Academic Research Journal of Agricultural Science and Research
Vol. 9(3), pp. 92-103, June 2021
DOI: 10.14662/ARJASR2021.095

ISSN: 2360-7874
http://www.academicresearchjournals.org/ARJASR/Index.htm

Full Length Research

Physicochemical Properties of Traditional Fermented Beverages in Adis Ababa, Ethiopia

Seferu Tadesse Wubie

Ethiopian Institute of Agricultural Research,Sebeta National Fishery and Aquatic Life Research Center, P.O. Box: 64, Sebeta, Ethiopia. Email:seferutadesse5@gmail.com.

Accepted 3 June 2021

Five brands of Ethiopian traditional fermented alcoholic beverages namely 'tella', 'tej', 'shameta', 'bordie' and 'korfie' were collected from Addis Ababa, the capital city of Ethipoia were analyzed for their ethanol, methanol, acidity, solidity, pH, conductivity and salnity contents. The alcohol contents of all types of alcholic beverages were analyzed by using fractional distillation method according to the the standared East African method. The average pH values of 'tella', 'shameta', 'korfie', 'bordie', 'tej' were 3.8, 3.8, 3.7, 3.5 and 3.6, respectively. The average ethanol content (%v/v) of the traditional fermented alcoholic beverages were found to be 5.2, 3.2, 34.0, 3.0 and 12.0, for 'tella', 'sahmeta', 'korfie', 'bordie' and 'tej' respectively. Methanol content of beverges was determined by GC - MS. All kinds of tradtional fermented alcholic beverages have no ditectabel methanol content. So all types of trdational fermented alcohols has not arisk on human's health after drinks, eventhouth they are varying with quality each other.

Key words: traditional fermented alcoholic beverages, Methanol, Ethanol, Acidity

Cite this article as: Seferu, T.W. (2021). Physicochemical Properties of Traditional Fermented Beverages in Adis Ababa, Ethiopia. Acad. Res. J. Agri. Sci. Res. 9(3): 92-103

INTRODUCTION

Fermented alcoholic beverages around the world are consumed in different occasions. In nearly all areas of the world some type of alcoholic beverages native to its region is prepared and consumed (Brereton, 2013). Fermented beverages vary considerably in type. Fermented beverages produced from cereals usually referred to as beers while those produced from fruits are classified as wines (Cabaroglu and Yilmaztekin, 2011). Indigenous fermented alcoholic beverages from different parts of the world are described (Kebede et al., 2002). Among these information on the microbiology and biochemical properties of varieties of the indigenous African fermented alcoholic beverages is available. These include Egyptian *bouza*, Tanzanian *wanzuki*, *gongo, tembo-mnazi* and *gara*, Nigerian *palm-wine*, Kenyan *muratna* and *uragela* and South African *kaffir* beer (Ashenafi and Mehari, 1995). Indigenous Ethiopian fermented beverages include *tej (*Berza and Wolde, 2014). *Tella* (Sahle and Gashe, 1991), *borde* and *shamita* (Debebe,2006), *araki* [Desta B., 1977; Fite, *et al*., 1991]. Fermented beverages constitute a major part of the diet of traditional African rural homes serving as inebriating drinks and weaning foods in addition to their role in social functions such as marriage, naming and rain making ceremonies (Tafere, 2015). Kenyan *muratina* and *uragua* are drunk largely at festivals and social gatherings (Segura *et al*., 1984). Palm wines (*toddys*) are fermented and consumed under different parts of the world. Palm wine has special place in traditional celebrations and ceremonies such as marriages, burials and settling disputes (Berza and Wolde, 2014). In West Africa in addition to their use as beverages *toddys* are also used as medicines for fever and other ailments by adding barks or stems of certain pants (Paine and Dayan, 2001). It has often been observed that alcoholism is a more significant problem than all other forms of drug abuse combined (Paine and Dayan, 2001). According to some studies carried out in some African countries there is considerable evidence that home produced alcohol drinks are known to have toxic components (Kebede *et al*., 2002). A report from Zambia as quoted by (Kebede *et al*., 2002) indicates that moulds such as *Mucor* could frequently be found on the fermenting source of pectinase the enzyme that breaks down pectinto release methanol. Methanol was shown to be the common contaminants of traditional alcoholic beverages in the studies carried out so far. According to (Cabaroglu and Yilmaztekin, 2011) as cited in (Kebede *et al*., 2002) methanol is highly toxic and can cause blindness insanity and even death depending on the amount consumed. Toxic effects are usually associated with a methanol concentration in blood greater than 100g/ml. Fusel oil is a collective name of isopentyl alcohol, 2-methyl-1-butanol, isobutyl alcohol, propyl alcohol, esters and aldehydes. It is toxic and has been shown to cause cancer in experimental animals (Kebede *et al*., 2002). These alcohols are responsible for the severe headache and thirst associated with hangover and also account for taste and flavor of alcoholic drinks. From traditionally fermented beverages in Ethiopia the most popular alcoholic beverages are tej (honey wine), tella (a malt beverage like beer), shameta, Bordie and areki (distilled liquor). These drinks are widely served on festive occasions and at social gatherings. According to a census conducted in 1988 about 11,000 persons were then engaged in the trade of traditional beverages in Addis Ababa alone (Central Statistics Authority, 1988). This is about 32% of the population of the city engaged in internal trade. Traditional recipes are handed down through generation and are still used for food processing in many developing countries (Kebede *et al*., 2002). The traditionally fermented beverages are low-cost product in all aspect as they are usually manufactured using only rudimentary equipment. Because of their cheapness low income groups mostly consume them. Thus their handling and consumption often takes place under conditions of poor hygiene (Mulaw and Tesfaye, 2017). In Ethiopia as reported by (Kebede *et al*., 2002). Villagers prepare a wide range of traditional fermented foods and beverages from different raw materials such as cereals, *ensete* (false banana), honey, milk, etc. Most of the customs and rituals involving the Ethiopian traditional fermented foods and beverages are still prevailing today in urban areas village communities and rural households. Non-commercial (illicit) alcohol is defined as traditional alcohol drinks produced for home consumption or limited local trade. The very fact that illicit or non-commercial beverages are unrecorded makes it obviously difficult to assess their accurate alcohol contents or how much of this types of local drinks are being produced and consumed compared to legally sold alcohols. Yet they remain to be the most widely consumed alcohol as they are inexpensive and easily accessible than factory produced beverages. For this reason factory produced drinks tend to be mainly consumed by people who can afford the more expensive price and by urban dwellers while locally produced and home-brewed alcoholic beverages are predominantly used in the rural areas and by people living in the urban areas who cannot afford factory made drinks. For instance young people(as young as 14 yrs old and university students) tend to consume local beverages like arkai and tella as their main source of alcohol since these drinks are easily accessible to them and cannot afford other kinds of factory drinks. These traditional or locally produced alcohols are also quite significant in economic terms. Many households in the country especially women engage in the production and sales of these beverages as their main source of income to support themselves and their families. Some of the popular locally fermented produced beverages are tella, Shamita, Bordie, Korfie and Tej.

