Proceedings of the Annual Conference of the Agricultural Extension Society of Nigeria
Number: Twenty-Seventh Annual Conference
Theme: Enhancement of E-Agricultural Extension Systems
Date: 26-28, September 2022
Venue: Nnamdi Azikiwe University Awka
ISSN: 1595 – 1421.
Website: http://info@ajol.org .
Email: agricultural.extensionnigeria@gmail.com; editorinchief@aesonnigeria.org

Physiochemical, Proximate and Functional Analysis of Complementary Food Made from Maize, Dates, Groundnut and Soyabeans for Household Use.

https://dx.doi.org/10.4314/jae.v27i1.8S

Okwori[1], E and Zango[2], M
[1] National Agricultural Research Extension and Liaison Services (NAERLS), Ahmadu Bello University(A.B.U), Zaria, Nigeria.
[2]. Department of Home Economics, Ahmadu Bello University. Zaria, Nigeria
*Correspondence: estherokwori777@yahoo.com.Phone: 07068798168
http;//orcid.org/0000000257213926

Abstract
The study reports the physiochemical, proximate, functional and economic analysis of complementary food made from maize, dates, groundnut and soya beans. The proximate, elemental and mineral analyses were investigated by analyzing the moisture content, crude protein, crude oil, ash content, crude fibre, carbohydrate content, phosphorus and ascorbic acid. The Association of Official Analytical Chemists (AOAC, 1990) methods were used. The proximate composition of maize soya beans groundnut dates base complementary food shows moisture, 4.96 ± 0 .19, ash = 0.57 ± 0.03, lipid = 24.97 ± 0.12, protein = 13.15 ± 0.40, fibre = 0.00 ± 0.00, CHO = 56.36 ± 0. 11. Functional properties of maize soybeans groundnut dates based complementary food: bulk density (BD) = 0.66, Water Absorption Capacity (WAC) = 4.30, Oil holding Capacity (OHC) = 2.11, swelling capacity (SC) = 0.30, PH = 6.15. The sensory evaluation results was; aroma = 56.3333±45.74203, colour = 40.0000±35.80503, texture = 43.2500±37.55330, overall acceptability = 84.5000 ± 4.94975, palatability = 85.0000 ± 7.07107, taste = 56.3333±45.74203. Based on the results of the study, the following were drawn as conclusions from the study; the essential nutrients needed for the well-being of households and that of a growing child is present in appreciable amounts and have acceptable properties (Colour, texture, taste, etc.). Therefore, the study recommends that families or households should utilize these complementary foods, as they are relativity cheaper in procurement and nutritionally adequate.

Keywords: *Proximate, Functional analysis, Complementary Foods, Households*

Introduction:

In developing countries, such as Nigeria both household and complementary foods for children are mainly based on starchy tubers like cocoyam, and sweet potato or on cereals like maize, millet and sorghum. Complementary foods are any nutrient-containing foods or liquids other than breast milk given to young children along with breast milk within the 6-23 months window (UNICEF, 2016). During the time they are consumed, complementary foods make up a large proportion of the children's diet and contribute a significant amount of the nutrients that are necessary for growth and development (UNICEF, 2016, Carkramari and Rahamata 2016). Complementary foods are foods other than breast milk introduced to both younger and older children that provide nutrients for growth and development. Children are normally given these

staples in the form of gruels that is either mixed with boiled water or boiled with water (Otegbayo et al, 2018).

Thus, it is important that children receive appropriate, adequate and safe complementary food to ensure the right transition from breastfeeding to the full use of household foods. Lack of appropriate feeding (nutrition) can set up risk factors for ill health. The life-long impact may include poor school performance, reduced productivity, impaired intellectual and social development or chronic diseases (WHO, 2018, Kusuma, 2015,). The World Health Organization (WHO), 2018, Ojinnaka, et al., 2013) and UNICEF have been concerned about this trend, particularly of Protein Energy Malnutrition (PEM) and micronutrient deficiencies (Hidden Hunger) among households, particularly with children and pregnant women.

