PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
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Pakistan Journal of Nutrition 9 (8): 797-805, 2010
ISSN 1680-5194

The Nutritional Value of "Poha Beer" (Tamarind Fruit Drink) and its Social Usage in Tamale Metropolis

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Abstract: Tamarind fruit drink popularly known as "Poha Beer" in most parts of the Northern Ghana was prepared to test the nutritional value of the fruit. There is inadequate or lack of scientific data on its nutritional value and its usage especially in Ghanaian communities. This study was therefore carried out to survey the general usage of the tamarind fruit drink in the Tamale Metropolis and also to assess the nutritional value of some nutrients in the drink so as to contribute to the literature as well as bridge the knowledge gap. The study employed the use of questionnaire and the standard Association of Official Analytical Chemists (AOAC) official method of analyzing nutritional composition of foods to determine the vitamin C, the protein and carbohydrate composition values present in the Tamarind fruit drink. The results of the study indicate that "Poha Beer" generally compares favourably with most fruit juice (beverage) on the market. Considering the vitamin C level of the "Poha beer", it is very likely that, it could promote iron absorption. Reasons for non-preference include: taste, unhygienic method of preparation, unattractive packaging and its light nature. Improving on hygienic preparation, handling and good packaging could help curb the problem of non-preference by the populace in Tamale metropolis.

Key words: Tamarind, Poha, nutritional value, Tamale

INTRODUCTION

Tamarind fruit drink is popularly known as "Poha beer" in Northern Ghana and as its name suggests it is a drink (beverage) processed from the Tamarind fruit. The whole Tamarind plant, right from the root to the leaves, is of immense use, ranging from medicinal, decorative, brewing and dye production (Alfred and Ngoddy, 1992; Sidibe and Hofmanand, 1996).

Tamarinds are slow-growing, long-lived, evergreen trees that under optimum conditions can grow 80 feet high with a spread of 20-35 ft., in its native eastern Africa and Asia. However, in Southern California it seldom reaches more than 15-25 ft. in height (National Research Council, 2008). According to Watson and Dallwitz (1992) it is a legume popular in many tropical and sub tropical areas as an ornamental and as a fruit produce. It is from the class magnoliopsida and the family fabaceae. The genus Tamarindus is monotypic (having only a single species).

Although it is one of the conspicuous trees in the three Northern regions-Upper East, Upper West and Northern region, it is considered as a wild fruit and is not cultivated in Ghana. Also it can be seen across the entire nation.

Popenoe (1974) found the pulp of the fruit to be very rich in vitamin C and sugar. Hence it is used in syrups, juice concentrates, curries, pickles and meat sauces. The sugar in it is mainly glucose and fructose. Vitamin C is very important antioxidant in the body and it is also said to have a laxative effect (Kennedy and Santa, 2005; Ronald, 1998).

Problem statement: In Ghana, there are several claims on the usefulness of the Tamarind fruit and as such has led to it being one of the most patronized beverage by the people of Northern region, most especially during the period of Ramadan, These claims range from nutritional to medicinal and hence it is highly preferred to several beverages, alcoholic and non alcoholic sold on the market especially within the Muslim communities. In spite of the high patronage of this beverage in most parts of northern Ghana and the several claims on the nutritional value of the fruit, there is inadequate or lack of scientific data on its nutritional value and it usage specially in the Ghanaian communities. The paucity of literature relating to tamarind "Poha beer" (fruit drink) raises a number of pertinent research questions stated below:

- What are some of the vitamins in the "Poha beer"?
- What is the level of knowledge concerning the health benefit/risk concerning the use of "Poha beer"?
- What is the extent of usefulness of the "Poha beer" in Tamale metropolis?

The research questions underscore the aim and objectives of the study. The overarching aim is to assess the social uses of "Poha beer" (Tamarind fruit juice) and its nutritional value. The specific objectives are as follows:

- To determine the amount of vitamin C present in the beverage;

- To determine the amount of glucose present in the beverage;
- To determine the social usage of "Poha beer in Tamale metropolis and
- To determine the factors which limits the patronage and consumption of "Poha beer".

