Nutritional Composition and Sensory Attributes of Cocoa-Based Beverage Produced from Cocoa beans, Soybean, Sorghum leaves, and Date Fruit

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ABSTRACT

Background: *With the rise in the cost of commercial cocoa beverages nationwide, its pertinent to produce alternative cocoa beverages that can supply nutrients for the nourishment of the body as against the usual sugar-dense commercial beverages in the market*

Objective: *The nutritional composition and sensory attribute of cocoa-based beverage produced from cocoa beans, soybean, sorghum leaves and date fruit were assessed*

Method: *The Soybean, Sorghum leaf, date fruit and Cocoa beans were procured from King's Market and Okunriboye Merchant Company in Owo Local Government Area, Ondo State respectively. Products were formulated as follows: Sample $CSDS_1$ (70% Cocoa beans; 20% Soybean; 5% date fruit; 5% sorghum leaves, $CSDS_2$ (60% Cocoa beans; 25% Soybean; 10% date fruit; 5% sorghum leaves), $CSDS_3$ (50% Cocoa beans; 30% Soybean; 15% date fruit; 5% sorghum leaves), $CSDS_4$ (40% Cocoa beans; 35% Soybean; 20% date fruit; 5% sorghum leaves) and CCBB was used as control. Samples were subjected to chemical analyses and instrumental analysis according to standard. Analysis of variance using Statistical Package for Social Science (SPSS) version 23 was performed. Significance was accepted at $P<0.05$.*

Result: *Findings shows that the protein, selenium, sodium and vitamin B_1 were significantly ($p<0.05$) higher in the products than the control sample while vitamin C, vitamin B_2, B_3, B_5, B_6, and B_9, calcium, iron and zinc were significantly ($p<0.05$) higher in the control than the formulated products. Sample $CSDS_1$ had the highest (503mg) potassium while $CSDS_4$ was the most accepted in terms of colour*

Conclusion: *The formulated beverages had appreciable amount of protein, fat, sodium, potassium, phosphorus, selenium, zinc and thiamin. Acceptability in all the parameters increases with increase in the addition soybeans flour.*

Keywords: *Cocoa beverage, date fruit, soybeans, selenium, protein*

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INTRODUCTION

Beverages are liquid foods that serve as a source of both fluids and nutrients that refresh and nourish the body (1). Beverage manufacturing companies in Nigeria majorly produced product that provide mainly energy for daily manual work without necessarily consideration for other nutrients. Most beverages in Nigeria are made up of about 90% water, sugar, favouring agents and sometimes preservatives (1) which make unsuitable for consumption with people with

cardio-metabolic diseases (2,3). The common beverage produced from animal milk was reported to have bad cholesterol which may lead to hypertension (4). Elevation in the activity of nutritional antioxidants over the damaging effects of prooxidants has the potential to attenuate these diseases (5,6).

There are also epidemiological evidences and interventional studies to correlate higher level of antioxidant-rich food uptake with lower incidence of cardiovascular diseases (5,6).

The high prevalence of diet-related non-communicable diseases as a result of nutrition transition currently witnessing in Nigeria called for urgent need for food and beverage manufacturing companies to be caution on some nutrient content of their products most especially beverages consumed by Nigerians. Poor dietary pattern via consumption of excess refined sugar, excessive salt and fat intake couple with lack of physical activities are bane for the development of non-communicable diseases. The major strategy for prevention and treatment of NCDs is lifestyle modification, including controlled diet and physical activities (7,8). Developing countries are faced with the challenge of an increasing proportion of diet-related noncommunicable diseases like diabetes mellitus, cancer, cardiovascular diseases, and triple burden of malnutrition (9,10).

Cocoa (*Theobroma cacao)* is one of Nigeria's major cash crops and its products have been reported to be rich sources of flavonoids known as procyanidins (11). Nigeria is among the top producers of cocoa in the world with increase in production from 367,000 – 421,300 tones (12).

Cocoa-based beverages are very common food drinks in Nigeria. These cocoa beverages are known to contain essential minerals such as iron, calcium, phosphorus and vitamins and rich in energy most of which are from refined sugar and sweeteners (13).

Soybean (*Glycine max*) is a cheap, nutritious leguminous plant popularly used for its high protein and oil content, it's the only beans in the leguminous family with a favourable amino acid composition and significant use of these soy products are found to have a reduced risk of cancer and postmenopausal symptoms. Also, plant sterols similar in structure to cholesterol are found in soybeans oil and have been found to reduce low density Cholesterol (14).

Soybean, by virtue of its high protein content and generous amount of essential amino acids especially lysine, tryptophan and threonine, has been identified as a premier crop in finding solutions to problems of malnutrition and is being used as an alternative to animal milk in Nigeria (15).

Date palm (Phoenix dactylifera L) is the major fruit crop in the kingdom of Saudi Arabia. It is one of the sweetest fruits found in the world with good sources of macro elements like calcium, phosphorus, potassium and magnesium (16). It's a sugar substitute fruit and it duplicate the effect of sugar with taste but usually with less energy as observed in most fruits, Hence, the addition of date fruit to the composition of the formulated cocoa-based product.

Sorghum (*Sorghum bicolour*) is the fifth most important cereals crops in the world after rice wheat, corn and barley and it serves as the main cereal food for over 750 million people living in semi - arid tropical region of Africa, Asia and Latin America (17). Sorghum leaf is a nutrient pack leaf with a great colour similar to chocolate and contains an appreciable quantity of nutrient (18).

