World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(Research Article)

Physicochemical and sensory properties of wheat-germinated sorghum-pigeon pea flour blends and their chin-chin-making potential

Ehinola O.M [1,*], Akinwemoye BA [1], Adesuyan O [1], Ogunmuyide DB [1] and Ajongbolo KF [2]

[1] *Department of Nutrition and Dietetics, Rufus Giwa Polytechnic, Owo, Nigeria.*
[2] *Department of Science Laboratory Technology, Rufus Giwa Polytechnic, Owo, Nigeria.*

World Journal of Advanced Research and Reviews, 2024, 23(03), 915–922

Publication history: Received on 03June 2024; revised on 04 September 2024; accepted on 06 September 2024

Article DOI: https://doi.org/10.30574/wjarr.2024.23.3.2091

Abstract

The effects of the substitution of wheat flour (WF) with Germinated Sorghum Flour (GSF) and Pigeon Peas Flour (PPF) at ratios of 100:00:00; 90:5:5; 80; 10:10 and 70:15:15 respectively in the proximate and mineral composition of the flour blends and the sensory properties of the chin-chin produced from the composite flour using standard methods were evaluated. The substitution reduced the moisture content from 10.55 to 9.18% while ash, fiber, protein, and fat content increased from 5.25 to 8.16%; 0.45 to 1.23%; 8.11 to 14.19%, and 3.37 to 5.42% respectively. An expected decrease in the carbohydrate content was recorded. The addition of GSF and PPF increased the sodium (1.18 - 1.45mg/100g); Potassium (1.48 - 3.49 mg /100g) and magnesium (0.68 - 1.66mg/100g) while zinc which was the most abundant out of all the mineral element assessed decreased from 74.32 - 36.61 mg/100g. The 100% WF Chin- -chin was ranked highest in color, taste, aroma, crispness, and general -acceptability closely followed by chin-chin produced fun 80WF: 10GSF: 10 PPF. This implies that wheat flour, germinated sorghum four and pigeon pea flour blends will produce chin-chin of good nutritional qualities

Keywords: Flour; Proximate; Mineral; Sensory; Cinchin; Germination; Blends

1. Introduction

Snacks make up a significant part of people's nutrient intake as a source of carbohydrates, protein, minerals, phytonutrients, and vitamins and can be eaten anytime. According to Lobstein *et al*. (2014), the three main meals eaten in a day may not be enough to provide all the nutrients needed for growth, hence eating snacks between meals is essential to make up for the required nutrients. Chin-chin is a fried or baked snack, which is prepared in different shapes and sizes and commonly eaten among the people of Nigeria. Akubor (2014) reported that Chin-chin is a sweet cookie-like product manufactured from wheat flour and egg. Chin chin is prepared from a mixture of flour, sugar, salt, baking powder, egg, fat, nutmeg, and water. Wheat flour, the major ingredient for Chin chin production, is rich in carbohydrates but low in protein, minerals, and essential phytochemicals (Adegunwa *et al.,* 2014).

Chin-chin is a popular confectionary snack product in Nigeria and in Western African countries often prepared using wheat flour, butter, milk, and eggs made into a stiff paste and deep fried in vegetable oil until golden brown and crispy product is obtained. Chin-chin is sweet, slightly hard, and can be compared to a harder version of a doughnut and is sometimes prepared by baking instead of frying (Adegunwa*et al*., 2014). The current reality of trade imbalance in wheat importation, which is weighing much on developing nations' economies, has called for seeking alternatives to wheat or substitution with locally available flour to an acceptable level. Consumption cuts across ages and health improvement can be achieved if enrichment with protein and dietary fibers could be achieved. Chin-chin has been made from grain such as corn and sorghum at a substitution level with wheat flour.

*Corresponding author: Eniola, O.M

Wheat flour is the major ingredient used in chin chin production. It is obtained from the wheat grain which is not grown in Nigeria due to unfavorable climatic conditions (Babarinde *et al.,* 2022). The importation of wheat therefore increases the cost of wheat-based products and could lead to economic drain. Wheat like other cereals is limiting in certain essential amino acids. Thus, sustaining the production of affordable and nutritious cookies requires the development of an adequate substitute for wheat flour from locally available and inexpensive food crops. The use of flour blends from locally grown crops would not only reduce the high cost of importation of wheat but could also be a means of addressing the problem of food insecurity and malnutrition (Abioye *et al.,* 2018). Composite flours from tubers, cereals, and legumes have better nutritional value than flour milled from single crops alone (Abioye *et al.,* 2018).

