Original Research Article

Nutritional Composition and Sensory Evaluation of Malted Sorghum *(Sorghum bicolour)* Beverage fortified with Cocoa *(Theobroma cacao)*

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ABSTRACT

In this study, the fortification of malted sorghum with cocoa powder to produce non–alcoholic beverage was investigated. Cocoa powder was blended with malted sorghum in different proportion to produce fortified sorghum beverage products at ratio MS 10- (90% malted sorghum and 10% cocoa powder), MS 20 - (80%malted sorghum and 20% cocoa powder), MS30 - (70% malted sorghum and 30% cocoa powder), MS 40 - (60% malted sorghum and 40%cocoa powder), MS 50 - (50% malted sorghum and 50% cocoa powder), MS 60 - (Ovaltine beverage) as control. The vitamin, minerals, alkaloids, glucose, and sensory properties of all the fortified sorghum beverage samples were determined using standard methods. The range of results for vitamin B and C contents of the samples were (1.27mg/100g 1.97mg/100g) and (24.77mg/100g-54.48mg/100g) respectively. The respective values for glucose and alkaloids of the samples were (67.55%-71.02%) and (0.99%-3.13%).The contents of calcium (24.03mg/100g-274.26mg/100g), Magnesium (217.28mg/100g-322.97mg/100g), potassium (269.20mg/100g-699.63mg/100g), phosphorus (20.80mg/100g-81.91mg/100g) and zinc (2.21mg/100g-7.18mg/100g) of the malted sorghum beverage. The fortification of malted sorghum with cocoa powder enhanced the mineral content of the beverage except phosphorus. Also, the addition of cocoa powder had varying effects on the organoleptic perception of the developed food products. This work showed that all the samples were accepted by panelist with sample MS 20 - (80%malted sorghum and 20% cocoa powder) preferred to other samples except the control (ovaltine).

Aims: To investigate the effects of malted sorghum with cocoa powder to produce non–alcoholic beverage on vitamins, minerals, alkaloids, glucose contents and sensory properties.
Study design: The vitamin, minerals, alkaloids, glucose, and sensory properties of all the fortified sorghum beverage samples were determined using standard methods.
Place and Duration of Study: Department of Food Technology, Federal Polytechnic Offa, Kwara State, between June 2019 and July 2020.
Methodology: The method of Owolarafe *et al*. (2007) was adopted for production of cocoa powder. The method of Hallen *et al*. (2004) was used to produce malted sorghum flour. The method of Belšcak-Cvitanović *et al*. (2010) was adopted for the production of cocoa/sorghum beverage. Sample: Alkaloids in the sample were determined using the method of Harbone, 2003. Vitamin B and were determined, total glucose, minerals were analysed/calculated and sensory evaluation was also carried out.
Results: There was consistent increase in vitamin B_{12} of all the samples. The vitamin B content of all the samples ranges from (1.27mg/100g –1.79mg/100g). Sample MS 60 (Ovaltine beverage) which is the control sample had the highest value with (1.79mg/100g).

The result of vitamin C content obtained from this study showed an inconsistent increase. The value obtained ranged from 24.77mg/100g to 54.48mg/100g.Fortifying malted sorghum with 50% cocoa powder improved the vitamin C content. The result obtained from this study showed that cocoa was a good source of alkaloids. Alkaloids values in this study were significantly ($p<0.05$) higher in fortified malted sorghum samples than in the control sample MS 60 (Ovaltine beverage) except sample MS 10 (90% malted sorghum and 10% cocoa powder which showed (0.99%).The glucose content obtained from this study indicated that there was an inconsistent increase among the samples. Glucose value ranged from (67.55% -71.02%). All the sample variations had increase in minerals studied except phosphorus which decreased with increase in percentage of malted sorghum. It can be deduced from the result of this study that sample MS20 was rated best after the control sample (ovaltine) while sample MS50 was rated lowest in terms of sweetness.

Conclusion: The fortification of malted sorghum with cocoa powder enhanced the nutritional content of the beverage. The fortified beverage has radical scavenging activity due the increase in antioxidant such as alkaloid and could be used for health promotion and disease prevention as an alternative to beverages with low nutritional / nutraceuticals value.

