PROXIMATE COMPOSITION AND CONSUMER ACCEPTANCE OF COOKIES PRODUCED FROM COCOYAM AND MALTED SOYBEANS FLOUR

*Azeez, L.A., Adedokun, S.O., Adeoti, O.A., Babalola, J.O. and Elutilo, O.O.
Department of Food Science and Technology,
The Oke –Ogun Polytechnic, Saki, Oyo state, Nigeria.
*Correspondence Author: E-mail: azeezlukuman02@gmail.com Tel: 08153921979

Abstract

The production and quality evaluation of cookies produced from the blend of cocoyam and malted soybeans flour were studied. The cookies were formulated from blends of cocoyam-malted soybean flour in the ratio 95: 5, 90: 10, 85: 15 and 100 % wheat flour (control). The flour blends were evaluated for functional properties while the cookies produced were evaluated for proximate composition, minerals and sensory properties. Results of the proximate composition analysis showed that addition of soybean seed powder significantly increased the protein content (13.01-16.99 %. The moisture content increased from 3.05 -5.06 %, fiber content ranged from 1.62-2.04 %, ash content ranged from 1.84-4.89 %, fat content increased from 5.36-17.42 %, and carbohydrate content ranged from 54.21-75.12 %. Tapped bulk density (0.48 – 0.67((g/ml)), bulk density (0.68– 0.92((g/ml)), swelling capacity (3.73 – 4.58((g/ml)), oil absorption capacity (0.90 – 1.13((g/ml)) and water absorption capacity (1.00 – 2.13 ((g/ml)). The mineral analysis of the sample showed no significant difference ($p<0.05$) in the values for all the parameters analysed, calcium content (0.01-0.08 %), phosphorus (0.1 – 0.16 %), zinc (0.02-0.03 %) and iron content (0.02 – 0.93 %). Results of the sensory evaluation showed that cookies produced from 85 % cocoyam flour, 15 % malted soybean flour was the most acceptable among the tested samples. Addition of malted soybeans flour to cocoyam flour to formed blends successfully and greatly improve the nutritional quality of cookies.

Keywords: *Cocoyam, soybeans, cookies, Proximate Composition, Mineral Content, Sensory Evaluation*

Introduction

Cookies are nutritive snacks made from unpalatable dough that is processed into appetizing product through the application of heat in an oven (Anozie *et al.*, 2014). They differ from other baked product like bread because they contain low moisture content making them comparatively free from microbial spoilage and enhance the self-life and eating quality of the product (Hanan and Al-Sayed, 2013). Thakur and Saxena (2000) reported an increased demand for functional food, attempts are being made to improve the nutritive value and functionality of snacks by modifying their nutritive composition. This involves the incorporation of non-wheat flour with attempt to increase the protein content and nutritive value of the snacks.

Cocoyam *(Xenthosoma sagilthfelium*) is a monocotyledon plant and a tropical plant grown primarily as a root crop for its edible corm. Boudjeko *et al., (*2005) reported that cocoyam is a rich source of energy and a well-acceptable staple food. Cocoyam is a good source of medicinal food for diabetic patients because it has low starch content, is easily digestible, and contains protein more than the other root tubers (Okunade and Arinola, 2021).

Soybean *(Glycine max)* is an annual herbaceous legume plant of the pea family Leguminosae and subfamily Papilionnidea (Kure *et al*, 1998). Iwe (2003) soybean is an important source of vegetable protein (35-40%) with excellent source of the essential amino acid, it also contains a valuable amount of methionine lacking in cereal, which makes it a good supplement for cereal.

Malted soybeans are legumes that have been dried through a malting process, which `involve soaking, germination and drying. During the malting stage the enzyme convert starch into more digestible maltose and increase the absorption rate of vitamin during digestion. (Chinma & Gernah, 2007). The research is aimed to investigate the quality evaluation of functional cookies produced from the blend of cocoyam and malted soybeans flour as a positive way forward in adding value to indigenous food crops.

Materials and Methods

Materials

Cocoyam (*Xanthosoma sagittifollium*) were purchased from Oje market Ibadan, Oyo state. Commercial wheat flour (Golden Penny, Flourmills of Nigeria Limited) and other ingredients such as Soybeans, milk powder, sugar, egg, salt, margarine, and other ingredients were obtained from Owode market Sango Saki. Equipment, and other facilities used in the research work was obtained from the laboratory of Food Science and Technology, of Oke-Ogun Polytechnic Saki along the latitude 8° North and longitude 3° East.

