

Proximate and Antinutrient Composition of Some Local Food Condiments in Their Raw and Processed Form

ABSTRACT

Aim: The aim of this study is to survey the effect of processing on the proximate and anti-nutrient components of the seeds of some these local food condiments.

Study Design: Ability to improve proximate composition and decrease anti-nutrients in some local food condiments after processing. Five (5) samples in their raw and processed forms were used for this study. The samples are *Parkia biglobosa*, Oil bean seed, Sorel been seed, soybean and African Locust bean.

Place and Duration of Study: Department of Biochemistry, University of Jos, Nigeria and National Veterinary Research Institute (NVRI), Vom, Plateau State. The study was carried out between March, 2016 to October, 2016.

Methodology: Analysis on the proximate and anti-nutrient parameters was conducted using Standard analytical techniques.

Results: The results show that processed *Parkia biglobosa* (Okpehe) had the highest content of crude protein. Also processed Oil bean seed (Ugba) had the highest moisture content and crude fibre. Processed sorel bean seed (dawadawa botso) had the highest content of crude fat, Ash, Calcium and Phosphorus while raw soybean dawadawa had the highest content of NFE. Raw African locust bean dawadawa had the highest content of the anti-nutrients; oxalate and phytic acid while Raw *Parkia biglobosa* (Okpehe) had the highest content of Tannin.

21 **Conclusion:** The results of this study suggest that processing improved the proximate
22 components of these local food condiments and also significantly ($P<0.05$) reduced their anti-
23 nutritional concentration.

24 *Keywords: Parkia biglobosa; Oil bean seed; Sorel bean; Soya bean seed; African locust bean;*
25 *Fermentation; Proximate; Antinutrient.*

26 **1. INTRODUCTION**

27 Local food condiments (*Okpehe, soybean dawadawa, sorel bean dawadawa, locust bean*
28 *dawadawa and Ugba*) consumed by different ethnic groups in Nigeria have been the pride of
29 culinary traditions for centuries. It is evident that these products have played a major role in the
30 food habits of communities in the rural regions serving not only as a nutritious non-meat
31 proteins substitute but also as condiments and flavouring agents in soups (Achi, 2005). These
32 condiments are being increasingly marketed throughout the country and beyond in informal
33 ways. Differences in the chemical composition of local condiments are evident mainly because
34 different ingredients have been used in their preparation. Traditional method of manufacture
35 has taken advantage of biotechnological progress to assure reasonable quality and at the same
36 time assure safety of these products. Fermented condiments often have a stigma attached to
37 them; they are often considered as food for the poor.

38 Despite the huge nutritional values and availability of local food condiments such as Oil bean
39 seed, *Prosopis africana*, locust bean seed, sorel seeds and soybeans as food condiments, some
40 developing countries like Nigeria require more information on the needs for increasing their
41 utilization. Most of the consumers do not know much about the nutritional values; therefore use
42 them as functional ingredient in foods for the purposes of tastes or aromatic characteristics.

Hence strong emphasis on the nutritional values of “ugba” Oil bean seed, “okpeye” *Prosopis Africana*, “dawadawa” locust bean seed, “dawadawa” soybeans and “dawadawa baso” sorel seed are required in Nigeria so as to reduce the intake of industrial seasoning such as maggi.

Nutritionally, the main effects of processing are detoxification, increasing palatability and bioavailability of nutrients. However, there are still other individual effects caused by specific process (Walker and Kochhar, 1982).

2. MATERIALS AND METHODS

2.1. Sample Collection: The raw and processed forms of okpehe, soybean dawadawa, sorel bean dawadawa and locust bean dawadawa used for the study were bought from Tildey market along bauchi. Also both the processed and unprocessed forms of ugba were bought from Chobe market in Jos. Both the raw and processed forms of the samples were taken to National Veterinary Research Institute (NVRI), Vom in Plateau State for Proximate and Antinutrient Analysis. The samples were kept under room temperature until analysis.