Sorghum which is locally called (Guinea corn and "dawa") in Nigeria is a gluten-free grain that has the potential to be used as an alternative to wheat flour close to 50% of the land is devoted to sorghum and this makes the crop to be extensively grown in the country (Adegunwa *et al*., 2014). The protein content of sorghum is like that of wheat but lysine as the most limiting essentially Amino acid legumes like cowpeas, soya beans and pigeon peas is high in lysine but low in methionine which are high in sorghum (Maunder, 2016; Fashoyiro, 2019) and could complement each other's (Cook *et al*., 2015).

Pigeon pea (*Cajanus cajan*), an important food legume, is mainly a subsistence crop in the tropics and sub-tropics of India, Africa, South-East Asia, and Central America. The crop can survive and reproduce in environments characterized by severe moisture stress and poor soil fertility. It is cultivated as a sole crop or intermixed with such cereals as sorghum, millet, or maize. It also contains about 25.83% of protein (Tiwari *et al*., 2018). Pigeon peas are gluten-free and are locally available and affordable in the tropics and subtropics of the world but are been underutilized despite their high protein value range from 23 to 26%. It is a rich source of lysine compared to other legumes like cowpea and groundnut and is rich in mineral quality. Different varieties of pigeon peas grow well in Southwest Nigeria, which could be used in complementing the low nutrient-density starch Staples (Shewry, 2007; Fashoyiro, 2019). Therefore, the objective of this study is to evaluate the physicochemical properties, of the flour blends and the sensory properties of chin-chin produced from the flour blends.

2. Materials and methods

2.1. Collection of Raw Materials

Sorghum, Wheat, and Pigeon peas used for this study were purchased from a local market at Kings Market in Owo, Ondo state Nigeria. All reagents used were of analytical grade and is obtained from standardized local suppliers. The equipment used was a rolling pin, tray, knife, bowl, fry pan, stove, and rolling board. The experiment was carried out at the Food Science and Technology Laboratory, Rufus Giwa Polytechnic, Owo, Ondo State.

2.2. Sample Preparation

2.2.1. Pigeon pea flour preparation

Pigeon pea seeds were sorted to remove foreign materials seeds, washed, drained and sundried. Roasting was done by turning the seeds several times inside an iron pot placed over a slowly glowing pea flame for a period of 40min. The roasted pigeon pea was milled with a locally fabricated attrition milling machine to obtain pigeon pea flour (figure 1)

2.2.2. Preparation of germinated sorghum flour

Germinated sorghum flour was prepared using the method of (Hallen *et al*., 2004). The sorghum grains (2kg) were sorted to remove stone, dirt and other extraneous materials, the cleaned grains were thoroughly washed and steep in water for 12hrs to attain a 42.46% moisture level. The hydrated grains were spread on a moisture jute bag which had been previously sterilized by boiling for 30minutes and the grains were allowed to germinate for 4 days. Non-germinated grains were discarded, and the germinated seeds were dried at 60°C in a cabinet dryer to a moisture content of 10--12%. The germinated grain was gently brushed off before they shoot roots and were dried, milled, sieved, and packaged on an airtight container until ready for use (figure 2).

2.2.3. Preparation of wheat flour

In chin-chin production, fine ground wheat flour is required and normally 100% would pass through a 60-mesh sieved. The sieved flour is then packaged into HDPE bag and kept in the refrigeration until used.

2.2.4. Production of chin-chin using wheat flour-germinated sorghum-pigeon pea flour blends.

In the production of chin-chin some varied quantity of other ingredient was added to flour blends samples such as baking powder, sugar, egg, butter, nutmeg. Initial step was by putting the blended flour into a bowl followed by the addition of salt and ground nutmeg. After this, margarine was mixed with it evenly. Eggs, sugar, and other ingredients were added to make stiff dough; the thick dough was rolled tightly on a board and cut into Cubes followed by frying in deep vegetable oil until golden brown. It was allowed to cool and packaged in high density polyethylene bags for storage.

