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EFFECT OF BOILING AND ROASTING ON THE NUTRIENT AND ANTI-NUTRIENT CONTENTS IN CONOPHOR NUT FLOUR

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Abstract

In the current study, the effect of boiling and roasting conophor nuts on the nutrient and anti-nutrient contents in the flour was investigated. The proximate analysis showed that the flour from raw nut is rich in protein content (54.49%). Flours from the boiled nuts and roasted nuts contained lower protein, fat and ash contents, but higher crude fibre, carbohydrate and caloric value than their values in the flour from raw nut. Boiling and roasting of the nuts led to reductions in the Ca, Na, Mg, Fe and Zn contents in the conophor nut flour when compared with their values in the flour from raw nut. "Flour from roasted nuts had significantly ($p<0.05$) higher K and P contents than their values in the flours from raw and boiled nuts". Boiling and roasting of the nuts significantly ($p<0.05$) reduced the levels of HCN, oxalate, phytate, tannins and trypsin inhibitor in the flour when compared with their values in the flour from raw nut. Boiling was more effective in the reduction of the anti-nutritional factors than roasting.

Keywords: Conophor Nut Flour, Boiling, Roasting, Nutrients, Anti-Nutrients.

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INTRODUCTION

Tree nuts have been used for food since antiquity, although the potentials of most nuts have not been fully exploited (Adesioye, 1991). Conophor nut (*Tetracarpidium conophorum*) is one of the lesser known and underutilized perennial crops grown and consumed in the forest zones of Nigeria. For now, there is no yield record of its annual production for Nigeria. It is a tropical climbing shrub and belongs to the family Euphorbiaceae. The fruit is a four-winged and ribbed capsule, containing seeds with thin brown shell and yellowish kernel (Adesioye, 1991). Its cultivation is mainly for the nuts which are usually eaten traditionally as snack. The nuts have been reported to have high nutrient potentials by various researchers (Oke and Fatunso, 1975; Ogunsua and Adebona, 1983; Nwokolo, 1987). The protein content of 23.50% has been reported for the nuts (Adesioye, 1991) and 47.25% for the defatted flour (Ado and Akeredolu, 2005). The nut contains 48.90% fat (Adesioye, 1991). The oil from the shelled nuts contains over 60% linolenic acid which predisposes it for use as edible oil, soap making and in varnish and lacquer industries (Ogunsua and Adebona, 1983). Like other edible nuts, conophor nut can serve in food fortification and as special treat to be added to candy, cakes and cookies. Oyenuga (1998) noted that the vast majority of Nigerians are not only improperly fed but also underfed and concluded that the widespread use of wild fruits and nuts to supplement the traditional diets could help to alleviate this problem. A bitter taste is usually observed upon drinking water immediately after eating conophor nut. This has been attributed to the presence of alkaloids and other anti-nutritional constituents in the nuts including oxalates, phytates and tannins (Enujiugha and Ayodele-Oni, 2003). The presence of these anti-nutritional factors could reduce the bioavailability of some essential nutrients (Morrow, 1991; Stanley, 1992). Tannins for instance interact with protein and cause significant reduction in protein digestibility (Van der Poel; 1991). Phytic acid on the other hand affects the bioavailability of essential minerals such as calcium, iron, magnesium and zinc (Nolan and Duffin, 1987; Grosvernor and Smolin, 2002).

Many processing methods have been shown to reduce anti-nutrients and improve the nutritive quality of plant foods for human nutrition (Obizoba and Atti, 1994). Traditionally, conophor nut is usually boiled or roasted to improve its eating quality before consumption. The shelf life of boiled conophor nut at ambient tropical condition is about three days after which they develop off-flavour as a result of rancidity of its oil (Adesioye, 1991). This restricts its consumption to the peasant and marketing is often localized. Processing the cotyledons into flour would enhance the keeping quality and utility of the product in food formulation.