Tella

Tella is an Ethiopian home-brewed beer which differs from the others in some respects. First it is brewed with barley or wheat, hops, or spices. Secondly it has a smoky flavour due to the addition of bread darkened by baking and use of a fermentation vessel which has been smoked by inversion over smoldering wood. Tella is not processed under government regulations hence the alcohol content varies but is usually around 2% to 4%. Filtered tella has a higher alcohol content ranging from 5% to 6%. This drink is usually perceived as a harmless social drink and is usually prepared by women except in monasteries and church compounds. Tella is almost never sold in bars but in small houses “tella bets”. It is also the beverage of choice for family occasions and religious celebrations (mahebers). It is very popular and highly valued as its production requires considerable skill and patience. It is by far the most commonly consumed alcoholic beverage in the country and assumed that over two million hectoliters of it is brewed annually in households and drinking houses in Addis Ababa (Sahle and Gashe, 1991 cited in Gizaw, 2006).

Shamita

Shamita is another traditional beverage of Ethiopia which is low in alcohol content made by overnight fermentation of mainly roasted barley flour and consumed as meal-replacement (Brereton *et al*., 2003). Shamita is a widely consumed beverage in different regions of Ethiopia. It has a thick consistency and most people who cannot afford a reasonable meal consume it as meal replacement. It is produced by fermenting roasted barely overnight. Malt is not commonly used in shamita fermentation, although local shamita brewers in Addis Ababa use it frequently and starch is the only principal fermentable carbohydrate. The microorganisms responsible for fermentation are mostly from back slopping using small amount of shamita from a previous fermentation as well as from the ingredients and equipment. Ready to consume shamita has a high microbial count made up of mostly lactic acid bacteria and yeast [Bacha *et al*., 2003]. These microorganisms make the product a good source of microbial protein. However shamita has poor keeping quality because of these high numbers of live microorganisms and becomes too sour about four hours after being ready for consumption (Emilia *et al*., 2013).

Tej

Tej is a home-processed but also commercially available honey wine. It is a beverage mainly used for great feasts such as weddings and the breaking of fasting. It is prepared from honey, water and leaves of Gesho (*Rhamnus prenoides*). Sometimes widely for commercial purposes, mixture of honey and sugar could be used for its preparation. In cases where sugar is used as part of the substrate, natural food coloring is added so that the beverage attains a yellow color similar to that made from honey [Fite *et al*., 1991]. Some also add different concoctions such as barks or roots of some plants or secrete herbal ingredients to improve flavor or potency and to attract customers. Due to concoction adulteration practices and possibly some other reasons producers usually are not willing to tell about additives used and their composition [Bahiru B., 2000]. According to Vogel and Gobezie, [1983] during the preparation of tej the fermentation pot is seasoned by smoking over smoldering *Rhamnus prenoides* stems and olive wood. One part of honey mixed with 2 to 5% (v/v) parts of water is placed in the pot covered with a cloth for 2 to 3 days to ferment after which wax and top scum is removed. Some portion of the must is boiled with washed and peeled *Rhamnus prenoides* and put back to the fermenting must. The pot is covered and fermented continuously for another 5 days in warmer weathers or for 15-20 days in colder cases. The mixture is stirred daily and finally filtered through cloth to remove sediment and *Rhamnus prenoides*. Good quality *tej* is yellow, sweet, effervescent and cloudy due to the content of yeasts. The flavor of *tej* depends upon the part of the country where the bees have collected the nectar and the climate (Vogel and Gobezie, 1983). Fermentation of *tej* like other traditionally fermented alcoholic beverages relies on the microorganisms present in the substrates fermentation vats or equipment. As these fermentations are natural and thus uncontrolled alcohol and acidity produced during the fermentation can be hazardous to health if produced beyond acceptable levels. With the variable micro flora of such spontaneous fermentation variability of the product is inevitable (Bahiru B., 2000). The ethanol content of *tej* is reported to range from 8.94 % to 13.16 % (yohannes et al., 2013). (Desta , 1977), 7% to 14% (1991) and 9.07%, again with significant variations (Bahiru, 2000).

Borde

Borde is a traditional fermented beverage of Ethiopia a common meal replacement in Southern Ethiopia and some other parts of the country (Brill and Wagner, 2012). According to the report of Brill and Wagner, 2012 it is consumed while actively fermenting and has a short fermentation period usually overnight. On the average a laborer consumes about three liters of *borde* per day. Borde is prepared from unmalted maize (*Zea mays*), barley (*Hordeum vuldare*), wheat (*Triticum sativum*), finger millet (*Eleusine coracana*), sorghum (*Sorghum bicolor*) and/or *tef* (*Eragrostis tef*) and their malt, except sorghum and tef (Kebede *et al*., 2002). Tef is less frequently used for borde preparation may be due to its high cost and preference for use in injera (pancake-like bread). The type of cereal and amount of malt utilized for *borde* preparation varies both within and between localities. Maize followed by barley and wheat was found to be the most common ingredient of borde both as malt and unmalted ingredient in southern Ethiopia whereas wheat has been reported to be the preferred unmalted ingredient in Addis Ababa (Keno and Keskis, 2015). As reported by (Kebede *et al*., 2002) some brewers in Awassa and at Bedessa used both finger millet and sorghum as unmalted ingredient whereas some at Gununo and Sodo Zuria used sorghum but not finger millet. Sorghum was used as unmalted ingredient but not as malt in the study areas. Finger millet was more frequently utilized for malt preparation than as unmalted ingredient. The ingredients used and their possible combinations were found to vary within and between localities and are selected according to availability, price and preference. Seasonal variations in the price of the various cereals also affect the choice of ingredients (Kebede *et al*., 2002). Borde is also used for medical and ritual purposes. Consumers believe that borde enhances lactation and mothers are encouraged to drink substantial amounts of it after giving birth (Kebede *et al*., 2002). Borde is also considered to alleviate malaria, diarrhea, constipation and abscesses. Garlic, fresh chili (Capsicum minimum), ginger and salt are offered as appetizing accompaniments to reduce the feeling of fullness and encourage the intake which may also contribute to some medical effects if any (Kebede *et al*., 2002).

