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Formulation, nutritional, microbial quality and sensory acceptability of instant soup mix from low-grade cashew kernel splits

Olalekan- Adeniran Mujidat Adenike [1,*], Ogundeji Babatunde Ayodeji [2], Adeleke Sunday Akanji [1], Ajewole Abiodun Oluwasola [1], Ogunjobi Moruf Ayinla Kehinde [1], Igbinadolor Richard Osaretin [1], Orimoloye Philo Olotie [1], Adesokan Mutairu Abiola [1] and Jayeola Christiana Olayinka [1]

[1] *Department of Value Addition Research, Cocoa Research Institute of Nigeria, Ibadan. Nigeria.*
[2] *Plant Protection Section, Cocoa Research Institute of Nigeria, Ibadan. Nigeria.*

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Abstract

Ready to cook instant soup mix from broken cashew kernels was formulated as a means of value addition, stored for three months and prepared into soup for sensory evaluation to determine the product acceptability before and after storage. Four instant soup formulations (642, 679, 611 and 698) were made with varying quantities of ingredients while the main raw material (cashew splits) were made constant. The samples were subjected to proximate, minerals, physical properties and microbial analysis using standard methods. Protein content of the samples ranged from 8.77-13.67%, sample 642 had the highest concentration and sample 698 (12.89%). Non-fat extract also ranged from 69.69-75.50 with sample 642 having the least value. Sample 642 recorded the highest metabolizable energy of 466.28kcal/100g and all the physical characteristics analyzed while sample 611 had the lowest concentration of 351.84kcal/100g. It had the highest concentration in Mg, Na, and K while sample 698 was highest in C, Zn, Fe and Mn. Sample 611 was adjudged the best formulation for the freshly prepared soup mix in all the sensory attributes while sample 642 scored better in all the attributes after three months storage. No coliform or fungal growth was noticed in any of the samples all-through the period of storage. Sample 698 show a highly noticeable drop in bacterial population (from 2.0 x 10^3 cfu/g to 1.4 x 10^3 cfu/g) before and after storage, respectively. The recorded microbial populations in the samples fall within acceptable limits for yeast and mould, according to ICMSF standard.

Keywords: Instant Soup mix; Low-Grade Cashew Splits; Formulation; Value Addition; Acceptability.

1. Introduction

Cashew (*Anacardium occidentale* L.) is a nutrient dense crop that comes under the family Anacardiaceae. Cashew is cultivated as an agricultural crop. It was originated in Brazil but now cultivated in all tropical regions. The whole cashew fruit consists of cashew apple, cashew nut and cashew nut shell. Cashew apple is a pseudo fruit, the tip of which the nut is attached. Cashew is mainly cultivated for its nuts. Cashew nut is the primary commercial product, having a kidney-shaped structure that is only 10% of the total weight of the harvested cashew product. Cashew nut production is continuously increasing due to its demand in the market. The production of cashew nuts with shells increased in the last five years [34]. The total world production was 5,535,510 tons in 2020 [11]

According to FAOSTAT, [11], Nigeria is the second world's largest producer of cashew nut. Interestingly, cashew contributes substantially to the Nigerian Gross Domestic Product and foreign exchange earnings. Earnings from cashew nut exports amount to seven to eight per cent of non-oil export earnings in Nigeria [28]. The estimated export value from cashew nuts ranges from US$ 25 to 35 million per annum [2]. Cashew production and processing activities in

* Corresponding author: Olalekan- Adeniran Mujidat Adenike

Nigeria, provide employment and livelihood for smallholder farmers especially women [4], [36]. The demand for value-added cashew products is growing in the global market arena [22]. Cashew provides a livelihood for over 300,000 households and sustains 600,000 jobs across the value chain activities as harvesters, transporters, processors, marketers, and exporters [2].

Seeds are prominent features in the diet of the farmers and agricultural labour force, especially in the developing countries and oilseeds are becoming valuable sources of nutrient for man, especially in countries where the diet is plant based. Ignorance of their food value has resulted in their wastage in terms of economic returns or postharvest loses [9]. Cashew is mainly cultivated for its nuts. The higher amount of nutrients, pleasant taste and various biological properties impart value to nuts. Cashew nut is the primary commercial product, having a kidney-shaped structure that is only 10% of the total weight of the harvested cashew product. The cashew nut kernel is employed as a cocktail delicacy or in the food industry for the manufacture of biscuits, ice creams and chocolates. Its use is also employed in snack foods for mixing with pieces to make a cheaper roasted nut. Most cashews nuts are consumed by middle class people as roasted or deep-fried kernels which have been salted, spiced or coated with something sweet. This is true for the more-valuable whole kernels as well as the less-valuable, difficult to market broken kernels.