Keywords: Quality assessment, malting, sorghum, beverage, cocoa, minerals, alkaloid, sensory evaluation.

1. INTRODUCTION

Cocoa beans are derived from the fruit of the plant *(Theobroma cacao L)*. In Nigeria, dry cocoa beans is majorly exported as a foreign exchange earner, while a small percentage of the cocoa beans serve as raw material for cocoa powder, cocoa butter and chocolate products [1]. Cocoa as a food ingredient is fast becoming very popular in the food and confection industry worldwide. It is available in a wide variety of forms, colors and flavors and is used in numerous applications [2]. A good quality cocoa powder should be relatively free flowing, stable and uniform in colour and flavour, of good microbiological quality, and easy to handle by the user [3].Moreover, a range of other characteristics such as pH, fineness, fat content, wet ability, solubility and dispersibility, define the powder and have an important impact on the end product for which the cocoa is used [4]. The nutritional quality of cocoa products is determined largely by the chemical composition of the cocoa powder, which is dependent on the quantum of proteins, carbohydrates, fats, minerals and phytochemicals in the cocoa products and the corresponding digestibility coefficient [5].

Malting is a combined biotechnological approach Involving of steeping, germination and drying of the germinated seeds In controlled conditions of different Temperatures and humidity [6]. The major purpose of germination is synthesizing of the hydrolytic enzymes to decompose the Cell wall, Protein and endosperm starch Compounds leading to a desirable enhancement of brittleness and fragility of the barley grains [7].Usually, within the germination leg, the relative Humidity of the air passing through the grains' bed is almost 100% and the temperatures range are between12 and 19 °C depending on the barley variety applied in malting. Fageer (2004), [8] reported that an enhancement in the germination time will lead to an increase in the amount of albumin and globulin contents; therefore, the amount of available soluble proteins gets increased in the obtained extract.

Sorghum is a staple food in African and Asian subcontinents. Most of the grain produced in these countries is utilized for human consumption. The grain sorghum is utilized in preparation of many traditional foods and in bakery preparations like bread, cakes and biscuits. Sorghum is an important crop for food and fodder in the semi-arid tropical India. It is mainly grown in Kharif (rainy) and Rabi (post-rainy) seasons. Sorghum is a staple food in the states of Maharashtra and parts of Karnataka, Madhya Pradesh, Tamilnadu, Gujarat and Andhra Pradesh. Though sorghum is known for its nutritional quality, the consumption of this cereal is decreasing due to easy availability of rice and wheat through public distribution system and easy methods of processing and cooking of fine cereals (such as rice). The requirement of special skill in preparing sorghum rotis and non-availability of ready-made sorghum flour and suji in the market are deterrents for wider use of sorghum as food. On the other hand, the sorghum that is harvested in the post-rainy season is of superior quality and used only for food. At present most of the sorghum produced in India is consumed in the form of roti or chapatti (unleavened flat bread). Kharif sorghum grain can be polished with pearling machine and used for other food products like snack foods and baked foods [9].

A beverage is a drink specially prepared for human consumption either at meal or leisure times. There are a variety of beverages which can be broadly classified into alcoholic and non-alcoholic. Alcoholic beverages contain alcohol in varying concentrations while non-alcoholic beverages comprise soft drinks, fruit juices and hot beverages. Soft drinks and some fruit juices may contain caffeine arising from the raw materials used for its preparation or from deliberate addition. Hot beverages often contain caffeine and are termed 'hot' because they are usually served hot by addition of hot water or milk. This group consists of cocoa, tea and coffee-based products which are commercially available in the Nigerian market.

For several years, the powdered beverage manufacturing has been considered one of the slowest growing food industries worldwide [10]. Developing niche and healthy products as well as increasing the knowledge about product formulation are necessary to overcome this trend. Unfortunately, sufficient information about the addition of malted indigenous cereal such as sorghum is at present scanty in the literature, hence the need for this research work.

2. MATERIAL AND METHODS

2.1 SOURCE OF MATERIALS

Powder pod was obtained from Ilesha, Ilesha west local government, Osun state, Nigeria. Sorghum grains and other ingredients were purchased from Owode market Offa local government, Kwara State, Nigeria. The equipment was gathered for use in Food Technology processing laboratory, Federal Polytechnic Offa, Kwara state.