Methods

Preparation of Cocoyam

The cocoyam tubers (*xanthosoma Sagittifolium*) were processed into flour using the method described by (Oti and Akobundu, 2007). The cocoyam tubers were washed, peeled, sliced (0.5 cm thickness) and re -washed in water and blanched at 75ºc for 5 minutes in potable water. The blanched sliced was oven dried at 60ºc for 7 hours and milled into flour, sieved to yield flour of fine texture. The cocoyam flour was packaged in moisture proof polyethylene film and kept at ambient conditions (28±2 ºC) for further use.

Preparation of Malted soybean flour

Malted soybean flour was processed by the method described by Iwe (2003) the Soybean seeds was sorted, cleaned, washed and soaked overnight in a stainless steel bucket containing clean tap water, and was drained the following day, spread on a clean jute bag and covered to screen from direct sun light. Water containing 1% sodium hypochlorite was sprinkled twice a day on the soybean at the intervals of nine (9) hrs. to prevent the growth of microorganisms. The seeds were allowed to germinate for 96 hrs. at room temperature, dried in cabinet drier at 60ºC for 8 hrs., The dried seeds were ground, sieved and packaged in polyethylene bags until further analysis.

Formulation of Composite Flour

The composite flours used for the cookies production were obtained by mixing the flour blend of cocoyam and malted soybean together in different proportion (0:100; 95:5; 90:10 and 85:15 using a Kenwood blender (Model HM400). packed in polyethene container.

Preparation of Cookies

The cookies were produced using the method described by Okoye and Onyekwelu, (2018) 100 g of fat and 120grams of sugar was creamed to a smooth consistency in a clean bowl. Flours were added to the mixture then 50ml of egg and 5 grams of milk was added and mixed. The dry ingredients: the flour blend, baking powder and salt were mixed together, followed by 5 grams of vanilla flavour and 5 grams of nutmeg was mixed, the mixtures were thoroughly mixed into smooth dough with water. The dough was kneaded into uniform thickness, cut into shapes, placed in greased pans, egg washed .and baked at 150°C for 20 min. The cookies were packaged in cellophane bags prior to analysis.

Chemical Analyses

Proximate Composition

The proximate composition of the samples (The crude proteins, ash, crude fiber, crude fat, moisture and carbohydrates contents) was analyzed using AOAC (2012) methods.

Mineral Analysis

The cookies sample (5 g) was ashed, and the selected minerals, including Calcium, Phosphorus, Iron and Zinc were determined by atomic absorption spectrophotometer (Model 372) (AOAC, 2005).

Functional Properties of the Flour Blends

The bulk density and total bulk density of the flour samples was determined as described by Murphy *et al*. 2003). Water and oil absorption capacity of the flour was determined using the method of Onwuka (2005). Swelling capacity of the flour samples was determined as described by Oyeyinka *et al* (2013).

Sensory Evaluation

The cookies were subjected to sensory attributes for consumer's acceptance using 50 untrained panelists. The sensory evaluation of cookies samples was rated on a 9-point hedonic scale (1= dislike extremely, 5= neither like nor dislike, and 9= like extremely) to evaluate the coded samples for colour, taste, aroma, texture, crispiness and overall acceptability.

Statistical Analysis
All data were subjected to statistical analysis of variance (ANOVA). Means was separated using the Duncan's Multiple Range Test to detect significant difference (p<0.05) among the sample.

Results and discussions

Proximate Analysis of the sample

The result of the proximate composition of cookies produced from the blends of cocoyam and malted soybean flour was shown in Table 1. Moisture content of the sample ranged from 3.05 to5.06%, sample 421 (100% wheat flour) having the lowest value while sample 425 having the highest value. Significantly difference existed in sample 421. Atobatele and Afolabi (2016), reported the value of (5.45%) in the chemical composition and sensory evaluation of cookies baked from the blends of soya bean and maize flours which was higher than the value (3.05 to5.06%,) obtained in this work.

Protein content of the cookies varied from 13.01 to 16.99%, sample 421 having the lowest protein content of 13.0% while sample 425 having the highest content of 16.99%. Significant differences of (p< 0.05) existed in the protein content of the all the samples. An increase in protein content in sample 425 could be due to added malted soybean flour containing high percentage (85% cocoyam and 15 % malted soybean flour) of protein, similar protein content value was reported by Agu *et al*., *(*2015), in production and evaluation of malted soybean-acha composite flour bread and biscuit. The increase in the protein content proven that added malted soybean to be a good source of inexpensive protein (Okpala and Okoli, 2011).