With the rise in cost of commercial cocoa beverages nationwide, couple with high prevalence of metabolic syndrome and it risk factor, it is pertinent to produce alternative cocoa beverages that can supply nutrients for the nourishment of the body devoid of refined sugar as against the usual sugar dense commercial beverage in market which is a risk factor for non-communicable diseases. The potential of cocoa beans, soybean, sorghum leaves and date fruit in beverage production as well as the nutritional and sensory characteristics of the processed beverage was investigated.

MATERIALS AND METHOD

Procurement of Raw Materials

Fresh matured ripe cocoa pod was purchased from Okunriboye Merchant company Nig. Ltd while Soybean, Sorghum leaf and date fruit were

procured from King's Market in Owo Local Government Area of Ondo State respectively.

Production of cocoa beans flour

The cocoa beans were separated from the outer coat, defatted and later oven dried at 50^{0C} for 12hours. Milled into powder using an attrition milling machine to a smooth texture of 450mcg particle size and was sieved using a sieve of 300mcg hole size to remove coarse material. The resultant fine powder was packaged in polythene bags and stored in air-tight container and kept in the fridge for formulation (Figure 1).

Production of Soybean Flour

This was produced according to the methods of (19). Soybean was cleaned and sorted, washed and boiled in water at 100°C for 30 min. It was dehulled manually, sundried for five days and milled into flour using attrition milling machine and was sieved to remove coarse material. The resultant fine flour was packaged in polythene bags and stored in air-tight container and kept in the fridge
for further use (Figure 1).

Production of Date Fruit

Matured date fruits were cleaned manually (to remove, stones, damaged and immature seeds), the cleaned fruit was washed with portable water to remove dirt's and particulate contaminant. The date fruits were dissed and spread on a stainless tray, covered with mucilling cloth and was kept in sun dried for 72hrs and later oven dry for 24hours at 60^{oc} to ensure a lower moisture content of 15% using a digital moisture meter. The dried Date fruit was crushed and milled with upgraded attrition milling machine to a smooth texture of 400mcg particle size and was sieved through a screen cloth (300mcg) particle size to produce flour date fruits. The date fruits flour was sealed in polythene bags and stored at room temperature (25^{0}C) for further analysis (Figure 1).

Production of sorghum leaves

Sorghum leaves were cleaned (remove stones and immature leaves), the cleaned Sorghum leaves were washed with portable water to remove dirt's and particulate contaminant. The Sorghum leaves were dissed and spread on a stainless tray, covered with mucilling cloth and was kept in sun dried for 72hrs and later oven dry for 24hours at 60^{oc} to ensure a lower moisture content of 15% using a digital moisture meter (Figure 1).

Proximate Analysis

The standard method of AOAC (20) was used to determine the proximate content of the samples. The hot air oven method was used to determine the moisture content; Protein was determined using the Kjeldahl method of protein analysis. Fat was determined by the Soxhlet method of fat extraction, while ash was obtained by weighing 5g of the sample into a tarred porcelain crucible. The crucible and its content were then transferred into a muffle furnace set at 550^{0}C for 6hours until ash content was obtained. The crude fibre was determined, weighing 2.0g of each sample was weighed into separate beakers while total carbohydrate content was obtained by difference (20) (table 2)

Determination of mineral and vitamin analysis

Minerals determination was carried out in a dilute solution of the ashed samples according to the method outlined in AOAC (20). Potassium was determined by flame photometry (20), phosphorus by colorimetric method (20) while Atomic Absorption Spectrophotometer (Buck Scientific, Model 210) was used for Iron, Calcium, iodine, sodium, Zinc, Copper, Manganese and Magnesium (table 3). Water soluble vitamins such as thiamin, riboflavin, niacin, pantothenic acid, pyridoxine and folic acid were determined using the AOAC method of analysis (20). Each analysis was carried out in duplicates on all the samples, while vitamin C was determined using the method described by Rutkowski and Grzegorczyk (2007) (table 4).

Sensory evaluation of the cocoa-based samples

A structured questionnaire was used to collect information from 20 panelists on the sensory

characteristics of the formulated cocoa-based beverages. The samples were coded as **$CSDS_1$**, **$CSDS_2$**, **$CSDS_3$**, **$CSDS_4$** and **CCBB** and presented to the panelists who were staff and students recruited from the faculty of Applied Sciences, Rufus Giwa Polytechnic, Owo. The panelists were seated comfortably at the sensory unit of the department, and each panelist was served with a separate cup of the prepared beverage and teaspoon served at the same temperature (30°C) in line with method described by (21) (table 5).

Statistical Analysis

The results were expressed as mean ± standard deviation, and the test for statistical significance was carried out using a one-way analysis of variance (ANOVA). The Statistical Package for Social Sciences (SPSS, Version 20) software determined significant differences. Significant means were separated using Duncan's New Multiple Range Test (DNMRT), and differences were considered significant at $p<0.05$

RESULTS

Findings from the proximate analysis shows that sample $CSDS_2$ (12.02%) was significantly ($p<0.05$). had the highest value in moisture content. The ash content of the samples increases significantly ($p<0.05$) with the decrease in the quantity of cocoa in the formulation. Sample $CSDS_4$ had the highest (3.49%) ash content. The fat content decreases with the reduction in the percentage of cocoa bean used in the formulation. Sample $CSDS_1$ with highest percentage of cocoa seed had 16.24g of fat which is the highest and it was significant ($p<0.05$) compared to other samples. Fibre content of the cocoa beverage was low in all the samples while the protein content of the beverage increases with increase in the amount of soybean ratio in the formulation.

