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Research Article

# Proximal Composition of Indigenous Alcoholic Beverage Cheka in Konso, Southwestern, Ethiopia

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## ABSTRACT

Ethiopia is one of the countries where a wide variety of traditional fermented beverages are prepared and consumed. Cheka is one of the indigenously fermented alcoholic beverages that is extensively consumed and valued by consumers in urban and rural areas of the Konso Zone in southwestern Ethiopia. This study is aimed to determine the proximal composition, mineral, and alcohol contents of cheka. pH and titratable acidity of cheka samples were found to be in the range of (4.61-4.11)% and (1.25-1.78)% respectively. Proximal compositions including moisture, protein, ash, carbohydrate, fibre and gross energy of cheka samples were found to be in the range of (22.76-30.32)%, (5.97-4.95)%, (1.51-3.31)%, (59.08-64.41)%, (1.2 to 1.9)% and (270.79 to 287.87) Kcal respectively. Alcoholic content ranged from (4.05 to 6.75)% (v/v). Mineral contents of cheka samples such as magnesium, calcium, iron, and zinc range from (10.65-11.82) mg/l, (11.05-7.79) mg/l, (7.64-10.73) mg/l and (2.57-5.33) mg/l respectively. Cheka samples that were collected from the local house are relatively good in its nutritional content than samples collected from commercial sources. The result of this study shows that Cheka has less nutrient content and it does not match with recommended nutrient dietary reference intakes needed for a daily routine.

**Keywords:** Production; Cheka; Proximal composition; Konso

## INTRODUCTION

Fermentation has been a means of enhancing the storage quality of food for more than 6000 years. Beer brewed by the Babylonians and exported to Egypt around 3000 B.C. was most likely the product of both alcoholic and lactic fermentations [1]. It is a widely practiced ancient technology and fermented food items are essential parts of diets globally. Traditional fermented beverages are those that are indigenous to a particular area and have been developed by locals using age-old techniques and regionally available raw materials [2]. Fermentation methods for producing alcohol are inexpensive and adaptable at the household level among traditional communities [3]. Fermented food and beverages enhance the sensory properties and nutritional value of food items improve digestibility, reduce the toxicity and anti-nutritional factors, and improve the shelf life [4].

Nearly in all countries, some type of alcoholic beverages native to different regions are prepared and consumed. In Africa, every country and community has its recipe for the fermentation of indigenous fruits and cereals. A variety of cereals are used either alone or in combination to produce several fermented beverage and food items [5]. Fermented alcoholic beverages are consumed on different occasions such as marriage, naming, rain-making ceremonies, festivals and social gatherings, burial ceremonies and dispute settings [6].

Ethiopia is one of the countries where a wide variety of cereal-based traditional fermented beverages are prepared and consumed. Various traditional fermented beverages are produced on a fairly small scale and usually for local consumption. Some of the known beverages are tella, borde, shamita, cheka, korefe, keribo, bukire, merissa, etc. [6,7]. Cheka is a cereal and vegetable-based fermented

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beverage, which is widely consumed in the southwestern parts of Ethiopia, mainly in Dirashe and Konso. People of all ages including infants, pregnant and lactating women drink cheka. It provides an affordable source of drink and makes a substantial contribution to the nutritional security of the low-income group of consumers and adult men on average drink up to 8 litres per day [8]. The preparation of many indigenous or traditionally fermented beverages is still a household art [6]. Processing methods as well as the raw materials utilized and their proportions seem to vary among households, villages, and localities. Despite the importance of cheka in the Konso community information on the production technology, nutritional values, alcohol content and biochemical properties of cheka is limited as is the case of many other traditional fermented beverages in Ethiopia. Present study focuses on the proximal composition, mineral, and alcohol content of cheka in the Konso Zone, southwest Ethiopia [9,10].