2.2. Proximate Analysis of Raw and Processed Samples

The method used for proximate composition analysis was the AOAC method (2000). Proximate Analysis has to do with partitioning of compounds in a feed into six categories based on their chemical properties. The Proximate constituents determined during the analysis are as follows: moisture, ash, crude protein (or Kjeldahl protein), crude lipid, crude fibre and Nitrogen-free extracts (digestible carbohydrates).

2.3. Antinutrient Composition of Raw and Processed Samples

Tannins, Oxalates and Phytic acids were determined in the raw and processed samples. The method used in Phytic acids and Oxalates determination was the AOAC method (1990) while the Joselyn’s method was used in Tannin determination.

66 2.4. Statistical Analysis

67 The data obtained were expressed as mean $\pm$ standard deviation (n=3). One-way analysis of
68 Variance was used to test for the difference in means. Post-Hoc test using Duncan Multiple
69 Range Test (DMRT) was used to test for the means that are significantly different from each
70 other at (P<0.05), which are presented by alphabets in superscripts using the SPSS for Windows.

71 3. RESULTS AND DISCUSSION

72 3.1. Proximate Composition of the Raw and Fermented Samples

73 The mean proximate compositions of raw and processed forms of soyabean dawadawa, African
74 locust bean dawadawa (*Parkia biglobosa*), Okpehe (*Prosopis Africana*), *Cassia sieberiana* Seeds
75 (Dawadawan botso) and Oil bean seed (Ugba) are presented in tables 1.1 and 1.2 respectively.

76 The Proximate composition indicates that moisture content of all the processed samples were
77 higher when compared with the raw samples. The increase in moisture content of these
78 processed/fermented food condiments may be due to the hydrolytic activity of the fermenting of
79 the cotyledons. It is also believed to be likely due to the hydrolytic activity of the fermenting
80 organisms on the substrates releasing moisture as part of their metabolic products. The high
81 moisture content may make the condiments highly vulnerable to microbial attack and reduce
82 their shelf-life during storage. Low moisture in the raw samples will increase the shelf-life for
83 longer storage periods especially when out of seasons.

84 Crude protein content appeared to be lower in the processed local food condiments except
85 okpehe and oil bean seed. The crude protein content is dependent on the processing method
86 (Aremu *et al.*, 2011). High content of crude protein in okpehe and oil bean seed may have been
87 enhanced due to the processing method used which include soaking, boiling/cooking and

fermentation. The increase observed may also be due to the ability of the organisms to secrete extracellular protease during the fermented process (Erukainure *et al.*, 2010). Also, the multiplication of the fungi in the form of single cell protein could also contribute to the increase in the protein contents of these condiments (Sanusi *et al* 2013). The decreased protein contents in processed soya bean dawadawa, African locust bean and dawadawan Botso has been observed in other local condiments (Adegunwa *et al.*, 2012; Ndidi *et al.*, 2014). This reduction may be due to denaturation/leaching of the protein in the cooked samples.

The crude fat and crude fibre contents are higher in processed soya bean dawadawa and oil bean seed. The high crude fat content may be attributed to the increase activities of lipolytic enzymes which hydrolyse fat to glycerol and fatty acid. In the studies of Eka (1980) on the effect of fermentation on the nutrient content of locust beans, it was reported that protein and fat increased when fermented which is nearly similar to our present study, as increased crude fat content was observed in African locust bean.

Studies have shown that dietary fibre has a number of beneficial effects such as maintenance of internal distention in the intestine tract, help in protection against colon cancer and also help to prevent constipation (Asp, 1996).

The decreased crude fibre contents observed in processed dawadawan Botso, African locust bean and okpehe as well as decreased carbohydrate contents observed in all the food condiments in their processed form could be due to the utilisation of some of the sugars by the fermenting organisms for growth and metabolic activities. These observations are consistent with the report of Achinewhu, Isichei (1990) and Eka (1980) during oil seeds fermentation.

109 Ash content increased significantly in the processed dawadawan Botso may indicate that the
 110 fungi had perculiar role they play via biosynthetic or hydrolytic mechanisms to increase the
 111 inorganic mineral elements in the processed form of this condiment (dawadawa Botso). The
 112 lower amounts of ash content present in the processed African locust bean, soya bean dawadawa,
 113 okpehe and oil bean seed may be attributed to the loss of minerals during fermentation processes
 114 which result from the stimulator effects of cooking and leaching (Anigo *et al.*, 2015).