Mineral content of the Cocoa beverage

In terms of mineral content, Sample $CSDS_2$ was significantly difference ($p<0.05$) from other samples and contained the highest value of sodium (228mg/100g) calcium (117mg/100g) and potassium (503mg/100g) content while magnesium was significantly ($p<0.05$) higher in sample $CSDS_1$ (26.35mg/100g), and $CSDS_2$ had the least value (22.47mg). Sample $CSDS_2$ had the highest value for phosphorus content (81mg), while sample $CSDS_3$ had the least value (72mg/100g). The control sample CCBB had the least value for Na (110mg/100g). Calcium, Zinc and Iron was significantly ($p<0.05$) higher in the control sample compared to the formulated products. All the formulated product was significantly ($p<0.05$) higher in selenium compared to the control sample.

The vitamin content of the samples revealed that vitamin B_1 (17.91mg/100g), Vitamin B_2 (0.14mg/100g), Vitamin B_3 (2.61mg/100g), folic acid and (217mcg/100g) and pantothenic acid (0.31mg/100g) were significantly ($p<0.05$) higher in sample $CSDS_2$. But was significantly ($p<0.05$) lower than control samples (CCBB) except in vitamin B_1. Vitamin C content of the cocoa-based was significantly ($p<0.05$) higher in the control samples than the formulated beverage samples.

The result of the mean sensory scores is presented in Table 4. The scores for overall acceptability revealed that the control (8.98 ± 1.029) was the most accepted sample. Sample $CSDS_4$ was the most accepted in terms of colour. The acceptability was significantly ($P<0.05$) than the control samples. Acceptability in all the parameters increases with increase in the addition soybeans flour. Sample $CSDS_4$ could stand shoulder to shoulder with control sample in terms of acceptability in all parameters.

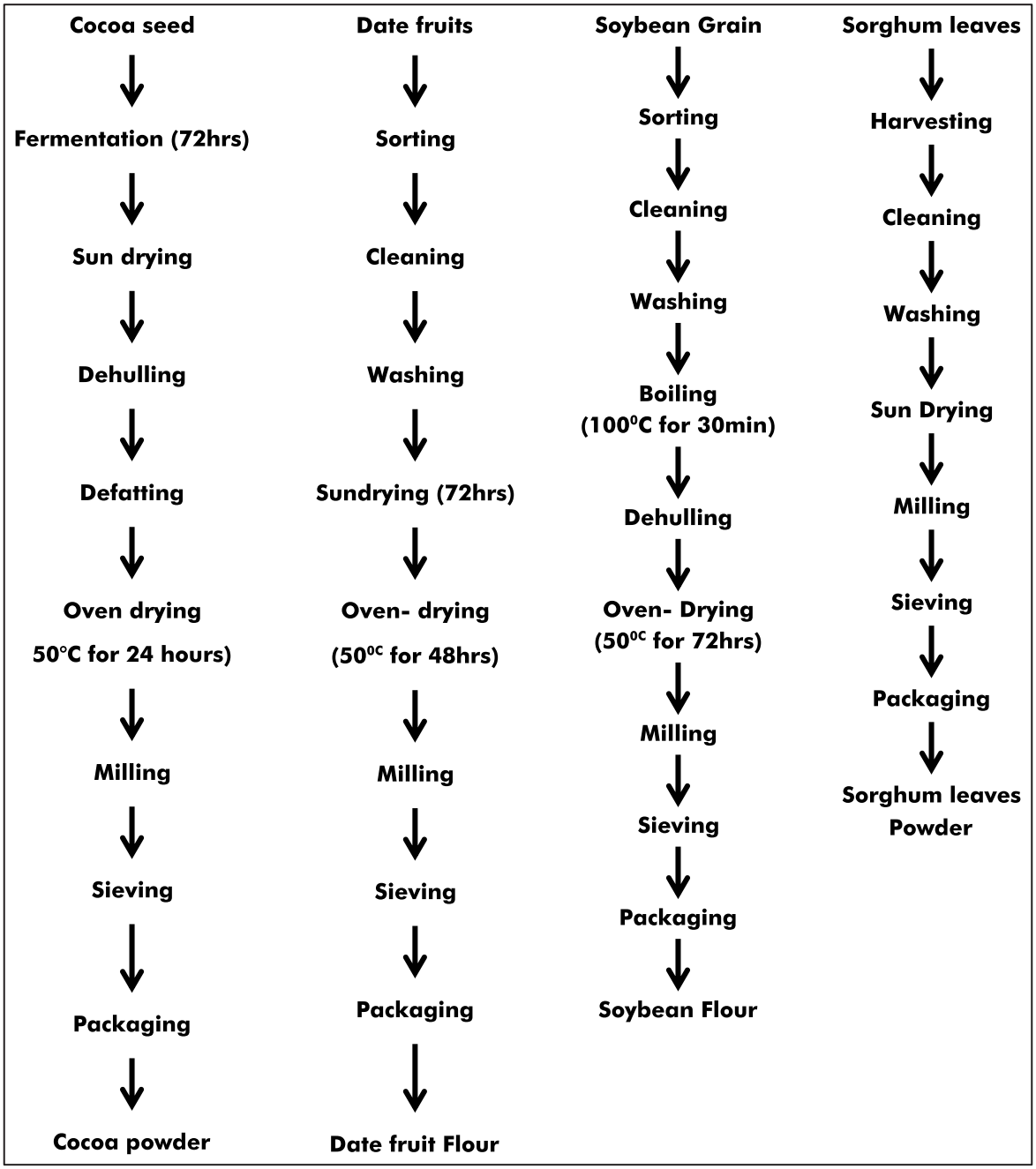

Table 1: Formulation of cocoa-based beverages in percentage (%)