Boiling and roasting have been reported to enhance taste, flavour and nutritional quality of foods (Sharma and Sehgal, 1992; Gahlawat and Sehgal, 1993). These treatments may also have adverse effect on some essential nutrients in the foods. Information on the effect of traditional processing of conophor nuts on the nutrients and anti-nutrients of the flour is limited. This study was therefore aimed at investigating the effect of boiling and roasting conophor nuts on the nutrients and anti-nutrients contents in conophor nut flour.

MATERIALS AND METHODS

Conophor seeds were purchased from Itam market in Uyo Local Government Area of Akwa Ibom State, Nigeria. The seeds were spit open and the nuts extracted. The nuts were shared into three equal portions of 2kg each and subjected to different processing treatments. Nuts in the first portion (control sample) were simply cracked open and the cotyledons manually separated from the shells. Nuts in the second portion were boiled in distilled water (1:3 w/v) for 1 hr, drained, cooled, cracked open and the cotyledons manually separated from the shells. Nuts in the third portion were dry roasted in a conventional air oven (Model P.P. 22US, Genlab, England) at 160^{o}C for 20 minutes, cooled, cracked open and the cotyledons manually separated from the shells. Cotyledons from portions 1, 2 and 3 were separately ground into coarse meal, defatled continuously for 8 hrs using food grade n-haxane (40 – 60^{o}C boling point) as solvent, oven dried at 60^{o}C, cooled, milled into fine flour, sieved to pass through 450µm pore size screen, packaged in plastic containers, labeled and stored at 4^{o}C for analysis.

Methods of Analysis

Protein, fat, ash and crude fibre were determined by AOAC (2000) methods. Carbohydrate was calculated by difference (Ihekoronye and Ngoddy, 1985). Caloric value was calculated using Atwater factor method as described by Osborne and Voogt (1978). Mineral elements (K, Na, Ca, Mg, Zn, Fe and P) were determined using atomic absorption spectrophotometer (UNICAM, Model 939, UK) as describe in AOAC (2000). HCN, oxalate and tannin were determined by AOAC (2000) methods. Phytate determination was by Oberleas (1973) method and trypsin inhibitor by Arnfield *et al.* (1985) method.

RESULTS

Effect of treatments on proximate composition

Table 1 shows the effect of boiling and roasting conophor nuts on the proximate composition of the flour. Flour prepared from boiled nuts had significantly ($p<0.05$) lower protein and ash contents and marginally ($p>0.05$) lower fat content than the flours prepared from the raw nuts and roasted nuts. Conversely, flour prepared from boiled nuts had significantly ($p<0.05$) higher carbohydrate content and marginally ($p>0.05$) higher crude fibre content than flours prepared from raw nuts and roasted nuts. Protein, fat, ash, crude fibre and carbohydrate contents in the flour from roasted nuts were not significantly ($p>0.05$) different from the values found in the flour from raw nuts. Flour from boiled nuts had significantly ($p<0.05$) higher caloric value than the values obtained for flours from raw nuts and roasted nuts.

Table 1. Effect of boiling and roasting conophor nuts on the proximate composition of the flours (dry weight basis)

Parameters	Raw	Boiled	Roasted
Protein (%)	54.49^{a}±0.20	46.35^{b}±0.11	54.21^{a}±0.13
Fat (%)	3.10^{a}±0.00	2.62^{a}±0.40	2.98^{a}±0.09
Ash (%)	5.74^{a}±0.15	3.08^{b}±0.20	5.60^{a}±0.05
Crude fibre (%)	4.67^{a}±0.09	5.30^{a}±0.14	4.63^{a}±0.11
Carbohydrate (%)	32.00^{a}±0.11	42.65^{b}±0.35	32.58^{a}±0.24
Caloric value (Kcal)	373.86^{b}	379.58^{a}	373.98^{b}

Values are Means ± SD of triplicate determinations. Means on the same row with different superscripts are significantly different at $p<0.05$.