There is need to include Cashew-based products in local cuisine, including cashew qualities that do not find export markets used in some types of ethnic cooking, especially Chinese and Indian food. Cashew is a highly nutritious and concentrated form of food, providing a substantial amount of energy. The cashew nut kernel has a pleasant taste and flavor and can be eaten raw, fried and sometimes salted or sweetened with sugar. It also contributes as an important source of invisible fat in the diet, being widely used in a variety of ways. There has been a growing demand for cashew in many temperate countries where the demand is increasing. It is rich and creamy and has a sweet and subtle nutty flavor. It is great for thickening smoothies and as a creamer in coffee [20]. Only a small percentage of locally produced RCN gets processed in Africa itself. Processing consists of two main stages: shelling of the RCN and peeling the cashew kernels [37]. It was also reported by [30], that cashew kernel is a rich source of fat, proteins, calcium, phosphorus, potassium, iron and high linoleic acid.

Shelling cashews is a difficult and sometimes hazardous process due to liquid in the shell (CNSL). The economics of cashew processing depends largely on the proportion of kernels extracted without being broken or damaged. High levels of kernel breakage resulted from the shelling of cashew nuts. Large quantities of this crop are thrown away during processing due to breakage, bruises and physiological deformities which invariably affect the taste. [3] reported that 30% of the nuts are likely to be lost annually in a similar way at the industrial processing level. Machine has been developed by the Indian Post Harvest Technical Centre at Kharagur which has a shelling rate of 70%, with a capacity of 18 kg/h and output of 50% wholes which leaves 50% broken kernels. Also, much larger machines with a capacity up to 200 kg per hour has been introduced to the international market by Vietnam. Breakage and damaged kernels were said to be in the range of 30-35% as reported by CAMBODIA AGRIBUSINESS SERIES, 2010. The broken pieces were used for confectioneries like biscuits and bakery products, and other prepared foods. The broken kernels have different grades like the 'butts', 'splits', 'pieces' 'baby bits' and so on, depending on the size of the piece [19].

Nigeria and other African countries, which grow over 50% of the global cashew are losing out on this booming wealth of opportunities as a result of low-value addition [39]. [25] reported that recent statistics show that only about 20% of cashew produced in Nigeria receives value addition while the rest are exported in their raw form. This unfortunate situation has been reversed as the discarded nuts are now being processed and put to good use in food value addition. Value addition in the agriculture context is the process of enhancing income generation, conservation and enhancement of the nutritional benefits in addition to extending the product's shelf-life [23]. Value addition increases the worth of agricultural produce, stimulates agricultural production, stabilizes the food supply, serve as wealth creation for the farmers. It also ensures adequate intake of nutrients including micronutrients (food fortification) by vulnerable groups like the children, women and the elderly.

Limited value addition is one of the major challenges constraining agricultural development and food security in Nigeria and sub-Saharan Africa as a whole. Nevertheless, there is still a high incentive for more local processors to tap into the booming wealth of opportunities offered by the increasing global demand for value-added cashew products. The capability of cashew processors to profit from value-added cashew products depends largely on its economic viability which is critical to the survival and sustainability of their enterprise. [33] deduced that this could provide the basis for the possible participation of non-participants in cashew value-addition activities and also provides evidence of the long-term sustainability of the business.

Soup is generally prepared by combining ingredients such as vegetables, green leaves, water or other liquid. Usually there are two kinds of soups like thick soup and clear soup [21]. Soup is an important type of food delicacy in the world

enjoyed by both the rich and the poor. In Nigeria, most people eat soup-based foods at least once daily, it has become necessary to exploit the available local food resources, in order to satisfy the need of the increasing population [1]. Instant soup plays an important role in balancing the nutrients required for the people to stay healthy and can become an alternative food for breakfast [35]. In addition to that, they are ready for reconstitution in a short time. The nutritional value of a particular soup type depends on its ingredients which are also determined by the financial strength of the person. Soup is generally made by combining ingredients such as vegetables green leaves with juice, water, or other liquid. Hot soups are additionally characterized by boiling solid ingredients in liquids in a pot until the flavors are extracted, forming a broth. These soups are made with different ingredients alongside nutritionally important indigenous tropical seeds like egusi' (*Citrullus vulgaris*) and groundnut seed (*Arachea hypogea*) among others that are highly cherished and usually used in the preparation of soups in Cross River State [40].

Instant soup can be categorized under Ready to Cook foods which are easy and simple to prepare [32]. Instant soup is a vast group of dried foods, which play a significant role in the nutrition of people as they serve the function of taking care of the present and future needs of the consumers. In the modern world commercially prepared instant soup has replaced homemade soup as preparing a soup is a time-consuming process [27]. Instant soups play an important role in balancing the nutrients required for the people to stay healthy and can become an alternative food for breakfast [24]. Increase in population and accumulation of industries made more people to stay alone after education for employment. Less time is available for them to prepare food. Hence most of them consume foods that requires less preparation time without considering the health benefits.

According to [6] dried soup powders have an advantage of protection from enzymatic and oxidative spoilage and flavor stability at room temperature over long periods of time (6–12 months). In addition, they are ready for reconstitution in a short time for working families, hotels, hospitals, restaurants, and institutional use as well as to military rations. Moreover, they exert light weight for shipping and availability at all time of the year.