Samples	Cocoa beans	Soybean	Date fruit	Sorghum leaves
$CSDS_1$	70	20		5
$CSDS_2$	60	25	10	5
$CSDS_3$	50	30	15	5
$CSDS_4$	40	35	20	5
CCBB	Commercial cocoa beverage			

Figure 2: shows the content of sample $CSDS_1$ and $CSDS_2$

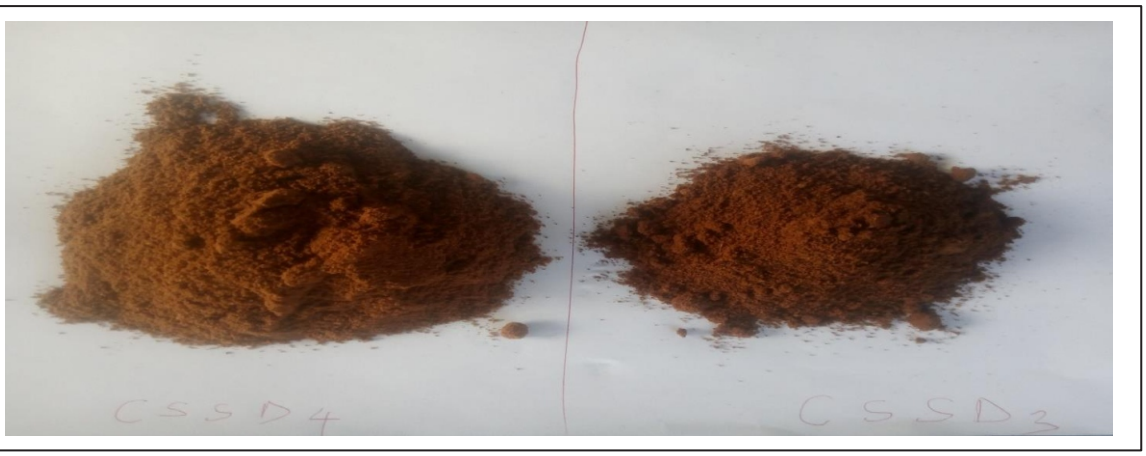

Figure 3: shows the content of sample $CSDS_3$ and $CSDS_4$

Table 2: Proximate composition of cocoa-based beverages

Nutrients	**Samples code**				
Proximate g/100g	**$CSDS_1$**	**$CSDS_2$**	**$CSDS_3$**	**$CSDS_4$**	**CCBB**
Moisture (g)	$11.15\pm.042^{c}$	$12.02\pm.021^{a}$	$11.37\pm.028^{b}$	$11.08\pm.028^{c}$	**ND**
Ash (g)	$2.80\pm.012^{d}$	$3.41\pm.004^{c}$	$3.46\pm.002^{b}$	$3.49\pm.009^{a}$	**ND**
Fat (g)	$16.24\pm.004^{a}$	$15.56\pm.007^{b}$	$11.16\pm.016^{d}$	$12.29\pm.002^{c}$	6.40
Fibre (g)	$2.04\pm.019^{c}$	$1.95\pm.012^{d}$	$2.18\pm.010^{a}$	$2.15\pm.010^{b}$	3.10
Protein (g)	$8.63\pm.019^{d}$	$8.81\pm.003^{c}$	$10.76\pm.001^{b}$	$10.93\pm.011^{a}$	8.10
Carbohydrate (g)	$59.11\pm.060^{c}$	$56.93\pm.034^{d}$	$61.40\pm.038^{a}$	$60.03\pm.021^{b}$	76.0

Values are mean ± standard deviation of duplicate analyses. Values with the same superscript in the same columns are statistically not significant at (P<0.05). **Key; CSDS$_1$** =, 70% Cocoa beans; 20% Soybean; 5% date fruit; 5% sorghum leaves **CSDS$_2$** = 60% beans; 25% Soybean; 10% date fruit; 5% sorghum leaves CSDS$_3$ = 50% Cocoa beans; 30% Soybean; 15% date fruit; 5% sorghum leaves, **CSDS$_4$** = 40% Cocoa beans; 35% Soybean; 20% date fruit; 5% sorghum leaves, ND= Not determine **CCBB**= Commercial cocoa-based beverages

Table 2: Mineral composition of cocoa-based beverages

Mineral	CSDS$_1$	CSDS$_2$	CSDS$_3$	CSDS$_4$	CCBB
Na (mg/100g)	216.30±0.141^b	228.50±0.282^a	194.90±0.141^d	203.50±0.14^c	110.0
Ca (mg/100g)	135.70±0.282^c	177.50±0.424^a	120.55±0.070^d	150.60±.28^b	900.0
K (mg/100g)	503.60±0.141^a	479.85±0.353^c	435.30±0.141^d	489.95±0.35^b	ND
Zn (mg/100g)	2.17±0.002^b	2.41± 0.004^a	1.95±0.010^d	2.15±0.005^c	11.30
Mg (mg/100g)	30.91±0.004^a	27.64±0.003^c	25.98±0.007^d	28.53±0.00^b	ND
Se (mcg/100g)	49.00±0.002^d	50.00±0.005^c	54.00±0.004^a	52.00±0.00^b	45.00
Fe (mg/100g)	2.06±0.012^a	1.71±0.007^c	1.91±0.004^b	1.52±0.00^d	16.50
Cu (mg/100g)	0.24±0.005^c	0.28±0.007^b	0.31±0.002^a	0.31±0.00^a	ND
P (mg/100g)	77.30±0.002^c	81.56± 0.004^a	72.45± 0.005^d	79.50±0.00^b	ND
Iodine(mg/100g)	4.17±0.002^b	4.32±0.014^a	3.68±0.014^c	3.42±0.00^d	ND