Literature review

Origin of Tamarind tree: Tamarind is native to tropical Africa and grows wild throughout the Sudan. It was introduced into India so long ago; it has often been reported as indigenous there. It is extensively cultivated in tropical areas of the world. Sometime during the sixteenth century, it was introduced into America and today is widely grown in Mexico (California Rare Fruit Growers, 1996).

Growth habit of Tamarind tree: Tamarinds are slow-growing, long-lived, evergreen trees that under optimum conditions can grow 80 feet high with a spread of 20-35 ft., in its native eastern Africa and Asia. However, in Southern California it seldom reaches more than 15-25 ft. in height (Caribbean Food and Nutrition Institute, 1993; Tamale *et al*., 1995).

Foliage: The bright green, pinnate foliage is dense and feathery in appearance, making an attractive shade tree with an open branch structure. The leaves are normally evergreen but may be shed briefly in very dry areas during the hot season. There are usually as many as 10-20 nearly sessile ½-1 inch, pale green leaflets per leaf. The leaflets close up at night (Caribbean Food and Nutrition Institute, 1993; Tamale *et al*., 1995; Morton, 1987).

Flowers: The inconspicuous, inch-wide, five-petalled flowers are borne in small racemes and are yellow with orange or red streaks. The flower buds are pink due to the outer colour of the 4 sepals which are shed when the flower opens (Tamale *et al*., 1995).

Fruit: The 3-8 inch long, brown, irregularly curved pods are borne in abundance along the new branches. As the pods mature, they fill out somewhat and the juicy, acidious pulp turns brown or reddish-brown. When fully ripe, the shells are brittle and easily broken. The pulp dehydrates to a sticky paste enclosed by a few coarse strands of fiber. The pods may contain from 1-12 large, flat, glossy brown, obviate seeds embedded in the brown, edible pulp. The pulp has a pleasing sweet/sour flavour and is high in both acid and sugar. It is also rich in vitamin B and high in calcium. There are wide differences in fruit size and flavour in seedling trees. Indian types have longer pods with 6-12 seeds, while the West Indian types have shorter pods containing only 3-6 seeds. Most tamarinds in America are of the shorter type (California Rare Fruit Growers, 1996) (Fig. 1, 2).

Fig. 1: Tamarind fruit. Source: http://www.wikipedia.org/*Tamarindus indica*

Fig. 2: Tamarind tree branch with the fruit. Source: http://www.wikipedia.org/*Tamarindus indica*

Location: The tamarind ultimately becomes a fairly large tree, so this should be kept in mind when planting out the tree. It is planted in full sun and is highly wind-resistant with strong, supple branches. The tree generally forms a beautiful spreading crown that casts a light shade (Dassanayake *et al*., 1991; National Research Council, 2008).

Soils: Tamarinds tolerate a great diversity of soil types but do best in deep, well drained soils which are slightly acid. Trees will not tolerate cold, wet soils but are tolerant of salt spray and can be planted fairly near the seashore (Morton, 1987; National Research Council, 2008).

Irrigation: The tamarind is adapted to semiarid regions of the tropics and can withstand drought conditions quite well. Young trees require adequate soil moisture until they become established, but mature trees do quite well without supplemental irrigation (California Rare Fruit Growers, 1996).

Fertilization: Young trees require fertilization every 2-3 months with a 6-6-3 NPK or similar analysis fertilizer. The requisite amount is 1/4 lb. and gradually increased to about ½ lb. Thereafter, young trees could receive ½ lb. per application, per year of tree age, 3-4 times a year. Bearing trees can be fertilized with 8-3-9 NPK or similar analysis, at rates of about ½ lb. per application per year of tree age. Microelements, particularly iron may be required for trees in alkaline soils (California Rare Fruit Growers, 1996).