115 The calcium concentration decreases in African locust beans and oil bean seed. This decrease
 116 may be due to leaching during processing or because of the utilisation of the compound by the
 117 fermenting organisms. Calcium concentration was higher in processed dawadawa Botso, okpehe
 118 and oil bean seed, and calcium in conjunction with other mineral is involved in the formation of
 119 bone. Calcium is also very vital in blood clothing, muscle contraction and in certain enzymes in
 120 metabolic processes.

121 Nitrogen free extract (NFE) which represents the total carbohydrate contents is higher in the raw
 122 samples when compared with the processed samples in this study except dawadawa botso,
 123 however with no significant difference. This may be attributed to amylase and sucrose by the
 124 fermenting microorganisms which hydrolyse carbohydrates into sugars. This concurs with the
 125 studies of Giwa *et al.* (2011).

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131 **Table 1.1:** Mean Proximate Composition (g/100g) of Raw and Processed Soyabean Dawadawa, African Locust Bean Dawadawa and
 132 Okpehe.

133		Soyabean dawadawa		African Locust bean		Okpehe (<i>Parkia biglobosa</i>)	
134	Parameters	Raw	Processed	Raw	Processed	Raw	Processed
135	Moisture	6.28±0.10 ^a	22.83±0.76 ^a	7.85±0.05 ^a	24.66±0.06 ^a	10.17±0.08 ^a	30.92±0.36 ^a
136	Crude Protein	39.05±0.50 ^b	34.65±0.58 ^b	32.76±0.21 ^b	31.38±0.06 ^b	28.28±0.60 ^a	54.50±0.06 ^a
137	Crude Fibre	13.13±0.28 ^a	20.96±0.51 ^a	17.37±0.32 ^b	15.17±0.15 ^b	9.20±0.06 ^b	2.66±0.06 ^b
138	Crude Fat	10.97±0.18 ^a	17.64±0.38 ^a	13.90±0.50 ^a	26.28±0.05 ^a	38.93±0.03 ^b	4.90±0.05 ^b
139	Ash	5.70±0.27 ^b	3.53±0.08 ^b	5.60±0.10 ^b	2.42±0.06 ^b	4.20±0.05 ^a	4.73±0.04 ^a
140	NFE	24.26±0.30 ^b	0.03±0.01 ^b	22.48±0.08 ^b	0.03±0.02 ^b	14.26±0.05 ^b	2.21±0.06 ^b
141	Calcium	0.35±0.05 ^a	0.38±0.15 ^a	0.38±0.05 ^b	0.30±0.05 ^b	0.38±0.05 ^a	0.45±0.06 ^a
142	Phosphorus	0.12±0.02 ^a	0.13±0.01 ^a	0.09±0.05 ^a	0.20±0.10 ^a	0.004±0.002 ^a	0.27±0.04 ^a
143	Carbohydrate	24.87±0.10 ^a	0.39±0.02 ^a	22.52±0.27 ^a	0.09±0.12 ^a	9.22±0.03 ^a	2.29±0.31 ^a
144	Energy (Kcal)	354.41	298.92	346.22	362.40	500.37	271.26

145 Values (mean ± standard deviation of triplicate determinations) with same superscripts in a row (Raw and Processed samples) are
 146 significantly (p<0.05) different. Where a = significantly different while b = insignificantly different

147 **Table 1.2:** Mean Proximate Composition (g/100g) of Raw and Processed Dawadawan Botso and Oil Bean Seed (Ugba).

