Global Journal of Food Science and Technology

ISSN: xxxx-xxxx Vol. 1 (1), pp. 086-090, November, 2013. © Global Science Research Journals

*Full Length Research Paper*

# Preparation and physicochemical analysis of some Ethiopian traditional alcoholic beverages

**Tadele Yohannes, Fekadu Melak* and Khalid Siraj**

Department of Chemistry, College of Natural Sciences, Jimma University, P.O. Box 378, Jimma, Ethiopia.

Accepted 8 August, 2013

**Ethiopian traditional alcoholic beverages namely *tella*, *tej* and *areki* are very common drinks in the country. Ten (10) alcohol vending houses were considered in the study by considering two from each five sub-cities, purposely for 'filtered' *tella* sampling and five for the unfiltered *tella, tej* and *areki* samples. The alcoholic contents of *filter-tella*, *tej* and *areki* were measured and found in the range of 3.84 to 6.48, 8.94 to 13.16 and 33.95 to 39.9% v/v ethanol, respectively. Difference in pH values and ethanol levels among all samples was significant ($p<0.05$). Variations within samples of each vending houses, coefficient of variation (CV>10%) among all samples were significant, though the variation in pH of the alcohols studied were analyzed and found at drinking range or according to European Brewery Convention. Finally, sensory responses which were taken from the community (people drinking these alcohols), indicated that they are high in aroma (bitterness for *tella* than other drinks reported).**

**Key words:** Filter-tella, tej and areki, traditional alcoholic beverages.

## INTRODUCTION

In nearly all areas of the world, some types of alcoholic beverage native to their region are prepared and consumed (Steinkraus, 1986). Indigenous fermented alcoholic beverages from different parts of the world are described (Abegaz et al., 2003; Kabak and Dobson, 2011). In Ethiopia, some of the fermented beverages include *tella, tej*, *borde* and *shamita* which are very popular traditional drinks. The latter two, *borde* and *shamita* are mainly prepared in central and southern Ethiopia (Alemu et al., 1991; Ghebrekidan, 1992) whereas considering popularity, traditional alcoholic beverages namely, *tella* and 'katikala'(*areki)* is very common in northern part of Ethiopia. Currently, even bottled 'Gojam *areki'* from north Ethiopia is in the market by gathering from different rular vending houses.

Among fermented foods, alcoholic beverages have been widely consumed since prehistoric times by people around the world. Fermented products can play an important role, contributing to the livelihoods of rural and perturbing dwellers (Gadaga et al., 1999; Jeyaram et al., 2009). In developing countries, traditional fermentation serves many purposes. It can improve the taste of food, enhance the digestibility of a food, preserve food from degradation by noxious organisms, and increase nutritional values. Further, it is used for medical reasons, recreational purposes, in marriages, in religious and non-religious ceremonies (Kohajdova and Karovicova, 2007; Anteneh et al., 2011), at festivals and social gatherings, at burial ceremonies and as food substitutes (Hall and Sharples, 2008).

Fermentation methods for traditional alcohols are inexpensive and adaptable at household level in traditional communities (Paredes-López and Harry, 1988). Its process involves chemical change in bringing organic substrates through the action of biochemical catalysts, called enzymes. In brewing industry: Starch substrate ↦ glucose ↦ ethanol + carbon dioxide + energy.

*Corresponding author. E-mail: melakrobel@yahoo.com. Fax: (047) 1111450.

Consumption of alcohols from different brewing products posses several damaging effects such as, mental problems, job trouble, loss of control, impaired judgment in humans and irresponsible behaviors (Coleman and Cater, 2005; Bhargav et al., 2008; Sui et al., 2009). Depending on the dose and the regularity of its consumption, alcohol is a more problematic causing heart disease, cancer diabetes, acute respiratory failure or death (Guidot and Hart, 2005; Gun et al., 2006). There are considerable evidences in some African countries that produced alcoholic drinks are known to have toxic components (Reilly, 1976; Sanni, 1993).