This study is therefore aimed at production of instant soup mix from the lowly graded cashew kernel splits for improved nutrition, improved market value through value addition, ease of preparation and time conservation as to mitigate high post-harvest processing loss through breakage.

2. Materials and Methodology

2.1. Raw materials collection

Broken cashew kernels (splits) were sourced from a raw cashew kernel processor in Oke Ogun area of Oyo state Nigeria. All other ingredients like dry chilli pepper, dry crayfish, salt, seasoning cube and locust bean used for soup mix preparation were purchased from Bodija raw food market in Ibadan and stored at room temperature of 27-28^{o}C. The media and chemical reagents used for the nutritional and microbial analysis were of analytical grade and were purchased from approved distributors.

2.2. Preparation of Raw Materials

The broken cashew kernels were sorted and cleaned of any broken testa, then the cashew splits and locust beans were separately grinded into pastes. Dry chilli pepper, dry crayfish were grinded into powder with the aid of a kitchen blender. Onion was oven dried at 60^{o}C for 24hrs then grinded into powder. The prepared samples were packed separately in zip locked plastic bags and placed in the refrigerator until use. For the desired freshness to be maintained, the vegetable was sourced at the point of preparation according to the consumers taste and preference.

2.3. Formulation of Acceptable Recipe of Instant Cashew Soup Mix

The formulation was done following the method of [12] with modifications (Table 1). Ordinary tap water was used as obtained in many homes as against the distilled water. Most of the ingredients differ both in quantity and type as the primary raw material for the soup was constant.

Table 1 Instant Cashew Soup Recipe Formulations (% for weight of ingredients)

Ingredients	642	679	611	698
CKP	65	65	65	65
Water	40	40	40	40
DCP	5.0	2.0	3.0	4.0
Salt	5.0	3.0	2.5	3.5
CP	5.0	5.0	5.0	5.0
Seasoning	1.5	1.5	1.5	1.5
Palm Oil	10	10	10	10
Locust Bean	5.0	3.5	0.0	3.0
Onion Powder	1.0	1.0	1.0	1.0

CKP = Cashew Kernel Paste, DCP = Dry Chlli Pepper, = CP Crayfish Powder,

2.4. Method of Preparation

Fresh vegetable leaves were cleaned and washed before shredding to prevent leaching of nutrients. Meat or fish as desired was washed boiled and kept aside. The soup mix was added to heated palm oil (90^{o}C) and stirred to avoid lumps. The meat or fish stock was added to ordinary water to make up to the required quantity needed was added to the mixture gradually and stirred until a smooth paste was formed. It was allowed to cook for 10 minutes before the shredded green leafy vegetables were added and allowed to steam for another 3 minutes. The soup was ready for consumption. All samples were drawn after 0 day for proximate, minerals, microbial and sensory analysis while at 60 days sensory qualities and microbial analysis were performed. The total plate count was done by using the method of [5].

2.5. Proximate Analysis

The moisture content, total ash, crude protein, crude fat, and crude fibre of samples were determined according to the standard methods of analysis described by the Association of Official Analytical Chemist [7]. The sum of the percentage moisture, ash, crude fat, crude protein, and crude fiber was subtracted from 100 to get the percentage total carbohydrate. Energy value (Kcal/100g) of the instant soup mix was obtained using bomb calorimeter.

2.6. Physical properties

Reconstitution Index (RI), water absorption capacity (WAC), bulk density (BD) determination, rehydration Ratio (RR) and rehydration index (RI) were all determined according to method described by [29]. The method as described by [38] was used in the determination of the swelling index. Peroxide value was determined by method described by [14].

2.7. Analysis of Mineral Elements Composition

Mineral elements composition of the formulated soup mixes was determined by the method described by [7].

- **Dry Ashing Method**: 2g of dry sample was weighed into a porcelain crucible and ashed at 550^{o}C for 3hrs. The crucibles were allowed to cool and the ash was dissolved with 100ml of 3N HCl. It was stored in a plastic bottle with a plastic cap and taken to AAS for readings.
- **Spectrophotometric Determination:** In the Atomic Absorption Spectrophotometer (AAS), corresponding lamps were placed for corresponding mineral or heavy metal and the wavelength was set for the specific metal to be determined. AAS siphoning hose was put into the digested sample after running the standards for the metal determined. The concentration of the metal in the solution was displayed on the screen of the AAS machine. (AAS Used: Bulk Scientific; Model: 2010)

2.8. Microbiological Analysis of Instant Cashew Soup Mix

One gram of each soup mix sample was weighed into 9 ml of already prepared Maximum Recovery Diluent, and then serially diluted up to 10^{-6}. The total viable count and the yeast/mould count were carried out using pour plate technique according to the ISO 4833-1:2013 standard [17]. The enumeration of yeast and molds was done according to the ISO

16212:2017 standard [16]. After incubation in each case, the numbers of visible colonies were multiplied by the reciprocal of the dilution factor and the counts were expressed as colony forming unit per gram (cfu/g) and spore forming unit per gram (sfu/g). All these analyses were conducted in triplicate.

