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Development of Functional Weanimix Using Sweet Potatoes Fortified with Carrots

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Functional weanimix was developed using sweet potatoes, soyabean and carrot.to see the best formulation and nutritional content. The consumer acceptability and the proximate composition of the product were determined. The product was prepared into porridge using three different formulations PSC100(sweet potato flour 60%, soya beans flour 30%, carrot flour 10%), PSC200(sweet potato flour 50%, soya beans flour 30%, carrot flour 20%) and PSC300(sweet potato flour 40%, soya beans flour 40%, carrot flour 20%). Thirty panellist assessed the products using the appearance, aroma, taste, mouthfeel, aftertaste, overall acceptability using point hedonic scale. Results of the study revealed that the PSC 300 was preferred in terms of appearance (4.37), aroma (4.33), after-taste (4.20), and general acceptability (4.53). PSC 100 competed fairly with PSC

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300 with ratings of 4.3 (appearance), 4.13 (aroma), 4.0 (after taste), and 4.23 in general acceptability. PSC 300 was the most preferred formulation. The level of nutrients (ash-1.66%, fat-17.64%, fibre-6.86%, protein -18.32%, and carbohydrate- 52.91%) in the most preferred formulation (PSC 300) met the FAO standards and that of the Codex Alimentarius Commission Guidelines for complementary foods for infants and young children.

Keywords: Weanimix; sweet potatoes; functional food; malnutrition; Vitamin A.

1. INTRODUCTION

Nutritional deficiencies have been connected to the generational transfer of poverty in low-income countries. These deficiencies ultimately lead to a halt in growth and/or mortality, preventing individuals from realizing their full potential as adults [1,2]. Chronic micronutrient deficiencies, such as those caused by a lack of vitamin A, zinc, or iron in young children, can impair cognitive development and raise a child's risk of infections, stunted growth, or blindness with vitamin A deficiency shown to have the highest illness loads [3]. Due to their high phytate content and lack of pro-vitamin A/beta-carotene content, cereal-legume combinations frequently used as supplemental diets in low-income countries contributes to nutritional inadequacies [4]. Because human intestinal phytase activity is modest, phytate can form insoluble complexes with various micronutrients. These complexes can only partially hydrolyze to liberate the bound minerals [5].

It has been suggested that one way to combat childhood malnutrition in underdeveloped nations is to improve the food of newborns [6]. As awareness in the role that food plays in promoting health and well-being as well as preventing disease has grown, the concept of "functional foods" has emerged. Regular or everyday meals that are included in a person's regular diet are known as functional foods [7]. Functional foods when ingested consistently at effective amounts offer health benefits that go beyond simple nourishment [8]. Today's consumers want foods that are safe, fresh, natural, and high in nutrients, as well as those that are processed and produced responsibly [9].

The absence of nutrient-dense supplemental meals is one of the main causes of malnutrition in Ghanaian babies and children, which is why the Ministry of Health in Ghana developed weanimix with assistance from UNICEF [10].

Weanimix is a flour product made from a blend of one part legume (such as groundnuts and cowpeas) and four parts cereal (such as rice, millet, and maize) [10]. In Ghana, cereals are a major constituent of weanimix with little attention given to root tubers such as sweet potatoes. It has been determined that sweet potatoes, when used as a supplemental food, are a feasible product for improving the crop's usage as well as meeting the nutritional needs of newborns in underdeveloped nations [11]. As sources of carbohydrates, starchy root and tuber crops are only second in significance to cereals and they contribute significantly to the global food [12].

The existence of bioactive chemicals in root vegetables has drawn attention to an increasing number of them. Root vegetables such as carrots are high in dietary fiber, vitamins, minerals, and β-carotene is a precursor to vitamin A and can thus help prevent vitamin A deficiency [11,13,14]. The most prevalent deficiencies are those in iron, zinc, and vitamin A, which have detrimental consequences on growth and development [15]. Therefore the creation of a fresh strain of weanimix that is high in macro- and micronutrients to aid in the fight against undernutrition in young children is essential. Hence, this study sought to develop functional weanimix using sweet potatoes fortified with carrots.

2. MATERIALS AND METHODS

2.1 Sources of Raw Materials

The white Bonita variety of Sweet potato was purchased from Agormanya Market in the Eastern Region of Ghana. The soybean were purchased from Somanya market in Eastern Region of Ghana. The carrot was also purchased from Bantama market in the Asante Region of Ghana

2.2 Flours

2.2.1 Preparation of sweet potato flour

The sweet potatoes were sorted by selecting the good ones from the unwanted ones. Sweet potatoes weighing 5.2 kg were washed, peeled, washed, sliced into 3mm thicknesses, and soaked in lemon solution for 5 minutes to prevent discoloration.

Sweet potatoes was then dried with a clean cloth and arranged in a dehydrator tray to dry at 125F/52°C for 11 hours. The sweet potatoes were arranged in a baking sheet, while the oven was pre-heated to a temperature of 100℃ for the baking of sweet potatoes, Sweet potatoes slices were put in the oven for 40 minutes to get the product very dry. The dried sweet potatoes were ground to fine powder using (model SC-1589 Silver Crest) blender sieved with a 0.150 μ sieve and packaged in an air airtight zip lock bag for further use.

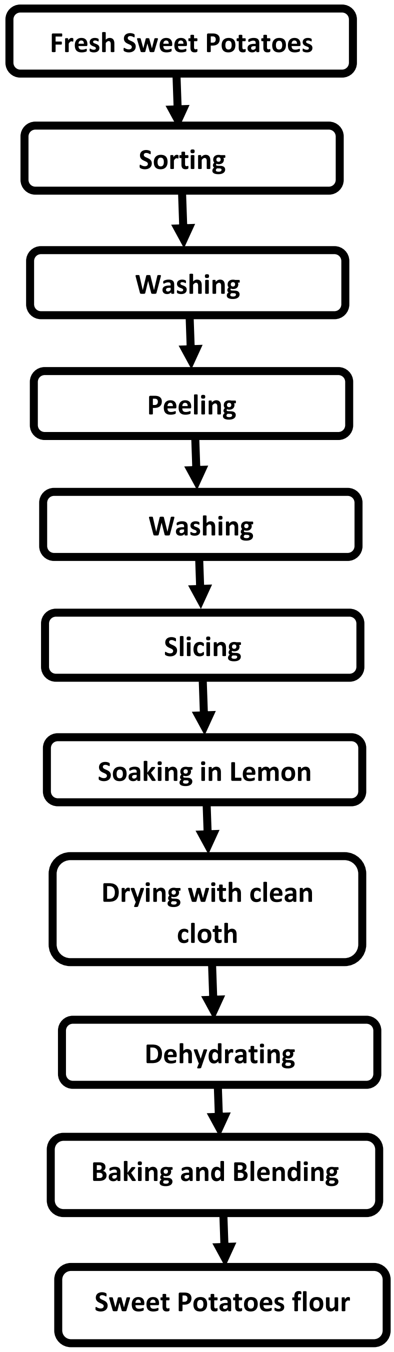

Fig. 1. Process flow diagram for Sweet Potatoes flour

2.2.2 Preparation of carrot flour

The carrot powder was made using the procedure outlined by Phebean [16]. The carrot fruits were cut into 56mm length and 2mm thickness after being cleaned in portable water, peeled, and sliced. The sliced carrots were blanched for 3 minutes in hot water containing sodium metabisulphite to prevent browning and discoloration. The purpose of dehydrating carrots, according to Gamboa-Santos[17], was to increase their shelf life for distribution and storage. Carrots are typically blanched in boiling water or steam before going through these procedures to eliminate air, stabilize colour, hydrolyze and solubilize protopectin, and inactivate enzymes and microbes. The sliced and blanched carrot were then Place on dehydrator tray to dry at 125F/52°C for 6-10 hours. When the carrot were dried few pieces were then picked to test from different trays, it was then allowed to cool for about five minutes, carrots become dry when their surfaces are leathery, and they break easily. The dried fruit was ground to fine powder (model SC-1589 Silver Crest) blender and sieved with a 0.150 µ sieve and was packaged in an air airtight transparent container for further uses.