Effect of treatments on minerals

Table 2 depicts the effect of boiling and roasting conophor nuts on the mineral contents in the flours. Flour prepared from boiled nuts had significantly ($p<0.05$) lower K, Na, Ca, Mg and P contents and marginally ($p>0.05$) lower Zn content than the values obtained for flours prepared from raw nuts and roasted nuts. Flour prepared from the roasted nuts had higher K and P contents than their values in the flours from raw nuts and boiled nuts. On the contrary, the Ca, Na, Mg, Fe and Zn contents in the flour prepared from the roasted nuts were lower than their values in the flour from the raw nuts.

Table 2. Effect of boiling and roasting conophor nuts on the mineral contents in the flours (mg/100g)

Parameters	Raw	Boiled	Roasted
K	586.94^{b}±0.35	550.83^{c}±0.78	597.30^{a}±0.55
Ca	168.51^{a}±0.16	149.32^{c}±0.52	166.09^{a}±0.47
Na	72.71^{a}±0.4	58.46^{c}±0.09	64.73^{b}±0.81
Mg	180.48^{a}±0.52	168.10^{c}±0.24	172.00^{b}±0.60
P	449.36^{b}±0.06	407.92^{c}±0.57	461.57^{a}±0.11
Fe	21.19^{a}±0.31	16.26^{b}±0.78	19.38^{a}±0.38
Zn	7.41^{a}±0.18	5.65^{a}±0.59	6.11^{a}±0.72

Values are Means ± SD of triplicate determinations. Means on the same row with different superscripts are significantly different at $p<0.05$.

Effect of treatments on anti-nutrients

Table 3 shows the effect of boiling and roasting conophor nuts on the anti-nutritional factors in the flours. Boiling and roasting of the nuts led to significant ($p<0.05$) reductions in HCN, oxalate, phytate, tannins and trypsin inhibitors in the flour when compared with their values in the flour from the raw nuts. Boiling of the nuts was more effective in reducing the anti-nutrients than roasting of the nuts as flour from boiled nuts had lower contents of HCN, oxalate, phytate, tanninis and trypsin inhibitors than their values in the flour from the roasted nuts.

Table 3. Effect of boiling and roasting on the anti-nutrient contents in conophor nut flour

Parameters	Raw	Boiled	Roasted
HCN (mg/100g)	5.86^{a}±0.11	0.18^{c}±0.05	1.28^{b}±0.55
Oxalate (mg/100g)	6.72^{a}±1.03	2.40^{b}±1.40	2.93^{b}±0.09
Phytate (mg/100g)	4.08^{a}±0.65	1.95^{b}±0.07	2.11^{b}±0.12
Tannin (mg/100g)	3.63^{a}±0.80	1.52^{b}±0.10	1.74^{b}±0.15
Trypsin inhibitor (TUI/mg)	2.41^{a}±0.00	0.82^{b}±0.35	0.76^{b}±0.71

Values are Means ± SD of triplicate determinations. Means on the same row with different superscripts are significantly different at $p<0.05$.

DISCUSSION

The result of the current study demonstrated that boiling and roasting of conophor nuts had varying effects on the proximate composition of the flours. The protein content (54.49%) in the flour from the raw nuts was higher than the value (47.25%) reported by Ado and Akeredolu (2005) for the defatted conophor nut flour. The observed variation could be due to genotype and growing conditions (Debre and Brindza, 1996). The result shows that conophor nut flour is a good source of protein and could be used to fortify carbohydrate based diets in order to reduce protein energy malnutrition prevalence in our communities. The significantly ($p<0.05$) lower protein and ash contents in the flour prepared from the boiled nut when compared with the flours from the raw nuts and roasted nuts could be attributed to leaching out of the protein and mineral elements during boiling of the nuts. This result is in agreement with the report by Fagbemi (2007) for flours prepared from boiled and roasted pumpkin seed. The treatments had no significant ($p>0.05$) effect on fat as it is not soluble in water. The marginal reductions in fat as a result of the treatments could be due to the loss of non fat components in the crude fat (Meyer, 1978; Murano, 2003). The higher crude fibre content in the flour from the boiled nuts when compared with the flours from the raw nuts and roasted nuts could be due to concentration effect as soluble constituents were leached out of the nuts during boiling. Variations in the carbohydrate contents in the flours from the raw and treated nuts could be due to variation in the other constituents since it was calculated by difference. The caloric value was highest in the flour from the boiled nuts when compared with their values in the flours from raw nuts and roasted nuts due to its significantly ($p<0.05$) higher carbohydrate content. Fagbemi (2007) similarly reported on higher levels of crude fibre, carbohydrate and energy value in the flour from boiled pumpkin seeds than their levels in the flour from roasted seeds.