2.1.1 PREPARATION OF COCOA POWDER

The method of [11] was adopted for production of cocoa powder. Freshly harvested cocoa pods were broken to extract the wet pulpy beans which were usually allowed to ferment for 4-7 days. During this process, the colour of the bean turns dark brown, while the thick pulp thins and gets ripped off while the distinctive flavor and aroma associated with cocoa beans products develop [11]. The fermented beans were sun-dried to reduce the moisture content from about 60% - 7.5%. The dried fermented cocoa beans were cleaned and roasted to sterilize them eliminate the acids formed during fermentation. The shells were removed from the decorticated beans; the cocoa nibs were then milled to create cocoa liquor. The liquor was pressed mechanically to obtain cocoa butter and a solid mass called cocoa pressed cake. The pressed cake was broken into small pieces, dried and pulverized to obtain cocoa powder.

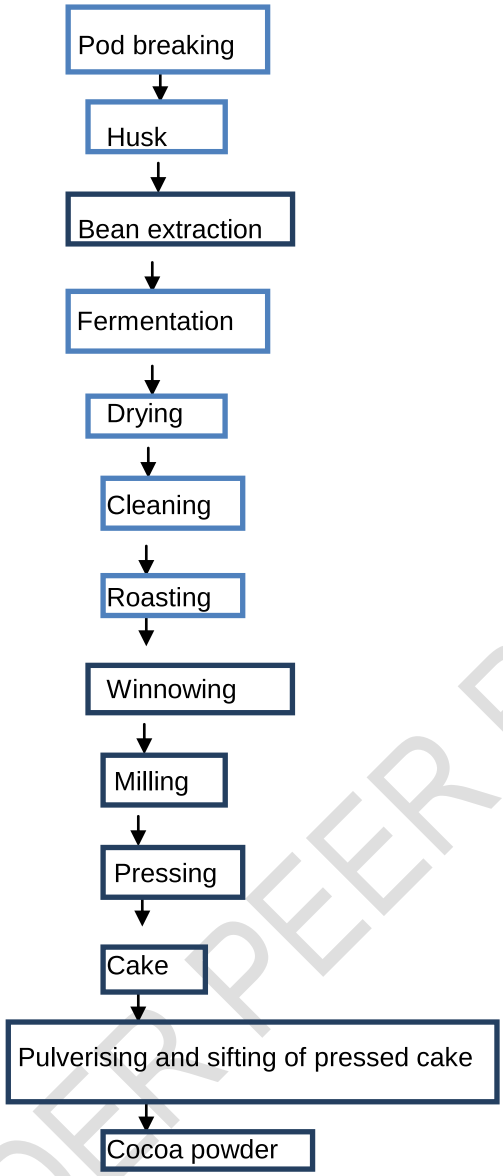

Figure 1: Flow chart for cocoa powder

Source: Owolarafe *et al,* (2007). [11]

2.1.2PREPARATION OFMALTED SORGHUM POWDER

The method of [12] was used to produce malted sorghum flour. Sorghum grains were sorted to remove extraneous material and spoiled grains. The sorghum grain was weighed and washed, and then soak in water for 12 hours, the sorghum was drained and spread thinly on raffia mat for 7 days to achieve malting. The malted sorghum was oven dried at 60 °C and dried milled, then sieved using 0.04mm aperture sieve. After sieving the powder was packed in HDPE bags and stored at ambient temperature until further processes.