Various works have been reported in fermented food analysis (Aloys and Angeline, 2009; Satish Kumar et al., 2012), particularly alcoholic beverages in different parts of Ethiopia including the data with regards to methanol, fuel oil and ethanol contents of *tella, areki and tej* (Urga et al., 1997; Bekele et al., 2001). The ethanol and metha-nol content were reported seemingly from *'*unfiltered*' tella* of Ethiopia though not clearly indicated (Desta, 1977). In light of this, 'filtered' *tella* physic-chemical parameters like ethanol level, pH, turbidity, sensory evaluation and community perception has been seldom addressed in Ethiopia. Hence, this study aimed to analyze ethanol level, pH and turbidity of some traditional alcoholic drinks accustomed in Ethiopia which include *tella*, *tej* and *areki.*

In the case of *tella*, both 'filtered' and 'unfilterd' products were considered for analysis. Moreover, sensory evaluation and community perception were taken into consideration with freshly homemade *tella*.

## MATERIALS AND METHODS

### Sampling and sampling site

Ten (10) samples of 'filtered' *tella*, five samples of *tej* and *areki* vending houses were considered from different sub-cities of Jimma, namely: Ajjip, Qochi, Markato, Menahera and Matrik Sefer. Moreover, five 'unfiltered' *tella* samples were monitored starting from preparation and taken for analysis from each five sampling sites. All those vending houses were selected purposively, and *tella* samples were collected using polyethylene bottles for analysis.

### Preparation of traditional alcoholic beverages: A case in Jimma, Ethiopia

#### *Tella*

*Tella* is one of the Ethiopian traditional beverages, which is prepared from different ingredients. It is brewed from various grains and different cereals which include; barely, corn, wheat and sorghum and also from teff and maize, although in some regions, millet and *Rhamnus prinioid* (Fite et al., 1991).

Pre-preparation steps were similar to that described by Sahle and Gashe (1991). The clay container (*insera*) was washed with *Grawa* (Vernonia amygdalina) and water several times and after that smoked with wood from *weyra* (*Olea eurapaea* subsp. Cuspidate) in order to find good fragrance or flavor and to be neat. During the preparation of *tella*, an average duration of six to eight days was required by the *tella* producers at winter season. The preparation of *tella* has four major phases.

#### *Tej*

*Tej* is a home processed, fermented alcoholic beverage; it is also commercially available honey wine. It is prepared from honey, sugar, water and leaves of *Gesho* (*Rhamnus prepoides*). Preparation procedure was similar to those reported by Bahiru et al. (2001).

#### *Areki*

*Areki* is a distilled alcoholic beverage. It is a colorless, traditional alcoholic beverage which is distilled from fermentation products prepared in almost the same way as *tella* except that fermentation mass in this case is more concentrated.

### Chemicals and apparatus

Abbee Refractometer (ATAGO, USA) pH meter, density meter (Compaq Evo D500, USA) were used for the experimental work. Distilled water was utilized. All experimental process was performed according to standard procedure.

### Experimental

The collected samples of *tella* ('filtered'-case) and 'unfiltered' *tella* monitored during the preparation process plus *tej* were primarily filtered with 150 µm sieve and kept in a refrigerator until experimental work. The density meter was adjusted to determine the desired parameters.

### pH values of the samples

The pH of the samples was measured by dipping the electrode of a digital pH meter into the samples after a proper calibration of the meter with standard solution.

### Determination of the refractive index

All the refractive indices was measured by using Abbee refractrometer on a water bath and thermostat. The function of the water bath and the thermostat is to keep the temperature of the system constant (20°C). Before and after measurement of the refractive index of each sample, the refracto-meter was calibrated with distilled water.