Also from Table 1, the fat content of the cookies ranged from 5.36 to 17.42%. Least value was shown in sample 421 while sample 425 having the highest value. Significant difference of (p < 0.05) existed in sample 421. The results (5.36 to 17.42%) was higher than the finding of Wardlaw, (2004) who recorded (2.52 to 4.80 %) on the effect of partially de-oiled peanut meal flour (DPMF) on the nutritional, textural, organoleptic and physicochemical properties of biscuits. An increase in the fat content of sample 425 could be due to the high fat content of the malted soybean (Iwe, 2003).

Crude fiber of the sample ranged from 1.62 to 2.04%. Sample 421 having the lowest crude content of 1.62 % while sample 425 having the highest content of 2.04%. Okpala *et al*., (2013) reported similar value in the evaluation of quality attribute of soy breakfast cereal flour. Significant differences existed in sample 421.

Ash content of the sample ranged from 1.84 to 4.89%, sample 421 having the least ash content while sample 425 having the highest ash content. Significant differences of (p < 0.05) existed in sample 421, and 425. The high ash content of the product suggests their richness in the specific minerals (Agu *et al*., 2015). The value (1.84 to 4.89%) obtained is comparable with (2.20 to 2.57 %) reported by Abayomi *et al*., (2013) in the Quality Evaluation of cookies produced from blends of sweet potato and fermented soybean flour. okpala *et al.*, (2015) reported similar ash content in the physiochemical and sensory properties of wheat-cassava, soy enriched composites cookies.

Carbohydrate content of the sample ranged from 54.21 to 75.12%. Sample 425, cookies produced from 85 % cocoyam and 25 % malted soybean flour having the lowest Carbohydrate content of 54.21 % while sample 421 cookies produced from 100% wheat flour having the highest carbohydrate content of 75.12 %. Iwegbue, (2012). recorded (72.28%) in the Nutritional and evaluation of cookies produced from pigeon pea, cocoyam and sorghum flour blends which was comparable to the value (75.12 %) obtained in this work.

Table 1: Results of the Proximate Analysis of the Cookies Samples

Samples	Moisture%	Protein%	Fat%	Fiber%	Ash%	Carbohydrate%
421	3.05^{a}±0.07	13.01^{d}±0.19	5.36^{c}±0.98	1.62^{b}±0.13	1.84^{d}±0.30	75.12^{a}±1.67
423	5.06^{c}±0.07	15.72^{b}±0.19	11.48^{b}±0.74	1.95^{a}±0.09	3.99^{b}±0.15	61.8^{b}±1.37
424	4.33^{b}±0.16	16.82^{a}±0.00	16.35^{a}±0.92	2.00^{a}±0.11	4.31^{b}±0.05	56.19^{c}±1.51
425	4.45^{b}±0.28	16.99^{a}±0.25	17.42^{a}±1.29	2.04^{a}±0.10	4.89^{a}±0.16	54.21^{c}±0.00

Means value with the same superscript within the column are not significantly different (p > 0.05)

Keys:
421 100% wheat flour
423 95% cocoyam flour, 5 % malted soybean flour
424 90% cocoyam flour, 10 % malted soybean flour
425 85% cocoyam flour, 15 % malted soybean flou

Mineral Composition of the Cookies

The result of the mineral properties of cookies samples produced from blends of cocoyam flour and malted soybean flour was shown in Table 2. Calcium content of the sample varied from 0.01 to 0.08 mg/kg. Sample 421, cookies produced from 100% wheat flour having the lowest calcium contentof0.01mg/kg while sample 425 having the highest calcium content of 0.08 mg/kg. Significant differences of ($p < 0.05$) exist in the Calcium content of the samples. An increase in the calcium content of sample 425, cookies produced from 85 % cocoyam and 15 % malted soybean flour could be due to the fact that cocoyam is naturally rich in calcium, with high incorporation level of malted soybean flour which is also rich in calcium.

Phosphorus content of the cookies varied from 0.10 to 0.16 mg/kg, minimum value of 0.10 was recorded in sample 421 while a maximum value of 0.16 mg/kg was recorded in sample 425.Significant difference of ($p < 0.05$) exist in the Phosphorus content of the samples. Iron content of the samples ranged from 0.02 to 0.83mg/kg which indicate that sample 421, have least iron content value while sample 424 have the highest iron content value. From the result the iron content of the cookies increases with an increase in the incorporation level of malted soybean. The iron content of all the cookies were ($p < 0.05$) significantly different. There was no significant different in zinc values of all the samples and all the cookies' samples have the same zinc value of 0.02 mg/kg. Peter-Ikechukwu (2023) reported the value 0.24 mg/ kg in Chemical Composition and Sensory Evaluation of Cookies Baked from the Blends from the Blends of Soya Bean and Maize Flours.