148	149 Parameter	Dawadawan Botso (<i>Cassia sieberiana</i>)		Oil bean seed (Ugba)	
		Raw	Processed	Raw	Processed
150	Moisture	6.19±0.20 ^a	7.39±0.09 ^a	20.26±0.06 ^a	46.16±0.58 ^a
151	Crude Protein	25.48±0.47 ^b	19.47±0.05 ^b	3.78±0.55 ^a	14.1±0.20 ^a
152	Crude Fibre	23.41±0.25 ^b	18.59±0.07 ^b	22.87±0.32 ^a	27.63±0.35 ^a
153	Crude Fat	38.56±0.06 ^a	46.83±0.03 ^a	9.44±0.36 ^a	11.13±0.02 ^a
154	Ash	6.20±0.05 ^a	7.69±0.04 ^a	2.81±0.08 ^b	0.73±0.03 ^b
155	NFE	0.03±0.01 ^a	0.03±0.02 ^a	12.35±0.13 ^b	0.02±0.02 ^b
156	Calcium	0.28±0.05 ^a	0.87±0.35 ^a	0.28±0.03 ^b	0.22±0.03 ^b
157	Phosphorus	0.14±0.05 ^a	0.33±0.15 ^a	0.07±0.02 ^b	0.027±0.002 ^b
158	Carbohydrate	0.16±0.03 ^a	0.04±0.21 ^a	40.84±0.001 ^a	0.25±0.25 ^a
159	Energy (Kcal)	449.60	499.51	263.44	157.57

160 Values (mean ± standard deviation of triplicate determinations) with same superscripts in a row (Raw and Processed samples) are
 161 significantly (p<0.05) different. Where a = significantly different while b = insignificantly different

3.2. Antinutrient Compositions

Anti-nutrients contents which include tannins, oxalate and phytic acid reduced in all the processed samples in this study. The decrease in anti-nutrient content may be attributed to leaching into the cooking water (Effiong and Umoren, 2011). This reduction may also be due to the activities of the indigenous microbes as well as processing, and the activities of some indigenous enzymes that degrade these anti-nutrients. The general significant reductions observed in the anti-nutrient contents after fermentation had been observed by many investigators in other substrates (Olajide *et al.*, 2011; Nwosu, 2010; Ndidi *et al.*, 2014). The decrease in the phytic acid content of the processed samples could be due to secretion of phytase by fungi thereby hydrolyzing the phytic acid (Obboh and Elusiyan, 2007). Tannins bind to proteins, carbohydrates and minerals. Tannins concentration decrease generally in the processed samples in this study. Fermentation is one of the processes that can be used to reduce the negative effects of tannins (Dicko *et al.*, 2005).

In general, the reduction in anti-nutrient is due to the fact that fermentation is usually preceded with soaking, hydration and cooking of the raw seeds; and these processes have reduction effects on the level of anti-nutritional factors in fermented food products. These findings concurs with the report of other investigators (Siddhuraju and Beckner, 2001; El-Adawy, 2002; Ugwu and Oranye, 2006).

185 **Table 2.1:** Mean Anti-nutrient Composition (mg/100g) of Raw and Processed Soyabean Dawadawa, African Locust bean Dawadawa
186 and Okpehe.

187		Soyabean dawadawa		African Locust bean		Okpehe (<i>Parkia biglobosa</i>)	
188	Parameters	Raw	Processed	Raw	Processed	Raw	Processed
189	Tannins	5.36 $\pm$ 0.06 ^b	2.18 $\pm$ 0.07 ^b	8.51 $\pm$ 0.04 ^b	6.05 $\pm$ 0.05 ^b	10.45 $\pm$ 0.52 ^b	2.44 $\pm$ 0.04 ^b
190	Oxalate	114.99 $\pm$ 0.52 ^b	50.00 $\pm$ 0.50 ^b	164.99 $\pm$ 0.06 ^b	84.99 $\pm$ 0.07 ^b	125.00 $\pm$ 0.50 ^b	60.00 $\pm$ 0.50 ^b
191	Phytic Acid	21.46 $\pm$ 0.04 ^b	16.44 $\pm$ 0.05 ^b	44.51 $\pm$ 0.06 ^b	15.28 $\pm$ 0.05 ^b	13.71 $\pm$ 0.05 ^b	12.55 $\pm$ 0.05 ^b

192 Values (mean $\pm$ standard deviation of triplicate determinations) with same superscripts in a row (Raw and Processed) are significantly
193 (p<0.05) different. Where a = significantly different while b = insignificantly different

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195 **Table 2.2:** Mean Anti-nutrient Composition (mg/100g) of Raw and Processed Dawadawan Botso and Oil Bean Seed (Ugba).

