Research Article

Effects of Fermentation on the Nutritive Value of *Aspergillus Niger* and *Aspergillus Fumigatus* Fermented *Hura Crepitans* Seed Flour

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ABSTRACT

Microbial fermentation was carried out on *Hura crepitans* seed flour using *Aspergillus niger* and *Aspergillus fumigatus*. Proximate and mineral analyses were carried out on both the fermented and unfermented samples using standard methods. A physicochemical property of the extracted oil was also carried out. The proximate analysis indicated that the fermented (with *Aspergillus niger* and *Aspergillus fumigatus*) and unfermented samples respectively contain moisture (4.66 ± 0.28) and (3.33 ± 0.25), crude fat (56.66 ± 0.11, 60.26 ± 0.23) and (52.73 ± 0.11), ash (6.23 ± 0.25, 6.33 ± 0.57) and (3.33±0.57), crude protein (4.24 ± 0.03, 3.12 ± 0.05) and (2.35± 0.01), crude fibre (11.24 ± 0.22, 11.56 ± 0.05) and (6.68 ± 0.03), carbohydrate (16.97 ± 0.12, 14.07 ± 0.63) and (31.58 ±0.82). Mineral analysis of the samples showed that fermentation with *Aspergillus niger* increased the Fe, Cu, Na, and Ca content while the K, Mg, and Zn content were decreased through fermentation. The physicochemical properties of the extracted oil showed that the fermented samples have similar values in specific gravity (0.77 ± 0.22) and refractive index (1.45 ± 0.01) while the oil from unfermented sample contained specific gravity (0.88 ± 0.01), acid value (2.82 ± 0.03), iodine value (22.63 ± 0.32), peroxide value (0.47 ± 0.01), free fatty acid (0.07 ± 0.01), saponification value (64.52 ± 2.80) and refractive index (1.46 ± 0.01). From the result, the fermentation increased most of the nutrient composition of the samples

Keywords: Microbial Fermentation, *Aspergillus niger, Aspergillus fumigatus, Hura crepitan.*

INTRODUCTION

Hura crepitans also known as sand box or dynamite tree belongs to the family Euphorbiaceae (spurge family).It is a tropical tree which reaches a height of 90 to 130 feet with spiny trunk and spreading branches. The seed pods are used to fashion toothed necklaces. The seed has a pleasant taste and also contain a potent substance called ricin which causes diarrhea. The seeds are also emetic and very purgative when green. (Bahamas wildlife, 2001).
Dallwitz and Richter in 2000 carried out a physical and chemical test on the wood but much research has not been done on the seed. Meanwhile, Shakuntala and Shadaksharaswamy in 1987 stated that in the fermentation of foods, a complex mixture of carbohydrates, proteins, fats, etc. undergo modifications simultaneously under the action of variety of microorganisms and enzymes present and that the nature and extent of these changes depend upon the food, types of microorganisms present and conditions affecting their growth and metabolic pattern. The present study was therefore undertaken to determine the effect of fermentation on the nutrient composition of the seed flour.

MATERIALS AND METHODS

Hura crepitans seeds were obtained from The Federal University of Technology, Akure premises. The seeds were crushed to remove the endosperm. They were later sun- dried, blended, put in an airtight container and kept in a refrigerator prior the analysis. Microorganisms used to ferment the samples were *Aspergillus niger* and *Aspergillus fumigatus*. The blended sample was divided into three portions. 4.5g of ammonium sulfate, 1.35g of urea and 2.5g of potassium dihydrogen phosphate were dissolved in 100ml of water in a plastic container and a portion of the sample was added to this solution. *Aspergillus niger* broth was finally added as the fermentation organism. This procedure was also repeated with*Aspergillus fumigatus* broth. The containers were left opened for 1 hour for absorption of

atmospheric oxygen after which the containers were closed and the fermentation proceeded for 96 hours at room temperature. The fermented samples were then sieved and sun dried for the analysis.

Analysis

The proximate analysis was carried out using the methods described AOAC (1990). The moisture content was carried out by heating 5g of the samples in a thermostatically controlled oven to a constant weight at 105^{o}C while the ash content was obtained by heating 1g of the sample in a muffle furnace at 550^{o}C until a light grayish residue was obtained. The crude fat was determined by solvent extraction using petroleum ether at 60^{o}C for 3hours. The crude fibre was also determined by boiling the samples with dilute tetraoxosulphate (vi) acid and dilute sodium hydroxide and later treated with dilute hydrochloric acid, alcohol and ether, and finally ashed. While the crude protein was analysed by digesting the samples in hot concentrated tetraoxosulphate(vi) acid and distilled in an alkaline medium into a boric acid and finally titrated with standard hydrochloric acid. The physicochemical properties of the extracted oil were carried out using the methods described by Pearson 1981.The minerals were obtained dry ashing. The resulting ash was dissolved 0.1M hydrochloric acid and solution was used to determine the mineral content of the samples using atomic absorption spectrophotometer. The results obtained were statistically analyzed using Duncan multiple range test and Analysis of variance.