2.9. Sensory Evaluation

The sensory appreciation of the different instant soup formulations was carried out immediately after the preparation. Sensory analysis was carried out using 9-point Hedonic scale as described by [18] with 1 representing the least score (dislike extremely) and 9 the highest score (like extremely). The samples were evaluated by ten (10) semi-trained panelists who are frequent soup eaters. They were made to taste the samples individually and provide their responses on the questioner provided. Attributes examined includes appearance, colour, aroma, taste, and overall acceptability There was provision of water to rinse their mouth after tasting each sample to avoid interference of the attributes from sample to sample. Section for comment was provided on the questioner to indicate any sample that needed any improvements for better organoleptic acceptability.

2.10. Statistical Analysis

The experimental data obtained from sensory evaluations were subjected to analysis of variance using statistical software SAS (2009,) while the means were separated using Duncan Multiple Range Test (DMRT) at the degree of confidence of 0.05%.

3. Results and Discussion

Results of proximate analysis for the formulated soup mix samples is presented in Table 2. The range of proteins for all the samples falls between 8.77-13.67 with sample 642 having the highest and 611 with the least values. These values are higher than the reported values by [22] where the percentage protein content recorded in the soup mix formulations were 3.06-8.53%. [6] reported values that are comparable with the protein values obtained in this study having the range of 13.48-13.67. Being a dry mix, the moisture content obtained from the study is in the range of across all the formulations of 5.71-9.18 which is within the safe range that can keep the product stable for a long time without spoilage. Similar results were reported by [12], [6] and [22] with the valuesof 8.96±0.84% and 8.41- 9.55% and 9.32% respectively.

Fat content of cashew soup mix also compares well with the result of the previous authors except forlower fat content reported by [6]. The crude fibre of the soup mix was 0.43-0.82. This value is within the range of 0.26 – 0.98% reported for instant I. gabonensis mix by [9]. The values of carbohydrates present in the soup mix are in line with the results of [40] who reported that formulated groundnut soup mix contains 68.9 ± 0.27% and 71.3 ± 0.23% carbohydrate. There are also differences in the values of ash. All these disparities could be attributable to the different proportions of ingredients used for the different soup mix types. Also, processing methods enployed, and type of proteins used in the preparation of the soup mix.

Table 2 Proximate Composition of the Formulated Cashew Soup Mix

Sample ID	% MC	% CP	%CFat	% CF	%T Ash	DM	%NFE	Energy kcal/100g
642	5.71	13.67	7.58	0.82	2.53	94.29	69.69	466.28
679	8.35	9.68	5.69	0.51	1.95	91.65	73.82	359.78
611	9.18	8.77	5.24	0.43	1.88	90.82	74.5	351.84
698	5.76	12.89	7.16	0.75	2.37	94.24	71.07	461.87

MC-Moisture content, CP- Crude Protein, CFat- Crude Fat, CF- Crude Fibre, T Ash- Total Ash, DM- Dry Matter, NFE- Non Fat Extract

The calorie values obtained for the samples in this study are higher than those reported by [22] and [26] (322.2-336.12 kcal/100g and 333.42 kcal/100g). However, the result of the energy values was in similar range with those of [10] and [27] (3.50.0 and 351.32kcal/100g).

Table 3 represents the composition of mineral elements present in the formulated instant soup mixes. The formulations contain highest amount of Sodium in the range of 1539.0-2025.0 mg/100g and the least minerals concentration was found in Manganese having the range of 1.20- 1.43mg/100g. Amongst all the samples, sample 642 had the highest values for magnesium, sodium and Potassium while sample 698 had the highest content for calcium, zinc, iron and manganese.

Copper was highest in sample 679 with concentration of 2.18mg/kg compared to the three remaining samples. Sample 642 contain the least concentration for zinc with a value of 3.67mg/kg. All these values differ from the value for minerals constituents of raw cashew kernel as reported by [31]. [31] reported that Fe, Zn, Na, K, Mg, and Ca constituents found in raw cashew kernel of Vietnam origin are 6.1, 4.9, 8.3, 660.0, 240.0 and 38.0 respectively. Higher values obtained in this study could easily be attributed to the incorporation local ingredients required for soup preparation. This has enhanced the nutritional status of the instant soup mix. Recommended Daily Amount (RDA) of iron is 8 mg/day for adult male and 18 mg/day for female [13]. The soup will also contribute well with other foods to increase the concentration of iron and other minerals to meet the recommended daily intake (RDI) for both males and females. Also, the inclusion of vegetables during the preparation of the soup will increase the concentration of the mineral.