Propagation: Rootstocks are propagated from seed, which germinate within a week. Seeds retain their viability for several months if kept dry. Plant seeds ½ inch deep in containers filled with a UC soilless type potting

media. Tamarind should be selected from trees of good production and quality. Even so, seedlings will be variable in quality and slow to bear. Veneer grafting, shield (T or inverted T) budding and air layering may be used to propagate desirable selections. Such trees will usually fruit within 3-4 years if provided optimum growing conditions. Seedlings should begin to produce fruit in 6-8 years, while vegetative propagated trees will normally bear in half that time (California Rare Fruit Growers, 1996).

Young trees should be planted in holes larger than necessary to accommodate the root system. They should be planted slightly higher than existing ground level to allow for subsequent settling of the soil and a water basin should be built around each tree to assure adequate moisture for young trees. Spacing of trees is normally 20-25 ft. in commercial orchards. However, solitary trees planted in Southern California rarely exceed 15 feet in diameter (California Rare Fruit Growers, 1996).

Pests and diseases: In California tamarinds are generally free of pests and diseases, although ants will sometimes spread black and olive scales. In India there are a host of pests that attack the tree, including mealy-bugs, caterpillars, aphids, white flies, trips and a variety of scales. Various weevils and borers can also infest the ripening pods or stored fruits (California Rare Fruit Growers, 1996).

Harvest: Tamarind fruits mature in late spring to early summer. They may be left on the tree for as long as 6 months after maturity so that the moisture content will be reduced to 20% or lower. Fruits for immediate processing are often harvested by pulling the pod away from the stalk. Mature trees are capable of producing 350 lb. of fruit a year. Ripe fruit in humid climates is readily attacked by beetles and fungi, so mature fruit should be harvested and stored under refrigeration (California Rare Fruit Growers, 1996).

Tamarinds may be eaten fresh, but they area most commonly used with sugar and water in the American tropics to prepare a cooling drink. The pulp is used to flavour preserves and chutney, to make meat sauces and to pickle fish. Candy can be made by mixing the pulp with dry sugar and moulding it into desired shapes (California Rare Fruit Growers, 1996).

Nutritional value of food: Food nutrients are classified generally into two namely macro-nutrients and micro-nutrients (Hamilton and Whitney, 1993; Lavon, 2001). Macro-nutrient basically include carbohydrates, fats and proteins whose constituent substance supply energy and build tissue. Micronutrient on the other hand embodies vitamins and minerals that the body uses in much smaller amounts to regulate and control body processes (William, 1994; Corinne *et al*., 1992). The nutritional value of a food refers to the amount of both macro and micro-nutrients present in that food item, in this case the Tamarind fruit drink.

Minerals: Minerals are inorganic nutrients that are required in minute quantity in the human organism. They are widely distributed in nature and perform metabolic functions like building, activating, regulating, transmitting and controlling (William, 1994; Susan, 2000). They are important nutrients which are categorized based on the amount needed per day. On a broader note if we require 100mg (1/50 a teaspoon) or more per day of a mineral, it is considered a major mineral; otherwise it is considered a trace minerals (Mallory and Julian, 1998; Wardlaw, 2003).

The more presence or supply of minerals in our diet is not an end in itself. The ability to absorb minerals from diet depends on so many factors (William, 1994; Charlotte and Nancy, 1991). Spinach for example contains a lot of calcium but only about 5% of it can be absorbed because it contains high concentration of oxalic acid and calcium-binder. Generally the more refined a plant food is-as in the case of white flour-the lower its mineral content (Wardlaw, 2003; King and Burgess, 1998).

Vitamins: They are vital organic dietary substances that are not an energy producing carbohydrate, fat, or protein and is usually necessary in only small quantities to perform a particular metabolic function or to prevent an associated deficiency disease and it cannot be manufactured by the body and therefore must be supplied in food (Watson and Dallwitz, 1992; William, 1994). Vitamins are thus classified into fat soluble (vitamins A, D, E and K) and water soluble vitamins (vitamins B and vitamins C) (Garrow and James, 1993). Vitamins can however be obtained from both plant and animal sources. Vitamins are very essential. It is also worth noting that when they are accumulated to some levels in the body, can cause toxic effects. Theoretically toxicity of any vitamin is possible, however toxicity of the fat soluble vitamins A and D are most frequently observed vitamin E and the water soluble vitamins niacin vitamin B and vitamin C can also cause toxic effects, but only when consumed in very large amount (15-100) time human need or more (Hampli and Hall, 2002; Wardlaw, 2003).