### Determination of the specific gravity

The specific gravity of the samples was determined using a pycnometer (long neck pycnometer). The weights of an empty pycnometer, pycnometer with distilled water, and pycnometer with the samples were measured using a balance.

$$\text{Specific Gravity} = \frac{\text{Weight of pycnometr with a sample} - \text{Weight of empty pycnometer}}{\text{Weight of distilled water}}$$

**Table 1**. Experimental results of physico-chemical parameters of 'filtered'-*Tella*.

| S/N | Collection area | pH values | Refractive index (RI) | Specific gravity (SG) | Alcohol content (%v/v) |
|---|---|---|---|---|---|
| 1 | Qochi1 | 4.00 | 1.3380 | 1.0080 | 4.82 |
| 2 | Qochi2 | 4.53 | 1.3378 | 1.0038 | 4.00 |
| 3 | Ajip1 | 4.99 | 1.3374 | 1.0047 | 3.98 |
| 4 | Ajip2 | 4.74 | 1.3372 | 1.0045 | 3.84 |
| 5 | Matrik 1 | 4.80 | 1.3379 | 1.0047 | 6.26 |
| 6 | Matrik 2 | 4.75 | 1.3353 | 1.0045 | 6.48 |
| 7 | Markato 1 | 4.68 | 1.3377 | 1.0053 | 6.15 |
| 8 | Markaro 2 | 4.81 | 1.3378 | 1.0052 | 6.19 |
| 9 | Menahara1 | 4.60 | 1.3405 | 1.0097 | 5.46 |
| 10 | Menahara2 | 4.76 | 1.3511 | 1.0087 | 4.51 |

**Table 2.** Ethanol level (%v/v) and original gravity measurements in each sample of 'unfiltered' *tella*.

| Sample type | Alcohol (%v/v) | Original gravity (%) |
|---|---|---|
| *Menahara* | 3.89 | 12.69 |
| *Matrik* | 4.52 | 13.74 |
| *Markato* | 4 | 12.69 |
| *Qochi* | 3.84 | 12.66 |
| *Ajip* | 3.5 | 13.00 |

**Determination of ethanol level of the samples**

The ethanol level of *tella, tej and areki* was determined in the quality control laboratory of Bedele Brewery, Bedele. It is first filtered using a fluted filter paper. Then, the ethanol level determination involved measurement of refractive index and specific gravity. The temperature of the filtrate was then set at 20°C. The refractive index and the specific gravity of the samples were measured at 20°C temperature. The alcoholic content of the samples were calculated using Dave Miller (Miller, 1988) who estimates the alcohol by volume using a formula: Alcohol by volume = (initial gravity - final gravity) / 0.75.

## RESULTS AND DISCUSSION

### Physicochemical properties of alcoholic beverages

Significant variations in pH values of the *tella* within the sampling sites and pH value ranged from 4.00 to 4.99 (Table 1). There were also significant variations in the alcohol content of *tella* samples observed where the values ranged from 3.98 to 6.48 (% v/v) and averaged 5.17 (%v/v). Wide variations in results were obtained and this might be attributed to different methods of preparation of the beverages at the domestic level and the constituent variations are also suggested in literatures (Vogel and Gobezie, 1983). As these fermentations are natural and, thus, uncontrolled, alcohol produced during the fermentation methods are spontaneous, and variability of the product is inevitable (Zvauya et al., 1997). Statistical one-way ANOVA analysis indicated that at the 0.05 ($p = 0.028$) level, the means of the ethanol (% v/v) of 'filterd' and 'unfiltered' *tella* are significantly different (Tables 1 and 2). The Original gravity reported for 'unfilterd' tella was found in the range of EBC (European Beer Convention).