The United Nations Standing Committee on Nutrition (SCN) pointed out that malnutrition is directly and indirectly associated with more than 50% of all children mortality, and is a contributor to diseases in the developing world (WHO, 2017, Cirle & Smith, 2013, Ayo et al., 2014, Avar et al 2016). But when blends such as soybean, are prepared in the appropriate ratio and methods, the starch structures bind large amounts of water, which results in gruels with high viscosity. Seed proteins especially from leguminous sources such as soybeans have been put forward as potentially excellent sources of protein for the nutritionally quality upgrading of starchy roots and tubers for use in household foods. In Nigeria and indeed most developing countries the fundamental problem has been identified to include poverty, inadequate nutrient intake particularly during pregnancy, periods of rapid growth and complementary feeding in older children, ignorance about nutrient values of foodstuff and parasitic infections. Results of the 2015-2018 food consumption and nutrition survey showed a step increase in the incidence of child wasting between 6 and 12 months, which is the period of complementary feeding for most children (WHO, 2015, Adelagan et al 2013, Almana, 2014).

Major international and national efforts towards addressing these problems include nutritional supplementation, fortification of staple food and modification of traditional diets to meet specific requirements. The promotion and support of exclusive breastfeeding, and access to and the initiation of nutritious household food between ages 6 months remain essential components of activating optimal nutrition and malnutrition control programmes for infants and children. Failure to achieve these components predisposes older infants to malnutrition, growth retardation, infection and increased risk of mortality (Oyeniye et al, 2014, Mckinley, 2015, Mbaeyi et al 2015).

Most households depend on locally formulated diets for older and young children. The locally formulated foods (pap and porridges) are low in protein and high in anti-nutritional factors that reduce the bioavailability of some micronutrients. Poor processing and cooking methods also contribute substantially to the loss of micronutrients, leading to micronutrient deficiency disorders in children fed these foods (WHO, 2017, Abolaji et al., 2019) Different approaches have been adopted to combat the problem particularly “hidden hunger” in Nigeria and most developing countries. Various organizations and individuals have upheld that, the most sustainable solutions are those that are likely to be maintained in the long term. These would include food-based approaches like diet diversity, food fortification and bio-fortification which could be the most cost-effective of all public health interventions and thus within the

economic reach of even the world's poorest households. Thus, this study seeks to determine the physiochemical, proximate, functional and economic analysis of complementary food made from Dates, Maize, Soybeans and Groundnut (DMSG)

Methodology

Materials

Dates, Maize, Soybeans and Groundnut (DMSG) were obtained from Sabon- Gari market in Zaria, Kaduna State, Nigeria.

Research Design

Experimental research was adopted. According to Oskar (2008, AOCA, 2013)) experimental design is the process of planning a study to meet specified objectives. Planning an experiment properly is very important in order to ensure that the right type of data and sufficient sample size and power are available to answer the research questions of interest as clearly and efficiently as possible.

Preparation of Dates, Maize, Soybeans and Groundnut (DMSG) Flour

The procedure for the DMSG flour is as thus;

1. One tya (A measure used in the northwest of Nigeria equals 12 milk cups) of Soybeans was cleaned, washed to remove impurity and was boiled for 20 minutes and drained and then allowed to cool for 5-10 minutes and dried by air. The seed was fried using firewood, and a mortar and pestle were used to remove the fibre. A commercial engine was used to grind the seed into powder
2. One tya of Maize was washed to remove dirt and dried by air and grind into powder
3. One tya of Dates: the seed was removed and cleaned to remove dirt, dried and grind into powder
4. One tya Groundnut was clean and dried, fried to brown using firewood and allow to cool and also ground into powder
5. All the ingredients (100%) were mixed thoroughly
6. Packaged

Sensory Evaluation

Sensory evaluation was conducted for the complimentary food sample by 20 panelist lactating mothers consisting of staff and students of the Faculty of Education, Ahmadu Bello University, Zaria. The method of Larmond (1977, Oskar, 2008) was used for the sensory evaluation. Fifty grams of each of the complementary food samples were reconstituted with 250 ml of water (warm). The samples were rated using a 9-point hedonic scale with 9 indicating, "liked extremely", 5 indicating "neither liked nor disliked" and 1 indicating "disliked extremely". The samples were evaluated for taste, aroma, colour, mouth-feel consistency and overall acceptability. The panelists were given water to rinse their mouths after each sampling. The evaluation was carried out in Home Economic Food Laboratory