Preservation of vitamins in food: Vitamins in food can be lost usually from the time period of harvested or gathered to consummation. Water soluble vitamins particularly thiamine vitamin and foliate can be destroyed with improper storage and excessive cooking, heat, light, exposure to open air which can destroy vitamins. The sooner food is eaten after harvest the lesser the chance of nutrient lost (Charlotte and Nancy, 1991). Freezing apparently is a good method of preservation than those

methods (blending, drying, frying etc) (Alfred and Ngoddy, 1992).

Function of vitamin C: It functions include assistance in the synthesis of protein and collagen. This protein is highly concentrated in connection tissues; epithelial tissue bone, teeth, tendons and blood vessels. The vitamin also plays an important role in wound healing (Remero and Rodriguez, 1992).
In addition, it helps the body to use calcium and other nutrients to build bones and blood vessels. It also assists iron absorption by keeping iron in its most absorbable form and destroys free radicals in the body (King and Burgess, 1998). Apart from this it helps to strengthen the immune system of man and also contribute to reducing stress, heart diseases and cancer (Wardlaw, 2003). Food sources of vitamin C include Green pepper, Potatoes, Citrus fruits, Cauliflower, Broccoli, Papayas and Strawberries etc.

MATERIALS AND METHODS

"Poha beer" production: The preparation of the "Poha beer" involves several key stages as shown in Fig. 3.

Threshing: The outmost covering is carefully threshed out manually or separated one at a time with the hands. This is done carefully to prevent soiling and contamination of the fruit to ensure safety.

Fermentation: After the outer cover has been removed, the fruits are kept in a container with water sprinkled on them and left to ferment.

Moulding: The fruits are then moulded into balls for use and storage. The moulding reduces the surface area. This prevents bacteria and fungal spore's development in the fruits. This preserves it for a longer time while ensuring its quality as well.

Soaking: The fruits are water soaked either with cold or warm water to help extract the pulp. It ensures good dissolution. All the water soluble nutrients sip out of fruit into solution. Cold or slightly warm water is used to ensure that much volatile nutrients such as vitamin C are not lost.

Mashing: The soaked fruits are mashed in enough water to extract enough pulp. It increase rate of dissolution.

Decanting: After the substance has been mashed, the seed aid suspending matter (fibre or pieces of outer cover) are removed leaving the drink where all the unwanted materials are removed with a sieve.

Spicing: Spices are added to taste. The basic spices usually include ginger, cloves and peppercorns.

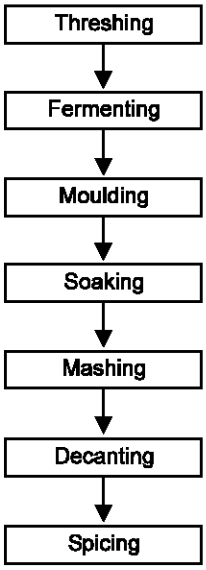

Fig. 3: Processing steps of "Poha beer"

Quantitative data on nutritional value
Sample source and preparation: A sample of Tamarind fruits was collected from fine tamarind fruit sellers in Tamale Central Market. The sample was soaked with warm water. The pulps of the fruits were extracted in the form of juice. The juice was stored in a refrigerator. After keeping the sample for a week, it was analyzed for its proximate compositions and mineral composition using standard Association of Official Analytical Chemists (AOAC) (1990) official method.