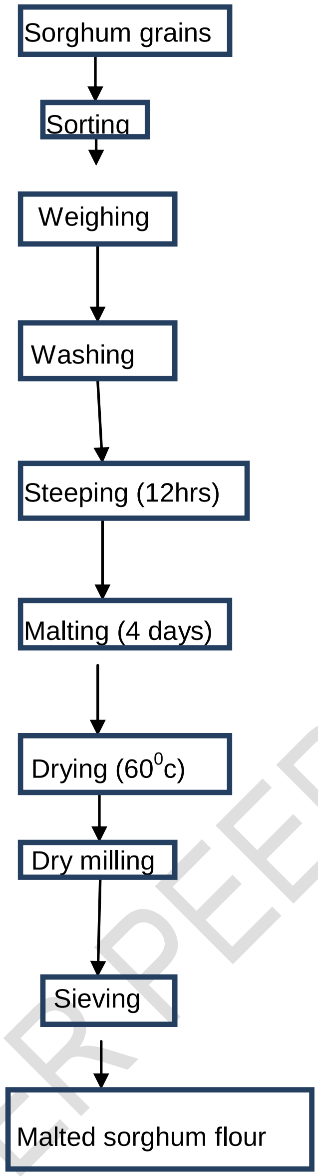

Figure 2: Flow chart for malted sorghum flour

Source: Hallen *et al.* (2004) [12]

2.1.3 PREPARATION OF COCOA/SORGHUM POWDER MIXTURE

The method of [13]was adopted for the production of cocoa/sorghum beverage. Composition of the cocoa/sorghum powder mixtures were mixed for 10 min at 40 rpm in a Turbula mixer (Willy A. Bachofen Maschienenfabrik, Muttenz, Switzerland) to obtain a homogenous mixture at an ambient temperature of 18–20 °C. After mixing, samples were packed in HDPE bags and stored further analyses.

2.1.4 DETERMINATION OF ALKALOIDS

This was determined by method of [14]. 5g of sample (W_0) was weighed into a conical flask and 200ml of 10% acetic acid in ethanol added. The flask was shaken and left to stand for

4hrs. The content was filtered and the filtrate evaporated to about a quarter of its original volume. Few drops of ammonium hydroxide were added to precipitate the alkaloid. The precipitate was trapped by filtering through a previously weighed filter paper (W_1). The filter paper was dried at 60^0C and final weight recorded as W_2.

The % alkaloid was calculated as $\frac{(W2 - W1)\ x\ 100}{W0}$

2.1.5 DETERMINATION OF VITAMIN B

50mg of sample was weighed into a 250ml flask and 150ml of acetic acid added. This was stirred on a hot plate at 70^0C for easy dissolution and allowed to cool and filtered No 1 Whatman filter paper. This was made up to mark of 250ml using acetic acid.

The absorbance of the solution was read at 440nm using 0.02M acetic acid as blank [15].

2.1.5.1 CALCULATION

Riboflavin (Vitamin. B_2) mg/kg = concentration obtained in (mg/l) for the sample x volume of extract x Dilution factor

2.1.6 DETERMINATION OF ASCORBIC ACID (VITAMIN C)

5.00 g of well blended sample was weighed into a conical flask and 25ml of 5% metaphosphoric acid in 10% acetic acid solution was added and thereafter gently agitated to obtain a homogenous dispersion. This was filtered and made up to volume of 50 ml using metaphosphoric acid. It was filtered and 4 ml of filtrate was pipette into a test tube 0.1ml of 2, 4-dinitrophenyl hydrazine dye was added and put in a water bath set at 37^0C for 3hours. After 3hours the tube was cooled and 5ml of cool 85% sulphuric acid was added. Absorbance was read at 521nm and vitamin C concentration was calculated [16].

2.1.6.1 CALCULATION

Ascorbic acid (mg/kg) = $\frac{\text{concentration}\left(\frac{mg}{l}\right)\text{ x volume of extract x dilution Factor}}{Sample\ Weight}$

2.1.7 DETERMINATION OF MINERAL

1.00g of dry sample was weighed into a porcelain crucible and ashed at 550^0C for 3hours. The crucibles were allowed to cool and ash was dissolved with 100ml of 3N HCL. This was stored in a plastic bottle with a plastic cap and taken to AAS for readings. (AAS USED: BULK SCIENTIFIC; MODEL: 2010).

2.1.7.1 SPECTROPHOTOMETRIC DETERMINATION

Using the Atomic Absorption spectrophotometer (AAS), corresponding lamp for corresponding mineral or heavy metal was placed in the AAS and the wavelength specific to a particular mineral to be determined was set. The AAS siphoning hose was dipped into the digested sample after running the standards for the mineral of interest. The concentration of the metal in the solution was displayed on the screen of the AAS machine. (AAS USED: BULK SCIENTIFIC; MODEL: 2010).