Table 3 Mineral Composition of Cashew Soup Mix Samples

Sample	**Ca**	**Mg**	**Zn**	**Fe**	**Cu**	**Mn**	**Na**	**K**
ID				mg/kg				
642	11.25	90.45	3.67	8.85	2.13	1.35	2025.00	705.50
679	10.35	90.00	3.77	8.38	2.18	1.30	1377.00	622.50
611	10.10	90.50	3.72	8.95	2.09	1.20	1134.00	498.00
698	12.30	90.10	3.81	9.03	2.15	1.43	1539.00	498.10

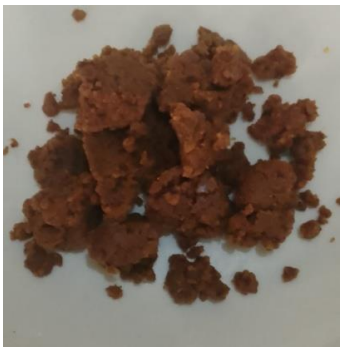
Reconstitution index (RI) is a measure of how a dehydrated food product can reabsorb water and regaina its original texture, consistency and appearance. The soup mix samples experienced a high RI with sample 642 having the highest value of 77.8% and the lowest value of 67.1%. The results also followed the same sequence for both rehydration ratio and the swelling index all having the highest and the lowest vaues as samples 642 and 611 respectively.

Physical properties of the soup mix samples are shown in Table 4. Water absorbtion capacity of the samples is the ability of the samples to absorb and retain water. It ranged from 103.6ml/100g to 126.8ml/100g and the highest was in sample 642 and it reduces in the order of 642>698>611>679 with values of 126.8>121.5>107.1>103.6ml/100g. These values are lower than the results reported by [6] on formulated instant soup mix from moringa oliefera pod powder which has the range of 270 to 290 ml/100g. Bulk density indicates how tightly packed the particles of the soup mixes were. All the samples are in the same range with the values 0.51, 0.50, 0.50 and 0.51 and follow the same order as water absorbtion capacity. However, the values obtained in this study is lower than those reported by [6]. Peroxide values is an indicator of rancidity and lipid oxidation in foods cantaining fats and oil. The peroxide value of the formulated soup mixes obtained in the study are 5.3, 6.1, 8.4 and 9.2meq/kg for samples 642, 698, 611 and 679 respectively. These values fall in line with the acceptable PV for dried foods which is 5-20mEq/kg. It was observed that the higher the water absorption capacity of the samples the lower the peroxide value.

Table 4 Physical Properties of the Formulated Soup Mixes

Sample	**WAC**	**BD**	**PV**	**RI**	**RR**	**SI**
ID	ml/100g	g/ml	meq/kg	(%)	g/g	ml/g
642	126.8	0.513	5.3	77.8	5.8	9.4
679	103.6	0.497	8.4	68.2	4.2	6.5
611	107.1	0.495	9.2	67.1	3.7	5.8
698	121.5	0.512	6.1	76.4	5.3	8.7

WAC = Water Absorption Capacity; BD = Bulk Density; PV = Peroxide Value; RI = Reconstitution Index (%); RR = Rehydration Ratio; SI = Swelling Index

	
Sample dry paste 698	**Sample 698 soup**
	
Sample dry paste 679	**Sample 679 soup**
	
Sample dry paste 611	**Sample 611 soup**
	
Sample dry paste 642	**Sample 642 soup**

Sample 698= (3.5% salt+3%locust beans+2%dry pepper+other ingredients constant); Sample 679= (3%salt+3.5%locust beans+3% dry pepper+other ingredients constant); Sample 611= (2.5%salt+0%locust beans+3%dry pepper+other ingredients constant); Sample 642= (3% salt+ 5% locust beans+5% dry pepper+other ingredients constant)

Figure 1 Cashew kernel soup prepared from different dry soup mix formulations

Table 5 shows the populations of bacteria, coliforms and fungi isolated from the soup mix samples. Noticeable increase was observed in the populations of bacteria found in each of the formulated soup mix samples evaluated, except for Sample 698 which depicted a highly noticeable drop in bacterial population (from 2.0 x 10^3 cfu/g to 1.4 x 10^3 cfu/g)

before and after storage, respectively. No coliform or fungal growth was noticed in any of the samples all-through the period of storage, but with the slight exception of Sample 679 which had a 1.2 x 10^2 sfu/g fungal population only at the end of the 90-day storage (Table 6). Findings on the microbial populations of the soup mix samples used in this study agrees with the stipulations of the International Commission on Microbiological Speccifications (ICMSF) that the total bacterial and fungal (yeast/mould) populations for general foods should not be more than 1.0 x 10^5 cfu/g and 1.0 x 10^2 sfu/g, respectively [15]. The recorded microbial populations therefore fall within acceptable limits for yeast and mould, according to ICMSF standard.

The exclusively significant reduction in the total bacterial population in soup-mix 698 after 90-day storage suggests the possible presence of antibacterial agent(s) in the sample.