RESULTS

Table I: Proximate analysis of fermentend and unfermented Hura crepitans seed flour

	Unfermented sample	Fermented with *A.niger*	Fermented with *A. fumigatus*
Moisture	$3.33^{a} \pm 0.28$	$4.66^{b} \pm 0.28$	$4.66^{b} \pm 0.28$
Crude fat	$52.73^{a} \pm 0.11$	$56.66^{b} \pm 0.11$	$60.26^{c} \pm 0.23$
Ash	$3.33^{a} \pm 0.57$	$6.23^{b} \pm 0.25$	$6.33^{c} \pm 0.57$
Crude protein	$2.35^{a} \pm 0.01$	$4.24^{c} \pm 0.03$	$3.12^{b} \pm 0.05$
Crude fibre	$6.68^{a} \pm 0.03$	$11.24^{b} \pm 0.22$	$11.56^{b} \pm 0.05$
Carbohydrate	$31.58^{c} \pm 0.82$	$16.97^{b} \pm 0.12$	$14.07^{a} \pm 0.63$

The means with the same superscripts along the row are not significantly different ($P < 0.05$)

Table II: Physicochemical properties of the extracted oil from Fermented and unfermented hura crepitans seed flour.

	Unfermented sample	Fermented with *A.niger*	Fermented with *A.fumigatus*
Refractive index	$1.46^{a} \pm 0.01$	$1.45^{a} \pm 0.01$	$1.45^{a} \pm 0.01$
Specific gravity	$0.88^{a} \pm 0.01$	$0.77^{a} \pm 0.02$	$0.77^{a} \pm 0.02$
Acid value	$2.82^{a} \pm 0.03$	$13.42^{c} \pm 0.03$	$11.18^{b} \pm 0.03$
Free fatty acid	$0.07^{a} \pm 0.01$	$0.97^{b} \pm 0.02$	$0.07^{a} \pm 0.02$
Iodine value	$22.63^{c} \pm 0.32$	$13.82^{a} \pm 0.25$	$14.47^{b} \pm 0.28$
Saponification value	$64.52^{a} \pm 2.80$	$75.73^{b} \pm 2.81$	$79.47^{c} \pm 4.28$
Peroxide value	$0.47^{a} \pm 0.01$	$1.55^{b} \pm 0.01$	$1.67^{c} \pm 0.03$
Unsaponifiable value	$26.02^{c} \pm 0.04$	$18.15^{b} \pm 0.04$	$16.26^{a} \pm 0.05$

The means with the same superscripts along the row are not significantly different ($P < 0.05$)

Table III: Mineral analysis of fermented and unfermented Hura crepitans seed flour

	Unfermented Sample	Fermented with *A.niger*	Fermented with *A.fumigatus*
Iron	$56.11^{b} \pm 0.95$	$62.94^{c} \pm 0.41$	$52.66^{a} \pm 0.87$
Magnesium	$654.53^{c} \pm 0.66$	$555.25^{b} \pm 0.53$	$469.44^{a} \pm 0.38$
Calcium	$564.16^{b} \pm 0.12$	$700.78^{c} \pm 0.72$	$510.61^{a} \pm 0.00$
Sodium	$211.32^{b} \pm 0.37$	$230.77^{c} \pm 0.00$	$159.82^{a} \pm 0.74$
Potassium	$825.39^{c} \pm 0.00$	$796.72^{b} \pm 1.59$	$793.60^{a} \pm 0.09$
Cobalt	nd	nd	nd
Lead	nd	nd	nd
Zinc	$349.38^{b} \pm 0.00$	$321.39^{a} \pm 0.71$	$210.28^{a} \pm 0.71$
Manganese	nd	$6.52^{a} \pm 0.00$	nd
Copper	$7.70^{a} \pm 0.07$	$55.05^{b} \pm 0.07$	$7.70^{a} \pm 0.09$

The means with the same superscripts along the row are not significantly different ($P < 0.05$)

nd – Not detected

DISCUSSION

Result of the **proximate content** of fermented and unfermented *Hura crepitans*seed as presented in the Table I shows that the moisture content of the fermented samples ($4.66^{b} \pm 0.28$) is higher than $3.33^{a} \pm 0.28$ obtained for unfermented sample. The fat content in fermented samples with*Aspergillus fumigatus* ($60.26^{c} \pm 0.23$) is higher than $52.73^{a} \pm 0.11$ and $56.66^{b} \pm 0.11$ obtained for unfermented and fermented with *Aspergillus. niger* respectively. Moreover, all these values are higher than 15.53 ± 0.64 obtained for *Bauhinia. racemosa* seed by Amoo and Moza(1999) and this implies that they all contain an appreciable amount of oil. For the Ash content, comparatively similar values obtained for the fermented samples are slightly higher than 5.76 reported for pigeon pea by Oshodi and Ekperigin(1989). The protein content of the unfermented sample islower than that obtained for the fermented samples. This may be due to the activity of these fermentative microbes to synthesize amino acid as reported by Nanson and Field(1984). Slightly similar values ($11.24^{a} \pm 0.22$, $11.56^{a} \pm 0.05$) are obtained for the crude fibre of the fermented samples but these values are higher than 4.51 ± 0.13 reported by Oshodi(1992) for *Adenopus breviflorus* benthwhole seed flour. Moreover, the decrease in carbohydrate content of the fermented samples is due to the usual conversion of carbohydrate to ethanol during the process of fermentation.