The significant ($p<0.05$) reductions in the contents of K, Ca, Na, Mg, P and Fe in the flour prepared from the boiled nuts when compared with their values in the flour prepared from the raw nuts could be attributed to leaching out of the minerals into the boiled water (Kiremire *et al.,* 2010; Musa and Ogbadoyi, 2012). This observation is in line with the findings of Augustin *et al.* (1981), Alvi *et al.* (2003) and Oboh (2005) that various conventional food processing techniques such as blanching and cooking cause a significant decrease in the mineral content of the vegetables. Fagbemi (2007) similarly reported that flour from boiled pumpkin seeds contained less K, Na, Mg, P, Fe and Zn than flour from the raw pumpkin seeds. The observed higher retention of all the minerals in the flour from roasted nuts relative to their values in the flour from boiled nuts could be due to the fact that roasting does not cause leaching of mineral elements. The effect of roasting on the mineral content in the flour obtained in the current study is in conformity with the report by Ezeokonkwo (2005) that roasted *Terminalia catappa* seed contained less Ca, Mg. Zn and Fe than the unprocessed seed. Kiremire *et al.* (2010) also reported on varying reductions of Ca, K, Na, Mg, P and Fe in oven dried, solar dried and traditionally sun-dried *Amaranthus dubius*. The higher values of K and P in the flour from roasted nuts relative to their values in the flour from raw nuts are in agreement with the report by Ezeokonkwo (2005) for roasted *Terminalia catappal* seed. Considering the macronutrients, K, Ca, Na, Mg and P, conophor nut flour could be considered as a fair source of minerals. High amount of K, Ca and Mg have been reported to reduce blood pressure in human (Ranhotra *et al.,* 1998). Blood pressure and blood volume in the human body are under the regulation and control of sodium (Grosvernor and Smolin, 2002). Calcium, phosphorus and magnesium are important in the formation of bones and teeth (Grosvernor and Smolin, 2002). The low sodium content in conophor nut flour makes it suitable for use in sodium restricted diets. The presence of anti-nutrients such as tannins, oxalates, phytates and trypsin inhibitors in foods hinders the efficient utilization, absorption or digestion of some nutrients and thus reduce their bioavailability and nutritional quality (Liener, 1976). Hence, the determination of anti-nutrients in conophor nut flour was of interest because of their negative effects on mineral bioavailability and poor growth effect (Abdullahi and Abdullahi, 2005). The significantly ($p<0.05$) lower levels of HCN, oxalate, phytate, tannins and trypsin inhibitor in the flours prepared from the boiled nuts and roasted nuts when compared with their values in the flour from raw nuts are in agreement with the reports by Igbedioh *et al.* (1994) and Nwosu (2011).

The knowledge of the hydrogen cyanide content in food is important because the cyanide usually inhibit the action of cytochrome oxidase in the respiratory cycle thereby becoming toxic to both man and other animals (Ihekoronye and Ngoddy, 1985). Reduction in oxalate and phytate contents as a result of boiling and roasting of the nuts may lead to the improvement on bioavailability of essential minerals like calcium, magnesium and iron that usually form complexes with these compounds (Grosvernor and Smolin, 2002; Akindahunsi and Salawu, 2005). Also, reduction in tannins and trypsin inhibitor may lead to the improvement on protein digestibility, better bioavailability and utilization of amino acid contents in the flour protein (Grosvernor and Smolin, 2002). The results of the current study demonstrated that boiling was more effective in the reduction of anti-nutritional factors than roasting. The reason may be attributed to the fact that boiling led to break down of the plant cell wall which permitted the leakage of cell contents including anti-nutrients (Ogbadoyi *et al.,* 2006) while roasting is a mere gradual evaporation processes.