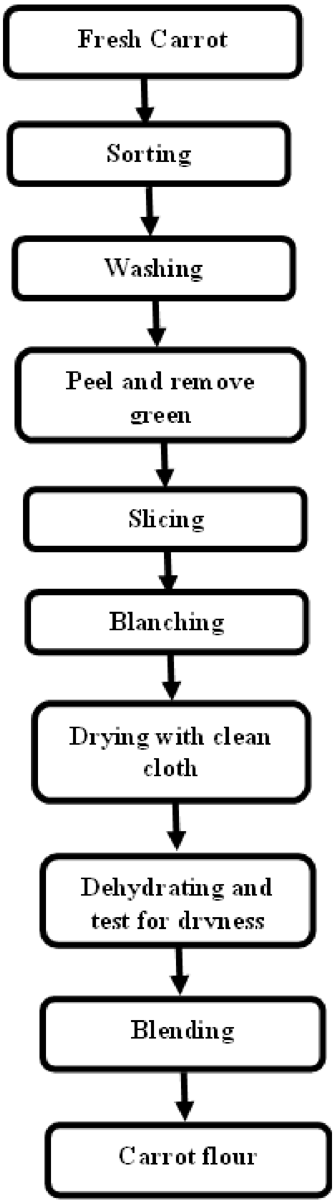

Fig. 2. Process flow diagram for carrot flour

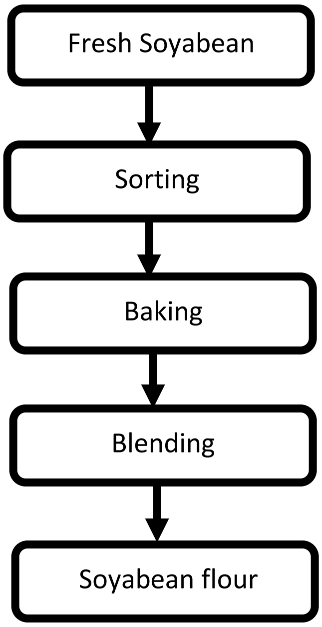

Fig. 3. Process flow diagram for soya bean flour

2.2.3 Preparation of Soya beans flour

Fresh soya beans were sorted to remove the unwanted ones. Soya bean weighing 2 Kg were put into a baking sheet, and transferred into a pre-heated oven (100℃ for 10minute) for the baking. The soya beans were baked at a temperature of 200℃ for 20 minutes. The baked product was allowed to cool and blended into fine powder (model SC-1589 Silver Crest). It was then sieved with a 0.150 µ sieve, and packaged in airtight containers for storage.

2.3 Preparation of Composited Mixture

Using the recipe listed in Table 1, 750ml of water were combined with sweet potatoes, soy beans, and carrot flour to create a puree that was used to prepare composite sample combinations for porridge. Product A (PSC 100) was prepared by using 60% (60g) sweet potatoes flour, 30%(30g) soya beans flour, 10%(10g) carrot flour, and some ingredients such as salt and sugar was added to enrich it. Product B (PSC 200) was prepared by using 50%(50g) sweet potatoes flour, 30%(30g) soya beans flour, 20%(20g) carrot flour, and some ingredients such as salt and sugar was added to enrich it. The last sample product C (PSC 300) was prepared by using 40%(40g) sweet potato flour, 40%(40g) soya beans, 20%(20g)carrot flour, and some ingredients such as salt and sugar was added to enrich it. It was prepared by using boiling method at 100℃ for 10 minutes.

2.4 Porridge Making Procedure

About 334g of flour (sweet potatoes, soya beans, and carrot), salt and 300ml water was mixed together by stirring with a wooden spoon. About 450ml of water was poured into a saucepan, placed on fire to heat for about 5 minutes. The mixed puree was then poured in the heated water and immediately stirred by moving the wooden spoon to one direction until it became thick and add sugar. The porridge was left to boil at 100℃ for 5minutes on fire. It was later taken from the fire and poured into a flask to maintain its hot temperature. Porridge were packed in a disposable cup and labeled according to formulations with codes prior to sensory evaluation.

2.5 Sensory Evaluation

Open and close-ended questionnaires concerning ‘functional weanimix’ using root tuber fortified with carrot’ was carried out in the Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development – Kumasi Campus in the Ashanti Region of Ghana. The three samples obtained from the different fractions of the flour (sweet potatoes, soya beans, and carrot) mixed and made into porridge were subjected to sensory evaluation.

Table 1. Flour of Sweet potato, Carrot, Soya beans for Porridge Production and some added Ingredients

Product Samples	Water (ml)	Sweet Potato Flour (%)	Soya beans Flour (%)	Carrot Flour (%)	Salt (g)	Sugar (g)
PSC 100	**750**	**60**	**30**	**10**	**2**	10
PSC 200	**750**	**50**	**30**	**20**	**2**	10
PSC 300	**750**	**40**	**40**	**20**	**2**	10

The various flour blends from sweet potato, carrot, and soya beans was done as shown in.