## MATERIALS AND METHODS

### Study area and period

This study was carried out at the Konso zone which is located 595 km away from Addis Ababa, the capital city of Ethiopia, and 365 km away from the capital city of SNNPR, Hawassa, and 90 km away from Arba Minch town. The zone comprises two urban and 39 rural Kebeles. The total population of the zone is 258,832 with a total number of households 51,334 [11]. The lively hood of the Konso community includes mixed farming; crop cultivation complemented by small livestock holdings. The zone is comprised of 49 Kebeles of which two are semi-urban. The zone has one district hospital and 9 health centres. The study was conducted from September 2019 to January 2020.

### Sample collection

Five cheka samples were collected using one-liter plastic container from local houses and local markets for analysis of their chemical properties, nutritional, and alcohol contents. After on spot measurement of some physical parameters, all samples were transported and brought to the Arba Minch University, Chemistry laboratory for analysis in an icebox jar to avoid unusual change in sample quality and stored in a refrigerator (4°C) until the analysis.

### Determination of nutrient and alcoholic contents

pH and titratable acidity determination: pH and titratable acidity were determined according to the method of AOAC 2000 [12]. pH of the cheka samples were measured using a digital pH meter after calibration at 25°C, using buffers of pH 4 and 7 by dipping the glass electrode of pH meter into 100 ml of the sample, after dilution with distilled water at a 1:1 (w/v) ratio into a thick slurry of cheka [13,14]. Acidity was measured by the titration of 5 mL cheka sample with 0.1N NaOH using 0.1 ml, 0.5% phenolphthalein as an indicator and then calculated as percentage lactic acid.

$$\%Lactic\ acid\ (w/v) = \frac{N \times V_{NaOH} \times Eq.wt \times 100}{V_s(mL) \times 1000}$$

Where; N=normality of NaOH (mEq/ml), $V_{NaOH}$=Volume of NaOH (ml), Eq. wt=Equivalent weight of lactic acid (90.08 mg/mEq), $V_s$=Volume of sample (ml) and 1000=factor relating mg to grams [14].

### Analysis of crude composition

The crude percentage of protein, fat, fibre, moisture, and ash contents of the samples were analyzed using AOAC (2000) methods [12].

### Moisture content

The amount of moisture in cheka samples was determined according to AOAC [12]. In a typical analysis 3 g of cheka samples was dried in an air oven at 105°C for about 3 hours until constant weights were obtained, cooled in a desiccator, and re-weighed.

$$Moisture\ (\%) = \frac{(W_1 - W_2) \times 100}{W_1}$$

Where: $W_1$=weight (g) of the sample before drying

$W_2$=weight (g) of the sample after drying

### Ash content

The determination of ash content was performed based on the method (AOAC, 2000) [12]. 5 g cheka samples were heated over low Bunsen flame with the lid half covered up to a point when fumes are no longer produced. Then it is heated in a furnace at 550°C overnight, cooled down in the desiccator, and weighted.

$$Ash\ (\%) = \frac{Weight\ of\ ash \times 100}{Weight\ of\ sample}$$

### Crude fibre content

Crude fibre analysis was conducted by using the standard method AOAC [12]. 5 g of weighed cheka samples were digested in 1.25% boiling sulphuric acid and then in 1.25% NaOH for 30 minutes and then the residue was filtered and it was dried in an oven at 130°C for 2 hours. It was then cooled and weighed as $W_2$. Thereafter the sample was kept in a muffle furnace at 550°C for five hours to obtain a white ash. Finally, the sample was cooled again in desiccators and re-weighed as $W_1$.

$$Fat\ (\%) = \frac{Weight\ of\ fat}{Weight\ of\ sample} \times 100$$

Where: $W_1$=Weight of crucible contain ashed sample, $W_2$=Weight of Crucible with dried sample, $W_3$=Weight of the sample.

### Crude protein content

The crude protein content of cheka samples in terms of nitrogen was analyzed by the Kjeldahl method [12]. Samples went through three essential steps of digestion, distillation, and titration.