In Table 3, the pH value of *tej* and *areki* ranged from 3.56 to 4.45, and 4.30 to 4.51, respectively. Moreover, alcohol contents of *tej* and *areki* samples ranged from 8.94 to 13.16 and 33.95 to 39.90 with average values of 11.47 and 37.22 %v/v, respectively. There is a significant variation in the alcoholic content of *tej* and *areki* samples collected from different area as it is supported by Gizaw (2006) through the study conducted at different location. The alcohol contents of the sub-cities reported (Figure 1) for each alcoholic drink is as indicated: Tella case; matrik> merkato> menaheria> Qochi> Ajip. For Areki the order of alcoholic content is matrik> merkato> qochi> menaheria> ajip. For tej: the order in alcoholic content is like merkato> qochi> menaheria> ajip> matrik.

In Jimma town, the variation in ethanol contents of traditional alcoholic beverages like *areki* and *tej* might be due to differences in preparation and fermentation as it is reported by Bahiru et al. (2001) and Susan and Lewis (1993). Conditions such as temperature, aeration and actions of the microorganisms also obviously affect the level of the alcohol in the samples (Sahle and Gashe,

**Table 3.** Experimental results of pH and ethanol level of Ethiopian traditional alcoholic drinks, *tej* and *areki*.

| S/N | Collection area | pH value | | Alcohol content (%v/v) | |
|---|---|---|---|---|---|
| | | Tej | Areki | Tej | areki |
| 1 | Qochi | 3.66 | 4.30 | 12.98 | 36.99 |
| 2 | Ajjip | 3.92 | 4.40 | 10.72 | 33.95 |
| 3 | Matrik | 3.56 | 4.51 | 8.94 | 39.90 |
| 4 | Markato | 4.45 | 4.49 | 13.16 | 38.96 |
| 5 | Menihara | 4.15 | 4.48 | 11.56 | 36.30 |
| 6 | Average | 3.948 | 4.436 | 11.472 | 37.22 |

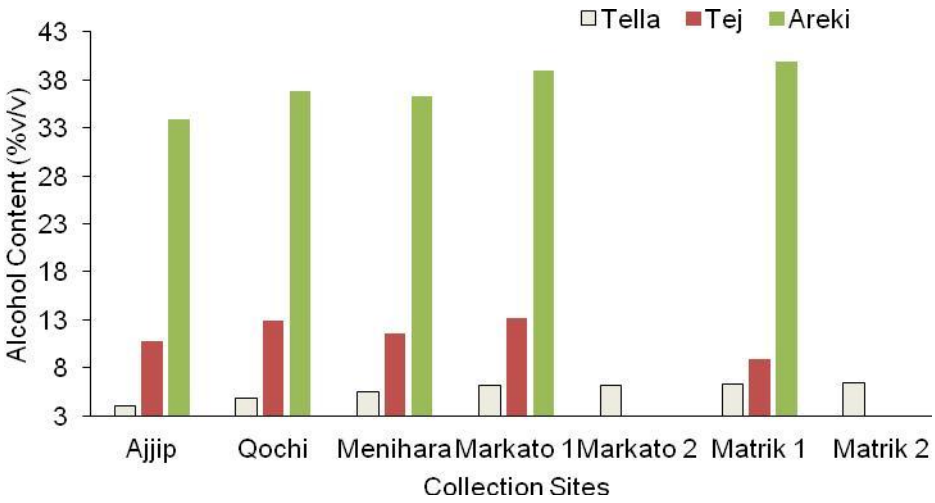


**Figure 1.** Alcoholic content versus study site variation of alcoholic drinks.

1991). The average pH values of *tej* and *areki* in this study show considerable variation for each sample as indicated in the results obtained. In comparing the mean alcohol contents of *tej* from other studies in Ethiopia, deviation was observed such that the result is more than that reported by Desta (1977), but similar to that reported by Gizaw (2006).