2.2.5. Formulation of Flour Blends

Germinated sorghum flour, Wheat flour and pigeon pea composite flour were prepared by blending germinated sorghum flour at 90:5:5; 80:10:10 and 70:15:15 wheat flour, germinated sorghum and pigeoa pea respectively. Wheat flour (100%) was used as control.

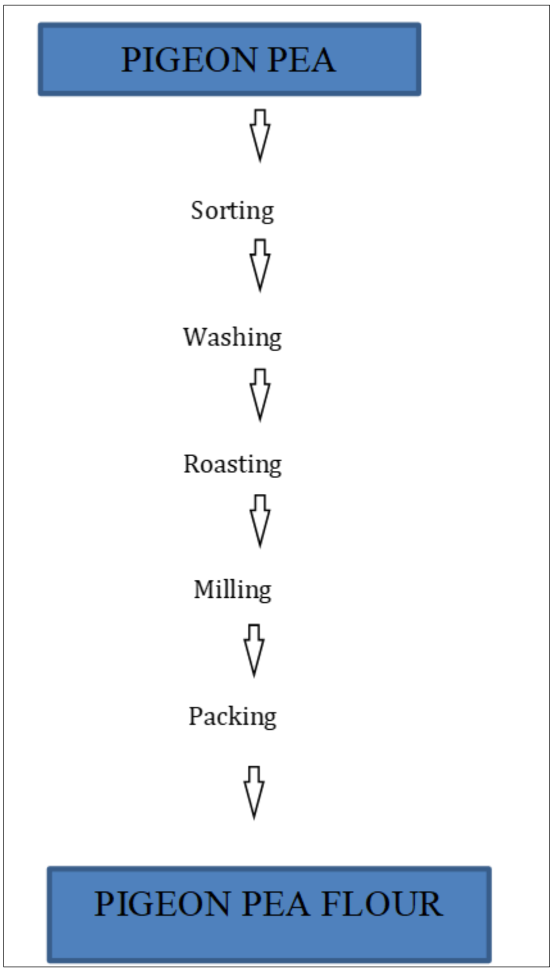

Figure 1 Production of pigeon pea flour.

Source: Fisoyiro *et al.* (2010)