### Fat content

The crude fat was extracted by the Rose Gottleib method [13]. 5 g of cheka sample was taken into the extraction thimble and transferred into Soxhlet apparatus using petroleum ether. Cheka samples were heated for about 14 hours (heat rate of 150 drops/min) and the solvent was evaporated by using a vacuum condenser. Residues left after the evaporation of solvent were weighed.

$$Fat\ (\%) = \frac{Weight\ of\ fat}{Weight\ of\ sample} \times 100$$

### Carbohydrate

The consumable carbohydrate content was determined by subtracting the summed up percentages of moisture, protein, lipids, fiber, and ash contents from 100 g of the sample.

% of Carbohydrate=(100-%(Moisture+Crude protein+Crude fat+Ash+Crude Fiber)) [12].

### Gross energy

The gross energy values were determined from fat, carbohydrate, and protein content using the Atwater's conversion factor; 4.0 Kcal/g for protein, 9.0 Kcal/g for fats, and 4.0 Kcal/g for carbohydrate [12].

Gross energy=(%Crude protein × 4)+(%Fat content × 9)+(%Carbohydrate × 4)

### Nutrient composition of cheka

The nutrient composition of the sample was determined by using the standard procedures of the Association of Official Analytical Chemists (AOAC) [12] meant for analysing Zn, Mg, Ca, and Fe contents. One gram of sample was ashed and then digested with hydrochloric acid, filtered and the filtrate was taken 5 ml volumetric flask and were loaded to Atomic Absorption Spectrophotometer. The standard curves for each mineral (iron, calcium, magnesium, and zinc), were prepared from known standards, and the mineral value of samples were then estimated against that of the standard curve.

### Determination of ethanol

The ethanol level of cheka was determined, by employing the measurement of refractive index and specific gravity. Refractive indices were measured by using Abbee refractometer at 25°C. 100 mL of cheka was taken into a 500 ml glass reagent bottle and stained for 2 hours to sediment the solid part from the liquid. The liquid part of cheka was decanted and distilled for about 45 min until the distillation thermometer reads between 77°C to 80°C. The specific gravity of the cheka sample was then determined using a pycnometer. The weights of an empty pycnometer, pycnometer with distilled water, and pycnometer with the distillate cheka samples were measured [3].

$$Specific\ gravity = \frac{Weight\ of\ pycnometer\ with\ sample - Weight\ of\ empty\ pycnometer}{Weight\ of\ distilled\ water}$$

Alcoholic content by weight [A (% W/W)]=[0.2965 × RI-295.8 × SG+291.285-0.04]

Where: RI is the Refractive Index and SG is the Specific Gravity

## RESULTS AND DISCUSSION

### Physicochemical characteristics and proximate composition of cheka samples

The physicochemical parameters, pH of cheka samples were found to be in the range of 4.61- 4.11. pH of the cheka sample obtained from householder such as homemade 1, homemade 2, homemade 3, commercial 1, and Commercial 2 were 4.61, 4.59, 4.44, 4.17, and 4.11 respectively (Table 1). The sample commercial 2, showed the highest pH of 4.11 and sample homemade 1 had the lowest pH of 4.61. The sample collected from the commercial source, commercial 2 was more acidic than other respective samples. The mean pH of cheka included in the current study is less acidic while comparing with samples of previous studies done in Konso (3.53), Shele (3.89) and Derashe (3.68) [14]. This difference in pH of the alcoholic beverage of cheka may be due to the variations in the art of preparation, fermentation process at the domestic level, and differences in the raw material constitution, from home to home in the study locality. Also, it is it has been observed that the results of this study are similar to the data reported by Ahemed et al., who prepared indigenous alcoholic beverages from fruits from Bangladesh [15] and Tadele et al., who did research in the estimation of alcohol content, from an indegenious drink, Unfiltered tella, Filter tella, and areki, from Ethiopia [3]. However, the present results are diversed when compared to different beverage that consumed are consumed in Ethiopia, such as, Teji, borde, Keribo, and Bokka [3,7,16,17].