Table 5 Microbial Analysis of Fresh and Stored Soup Mixes

Samples	**Bacterial population (cfu/g)**		**Coliform population (cfu/g)**		**Fungal population (sfu/g)**	
	Day 0	Day 90	Day 0	Day 90	Day 0	Day 90
642	1.8 x 10^3	2.1 x 10^3	Nil	Nil	Nil	Nil
679	1.0 x 10^3	1.4 x 10^3	Nil	Nil	Nil	1.2 x 10^2
611	1.5 x 10^3	1.6 x 10^3	Nil	Nil	Nil	Nil
698	2.0 x 10^3	1.4 x 10^3	Nil	Nil	Nil	Nil

Cfu/g=colony forming units per gram; sfu/g= spore forming units per gram

Sensory evaluation test of the freshly prepared soup formulations was done by 10-man panelists to determine the sample that is most acceptable. Table 6a shows the average results of hedonic sensory evaluation of the formulated cashew soup mixes, considering the effect of the quantity of additives used. The average means of the attributes tested for all the samples are: appearance has the value of 6.82, 6.48 for colour, 6.58 for taste, aroma recorded the value of 6.45 while the overall acceptability is 6.73. The samples were not significantly different from each other in all the attributes tested.

However, significant difference exists at (p≥0.05%) among samples 642 and the remaining three samples while there is no significant difference between samples 611 and 698 in appearance, 642 and 698 in colour. For the attributes of taste, aroma and overall acceptability, no significant difference exists at (p≥0.05) for all the samples. Although, all the samples were highly rated but sample 611 was rated highest in all the sensory attributes tested including the overall acceptability. Table 6b represents the response of the panellists for the sensory appreciation of the formulated cashew soup mix after three months storage. The average mean values for appearance (6.73), colour (6.72), taste (6.95), aroma (6.75) and overall acceptability (7.28) were slightly higher than the values obtained for the freshly formulated samples most especially the overall acceptability. Even though all the attributes tested were highly rated and acceptable after three months storage,

Table 6a Mean Sensory Evaluation of Freshly Prepared Instant Cashew Soup Mix

Attributes	642	679	611	698
Appearance	6.55 ± 0.88^{ba}	6.48 ± 1.49^{ab}	7.80 ± 1.49^{a}	6.45 ± 1.96^{b}
Colour	6.40 ± 1.17^{ba}	5.50 ± 1.65^{c}	7.50 ± 1.35^{a}	6.50 ± 1.84^{ba}
Taste	6.60 ± 1.17^{a}	6.50 ± 1.52^{a}	7.30 ± 1.05^{a}	5.90 ± 1.77^{b}
Aroma	6.40 ± 1.17^{a}	6.10 ± 1.52^{a}	7.00 ± 1.05^{a}	6.30 ± 1.77^{a}
Overall Acceptability	6.70 ± 0.68^{a}	6.40 ± 1.35^{a}	7.4 ± 1.51^{a}	6.40 ± 1.84^{a}

Means with the same superscripts are not significantly different at p≤ 0.05 degree of difference

sample 642 had the highest ratings and was adjudged the best sample with the value of 8.0 out of 9.0 from the hedonic scale. This result can be attributable to the probability that as the soup mix ages, the different flavour components of the ingredients used meld together creating a more balanced and harmonious taste experience.

Also, aroma maturation may develop during storage thus, contributing to a more appealing aroma and enzymes present in the soup mix may have modify certain compounds which may have resulted in changes in aroma, taste and the overall acceptability of the stored products.

Table 6b Mean Sensory Evaluation of Stored Instant Cashew Soup Mix

Attributes	642	679	611	698
Appearance	8.00±1.00 [a]	6.00±1.66[b]	6.22±1.56[b]	6.70±0.87[b]
Colour	8.44±0.53 [a]	5.67±1.73 [b]	6.00±1.41 [b]	6.78±0.67[b]
Taste	8.11±1.05 [a]	6.33±1.50 [b]	6.22±1.56 [b]	7.00±0.87[ba]
Aroma	7.33±0.87 [a]	6.56±1.42 [a]	6.44±0.88[a]	6.67±1.12[a]
Overall Acceptability	8.00±1.00 [a]	6.78±1.39 [a]	7.00±1.41[a]	7.33±0.87[a]

Means with the same superscripts are not significantly different at p≤ 0.05 degree of difference

Based on the results of the sensory evaluation data obtained for the soup mixes by the consumers, sample 642 was adjudged the best formulation, Also, considering the results of the chemical analysis, physical properties, minerals composition and microbiological evaluation conducted, sample 642 performed better in most of the parameters tested, thus this sample was chosen as the acceptable formulation.