2.1.8 DETERMINATION OF TOTAL GLUCOSE

Anthrone reagent was prepared by dissolving 0.2g of anthrone powder in 100ml of 95% sulphuric acid. 0.1g of sample was weighed into a centrifuge tube. This was hydrolysed by adding 5ml of 2.5N HCl and placing it in a water bath for 3hours. After 3hours, it was neutralized by adding solid sodium carbonate until effervescence ceases. The content was transferred into 100ml standard flask and made up to mark using distilled water. This was centrifuged and 0.5ml aliquot was taken for total glucose determination. 4ml of the prepared anthrone was added and heated in a boiling water bath for 8minutes. This was cooled and absorbance read at 630nm using spectrum2MS 10 (90% malted sorghum and 10% cocoa powder UV visible spectrophotometer. The total glucose content was gotten by extrapolating the absorbances from a glucose standard graph [17].

2.1.9 SENSORY EVALUATION

The samples were subjected to sensory analysis by using a 9 point hedonic. A panel of 20 members which consist of staff and students of Department of Food Technology, Federal Polytechnic Offa, who were familiar with cocoa beverage, were selected for sensory evaluation.

3. RESULTS AND DISCUSSION

Table 1: Result of alkaloids, total glucose, vitamins B_{12} and C content for beverage produced

Sample	Vitamin B_{12} (mg/100g)	Vitamin C (mg/100g)	Alkaloids (%)	Glucose (%)
MS 10	1.27 ± 0.03^{a}	24.77 ± 0.80^{a}	0.99 ± 0.06^{a}	67.89 ± 0.30^{a}
MS 20	1.37 ± 0.02^{b}	32.24 ± 0.01^{b}	2.26 ± 0.11^{c}	67.55 ± 0.23^{a}
MS 30	1.46 ± 0.04^{c}	32.31 ± 0.00^{b}	2.72 ± 0.02^{d}	69.88 ± 0.79^{b}
MS 40	1.57 ± 0.01^{d}	49.84 ± 0.39^{d}	3.01 ± 0.05^{e}	69.53 ± 0.14^{d}
MS 50	1.70 ± 0.02^{e}	54.48 ± 0.02^{f}	3.13 ± 0.04^{e}	70.19 ± 0.09^{bc}
MS 60	1.79 ± 0.06^{f}	45.09 ± 0.04^{c}	1.17 ± 0.10^{b}	71.02 ± 0.25^{c}

The superscript is used to show significant differences among the samples. Values are means of triplicate determination. Values for a particular column differ significantly when followed by different letter ($p \leq .05$); Values are mean ± standard deviation.

Key
MS10 - (90% malted sorghum and 10% cocoa powder)
MS20 - (80%malted sorghum and 20 % cocoa powder)
MS30 - (70% malted sorghum and 30% cocoa powder)
MS40 - (60% malted sorghum and 40%cocoa powder)
MS50 - (50% malted sorghum and 50% cocoa powder)
MS60 - (Ovaltine beverages as control)

Vitamins are essential substances for the normal functioning and development of the body [18], there was consistent increase in vitamin B_{12} of all the samples. The vitamin B content of all the samples ranges from (1.27mg/100g –1.79mg/100g). Sample MS 60 (Ovaltine beverage) which is the control sample had the highest value with (1.79mg/100g) while sample MS10 (90% malted sorghum fortified with 10% cocoa powder) had the lowest value with (1.27mg/100g). However, increase in vitamin B showed that cocoa has a higher anti oxidative potential since vitamins are antioxidant nutrients. Thus consumption of these beverages may further aid in safe guarding cells from damage by free radicals, among other benefits of antioxidants [19].

Vitamin C (ascorbic acid) is a crystalline solid which is soluble in water [20].Vitamin C is needed to form collagen that gives strength to the connective tissues and required for wound healing and a normal immune function [21]. The result of vitamin C content obtained from this study showed an inconsistent increase. The value obtained ranged from 24.77mg/100g to 54.48mg/100g. Sample MS50 (50% malted sorghum and 50% cocoa powder) has the highest value of vitamin C content with (54.48mg/100g) while sample MS10 (90% malted sorghum and 10% cocoa powder had the least value (24.77mg/100g). There was no significant (*P* = .05) difference between samples MS20 (32.24mg/100g) and MS30 (32.31mg/100g). This study showed that fortifying malted sorghum with 50% cocoa powder improved the vitamin C content.