Titratable acidity of cheka samples were found to be 1.13, 1.25, 1.36, 1.65, and 1.78 for homemade 1, homemade 2, homemade 3, commercial 1 and commercial 2 respectively. The cheka sample that is collected from commercial source is more acidic than other samples collected from local households. Since during the processing cheka needs to be fermented for five days at room temperature, it tends to increase its lactose content which leads to decrease in pH values. Increase in titratable acidity and decrease in pH impacts directly and hence increase the shelf life and quality of alcoholic beverages [17]. These results are different from the outcome of the study by Binitu Worku et al. which reported that the percentage of titrable acidity of Cheka are in the range of 1.11 to 0.77 [14]. The moisture content of cheka samples are found to be in the range of 22.76-30.32 (Table 1). The texture, taste, appearance, and stability of food depend on the amount of water they contain. Moisture content of foods can be influenced by the processing procedures, type and variety of storage conditions. Moisture-related microbial growth is a key factor contributing to food spoilage in developing countries [18]. Cheka has less moisture content compared to other local alcoholic drinks that are consumed commonly in Ethiopia, like tella and booka [6,19]. The low moisture content of cheka would enhance its quality, resistance to deterioration, and shelf life.

The percentage content of proteins in cheka was found to be in the range 5.97-4.95. Samples collected local households and labelled as home made1 has high protein percentage, 5.97, compared to other samples (Table 1). The higher protein content in this cheka sample had rendered it to be more nutritious than other samples which have fewer percentages of proteins. The highest alcoholic content among the cheka samples was found to be 6.75% (v/v) for the sample, commercial 2, which corresponds to 6.75 ± 0.08. Significant variations in alcohol contents of cheka within the sampling sites ranged from 4.05 to 6.75. Alcohol content of cheka samples which were labelled as homemade 1, 2, 3, and commercial 1, 2 were 4.57, 4.05, 4.53, 5.32 and 6.75 respectively (Table 1). The result of this study illustrate that there is less alcohol content in the present set of cheka samples compared to that compare to that report by Binitu Worku et al. [14]. Compared to the alcohol contents of samples from other studies done in Ethiopia, it was observed that the current set of cheka samples have more alcoholic content, for instance, more than Tella and Bokka [19,20]. Lipids are an alternative energy source in times of fasting and starvation. Fats are important in the structural and biological functioning of cells and it act as major food reserves along with proteins [21]. The crude fat content of the cheka samples ranged from 1.13 for commercial 1 to 1.63 for homemade 3 (Table 1). Diets with high-fat content significantly enhance the flavour and are also useful in improving the palatability of food serving the energy requirement of human body [22]. The results of this study show that the crude fat content of cheka is similar to that found in a report related to a previous study done on cheka by Binitu Worku et al. [14].

On the other hand, the ash content of cheka samples varied from 3.31 for homemade 1 to 1.51 for commercial 2 (Table 1). Percentage ash contents of the presently studied set of samples were larger than the ash content obtained in a previous study done on cheka by Binitu Worku et al. [14]. These differences in ash contents may be due to the variations in raw material processing methods applied for making cheka. Ash content is an indication of the mineral composition of a food item [22]. This, therefore, suggests that sample homemade 1 could be important sources of minerals compared to other samples. In this study, the carbohydrate content of cheka found to be 59.11 for homemade 1, 61.22 for homemade 2, 59.08 for homemade 3, 60.93 for commercial 1, and 64.41 for commercial 2 (Table 1). The carbohydrate percentages in the presently studies series of cheka samples are higher compared to those reported by Binitu Worku et al. [14]. The high carbohydrate contents in cheka provide good source of energy for the consumer. The fibre and gross energy contents of cheka samples ranged from 1.2 to 1.9 and 270.79 to 287.87 respectively (Table 1). Crude fibre helps in the prevention of heart diseases, colon cancer, diabetes, and in relieving constipation, etc [22]. Thus, it indicates that the samples collected from local households are much better than the samples which are collected from commercial sources in terms of fibre content.