Table 7 Acceptable recipe for the Cashew Kernel Instant Soup Mix

Ingredients	642
CKP	49.12
Water	28.07
DCP	3.51
Salt	3.51
GCP	3.51
Seasoning	1.05
Palm Oil	7.02
Locust Bean	3.51
Onion Powder	0.70
Total	100

4. Conclusion

From the study, it can be concluded that highly nutritious, convenient and shelf stable instant soup mix can be prepared from low priced broken cashew kernel. This can play a significant role in enhancing dietary diversity in developing countries by providing convenient, nutritious, and culturally adaptable food options. This is a novel study as it added more value to the crop which does not only enhances food security but also utilizes local agricultural resources effectively. The instant soup mix was stable at ambient temperature for a period of 90 days without any deterioration in its quality and acceptability. The ingredients used in the formulation were sourced from the open market which accounts for the total viable count found on the mixes even though processing had minimized the load coupled with the low moisture content of the soup mix. This made it shelf stable and suitable for consumption.

Compliance with ethical standards

Disclosure of conflict of interest

No competing interest to be disclosed.

References

[1] Aburime, L. C., Eno-Obong, N. H., & David-Oku, E. (2020). Effect of citric acid treatment and fermentation on the chemical composition of African yam bean (*Sphenostylis stenocarpa*) and sensory evaluation of its gruel. *European Journal of Nutrition & Food Safety*, 51–65.

[2] Adeigbe, O. O., Adewale, B. D., Muyiwa, A. A., Olasupo, F. O., Olaniyi, O. O., Adenuga, O. O., Williams, O. A., & Aliyu, O. M. (2016). Quantitative descriptors of cashew nut categories in Nigeria: Providing indices for superior nut selection. *ARPN Journal of Agricultural and Biological Science, 11*(4).

[3] Akande, T. O., & Gbadamosi, F. A. (2018). Feeding value of defatted cashew kernel as an alternative protein source in broiler diets. *Nigerian Journal of Animal Production, 45*(5), 39–45.

[4] Akinwale, T. O. (2000). Cashew apple juice: Its use in fortifying the nutritional quality of some tropical fruits. *European Food Research and Technology, 211*(3), 205–207.

[5] Aneja, K. R. (2003). *Experiments in microbiology, plant pathology and biotechnology* (4th ed.). New Age International.

[6] Ansari, F., Singh, A., Patidar, S., & Rana, G. K. (2022). Production and evaluation of immunity boosting instant soup mix from *Moringa oleifera* Lam. pod powder. *Bangladesh Journal of Botany, 51*(1), 75–81.

[7] Association of Official Analytical Chemists. (2010). *Official methods of analysis* (18th ed.). AOAC.

[8] Bamidele, O. P., Ojedokun, O. S., & Fasogbon, B. M. (2015). Physico-chemical properties of instant ogbono (*Irvingia gabonensis*) mix powder. *Food Science & Nutrition, 3*(4), 313–318.

[9] Bamidele, O. P., Ogundele, F. G., Ojubanire, B. A., Fasogbon, M. B., & Bello, O. W. (2014). Nutritional composition of gari analog produced from cassava (*Manihot esculenta*) and cocoyam (*Colocasia esculenta*) tuber. *Food Science & Nutrition, 2*(6), 706–711.

[10] Ejueyitsi, O. E., George, B. O., Anigboro, A. A., & Okpoghono, J. (2022). Assessment of frequency and consumption pattern of some indigenous soups in Delta State. *Tropical Journal of Natural Product Research, 6*(4).

[11] Food and Agriculture Organization of the United Nations. (2022). *FAOSTAT statistical database*. https://www.fao.org/faostat/

[12] Fasogbon, B. M., Taiwo, K. A., & Adeniran, H. A. (2017). Sensory profiling of ogbono soup mix and its nutritional characterisation. *Journal of Applied Research on Children, 8*(2).

[13] Food and Nutrition Board. (2001). *Dietary reference intakes for vitamin A, vitamin K, arsenic, boron, molybdenum, nickel, silicon, vanadium, and zinc*. National Academy Press.

[14] Habib, M. A., Hammam, M. A., Sakr, A. A., & Ashoush, Y. A. (1986). Chemical evaluation of Egyptian citrus seeds as potential sources of vegetable oils. *Journal of the American Oil Chemists' Society, 63*(9), 1192–1196.

[15] International Commission on Microbiological Specifications for Foods. (2020). *Microorganisms in foods 2: Sampling for microbiological analysis; principles and specific applications* (2nd ed.). University of Toronto Press.

[16] International Organization for Standardization. (2008). *Microbiology of food and animal feeding stuffs—Horizontal method for the enumeration of yeasts and moulds* (ISO Standard No. 21527-2:2008).

[17] International Organization for Standardization. (2013). *Microbiology of the food chain—Horizontal method for the enumeration of microorganisms—Part 1: Colony count at 30°C by the pour plate technique* (ISO Standard No. 4833-1:2013).

[18] Iwe, M. O. (2002). Proximate, physical and sensory properties of soy-sweet potato flour cookie. *Global Journal of Pure and Applied Sciences, 8*(2), 187–192.

[19] Jaeger, P. (1999). The Market for Cashew Nuts and its Relevance to African Production. USAID / STCP. CASHEW MARKET.

[20] Jayeola, C. O., Adebowale, B. A., Yahaya, L. E., Ogunwolu, S. O., & Olubamiwa, O. (2018). Production of bioactive compounds from waste. In *Therapeutic, probiotic, and unconventional foods* (pp. 317–340). Academic Press.