Iodine(mg/100g)4.17±0.002^{b}4.32±0.014^{a}3.68±0.014^{c}3.42±0.00^{d}NDValues are mean ± standard deviation of duplicate analyses. Values with the same superscript in the same columns are statistically not significant at (P<0.05). **Key; CSDS$_1$** =, 70% Cocoa beans; 20% Soybean; 5% date fruit; 5% sorghum leaves **CSDS$_2$** = 60% beans; 25% Soybean; 10% date fruit; 5% sorghum leaves **CSDS$_3$** = 50% Cocoa beans; 30% Soybean; 15% date fruit; 5% sorghum leaves, **CSDS$_4$** = 40% Cocoa beans; 35% Soybean; 20% date fruit; 5% sorghum leaves, ND= Not determine

Table 3: Vitamin composition of cocoa-based beverages

Vitamins	CSDS$_1$	CSDS$_2$	CSDS$_3$	CSDS$_4$	CCBB
B1 (mg/100g)	15.73± 0.005^b	17.91±0.003^a	15.52±0.014^c	14.68±0.002^d	1.90
B_2 (mg/100g)	0.11±0.049^b	0.14±0.005^a	0.09 ±0.002^c	0.10 ±0.002^b	2.10
B_3 (mg/100g)	2.16±0.004^b	2.61±0.002^a	1.91±0.007^d	2.10±0.011^c	25.0
B_5 (mg/100g)	0.27±0.004^b	0.31± 0.002^a	0.23±0.001^d	0.25±0.001^c	12.5
B_6 (mg/100g)	0.19±0.002^c	0.22±0.003^a	0.17±0.004^d	0.20±0.004^b	1.50
B_9 (mcg/100g)	210.45±0.212^b	217.05±0.21^a	203.55±0.21^d	208.40±0.02^c	300
Vit C (mg/100g)	15.00±0.216^a	11.00±0.112^a	14.00±0.312^a	12.00±0.232^a	50.0

Values are mean ± standard deviation of duplicate analyses. Values with the same superscript in the same columns are statistically not significant at (P<0.05). **Key; CSDS$_1$** =, 70% Cocoa beans; 20% Soybean; 5% date fruit; 5% sorghum leaves **CSDS$_2$** = 60% beans; 25% Soybean; 10% date fruit; 5% sorghum leaves **CSDS$_3$** = 50% Cocoa beans; 30% Soybean; 15% date fruit; 5% sorghum leaves, **CSDS$_4$** = 40% Cocoa beans; 35% Soybean; 20% date fruit; 5% sorghum leaves, **CCBB**= Commercial cocoa-based beverages.

Table 5: Sensory attribute of cocoa-based beverages

Sensory attributes	$CSDS_1$	$CSDS_2$	$CSDS_3$	$CSDS_4$	CCBB
Flavour	6.07 ± 0.632^{d}	6.47 ± 2.719^{c}	6.60 ± 1.494^{b}	7.33 ± 1.174^{a}	8.20 ± 1.114^{a}
Aroma	6.40 ± 0.632^{b}	6.60 ± 1.420^{d}	7.13 ± 1.853^{c}	7.33 ± 1.989^{a}	8.23 ± 1.919^{a}
Mouth feel	5.60 ± 0.699^{d}	6.30 ± 1.626^{c}	6.89 ± 1.838^{b}	7.27 ± 2.201^{a}	8.88 ± 2.201^{a}
Taste	5.87 ± 0.949^{d}	6.00 ± 1.484^{bc}	6.91 ± 2.163^{b}	7.27 ± 1.080^{a}	8.95 ± 1.060^{a}
Colour	5.93 ± 1.687^{b}	6.67 ± 2.058^{bc}	7.60 ± 2.541^{cd}	8.25 ± 2.506^{a}	8.10 ± 2.516^{b}
Overall acceptability	5.80 ± 1.370^{c}	6.40 ± 1.252^{d}	7.07 ± 1.160^{b}	7.47 ± 1.059^{a}	8.98 ± 1.029^{a}

Values are mean ± standard deviation of duplicate analyses. Values with the same superscript in the same columns are statistically not significant at ($P<0.05$). **Key; $CSDS_1$** =, 70% Cocoa beans; 20% Soybean; 5% date fruit; 5% sorghum leaves **$CSDS_2$** = 60% beans; 25% Soybean; 10% date fruit; 5% sorghum leaves $CSDS_3$ = 50% Cocoa beans; 30% Soybean; 15% date fruit; 5% sorghum leaves, **$CSDS_4$** = 40% Cocoa beans; 35% Soybean; 20% date fruit; 5% sorghum leaves,
CCBB= Commercial cocoa-based beverage

DISCUSSION

Cocoa-based powder is dense in nutrients, including minerals such as iron, zinc, selenium, and magnesium (11). Study has suggested that adding more cocoa powder to our diet helps to improve attention, working memory, and general cognition. It may also restore cognitive performance in people with insomnia (22). The study examined the nutritional composition, and sensory attributes of cocoa-based beverages produced from cocoa beans, soybean, sorghum leaves, and date fruit. Moisture content from the results revealed that none of the formulated samples meet the approved standard moisture of less than 10% or flour or powder food products. There is a tendency for microbial growth, increase deterioration, and reduce Shelf life (22,23). Cocoa powder is hygroscopic and deliquescent in nature. That is, it has the ability to absorb water and cause loss in flavour and deterioration (24). Good packaging and storage conditions are essential to preventing the take-up of moisture (25). Moisture content is an index of quality in the food production industry. This suggest that there is a need for improvement to reduce the water level in the samples. Although the formulated samples were not doing bad in terms of moisture content, the result from this study is higher than the 6.56 g/100 g reported by Galli, (26).

