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Nutrient and Antinutrient Composition of Bouillon Cubes Developed from Fermented Condiments of *Ricinus communis* L. Seeds

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Abstract

Fermented condiments are part of the diets of many African nations and, they serve as a good source of protein and other nutrients for rural populations. They are used as alternatives for expensive protein sources such as meat and egg in poor households. In Nigeria, these condiments are presented in slurry, paste or loose solid form and are usually wrapped in leaves. *Ricinus communis*, an oil seed plant that grows both in the tropical and temperate climate is one of the seeds processed into a fermented condiment and is locally known as "*ogiri*". The development of fermented bouillon cubes offers an opportunity to enhance the safety and attract more consumers to the product. This study therefore developed three samples of bouillon cubes (A, B and C) containing fermented *R. communis* seeds and binder (cassava starch) at ratio 20:5, 20:10 and 20:20, respectively. The bouillon cubes were subjected to proximate, total carotene, vitamin C, minerals and antinutrient analysis. The results showed that the protein and fat content decreased while the carbohydrate content increased significantly ($p < 0:05$) with increasing binder proportion. The protein content was 9.93 %, 7.04 % and 3.49 %, fat content was 29.33 %, 28.00 % and 22.77 % and carbohydrate content was 48.99 %, 52.46 % and 60.09 % for samples A, B and C, respectively. The total carotene increased with increasing binder concentration while the vitamin C did not vary significantly. As for the minerals, Na, K, Zn and Fe increased with increasing binder concentration while Ca did not vary significantly. Phytate was significantly higher in sample C (0.45 mg g-1) than samples A and B (0.35 and 0.32 mg g-1, respectively). In conclusion, the addition of cassava binder in the production of fermented bouillon cubes of *R. communis* produced products with decreased protein content, increased phytate content and, increased mineral and total carotene content. The use of high protein binders or blend of binders should be considered for the development of this novel product as they are known to be rich sources of protein.

Keywords: Bouillon cubes, fermented condiments, protein, *Ricinus communis*

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Introduction

Bouillon cubes are taste enhancers added to food to improve their palatability. Commercial bouillon cubes are composed of ingredients such as salt, sugar, flavour enhancers (monosodium glutamate), herbs, spices, pieces of vegetables, dyes and fragrances. Industrially, they are prepared by mixing these ingredients with powder-like fat and oil; and pressing to form cube shape (Mejia et al. 2015). *Ogiri*, a common condiment in Nigeria, is obtained by a traditional uncontrolled fermentation of oil seeds such as *Ricinus communis* L; also known as castor plant. Sometimes, the seeds of *Citrullus vulgaris* or *Telfairia occidentalis* are also used for making *ogiri*. Castor plant is one of the oldest cultivated crops. The plant (*R. communis* L.) is native to Africa, though widely distributed throughout the tropical, subtropical and some warm temperate regions of the world (Salihu et al. 2014). It grows in the wild in large quantities making it available and affordable to the rural poor.

Fermentation is used traditionally to improve the sensory qualities, digestibility and nutritional composition of foods (Edema and Fawole 2006). Fermented foods constitute a substantial part of African diets. Common among the different categories of fermented foods in Africa are condiments used for seasoning food. They are widely consumed in households and communities where animal protein is limited. The conventional substrates for these condiments' production are diverse but are mainly legumes and oil seeds. The fermentation of seeds dates back many centuries and was first described in the 14th century by Sina and Traore (2002). These condiments are usually in form of paste, slurry, loose solids or solids. Traditionally, they are wrapped in leaves; this presentation makes it less appealing and poses some safety concerns. The development of bouillon cubes from these condiments may help to remove the safety concerns and attract more consumers to the product. This study, therefore, seeks to develop bouillon cubes from fermented *Ricinus communis* L seeds in an effort to improve its acceptability and nutritional composition.