Protein/total nitrogen: The protein content in the Tamarind fruit drink was determined by measuring the total nitrogen using the Kjeldahl method (this is a food composition determinant procedure propose by Kjeldahl) of AOAC. 2.00 grams sample and half of selenium based catalyst tablet and 0.5 g of anti-bumping agent was added to the digestion flask. 25 ml of concentrated H_2SO_4 (Sulphuric acid) was added and the flask was shooked gently to make the sample wet. The mixture was then digested until a clear solution was obtained. Solution was cooled to room temperature. The digested sample was then transferred into a 100ml volumetric flask and made to the mark using distilled water. 10 ml aliquot of the digested was measured into the disposition chamber of a distillation apparatus.
A 15 ml 40% Sodium Hydroxide (NaOH) solution was added and the solution distilled. The ammonia released was trapped into 25 ml of 2% boric acid solution containing mixed indicator. A colour change from pink to green was observed as the ammonia was trapped. Distillation was contained for 5 min. The boric ammonia acid solution obtained was titrated against 0.1 ml of Hydrogen Chloride (HCl). The percentage protein was then calculated as shown in appendix 4a.

Moisture: Moisture was determined using the method of AOAC (1990). 5 g of the sample was transferred to previous weighed and dried dish. Dish was place in a hot air oven thermostatically controlled at 105°C for 5 h. Dish was then removed, placed in desiccators to cool and weighed. It was replaced in an oven and weighed. This was repeated until constant weight was obtained.

Estimation of vitamin C (Trimetric method): Vitamin C content was measured using the trimetric method.

Materials: Ascorbic acid, indophenols and sample. A burette was filled with 0.001% of indophenols solution. A solution containing 1g/dm^3 of Ascorbic acid was prepared (such that 1 cm^3 = 1 m of Vitamin C). 10 cm^3 solution of Ascorbic acid was acidified with three drops of diluted hydrochloric acid. It was run in indophenols solution until the solution was permanently pink.
For easy and accurate calculations, it was taken that if x cm^3 of sample is required; 1cm^3 of indophenols solution is equivalent to 10/x mg of vitamin C. Having standardized the indophenols solution, 10 cm^3 of the given sample was taken and treated in a similar way. The mass and volume of vitamin C was calculated as in appendix 4c.

Sugar: The total sugar was measured using the Abc tetrameter. The sample (dry) was divided corresponding to the international sugar scale, 1996. In taking the measurement a rounded glass rod was used to introduce 2-3 drops of sample into the funnel shaped opening on the right side of the measuring prism. The prism body was turned until a boundary was exactly in the intersection point of telescopes cross hair line by means of the focusing telescope. Reading were taken using the reading telescope which has a graduated circle which carries graduation for refractive indices and sugar percentage (dry substance) side by side Model: Carl Zeiss JENA SRN 291765.

Data analysis: The quantitative data were subjected to descriptive statistics using statistical tools such as percentages, tables, bar and pie charts. However the quantitative data were analyzed using nutrient specific protocols as indicated above.

Quantitative data on survey stand of the study

The survey area: The survey was carried out in Tamale central market, with the characteristics of a metropolitan setting, such as ethnicity, educational levels, religion reflected in the respondents' responses based on their diverse socio-demographic backgrounds.

Sample size determination: The sample size was determined using the statistical formulae:

$$N = z^2 pq/d^2$$

When,

n = Sample size
z = Statistical certainty chosen
p = Estimated prevalence/ level of investigation
q = 1-p
d = Precision desired
z = 99% = 1.96
p = 0.5
q = 0.5
d = 0.14

Therefore, $n = (1.96)^2 \times 0.5 \times 0.5/(0.14)^2 = 49$

Selection of participants: Participants were selected from the Tamale central market. It was mainly women dealing with "Poha beer" and a cross section of their customers. These customers included school children.

Information acquisition: It was acquired from participants via the use of semi-structured questionnaires. It was basically done in a form of conversation and written down later (shortly after the conversations). This was done to get full participation of the participants.

RESULTS

The nutritional value of "Poha beer" obtained from proximate analysis are given in Table 1.

Table 1: Nutritional value of "Poha beer"

Item	Amount
Protein	1.75%
Total solids	22.74%
Ash	1.04%
Sugar	26%
Vitamin C	30 mg/100 ml

Nutritional values of some beverages: The under listed drinks and their nutritional values were those sampled from the Tamale Central Market for the purpose of comparing them with that of "Poha Beer".

Sampling procedure: All drink with nutritional labeling in six Supermarkets in Tamale central market square were selected.