Table 2: Result of the Mineral Analysis of the Cookies Samples

Samples	Calcium (mg/kg)	Phosphorus (mg/kg)	Iron (mg/kg)	Zinc (mg/kg)
421	$0.01^{c}\pm0.00$	$0.10^{c}\pm0.00$	$0.02^{e}\pm0.00$	$0.02^{b}\pm0.00$
423	$005^{a}\pm0.00$	$0.15^{b}\pm0.00$	$0.63^{d}\pm0.00$	$0.02^{b}\pm0.00$
424	$0.06^{c}\pm0.00$	$0.15^{b}\pm0.00$	$0.83^{a}\pm0.00$	$0.03^{b}\pm0.00$
425	$0.08^{b}\pm0.00$	$0.16^{a}\pm0.00$	$0.93^{b}\pm0.00$	$0.02^{a}\pm0.00$

Means value with the same superscript within the column are not significantly different ($p > 0.05$)
Keys:
421 100% wheat flour
423 95 % cocoyam flour, 5 % malted soybean flour
424 90 % cocoyam flour, 10 % malted soybean flour
425 85 % cocoyam flour, 15 % malted soybean flour

Functional Properties of the Cookies

The result of the functional composition of the flour blends of cocoyam and malted soybean flour are presented in Table 3. The bulk density of flour blend ranged from 0.68 to 0.92 g/cm^3, sample 421, having the least value, while sample 423 having the highest value. Bulk density of the flour increases with an incorporation level of cocoyam flour. Significant differences of ($p<0.05$) existed in all the flour samples. Bulk density measures the heaviness of the flour, it is important in determining packaging requirement, materials handling and application of wet processing in food industry (Abraham and Jayamuthungal, 2014).

Tapped bulk density of the cookie's samples ranged from 0.48 to 0.67 g/cm^{3,} sample 421 having the least value of tapped bulk density while sample 423 having the highest tapped bulk density. There were no significant differences in the tapped bulk density of the sample at ($p >0.05$).

Water absorption capacity of the samples varied from 1.00 to 2.13%, significant differences of ($p > 0.05$) existed in the water absorption capacity of the samples. Water absorption capacity describes how the flour associate with limit amount of water (Adegunwa *et al*., 2019).

Singh *et al.,* (2000) reported the 2.04% which was comparable to the value obtained in this work. Flours with high water absorption capacity would be very useful in bakery products as this could prevent staling by reducing moisture loss (Okpala *et al.,* 2013). Water absorption capacity is important in the development of ready to eat foods and a high capacity may assure product cohesiveness (Okpala and Chinyelu, 2011).

Oil absorption capacity of the sample ranged from 0.90 to1.13 % sample 421, having the least value of 0.90% while sample 423 having the highest value of 1.13 %. Sample 422 and 423 have similar value of 1.13%. Significant different of (p> 0.05) existed in sample 421 compared to other samples. Oil absorption capacities are reported to be influenced by the nature and behavior of seed macromolecules especially, protein and the nature of starch (Okpala and Chinyelu, 2011).

Swelling capacity of the sample varied from 3.73 to 4.58 (g/g), sample 421 having the lowest value of 2.50 (g/g) while sample 423 having the highest value of 4.58(g/g). The results shown that the swelling capacity increased with the incorporation of cocoyam flour. Swelling capacity measure the hydration capacity of the flour because its determination is a weight measure of swollen starch granule obstructed by the water molecules (Iwegbue, 2012))

Table 3: Result of the Functional Analysis of the Flour Blend Samples

Samples	BD (g/ml)	TBD	WAC%	OAC	SC(g/g)
421	0.68^{d}±0.02	0 .48^{c}±0.00	1.00^{c}±0.03	0.90^{b}±0.00	3.73^{a}±0.32
423	0 .92^{d}±0.03	0 .67^{bc}±0.01	1.64^{b}±0.07	1.13^{a}±0.00	4.58^{a}±0.40
424	0.89^{c}±0.02	0.58^{abc}±0.01	1.56^{b}±0.06	1.13^{a}±0.00	4.42^{a}±0.45
425	0 .77^{a}±0.01	0 .56^{ab}±0.00	2.13^{a}±0.06	1.13^{a}±0.00	4.40^{b}±0.38

