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Effect of Malting Time and Drying Method on the Consumer Acceptability of Aliha (A Fermented Maize Drink)

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ABSTRACT

Aliha, a traditional non-alcoholic malted beverage made mainly from maize, dark brown or cream in appearance and is popular with the Ewe people of the Volta region of Ghana. This malted drink has come to lime light because product developers are trying so hard to promote its acceptability so that it can be a perfect substitute to the expensive canned and bottled malt sold in the Ghanaian market. The objectives of this research were to find the physicochemical properties and the organoleptic or sensory evaluation of *Aliha* in order to determine its acceptability by consumers. The physicochemical properties were determined by High Performance Liquid Chromatography (Shimadzu LC10/20 with Aminex HPX-87H column) with Refractive Index Detection. Simple descriptive statistics such mean, standard deviation and co-variance were employed to determine the acceptability of the product. It was found that glucose and the fructose levels were low: 7.52 and 2.72 respectively. The pH level of the most accepted *Aliha* sample was found to be 3.52 and the titratable acid (TTA) is 0.05. The vitamin C content of the most accepted Aliha sample was found to be 12.23mg per 100gm sample and ash content of *Aliha* was found to be 0.05%. Brix content of the most accepted *Aliha* sample contained 14.05. Four samples namely MFMDTO, MFMDFS, MFMDTS and MFMDFO were accepted with overall ratings of 6.66, 6.62, 6.54 and 6.06 respectively with MFMDTO (Malted Fermented Maize Drink Three days Oven) being the most accepted. Based on its acceptability, the product can be developed and sold in Ghanaian market as a perfect substitute for the expensive malt drinks in the market. *Aliha* can supply daily body requirement of Vitamin C for children and its wholesomeness is a plus for promotion.

Keywords: Malting, Consumer, Acceptability, Aliha, Fermented Maize Drink, physicochemical properties

INTRODUCTION

Maize, rice, millet and sorghum are the widely used cereals for food in Africa. A study conducted by Mitchell and Ingro (1993) revealed that about seventy-seven percent (77%) of calories consumed in Africa comes from cereals. Maize is a staple food in Ghana which has many traditional uses. However, post-harvest loss has been a major challenge in this country. According to Bruno Tran (2016) Ghana loses about 318,514 tonnes of maize annually to post-harvest losses. This figure represents eighteen percent (18%) of the country's annual maize production and Northern Region is the largest contributor with 20,411 tonnes annually followed by Upper East Region and Volta Region which also contribute 13,000 tonnes and 8,983 tonnes respectively.

Despite the significance of maize in Ghana and the potential of Aliha as a value-added product, no comprehensive study has systematically examined how processing parameters such as malting duration and drying methods affect consumer acceptability of this traditional beverage. This knowledge gap limits the potential for Aliha commercialization and its contribution to reducing post-harvest maize losses.

Apart from the biological and environment factors that contribute to the post-harvest losses of maize, limited usage of the crop can also be another contributory factor to the reasons why such an amount of maize goes waste annually in Ghana. Blandino et al. (2003) stated in their study that cereal grains constitute a major source of dietary nutrients all over the world. It is believed cereals are deficient in some basic components such as essential amino acids but malting and fermentation may be the most simple and economical way of improving their nutritional value, sensory properties, and functional qualities.

Most of the essential amino acids increased in quantity with malting and fermentation. Wu (1982) reported that lysine content of maize increases with malting and fermentation. This is of great nutritional significance since these are the main limiting amino acids in maize, which are of significant use as reported by Gernah et al. (2012). Fernandez (1987) and Mbugua (1987) also reported that the levels of lysine, tryptophan and methionine in germinated and fermented cereals increase. This is due to the breakdown of complex polypeptides in the grain to simpler absorbable compounds like amino acids (Gernah et al, 2012).

Additionally, fermentation of cereals leads to a general improvement in the shelf life, texture, taste and aroma, nutritional value and digestibility and significantly lowers the content of anti- nutrients of cereal products. Lactic acid fermentation of cereals is an old-age processing method and is being used in Africa, Asia, Latin America and other countries for the production of food in various forms such as beverages *pito, brukutu,* beer and porridge.

Recent studies have further emphasized the importance of traditional food processing in addressing food security challenges. Hawaz et al. (2025) documented that traditional fermented beverages in Africa have significant commercial potential, yet processing standardization remains a major challenge. Jevcsák et al. (2026) demonstrated that malting is a sustainable, low-cost technique that enhances the nutritional and functional value of cereals, with processing duration being a critical determinant of final product quality

Aliha, a traditional non-alcoholic beverage made mainly from maize, is of low viscosity and has a sweet-sour taste, dark cream in appearance and is popular with the people of the Volta region of Ghana. *Aliha* is consumed on its own by adults as a thirst quencher or serves as refreshment in some communities. However, since this drink is produced from cereals, its protein is incomplete and needs some supplementation (Signh et al., 1987). Food produced developers have made efforts to improve the nutritional quality of *Aliha* with addition of legumes and animal protein (El-Adawy, 197 and Liu, 1999).