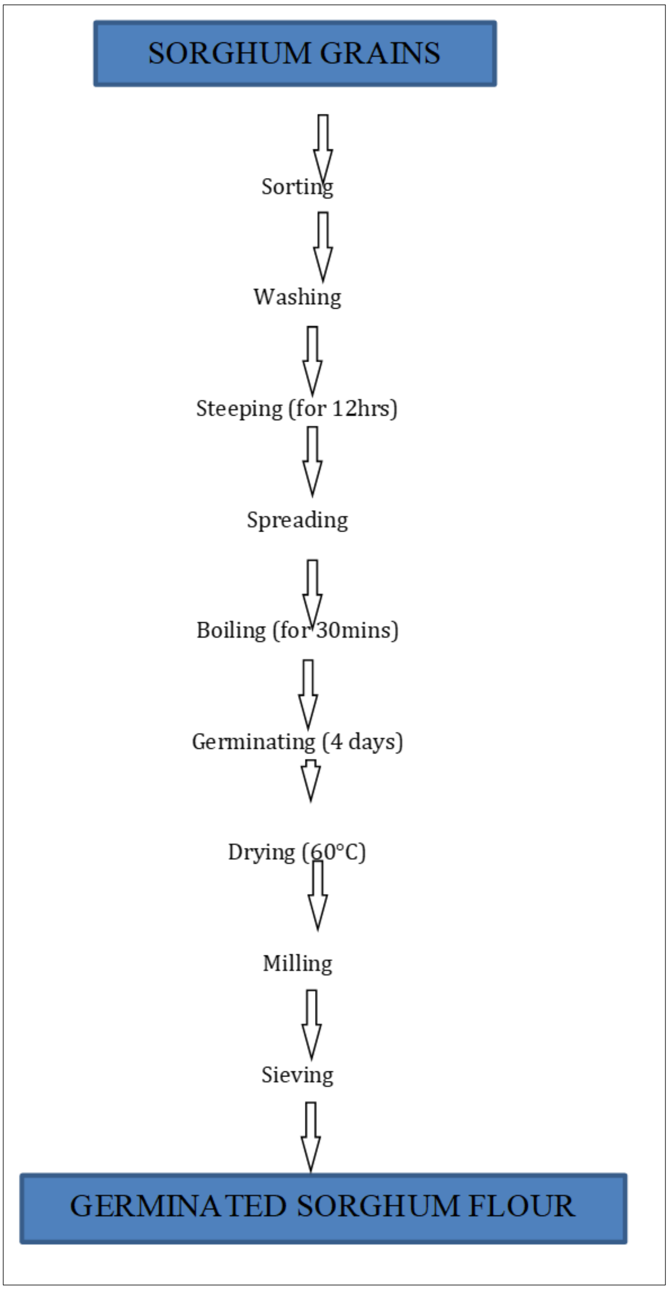

Figure 2 Production of germinated sorghum flour.

Source: Hallen *et al.* (2004)

2.3. Proximate Analysis

Protein, fat, fibre, moisture, ash and mineral analysis were determined by the method of analysis of the Association of Official Analytical Chemists (2005) while carbohydrate was determined by difference.

2.4. Functional Properties of Flour Blends

Water absorption capacity is an index of the amount of water retained within a food matrix under certain conditions (Ayinde *et al*., 2012). Oil absorption capacity is an index of the amount of oil retained within a protein matrix under certain condition. It was determined using the method of Sathe and Salunkhe (1981) as modified by Adebowale *et al*. (2005). The method of Sathe *et al*., (1982) was used with slight modification. The swelling index of the samples were determined by them method of Ukpabi and Ndimele (1990).

2.5. Sensory Evaluation of Product Samples

A ten-man panelist comprising of staff and students of Rufus Giwa Polytechnic, Owo was used and selection was made on the basis of familiarity with “bread”. The samples were presented to panelists in a randomized order and were evaluated for appearance, taste, aroma, mouthfeel and overall acceptability on a 7-point hedonic scale (Larmond, 1977).

3. Results

The results of the proximate and mineral properties of flour blends produced from wheat, germinated sorghum and pigeon pea flours and the sensory evaluation of the chin-chin produced are shown in the tables below.

Table 1 Proximate composition of Flour Blends

	WF: GSF: PPF			
Proximate Composition	100:00:00	90:5:5	80:10:10	70:15:15
Moisture (%)	10.55	10.02	9.25	9.18
Ash (%)	5.25	6.71	7.95	8.16
Crude Fibre (%)	0.45	1.04	1.16	1.23
Protein (%)	8.11	12.42	14.01	14.19
Fat (%)	3.37	3.96	4.87	5.42
Carbohydrate (%)	72.27	65.85	62.76	61.82
Energy value (Kcal)	351.85	348.72	350.91	352.82

Keys:WF: Wheat Flour, GSF: Germinated Sorghum Flour, PPF: Pigeon – Peas Flour

Table 2 Mineral Content (mg/100g) of Flour Blends

	WF : GSF : PPF			
Mineral Content (mg/100g)	100:00:00	90:5:5	80:10:10	70:15:15
Sodium	1.18	1.38	1.72	1.45
Potassium	1.48	3.20	4.31	3.49
Magnesium	0.68	0.72	1.69	1.66
Zinc	74.32	45.80	41.79	36.11

Keys:WF: Wheat Flour, GSF: Germinated Sorghum Flour, PPF: Pigeon – Peas Flour

Table 3 Sensory Properties of Chin-Chin

	WF : GSF : PPF			
Sensory Properties	100:00:00	90:5:5	80:10:10	70:15:15
Colour	6.78^{a}	5.45^{a}	6.18^{a}	5.20^{a}
Taste	7.49^{a}	5.37^{a}	6.83^{ab}	5.96^{ab}
Aroma	7.70^{a}	5.18^{b}	6.29^{ab}	5.80^{b}
Crispness	7.25^{a}	6.01^{ab}	6.93^{ab}	5.41^{b}
General Acceptability	7.95^{a}	6.10^{b}	7.02^{ab}	6.49^{ab}

Values followed by different superscripts within a row are significantly different ($p \leq 0.05$)Keys:WF: Wheat Flour, GSF: Germinated Sorghum Flour, PPF: Pigeon – Peas Flour