Korefe

Korfie is the name of the local beer made in Begemder province among the Koumant ethnic group. Dehusked barley is left in water overnight and after that roasted and milled. It is mixed with water and dried gesho leaves and fermented in a clay container for two to three months. When the beverage is needed a small quantity of the mixture is taken more water is added and after a day's fermentation the beverage is ready for consumption. However, no systematic study has been reported on the assessment of all the quality parameters (levels of the methanol, ethanol, solids, acids, pH, salinity and conductivity) of different brands of traditional fermented alcoholic beverages. Therefore, the main objective of this study is to determine the physicochemical parameters of traditional fermented alcoholic beverages.

MATERIALS AND METHODS

Alcholic Beverge Sampls

For this study five types of traditional fermented alcoholic beverages (tella, tej, shamita, borde, korefe from two areas of Addis Abaeba were collected. The samples were collected from localities within the Addis Ababa low land (Kality) and from areas located high land (Kotebie). All the samples were collected based on universality of consumption from adolescents to the elderly and were widely available at the household levels. From each sample area theree representative samples each of 0.5 L were collected from different vending houses which were selected randomly to prepare a bulk sample by mixing instead of analyzing separately because analyzing the mixture reduces the variance and resource consumption. The collected alcoholic beverages were in the categories of their types. Triplicate analysis was performed for each. All the samples were collected using polyethylene plastic bottles and the bulk samples were kept in refrigerator at 4ºC until analysis.

Chemicals

Methanol (99.9%, Sigma-Aldrich, France) ethanol (99.99%, Fisher Scientific, UK)), dichloro methane (99.7%, Fisher Scientific, UK), sodium sulphate were utilized to prepare standard solutions. Sodium hydro oxide, hydro chloric acid and Phenolphthalein indicator were used for the determination of acidity content of alchols. Distilled-deionized water (Chemistry Department, Addis Ababa University, Ethiopia) was used for dilution of samples.

Instrument and Appartus

The laboratory apparatus and instruments used in this study are the following: Traditional grained, beakers, measuring cylinders, pipettes, volumetric flasks, spatula, separatory funnel, glass filter, Whatman filter paper (11 cm Diameter, China), shaker (KS125 basic, Germany), centrifuge (Janetzki, model T32c, Olympus, Japan) and Electronic balance (SP 1500, USA), burtte, oven, fractional distillation set up, pH meter, Agilent GC 7890 coupled to a MS 5975 (AgilentTechnologies, CA, USA) were used for all samples of methanol content determination Table detailed description of the opertating condtion of GC- MS.

Standared Methanol Solutions for GC-MS

Methanol stock solution (200 mg/L) was prepared by dissolving 0.10 mL of absolute methanol (99.99 % or 999900 mg/L with 500 mL distilled water and preapred intermidate solution (500 mg/L) in 50 mL of volumetric flask. Then 1, 10, 30, 60 and 100 mg/L methanol working solutions were prepared in 25 mL volumetric flasks. By using five different known concenteration and peak area of the cromatogram linear equation was devloped. From Regression linear equation the regression linear cofficent was 0.997.

Table 1. Concenteration and area of methanol standared solutions for GC-MS.

Concenteration (mg/L)	1	10	30	60	100
Area of the peak	12763471	14122287	15797899	17595798	19326330

Alcholic beverge sample preparation for GC-MS

The method was combined with a simple sample preparation procedure using sodium sulphate and dichloro Methane. It used only 1000 µL of alcholic beverage sample to quantify all volatile components of samples. 1000 µL of alcholic beverage sample mixed with 2000 µL dichlomethane in 10 mL test tubes. Approximately 100–150 mg of sodium sulphate salt was added to the mixture until saturation followed by intense mixing using a vortex mixer for 10–15s. The samples were then centrifuged for 2 min at 2000*g to separate the aqueous and non-aqueous layers. Approximately 200 µL of the upper non-aqueous phase was transferred to a 2 µmL GC-MS vial for analysis.

Determination of Methanol Content and Qualitative Analysis of Volatile Metabolites of Femented Alcoholic Beverges by GC-MS

The methanol content and other volatile componets of fermented alcholic beverges were analyzed using an Agilent GC 7890 coupled to a MS 5975 (Agilent Technologies, CA, USA) with a quadruple mass selective detector (electron impact ionization positive mode) operated at 70 eV. A Zebron ZB-1701 (Phenomenex) 30 m*250 µm (internal diameter)*0.15 µm (film thickness) with 5 m guard column was used for the analysis. 1µL of sample was injected into the GC under split mode at a 100:1 split ratio under constant flow of 48.851 mL/min on column. The temperature of the inlet was kept at 180 ^{o}C. The GC oven temperature was initially held at 50 ^{o}C for 1 min and then raised to 200 ^{o}C at 40 ^{o}C/min. The total running time for this method was 4.75 min. The equilibration time was set to 2 min. The interface and quadrupole temperatures were 230 ^{o}C and 150 ^{o}C respectively. The MS detector was turned off between 2.03 min to 2.21 min to offload ethyl acetate peak. The MS was operated in scan mode with a mass range of 30 to 250 a.m.u. The ion (m/z) used for identification and quantification of target compounds.

Determination pH Values of Fermented Alcholic Beverges

pH indicates the acidic level of alchols. The pH of the samples was measured by dipping the electrode of a digital pH meter (schott cg 837) to the samples. Before using it a calibration routine was performed with pH 4, 7, and 10 buffers. Subsequently the sensor was immersed in the samples and the pH was measured in triplicate. The pH electrode was rinsed with abundant distilled water before and after each pH.