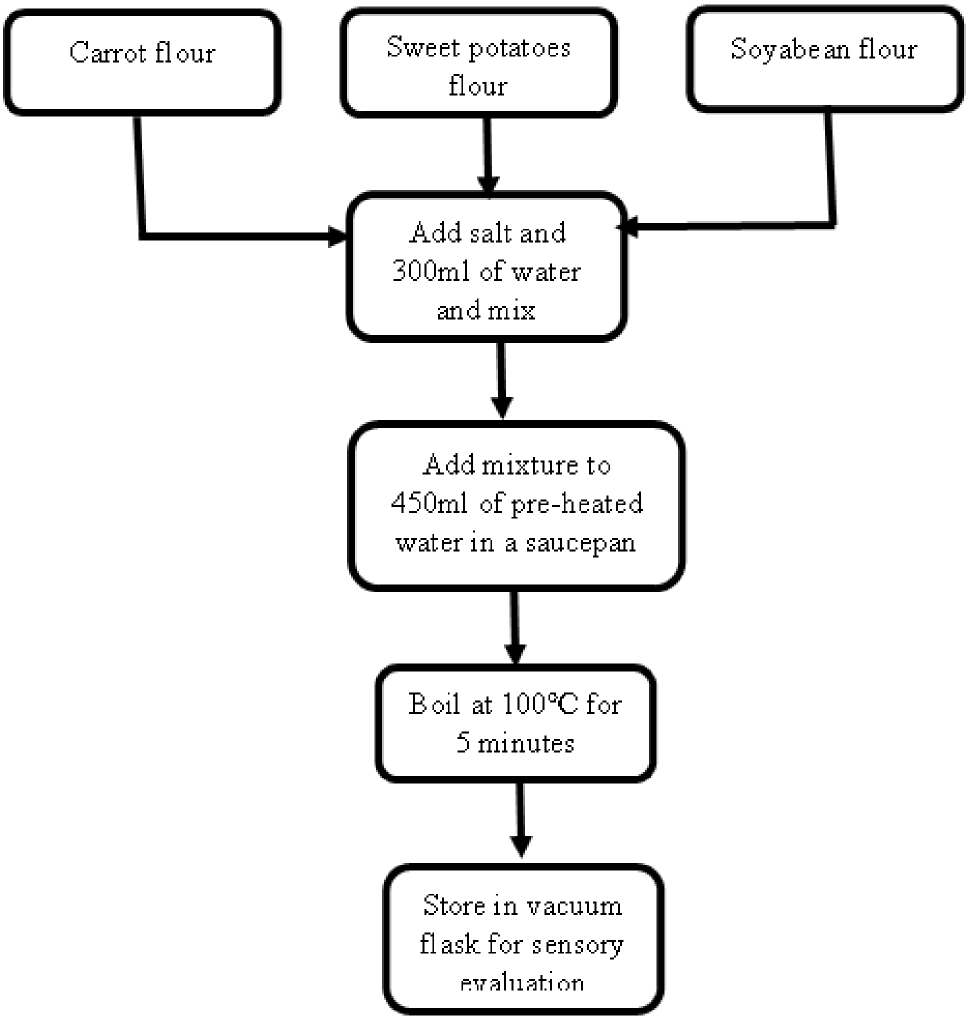

Fig. 4. Process flow of Porridge preparation

The following attributes namely appearance, aroma, taste, mouthfeel, aftertaste and overall acceptability were assessed on the porridge samples using 5-point hedonic scale was 1= dislike very much, 2=dislike slightly, 3=neither like nor dislike, 4= like slightly, 5= like very much. Convenient sampling was used to select 30 semi-trained panelists (nursing mothers) who were neither sick nor allergic to porridge products to assess the products. The panelists were instructed to rinse their mouth with water after tasting each sample.

2.6 Proximate Analysis

The proximate analysis of the "functional weanimix" were determined. The fat AOAC [18] and crude fiber AOAC [19], were determined by standard methods. The protein test was determined using the Kjeldah method AOAC

[19]. The AOAC [19] method was used to calculate the total amount of ash. Five grams of the weanimix samples were weighed into porcelain crucibles, and the samples were burned for two hours in a 600°C prepared muffle furnace (Thermolyne Benchtop Muffle furnace F48025-60, ThermoFisher Scientific). A thermostatically controlled oven (Carbolite, PN 60 with 301 controller option) was used to measure the sample's moisture content using the AOAC [19] approach at 105°C for a 24-hour period. The moisture % was calculated using the formula below.

$$\%\,moisture = \frac{w_1 - W_2 \times 100}{W_1}$$

Where
W_1=initial weight of sample; W_2=weight of the dried sample

The total carbohydrate was determined by difference.

2.7 Statistical Analysis

The data obtained from the sensory tests were coded and inputted into the Statistical Package for Social Science (SPSS version 21) for further statistical analyses. Also, descriptive statistics were conducted and this encompassed means, standard deviation, coefficient of variations as well as significant difference. The Analysis of Variance (ANOVA) was conducted by use of Turkey at a confidence level of 95%.

3. RESULTS AND DISCUSSION

3.1 Consumer Acceptability of Functional Weanimix

The consumer acceptability revealed that, sample PSC 300 was scored 4.30 for its appearance, which corresponds to like slightly on the hedonic scale. This was followed by samples PSC 100 (4.30) and PSC 200 (4.10), which also correspond to like slightly on the hedonic scale. There was no statistically significant difference between the appearance of the samples (p>0.05). This results is similar to work than Kweku Amagloh [20] which showed all of the three formulations of sweet potato-based complementary foods were judged to be acceptable on all of the indicators. Again, Hagan et al. [21], reported that, the appearance of mushroom cereal blend product was liked whereas the appearance of mushroom orange flesh sweet potatoes was neither liked nor disliked. This could be as a result of different ingredients used as well as different formulations used.

All of the samples aromas were slightly liked with ratings 4.13, 4.03 and 4.33 for PSC 100, PSC 200 and PSC 300 respectively (Table 2). There was no statistically significant difference between the aromas of the samples (p>0.05). This was similar to that reported by Adetola et al. [15] who reported the flavor of sweet potato-based complementary foods (OFSP-CF1: OFSP 64.57%, soybean 34.76%, carrot 0.68%) was liked slightly. Samples PSC 100, PSC 200 and PSC 300 were each given a taste rating of 4.27, 4.17, and 4.23 on the hedonic scale, respectively, representing like slightly, with sample PSC 100 slightly preferred, which is consistent with that reported by Adetola et al. [15], who reported the taste of sweet potato-based complementary foods (OFSP-CF1: OFSP 64.57%, soybean 34.76%, carrot 0.68%) was liked slightly. The sample’s aftertaste was liked slightly with rating 4.00, 4.17 and 4.20 for PSC 100, PSC 200 and PSC 300 respectively. There was no statistically significant difference between the aftertaste of the samples (p>0.05).

Table 2. Consumer acceptability of functional weanimix

Attributes	Samples		
	PSC 100	PSC 200	PSC 300
Appearance	4.30±0.65[a]	4.10±0.92[a]	4.37±0.56[a]
Aroma	4.13±0.86[a]	4.03±0.93[a]	4.33±0.92[a]
Taste	4.27±0.74[a]	4.17±0.83[a]	4.23±0.77[a]
Mouthfeel	3.86±0.97[a]	3.90±0.92[a]	3.77±1.00[a]
Aftertaste	4.00±0.83[a]	4.17±0.79[a]	4.20±1.03[a]
Overall acceptability	4.23±0.72[ab]	4.00±0.83[a]	4.53±0.73[b]

Data is represented as mean ± standard deviation
Means bearing different superscripts in the same row are significantly different (P<0.05).

Sample PSC 200 had the highest mouthfeel rating of 3.90, followed by sample PSC 100 (3.86) and sample PSC 300 (3.77). All the samples mouthfeel were liked slightly with no statistical significant difference between them.

All of the samples received a generally favourable rating PSC 100 (4.23), PSC 200(4.00) and PSC 300 (4.53) for overall acceptance, with PSC 300 being preferred over the other two with rating like very much on the hedonic scale (Table 2) which aligns with the results of Kweku Amagloh et al.[20], and Adetola et al.[15], which showed all of the three formulations of sweet potato-based complementary foods were judged to be acceptable on all of the indicators. There was a statistically significant difference between the overall acceptance of the samples ($p<0.05$).