Proximate Analysis

Protein, moisture, fat, crude fibre, ash and carbohydrate were determined using Association of Official Agricultural Chemists (AOAC, 2013). The condensed ammonia is then back titrated with 0.01m HCL to pick color end point (Maitera, et al*.,* 2014, Oskar, 2008). % crude protein (Kjeldahl method) was calculated thus:% Nitrogen by weight N =$\frac{titre\ value\ (A) X\ 1.4x10^{-4}\ X\ Volume\ made\ X\ 100}{Aliquor\ taken\ X\ wt\ of\ sample\ digest}$% crude protein = N x 6.25, % of fibre was calculated as: $\frac{C2-C3\ X\ 100}{W}$ while % of moisture, fat, ash and carbohydrate was calculated as:$\frac{W2-W3\ X\ 100}{W2-W1}$**.**

Physicochemical and Functional Analyses

Packed bulk density was determined by the method of Hailru and Getache(2016). Loose bulk density was determined according to the method described by Yusuf (2013). The water absorption capacity (WAC) was determined at room temperature and at temperatures ranged between 60OC and 90OC using a combination of methods (Hind 2017; Heuze et al, 2015). Oil absorption capacity of the formulated samples was determined by the centrifugal method elicited by Beuchat (1977) with slight modifications. One gram of sample was mixed with 50 ml of pure edible palm olein oil for 60s; the mixture was allowed to stand for 10min at room temperature, centrifuged (0502 – 1 Hospibrand, USA) at 4000 x g for 30 min. The oil that separated was carefully decanted and the tubes were allowed to drain at a 45O angle for 10 min and then weighed. Oil absorption was express as percentage increase of the sample weight. Emulsifying capacity was determined using the method elicited by Rousseau et al., 2019).

Swelling index was done using the method of Otegbayo et al., (2018, Gemede, 2020) with slight modifications. A 10 g of the sample was transferred into a clean, dried, calibrated measuring cylinder. The sample was gently leveled by tapping and the initial volume recorded. A 50 ml of distilled water was added to the tube containing the sample and allowed to stand for 4h before observing the level of swelling. The value of swelling index (SI) was taken as the multiple of the original volume. Gelatinization temperature was determined using the method of Genah *et al*. (2012, Etiosa et al., 2018).

Data Analysis

Analysis of Variance (ANOVA) using SPSS version 23.0 determined statistical differences among samples. Mean were separated using Duncan's Multiple Range Test.

Results and Discussion

The Proximate Composition of Maize, Soya Beans and Groundnut Dates Based Complementary Food

The moisture content of the sample was obtained to be 4.96 $\pm$ 0.19. The protein and lipids contained in the sample are 13. 15 $\pm$ 0.40 and 24.97 $\pm$ 0.12.(Table 1) Values are expressed as mean $\pm$ standard deviation (SD) .

The carbohydrates level was the highest contributor as it contained 56.36 ± 0.11. The fibre level was the lowest contributor as it contained 0.00 ± 0.00. The ash content of the sample was obtained to be 0.57 ± 0.03.

Table 1: The proximate composition of maize, soya beans and groundnut dates base complementary food

Parameter	Values (%)
Moisture	4.96 ± 0 .19
Ash	0.57 ± 0.03
Lipid	24.97 ± 0.12
Protein	13.15 ± 0.40
Fibre	0.00 ± 0.00
CHO	56.36 ± 0. 11

Values are expressed as mean ± standard deviation (SD)

Functional Properties of Maize Soybeans Groundnut Dates Base Complementary Food

The analysis of the functional properties of product was carried out, and the result shows that, BD is 0.66g/ml, WAC is 4.30%, OHC is 2.11 m/g, SWC is 0.30m/g and PH is 6.15.(Table 2). Generally, it can be observed from the analysis carried out to determine the functional properties of flour that, flour is not really a heavy complementary food as it can be seen that the bulk density (BD), 0.66 g/ml, also flours water adsorption capacity, WAC is not too high, just 4.30%, Oil Holding Capacity, (OHC) of flour is found to be 2.11m/g, the swelling capacity, SWC is quite minimal, just 0.30 m/g and the PH of the flour is almost neutral, 6.15. this shows that flour is not alkaline in nature but also not highly acidic.