196	Parameter	Dawadawan Botso (<i>Cassia sieberiana</i>)		Oil Bean Seed (Ugba)	
197		Raw	Processed	Raw	Processed
198	Tannins	3.51 $\pm$ 0.05 ^b	3.24 $\pm$ 0.05 ^b	6.25 $\pm$ 0.05 ^b	3.23 $\pm$ 0.05 ^b
199	Oxalate	80.06 $\pm$ 0.05 ^b	35.00 $\pm$ 0.50 ^b	90.23 $\pm$ 0.25 ^b	84.99 $\pm$ 0.01 ^b
200	Phytic Acid	17.80 $\pm$ 0.05 ^b	10.04 $\pm$ 0.05 ^b	13.92 $\pm$ 0.04 ^a	20.10 $\pm$ 0.05 ^a

201 Values (mean $\pm$ standard deviation of triplicate determinations) with same superscripts in a row (Raw and Processed) are significantly
202 (p<0.05) different. Where a = significantly different while b = insignificantly different

4. CONCLUSION

The results obtained from the present study showed that soya bean dawadawa, African locust bean, okpehe, dawadawan Botso and oil bean seed have good nutritional profile levels. Fermentation as a way of food processing improves nutritional quality, shelf life of food and enhances sensory qualities of food. Processing/fermentation reduced the level of anti-nutrients in the local food condiments in this study. However; some quantity of the nutrients could still not be available due to the presence of the anti-nutrients. For example, oxalate, tannin and hydrogen cyanide will negatively affect the mineral level (ash), carbohydrate and nitrogen free extract. This can be attributed to the unavailability of these nutrients. Phytic acid negatively affects protein content, lipid and fibre. This is likely to explain why processing/fermentation seems not, in some cases, to increase the level of nutrients.

Notwithstanding, in view of the nutrient availability, low anti-nutrient content and high level of proteins present in these samples after processing could be used as alternative source of protein in the diet/protein supplement especially in okpehe and oil bean seed.

The values for each parameter checked may be lower or higher than other values reported in other studies. These variations may be due to different species of these local food condiments seeds used, the climate and environmental conditions which plant grow.

226 REFERENCES

- 227 1. Achi OK. Traditional fermented protein condiments in Nigeria. *Afr. J. Biotechnol.* 2005;
228 4: 1612-1621.
229
- 230 2. Walker AF, Kochhar N. Effect of cooking including domestic cooking on
231 nutritional quality of legumes. *Proc. Nutr. Soc.* 1982; 41: 41-51.
232
- 233 3. AOAC. Association of Official Analytical Chemicals. Ash of animal feed, Protein
234 (crude) in animal feed and pet food, copper catalyst Kjeldahl method, Nitrogen-
235 ammonia-protein modified Kjeldahl method, titanium dioxide + copper sulphate catalyst,
236 Fat (crude) or ether extract in animal feed and Moisture in animal feed, loss on drying at
237 135°C for 2 hours. Gaithers-burg, MD, USA; 2000
238
- 239 4. AOAC. Association of Official Analytical Chemicals. Official methods of analysis p.
240 800. (modified); 1990
241
- 242 5. Aremu MO, Nweze CC, Alade P. Evaluation of protein and amino acid composition of
243 selected spices grown in the middle belt region of Nigeria. *Pakistan Journal of Nutrition.*
244 2011; 10: 991 – 1995.
245
- 246 6. Erukainure O, Oke OO, Daramola AO, Adenekan SO, Umanhonlen EE. Improvement of
247 the biochemical properties of watermelon rinds subjected to *Saccharomyces cerevisiae*
248 solid substrate fermentation. *Pak. J. Nutri.* 2010; 9(8):806-8092.
249
- 250 7. Sanusi GO, Belewu MA, Oduguwa BO. Changes in chemical composition of *Jatropha*
251 *curcas* kernel cake after solid-state fermentation using some selected fungi. *Global J.*
252 *Biol. Agric. Health Sci.* 2013; 2(2):62-66.
253
- 254 8. Adegunwa MO, Adebawale AA, Solano EO. Effect of thermal processing on the
255 biochemical composition, anti-nutritional factors and functional properties of beniseed
256 (*Sesamum indicum*) flour. *American Journal of Biochemistry and Molecular Biology.*
257 2012; 2(3):175–182.
258
- 259 9. Ndidi SU, Ndidi UC, Olagunji A, Muhammad A, Billy GF, Okpe O. Proximate, anti-
260 nutrients and mineral composition of raw and processed (boiled and roasted) *Sphenostylis*
261 *stenocarpa* Seeds from Southern Kaduna, Northwest Nigeria. *ISRN Nutr.* doi. 2014;
262 10:1155/2014/280837