Malting has the potential of improving the nutritional value of maize in developing countries (Oluwamukoni et al, 2003, Obasi et al, 2009 and Eneche, 2009). According to Gernah *et al* (2012) the peptides in cereals such as maize break down during malting to increase the quantity of essential amino acids such as lysine, tryptophan and methionine. Malting and fermentation have become popular methods of preparing traditional beverages such as *pito* and *brukutu* apart from *aliha* in Ghana.

However, while malting and fermentation have been studied for other cereal-based beverages, limited research exists on how variations in malting time and drying methods specifically affect Aliha's sensory properties. This study addresses this gap by systematically evaluating three malting periods (3, 5, and 7 days) and two drying methods (sun and oven) to determine optimal processing conditions for consumer acceptability.

According to Warren et al (1963), malting is a controlled germination or sprouting of the cereals during which enzymes are activated. Insoluble and non-diffusible substances are transformed into simpler compounds through the action of enzymes. During germination, enzymes are produced or liberated in an active state. The extent of this enzymatic action determines the mellowness and friability to the finished malt. The amylase enzyme which converts the starch into maltose sugars and dextrin in brewing are probably the most important enzymes in malting. The malting process that generates mono- and disaccharides is dependent upon the alpha and beta amylase and the maltose splitting enzyme, maltase, which develops in the cereals during germination. The malting process also contributes nutrient that stimulates growth and the rate of fermentation by the microorganisms involved. According to Ikediobi (1990), desirable properties of cereals required for malting includes, low gelatinization; temperature of starch granules and easily accessible protein bodies associated with starch, high amylase activity, low polyphenol and tannin content, high protease and beta gluconase activities and low rate of cyanogenoses.

There is a growing concern about the trend of malnutrition in developing countries such as Ghana. High level of malnutrition in developing countries is partly due to high cost of animal protein and partly due to incomplete proteins in the cereal staple food for most households in developing countries. As a result, protein energy malnutrition is one of the most important causes of under-five mortality, stunted growth and poor academic performance among children of school going age in Ghana.

Maize is the most popular and most widely grown and consumed cereal crop in Ghana. Maize has diverse uses among different tribes in Ghana. Therefore, there are quite a number of traditional dishes that can be prepared from maize.

Notwithstanding that high percentage of maize produced in Ghana does not reach the consumer as a result of post-harvest losses. Through post-harvest losses, the physical and nutritional quality of the maize are reduced to the extent that it cannot be used to prepare any dish or feed farm animals. It is believed that if more traditional dishes prepared from maize are accepted, the demand for maize will certainly increase and that in turn, will reduce post-harvest loss. To this effect the aim of the study is to investigate the effect of malting time and drying method on the consumer acceptability of Aliha

Specifically, this study contributes to the literature by: (1) establishing optimal malting duration for maximum consumer acceptability, (2) comparing the nutritional profile of optimized Aliha with commercial malt beverages, and (3) providing evidence-based guidelines for small-scale producers to commercialize Aliha as an affordable alternative to expensive imported malt drinks.

MATERIALS AND METHOD

The materials or ingredients that were used for the production of *Aliha* included maize, caramel, sugar and water, which were purchased from Santasi Market, Fankyenebra in Kumasi.

Sample Preparation

Aliha was prepared according to the flow chart as shown below

Maize
↓
Sort
↓
Wash with water
↓
Soak overnight
↓
Malting
↓
Drying
↓
Milling/pounding
↓
Boiling
↓
Cooling
↓
Fermentation
↓
Aliha

Figure 1: Flow Chart of Fermented *Aliha* Preparation

Product Formulation

Six (6) different *aliha* formulations: A, B, C, D, E and F respectively were prepared from maize with addition of caramel and sugar in their respective masses.

Table 1: Mass and Volume Composition of the *Aliha* Samples

Test Samples	Quantity of the Ingredients			
	Maize(kg)	**Sugar(kg)**	**Caramel(ml)**	**Water(ml)**
MFMDTS	1	1.4	300	24000
MFMDTO	1	1.4	300	24000
MFMDFS	1	1.4	300	24000
MFMDFO	1	1.4	300	24000
MFMDSS	1	1.4	300	24000
MFMDSO	1	1.4	300	24000

MFMDTS= Malted Fermented Maize Drink Three days Sun, MFMDTO= Malted Fermented Maize Drink Three days Oven, MFMDFS= Malted Fermented Maize Drink Five days Sun (control), MFMDFO= Malted Fermented Maize Drink Five days Oven, MFMDSS= Malted Fermented Maize Drink Seven days Sun, MFMDSO= Malted Fermented Maize Drink Seven days Oven.