3.2 Commercial Availability of Functional Weanimix

Fig. 5 indicates that 14 respondents representing 47% are willing to buy product PSC300 if it is commercially available whilst 9 respondents representing 30% are willing to buy product PSC200 if it is commercially available and 7 respondents representing 23% are willing to buy product PSC100 if it was commercially available. It can then be concluded that the product PSC300 which is rated highest will be bought by the majority of the respondents if it was commercially available followed by the product PSC200 and lastly the product PSC100.

3.3 Reasons for Choice of the Functional Weanimix

Again, when respondents were asked in the questionnaire to give their reasons why they would buy the product if it was commercially available, it was recorded that 4% would buy the product because of its appearance, 14% would buy the product because of the aroma, 4% will buy the product because the product is nutritious, 14% will buy the product because of the overall acceptability and 64% will buy the product because of the taste (Fig. 6)

3.4 Recommendation of Functional Weanimix to Others

Finally, respondents were asked to respond to whether they would recommend the product to consumers on a rating scale of YES or NO. From Fig. 7 it shows that 100% of the respondents (all the 30 respondents) responded yes to the products they have chosen but no respondent responded NO to the choice of the product he or she has made.

Table 3. Nutrient composition of functional weanimix

Proximate Components	PSC 300
Moisture (%)	9.47±0.39
Ash (%)	1.66±0.03
Fat (%)	17.64±0.37
Fibre (%)	6.86±0.28
Protein (%)	18.32±3.02
Carbohydrate (%)	52.91± 0.07

The data is shown as mean ± standard deviation

3.5 Proximate Composition of Functional Weanimix

The nutritional composition of the most preferred formulation was investigated. The results showed that the moisture, ash, fat, fibre, protein and carbohydrate content were 9.47, 1.66, 17.64, 6.86, 18.32 and 52.91 respectively. The moisture content (9.47%) was higher than that reported by Adetola et al. [15], (4.38%) and that of Laryea et al.[11], (6.47%). Food manufucturers consider the moisture content of their products to be crucial for several reasons. When it comes to food quality, preservation, and resistance to deterioration, moisture is crucial. [22].

The presence of ash is an indication of minerals present in the sample [23]. The ash falls within the range reported by Bonsi et al. [24] (1.39–1.98%) but lower than that of Haque et al. [25] (1.90–2.14%) in their orange-fleshed sweetpotato complementary foods. According to FAO [26], a supplemental food's ash level should be no more than 5%. Thus, the sample that is most preferred satisfies this requirement.

The sample that was most preferred had a much greater fat content (17.64%) than that reported by Laryea et al.[11](6. 20%). Weanimix has a greater fat level, which may be related to the product's composition; the product was soybean, carrot and sweet potatoes. The soybeans contributed to the fat content. Complementary meals should have a fat level of at least 12%, according to the FAO [26]. Additionally, according to CAC/GL 08 [27], the fat content should be at least 20%. Although the fat content of the functional weanimix was above FAO standards, it met the standard of CAC/GL 08[27].

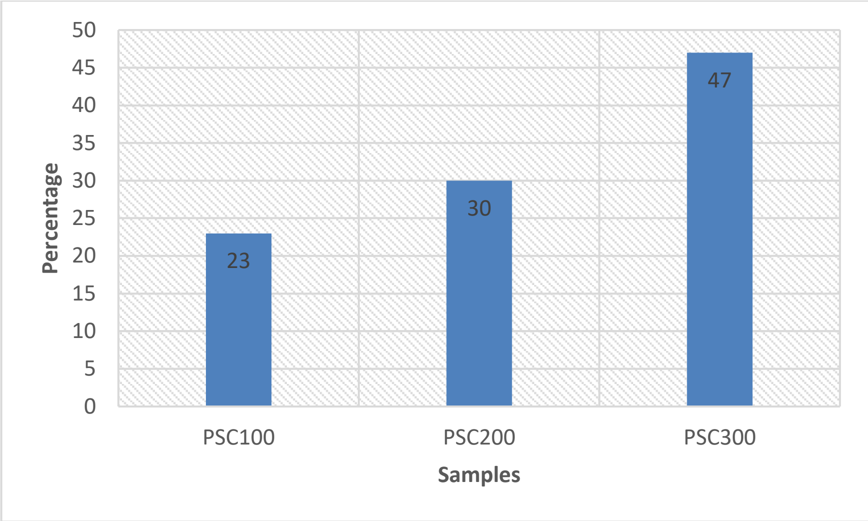

Fig. 5. Commercially Availability

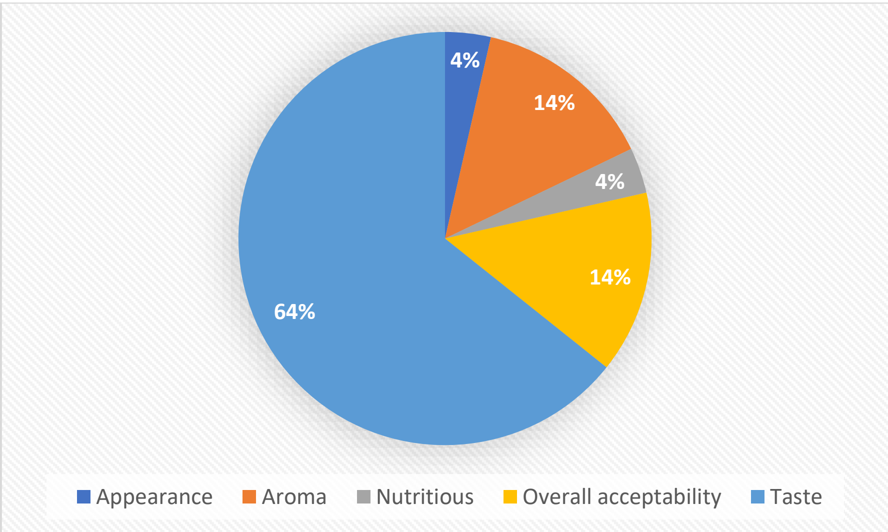

Fig. 6. Reasons for Choice

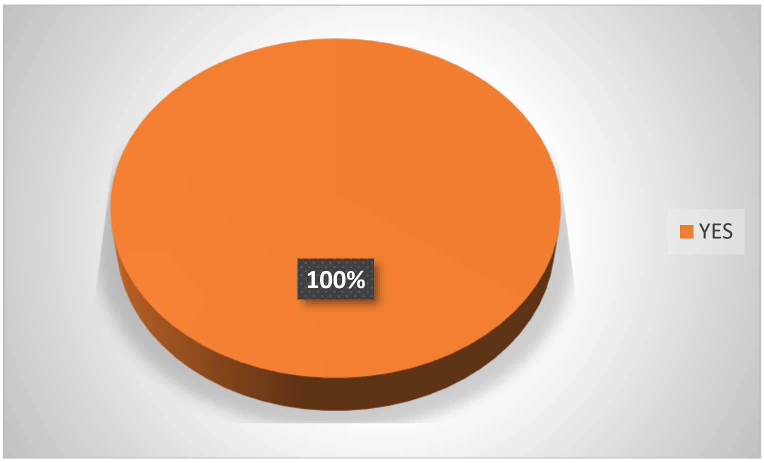

Fig. 7. Recommendation of Product

Table 4. Cross Tabulation of Sensory Attributes and "Functional Weanimix" Samples