- 263 10. Eka OU. Effects of fermentation on the nutrient status of locust beans. Food chem. 1980;
264 5:305-308
265
- 266 11. Asp NG. Dietary Carbohydrate, Classification by chemistry and physiology. Food Chem.
267 1996; 7: 9 – 14.
268
- 269 12. Achinewhu SC, Isichei MO. The nutritional evaluation of fermented fluted pumpkin
270 seeds (*Telferia occidentalis* Hook). Discovery and Innovation. 1990; 2: 62 -65.
271
- 272 13. Anigo MK, Abdullahi SA, Olagunju, Michael SA. Effect of Open and Controlled
273 fermentation on proximate and antinutrient compositions of Glycine max (Soya bean).
274 Advances in research. 2015; 3 (1): 1- 6.
275
- 276 14. Giwa OE, Seyifunmi OE, Aladekoyi G. Effect of fermentation on the physiochemical
277 and sensory attributes of beverages produced from Citrus lemon using both isolated
278 normal flora and propagated *Sacchomyces cerevisiae*. Int. Journal. Physical Sci. 2011; 3
279 (3): 133-140
280
- 281 15. Effiong OO, Umoren UE. Effects of multiprocessing techniques on the chemical
282 composition of horse eye beans (*Mucuna urens*). Asian J. Ani. Sci. 2011; 5(5): 340-248.
283
- 284 16. Olajide R, Akinsoyinu AO, Babayemi OJ, Omojola AB, Abu AO, Afolabi KD. Effect of
285 processing on energy values, nutrient and anti- nutrient components of wild cocoyam
286 [*Colocasia esculenta* (L.) Schott] Corm. Pak.J. Nutr. 2011; 10(1): 29-34
287
- 288 17. Nwosu JN. Effects of soaking, blanching and cooking on the antinutritional properties of
289 asparagus bean (*Vigna sesquipedalis*) flour. Nature and Science. 2010; 8(8):163–167.
290
- 291 18. Oboh G, Elusiyan CA. Changes in the nutrient and anti-nutrient content of micro-fungi
292 fermented cassava flour produced from low-and medium- cyanide variety of cassava
293 tubers. Afr. J. Biotechnol. 2007; 6(18): 2150-2157.
294
- 295 19. Dicko MH, Gruppen H, Traore AS, Van Berkel WJH, Voragen AGJ. Evaluation of the
296 effect of germination on phenolic compounds and antioxidant activities in Sorghum
297 varieties. Journal of Agricultural and Food Chemistry. 2005; 53:2581-2588.
298
- 299 20. Siddhuraju P, Becker K. Effect of various indigenous processing methods on the
300 galactoside and mono and disaccharide content of an Indian tribal pulse (*Mucuna*
301 *pruriens* var. *utilis*). J. Sci. Food Agric. 2001; 81: 718-725.
302

- 303 21. El-Adawy TA. Nutritional composition and antinutritional factors of chickpeas (*Cicer*
304 *arietinum* L.) undergoing different cooking methods and germination. *Plant Food Hum.*
305 *Nutr.* 2002; 57: 83-97.
306
- 307 22. Ugwu FM, Oranye NA. Effects of some processing methods on the toxic components of
308 African breadfruit (*Treculia Africana*). *Afr. J. Biotech.* 2006; 5: 2329-2333.
309