## Mineral composition of cheka

The mean mineral compositions of five cheka samples are presented in Table 2. Magnesium reduces muscle tension, lessen pain associated with migraine headaches, and improve sleep and adverse neurological disorder such as anxiety and depression. Magnesium is needed for more than 300 biochemical reactions in the body. It is an essential micronutrient and a potential component that can help to maintain normal nerve and muscle functions supports a healthy immune system, keeping the heartbeat steady, and helping bones to remain strong. It also helps to regulate blood glucose levels and aiding in the production of energy and proteins [23]. Magnesium content in the beverage of cheka ranged from (10.65-11.82) mg/L in this study, which express a lower level in terms of the dietary reference intake, 400 mg/day, for men and 310 mg/day, for women. Calcium is one of the major mineral elements that help in building and maintain strong bone, teeth, and metabolism of vitamin D. Calcium aids in enzyme secretion, fat metabolism, eggshell formation, and also it lowers the blood pressure. Other function of calcium include regulation of hormones, enzyme production, and activity, transmission of nerve impulse, blood clotting, wound healing, muscle growth, and contraction. It also helps to maintain a healthy heart and also it facilitates the passage of nutrients in and out of the cell wall [21,23-25]. As can be seen in Table 2, homemade 1 had the highest calcium content (11.05%) and homemade 2 had the least (7.79%). This finding is too different from that of Binitu Worku et al. [14] Who reported calcium content between 8.31% and 19.6% in cheka samples collected from different parts of southwestern Ethiopia. This difference may be due to variation in the characteristics of ingredients utilized for the preparation of cheka. Iron level of the alcoholic cheka drinks ranged between 7.64 mg/l and 10.73 mg/l. The dietary reference intake for iron is 10 mg/day for men and 15 mg/day for women. However, the iron content of cheka reported in this study was comparably lower than that was earlier reported by Binitu Worku et al. viz, (14.41-18.96) mg/100 g [14]. Iron contents found in this study are in fact not sufficient for the daily level required, in comparison to the recommended standard limits. Iron is important in many biological processes because it is an ideal oxygen carrier and it can function as a protein-bound redox element.

Zinc is an essential mineral that is involved in numerous aspects of cellular metabolism. It is required for the catalytic activity of approximately 100 enzymes and also it plays active roles in immune function, protein synthesis, wound healing, DNA synthesis, and cell division. Zinc also supports normal growth and development during pregnancy, childhood, and adolescence and is required for proper sense of taste and smell. The Dietary Reference Intakes recommendations for zinc are 15 mg for ages 4 and above. Zinc is