Demographic characteristics of respondents: A total of 50 people were sampled and interviewed. Table 3 gives details of the demographic characteristics of the respondents.
In terms of age distribution, most of the participants (46%) were within the age group of 26-35 years followed by 36% for those within the age group 10-25 years. The age range of 36-55 recorded the least number of participants (18%).
The participants were mainly Dagombas (64%) with Ewes being the least (2%). Majority of the participants were Muslims (62%) followed by Christians (38%).

Table 2: Nutritional value of massig fruit drinks

	Nutrient				
Drink	Carbohydrates (mg) (100 ml)	Protein (%)	pH	Ash	Acid (%)
Massig Banana	20	1.65	3.58	1.77	2.49
Massig Guava	18	3.5	3.4	1.06	1.41
Massig Melon	14	1.60	3.75	1.03	1.38

Mineral present: Fe, Na, K, Ca. The guava drink has been enriched with Vitamin C*

Table 3: Socio demographic characteristics of the participants

Sex	Number of respondents	Percentage
Males	21	42
Females	29	58
Ethnicity		
Dagomba	32	64
Gonja	8	16
Kasena	4	8
Akans	2	4
Ewes	1	2
Others	3	6
Religion		
Muslim	31	62
Christians	19	38
Education		
Primary	5	10
Middle/j.S.S	16	32
Secondary/s.S.S	10	20
Tertiary	9	18
No formal education	4	8
Arabic	6	12
Occupation		
Trader	20	40
Salary worker	4	8
Students	21	42
No employment	5	10

Table 4: Utilization of Poha beer

Items	Number respondents	Percentage
Source		
Market	18	36
Self-process	8	16
Relatives/friends (gifts)	3	6
Reasons for use		
Cheap not expensive	19	38
Readily available	4	8
Medicinal value	6	12
Amount consumed-50 ml cup	**Frequency**	**Percentage**
3 + cups daily	4	8
1-2 cups a week	14	28
3-4 cups in 2 weeks	2	4
Don't know	6	12
Occasionally	3	6
Preference		
Poha beer	13	26
Others	37	74

The detailed information on the participants socio-demographic characteristics are as illustrated in Table 3.

Table 4 shows the sources of "Poha beer" and some responses of the respondents.

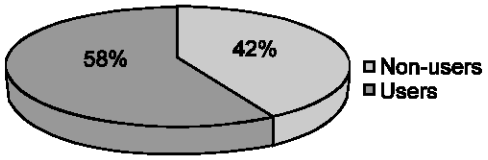

Fig. 4: A pie chart showing users and non-users

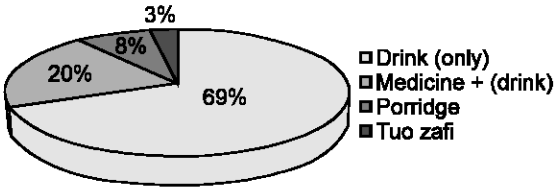

Fig. 5: A pie chart showing the utilization of "Poha Beer"

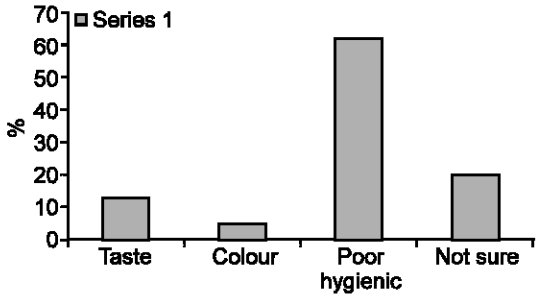

Fig. 6: A bar chart showing the reason for non-utilization

Figure 4 shows a high user's level (58%) of the beverage while 42% do not use it at all.

Figure 5 shows the utilization of "Poha beer". It could be seen that 69% of the respondents take "Poha beer" as a beverage (drink only), 20% of them took it because of its medicinal value while 8% and 3% user for porridge and T Z respectively.

Figure 6 is a bar chart showing the reasons for non-utilization, it revealed that the high level of non-utilization of "poha beer" was due to poor hygienic preparation (62%) and the taste (13%) while 5% do not use it because of its colour 20% were not sure.