Means value with the same superscript within the column are not significantly different (p > 0.05)
Keys:
421 100% wheat flour
423 95 % cocoyam flour, 5 % malted soybean flour
424 90 % cocoyam flour, 10 % malted soybean flour
425 85 % cocoyam flour, 15 % malted soybean flour

Sensory Evaluation of the Cookies

The sensory evaluation of the Cookies produced from the Blends of Cocoyam and Malted Soybean Flour was shown in Table 4. In all the quality parameters analyzed for sensory evaluation the results of cookies produced from 100 % wheat flour (control) was the most acceptable, this was closely followed by sample 425. There was no significant different between sample 423,424 and 425. Cookies produced from composite flour of cocoyam malted soybean were compared favourably with the control.

Table 4: Sensory Evaluation of the Cookies Sample

Sample	Colour	Taste	Texture	Aroma	Crispiness	overall Acceptance
421	8.50^{a}±.88	8.30^{a}±.92	7.50^{a}±1.42	7.80^{a}±1.10	7.50^{a}±1.53	8.45^{a}±1.09
423	5.20^{b}±2.26	3.55^{c}±1.84	4.70^{c}±2.53	4.50^{c}±1.96	5.55^{b}±2.98	7.40^{c}±1.63
424	5.70^{b}±2.10	4.60^{bc}±2.62	5.25^{bc}±2.26	4.25^{c}±2.38	5.70^{b}±2.67	8.00^{c}±1.86
425	5.10^{b}±1.91	4.70^{bc}±2.22	4.70^{c}±2.22	4.10^{c}±2.59	5.65^{b}±3.09	8.10^{c}±1.68

Means value with the same superscript within the column are not significantly different (p > 0.05)
Keys:

421 100% wheat flour
423 95 % cocoyam flour, 5 % malted soybean flour
424 90 % cocoyam flour, 10 % malted soybean flour
425 85 % cocoyam flour, 15 % malted soybean flour

Conclusion

This research work demonstrated that acceptable cookies with nutritional advantage could be successfully produced from flour blends of cocoyam and malted soybean. The study revealed that cookies that was supplemented with 85% cocoyam flour and 15 % malted soybean generally have the highest protein and mineral content. Based on these facts, substitution of cocoyam flour with soybean flours up to 15 % level could be encouraged at commercial level. It is thus recommended that further research should be carried out on the antioxidant, phytochemical and anti-nutrient properties on both flours and cookies.

References

Abayomi, H. T., Oresanya, T. O., Opeifa, A. O., & Rasheed, T. R. (2013). Quality Evaluation of Cookies Produced from Blends of Sweet Potato and Fermented Soybean Flour. *International Journal of Biological, Biomolecular, Agricultural, Food and Biotechnological Engineering*, 7 (7): 642–643.

Abraham, A. & Jayamuthungai, J. (2014). An analytical study of jackfruit seed flour and its incorporation in pasta, Research Journal *of Biochemistry* (2): 1597-1610.

Adegunwa, M. O., Adelekan, E.O., Adebowale, A. A., Bakare, H. A. & Alamu, E. O. (2019). Evaluation of nutritional and functional properties of plantain (*Musa paradisiaca L*.) and tigernt (Cyperus esculentus L.) flour blends for food formulations. Cogent chemistry, 3(1): 13 -20.

Agu, H.O, Ayo J.A & Jideani A. (2015). Evaluation of the Quality of Malted Acha-soy Breakfast Cereal Flour *journal of food chemistry* 25(7): 156-169.

Anozie, G. O., China, M. A., & Beleya, E. A. (2014). Sensory evaluation and proximate composition of snacks produced from composite flour of *Discorea alata* flours. *Journal of Home Economic Research, (*20): 100–108.

A.O.A.C. (2012). Association of Official Analytical Chemists Official methods of analysis (18th ed.). Washington, D. C.USA.

A.O.A.C. (2005). Association of Official Analytical Chemists, Official methods of analysis (18th ed.). Washington, D C.USA.

Atobatele, O.B. & Afolabi, M.O. (2016). Chemical Composition and Sensory Evaluation of Cookies Baked from the Blends of Soya Bean and Maize Flours. *Journal of Applied Tropical Agriculture*, 21(2): 8-13.

Boudjeko, T., Mbouobda, H. D, & Omokolo, D. N. (2005). Morphological Characterization and Agronomic Evaluation of Cocoyam. *Journal of Biological Sciences, (*1): 27- 33.