Conclusion

The study revealed that boiling and roasting of conophor nuts affected the nutrients and anti-nutrient contents in the flour. Boiling led to higher reductions in protein, fat, ash, Ca, Na, Mg, Fe, Zn and anti-nutritional factors than roasting. Flour prepared from roasted nuts had higher K and P contents than their values in the flours prepared from raw and boiled nuts.

REFERENCES

Abdullahi, S. A. and Abdullah, G. M. 2005. Effect of boiling on the proximate, anti-nutrients and amino acid composition of raw Delonix regia seeds *Nig. Food J.,* 23:128-132.

Adesioye, H. O. 1991. The effect of processing and storage on the chemical and sensory quality of Conophor nut. *Nig. Food J.*, 9:33-38.

Ado, A. A. and Akeredolu, I. A. 2005. Organoleptic and Objective evaluation of pearl, millet-conophor weaning mix. *Nig. J. Nutr. Sci.,* 26(1):13-18.

Akindahunsi, A. A. and Salawu, S. O. 2005. Phytochemical screening of nutrient and anti-nutrient composition of selected tropical green leafy vegetables. *Afr. J. Biotech*., 4(6):497-501.

Alvi, S., Khan, K. M., Sheikh, M. A. and Shahid, M. 2003. Effect of peeling and cooking on nutrients in vegetables. *Pak. J. Nutr*., 2:189-191.

AOAC 2000. Official Methods of Analysis of Association of Analytical Chemists (17th edn.), Washington D. C.

Arnfield, S. D., Ismond, M. A. H. and Murray, E. D. 1985. The fate of anti-nutritional factors during the preparation of faba bean protein isolate using micellization technique. *Can. Inst. Food Sci. Technol. J.,* 18:137-143.

Augustin, J., Beck, C. B., Kalbfleish, G., Kagel, L. C. and Matthew, R. H. 1981. Variation in the vitamin and mineral content of raw and cooked commercial *Phaseolus vulgaris* classes. *J. Food Sci.,* 46:1701-1706.

Dabre, F. and Brindza, J. 1996. Potatoes genotypes from the view of production and utility value. *Rost. Vyr*., 42:509-515.

Enujiugha, V. N., Ayodele-Oni, O. 2003. Evaluation of nutrients and some anti-nutrients in lesser known under-utilized oil seeds. J. Food Sci. Technol. 38:525-528.

Ezeokonkwo, C. A. 2005. Effect of roasting on the nutrient composition of *Terminallia catappal* seed. *Nig. J. Nutr*., Sci. 26(1):19-24.

Fagbemi, T. N. 2007. Effects of processing on nutritional composition of flutted pumpkin (*Telfairia occidentalis*) seed flour. *Nig. Food J*., 25(1):1-22.

Gahlawat, P. and Sehgal, S. 1993. Effect of processing and cooking on the anti-nutritional factors of faba beans (*Vicia faba*). *Food Chem*., 43:383-385.

Grosvernor, M. B. and Smolin, L. A. 2002. Nutrition: From science to life. Harcourt College Publishers, New York. pp. 288-371.

Igbedioh, S. O., Olugbemi, K. T. and Akpapunam, M. A. 1994. Effect of processing methods on physic acid level and some constitutents in bambara groundnut (*Vigna subterranean*) and pigeon pea (*Cajanus cajan*). Food Chem. 59:147-151.

Ihekoronye, A. I. and Ngoddy, P. O. 1985. Integrated Food Science and Technology for the Tropics. MacMillan Edu. Pub. London, 28-91.