Figure 7 is showing the reasons for preference of "Poha beer", 62% of the respondents prefer it to other drinks because they believe it has medicinal values, 23% of them prefer it because they believe it has a laxative effect and 15% prefer it for its taste.

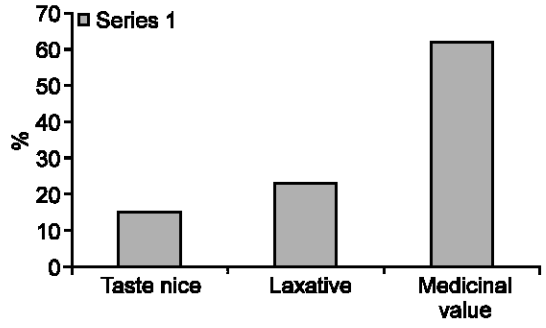

Fig. 7: A bar chart showing the reasons for preference of "Poha beer"

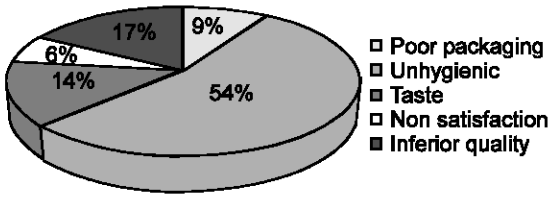

Fig. 8: A pie chart showing reasons for non-preference of "Poha beer"

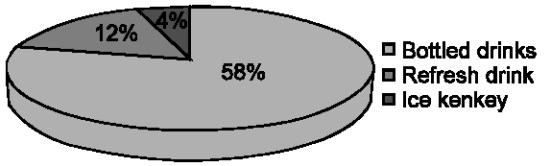

Fig. 9: Preference for other drinks

The pie chart it shows the distribution of reason for non preference "Poha beer" (Fig. 8). The result showed that 54% of the respondents do not prefer the drink because they believe it is unhygienically prepared, 14% of them do not prefer it because of its taste, 17, 9 and 6% do not prefer it because they find it to be non-satisfactory, poor packaging and an inferior drink respectively.

Figure 9 shows preference of other drinks. When "Poha beer was compared to other drinks majority of the respondents (58%) prefer bottled drinks to "Poha beer", 12% of the respondents prefer refresh and 4% prefer "ice kenkey" because they find it to be thicker than "Poha beer".

DISCUSSION

The nutritional value of a food refers to the amounts of nutrients present in the particular food. A food item is said to be nutrient rich with particular nutrients, when it has large amounts of those nutrients in it (Lavon, 2001). "Poha beer" nutritionally contains macronutrients (carbohydrates and proteins) and micronutrients (minerals and vitamins).

It contains substantial amount of carbohydrates-sugar (26%) (Table 1), which is mainly glucose and fructose. The beer could therefore be said to be a good source of carbohydrate, hence an energy giving drink. According to Wardlaw (2003) the presence of glucose in the drink could aid the absorption of calcium.

The protein content of the Tamarind fruit drink was 1.75% and hence it is relatively high compared to Massig's banana (1.60%) and melon drink (1.60%).the guava drink (3.5%).

Vitamin C is an essential vitamin, which plays a vital role in wound healing (Garrow and James 1993), reduction of the risk of cancer, heart diseases and stress (Ronald, 1998; Wardlaw, 2003). Vitamin C also aids the synthesis of collagen. A protein that is concentrated in bone, teeth, tendons, blood vessels and connective tissues (Garrow and James, 1993). "Poha beer" may be regarded as an important source of vitamin C. It contains 30 mg per 100 ml. Vitamin C (40% RDA), which compares favourable with the recommended daily allowance (75 mg). It is still a good source of vitamin C (Table 1) compared to other food drinks, for example, Pure Heaven (25 mg). The values for Massig Banana, Massig Guava, Massig Melon were however not shown indicating negligible amounts. "Poha beer" however has a lower vitamin C content as compared to Ceres (35 mg) and Farm Fresh (40 mg). Tapioca and other fruit drinks have the same amount of vitamin C as contained in "Poha beer" even though they have been enriched with vitamin C.