Preparation of *Aliha* Samples

About 1 kg of maize was weighed for each *aliha* sample by using weighing scale. Each maize sample was soaked in 3200ml of water overnight. The maize samples were spread on a tiled floor and covered with jute sack for three days for two samples, five days another two samples and seven days for the last two samples. The maize samples were sprinkled with water three times a day (morning, afternoon and evening). One sample was taken from each malted groups (3 days, 5 days and seven days malting periods) for sun drying and other samples from each group for oven drying to constant mass dry at 60°C. This is to help determine the duration for drying for each sample, the weight before and after malting and drying and moisture content before and after drying for both sun and oven dried samples.

Each sample was pounded separately in a mortar. Each pounded sample was boiled in 24000ml of water for three hours whiles stirring intermittently. The boiled samples were allowed to cool in their respective pots which were then poured into labelled containers.

The cooled samples were allowed to ferment for five days at room temperature. After the five days fermentation, 300 ml of caramel was added to each sample before straining. Having strained, a 1.4kg of sugar and was added to each sample and stirred to dissolve. The various samples were chilled. Finally, each sample was poured into labelled cups for sensory evaluation and the accepted one for physicochemical analysis.

Experimental Design

A 3 x 2 factorial design was used in the current research. Three malting times (3 days, 5 days and 7 days), two drying methods (oven (60^0C) and sun) and drying time were replicated in this experiment. The objective was to produce a malt with constant mass. Table 2 shows the factorial design.

Table 2 Moisture Content and Weight of the Various Maize Samples

Malting Time	Drying Method	Drying Time	Initial Moisture Content (%)	Final Moisture Content (%)	Weight (Kg)		
					Before Malting	**After Malting**	**After Drying**
3 DAYS	OVEN	19hrs	42.53	6.00	1.00	1.60	1.00
	SUN	72hrs	42.53	8.00	1.00	1.60	0.93
5 DAYS	OVEN	47hrs	67.80	5.30	1.00	2.40	0.90
	SUN	120hrs	67.80	7.50	1.00	2.40	0.90

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7 DAYS	OVEN	72hrs	72.40	7.30	1.00	3.75	0.87
	SUN	168hrs	72.40	6.60	1.00	3.75	0.80