Samples	**ATTRIBUTES**							
	Appearance							
	Dislike very much	**Dislike slightly**	**Neither like nor dislike**	**Like Slightly**	**Like very much**	**Total**	**X^2**	**p-value**
PSC100	0(0%)	0(0.0%)	3(10.0%)	15(50.0%)	12(40.0%)	30(100%)	7.361	0.29
PSC200	0(0%)	3(10.0%)	2(6.7%)	14(46.7%)	11(36.7%)	30(100%)		
PSC300	0(0%)	0(0.0%	1(3.3%)	17(56.7%)	12(40.0%)	30(100%)		
Total	0(0%)	3(3.3%)	6(6.7%)	46(51.1%)	35(38.9%)	90(100%)		
	Aroma							
PSC100	0(0%)	2(6.7%)	3(10.0%)	14(46.7%)	11(36.7%)	30(100%)	9.150	0.17
PSC200	0(0%)	1(3.3%)	9(30.0%)	8(26.7%)	12(40.0%)	30(100%)		
PSC300	0(0%)	2(6.7%	3(10.0%)	8(26.7%)	17(56.7%)	30(100%)		
Total	0(0%)	5(5.6%)	15(16.7%)	30(33.3%)	40(44.4%)	90(100%)		
	Taste							
PSC100	0(0%)	1(3.3%)	2(6.7%)	15(50%)	12(40.0%)	30(100%)	0.888	0.99
PSC200	0(0%)	2 (6.7%)	2(6.7%)	15(50%)	11(36.7%)	30(100%)		
PSC300	0(0%)	1(3.3%)	3(10.0%)	14(46.7%)	12(40.0%)	30(100%)		
Total	0(0%)	4(4.4%)	7(7.8%)	44(48.9%)	35(38.9%)	90(100%)		
	Mouthfeel							
PSC100	0(0%)	4(13.3%)	4(13.3%)	14(46.7%)	8(26.2%)	30(100%)	0.741	0.99
PSC200	0(0%)	3(10.0%)	5(16.7%)	14(46.7%)	8(26.2%)	30(100%)		
PSC300	0(0%)	5(16.7%)	4(13.3%)	14(46.7%)	7(23.3%)	30(100%)		
Total	0(0%)	12(13.3%)	13(14.4%)	42(46.7%)	23(25.1%)	90(100%)		
	After taste							
PSC100	0(0%)	2(6.7%)	4(13.3%)	16(53.3%)	8(26.7%)	30(100%)	9.481	0.30
PSC200	0(0%)	0(0.0%)	7(23.3%)	11(36.7%)	12(40.0%)	30(100%)		
PSC300	1(3.3%)	1(3.3%)	4(13.3%)	9(30.0%)	15(50.0%)	30(100%)		
Total	1(1.1%)	1(1.1%)	15(16.7%)	36(40.0%)	35(38.9%)	90(100%)		
	Overall Acceptability							
PSC100	0(0%)	1(3.3%)	2(6.7%)	16(53.3%)	11(36.7%)	30(100%)	12.455	0.05
PSC200	0(0%)	1(3.3%)	7(23.3%)	13(43.3%)	9(30.0%)	30(100%)		
PSC300	0(0%)	1(3.3%)	1(3.3%)	9(30.0%)	19(63.3%)	30(100%)		
Total	0(0%)	3(3.3%)	10(11.1%)	38(42.2%)	39(43.3%)	90(100%)		

The fibre content of the PSC 300 was high (6.86) compared to that reported by Laryea et al., [11] (1.70%) and is slightly above the criteria set by CAC/GL 08 [27] and CAC [26]; which reports that fibre content should be less than 5%. This is because a high fiber content makes the food bulky and causes infants to experience flatulence [26, 27], which is an uncomfortable feeling. Furthermore, because of their immature digestive systems, newborns have a hard time breaking down foods heavy in fibre

Protein content of sample PSC 300 was significantly higher than that of complementary food reported by Laryea et al. [11]. It was able to meet the protein standard of FAO and CAC standards [26,27]