Chinma, C. E. & Gernah, D. I. (2007). Physiochemical and Sensory Properties of Cookies produced from Cassava, Soybean composite Flours. *Journal of Food Technology page* (5): 256-260.

Hanan, M, & Al-sayed, P. (2013). Quality characteristics of Cantaloupe seed oil and Cookies substituted with ground full fat and defatted seed. *Journal of Applied Science Research*, 9(1): 435-443.

Iwe, M.O, (2003). The science of soybean Chemistry Processing and Utilization. The Science and Technology of Soybeans, Chemistry Nutrition Processing and Utilization. 1st edition. Rejoint Communication Services Ltd., Uwani, Enugu.

Iwegbue, C.M.A, (2012). Metal Contents in Some Brand of Biscuits Consumed in Southern Nigeria. AMJ Food Technology, (7): 160-167.

Kure, O. A., Bahago, E. J. & Daniel, E. A. (1998). Studies on the proximate composition and effect of flour particle size on acceptability of biscuits produced from blends of soybeans and plantain flours. Namoda *Technology Scope Journal*, 3(2): 17-22.

Murphy, M. G., Skonberg D. I. & Camire M. E. (2003). Chemical composition and physical properties of extruded snacks containing crab processing products. *Journal of Food Science Agriculture*, (83): 1163-1167.

Okoye, E.C & Onyekwelu, C.N. (2018). Production and quality evaluation of enriched cookies from wheat, African yam bean and carrot composite flours 22(5):254 - 262

Okpala, L. C. & Okoli, E. C. (2011). Nutritional evaluation of cookies produced from pigeon pea cocoyam and sorghum flour blends. *African Journal Biotechnology,* 10(3): 433-438.

Okpala, L.C., Okoli, E. C. & Udensi, E. A. (2013). Physicochemical and sensory properties of cookies made from blends of germinated pigeon pea, fermented sorghum and cocoyam flours. *Food Science and Nutrition,* (4): 8–14.

Okpala, L.C. & Chinyelu, V. A (2011). Physicochemical, nutritional and organoleptic evaluation of cookies from pigeon pea (Cajanus cajain) and cocoyam (Xanthosoma sp) flour blends. *Africa Journal of Food Agriculture and Nutritional Development*, (11): 5431-5443.

Okunade, O.A. & Arinola, O. (2021). Physicochemical Properties of Native and Heat Moisture Treated Starches of White and Red Cocoyam (Colocasia esculenta) Varieties. Turkish *Journal of Agriculture - Food Science and Technology*, (5): 1195–1200.

Onwuka, G.I. (2005). Soaking, boiling and antinutritional factors in Pigeon Peas (*CajanusCajan*) and cowpeas (*Vigna Unguiculata*). *Journal of Food Processing and Preservation*, 30(5): 616-630.

Oti, E. & Akobundu, E. N. T. (2007). Physical,Functional and Amylograph Pasting Properties of Cocoyam Soybean Cray Fish Flour Blends. *Nigerian Food Journal*, 25(1): 161- 165.

Oyeyinka, S.A., Oyeyinka, A.T., Karim, O.R., Kayode, R. M.O., Balogun, M.A., & Balogun O.A. (2013): Quality sttributes of Weevils (Callosobruchus Maculatus) infested cowpea (Vigna Unguiculata) products. Nig. *J. of Agric. Food. and Environ.*, 9 (3): 16-22.

Peter-Ikechukwu1, G. C. Omeire1, N. O. Kabuo1, C. N. Eluchie1, C. & Amandikwa1 G. I. (2018). Production and Evaluation of Biscuits Made from Wheat Flour and Toasted Watermelon Seed Meal as Fat Substitute, 18(9):112-120.

Singh R. Singh G. & Chauhan G.S. (2000). Development of Soy Fortified Biscuit. *Journal of Food Science and Technology.* 17 (6): 56-72.

Thakur, S. & Saxena, D. C. (2000). Formulation of extruded snack food (gum-based cereal–pulse blend): Optimization of ingredients levels using response surface methodology. Technol., (33): 354-361.

Wardlaw, G. M. (2004). Perspectives in Nutrition. ((6th ed.). McGram Hill Companies, New York, U.S.A Yadav, D.N., Thakur, N. & Sunooj, K.V. (2012). Effect of partially de-oiled peanut meal flour (DPMF) on the nutritional, textural, organoleptic and physicochemical properties of biscuits. Food and Nutrition Science, (3): 471- 476.