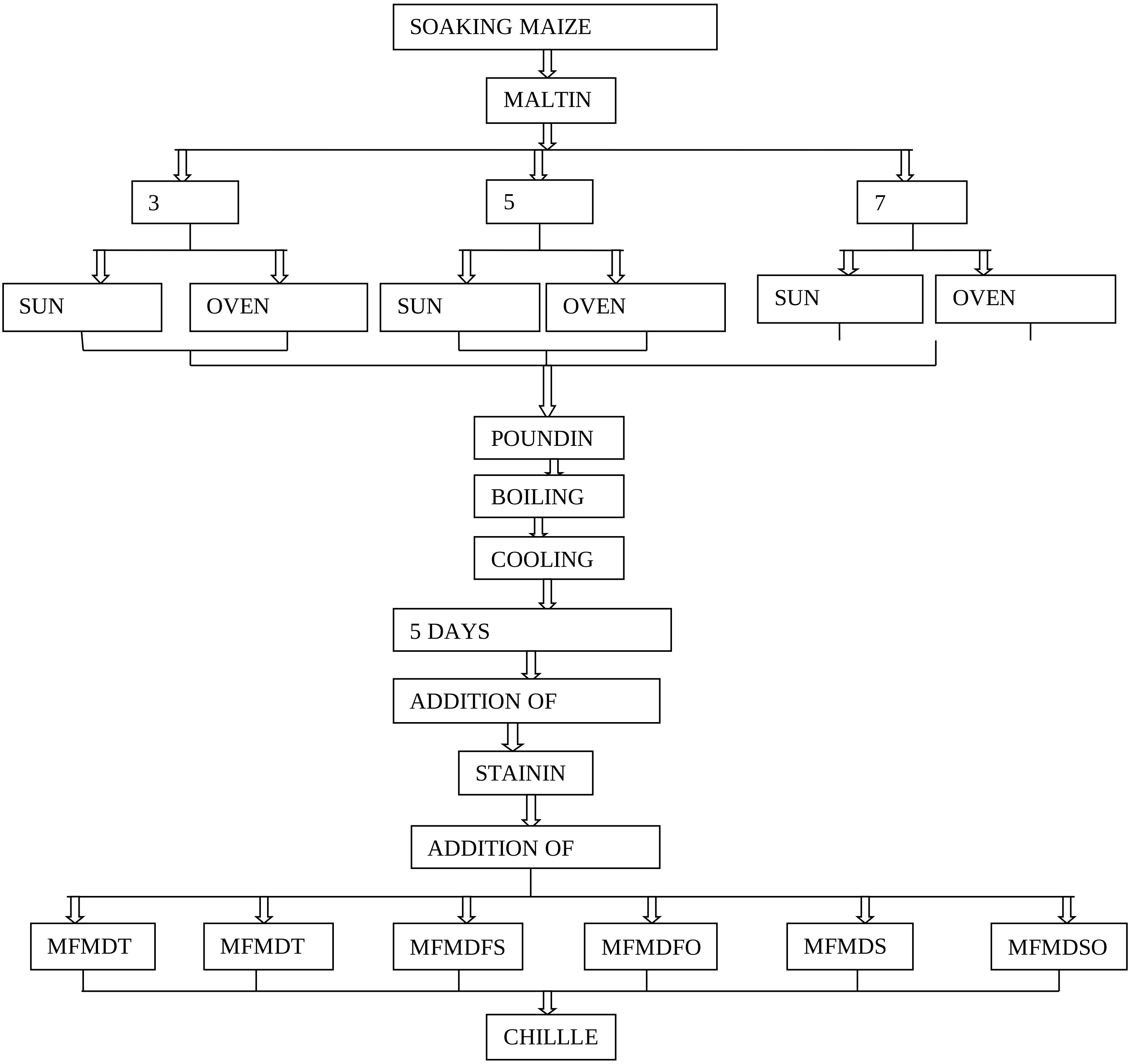

Figure 2: Flow Chart of the Preparation of the *Aliha* Samples with Varying Malting Time and Drying Methods

Physicochemical Parameters

Physicochemical analysis of Ash, Acid Insoluble Ash, Moisture, Sugars (Glucose and Fructose), Vitamin C, Titratable Acid, pH and Brix (Total Suspended Solids) content of accepted Aliha sample was carried out using the methods of Association of Official Analytical Chemists (AOAC 2005).

Determination of Ash Content

Transfer 2.00g of sample into the crucible which has previously been ignited and cooled before weighing. The crucible and content is ignited in muffle furnace (pre-heated to 600 °C) for 2 hours. Remove the crucible, permit to cool in desiccators and weigh.

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Express the total ash content based on weight loss as weight percentage (%).

Let W_1 be the weight of the empty crucible

W_2 be the weight of the empty crucible + wet sample

W_3 be the weight of crucible + dry sample.

Then the percentage of total ash is given as:

$$\%Ash = \frac{weight\ of\ ash}{weight\ of\ sample} \times 100$$

$$= \frac{W_3 - W_1}{W_2 - W_1} \times 100$$

Determination of Acid Insoluble Ash

Weigh accurately about 10g of the prepared sample in a tarred clean and dry crucible.

Keep it in the oven at 105°C to dry. Complete ignition by keeping in a muffle furnace at 600 °C until gray ash results. Cool in a desiccator.

To the ash, add 25ml of dilute hydrochloric acid (10% of density 1.05), and filter through fisher's crucible previously weighed. Wash severally with distilled water.

Return the crucible and the residue to the oven maintained at 105°C to dry and Ignite in the muffle furnace at 600°C for 30 minutes. Cool the dish in a desiccator and weigh.

Let W_1 be the weight of the empty crucible

W_2 be the weight of the dry sample

W_3 be the weight of crucible + Ash.

Then the percentage of total acid insoluble ash is given as:

$$\text{Acid insoluble ash (\%)} = \frac{weightofcrucible + Ash - weightofcrucible}{weightofdrysample} \times 100$$

$$= \frac{W_3 - W_1}{W_2} \times 100$$

Determination of Vitamin C (Ascorbic Acid) Content

Pipette 10 ml aliquot of the sample solution into a 100 ml conical flask and add 50 ml of distilled water and 1 ml of starch indicator solution.

Titrate the sample with 0.005 M iodine solution.

The endpoint of the titration is identified as the first permanent trace of a dark blue-black colour due to the starch-iodine complex.

Repeat the titration with further aliquots of sample solution until you obtain concordant results (titre agreeing within 0.1 ml).

$$\%\text{Ascorbic acid content (mg/100ml)} = \frac{\text{titre x molarity of titrant x 176.12 x 100}}{\text{Volume of sample}}$$

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Determination of Titratable Acidity

Weigh 5g of the sample into 200ml conical flask and add 50ml of distilled water. Titrate to a pale pink end-point with 0.5N NaOH solution using phenolphthalein as indicator.

Total titratable acidity value was calculated using the following formula;

$$\text{Titratable acidity (\%)} = \frac{\text{titre x Normality of titrant x 64 x 100}}{\text{Weight of sample x1000}}$$

Determination of Total Soluble Solids (Brix)

Transfer a drop or two of well mixed (homogenized) sample onto the prism of a refractometer and read for Brix.

Determination of pH

In the laboratory, pH meter (HACH HQ11d) was used to determine the pH of the *aliha* samples. Buffer solutions of pH 4.01, 7.0 and 9.21 were used to calibrate the pH meter.