Table 2: Functional Properties of Maize Soybeans Groundnut Dates Base Complementary Food

Parameter	Concentration (g/ml/%/m/g)
Bulk Density (BD)	0.66
Water Absorption Capacity (WAC)	4.30
Oil Holding Capacity (OHC)	2.11
Swelling Capacity (SC)	0.30
PH	6.15

The Mineral Concentration of Maize Soybeans Groundnut Dates Base Complementary Food

The analysis for minerals was carried out and the result shows that phosphorus (P), was present in appreciable amount which is 670.70 mg/kg, while calcium (Ca), was found amounting to 1875.00 mg/kg, potassium (K), was found to be 307.15 mg/kg in amount. Generally, the sample we can say has very high essential nutritional requirements and this shows that it will be quite effective.

Table 3: The Mineral Concentration of Maize Soybeans Groundnut Dates Based Complementary Food

Parameter	Concentration (mg/kg)
Phosphorus (P)	670.70
Calcium (Ca)	1875.00
Potassium (K)	5375.00
Sodium (Na)	307.15

The photochemical and anti – nutritional factors of Maize Soybeans Groundnut Dates Base Complementary Food

The sample was analyzed, and the result shows that alkaloid is present in the sample and the amount is very low which is 1.02mg/100g, while phytate falls with 0.30mg/100g, tannin is also present and is 1.34mg/100gwhich shows that is also low, Oxalate is extremely low with 0.07mg/100g while Saponin has 18.22 mg/100g which is result of oil contexts in the sample. Generally the sample we can say has very low Anti-nutrients, which show it, will not affect children when consuming it.

Table 4: The photochemical and anti – nutritional factors of Maize Soybeans Groundnut Dates Base Complementary Food

Anti – nutritional factor	Concentration (%)
Alkaloid	1.02
Phytate	0.30
Tannin	1.34
Oxalate	0.07
Saponin	18.22

Sensory Evaluation Results

Mean $\pm$ Standard Deviation for the sensory evaluation of complementary food made with Date, Maize, Groundnuts and Soy beans (DMGS). The result shows high acceptability and palatability rate, which has the mean and standard deviation of 84.5000±4.94975 and 85.0000±7.07107 respectively.

Table 5: Sensory evaluation results

Aroma	Colour	Texture	Overall Acceptability	palatability	taste
56.3333 ±45.742 03	40.0000 ±35.805 03	43.2500 ±37.553 30	84.5000±4.94 975	85.0000±7. 07107	56.3333 ±45.742 03

The results of the sensory evaluation of the complementary food are shown in Table 5. The result shows an average likeness of the formulated complementary foods with respect to the aroma, colour, texture, overall acceptability, palatability and taste. The mean scores and standard deviation ranges of attributes evaluated were: aroma (56.3333±45.74203), colour (40.0000±35.80503), texture (43.2500±37.55330), overall acceptability (84.5000±4.94975), palatability (85.0000±7.07107) and taste (56.3333±45.74203). Taste is an important parameter when evaluating sensory attributes of food. The product might be appealing and have a good aroma but without good taste, such a product is likely to be unacceptable. Appearance is an important attribute in food choice and acceptance. Aroma is an integral part of the taste and general acceptance of the food before it is put in the mouth. It is therefore an important parameter when testing the acceptability of formulated foods (Bermoth, 2015, Pruulavic et al., 2016), . According to Bermoth *et al.* (2015), sensory qualities of complementary food formulations correspond to food preferences for infants and young children are of the highest importance. Sensory evaluation is easy in its principle but its implementation in the field is often complicated because of low literacy among the rural mothers' and the difficulty for them to understand some sensory testing methods.