4. Discussion

The proximate composition of flour blends produced from wheat–Germinated sorghum–pigeon pea flour (WF: GSF: PPF) is shown in Table 1. The moisture content of the flour blends ranged between 9.18 – 10.55% in WF-GSF-PPF blends at a 70:15:15 ratio had the lowest value of 9.18%. The range of values obtained in this study had a similar trend of reduction as the level of substitution increased in the blends when compared with that of the flour blends when compared with that of the flour blends produced from cassava-pigeon pea flour blends (Ogundowole *et al.,* 2022). This reduction was probably due to the additional effect of pigeon pea flour. The moisture content of any sample is an index of keeping quality and thus an indicator of shelf life. The ash content ranged in the blends from 5.25 to 8.16% and the result showed an increase in the ash contents as the substitution increased in the blends. This result may indicate the presence of high inorganic nutrients in the samples. Food samples containing high ash contents tend to have more mineral elements (Onwuka, 2005).

The addition of GSF and PPF increased the fiber contents in the blends. 100%WF had the lowest fiber content of 0.45% and this increased in the blends with values of 1.04; 1.16 and 1.23% for the blends with ratios of 90:5:5; 80:10:10 and 70:15:15 (WF: GSF: PPF) respectively. These results indicate that the flour blends produced in this study are a good source of fiber, which makes it suitable in the preparation of functional food products. It was reported that food samples high in fibre facilities digestion, reduces hemorrhoid, diabetes, high blood pressure and obesity (Onwuka, 2005).

The Protein content increased from 8.11 to 14.19% as the level of substitution with GSF and PPF increased in the blends. This was expected because germination of the sorghum would have increased its protein content; and also, pigeon pea being a leguminous crop is highly favourable because of its rich protein composition, energy and mineral content (Ojo *et al.,* 2019). Babarinde *et al.* (2020) further confirmed that pigeon pea is high in protein and minerals. This result indicates that consuming products produced from the flour blends could contribute to the required daily intake of protein. The fat content ranged from 3.37% (100%WF) to 5.42% in the 70:15:15 (WF: GSF: PPF) blend. The obvious high fat content in the 70:15:15 (WF: GSF: PPF) blend is an indication that the blend will be more susceptible to oxidative rancidity than the other samples but will also stand out to be good source of energy supply as shown in Table 1. Babarinde *et al.* (2022) reported an increase in fat content of flour blends produced from unripe plantain-orange fleshed sweet potato-pigeon pea flour blends as the level of substitution increased. The increase in fat content may be due to the addition of GSF and PPF.

The carbohydrate content decreased from 72.27 to 61.82% across the line with the 100% WF having the highest value. This decrease in carbohydrate content may be due to the increase in other constituents (ash, fibre, protein and fat) of the flour blends as the level of substitution with GSF and PPF increased in the blends. The highest energy value was recorded in the sample containing 70WF: 15GSF: 15PPF with a value of 352.82kcal. This may be due to the fact that the sample had the highest fat content (5.42%) which serves as a major supply of energy in human diet (Onwuka, 2005). It was reported in the literature that high energy value in composite flours may be advantageous for the formulation of complementary diets (Ojo *et al.,* 2019). The energy value ranged between 348.72 to 352.82kcal.

Table 2 shows the mineral composition of flour blends produced in this study. The sodium content of the flour blends ranged from 1.18 to 1.72%. The flour produced from 80WF: 10GSF: 10PPF was observed to have the highest sodium content of 1.72mg/100g while the control sample (100% WF) had the lowest value (1.18mg/100g). Raheena (2007) reported that sodium played an important role in the normal functioning of the body and in the regulation of acid-base balance and water metabolism in the body. The potassium content in the flour blends ranged between 1.48 and 4.31mg/100g and the flour blends produced from 80WF: 10GSF: 10PPF had the highest (4.31mg/100g). Potassium is an important constituent of cells and it helps in muscular function (Raheena, 2007).