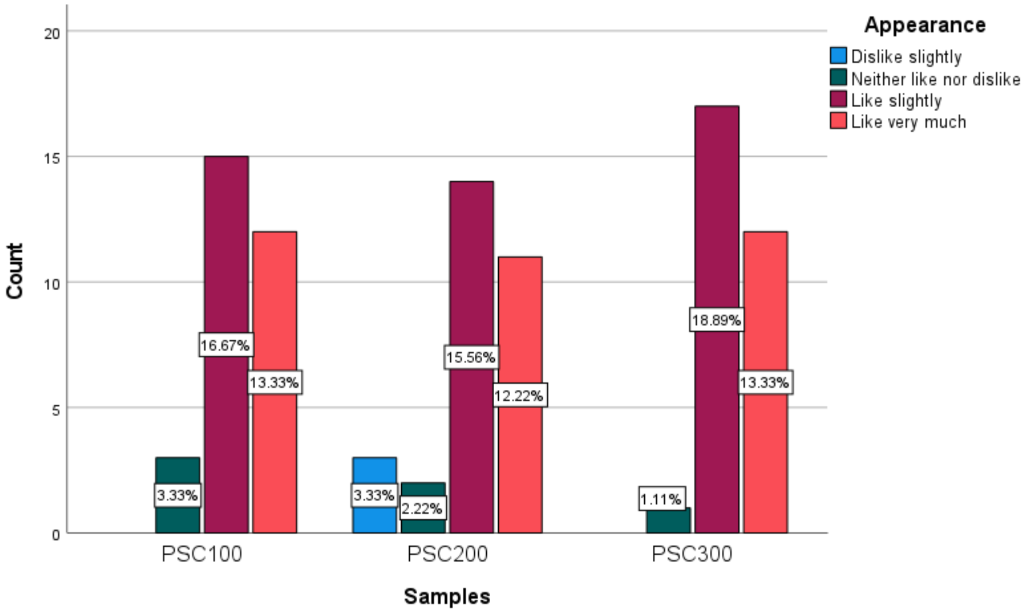

Fig. 8. Percentage distribution of appearance of weanimix samples

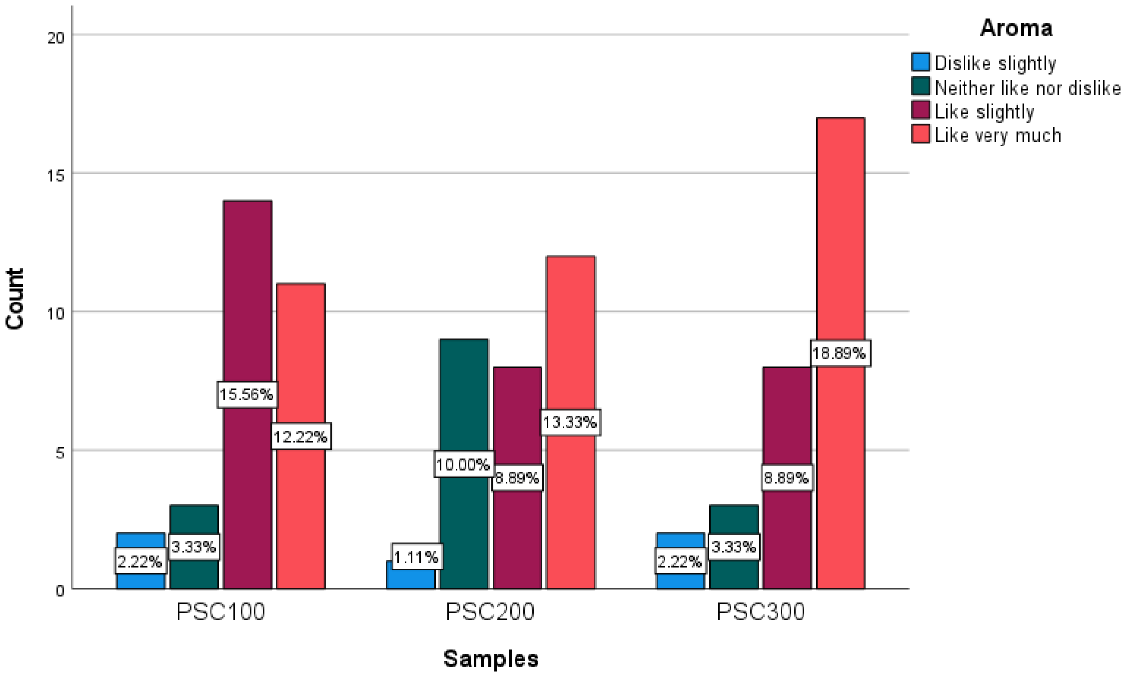

Fig. 9. Percentage distribution of aroma of weanimix samples

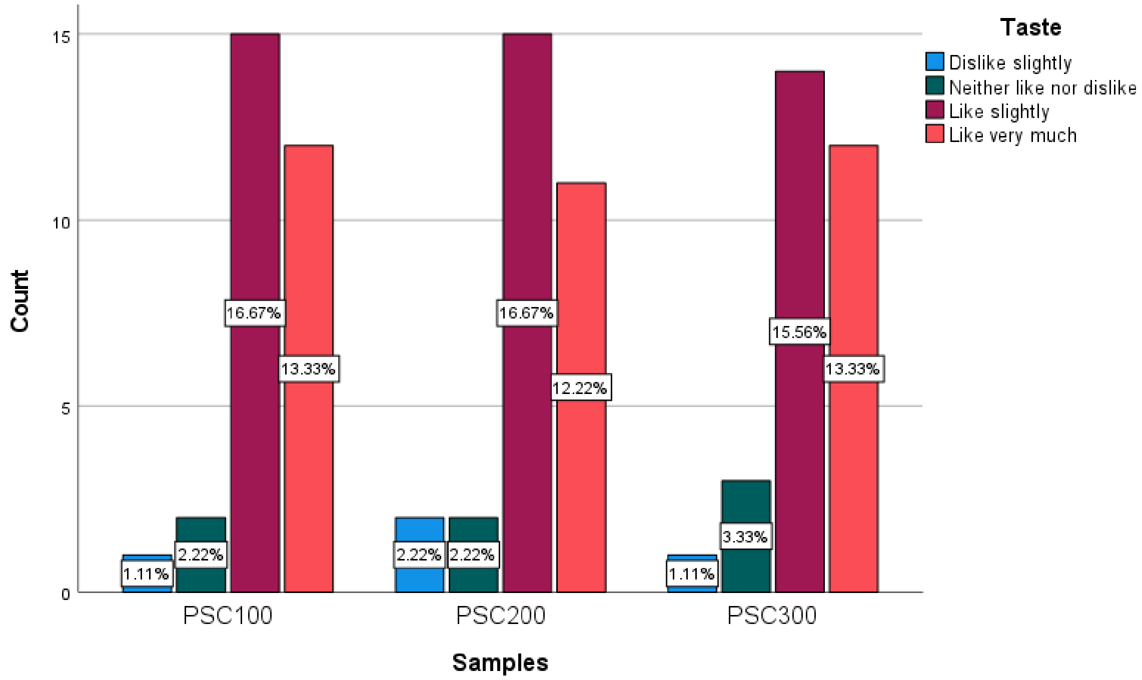

Fig. 10. Percentage distribution of taste of weanimix samples

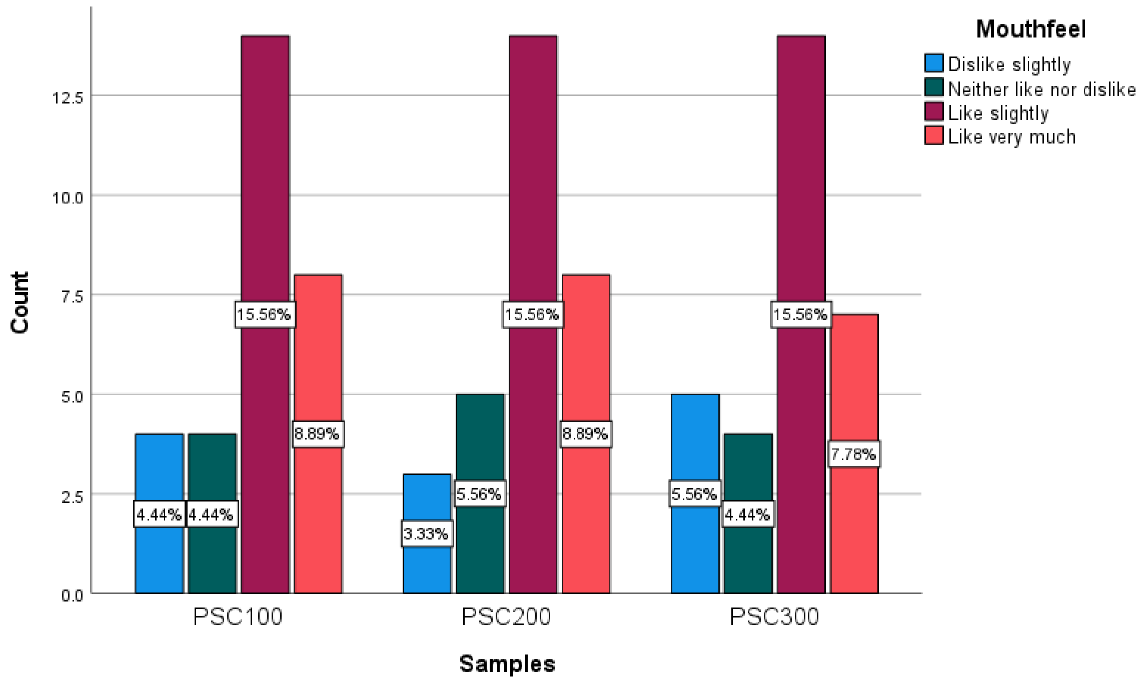

Fig. 11. Percentage distribution of mouthfeel of weanimix samples

In complementary foods, carbohydrates play a major role in providing energy. Its content could be high, but it has to be easily absorbed so that babies and young kids can get the energy they need [26, 27]. The carbohydrate content obtained (52.91%) compared with Laryea et al. [11] (65.95%) was lower. The complementary food's carbohydrate contents satisfied FAO, CAC/GL 08, and CAC requirements [26, 27]. The carbohydrate content (42.30-54.5%) was likewise in line with reports by Bonsi et al. [24] and Haque et al. [25].