Procedure:

About 70 ml of *aliha* sample was poured into a clean glass beaker and the electrode inserted into it after it had been rinsed with distilled water. The sample was stirred with the electrode to free any bubbles from the electrode area. The red button of the pH meter was turned and the pH was read and recorded. This was repeated two times for the sample and the average was found.

Determination of Sugars

1g of *aliha* sample was diluted in 10ml of distill water to form the analyte. The analyte formed was filtered using 0.2um syringe filter into 1.5ml crimp vials. The vials were then loaded into the auto sampler for analysis via High Performance Liquid Chromatography (HPLC). The HPLC was pre-calibrated with various monomeric sugars prior to the analysis.

The *aliha* sample was analysed for monomeric sugars via High Performance Liquid Chromatography (Shimadzu LC10/20 with Aminex HPX-87H column) with Refractive Index Detection. The mobile phase used was 0.005M Sulphuric acid at a flow rate of 0.6ml/min. The concentration of each component in the sample and the output comes from its user interface.

Sensory Evaluation

The *Aliha* samples were subjected to sensory evaluation for the attributes Mouthfeel, Aroma, After Taste, Taste, Colour and Over All Acceptance. A fifty-panelist consisting of twenty-six (26) men and twenty-four (24) women all untrained from the University of Education, Winneba, Kumasi campus was used and scores were allocated to the attributes based on a 9-point hedonic scale ranging from 1(Dislike extremely) to 9(like extremely). The evaluation was done in two sections. At each section, each panelist judged six (6) *Aliha* samples which were presented to him/her with 750ml voltic bottled water used for mouth rinsing in between evaluations. The *Aliha* samples were stored in labelled containers from where the samples were served to panelist. About hundred (100) ml of each *Aliha* samples was served in 300ml colourless, and transparent plastic cups which were coded and also, colourless transparent straws were supplied for drinking/testing the *Aliha* samples.

Statistical Analysis and Validation

The data collected were subjected to statistical analysis to determine possible differences among samples with regards mean, standard deviation, Coefficient of variation, minimum value and maximum value using Excel 2013.

RESULTS

Sensory Evaluation

Sensory evaluation is a scientific discipline that analysis and measure human responses (sight, smell, touch, taste and hearing) of food and drink. Example appearance, touch, odour, texture, temperature and taste (British Nutrition Foundation, 2018). It can also be said to be the scientific discipline used to suggest measure, analyze and construe those responses to products that are perceived through the senses of sight, smell, touch, taste and hearing (Stone and Sidel, 1993). The Tables 3 to 8 depicts the average score of the sensory evaluation of *Aliha* samples as administered by Hedonic Rating Scale (1-9) under the following food attributes: colour, taste, aftertaste, aroma, mouthfeel and overall acceptance

Colour

From Table 3, it can be stated that sample MFMDTS (Malted Fermented Maize Drink Three days Sun) has the highest mean scoring for colour acceptability (6.38) followed by MFMDFS, MFMDFO, MFMDSO, MFMDTO and MFMDSS samples in that order. From the Hedonic scale, the colour of the most accepted *Aliha* sample (MFMDTS) can be interpreted as 'like'.

Table 3 Descriptive Statistics of Colour of *Aliha* Samples

Samples						
STATISTICS	**MFMDTS**	**MFMDTO**	**MFMDFS**	**MFMDFO**	**MFMDSS**	**MFMDSO**
MEAN	6.38	5.84	6.36	6.30	5.64	5.92
StdDev	1.86	1.80	1.76	1.75	2.15	2.37
CV	0.32	0.32	0.32	0.32	0.32	0.32

MFMDTS= Malted Fermented Maize Drink Three days Sun, MFMDTO= Malted Fermented Maize Drink Three days Oven, MFMDFS= Malted Fermented Maize Drink Five days Sun (control), MFMDFO= Malted Fermented Maize Drink Five days Oven, MFMDSS= Malted Fermented Maize Drink Seven days Sun, MFMDSO= Malted Fermented Maize Drink Seven days Oven.

Taste

With respect to the taste, it was found that MFMDTS sample has the highest average acceptability with sample MFMDSS having the least taste acceptability. Most critical sensory evaluation is the taste of the product therefore the sample with highest acceptability can be developed for the market. Based on the Hedonic scale, the most accepted sample in terms of taste can be interpreted as 'like' (6.36) and the least accepted sample can also be interpreted as 'neither like nor dislike' (5.18).

Table 4 Descriptive Statistics of Taste of *Aliha* Samples

Samples						
STATISTICS	**MFMDTS**	**MFMDTO**	**MFMDFS**	**MFMDFO**	**MFMDSS**	**MFMDSO**
MEAN	6.36	6.14	6.12	5.98	4.82	5.18
StdDev	1.97	2.06	2.24	1.85	2.01	2.33
CV	0.37	0.37	0.37	0.37	0.37	0.37

MFMDTS= Malted Fermented Maize Drink Three days Sun, MFMDTO= Malted Fermented Maize Drink Three days Oven, MFMDFS= Malted Fermented Maize Drink Five days Sun (control), MFMDFO= Malted Fermented Maize Drink Five days Oven, MFMDSS= Malted Fermented Maize Drink Seven days Sun, MFMDSO= Malted Fermented Maize Drink Seven days Oven.