Material and Methods

Castor seeds were purchased from a local farm in Ogbomosho, Oyo State, Nigeria while cassava tubers were purchased from a local market (Bodija) in Ibadan, Oyo State. Cassava starch was obtained by peeling, grating and mixing the tubers with water; and screening using muslin cloth. The starch extracted was dried in a food dehydrator at 65^0C, milled and sieved with 150 mm mesh sieve. Fermented condiment of castor seed was prepared following the method of Olasupo and Okorie (2019). The fermented condiment was then mixed with cassava starch at condiment to starch ratio of 20:5, 20:10 and 20:20. They were then shaped into cubes, dried at 55^0C and labelled as sample A, B and C respectively. Proximate analysis was done using the method of the Association of Official Analytical Chemist (2005), mineral analysis was carried out on digested samples using atomic absorption spectrophotometer (Buck Scientific Acussy 211), total carotene was determined using the method described by Rodriguez-Amaya and Kimura (2004) while vitamin C analysis followed the method of Ibitoye (2005). As for phytate, the method of Wheeler and Ferrel (1971) was employed.

Results and Discussion

The results (Figure 1) showed that the protein and fat content decreased while the carbohydrate content increased significantly ($p < 0.05$) with increasing binder proportion. Fermentation of seeds have been shown to enhance their protein and lipid value while reducing total carbohydrate content (Chukwu *et al*., 2010). Fermentation of castor seed occurs through an extensive hydrolytic process that releases proteins from their carbohydrate matrix (Ojinnaka and

Ojimelukwe, 2013). However, the opposite was observed in the bouillon cubes produced in the present study; this can be attributed to the inclusion of cassava starch as a binder. The same trend was reported in the work of Ajayi et al (2015) where *Iru* (a fermented condiment of *Parkia biblogosa* seeds) bouillon cubes were developed using various starchy binders; it was thought that this resulted from the dilution of the protein content by the binders.

The total carotene increased as binder proportion increased but the vitamin C did not vary significantly (Table 1). Cassava starch may have contributed to the total carotene content of the cubes. Of all the minerals elements analysed, only Ca did not vary significantly. Phytate was significantly higher in the cube prepared at condiment to binder ratio of 20:20 (i.e. sample C) than others (Table 1). Reduction in anti-nutritional and toxic components in plant foods by fermentation has been reported (Egwim Evans et al. 2013). The higher phytate content observed in the present study may be as a result of the inclusion of cassava starch. Albert et al (2004) reported a phytate content ranging from 95–135 mg g−1 in five different genotypes of cassava tubers.

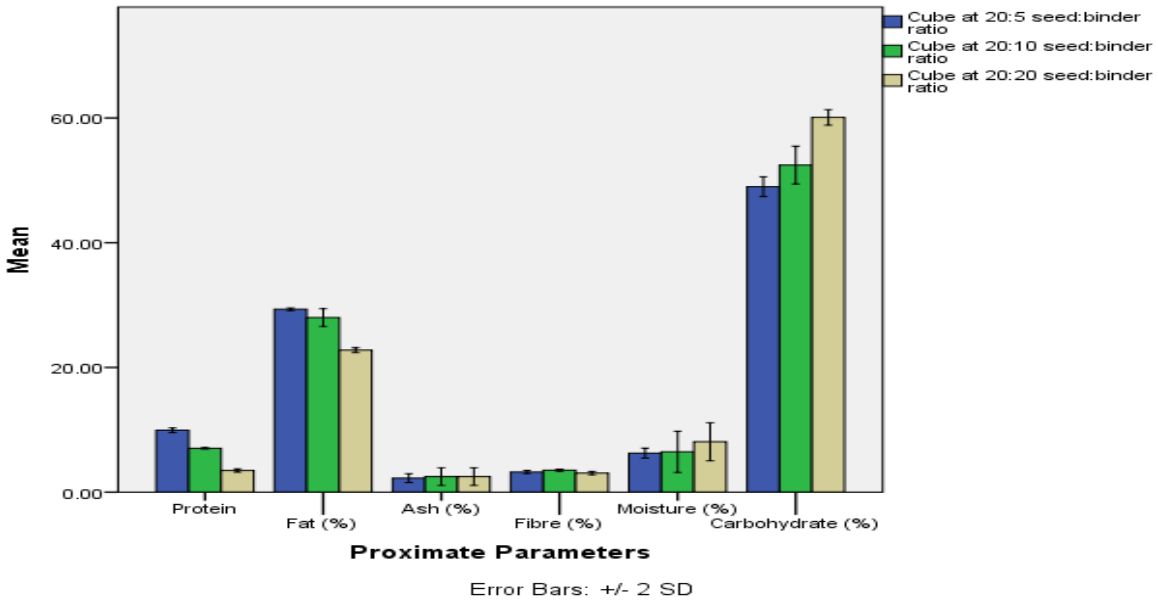

Figure 1: Proximate composition of bouillon cubes

Table 1. Mean Values of Phytate and Mineral Composition of Bouillon Cubes developed from *Ricinus communis* L. Seeds