Most commercially available cocoa powders contain between 10 and 24 % fat while the 10-12 % fat range is the most frequently used standard (27). Only sample was closed-to standard recommendation. The fat content of these formulations was higher than the control sample. The difference could be linked to the method of fat extraction of cocoa beans prior to the processing coupled with the fact that soybeans were added being an oil seed. The higher fat content, especially the unsaturated fat for which soybeans and cocoa beans are known for are prone to oxidation and shorten shelf-life of food products (28). The protein content of the samples was widely varied with samples $CSDS_3$ & $CSDS_4$ being the highest value was significantly higher than the protein content of the control sample. Variations in cocoa beans and the addition of soybeans, a legume could had been responsible for the high protein seen in the formulation (29). The composition of the ingredients was in the right proportion considering the similar protein content of the formulated samples and the control. The fibre content in the samples ranged as 2.80-3.49%. These values were all less than the value reported in the literature for cocoa powder as 6.6g/100g (30). This high difference could be due

to the different sources of the cocoa beans since similar methods of determination were used for the analyses. The fibre content of the formulated samples increases with an increase in the quantity of date fruit used in the formulation. Dietary fiber has been found to reduce the risk of cancer in the digestive tract (31). The results also revealed an appreciable amount of obtained as minerals. The sodium content of samples was higher than the control i.e., the commercially available cocoa beverage. A similar result was obtained in cocoa powder by Chukwuka (27) in his study. Sodium functions in the maintenance of extracellular fluids and blood pressure and is also required for nerve and muscle functioning Badru, (32). Calcium content reported in this study was lower than the value obtained in the control sample. The differences may be triggered by the fortification of the control sample. Calcium aids in building strong bones and teeth and its deficiency leads to rickets and stunting in children (33). The potassium content of the formulated samples was relatively high. The potassium content reported in this study was similar to the potassium content of pure cocoa powder (503.6mg/100g) in the study conducted by Al-Farsi, et al. (34). But higher than the reported value for Potassium by Ogunledun (35) is very important in that it is essential for blood clothing and relaxation of muscles. Potassium is required in the body for regulation of fluid, muscle control and normal functioning of the nerves (23). Zinc plays a central role in cell division, protein synthesis and growth. Zinc is very useful in protein synthesis, cellular differentiation and replication, immunity and sexual functions (23). In this study, the formulated samples had a lower value compared to the control. The value was similar to the value obtained from varieties of cocoa powder in Nigeria (36). Magnesium content was similar to what was obtained by Jinap *et al.,* (37) in cocoa powder. Magnesium helps in the relaxation of nerves and muscles. It is also essential for the formation of bone and clotting of the blood Toniolo *et al.,* (38). The result obtained for selenium was significantly difference ($p<0.05$) from the control. The formulated samples had an exceptional quantity of selenium. Balogun & Fetuga, (39) reported a different from this study. Selenium is important for regulating muscle contraction and helping with nerve function and protecting the body from oxidative damage and infection (25). The iron content of the samples was lower than the control sample. Iron plays key role in the blood formation in the body. Similar result was obtained by Asiedu (40), in cocoa powder. In this study, appreciable quantity of water-soluble vitamins was discovered in the formulated samples were significantly ($P<0.05$) lower than the value of the control sample except in the thiamin content of the formulated samples. The differences, of course can be attributed to the fact that ingredients used in the preparation of the commercial beverage which was the control used in this study couple with the fact that most of the commercial cocoa-based beverages had been enriched during processing. On the other hand, the formulated samples had an exceptional higher content of thiamin, appreciable quantity of folic acid and ascorbic acid, this could be attributed to the high content of these nutrients in date fruit and soybean which the major ingredients in the formulation. The role of vitamins is enormous in human nutrition, apart from its energy releasing ability, vitamins regulate the processes necessary for growth, reproduction, and the maintenance of health (41). Result from the sensory evaluation revealed that the control sample was accepted the most in terms of taste, aroma, mouth feel and general acceptability except in colour in which sample $CSDS_4$ had the highest score. This outcome was expected from the panelist because the students and staff are used to cocoa-based beverage. The acceptability of the formulated products increases with the increase in the percentage of the soybean and date fruit usage in the study. However, the formulated blends were significantly accepted from the scores of the results obtained. In terms of general acceptability, sample $CSDS_4$ could stand shoulder to shoulder with control sample in terms of acceptability in all parameters.