Determination of Acids in Fermented Alcoholic Beverges

There are two typs of acids which is present in alcohols these are fixed acids and volatile acids. Most of alcohols contain volatile and fixed acids. The combination of fixed and volatile acids is called total acids. When acids are present above a standared limit on alcholic beverages it affects human's health. Both types of acids were determined by using the method of East African standard alcoholic beverages methods of sampling and test. Volatile acidity is derived from the acids of the acetic series present in alchols in the free state and combined as salts where as fixed acidity is derived from tartaric acid series. The amount of total and fixed acids in terms of tartaric acid is calculated by using the formula:

$$\text{Total acids interms of tartaric acid}\left(\frac{\text{g}}{\text{l}}\right) = \frac{0.00375 * 2 * \text{vol. of NaOH taken for titration} * 1000 * 2}{\text{The absolute alcohol percent by volume}}$$

Even if fixed acids and total acids are calculated in grams of tartaric acid present in one liters of ethanol, it also possible to convert the amount of tartaric acid in to acetic acid by using the formula:

$$\text{value of acids in acetic acids}\left(\frac{\text{g}}{\text{l}}\right) = \frac{\text{value of acids in tartaric acid}}{1.53} * 1.22$$

The maximium limit of volatile acid present in alchols interms of acetic acid is 1.50 g/l. Volatile acidity is determined from the difference of total acidity and fixed acidity

$$\text{Volatile acidity} = \text{Total acidity}\left(\frac{\text{g}}{\text{l}}\right) - \text{fixed acidity}\left(\frac{\text{g}}{\text{l}}\right)$$

Determination of Solids in Fermented Alcoholic Beveages

Solids of alcohols present in alcoholsges were three types. These were total solids, dissolved solids and suspended solids. The presence of solids indicate that the impurities of alcohols. The dissolved solids of alcohols were determined by chlometric 6000 digital. Electrode immersed in samples and recorded the reading display on it. Each samples were determined there times. The results of solids present in alchols have significance difference. Dissolved solids were measured in terms of miligram per liter of solution. Total solids were determined according to the method set by east African standard method. Dry empty dish with 105^{o}c for 30 minutes. Take out from oven and put in dissector until it reaches to room temperature. Then weight empty dish and add 100 ml samples on it. Put the sample in oven with 105^{o}c for 3 hours. Take out the sample from oven and put immediately in dissector. Wait until it reaches to room temperature. Weight the sample and recorded it. Total solids in alcohols were calculated by:

$$\text{Total solids}\ (\frac{\text{W}}{\text{W}}) = \text{Weight of dry sample and dish} - \text{weight of empty dry dish}$$

Total suspended solids are the slice of solids that typically residues on the filter paper. Suspended solids encompass of silt, clay, fine particles of organic and inorganic matter which is viewed as a type of pollution because alchol high in concentration of suspended solid may harmfully affect the growth of human's health. In some alcoholic beverages suspended solids are present. These solids were determined by taken the difference from total solids and total dissolved solids.

Determination of Conductivity and Salinity of Fermented Alcoholic Beverges

Conductivity of alcohols tells us how the electric power is passes through it. Conductivity of alcohols was determined by the instrument of calorometry 6000 by immersing the electrode in to the sample. Before measurements conductivity metrer was calibrated using its own calibration solution by adjusting the temperature coefficient from 0 % to 2.5 % /°C (199.9 μs ranges). Salinity tells as the dissolved amount of salts present in alcohols. The source of salinity in alchols is process of making alcohols, storage condition and types of ingredients used for production of alchols. The procedure consisted in calibrating the instrument with 1413 μS and 12.9 mS/cm standards and subsequently the sensor was immersed in alchols and the conductivity was measured in triplicate and at the same time by adgusting the instrument salnity (%) is measured. The electrode was rinsed with abundant distilled water before and after each immersion.

Determination Ethanol Content of Fermented Alcholic Beverges

The ethanol content tells as the strength of alcohols. The ethanol level of collected samples was done by fractional distillation method in Addis Ababa university analytical chemistry laboratory. The method is set by East African community which is applying for all types of traditional and industrially produced alcohols. The method is verified by run spiked absolute alcohol which ethanol content is 99.99% for each types of samples and by calculates its recovery. Based on this the recovery got is 99%- 101% , which is good and the method is functional and perfect for the collected samples. The way of determination were taking 100 ml samples and add it in separatory funnel. In the measuring alcohol add sufficient powder sodium chloride in order to saturate the samples. On these samples 50 ml of petroleum ether was added in order to extract ethanol and other volatile components. The solubility of ethanol and petroleum ether is very high as compared to the solubility of water and ethanol. The mixure of ethanol and petrolium ether makes alayer. After15 minutes the layer of water is remove from the sepratory funnel where as the layer of petroleum ether is pour in to the distillation flask. Wash the layer of petroleum ether with 20 ml of saturated sodium chloride solution two times and add the washing solutions in to distillation flsak. The mixture of ethanol and petroleum ether was going to distillation process. The distillation is done by fractional distillation. The final temperature of the ethanol to completely evaporate is identified by run Absolute ethanol. This is done by using Absolute Ethanol five times. Then with similar sample preparation process the distillation is performed. Finally the time was waiting until the recovery absolute ethanol was 100%. Based on the five rpeat data the final temperature was 72^{o}c. In this temperature ethanol was completely evaporate and collect on reciver. What ever the time was long it did not evaporate other volatile components which boling point is more than ethanol. So the optimum boling point of ethanol was 72^{o}c. By setting this

Temperature the ethanol level of the alcohols was determined according to the following formula:

$$\%\text{Ethanol level} = \frac{\text{Sample volume} + \text{Volume of petrolium ether}}{\text{Volume of distillate sample} + \text{Volume of petrolium ether}} * 100$$

RESULT AND DISCUSSION

Methanol Content in Fermented Alcoholic Beverages

Calibration curve of methanol in dichloromethane for GC- MS.

The methanol content of alcholic beverges was determined from the chromatogram of GC-MS. In the data peak area and width of the chromatogram was mentioned. By inserting peak area and peak width of chromatogram in linear equation of calbirationurve concenteration of analyzed alcoholic bevareges was determined.