## Sensory evaluation of *tella*

A panel of ten people afterwards called judges who have had experiences in drinking alcohols were selected from the community on the basis of interest and availability. They were initially trained in descriptive analysis of the mouth feel attributes of *tella*. Most of the judges provide a sensory evaluation reflection of bitterness in the 'unfiltered' *tella* samples prepared under the supervision of the researcher. But for the cases of 'filtered' *tella* collected from five study sites, the judges dictated that most of the samples >70% have medium sourness by stating that they feel sweet taste and sour homogenized. Some of the mouth feels such as bitterness, sweet, sour, soapy and aromatic used by these judges were reported by Langstaff and Lewis (1993) though they used a term softness instead of soapy or $CO_2$ (Kebede et al., 2002). The judges emphasized that the reason for bitterness might be the higher use of *gesho* in the preparation. In view of this, it seems evident (Motarjemi and Nout, 1996) that the raw materials utilized for the production of the beverages as well as the type of yeast during fermentation conditions played the major role in defining the mouth feel parameters. In sensory evaluation, tella were found to be strongly affected by the method of preparation, which in turn played an important role in the perception of the people in the ingredient at the initial. The judges were also interviewed on the perception of the community on alcoholic beverages in general about *tella*, *areki* and *tej* and responded as follows: there are assumptions that *tej* is to be consumed by peasants living near the town or by the aged people in the town. All the judges agreed that on the perceptions or importance, they

they accepted because they contribute to medicine, it makes them to get fatter in short periods, and there is eye-watering as length of consumption period increased. Other serious cases those judges suggest when asked to provide their last words, was about the secrets things done to increase the alcoholic content of tella in the community which is adding cement and the use of certain plants. Market value or the business of venders is not as expected due this related secret perceptions and trigs-judges prediction.

## Conclusion

The study indicates that the alcoholic content (% v/v) of traditional alcoholic drinks (*tella, tej* and *areki*) in Jimma town varied considerably by the type of alcoholic drink considered. Similarly, there was a significant variation in pH values of the three alcoholic drinks (*tella, Tej and Areki)* though it was on drink range. Not only the variation in alcoholic drinks but also ethanol level were reported with significant variation from each experimental site studied. The alcoholic content variability in local alcoholic beverages could be attributed to the spontaneous fermen-tation differences that the producers build.

## ACKNOWLEDGEMENT

We thankfully acknowledge the Department of Chemistry, College of Natural Sciences, Jimma, University, Ethiopia, for providing necessary facilities to carry out this work.

### REFERENCES

Abegaz K, Beyene F, Langsrud T, Narvhus JA ( 2003). Indigenous processing methods and raw materials of borde, an Ethiopian traditional fermented beverage. J. Food Technol. Afr. 7:59-62.

Alemu F, Amha-Selassie T, Kelbessa U, Elias S (1991). Methanol, fuel oil and ethanol contents of some Ethiopian traditional alcoholic beverages. SINET:Ethiop. J. Sci. 14:19-27.

Aloys N, Angeline N (2009). Traditional fermented foods and beverages in Burundi. Food Res. Int. 42:588-594.

Anteneh T, Tetemke M, Mogessie A (2011). Antagonism of lactic acid bacteria against foodborne pathogens during fermentation and storage of borde and shamita, traditional Ethiopian fermented beverages. Int. Food Res. J. 18:1189-1194.

Bekele B, Tetenike M, Mogessie A (2001). Chemical and nutritional properties of “tej”, an indigenous Ethiopian honey wine: variations within and between production units. Food Technol Afr. 6:104-108.

Bhargav S, Panda BP, Ali M, Javed S (2008). Solid-state Fermentation : An Overview. Chem. Biochem. Eng. Quart. 22:49-70.

Coleman LM, Cater SM (2005). A qualitative study of the relationship between alcohol consumption and risky sex in adolescents. Arch. Sex. Behav. 34:649-661.

Desta BA (1977). Survey of the alcoholic contents of traditional beverages. Ethiop. Med. J. 15:65-68.

Fite A, Tadesse A, Urga K, Seyoum E (1991). Methanol, fusel and ethanol contents of some Ethiopian traditional alcoholic beverages. SINET. Ethiopia JSCi. 14:19-27.