The magnesium content ranged from 0.68 to 0.72 mg/100g across the flour blends. The flour blends made from 90WF: 5GSF: 5PPF has the highest magnesium value of 0.72mg/100g. Garvin *et al*. (2006) reported that magnesium play an important role in normal calcium and Phosphorus metabolism in man. Zinc was found to be the most abundant in all the four mineral element evaluated in this study and decreased from 74.32 to 36.61mg/100g as the level of substitutes with GSF and PPF increased in the blends. Zinc plays an important role in enzymatic action and aids in the healing of burns and wounds (Adelekan *et al*., 2016). Water balance, fluid regulation and acid balance in the body depend to a great extent on certain mineral balance in the body (Adelekan *et al*., 2016). Minerals are inorganic substances necessary for maintaining good health.

The results of the sensory properties of Chin-chin produced from WF: GSF: PPF blends are shown in Table 3. The control Sample (100%WF) was ranked highest in all the sensory attributes assessed in this study with values of 6.78 (colour); 7.49 (Taste); 1.70 (Aroma); 7.25 (Crispness) and 7.95 (General - acceptability). It was observed however that out of the

Chin-chin samples produced from the flour blends; the Chin-chin produces from 80WF: 10 GSF: 10PPF blends has the best rating in all the quality attributes.

There was no significant difference among the four samples in terms of colour, taste and crispness. But Chin- chin samples produced from the composite flour blends (90:5:5; 80:10:10 and 70: 15: 15) did not differ in all the quality attributes evaluated in this study. The results of the sensory properties in this study showed that substitution with 10% GSF and 10% PPF produced the best chin-chin samples among the chin-chin samples produced from all the composite flours.

5. Conclusion

Substituting wheat flour with germinated Sorghum flour (GSF) and Pigeon pea flour (PPF) to produce chin-chin improved some of the proximate composition (ash, fibre, protein and fat) as their values increased as the level of GSF and PPF increased in the flour blends. A corresponding decrease in the carbohydrate content from 72.27 to 61.82% was recorded. Also the reduction in the moisture content is an indication of a good shelf stability of the flours produced. The substitution on the other hand also led to the increase in three of the mineral elements evaluated in this study as they are sodium, potassium or magnesium while the values of zinc reduced along the line. It should be noted that zinc was the most abundant among all the mineral elements asserted in this study.

The sensory scores of the chin- chin produced from the composite flours were slightly lower than that from 100% Wheat flour. It was however observed that Chin- chin produces from 80WF: 10GSF: 10PPF was ranked best in all the sensory quality attributes (colour, taste, aroma, crispness and general -acceptability) assessed out of the samples produced from the composite flours. No significant difference exists among the four samples produced in terms of colour, taste and crispness.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] Abioye, V.F., Olatunde, S.J. and Elias, G. (2018). Quality attributes of cookies produced from composite flours of wheat, germinated finger millet flour and African yam bean. *International Journal of Research –Granhaalayah*, 6(11): 172-183.

[2] Adebowale, A.A., Sanni, L.O. and Awonorin, S.O. (2005). Effect of texture modifiers on the physicochemical and sensory properties of dried fufu. *Food Sci. Tech. Int*. 11, 373–382.

[3] Adegunwa M.O, Ganiyu A.A, Bakere H.A &Adebowale A.A (2014). Quality evaluation of composite sorghum Wheat, pigeonpea chin-hin. *Agricultural and Biology journal of North America*,5(1), 33-39.

[4] Adelekan, A.O. Arisa, N.U. and Ogunseye, F.R. (2016) Physicochemical, Nutritional and Sensory Characteristics of Chin-chin made from Trifolate yam flour enriched with pumpkin seeds flour. *Journal of Food Technology and Nutrition* 21(2): 44-52.

[5] Akubor, P.I. (2014): Chemical composition, functional properties and baking potential of African breadfruit kernel and wheat flour blends. *International Journal of Food Science and Technology*: 39: 223-229.

[6] AOAC (2005), Official methods of analysis, 18th Edition, Association of Official Analytical Chemists, Washington, D. C., U.S.A.

[7] Ayinde, F.A. Bolaji O.T, Abdulsalaam, R.B. and Osidipe O. (2012): Functional properties and quality evaluation of ‘kokoro’ blended with beniseed cake (sesame indicum). *African Journal of Food Science* 6(5): 117-123.

[8] Ayinde, F.A., Bolaji, O.T., Abdulsalaam, R.B. and Osidipe O.(2012). Functional properties and quality evaluation of kokoro blended with beniseed cake (Sesame indicum). *African Journal ofFood Science* 6(5): 117 – 123.