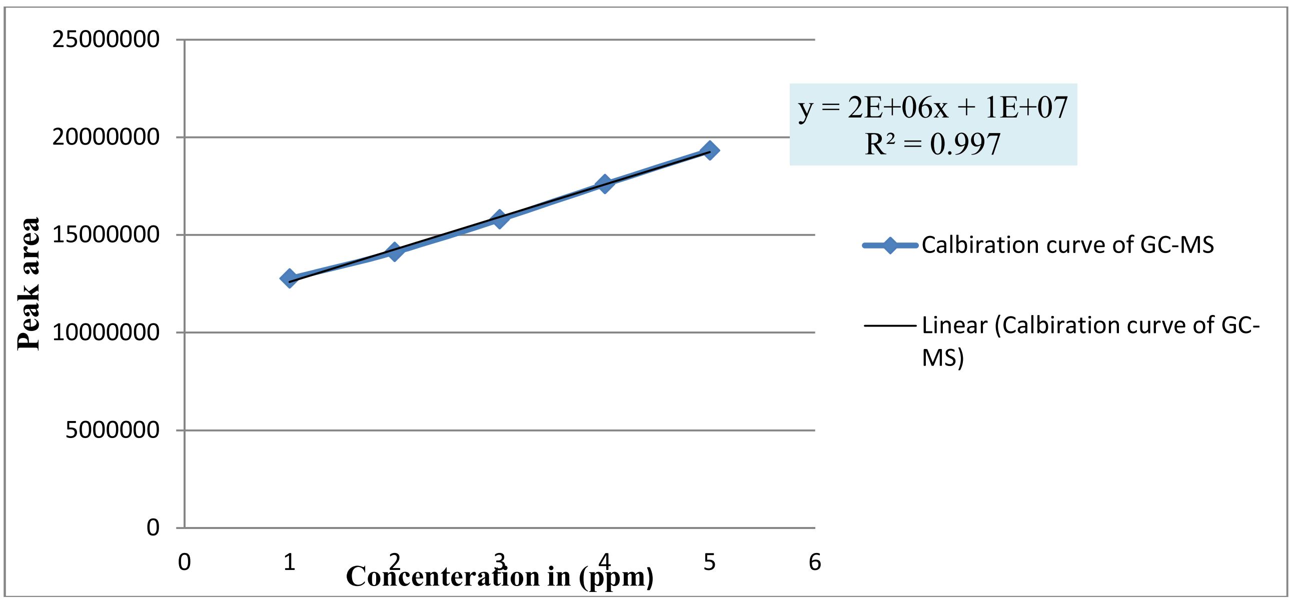

Figure 1. Calbiration curve of methanol standared for GC-MS

Table 2. Metahnol content of tradtional fermnted alcholic beverages

No.	Alchol types	Concentration (%)	Max. lmit of methanol in alcohol	Reamark
1	Shameta	ND	0.03	Safe to humans
2	Tej	ND	0.12	Safe to humans
3	Tella	ND	0.05	Safe to humans
4	Korfie	ND	0.34	Safe to humans
5	Bordie	ND	0.03	Safe to humans

The methanol content of of shameta, tej, tella, korfie and Bordie was below the detection limit of the instrument. According to stanadred limit no one analysed samples is risk to humans. In another way all tested samples are safe to humans. The current Erope union general limit for naturally occurring methanol of 10 g methanol/L ethanol which equates to 0.4% (v/v) methanol at 40% alcohol provides a greater margin of safety. Generally all traditional prepared fermented alcohols have low amount of methanol. The methanol content found in tradational beverages is not excess from the standared lmit. So peopels drink alchols which preapred tradtionally is not affect their health with the problem of methanol.

Qualitative Determination of Volatile Components of Fermented Alcoholic Beverages

Qualtative data of alchols indicates the type of components present in alcoholic beverages. Five different types of traditional fermented alchol beverages were run in GC-MS for qualitative analyis. From the spectra of chromatogram many volatile component is identfied based on the retintion time of componets compared with its MS librarey. In this study methanol and ethanol is quantitivly determined other volatile components were identfied. From the result ethanol was present in all alcholic beverages. In shameta, tej, and tella alcholic beverages only ethanol was present. Other volatile major components were not found in shameta, tej and tella. In korfie ethanol, iso amyl alchol, butanoic acid ethyl ester and 1-butanol 3 methyl ester were present. In bordie only ethanol is majourly present. Ethanol, iso amyl alchol and lactic acid ethyl ester were the minor volatile components of bordie.

Determination of pH, Conductivity, Salnity, Acidity and Solidity Contents in Tradational Fermented Alcoholic Beverges

Table 3. Quality parameters in tradtional feremented alcholic beverges (tej, shameta, bordie, tella and korfie) drinks.

Quality parameters	Traditional fermented alchol beverage types				
	Tej	Shameta	Bordie	Tella	Korfie
pH (H^+)	3.6 ± 0.08	3.8 ± 0.03	3.5 ± 0.01	3.8 ± 0.01	3.7 ± 0.01
Conductivity (µS/cm)	810.0 ± 0.1	8390.0 ± 0.3	7140.0 ± 0.4	2360.0 ± 0.4	3200.0 ± 0.2
Salinity (%)	0.4 ± 0.001	4.6 ± 0.003	3.9 ± 0.002	1.20 ± 0.001	1.70 ± 0.001
TDS (mg/L)	387.0 ± 0.12	4520.0 ± 0.12	3830.0 ± 0.12	1180 ± 0.12	1610 ± 0.12
TSS (mg/L)	4673.0 ± 0.03	11273.0 ± 0.02	16497.00± 0.15	540.00 ± 0.16	5680.0 ± 0.04
TS (mg/L)	5060.00 ± 0.1	15793.0 ± 0.1	20327.0 ± 0.1	1720.0 ± 0.1	7290.0 ± 0.1
Fixed acidity (g/L)	56.6 ± 0.2	351.7 ± 0.2	233.63 ± 0.1	118.00 ± 0.3	121.52 ± 0.3
Volatile acidity (g/L)	42.0 ± 0.1	205.78 ± 0.1	258.00 ± 0.1	135.60 ± 0.1	145.14 ± 0.1
Total acidity (g/L)	98.6 ± 0.15	557.5 ± 0.15	491.63 ± 0.1	253.60 ± 0.2	266.66 ± 0.2

* = Values are mean ± SD of triplicate readings of triplicate analysis

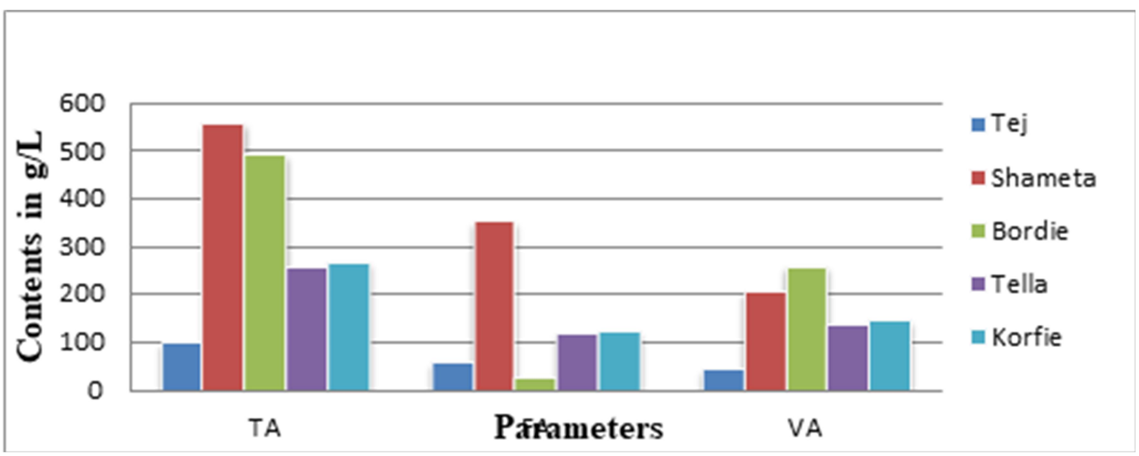

Figure 2. The comparison of TA, FA and VA contents in g/L between tradtionaly fermented alcoholic bevareges