Gadaga TH, Mutukumira AN, Narvhus JA, Feresu SB (1999). A review of traditional fermented foods and beverages of Zimbabwe. Int. J. Food Microbiol. 53:1-11.

Ghebrekidan H (1992). The effect of different chemical and physical agents on the viability of Cysticercus bovis:a preliminary report. Ethiop. Med. J. 30:23-31.

Guidot DM, Hart CM (2005). Alcohol abuse and acute lung injury:epidemiology and pathophysiology of a recently recognized association. J. Investig. Med. 53:235-245.

Gun, RT, Pratt N, Ryan P, Gordon I, Roder D (2006). Tobacco and alcohol-related mortality in men:estimates from the Australian cohort of petroleum industry workers. Aust. N. Z. J. Public Health 30:318-324.

Hall CM, Sharples L (2008). Food and Wine Festivals and Events Around the World:Development, Management and Markets.

Jeyaram K, Singh TA, Romi W, Devi AR, Singh WM(2009). Traditional fermented foods of Manipur. Knowledge Creation Diffusion Utilization. 8:115-121.

Kabak B, Dobson ADW (2011). An introduction to the traditional fermented foods and beverages of Turkey. Crit. Rev. Food Sci. Nutr. 51:248-260.

Kebede A, Fekadu B, Thor Langsrud JA ( 2002). Indigenous processing methods and raw materials of borde, an Ethiopian traditional fermented beverage. J. Food Technol. Afr. 7:59-64.

Kohajdova Z, Karovicova J (2007). Fermentation of cereals for specific purpose. J. Food Nutr. Res. 46:51-57.

Miller DG (1988). The Complete Handbook of Home Brewing. Storey Publishing, LLC, Bowker.

Motarjemi Y, Nout MJ (1996). Food fermentation: a safety and nutritional assessment. Joint FAO/WHO Workshop on Assessment of Fermentation as a Household Technology for Improving Food Safety. Bull. World Health Organ. 74(6):553-559.

Paredes-López O, Harry GI (1988). Food biotechnology review:traditional solid-state fermentations of plant raw materials--application, nutritional significance, and future prospects. Crit. Rev. Food Sci. Nutr. 27:159-187.

Reilly C (1976). Cancer and the consumption of home-produced alcoholic drinks in Zambia: a possible correlation. Afr. J. Med. Med. Sci. 5:191-194.

Sahle A, Gashe BA (1991). The microbiology of Tella fermentation. SINET: Ethiop. J. Sci. 14: 81-92.

Sanni AI (1993). The need for process optimization of African fermented foods and beverages. Int. J. Food Microbiol. 18:85-95.

Satish Kumar R, Kanmani P, Yuvaraj N,. Paari KA, Pattukumar V, Arul V (2012). Traditional Indian fermented foods:a rich source of lactic acid bacteria. Int. J. Food Sci. Nutr. 1-14.

Steinkraus KH (1986). Fermented foods, feeds, and beverages. Biotechnol. Adv. 1:219-243.

Sui D.-Y, Liu T.-Q., Jiang X.-M., Ge D., Li X.-Q., Mu C.-F., Sun X.-Y. (2009). Ethanol fermentation process in series with gel immobilized cells and integrated with membrane. Gao Xiao Hua Xue Gong Cheng Xue Bao. J. Chem. Eng. Chin. Univ. 23:80-86.

Susan AL, Lewis MJ (1993). The mouth feel of beer - a review. J. Inst. Brew. 99:31-37.

Urga K, Fite A, Biratu E (1997). Effect of natural fermentation on nutritional and antinutritional factors of tef (Eragrostis tef). Ethiop. J. Health Dev. 11:61-66.

Vogel S, Gobezie A (1983). Ethiopian “Tej” In: Hand book of indigenous fermented Foods.

Zvauya R, Mygochi T, Parawira W (1997). Microbiological and biochemical changes occurring during production of masvusvu and mangisi, traditional zimbabulean beverages. Plant Foods Hum. Nutr. 51:43-51.