Alkaloids are naturally occurring chemical compounds containing basic nitrogen atoms [22]. The alkaloids content of the samples ranged from 0.99% to 3.13%. Sample MS50 (50% malted sorghum and 50% cocoa powder) has the highest value with (3.13%) while sample MS10 (90% malted sorghum and 10% cocoa powder had the lowest value with (0.99%). The result obtained from this study showed that cocoa was a good source of alkaloids. Alkaloids values in this study were significantly (*P* = .05) higher in fortified malted sorghum samples than in the control sample MS 60 (Ovaltine beverage) except sample MS 10(90% malted sorghum and 10% cocoa powder which showed (0.99%) and lower than (1.35%) which was reported by [23] for theobromine. Cocoa beans (*Theobroma cacao*) contain secondary metabolites in the form of purine alkaloids derived from xanthine such as theobromine has been explored to find its benefits for dental health [24].
The glucose content obtained from this study indicated that there was an inconsistent increase among the samples. Glucose value ranged from (67.55% -71.02%). However, sample MS60 (Ovaltine beverage) was rated best with (71.02%) while sample MS 20 (80% malted sorghum and 20% cocoa powder was rated least with (67.55%). There was no significant ((*P* = .05) difference among all samples. In comparison with carbohydrate of cereal based food reported by other researchers, Aminigo and Akingbala (2004) [25], reported higher carbohydrate content ranging from (74.30% -81.50%) for maize “ogi” sample fortified with 20 to 10% okra seed meal respectively. (Oluwamukomi *et al.,* 2005) [26] reported a lower range of carbohydrate contents (57.70% -59.10%) for maize “ogi” fortified with 30% soybean. The observed glucose content in this study would aid provision of energy to consumers of the products. This is because the lower the carbohydrate the higher the other food macromolecules namely protein and fat [27].

Table 2: Result of mineral composition of beverage produced

Sample	Calcium (mg/100 g)	Magnesium (mg/100 g)	Potassium (mg/100 g)	Phosphorus (mg/100 g)	Zinc (mg/100 g)
MS 10	24.03±0.11^{a}	217.28±0.13^{a}	269.20±0.35^{a}	81.91±0.34^{f}	2.21±0.01^{a}
MS 20	129.92±0.04^{c}	235.14±0.06^{b}	310.120±0.40^{b}	79.10±0.04	2.77±0.01^{b}
MS 30	206.54±0.66^{d}	261.27±0.76^{c}	366.17±0.65^{c}	75.95±0.21^{d}	2.93±0.06^{c}
MS 40	244.10±0.07^{e}	285.34±0.83^{d}	444.08±0.04^{d}	72.97±0.20^{c}	3.13±0.04^{d}
MS 50	274.26±0.15^{f}	302.95±0.25^{e}	515.8±0.13^{e}	43.25±0.55^{b}	4.49±0.04^{e}
MS 60	99.10±0.51^{b}	322.97±0.32^{f}	699.63±0.82^{f}	20.80±0.35^{a}	7.18±0.03^{f}

The superscript is used to show significant differences among the samples. Values are means of triplicate determination. Values for a particular column differ significantly when followed by different letter ($p \le .05$); Values are mean ± standard deviation.

Key
MS10 - (90% malted sorghum and 10% cocoa powder)
MS20 - (80%malted sorghum and 20% cocoa powder)
MS30 - (70% malted sorghum and 30% cocoa powder)
MS40 - (60% malted sorghum and 40%cocoa powder)
MS50 - (50% malted sorghum and 50% cocoa powder)
MS60 - (Ovaltine beverages)