The moisture content of the sample was obtained to be 4.96 $\pm$ 0.19. The protein and lipids contained in the sample are 13. 15 $\pm$ 0.40 and 24.97 $\pm$ 0.12. The carbohydrates level was the highest contributor as it contained 56.36 $\pm$ 0.11. The fibre level was the lowest contributor as it contained 0.00 $\pm$ 0.00. The ash contents of the sample were obtained to be 0.57 $\pm$ 0.03.

Conclusion and Recommendations

Based on the result gathered from the study on physiochemical, proximate and functional analysis of complementary foods made from maize, soya beans, groundnut and dates; it can be said that; the essential nutrients needed for the well being of households, mothers and the growing child are present in appreciable amount. The amount of these essential nutrient (phosphorus, calcium and potassium), according to the proximate analysis has been found to supersede those of the anti-nutritional factors of these same complementary foods. These anti-nutritional factors that include: Alkaloid, Phytate, Tanin, Oxalate and Saponin, according to the analysis carried out have been found to be in a very minimal amount.

Health workers within communities with nutritionists should organize meetings in the community to educate households, mothers and the community in general on the importance of using available food materials like maize, groundnut and soybean within the community for nutrient adequacy and cost effectiveness

References

Abolaji, B.F., Edeke, E.F., and Ajake, S.M (2019). Evaluation of Chemical, Functional and Sensory Properties of Flour Blends from Sorghum, African Yam Bean and Soybean for Use as Complementary Feeding. International Journal of Food Science and technology.5 (3) pp74 – 81.

Adelakan, O. E., Duadu, K.G., Buys, E and Olanipekun, B,F,. (2013) Potential use of soybean flour in food fortification. Interch. pp,513 – 520

AOAC (2013). Official Methods of Analysis. Association of Official Analytical Chemists.18th edition Washington D.C pp. 216 – 246

Ayo, J.A., Ajo, V.A, Poppla, C., Omasebi, M. and Joseph, l (2014) production and evaluation of malted soybean-acha composite flour bread and biscuit. African Journal of food science and technology; 5(11): 21 -28

Almana, H.A., (2014) Palm Date seeds an an alternative source of dietary fibre in Saudi bread. ecology of food and Nutrition, 32(3-4);261 – 270

Ayar, A., Sert., D,., Kalyoncu, H.I and Yazici, F., (2016) Physical, chemical nutritional and organoleptic characteristics of fruit added yoghurts. Journal of food Technology, 4 (1);44 -49.

Bennett, J. Michael; Rhetoric, Emeritus; Hicks, Dale R.; Naeve, Seth L.; Bennett, Nancy Bush (2014). The Minnesota Soybean Field Book (PDF). St Paul, MN: University of Minnesota Extension. p. 33. Archived from the original (PDF) . Retrieved January16, 2022.

Cakrawati, D., and Rahmawati, P(2016) The Effect of Madfield Potatoes Flour Substitution on the Organoleptic Characteristics of Toddler Biscuit IOP Conference. Series : Materials Science and Engineering .128012053

Circle, S. J. and Smith, A. H. (2013). Soybeans: Chemistry and Technology. Westport, CT: Avi Publishing. pp. 104, 163. ISBN 978-0-87055-111-6.

El-Juhany, L., (2010). Degradation of date palm trees and date production in Arab countries: causes and potential rehabilitation. Aust. J. Basic Appl. Sci., 4 (8): 3998-4010

Etiosa, O. R., Nnadizie,B.C and Anuge, B. (2018) Mineral and Proximate Composition of Soy-bean. Asian Journal of Physical and Chemical Science, 4(3) 1 – 6.

Gemede, H.F.(2020). Nutritional and Anti nutritional evaluation of complementary foods formulated from Maize, Peas and anchote flours. Food Science Nutrition. 2020;8; 2164.https://doi.org/10.1002/fsn3.1516.

