*Chhyang*' and '*Tongba*' are the non-distilled beverages with sweet and sour in taste.

*Jand* is thick and people eat whole grain whereas *Chhyang* is juicy portion of fermented whole grain usually prepared by rice and millet. These types of beverages are considered as an inexpensive high calorie mild-alcoholic beverage in Himalayan

regions of India, Bhutan and Nepal.<sup>14</sup> Good quality Jand usually has sweet taste.<sup>15</sup> People in Nepal believe that Jand with the sweetened taste is better for health; and it is ready to use normally on third day of its earthen pot fermentation. '*Tongba*' is more fanciful drink and produced only from the millet grains; this is always served in a traditional '*Tongba*' pot. The production process of these beverages are almost similar as explained previously.<sup>12,22,23</sup> and involves series of steps; cooking of the cereals, mixing it with *Marcha* (yeasts) and keeping it in an air-tightened earthen pot for fermentation.

A significant difference was found in alcohol strength according to the types, ingredients used, development regions and urban and rural location. Among 5 development regions of Nepal, the HBAB from western and farwestern development regions were stronger. Furthermore, the urban produced HBAB were significantly stronger than those of produced in rural. The variability of alcohol strength could also be attributed to the fermentation differences, ingredient used and the procedures

followed. Moreover, higher alcohol strength of distilled beverages in urban location could also be due to people's choice of drinking strong alcohol. Another explanation may be the fact that HBAB in urban locations are produced for commercial purpose as well. Stronger the alcohol, better the business. The producer separately collect the distillate (the stronger one) which are collected from the steam of cooked fermented ingredients as a first lot (*Nepali name: Ek Pane Raksi, which means the first water*). This *Ek Pane* is strongest and preferred by people in local areas. This *Ek Pane Raksi* is similar in the sense as explained the 'Super' by Rana T in his study.<sup>24</sup> In rural areas, rather than commercial view point, people produce alcohol for their own consumption thus prefer mild alcoholic beverages.

It is well documented that the alcohol issues has been a global concern for the health of the people and viewed as a prioritized research area. In Nepal, this area has been almost negligible and out of public attention. Home brewed alcohol production and drinking has been commonly practicing as part

of daily life and as tradition.<sup>17,25-27</sup> As shown by study in Nepal, among women who drink alcohol, 89% of them drink HBAB.<sup>27</sup> Hence this area has to be explored further.

In this regard, our study could pave a way forward by seeking attention of the policy makers, academia and research institutes for further investigation. Because of the inadequate data, present study did not include ‘maturation time’ of HBAB. It is recommended that concerned authority to look into the quality aspects of these beverages similar to other studies across the world<sup>28-31</sup>, by using different parameters during the entire process of production, selling and consumption of these beverages for the prevention of associated public health problem and social harms. Besides several health consequences of alcohol consumption, these HBABs could have other potential health risks for mother and child if a pregnant or lactating mother consumes as shown by several studies.<sup>17, 30-31</sup> Local HBABs could also have potential health effects due to its contents and production process which also needs to be further investigated.

## CONCLUSIONS

Common types of HBAB readily available in Nepal were distilled liquors (local raksi) and non-distilled (Jand, Chhyang, Tongba). The median ethanol concentration of these brews was above the commonly available market beers and wine but lesser than the branded liquor. Distilled ones were more than two-folds stronger than the non-distilled beverages. Ingredients commonly used in HBAB were cereals, fruits, sugar, and mix of cereals and fruits. Home brews made of mixed ingredients, produced in urban areas, and from western regions of the country were significantly stronger in ethanol concentration. Almost similar concentration was found across the ecological belts.

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