The **physicochemical analysis** of the extracted oil is depicted in Table II. It shows that thespecific gravity and refractive index of oil from unfermented sample are $0.88^{b} \pm 0.11$ and $1.46^{a} \pm 0.11$ respectively. These values are higher than $0.77^{a} \pm 0.22$ and $1.45^{a} \pm 0.01$ obtained for the fermented samples. However, the acid values of oil from the fermented samples are higher than that obtained from the unfermented samples. This could result from an increment in the amount of free fatty acid through microbial activities. The peroxide values obtained for both fermented and unfermented oil samples ($1.55^{b} \pm 0.01$, $1.67^{c} \pm 0.03$, $0.47^{a} \pm 0.01$) are lower compared to 4.85 ± 0.05 obtained by Amoo and Moza(1999) for *B.racemosa* seed oil. In addition, the iodine value and the unsaponifiable matter of the unfermented sample are higher than the fermented ones but these values are low compared to that reported for *Bliphia. sapida*seed (394.42 ± 2.62) by Esuoso and Odetokun(1995). Whereas, the saponification value for the fermented samples ($75.73^{b} \pm 2.81$, $79.47^{c} \pm 4.28$)are higher than the unfermented ($64.52^{a} \pm 2.80$). Moreover, low but slightly similar values are obtained for free fatty acid in oil from unfermented sample ($0.07^{a} \pm 0.01$) and *Aspergillus fumigatus* fermented sample ($0.07^{a} \pm 0.02$) which shows their high degree of unsaturation.

The **mineral analysis** of the fermented and unfermented samples as presented in table III shows that the content of Mg, K, and Zn of the unfermented sample are higher than the fermented ones. Also, the content of Na ($211.32^{b} \pm 0.37$), Ca($564.16^{b} \pm 0.12$), Cu ($7.70^{a} \pm 0.07$) of the unfermented sample is lower compared with those of the fermented with *Aspergillus niger* which contain Na ($230.77^{c} \pm 0.00$), Ca ($700.78^{c} \pm 0.72$) and Cu ($55.05^{b} \pm 0.07$) but these values are lower in *Aspergillus fumigatus* fermented samples. Pb, Co, and Mn were not detected in both fermented and unfermented samples but little amount of manganese was discovered in fermented sample with *Aspergillus niger*. Moreover, the Fe content of all the samples are not too high compared to other minerals in the samples but only a slight difference in Fe content between the fermented an unfermented were discovered.

In general, fermentation increased all the proximate composition except carbohydrate; acid and saponification values; and few of the minerals. The samples are good source of protein and fat; high saponification value would make them useful for soap production and the high content of Ca and Fe make them a good supplement for bone and blood building.

REFERENCES

Amoo IA and Moza L (1999).Extraction and Physicochemical properties of oil from *Bauhinia racemoza* seeds, La RivistaItaliana.Dellesostanze. Grasse, vol LXXVI, settebre.

AOAC (1990), Official method of analysis (15th edn), Association of official analytical chemists, Washington D.C, U.S.A, pp 85-89.

Dallwitz MJ, Richer HG (2000). Commercial timbers, descriptions, illustrations, identification, and information retrieval. http://biodiversity.uno.edu/delta/wood/en/www/refs.htm.

Esuoso KO, Odetokun SM (1995).Proximate chemical composition and possible industrial utilization of *Bliphia sapida* seed and seed oil, Riv. Ital. Sostanze Grasse.72.

Nason NJ, Field ML (1984). Influence of temperature on the nutritive value of lactic acid fermented cornmeal, Journal of food science, vol. 49, pp 958 – 959.

Oshodi AA, Ekperigin MM (1989). Functional properties of pigeon pea (*Cajanuscajan*) flour, food chemistry, 34, 187 – 191.

Oshodi AA (1992). Proximate composition, nutritionally valuable minerals and functional properties of *Adenopus breviflorus*benth seed flour and protein concentrate, J of food chemistry, 45, pp79 – 83.

Pearson D (1981). Chemical Analysis of Foods, 7th edn, AVI publisher, West port, pp 100 – 105.

Shakuntala MN,Shadaksharaswamy (1987). Foods Facts and Principles, Wiley Eastern Limited, Bombay, pp80 – 86.