From result of tradtional fermented beverges shameta had high amount of total acidity and fixed acidity but in contents of volatile acidity bordie had high amount. Tej had small amount of total acidity and volatile acidits from all analyzed tradtional fermented samples. In types of fixed acidity bordie had samall amont from all analyzed tradtional fermented samples

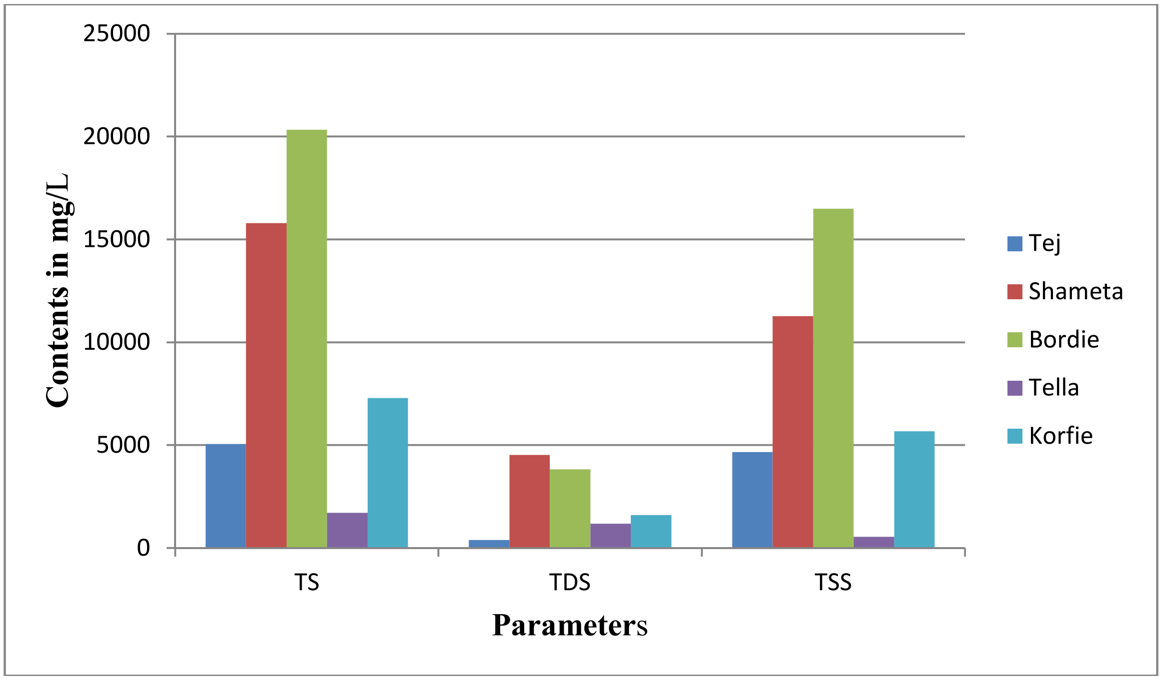

Figure 3. The comparison of TS, TDS and TSS contents in g/L between tradtionaly fermented alcoholic bevareges.

Bordie had high contents of total solidity and total suspended solids. In total dissolved solids shameta had high contents than bordie. From result tella had low contents of total solids and total suspended solids. In total dissolved solids tej had low contents from all analyzed tradtional fermented samples. Femention is the main sourse of acids as a result the alchols which produce by fermention process is highly acidic or the have low pH values. From the result the acidity of tella, tej, korfie, shameta and bordie have high amount of acids. So from this result we observed that the cause of pH different in alchols is the way of process to produce alcohols, the ingredients used for alcohol making and storage time are the factors to alter acidity of alcohols.

From the result bordie and shmeta have high acids. Fermentedend product of alcohols have high amount of fixed acids. From the results got tej, shemeta, bordie, korfie and tella have high amount of fixed acidity that express in terms of tartaric acid. From the result korfie, tella, Bordie, Shameta and tej have 145g/L, 136g/L, 258 g/L, 205g/L and 42g/L of volatile acids that is above the lmit of volatile acidity present in liters of alchols. Tradational fermented alchols conatin signficantly high amount of volatile acids. Tradational fermented beverages (shameta, bordie, tella, korfie and tej) had a large amount of dissolved solids because they were prepared directly from water by fermention process or no distillation is takes place after fermention. As a result high amount of dissolved solids such as sodium chloride were present. From the result tradtional fermented beverages have signficantly high amount dissolved solids. Fermented traditional alcohols (tella, tej, shameta, bordie and korfie) had high contents of total solids because fermented beverages were prepared directly with fermention so it contaminated with different sources such as water, process and cereals. Korfie, tella, tej, shameta and bordie had signficantly high amount of suspended solids. From the result tej, shameta, bordie, korfie and tella had high contents of salts. The reason is that the process of making such alchols is fermention with out passes distillation. So salnity is accumalte in fermented end product of alcholic beverages from water. Water is used for making all alcohol types. In fermented type of alcohols the dissolved chlorides found in water is directly transfer to alcohols.

Ethanol Content of Fermented Alcholic Beverges

Table 3. The mean ± SD,%(v/v), n=3 of ethanol in the tradtional frermented alcoholic beverage samples collected from two areas of Addis Ababa using fractional distillation.