[9] Babarinde, G.O., Adeyanju, J.A., Ogunleye, K.Y. Adegbola, G.M., Ebun, A.A. and Wadele, D. (2020): Nutritional Composition of gluten -free flour from a blend of fonio (Digitariaiburna) and Pigeon pea (Cajanuscajan) and its suitability for breakfast food. *Journal of Food Science and Technology*.

[10] Babarinde, G.O., Alawode, O.W; Adesola, M.O, Taiwo, O.U and Adejumon, S.O. (2022): Nutritional Composition and functional properties of Cake produced from blends of Unripe Plantain, Pigeon Pea and Orange fleshed-sweet Potato flour. Proceedings of the 8th Regional Food Science and Technology Summit (ReFoSTS) held at University of Ibadan, Nigeria. Pp 404 - 409.

[11] Cook, B.G, B.Cpengelly, S. D. Brown, J.H. Donnelly,D.A. Eagles,M.A. France, J.Hanson, B.F. Mullen, and R.schultze. kraft. (2015): Typical forages.an interactive selection tools. Cajanuscajan. CSIRU, OPI&COidj, GAT, and ILRI, Bristibane Australia.

[12] Fashoyiro, T.O. (2019a) Complimenting the low nutrient density starch Staples (Fashoyiro et al., 2019b).

[13] Garvin, D.F., Welch, R.M. and Finley, J.W. (2006): Historical shifts in the seed mineral micronutrient concentration of United State Hard red winter wheat germplasm, *Journal of the Source of Food and Agriculture:* 86(2) : 213-220.

[14] Lobstein T, Baur L, Uauy R (2014): Obesity in children and young people: a crisis in public health. Obes. Rev 5(suppl. 1):4-85.

[15] Maunder, B. (2016) "SORGHUM: the global grain of the future", from national sorghum producers. 2016. What is sorghum? www.sorghum rowers.com/sorghum Hol,(Accessed may 18, 2016).

[16] McDonough, C. M., Rooney, L. W., and Earp, C. F. (2016). Structural characteristics of Eleusine coracana (Finger millet) using scanning electron and fluorescence microscopy. Food Microstructure, 5, 247–256.

[17] Ogundowole, O., Oluwafemi, T.N., Faboya, E.T., Omosuli, S.V. and Oloye, P.O. (2022): Proximate and Antinutrient properties of Cassava - Pigeon Pea flour. Proceeding of the 8th Regional Food Science and Technology Summit (ReFoSTS) Held at University of Ibadan, Nigeria. Pp 128 - 133.

[18] Ojo, T.P.; Oluwafemi, G.I and Ojo, O.J. (2019) Physiochemical Properties of Cassava - Pigeon Pea flour blends. Proceedings of the 5th Regional Food Science and Technology Summit (ReFoSTS) held at University of Ilorin, Nigeria. Pp 319 - 324.

[19] Onuka, J.E. (2005): Functional properties of Proteins (Alfafa leaf protein). *Journal of Food Science*. 41: 286-292.

[20] Raheena, B.M. (2007) A textbook of Foods, Nutrition and Dietetics (2nd Edition). Published by Sterling Publisher's Privates Ltd; New Delhi, India PP 106-109.

[21] Sathe, S. K. and Salunkhe, D. K. (2012). Effects of germination on proteins, raffinose oligosaccharides and anti-nutritional factors in the Great Northern beans (*Phaseolusvalganis, L.*). *Journal of Food Science*, 18, 234–245.

[22] Sathe, S. K., Shamsudin, R. and Salunkhe, D. K. (1982). Effects of germination on proteins, raffinose oligosaccharides and anti-nutritional factors in the Great Northern beans (*Phaseolusvalganis, L.*). *Journal of Food Science*, 18, 234–245.

[23] Shewry, P.R. (2007): Improving the protein content and composition of cereal grain. *Journal of Cereal Science*, 46:239-250.

[24] Tiwari, B.K., Tiwari, U., Mohan, R.J. and Alagusundaram, K. (2018): Effects of various pre-treatments on functional, physicochemical and cooking properties of pigeon pea (*Cajanuscajan* L.) Food Sci. Technol.; 14:487–495.