CONCLUSION

The result of this study has shown that alternative coca-based beverage could be produced using plant-based ingredient devoid of animal product

such as milk, and white sugar and still get a desirable healthy product as seen in this study. The four formulated beverages had appreciable amount of Protein, fat, sodium, potassium, phosphorus, selenium, zinc and thiamin. But was low in carbohydrate, calcium and iron, when compared with the commercial product which is the control sample. The acceptability of the cocoa-based beverage produced compared well with the commercial sample used for control with exceptional preference in colour than the control sample. The addition of date fruit and soybean improved the acceptability of the product

Ethical Approval

Ethical approval reference number RUGIPO/NUD/2022/100 was obtained for the study from the Ethic committee of the department of Nutrition and Dietetics Rufus Giwa Polytechnic, Owo, Ondo State

Informed Consent

Before the sensory evaluation, each panelist was informed about the objective of the study. Verbal consent from the panelist was obtained after the objective of the study was explained to them

Declaration of Conflict of Interest

The authors alone are responsible for the design, data collection, writing and funding of this research and no declared no conflicts of interest declared

Author's Contribution

Olanrewaju, O.I and Adedayo, E. O, contributed to the design of the study. Yisa, O.O, Ukah, O.H were involved in the purchase and processing of the cocoa-based beverage samples. Olanrewaju, O.I and Adedayo, E. O, were involved in the writing of the final draft and they are responsible for the integrity of the work as a whole. All authors reviewed and edited the draft, and approved the final manuscript

REFERENCES

1. Buijsse, B., Fesken, E.J., Kok, F.J. and Kromout, D. (2012). Cocoa intake, blood pressure, and cardiovascular mortality: the Zutphen Elderly Study. *Archaeology International Medicine*. 166 (4):411-417.
2. Zou, Y., Yang, M., Wang, J., Cui, L., Jiang, Z., Ding, J., Li, M., & Zhou, H. (2020). Association of sclerostin with cardiovascular events and mortality in dialysis patients. *Renal Failure*, *42*(1), 282–288.
3. Zhang, D., Tang, X., Shen, P., Si, Y., Liu, X., Xu, Z., Wu, J., Zhang, J., Lu, P., Lin, H., & Gao, P. (2019). Multimorbidity of cardiometabolic diseases: prevalence and risk for mortality from one million Chinese adults in a longitudinal cohort study. *BMJ Open*, 9(3), e024476. https://doi.org/10.1136/bmjopen-2018-024476
4. Amusa N.A. and Ashaye, O.A. (2009). Effect of Processing on Nutritional, Microbiological and Sensory Properties of Kunun-Zaki (A Sorghum Based Non-Alcoholic Beverage) Widely Consumed in Nigeria. Pakistan Journal of Nutrition, 8: 288-292.
5. Alten, J. A., Klugman, D., Raymond, T. T., Cooper, D. S., Donohue, J. E., Zhang, W., Pasquali, S. K., & Gaies, M. G. (2017). Epidemiology and Outcomes of Cardiac Arrest in Pediatric Cardiac ICUs. Pediatric Critical Care Medicine : A Journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies, 18(10), 935–943
6. Egbuche, O., Biggs, M. L., Ix, J. H., Kizer, J. R., Lyles, M. F., Siscovick, D. S., Djoussé, L., & Mukamal, K. J. (2020). Fatty Acid Binding Protein-4 and Risk of Cardiovascular Disease: The Cardiovascular Health Study. Journal of the American Heart Association, 9(7), e014070. https://doi.org/10.1161/JAHA.119.014070
7. Alghamdi, S. A., Tourkmani, A. M., Alharbi, T. J., Rsheed, A. Bin, & Almadani, W. H. (2021). Prevalence of retinopathy and associated risk factors among high- and low-risk patients with type 2 diabetes mellitus: An observational study. Saudi