Bouillon cubes samples (ratio of condiment to binder	Phytate Mg/g	Fe Mg/g	Zn Mg/g	Na Mg/g	K Mg/g	Ca Mg/g
A (20:5)	0.32^{a}	0.62^{a}	0.63^{a}	1.25^{a}	35.9^{a}	0.14
B (20:10)	0.35^{a}	0.91^{b}	0.75^{a}	1.73^{b}	36.0^{a}	0.15
C (20:20)	0.44^{b}	0.93^{b}	0.80^{b}	3.13^{c}	64.4^{b}	0.15

Values with different superscripts within a column are significantly different at $P<0.05$

Conclusions and Outlook

The development of bouillon cubes from fermented seeds of *Ricinus communis* L. is promising. However, the reduced protein and increased phytate content reported; which is attributed to inclusion of cassava starch, is undesirable as this product is consumed for its richness in protein. The use of cassava starch in this product can thus be considered not beneficial in nutritional terms. Thus, special consideration should be given to the type of binder and rate of inclusion in the development of bouillon cubes.

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References

Ajayi O.A., Akinrinde I.M. and Akinwunmi O.O. 2015. Towards the development of shelf stable 'iru' (Parkia biglobosa) condiment bouillon cubes using corn, cassava and potato starch extracts as binders. *Nigerian Food Journal*, *33*(1): 67-72.

Albert L.C., Klamarong S. and Tzou T.H. 2004. Proximate composition, mineral contents, hydrogen cyanide and phytic acid of 5 cassava genotypes. *Food Chemistry,* 92(4): 615-620.

Association of Official Analytical Chemists. 2005. *Official Methods of analysis of the Association of Analytical Chemists* International, 18th ed. Gathersuburg, MD: Official Methods. 2005.08

Chukwu O., Orhevba B.A. and Mahmood, B.I. 2010. Influence of hydrothermal treatments on proximate compositions of fermented locust bean (dawadawa). *Journal of food technology*, 8(3): 99-101.

Edema M.O. and Fawole O. 2006. Evaluation and Optimization of Critical Control Points in the Production of Iru. *Research Journal of Microbiology,* 1(6): 503-511.

Egwim Evans A.M., Abubakar Y. and Mainuna B., 2013. Nigerian indigenous fermented foods: processes and prospects. *Mycotoxin and food safety in developing countries*, *153*.

Ibitoye A.A. 2005. Basic methods in Plant analysis. Concept IT and 343 educational consults. Pp 6 Akure, Nigeria.

Mejia E.G., Aguilera-Gutiérrez Y., Martin-Cabrejas M.A. and Mejia L.A. 2015. Industrial processing of condiments and seasonings and its implications for micronutrient fortification. *Annals of the New York Academy of Sciences*, 1357(1): 8-28.

Olasupo N.A. and Okorie P.C. 2019. African Fermented Food Condiments: Microbiology Impacts on Their Nutritional Values. *Frontiers and New Trends in the Science of Fermented Food and Beverages*. IntechOpen.

Ojinnaka M.C. and Ojimelukwe, P.C. 2013. An assessment of the microbial and amino acid contents of *ogiri* produced by fermenting oil bean seeds of *Ricinus communis*. *American Journal of Food and Nutrition*, 3(3): 155-161

Rodriguez-Amaya D.B. and Kimura M. 2004. Harvestplus Handbook for Carotenoid Analysis.

Salihu B.Z., Gana A.K. and Apuyor, B.O. 2014. Castor Oil Plant (Ricinus communis L.): Botany, Ecology and Uses. *International Journal of Science and Research*, 3 (5): 1333-1341

Sina S. and Traoré S.A. 2002. Parkia biglobosa (Jacq.) R.Br. ex G.Don. Record from Protabase. Oyen, L.P.A. & Lemmens, R.H.M.J. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, the Netherlands.

Wheeler E.L. and Ferrel R.A. 1971. A method for phytic acid determination in wheat and wheat flour. *Cereal Chemistry*, 48: 312–320.