NO	Alchol type	Loaction	Ethanol content(%v/v)
1	Tej	Kotebie	12.0 ± 0.60
		Kality	13.5 ± 0.2
2	Shameta	Kotebie	3.20 ± 0.20
		Kality	3.5 ± 0.7
3	Bordie	Kotebie	3.00 ± 0.10
		Kality	2.5 ± 0.3
4	Tella	Kotebie	5.20 ± 0.20
		Kality	6.1 ± 0.8
5	Korfie	Kotebie	3.5 ± 0.10
		Kality	4.0 ± 0.1

Annalysis of Variance

In this study five different types of tradational fermented alcoholic beverages were collected from two areas of addis abeba. During the processes of sample preparation and analysis a number of random errors may be introduced in each type of alcholic beverages. The varation in the mean etahnol content of analyte was tested by using ANOVA to see wether the source of the vartion was from the varaitys of samples or/and due to areas of analysed sample collected (i.e. differences in topographical location; differences in the mineral contents of the water and atmosphere; variations in the brewing process between the womens who prepared alcholic beverages). The ANOVA results for all five analysed alcoholic beverge samples showed that statistically highly significant differences existed at the 95% confidence level in the mean ethanol content due to the difference varaites of alcohols and signficant difference due to the intraction effect of varitres difference and areas of sample collection where as areas of alcholic beverage sample collection was not signficant effcet at the 95% confidence level in the mean ethanol content for all analysed alcholic beverage samples.

Table 4. Analysis of variance (ANOVA) for the ethanol concentrations between the samples of the traditional fermented beverages which were collected from two reas namly Kality and kotebie at the 95% confidence level.

Source of vartion	Df*	SS	MS	F calcuated	F critical	Reamark
Area	1	0	0	0	4.2	Non signficance difference of alcohols in ethanol content b/n areas
Types/kinds	14	24765.54	2751.73	19655.2	4.1	Highly signficant difference of alcohols in ethanol content b/n varaties.
Types x Varity	14	22.56	2.51	17.93	4.1	Signficance difference of alcohols in ethanol content due to intraction of area and varaity.
MS within	60	5.47	0.14	-	-	-
Total	89	24793.57	2754.38	19673.13	12.4	-

Fermented tradtional alcholic beverages five samples (tella, korfie, bordie, tej and shameta) alcholic beverges were concidered. For this collected five samples pH, acidity content, solids present, conductivity, salnity , Ethanol and methanol contents were determined. All analyzed samples are slightly acidic.The pH of tej, shameta, bordie and korfire were low from other collected samples. Total acidity of fermented beverages were determined in terms of tartaric acid present in gram per liter of alcohol. The average total acidity of traditional fermented beverages of tej, shameta, bordie, koso, tella and korfie were 29.0, 235.3, 35.0, 12.4 and 7.2 respectively. From the result got tella, tej, shameta, bordie and korfie have high amount of total acidity. The fixed acidity of alcoholic beverages was determined. In the study the average value of fixed acidity of traditionally fermented beverages in gram of tartaric acid per liters of alcohols, tej, shameta, bordie, tella and korfie were 25.0, 20.5, 30.0, 10.4, and 5.2. Fermention process of non-distilled alcohols is fast as a result they produce a great amount of tartaric acid. In this study volatile acidity were measured in terms of the grams of acetic acid present in liters of alchols. The volatile acidity of alcoholic beverages was determined. The average volatile acidity of traditional fermented alcoholic beverages of tej, shameta, bordie, tella, korfie and different types of tera arkie were 4.0, 3.0, 5.0, 2.4 and 2.0 respectively. Tej, shameta, bordie, tella and korfie have high amount volatile acidity. The suspended solids present in alcoholic beverages were determined in terms of the amount of gram of suspended solids present in liters of samples. The mean value of suspended solid of tej, shameta, bordie, tella and korfie were, 4.6 g/L, 11.3 g/L, 16.5 g/L, 0.5g/L and 0.8 g/L respectively. The amount of suspended solids in fermented traditional beverages was relatively high.

The dissolved solids were determined in gram per liters of alcohols. The mean value of dissolved solids of traditional alcoholic beverages of tej, shameta, bordie, tella and korfie were 0.387, 4.52, 3.83, 1.18 and 1.61 respectively. In the study the average salinity of tej, shameta, bordie, tella and korfie were 0.4%, 4.6%, 3.9%, 1.2% and 1.7% respectively. Fermented beverages of tella, shameta, korfie and bordie had a high amount of salinity because in the fermentation process no distillation is performed. Fermented beverages were prepared directly from water and cereals. Cereals and water is the cehif source of salts. For the preparation of non-distilled alcohols poor water quality were used due to that in most non distilled alcohols salinity is very high. In the study conductivity of traditional prepared fermented beverages were determined. The average conductivity of tej, shameta, bordie, tella and korfie beverages were 810 μS, 8390 μS, 7140 μS, 2360 μS and 3200 μS respectively. The conductivity of alchols is directly proportional to salnity. When salts are dissocitae it transfers electric. Fermeted beverages have high salts as aresult it have high conductivity.

Conclusion and Recommendation

In Ethiopia the government has no control over the production and quality of traditional beverages. There is however wide spreading and serious alcohol related problems (Ellison *et al*., 2001). Thus control in the production and supervision with the development of comprehensive national alcohol policy is recommended. It is not difficult to imagine that large number of population in the most parts of the country consumes the local beverages. As the process of fermentation is spontaneous high amount and variability of toxic substances is inevitable. Hence from the point of view of public health investigation on the mechanism of production and means to avoid predominance of harmful contents are necessary. Further researches need to be conducted to ward the development of standardized ways of production. Estimation of the amount of the harmful components of the traditional beverages in relation to human health is required. It is also important to deal with these harmful components so as to assess whether they are found in the beverages above or below their maximum allowableconcentrations.

REFERENCES

Admas Berhanu (2014). Microbial profile of Tella and the role of gesho (*Rhamnus prinoides*) as bittering and antimicrobial agent in traditional Tella (Beer) production. *Int. Food Res. J.* **21**:357–365.

Carreon-Alvarez, A. ;Suárez-Gómez, A.; Zurita, F.; Gómez-Salazar, S.; Soltero, J. F. A.; Barcena-Soto, M.; Casillas, N.; Porfirio-Gutierrez and Moreno-Medrano, E. D. (2016). Assessment of physicochemical properties of Tequila brands: authentication and quality. *J. Chem.* **2016**: 1–13, Article ID 6254942. http://dx.doi.org/ 10.1155/2016/6254942.

AOAC (2010a). AOAC Official Methods of Aanalysis 945.08, 950.15, 962.12 (17th Ed) (2010). List of methods of analysis for beverage Alcohol http://www.ttb.gov/ssd/pdf/list of beverage methods.pdf (Accessed October, 2018).