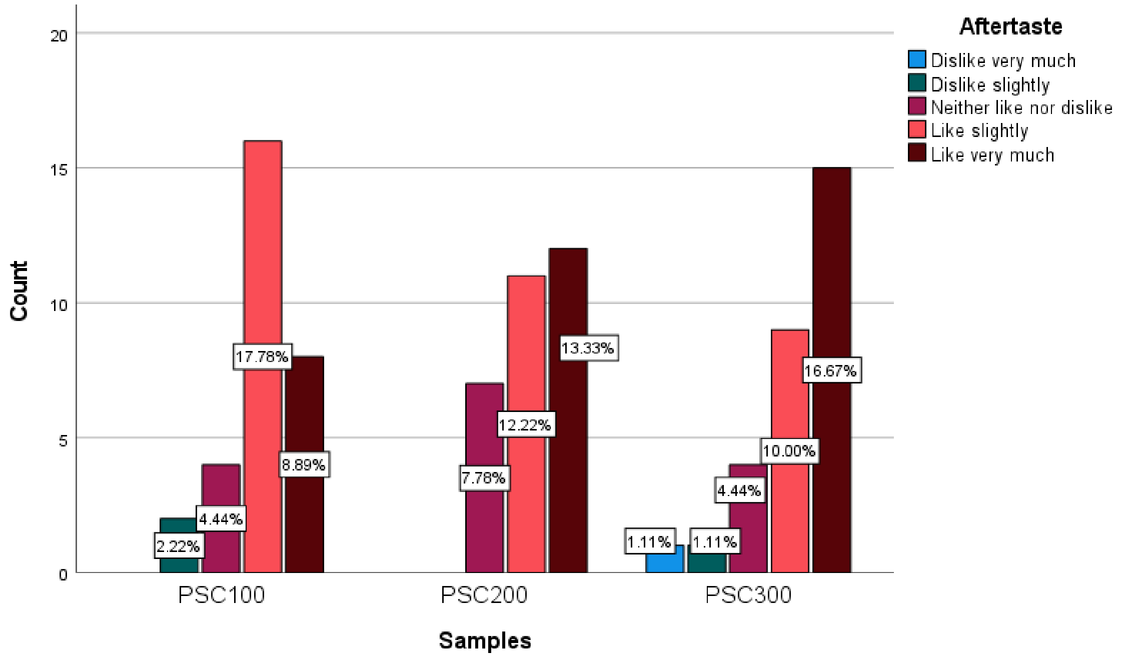

Fig. 12. Percentage distribution of after taste of weanimix samples

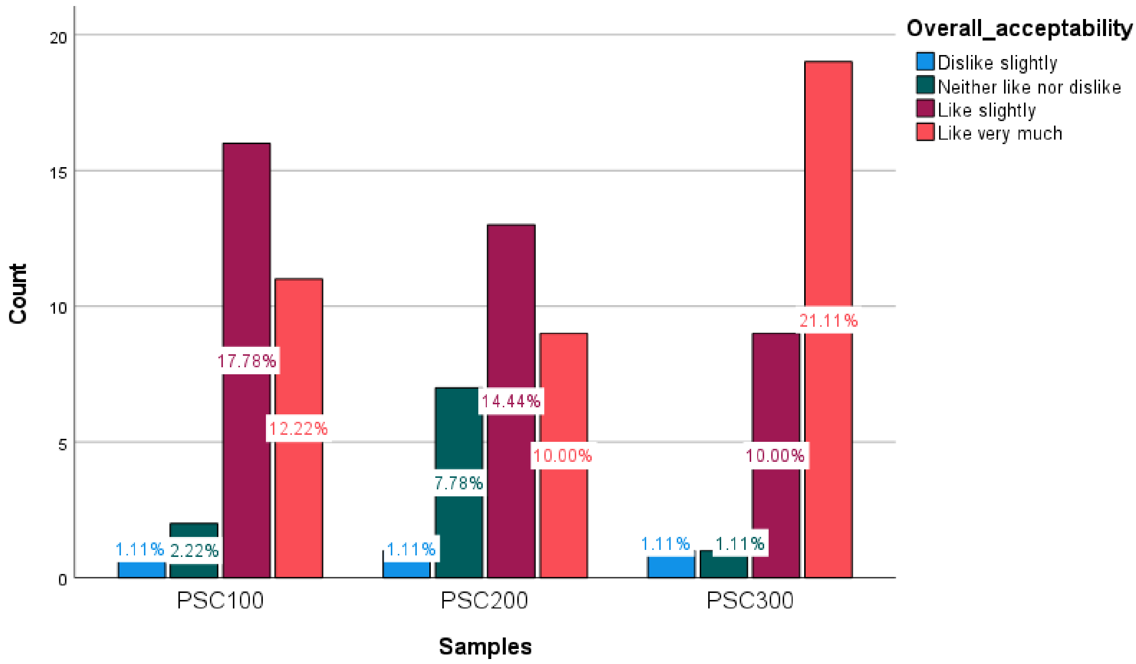

Fig. 13. Percentage distribution of after taste of weanimix samples

3.6 Percentage Distribution of Sensory Attributes of the "Functional Weanimix" Samples

The percentage distribution of the sensory attributes and of the functional weanimix samples were analyzed. The results showed that, 40% of the panelist liked the appearance of samples PSC100 and PSC 300 very much whiles 36.7% liked the appearance of sample PSC200. Ten percent of the respondents slightly disliked the appearance of sample PSC200 (Table 4, Fig. 8). There was no statistically significant difference between the appearance of the samples (p>0.05). Majority of the respondents (56.7%) liked the aroma of PSC300 very much, followed by sample PSC200 (40%) and Sample PSC100 (36.7%). Less than 10% of the respondents slightly disliked the aroma of all the samples (Fig. 9). There was no statistically significant difference between the aromas of the samples (p>0.05). The taste of sample PSC100 and PSC300 received a rating of "like very much" by majority (40%) of the respondent. Less than 10% of the respondents slightly disliked the aroma of all the samples (Fig. 10). There was no statistically significant difference between the taste of the samples (p>0.05).About 46.7% of the respondents slightly like the mouth feel of all the samples (PSC100, PSC200 and PSC 300), 10% slightly disliked the mouth feel of sample PSC200, 16.7% slightly disliked the mouthfeel of sample PSC300 and 13.3% slightly disliked the mouth feel of PSC100. There was no statistically significant difference between the mouthfeel of the samples (p>0.05). With regards to aftertaste, majority of the respondents (50%) liked the after taste of sample PSC300 very much, 40% preferred the aftertaste of sample PSC200 while 26.7% preferred that of sample PSC100. About 3.3% of the respondents disliked the after taste of sample PSC300 very much. Majority of the respondents (63.3%) liked very much the overall acceptance of sample PSC300, while 36.7% liked very much the overall acceptance of sample PSC 100 and 30% liked very much the overall acceptance of sample PSC 200. A statistically significant variation was seen in the samples' overall acceptability (p<0.05).