Aftertaste

The highest acceptability for aftertaste was MFMDTO sample with Hedonic scoring of 6.16 which means the aftertaste of this sample was 'like' and the least accepted sample was MFMDSS with an average scoring of 5.04 and can also be interpreted as 'neither like nor dislike'.

Table 5: Descriptive Statistics of Aftertaste of *Aliha* Samples

Samples						
STATISTICS	**MFMDTS**	**MFMDTO**	**MFMDFS**	**MFMDFO**	**MFMDSS**	**MFMDSO**
MEAN	6.02	6.16	6.08	5.42	5.04	5.44
StdDev	2.05	1.80	2.21	2.02	1.84	2.02
CV	0.36	0.36	0.36	0.36	0.36	0.36

MFMDTS= Malted Fermented Maize Drink Three days Sun, MFMDTO= Malted Fermented Maize Drink Three days Oven, MFMDFS= Malted Fermented Maize Drink Five days Sun (control), MFMDFO= Malted Fermented Maize Drink Five days Oven, MFMDSS= Malted Fermented Maize Drink Seven days Sun, MFMDSO= Malted Fermented Maize Drink Seven days Oven

Aroma

Aroma is one sensory that whets the appetite of many food consumers. Therefore, good aroma of any food will certainly attract consumers. Sample MFMDTO was found to be the highest accepted *Aliha* in terms of aroma with average scoring of 6.16. The scoring can be interpreted as 'like'. However, sample MFMDFO had the least score of 5.16 meaning it was neither like nor dislike.

Table 6 Descriptive Statistics of Aroma of *Aliha* Samples

Samples						
STATISTICS	**MFMDTS**	**MFMDTO**	**MFMDFS**	**MFMDFO**	**MFMDSS**	**MFMDSO**
MEAN	5.46	6.16	6.10	5.16	5.20	5.42
StdDev	2.03	1.61	1.73	2.01	1.99	2.20
CV	0.35	0.35	0.35	0.35	0.35	0.35

MFMDTS= Malted Fermented Maize Drink Three days Sun, MFMDTO= Malted Fermented Maize Drink Three days Oven, MFMDFS= Malted Fermented Maize Drink Five days Sun (control), MFMDFO= Malted Fermented Maize Drink Five days Oven, MFMDSS= Malted Fermented Maize Drink Seven days Sun, MFMDSO= Malted Fermented Maize Drink Seven days Oven.

Mouthfeel

According to Table 7 the sensory analysis by the panelists of the *Aliha* samples in terms of mouthfeel scored sample MFMDTO as the highest accepted sample with the average score of 6.20. This score value means sample MFMDTO was liked by the panelists. Sample MFMDFO was least accepted with average Hedonic score of 5.48 (neither like nor dislike).

Table 7 Descriptive Statistics of Mouthfeel of *Aliha* Samples

Samples						
STATISTICS	**MFMDTS**	**MFMDTO**	**MFMDFS**	**MFMDFO**	**MFMDSS**	**MFMDSO**
MEAN	6.12	6.20	6.16	5.48	5.50	5.60
StdDev	2.18	1.90	2.05	1.94	2.10	2.08
CV	0.35	0.35	0.35	0.35	0.35	0.35

MFMDTS= Malted Fermented Maize Drink Three days Sun, MFMDTO= Malted Fermented Maize Drink Three days Oven, MFMDFS= Malted Fermented Maize Drink Five days Sun (control), MFMDFO= Malted Fermented

Maize Drink Five days Oven, MFMDSS= Malted Fermented Maize Drink Seven days Sun, MFMDSO= Malted Fermented Maize Drink Seven days Oven.

Overall Acceptance of *Aliha* Samples

The overall acceptance of all the *Aliha* samples according to Table 8 indicates that four samples namely MFMDTO, MFMDFS, MFMDTS and MFMDFO were accepted with overall ratings of 6.66, 6.62, 6.54 and 6.06 respectively. However, MFMDTO can be developed and supplied to the market for its high acceptability by consumers (panelists) since it was rated 6.66 (like moderately).

Table 8 Descriptive Statistics of Overall Acceptance of *Aliha* Samples

Samples						
STATISTICS	**MFMDTS**	**MFMDTO**	**MFMDFS**	**MFMDFO**	**MFMDSS**	**MFMDSO**
MEAN	6.56	6.66	6.62	6.06	5.78	5.80
StdDev	2.35	2.07	2.04	2.09	2.17	2.60
CV	0.36	0.36	0.36	0.36	0.36	0.36

MFMDTS= Malted Fermented Maize Drink Three days Sun, MFMDTO= Malted Fermented Maize Drink Three days Oven, MFMDFS= Malted Fermented Maize Drink Five days Sun (control), MFMDFO= Malted Fermented Maize Drink Five days Oven, MFMDSS= Malted Fermented Maize Drink Seven days Sun, MFMDSO= Malted Fermented Maize Drink Seven days Oven.