Minerals are key elements of the body. They are needed in the buildup and function of important biomolecules in the human body. Although, minerals are not a source of energy in

the body but they are necessary for the maintenance of normal biochemical process in the body [28.]
Calcium contain adequate amount of cell require to perform various functions [29]. Teeth and bones are rich in calcium [30]. Most of the calcium is found in bones [31].The calcium contents of the samples ranged from (24.03mg/100g - 274.26mg/100g).Sample MS 50 (50% malted sorghum and 50% cocoa powder) has the highest value with 274.26mg/100g while sample MS10 (90% malted sorghum and 10% cocoa powder) had the lowest value with 24.03mg/100g. Holistically, the result obtained indicated that cocoa was a good source of calcium. Calcium values in this study were significantly (P = .05) higher in the fortified malted sorghum samples than the control sample (Ovaltine beverages) except sample MS10 (90% malted sorghum and 10% cocoa powder) which showed (24.03mg/100g) and lower than 36.97mg/100 g reported by [27] for 90% sorghum “ogi” fortified with 10% cocoa powder. However, the results of this study indicated that sample MS50 (50% malted sorghum and 50% cocoa powder) was higher than the recommended daily allowance of 255mg/d required from complementary foods for 6 to 23 months infant and lower than 1000mg/day for adults. The fortified samples could be significant source for human; the rest of the calcium required would come from other meals [27].

The magnesium content increased significantly as quantity of the cocoa increased while the control sample (MS60 (Ovaltine beverages) had the highest value. The magnesium content obtained from this study ranges from (217.28mg/100g –322.97mg/100g). However, the results of this study indicate that the samples are far lesser than the toxicity level per day. According to [32], toxic level of magnesium is 1.5g/day as reported by [33.] Sample MS60 (Ovaltine beverage) had the required daily intake for adult. Magnesium daily intake for adult is 320mg/day according to [27]. All the fortified samples were good sources of magnesium but not up to the required daily intake.

Potassium helps in metabolism, nerve impulses transmission, growth, muscle building and maintaining of acid-base balance in the human body. The potassium content of the samples ranges from (269.20mg/100g –699.63mg/100g). SampleMS60 (Ovaltine beverages) had the highest value with 269.20mg/100g. Also it can be deduced from the result obtained that there is significant (P = .05) difference between the six samples. The values of potassium in this study therefore suggest that the potassium level of all the fortified malted sorghum samples were influenced by fortification variations with cocoa powder. However, the potassium value obtained for samples MS20 to MS50 which ranged from 310.12mg/100g to 515.76mg/100g was far lesser than 415.60mg/100g to 996.87 mg/100g reported by [27]for fortified sorghum “ogi” with cocoa powder.

Generally phosphorus content of all the samples decreased significantly as quantity of the cocoa increased including the control sample MS60 (Ovaltine beverages). Phosphorus content was highest in the malted sorghum samples fortified with 10% cocoa powder (MS10) with 81.91mg/100g. Helen *et al.* (2019) [12] reported higher range of phosphorus content (110.20mg/100g-120mg/100g) for beverages from milk and cocoa powder blends. Holistically, the result obtained showed that sorghum was a good source of phosphorus.

Zinc is part of many enzymes, required for the body immune system, having role in cell division, growth and wound healing. The zinc content observed from this study ranged from (2.21mg/100g–7.18mg/100g). It can be deduced from the result of this study that sample MS60 (Ovaltine beverages) had the highest value with (7.18mg/100g) while sample MS10 (90% malted sorghum and 10% cocoa powder) has the lowest value with (2.31mg/100g). Zinc content was significantly lower (P = .05) in fortified samples when compared with control sample. Also the zinc value obtained from this study was higher than zinc (1.41mg/100g) reported for fermented mixture of millet and cowpea “ogi” by [34]. However, the result of this study showed that zinc content of all the samples were higher than the recommended zinc composition of (2.08mg/100g) for complementary foods for 11-23 months infants based on Krebs standards [27].It is therefore concluded that cocoa had significant impact on the zinc content of all the samples.

Table 3: Result of sensory evaluation of beverage produced

Sample	Appearance	Flavour	Sweetness	Thickness	Colour	Overall Acceptability
MS 10	7.1	7.2	6.9	6.8	6.7	7.5
MS 20	7.8	7.6	7.7	7.7	7.4	8.0
MS 30	6.6	7.1	6.7	7.0	7.0	7.1
MS 40	7.0	6.9	6.7	6.8	7.1	7.4
MS 50	6.2	6.7	6.6	6.8	7.0	7.1
MS 60	8.6	8.5	8.3	8.2	8.6	8.6