4. CONCLUSION

Three formulations were used in the production of functional weanimix using root tubers fortified with carrots. The formulation PSC 300 was the most preferred (PSC 300; 40% sweet potato: 40% soybean: 20% carrot).PSC 300 was preferred in terms of appearance, aroma, after-taste, and general acceptability. PSC 100 competed fairly with PSC 300 with in appearance, aroma, after taste, and general acceptability. The most preferred formulation (PSC 300) met the FAO standards and that of the Codex Alimentarius Commission Guidelines for complementary foods for infants and young children. This product is a very innovative and nutritious dish for all ages, and it will provide variety and support for the use of sweet potatoes; soyabean and carrots in complementary food which can help control protein-energy malnutrition and Vitamin A deficiency in children.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

The authors certify that throughout the writing and editing of manuscripts, NO generative AI tools, such as text-to-image generators and large language models (ChatGPT, COPILOT, etc.), were employed.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Amagloh FK. Sweetpotato-based complementary food for infants in Ghana (Doctoral dissertation, Thesis Submitted for Doctor of Phylosophy in Human Nutrition, Insitute of Food, nutrition and Human Health University of New Zealand; 2012.
2. Tacoli C. Food security in rapidly urbanising, low-income contexts. International journal of environmental research and public health. 2017;14(12): 1554.
3. Lam LF, Lawlis TR. Feeding the brain–The effects of micronutrient interventions on cognitive performance among school-aged children: A systematic review of randomized controlled trials. Clinical Nutrition.2017;36(4):1007-1014.
4. Gibbs M, Bailey KB, Lander RD, Fahmida U, Perlas L, Hess SY, Gibson RS. The adequacy of micronutrient concentrations in manufactured complementary foods from low-income countries. Journal of Food Composition and Analysis. 2011; 24(3):418-426.
5. Elliott H, Woods P, Green BD. Nugent AP. Can sprouting reduce phytate and improve the nutritional composition and nutrient bioaccessibility in cereals and legumes?. Nutrition Bulletin. 2022;47(2);138-156.
6. Obiri-Asamoah D, Fraikue FB. The use of sweet potato flour in the production of weanimix. In Third Applied Science Research and Conference; 2018.
7. Reis FS, Martins A, Vasconcelos MH, Morales P, Ferreira IC. Functional foods based on extracts or compounds derived from mushrooms. Trends in Food Science & Technology. 2017;66:48-62.

8. Granato D, Branco GF, Nazzaro F, Cruz AG, Faria JA. Functional foods and nondairy probiotic food development: trends, concepts, and products. Comprehensive reviews in food science and food safety. 2010;9(3);292-302.
9. Putnik P, Bursać Kovačević D, Režek Jambrak A, Barba FJ, Cravotto G, Binello A, Shpigelman A. Innovative "green" and novel strategies for the extraction of bioactive added value compounds from citrus wastes—A review. Molecules. 2017;22(5):680.
10. Omari R, Anyebuno G. Risk assessment of aflatoxins in maize-groundnuts complemen-tary foods consumed by Ghanaian infants. Journal of food quality and hazards control; 2020
11. Laryea D, Wireko-Manu FD, Oduro I. Formulation and characterization of sweetpotato-based complementary food. Cogent Food & Agriculture. 2018;4(1): 1517426.
12. Chandrasekara A, Josheph Kumar T. Roots and tuber crops as functional foods: a review on phytochemical constituents and their potential health benefits. International journal of food science; 2016.
13. Kambabazi MR, Okoth MW, Ngala S, Njue L, Vasanthakaalam H. Evaluation of nutrient content in red kidney beans, amaranth leaves, sweet potato roots and carrots cultivated in Rwanda. African Journal of Food, Agriculture, Nutrition and Development. 2021;21(4):17801-17814.
14. Siddiqui S, Ahmed N, Devi CA, Singh PR, Lalramhlimi B. Root Vegetables Having Medicinal Properties: Their Possible Use in Pharmaceutical and Food Industries; 2022
15. Adetola OY, Onabanjo OO, Stark AH. The search for sustainable solutions: Producing a sweet potato based complementary food rich in vitamin A, zinc and iron for infants in developing countries. Scientific African. 2020;8;e00363.
16. Phebean IO, Akinyele O, Toyin A, Folasade O, Olabisi A, Nnenna E. Development and quality evaluation of carrot powder and cowpea flour enriched biscuits. International Journal of Food Science and Biotechnology. 2017;2(2):67-72.
17. Gamboa-Santos J, Montilla A, Soria AC, Villamiel M. Effects of conventional and ultrasound blanching on enzyme inactivation and carbohydrate content of carrots. European Food Research and Technology. 2020;234:1071-1079.
18. AOAC. Official methods of analysis (18th ed.). Association of official analytical chemists.2005.
19. Association of Official Analytical Chemists (AOAC). Official Methods of Analysis. 2000 17th ed Washington DC USA.
20. Kweku Amagloh F, Mutukumira AN, Brough L, Weber JL, Hardacre A, Coad J. Carbohydrate composition, viscosity, solubility, and sensory acceptance of sweet potato-and maize-based complementary foods. Food & Nutrition Research. 2013;57(1);18717.
21. Hagan LL, Johnson PNT, Obodai M, Blay AMY, Simons C, Dzomeku M. Sensory attributes of three edible tropical mushrooms and their use in formulating food products for children 2-5 years old. International Journal of Nutrition and Food Sciences. 2018;7(3),100-109. DOI:10.11648/j.ijnfs.20180703.14
22. Nielsen SS. Determination of moisture content. Food analysis laboratory manual.2010; 17-27.
23. Owiredu I, Laryea D, Barimah J. Evaluation of cashew nut flour in the production of biscuits.Nutrition and Food Science.2013;44, 204–211. Available:https://doi.org/10.1108/NFS-06-2013-0067
24. Bonsi EA, Plahar WA, Zabawa R. Nutritional enhancement of Ghanaian weaning foods using the orange-fleshed sweet potato. African Journal of Food Agriculture Nutrition Development. 2014;14:9236–9256
25. Haque MR, Hosain MM, Khatun H, Alam R, Gani MO. Evaluation of nutritional composition and sensory attributes of weaning food prepared from sweetpotato and soyabean. Bangladesh Research Publications Journal. 2013;8;127–133.
26. CAC. Guidelines on formulated supplementary foods for older infants and young children, Proposed Draft Revision, Codex Alimentarius Commission, Joint FAO/WHO Food Standards Programme, Codex Committee on Nutrition and Foods for Special Dietary Uses. 2011 CX/NFSDU 11/33/8.
27. CAC/GL 08. Codex Alimentarius: Guidelines on Formulated Supplementary. Foods for Older Infants and Young Children. FAO/WHO Joint Publications. 1999;4:144

APPENDIX

Sweet Potato

Freshly Cut Sweet Potato

Dried Sweet potatoes

Sweet potatoes flour

Fresh Soya beans

Baked Soya beans

Soya beans Flour

Fresh Carrot

Sliced Carrot

Sliced Dried Carrot

Carrot Flour

PSC 100

PSC 200

PSC 300

Sweet potato carrot mix (sweet potato)

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