Gernah, R.E., Allen, L.H., Bhutta, Z.A., Caulfield, L.E., Ezzati, M., Mathers, C., Rivera, J. (2016). Maternal and Child Under nutrition Study Group. Maternal and child under-nutrition: global and regional exposures and health consequences. Lancet 2008;371:243–60.

Hailu, A.A and Getache, w, A (2016) The content and Bioavailability of Meral Nutrients of selected Wild and Traditional Eatable Plants as affected by Household Preparation methods Practiced by Local Community in benishangul Gumuz regional State. Ethiopia International Journal of Food Science.http://www.ncbi.nlm.nih.gov/pubmed/16929

Heuzé V., Tran G., Giger-Reverdin S., Lebas F.(2015). Perennial soybean (Neonotonia wightii). Feedipedia,a programme by INRA, CIRAD, AFZ and FAO. https://www.feedipedia.org/node/293 Last updated on January 30, 2022, 15:09

Hind, A.A (2017) Chemical composition, Flavonoids and B-sitasterol contents of pulp and rind of watermelon fruit. Pakistan Journal of Nutrition, 16; 502 – 507

Kusuma, N.B.(2015) Soybean consumption and health benefits. International Journal of scientific and technology Research, 4(7): 50-53

Mckinley,M.C (2015). The nutrient and health benefits of yoghurt; international Journal of Dairy Technology, 58(1); 1-12

Mbaeyi – Nwaoha, I.O., Nnagbo, C.L., Obadaechi, C.M Nweze B.. C., and Okonkwo, T.M(2021) Production and evaluation of yoyhurt contained local stabilizers-Brachystegliaeurycama (ACHI) and Detariummicracarpium (OFO). International Journal of Biotechnology and Food Science. Vol 5 (2).pp 23 – 31

Otegbayo, B.O., Ogunniyan, D.J., Olunlade, B.A., Oroniran, O.O and Atobatele, O.E (2018) Characteristizing genotypic variation in biochemical Composition, anti nutritional and Mineral bioavailability of some Nigerian yam(Dioscareaspp)land Journal of Food Science and Technology. Vol 55(1). 205-216

Ojinnaka, M. C., Ebinyasi, C. S., Ihemeje, A. and Okorie, S. U. 2013. Nutritional Evaluation of Complementary Food Gruels Formulated from Blends of Soybean Flour and Ginger Modified Cocoyam Starch. Advance Journal of Food Science and Technology 5(10): 1325- 1330

Oyeniyi, A.O., Awarrh, OC and Olaniyan, J,O (2014) Effects of Flavourings on Quality and consumer acceptability of soy – yoghurt IOSR *Journal of Environmental Science, Toxicology and Food Techology, 8(1); 38 -44*

Oskar, B. (2008). Experimental Research. Retrieved April 02, 2022 from Explorable.com: https://explorable.com/experimental-research

Prvulavic, D., Malencie, D and Miladinovic, J(2016) Antioxidant activity and phenolic content of soybean seed extracts.Agro- Knowledge, 17(2).121 – 132

Peter R. S. and Rod, C. (Eds) (2017). Seed Proteins;. Kluwer Academic Publishers, Dordrecht,

Sanni, O and Oladapo, F.O. (2008). Chemical, Functional and Sensory Properties of Instant Yam Bread Fruit Flour. *Nigerian Food Journal* 26:2-12.

Rousseau, S., Kyamugasho, C., Miete, C., Marc, E.G., Hendrick, X., and Grauwet, T(2019) Barriers impairing bioavailability in plant – based foods and the perspective for food processing.Critcal Reveiws in Food Science and Nutrition.DOI: 101080/110408398.2020/15/52243

United Nations International Children Emergency Funds (2016).The State of the World. Children. A Fair chance for every child. UNICEF.NewYork

WHO.(2015) WHO estimates of global burden of foodborne diseases: Food –borne Diseases burden epidemiology reverence group 20007- 2015 WHO Library Cataloging,1-

WHO. (2017). Food Safety Fact Sheet No. http://www.who.int/whr/2003/en/whr03_en.pdf?ua=1