AOAC (2010b). AOAC Official Methods of Analysis 920.47, 940.09, 950.27 (17th Ed) (2010). List of methods of analysis for beverage Alcohol http://www.ttb.gov/ssd/pdf/ list of beverage methods.pdf (Accessed October, 2018).

AOAC (2010c). AOAC Official Methods of Aanalysis 920.47, 942.06, 945.07, 982.10, 983.12 (17th Ed); ASBC official method Beer-4; 27 CFR part 30 (2010). List of methods of analysis for beverage Alcohol http://www.ttb.gov/ssd/pdf/ list of beverage methods. pdf (Accessed October, 2018).

Ayalew Debebe; Abel Anberbir; Mesfin Redi-Abshiro; Chandravanshi, B. S.; Araya Asfaw; Negist Asfaw; Nigussie Retta (2017b). Alcohol determination in distilled alcoholic beverages by liquid phase Fourier transform mid-infrared and near-infrared spectrophotometries. *Food Anal. Methods* **10**:172–179.

Ayalew Debebe; Chandravanshi, B. S. and Mesfin Redi-Abshiro (2016). Total contents of phenolics, flavonoids, tannins and antioxidant capacity of selected traditional Ethiopian alcoholic beverages. *Bull. Chem. Soc. Ethiop.* **30**:27–37.

Ayalew Debebe; Chandravanshi, B. S. and Mesfin Redi-Abshiro (2017a). Assessment of essential and non-essential metals in Ethiopian traditional fermented alcoholic beverages. *Bull. Chem. Soc. Ethiop.* **31**:17-30.

Ayalew Debebe; Shibru Temesgen; Mesfin Redi-Abshiro and Chandravanshi, B. S. (2017c). Partial least square-ultra violet near infrared spectrometric determination of ethanol in distilled alcoholic beverages and its comparison with reference method, gas chromatography. *Bull. Chem. Soc. Ethiop.* **31**:201-209.

Ayelew Debebe; Mesfin Redi-Abshiro and Chandravanshi, B. S. (2017d). Non-destructive determination of ethanol levels in fermented alcoholic beverages using Fourier transform mid-infrared spectrometry, *Chem. Cent. J.* **11**:27. DOI 10.1186/s13065-017–0257-5.

Ayelew Debebe; Shibru Temesgen; Mesfin Redi-Abshiro; Chandravanshi, B. S. and Estifanos Ele (2018). Improvement in analytical methods for determination of sugars in fermented alcoholic beverages. *J. Anal. Methods Chem.* **2018**:4010298. DOI: https://doi.org/10.1155/2018/4010298.

Bekele Bahiru; Tetemke Mehari and Mogessie Ashenafi (2001). Chemical and nutritional properties of '*Tej*' an indigenous Ethiopian honey wine variations within and between production unit. *J. Food Technol. Afr.* **6**:104–108.

Belachew Desta (1977). A survey of the alcoholic contents of traditional beverages. *Ethiop. Med. J.* **15**:65–68.

Belay Getnet and Admas Berhanu (2016). Microbial dynamics, roles and physico-chemical properties of Korefe, a traditional fermented Ethiopian beverage. *Biotechnol. Int.* **9**:156–175.

Canaroglu, T. and Yilmaztekin, M. (2011). Methanol and major volatile compounds of Turkish raki and effect of distillate source. *J. Inst. Brew.* **117**:98–105.

Daniel Minilu Woldemariam and Chandra- vanshi, B. S. (2011). Concentration levels of essential and non-essential elements in selected Ethiopian wines. *Bull. Chem. Soc. Ethiop.* **25**:169–180.

Dereje Bekele and Chandravanshi, B. S. (2012). Levels of essential and non-essential metals in Ethiopian Ouzo. *SINET: Ethiop. J. Sci.* **35**:19-28.

Getachew Tafere (2015). A review on traditional fermented beverages of Ethiopia. *J. Nat. Sci. Res.* **5**:94–102.

Guesh Mulaw and Anteneh Tesfaye (2017). Technology and microbiology of traditional fermented food and beverage products of Ethiopia. *Afr. J. Microbiol. Res.* **11**:825–844.

Jahagirdar, S. S.; Patki, V. K. and Thavare, R. M. (2015). Comparative study of water quality parameters of different brands of soft drinks. *J. Mech. Civil Eng.* **2**:142–149. ***SINET: Ethiop. J. Sci.,*** **40(1), 2017 35**

Katema Bacha*;* Tetemke Mehari and Mogessie Ashenafi (1999). Microbiology of the fermentation of shamita, a traditional Ethiopian fermented beverage. *SINET: Ethiop. J. Sci.* **22**:113–126.

Kebede Abegaz; Fekadu Beyene, Langsrud, T. and Narvhus, J. A. (2002). Indigenous processing methods and raw materials of Bordie, an Ethiopian traditional fermented beverage. *J. Food Technol. Afr.* **7**:59–64.

Kofi, S.; Preko, A.; Dzidefo, G.; Yaw, A. and Wiredu, A. (2017). Determination of methanol and ethanol concentrations in local and foreign alcoholic drinks and food products (Banku, Gakenkey, Fantekenkey and Hausakoko) in Ghana. *Int. J. Food Contam.* **4**:1–5.

Lachenmeier, D. W. (2007). Rapid quality control of spirit drinks and beer using multivariate data analysis of fourier transform infrared spectra. *Food Chem.* **101**:825–832.

Lachenmeier, D. W.; Schmidt, B. and Bretschneider, T. (2008). Rapid of vodka using conductivity measurement. *Microchim. Acta* **160**:283–289.

Miller, J. N. and Miller, J. C. (2005). *Statistics and Chemometrics for Analytical Chemistry*, 5th ed., Pearson Practice Hall: England; 2005; pp 55–72.

Oladeinde, F. O.; Nwankwo, E. I; Moronkola, O. A; Amosu, M. A. and Farayola, B. (2002). Determination of indigenous and foreign alcoholic beverages levels in urine by quantitative infrared spectroscopy. *Afr. J. Biomed. Res.* **5**:73–76.

Paine, A. and Dayan, A. (2001). Defining a tolerable concentration of methanol in alcoholic drinks. *Human Exp. Toxicol.* **20**:563–568.

Pinu, F. and Villas-Boas, S. (2017). Rapid quantificationof major volatile metabolites in fermented food and beverages using gas chromatography-mass spectrometry. *J. Mol. Diver.Preserv. Int. Multidiscipl. Dig. Publ. Inst.* 7:1–13.

Rajković, M.; Ivana D. Novaković, I. and Petrović, A. (2007)