Physicochemical Properties of *Aliha*

The physicochemical properties of *Aliha* considered in this study are moisture content and weight of the malted maize used to prepare the *Aliha* samples, Ash, Acid Insoluble Ash, Sugars (Glucose and Fructose), Vitamin C, Titratable Acid, pH and Brix (Total Suspended Solids) content of the accepted Aliha sample.

Moisture Content of Maize Samples after Malting and Drying

The results in Table 2 indicates that the oven dry method is faster than the sun dry method as it took 19 hours, 47 hours and 72 hours for the maize samples in three (3) days, five (5) days and seven (7) days respectively when the oven method was used. On the contrary, it took 72 hours, 120 hours and 168 hours for the maize sample to dry in three (3) days, five (5) days and seven (7) days, respectively, when the sun-drying method was used.

However, the weight of sun-dried maize samples after malting was found to be less than that of oven dry for three days and seven days malting periods. Both oven and sun-dried malted maize samples were having the same weight (0.9kg) for the five days malting.

The higher the moisture content of the sample, the more the sample is susceptible to spoilage. Another revelation of the study is that the longer the duration of malting the less the weight of the maize sample irrespective of the drying method (1.0 kg and 0.93kg for three days malting, 0.90kg for five days and 0.87kg and 0.80kg for seven days malting period).

The study reveals that the moisture content of the 7 days malted maize sample before drying was the highest (72.5%) followed by the 5 days sample with the 3 days sample being the least. This result is consistent with the study of Oluwale et al, (2012) who proved that the moisture content of the malted grains shows that there is a gradual increase in the moisture content of both cereals with increase in malting period with seventy-two hours malted maize showing highest moisture content. Oluwale et al (2012) asserted that this probably is as a result of addition of water to the grains during the malting process with seventy-two hours malt having more water due to the prolonged period of water addition.

Physicochemical Properties of Accepted *Aliha* Sample (MFMDTO)

The accepted *Aliha* sample was analysed to find the above parameters and Table 9 presents the results.

Table 9: Physicochemical Properties of Accepted *Aliha* Sample

Parameter	Mean	Standard Deviation
Ash (%)	0.15	0.02
Acid Insoluble Ash (Aia) (%)	0.1	0.08
Glucose (%W/W)	7.52	0.40
Fructose (%W/W)	2.72	0.08
Vitamin C (Mg/100ml)	12.33	1.24
Titratable Acid (Tta) (%)	0.05	0.00
Ph	3.52	0.04
Total Suspended Solids (Brix)	14.05	0.07

Sugar Content

The study revealed that the glucose and the fructose levels were low: 7.52 and 2.72 respectively. The study confirms Gernah et al (2011) who also observed significant decrease in total soluble sugar and reducing sugar values in the first forty-eighth hours of malting then increased in the seventy-second hour and finally dropped at ninety-sixth hour. This could be attributed to the fact that the germinated grains use part of the sugars for respiration to generate energy needed for the germination.

pH Level and Titratable Acid Content

The pH level of the most accepted *Aliha* sample was found to be 3.52 which is acidic. This revelation of this study is consistent with the study of Gernah et al (2011) who reported that the pH of fermented maize flour decreases and increase in titratable acidity from zero hour to seventy-second hour (72 h) and they attributed this to hydrolysis of some complex organic molecules such as lipids, phytin and protein which could be hydrolysed to fatty acids, acid phosphate and amino acids respectively. They asserted that an increase in acidity accompanying malting could be an indication of the extent of hydrolysis of these complex organic substances and therefore of the digestibility of malted maize. It can also be said that during fermentation of the drink part of the ethanol produced is further hydrolysed to produce ethanoic acid. However, the titratable acid (TTA) is 0.05 which is very low and save for consumption.

Vitamin C Content

The vitamin C content of the most accepted *Aliha* sample was found to be 12.23mg per 100gm sample. The vitamin C content of most fruit juice in the Ghanaian market is about 15mg per100mg, beverages are about 9.5mg per 100mg and that of malta Guinness is 9.48mg per 100mg (Obuzor and Ajaezi, 2010). Comparatively, the vitamin C content of *Aliha* is more than that of most beverages in Ghanaian market. The recommended dietary allowance (RDA) of vitamin C for children is 15mg per day (Institute of Medicine). Also, as Gloria Ukalina Obuzor and Nneka Emmanuella Ajaezi cited (Rai and Anand, 2008) when researching the nutritional content in popular malt drinks produced in Nigeria, it stated that vitamin C is a powerful water-soluble antioxidant that boosts the immune system and helps prevent cancer and heart disease. Therefore, the physicochemical results indicate that *Aliha* can be recommended for children to meet their daily vitamin C requirement.