Kiremire, B. T., Musinguzi, e., Kikafunda, J. K. and Lukwago, F. B. 2010. Effects of vegetable drying techniques on nutrient content: A case study of South-Western Uganda. *Afr. J. Food Agric. Nutr. Dev*., 10(5):2587-2600.

Liener, I. E. 1976. Legume toxins in relation to protein digestibility – a review. *J. Food Sci.,* 41:1076-1081.

Meyer, L. H. 1978. Food chemistry (3rd edn.). The AVI publishing company. INC., Westport, Connecticut. pp. 115-146.

Morrow, B. 1991. The rebirth of legumes. Food Technol. 45:96-121.

Murano, P. S. 2003. Understanding Food Science and Technology. Brooks/Cole Cengage learning, Balmont, pp. 121-150.

Musa, A. and Ogbadoyi, E. O. 2012. Effect of processing methods on some micronutrients, anti-nutrients and toxic substances in Hibiscus sabdariffa. *Asian. J. Biochem*, 7:63-79.

Nolan, K. B. and Duffin, P. A. 1987. Effect of phytate on mineral bioavailability. In vitro studies on Mg^{+2}, Ca^{+2}, Fe^{+3}, Cu^{+2} and Zn^{+2} solubilities in the presence of phytate. *J. Sci. Food Agric.*, 10:79-83.

Nwokolo, E. 1987. Composition and availability of nutrients in some tropical grains and oil seeds. *Nutr. Rep. Int.*, 36:631-640.

Nwosu, J. N. 2011. The effects of processing on the anti-nutritional properties of "Oze" (*Bosqueia angolensis*) seeds. *J. Amer. Sci*., 7(1):1-6.

Oberleas, D. 1973. Phytates In: Toxicants occurring naturally in foods. F. strong (ed.), National Academy of Science, Washington D. C. pp. 363-371.

Obizoba, I. C. and Atti, J. V. 1994. Evaluation of the effect of processing techniques on the nutrient and anti-nutrient contents of pearl millet (*Pennisatum glaucum*) seeds. *Plant Foods Hum. Nutr*., 45:23-34.

Oboh, G. 2005. Effects of some post-harvest treatments on the nutritional properties of *Cnidoscolus acontifolus* leaf. *Pak. J. Nutr*., 4:226-230.

Ogbadoyi, E. O., Makun, H. A., Bamigbade, R. O., Oyewale, A. O. and Oldiran, J. A. 2006. The effect of processing and preservation methods on the oxalate levels of some Nigerian leafy vegetables. Biokimistri. 18:121-125.

Ogunsua, A. O. and Adebona, M. B. 1983. Chemical composition of *Tetracarpidium conophorum. Food Chem*., 10:173-177.

Oke, O. L. and Fatunso, M. A. 1975. Lesser known oilseeds: The nutritive value of conophor seeds in vitro. *Nutr. Rep. Int.*, 12:41-49.

Osborne, D. R. and Voogt, P. 1978. The analysis of nutrients in foods. Academic Press, London and New York. pp. 167-180.

Oyenuga, V. A. C. 1998. Nigeria's food and feeding stuffs: Their chemistry and nutritive value. Ibadan university Press, Ibadan. pp. 18-36.

Ranhotra, G. S., Gelrorth, J. A., Leinen, S. O. and Vrnas, M. A. and Lorenz, K. J. 1998. Nutritional profile of some edible plants from Mexico. *J. Food Comp. Anal*., 11;298-304.

Sharma, A. and Sehgal, S. 1992. Effect of processing and cooking on the anti-nutritional factors of faba beans (*Vicia faba*). Food Chem. 43:383-385.

Stanley, D. M. 1992. Hard beans. A problem for growers, processors and consumers. Hort. Technol. 2:370-378.

Van der Poel, A. F. B., Gravandoel, S. and Boer, H. 1991. Effect of different processing methods on the tannin contents and protein digestibility of faba beans. *Anim. Feed Sci. Technol*, 33:49-58.

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