Medical Journal, 42(6), 693–697. https://doi.org/10.15537/smj.2021.42.6.20210016

8. Alıcı, G., & Genç, Ö. (2021). Spectrum of cardiovascular diseases at a referral tertiary care hospital in Somalia, Mogadishu: an echocardiographic study. BMC Cardiovascular Disorders, 21(1), 599. https://doi.org/10.1186/s12872-021-02417-4
9. Allan, K. S., Morrison, L. J., Pinter, A., Tu, J. V, & Dorian, P. (2019). Unexpected High Prevalence of Cardiovascular Disease Risk Factors and Psychiatric Disease Among Young People With Sudden Cardiac Arrest. Journal of the American Heart Association, 8(2), e010330. https://doi.org/10.1161/JAHA.118.010330
10. Rathore, T., Singh, R., Kamble, D.B., Upadhyay, A. and Thangalakshmi, S. (2019). Review on finger millet: Processing and value addition. *The Pharmaceutical Innovative Journal*, 8(4):283-291.
11. Adeyeye, E.I., & Ayejuyo, O.O. (2011). Proximate and mineral compositions of nibs and shells of processed ungerminated and germinated cocoa beans flour. *International journal of chemical sciences,* 3(1), 41-50.
12. Food and Agriculture Organization/ STAT. (2012). Crop Production and Trade Data. Food and Agriculture Organization of the United Nation. Available at http://faostat.fao.org (accessed December 21, 2012).
13. Lazarus SA, Hammerstone JF, Schmitz HH (2019). Chocolate contains additional flavonoids not found in tea. *Lancet,* 354(9192): 1825
14. Bolarinwa I.F, Olajide J.O, Oke M.O, Olaniyan S.A and Grace F.O (2016). Production and quality evaluation of complementary food from malted millet, plantain and soybean blends. *International Journal of Scientific and Engineering Research,* 7(5): 663-674
15. Ojinaka, M.C, Ebinyasi, C.S, Ihemeje, A and Okorie, S.U. (2013). Nutritional evaluation of complementary food formulated from blends of soybean flour and ginger modified with cocoyam starch. *Advanced journal of food science and technology* 5(10)1325-1335
16. Al-Hooti, S. Sidhu, J.S, Qabazard, H (2002). Physicochemical characteristics of five date fruit cultivars grown in the United Arab Emirates. *Plant Foods Human. Nutrition*. 50, 101–113.
17. Codex Committee in Contamination in Foods; 2011
18. Gyan-Chand, K., Morya, V., Mishra, H.S., Shakya, S., Raj, B. and Yadav, K.N. (2017) *International Journal of Advanced Ayurveda, Yoga, Unani, Siddha and Homeopathy,* 6(1):447-452.
19. Ikujenlola, V.A. & Fashakin, J.B (2005). The physiochemical properties of complementary diet prepared from vegetable proteins. Journal of food, Agriculture environment; 3 (3 & 4), 20-22.
20. AOAC. Official Methods of Analysis, 19th ed. Association of Official Analysis Chemist, Washington, 2012
21. Ihekoronye, R.I and Ngoddy, P.O. (1985). Integrated food science and technology for the tropics. Macmillan Publishers, London, pp 259-262 ISBN: 0333388836
22. Ding EL, Hutfless SM, Ding X, Girotra S. (2016). Chocolate and prevention of cardiovascular disease: a systematic review. *Nutrition and metabolism* 3: (2) 101–113
23. Rusconi M, Conti A. 2010. Theobroma cacao L., the Food of the Gods: a scientific approach beyond myths and claims. *Pharmacology Research*. 61:5–13
24. Adeyeye, E.I., Akinyeye, R.O., Ogunlade, I., Olaofe, O., & Boluwade, J.O. (2010). Effect of farm and industrial processing on the amino acid profile of cocoa beans. *Food Chemistry*, 118(2010), 357-363.
25. Rodriguez-Campos, J., Escalona-Buendía, H., Contreras-Ramos, S., Orozco-Avila, I., Jaramillo Flores, E. and Lugo-Cervantes ,E. (2012). Effect of fermentation time and

drying temperature on volatile compounds in cocoa. *Food Chemistry,* 132: 277-288.

26. Galli, C. (2012). Cocoa, chocolate and blood lipids. In: Paoletti, R.; Poli, A.; Conti, A.; Visioli, F. eds. Chocolate and health. Milan: Springer-Verlag Italia; pp. 127-36.
27. Liendo R, Padilla FC, Quintanab A. 2017. Characterization of cocoa butter extracted from Criollo cultivars of Theobroma cacao L. *Food Research International*. 30:727–731
28. Olaofe, O., & Sanni, C.O. (2018). Mineral contents of agriculture products. *Food Chemistry*, 30, 73-77.
29. Cooper KA, Donovan JL, Waterhouse AI, Williamson G. 2008. Cocoa and health: a decade of research. *British Journal of Nutrition*. 99:1–11.
30. Adeyeye, E.I., Akinyeye, R.O., Ogunlade, I., Olaofe, O., & Boluwade, J.O. (2018). Effect of farm and industrial processing on the amino acid profile of cocoa beans. *Food Chemistry*, 118(2010), 357-363.
31. Ackar D, Lendıc KV, Valek M, Subaric D, Milicevic B, Babic J, Nedic I. 2013. Cocoa polyphenols: can we consider cocoa and chocolate as potential functional foods? J Chem. 2013:1–7.
32. Badru MA (2005). Mycoflora and Ochratoxins in local cocoa-based beverages in Lagos Nigeria. Msc. Theses, OOU Nigeria
33. Wardlaw GM, Hampl JS. Perspective in Nutrition, 7th ed. McGraw-Hill press, New York, 2007, 1-758.
34. Al-Farsi, M., Alasalvar, C., Morris, A., Baron, M. and Shahidi, F. (2011). Comparison of antioxidant activity, anthocyanins, carotenoids, and phenolics of three native fresh and sundried date (*Phoenix dactylifera* L.) varieties grown in Oman. *Journal of Agriculture and Food Chemistry* 53:7592–99.
35. Ogunledun A (2007). Incidence of microbial contaminant and nutrient composition of selected cocoa-based beverages in Ibadan, Nigeria, PhD Thesis, University of Ibadan
36. Torres-Moreno M, Torrescasana E, Salas-Salvado J, Blanch C. 2015. Nutritional composition and fatty acids profile in cocoa beans and chocolates with different geographical origin and processing conditions. Food Chem. 166:125–132.
37. Jinap S, Wan-Rosli WI, Russly AR, Nordin LM. 2018. Effect of roasting time and temperature on volatile component profiles during nib roasting of cocoa beans (Theobroma cacao). *Journal of Science Food and Agriculture*. 77:441–448.
38. Toniolo C, Nicoletti M, Maggi F, Venditti A. 2014. HPTLC determination of chemical composition variability in raw materials used in botanicals. Nat Prod Res. 28:119–126.
39. Balogun, A.M., & Fetuga, B.L. (2019). Anti-nutritional components in some lesser-known leguminous crop seeds in Nigeria. *Biological Wastes*, 28, 303-308
40. Asiedu J.J. (2019). Processing tropical Crops-a technological approach. Macmillan Education Ltd, London and Basingstoke, pp. 24-42.
41. Mahan, LK. & Escott-Stump, S. (2008). Krause's Food Nutrition Therapy: Nutrition during infancy, 12th ed. Saunders Elsevier pub.2008, pp 199-221.