**Table 1:** Physicochemical characteristics and proximate compositions of cheka samples.

| Parameters | Homemade 1 | Homemade 2 | Homemade 3 | Commercial 1 | Commercial 2 |
|---|---|---|---|---|---|
| | Mean ± SD | Mean ± SD | Mean ± SD | Mean ± SD | Mean ± SD |
| pH | 4.61 ± 0.026 | 4.59 ± 0.01 | 4.44 ± 0.021 | 4.17 ± 0.028 | 4.11 ± 0.025 |
| % Titratable acidity | 1.13 ± 0.12 | 1.25 ± 0.01 | 1.36 ± 0.09 | 1.65 ± 0.13 | 1.78 ± 0.22 |
| % Protein | 5.97 ± 0.10 | 4.96 ± 0.03 | 4.95 ± 0.11 | 4.98 ± 0.01 | 4.97 ± 0.02 |
| % Ash | 3.31 ± 0.24 | 3.00 ± 0.03 | 2.32 ± 0.11 | 2.12 ± 0.01 | 1.51 ± 0.22 |
| % Crude fiber | 1.90 ± 0.22 | 1.80 ± 0.06 | 1.70 ± 0.11 | 1.50 ± 0.18 | 1.20 ± 0.03 |
| % Crude fat | 1.25 ± 0.13 | 1.19 ± 0.33 | 1.63 ± 0.11 | 1.13 ± 0.09 | 1.15 ± 0.23 |
| % Moisture content | 28.46 ± 0.20 | 27.83 ± 0.12 | 30.3 ± 0.10 | 29.34 ± 0.01 | 26.76 ± 0.01 |
| % Carbohydrate | 59.11 ± 0.14 | 61.22 ± 0.08 | 59.08 ± 0.09 | 60.93 ± 0.06 | 64.41 ± 0.11 |
| Gross energy (Kcal) | 271.57 ± 0.04 | 275.43 ± 0.10 | 270.79 ± 0.21 | 273.81 ± 0.12 | 287.87 ± 0.01 |
| % Alcohol content (%v/v) | 4.57 ± 0.20 | 4.05 ± 0.32 | 4.53 ± 0.15 | 5.32 ± 0.12 | 6.75 ± 0.08 |

**Table 2:** Mineral content of cheka samples.

| Sample | Mg (mg/l) | Fe (mg/l) | Ca (mg/l) | Zn (mg/l) |
|---|---|---|---|---|
| | Mean ± SD | Mean ± SD | Mean ± SD | Mean ± SD |
| Homemade 1 | 11.82 ± 0.08 | 10.71 ± 0.26 | 11.05 ± 0.25 | 3.83 ± 0.32 |
| Homemade 2 | 10.99 ± 0.03 | 7.64 ± 0.09 | 7.79 ± 0.64 | 2.48 ± 0.11 |
| Homemade 3 | 10.65 ± 0.01 | 10.73 ± 0.23 | 9.28 ± 0.10 | 2.57 ± 0.25 |
| Commercial cheka 1 | 11.55 ± 0.11 | 11.70 ± 0.05 | 9.45 ± 0.32 | 5.09 ± 0.04 |
| Commercial cheka 2 | 11.28 ± 0.12 | 8.52 ± 0.18 | 8.98 ± 0.05 | 5.33 ± 0.03 |

such a critical element in human health of which, a small deficiency creates severe malfunctions. Zinc deficiency is characterized by growth retardation, loss of appetite, and impaired immune function. In more severe cases, zinc deficiency causes hair loss, diarrhoea, delayed sexual maturation, impotence, hypogonadism in males, and eye and skin lesions [24]. The mean concentration of zinc in cheka samples collected from homemade 1, homemade 2, homemade 3, commercial 1, and commercial 2 were (3.83, 2.48, 2.57, 5.09, and 5.33) mg/l respectively. The mean concentration of zinc in commercial cheka samples was higher compared to that found in homemade samples. The level of zinc found in this study is much lower than that obtained from a previous work were it ranged between 7.9 and 10.7 mg/l in cheka samples collected from Konso and Shele of southwestern Ethiopia [14]. This may due to the differences in the art of fermentation applied in the preparation of the drink as well as the variations in the type and number of ingredients added.

Daily intake of zinc is required to maintain a steady-state because the human body has no specialized zinc storage system [24]. However, cheka is not the best optional indigenous food that can be consumed daily since it has less amount of micronutrient of Zinc in a comparison to that of dietary intakes which has been recommended for daily usage.

## CONCLUSION

Cheka samples which are collected from local households are relatively good in its nutritional content than samples collected from commercial sources. Commercially brewed alcohol like cheka does not contain many ingredients for production as it is fermented for more than a week, resulting only in the enhancement of alcoholic percentage and reduction in nutrient content. Most of locals in Konso are habituated to the consumption of cheka as their main daily drink. However, the result of this study shows that cheka has less nutrient content and does not fit to be recommended as nutrient drink matching the dietary reference intake need for a day. It needs to take other food items besides cheka to gain nutrient required for daily activities.

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