[21] Jefrin, R., & Rodchua, S. (2022). *Application of robotics in manufacturing industry*. Seminar in Industrial Management.

[22] Jeyavishnu, K., Thulasidharan, D., Shereen, M. F., & Arumugam, A. (2021). Increased revenue with high value-added products from cashew apple (Anacardium occidentale L.) addressing global challenges. *Food and Bioprocess Technology*, *14*(6), 985-1012.

[23] Karthika Devi, B., Kuriakose, S. P., Krishnan, A. V. C., Choudhary, P., & Rawson, A. (2016). Utilization of by-product from tomato processing industry for the development of new product. *Journal of Food Processing & Technology, 7*(8), 608.

[24] Lawal, J. O., & Jaiyeola, C. O. (2007). Economic analysis of cocoa wine produced from cocoa powder. *Journal of Agriculture, Food and Environment, 5*(2), 76–77.

[25] Mathangi, S. S., Geethanjali, S. S., & Visalachi, V. (2017). Development and formulation of instant soup mix from sprouted horse gram and radish leaves. *International Journal of Home Science, 3*(1), 346–349.

[26] Muktar, F. (2021, May 25). Nigeria's cashew sector challenges remain despite new facilities. *Premium Times*.

[27] Nishanthan, G., Wickramasinghe, I., Navaratne, S. B., & Dissanayake, D. C. T. (2021). Ready-to-prepare soup mix enriched with sea cucumbers: Production, sensory attributes and nutritional composition. *Journal of Food Science and Technology, 58*(6), 2078–2088.

[28] Niththiya, N., Vasantharuba, S., Subajini, M., & Srivijeindran, S. (2017). Formulation of instant soup mix powder using uncooked palmyrah (*Borassus flabellifer*) tuber flour and locally available vegetables. *Journal of Applied and Natural Science, 9*(3), 1815–1820.

[29] Nugawela, P. A., & Oroch, R. (2005). *Cashew sub-sector strategic framework*. Department for International Development (UK)-Nigeria.

[30] Onwuka, G. I. (2005). *Food analysis and instrumentation: Theory and practice* (pp. 133–137). Naphtali Prints.

[31] Owiredu, I., Laryea, D., & Barimah, J. (2014). Evaluation of cashew nut flour in the production of biscuit. *Nutrition & Food Science, 44*(3), 204–211.

[32] Rico, R., Bulló, M., & Salas-Salvadó, J. (2016). Nutritional composition of raw fresh cashew (*Anacardium occidentale* L.) kernels from different origin. *Food Science & Nutrition, 4*(2), 329–338.

[33] Sarkar, B., Upadhyay, S., Gogoi, P., Das, A., Hazarika, M., Rahman, Z., & Datta, A. (2019). Development and quality evaluation of instant soup mix incorporated with spent hen meat shred. *Journal of Entomology and Zoology Studies, 7*(2), 24–30.

[34] Spicka, J., Hlavsa, T., Soukupova, K., & Stolbova, M. (2019). Approaches to estimation the farm-level economic viability and sustainability in agriculture: A literature review. *Agricultural Economics, 65*(6).

[35] Sruthi, P., & Naidu, M. M. (2023). Cashew nut (*Anacardium occidentale* L.) testa as a potential source of bioactive compounds: A review on its functional properties and valorization. *Food Chemistry Advances, 3*, 100390.

[36] Sudarsan, S. M., Santhanam, S. G., & Visalachi, V. (2017). Development and formulation of instant soup mix from sprouted horse gram and radish leaves. *International Journal of Home Science, 3*, 346–349.

[37] Topper, C. P., Calidari, P. D. S., Camara, M., Diaora, S., Djaha, A., Coulibay, F., Asante, A. K., Boamah, A., Ayodele, E. A., & Adebola, P. O. (2001). *West African regional cashew survey covering Guinea, Guinea Bissau, Cote d'Ivoire, Ghana and Nigeria* (STCP Report No. BHA-01109). Biohybrids Agrisystem Ltd.

[38] Ton, P., Hinnou, L. C., Yao, D., & Adingra, A. (2018). *Cashew nut processing in West Africa: Value chain analysis, Benin and Côte d'Ivoire*. CBI Ministry of Foreign Affairs.

[39] Ukpabi, U. J., & Ndimele, C. (1990). Evaluation of the quality of gari produced in Imo State. *Nigerian Food Journal, 8*, 105–110.

[40] United Nations Conference on Trade and Development. (2021). *Commodities at a glance: Special issue on cashew nuts*. https://unctad.org/system/files/officialdocument/ditccom2020d1_en.pdf

[41] Winifred, S. B. L. A., Ako, F., & Odey, R. (2020). *Impact of indigenous methods of preparation and cooking on the proximate, mineral, vitamins, amino and fatty acids compositions of groundnut soups prepared in Cross River State, Nigeria*.