Key
MS10 - (90% malted sorghum and 10% cocoa powder)
MS20 - (80%malted sorghum and 20% cocoa powder)
MS30 - (70% malted sorghum and 30% cocoa powder)
MS40 - (60% malted sorghum and 40%cocoa powder)
MS50 - (50% malted sorghum and 50% cocoa powder)
MS60 - (Ovaltine beverages)

Discussion

The organoleptic properties of food products are essentially part of the limiting factors affecting consumers' acceptability. Therefore, organoleptic evaluation of appearance, flavour, sweetness, thickness, colour and overall acceptability were performed on malted sorghum fortified with cocoa powder. The mean sensory scores as assessed by the sensory panelist, showed an inconsistent increase among all the samples.

The appearance of sample MS 60 (control) was liked very much with the value of 8.6 while sample MS50 (50% malted sorghum fortified with 50% cocoa powder) was the least acceptable in terms of appearance with (6.2). Flavour ranges from (6.7 –8.5). The beverage made from sample MS 60 (Ovaltine beverage) (control) recorded the highest score of (8.5) while sample MS 50 (50% malted sorghum and 50% cocoa powder (50% cocoa powder fortification level) ranked lowest with a score of (6.7). These result indicated that sample MS 60 (Ovaltine beverage) was the most preferable in terms of flavour.

Sensory scores for sweetness ranged between 6.6 and 8.3. There were no distinct differences between samples MS 10, MS 30, MS 40 and MS 50. However, it can be deduced from the result of this study that sample MS20 was rated best after the control sample (ovaltine) while sample MS50 was rated lowest in terms of sweetness.

Thickness is an important attribute to consider during sensory evaluation of beverage sample. The thickness value obtained ranged from 6.8 to 8.2. The mean value obtained for thickness of sample MS10 (90 % malted sorghum and 10 % cocoa powder), MS 20 (80 % malted sorghum and 20 % cocoa powder and MS 40 (60% malted sorghum and 40% cocoa powder) was rated least with range value of (6.8) for each of them while sample MS 60 (Ovaltine beverage) were rated (8.2) high which indicates its high preference to other samples.

The mean value scores for colour as assessed by the sensory panelist showed clear difference when compared with MS 60 (Ovaltine beverage) (control sample). Sample MS 10 (90% malted sorghum and 10% cocoa powder (6.7) was rated lowest while sample MS 60 (Ovaltine beverage) (8.6) was rated highest.

Overall acceptability deals with how well consumers accept or detest a sample. Sample MS60 (Ovaltine beverage)(control) had the highest value of preference with (8.6) while malted sorghum fortified with (30% and 50%) cocoa powder had the lowest value of 7.1. The overall acceptability results from this study showed that the panelist like all the samples, however, malted sorghum fortified with 20% cocoa powder was most preferred among the fortified samples in term of overall acceptability.

4. CONCLUSION

This study revealed that there was an increase in alkaloids, glucose, vitamins B and C calcium, magnesium, potassium, and zinc as substitution with cocoa powder increased. Whereas phosphorus decreased as substitution with cocoa increased indicating that cocoa may not be a good source of phosphorus. The fortification of malted sorghum with cocoa powder enhanced the nutritional content of the beverage.

The fortified beverage has radical scavenging activity due the increase in antioxidant such as alkaloid and could be used for health promotion and disease prevention as an alternative to beverages with low nutritional / nutraceuticals value.

DISCLAIMER:

AUTHORS HAVE DECLARED THAT NO COMPETING INTERESTS EXIST. THE PRODUCTS USED FOR THIS RESEARCH ARE COMMONLY AND PREDOMINANTLY USE PRODUCTS IN OUR AREA OF RESEARCH AND COUNTRY. THERE IS ABSOLUTELY NO CONFLICT OF INTEREST BETWEEN THE AUTHORS AND PRODUCERS OF THE PRODUCTS BECAUSE WE DO NOT INTEND TO USE THESE PRODUCTS AS AN AVENUE FOR ANY LITIGATION BUT FOR THE ADVANCEMENT OF KNOWLEDGE. ALSO, THE RESEARCH WAS NOT FUNDED BY THE PRODUCING COMPANY RATHER IT WAS FUNDED BY PERSONAL EFFORTS OF THE AUTHORS.

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