Based on the vitamin C content, it could be said that the beer promotes the absorption of iron. It is very likely that the consumption of adequate amount of poha beer could help reduce the prevalence of iron deficiency anaemia. This is because according to Kennedy and Santa (2005), Wardlaw and Insel (1995) vitamin C enhance bioavailability of non-haem iron. This is however possible if some amounts of non-haem iron have been consumed in a diet.

Utilization of "Poha beer" in Tamale metropolis: The survey reveals that 5% of the sampled population uses "Poha beer" (Fig. 4). Most people prefer it because of its medicinal value (Fig. 5). The beverage was readily available and cheap. This possibly explains its high patronage by the people. The medicinal values could be due to vitamin C, which is known to boost immune system in man. It is also known to be involved in the development of epithelial tissues (Wardlaw, 2003). Beside its uses as medicine and as a beverage, it is also used in the preparation of food in Northern Ghana, 8 and 3% of the respondents used it in the preparation of Tuo Zaafi and porridge respectively (Fig. 4).

Consumption of the beverage is usually high during the month of Ramadan. This could be due to the fact that majority of the people in the study area are Moslems (Table 4) and possibly use it to break their fast or as a starter meal.

Figure 7 show that most of the respondents prefer other drinks to "Poha beer". Several reasons were given for either non-preference or non-utilization. These include poor hygiene (62%) as shown in Fig. 6 and to a limited extent the taste. This could be due to the educational level of the respondents. It could be seen from Table 3 that only 12% of the respondents had no formal education.

The unhygienic nature could be due to the mode of preparation and the environment in which it is sold. Another reason for the low usage of this beverage is the poor packaging which makes it unattractive. Most people would have preferred the beverage bottled, cannedor sealed in polyethylene sachets like voltic water (Fig. 9). Information gathered from interactions with respondents revealed that the respondents did not really know the nutritional value of "Poha beer" and though its prestigious consuming other canned or bottled drinks, which are relatively more expensive.

The surveys also revealed that majority of the respondents were traders (Table 3) who could in a way afford other drinks/beverages in the market.

Most of the school children saw it as an inferior beverage of its poor packaging and unhygienic mode of preparations. Some of the respondents do not take it because they claim it has some laxative effect on them when they consume it, this could be due to the possible presence of microbes and its unhygienic nature.

On a whole, usage level and non-usage level of the "Poha beer" could also be attributed to it being in Tamale metropolises and hence have people of diverse ethnicity and socio-economic backgrounds (Table 3).

Conclusion and Recommendations: The results of the study indicate that "Poha beer" generally compares favourably with most fruit juice (beverage) in the market. The micronutrient tested of vitamin C (30 mg/100 ml).

The vitamin C content of "Poha beer" is lower than that of Ceres (35 ml/L) and farm fresh (40 mg/L) but has the same amount as in Tampico and Liquid fruit, though these were vitamin C enriched. It however has a higher vitamin C level than the Massig's fruit juice (banana, guava and melon). It is possible that there was loss of vitamin C during the processing of the juice. Considering the vitamin C level of the beverage; it is very likely that it could promote iron absorption.

Reasons for non-preference included: taste, poor hygiene and packaging, inferior quality and its light nature. Improving on hygiene, good packaging and adequate preparation could help curb the problem of non-preference. Adequate spicing would also contribute to solving this problem.

The following recommendations are made based on the study findings:

- Nutritionally accepted preservatives that will increase it shelf live should be investigated and consequently added in it preparation so as to have a sealed and hygienic package that can be display along side other drinks on the shelf.
- Awareness should be created on the nutritional values of "Poha beer" and it possible nutritional benefits so as to encourage increased production and consumption thereby creating a ready market for the beverage. This would go a long way to alleviate poverty especially in our rural settings via job creation.
- A national survey should be conducted, so as to access it marketability national.
- Further research should be conducted on the other nutrients of "Poha beer".
- Studies should be conducted on possible health effects of "Poha beer".

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