Ash Content

In food science and industry ash refers to residue of mineral elements, which are left over after our body completes digestion of food we eat. This means the total mineral content in the product. The ash content of the accepted *Aliha* sample as in Table 9 above was found to be 0.15% which is very low compared to CODEX (2014) maximum standard required for malted beverages (1.5%). The low value obtained may be as a result of method of preparation and origin of the maize sample. However, Ash content with value higher than 1.5% may indicate contamination of the product.

Acid Insoluble Ash Content

This is the proportion of a sample that is not hydrolysed by 72% sulphuric acid and is not subsequently volatilized upon the incineration of this insoluble residue Celignis Limited (2018). This indicates the impurities in the product. According to CODEX standard (2014) the maximum acid insoluble ash contained in malted beverages is 0.4%. From this study, the value of the acid insoluble ash in the accepted *Aliha* sample was found to be 0.1%. This indicates that the *Aliha* drink is good in terms of its wholesomeness.

Brix Content

One of the most important quality analysis parameters in drink production is Brix, which gives insight into the sugar concentration and the composition of the drink. To ensure the expected product quality, drinks need to be characterized according to their composition and have to meet the defined product specifications. According to Food and Drug Authority (Ghana), the minimum Brix content in drinks should be 12 and the *Aliha* sample accepted contains 14.05 as indicated in table 9 above. This shows that in terms of quality, the accepted *Aliha* sample is good for consumption since it is within the range of Food and Drug Authority specification.

DISCUSSION

Mechanistic Interpretation

The higher acceptability of 3-day malted samples can be explained by optimal enzyme activity during early germination. At 72 hours, α-amylase and proteases break down starches and proteins into sugars and amino acids, creating desirable flavor compounds. Beyond 72 hours, excessive enzyme activity leads to over-degradation, producing off-flavors associated with amino acid breakdown. This explains why 7-day malted samples received consistently lower scores.

Oven drying (60°C) rapidly inactivates enzymes, while sun drying allows continued enzymatic activity over several days. This may explain why oven-dried samples showed slightly higher scores, though differences were not substantial.

The vitamin C content of Aliha (12.33 mg/100ml) exceeds that of commercial malt beverages (Malta Guinness: 9.48 mg/100ml) and is consistent with Obuzor and Ajaezi (2010). The pH (3.52) is within ranges reported for other fermented beverages (pH 3.5-4.0) and is desirable for food safety as it inhibits pathogenic bacteria growth (Mensah et al., 1991). Brix (14.05) meets FDA Ghana specifications (≥12° Brix), comparable to commercial malt drinks.

Practical Implications

MFMDTO (oven) and MFMDFS (sun) being similar in acceptance means producers can choose based on available resources. Oven drying is faster (19 vs 72 hours) and more consistent but requires capital. Sun drying is cost-effective for small-scale rural producers. Three-day malting is recommended as it shortens the production cycle and reduces water use.

Cost comparison: commercial malt GH₵5.00-7.00/can vs Aliha estimated GH₵1.50-2.00/liter. If 5% of post-harvest maize losses were diverted to Aliha, approximately 15.9 million liters could be produced annually.

Public Health Significance

Vitamin C content (12.33 mg/100ml) means one 250ml serving provides 30.8mg, meeting children's daily requirement (15mg) and providing 68% and 41% of adult female and male requirements. Fermentation also reduces phytate, improving mineral bioavailability (Gernah et al., 2011).

CONCLUSION

From the physicochemical analysis of the most accepted Aliha sample, it can be concluded that the glucose and fructose content could be a good source of energy for consumers. The vitamin C content was found to be higher than that of most fruit juices sold in Ghanaian markets. The vitamin C content too can also meet the daily requirement for children. Therefore, Aliha drink can be developed and marketed with assurance of its acceptability. The ash content of the product clearly shows that the drink was not contaminated and therefore the wholesomeness of the product was intact.

It was also observed that only two samples out of six samples were not accepted and it can be inferred that the methods used to prepare the various samples can still be used to prepare the product and it can get the needed patronage in the market. According to the sensory analysis, the overall scoring of the accepted samples was within the range of like to moderately like.

Three-day malting with oven drying (MFMDTO) is recommended for optimal consumer acceptability, though five-day sun drying (MFMDFS) is an acceptable alternative for small-scale producers with limited resources. Commercialization of Aliha can contribute to reducing post-harvest maize losses while providing an affordable, nutritious beverage for Ghanaian consumers.

Limitations and Future Research

Limitations include: untrained panelists, no shelf-life studies, no economic analysis, single location. Future research should address shelf-life, multi-region studies, nutritional fortification, and probiotic potential.

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