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Biochemical Assessment of '*Daddawa*' Food Seasoning Produced by Fermentation of Pawpaw (*Carica papaya*) Seeds

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Abstract: Biochemical assessment of pawpaw (*Carica papaya)* seeds and *daddawa* produced from the seed by fermentation was carried out. *B. Subtilis*, *B. pumilus* and *B. licheniformis* were found to be involved in the fermentation. The proximate composition showed that the seed had high lipid (48.50±0.45%) and protein (21.72±0.37%) contents, which increased significantly ($p<0.05$) after fermentation to 54.19±0.42 and 23.56±0.33% respectively. The main mineral elements found in fermented and unfermented seeds were magnesium, calcium and sodium. Fermentation decreased the level of antinutritional factors: oxalate from 210.1-40.2 mg/100 g, phytic acid from 102.0-68.0 mg/100 g, tannin from 15.5-8.3 mg/100 g and trypsin inhibitor from 2431.2-63.0 mg/100 g. Both fermented and unfermented papaya seeds were rich in the essential amino acids, leucine, lysine isoleucine and phenylalanine. Oleic acid is the predominant fatty acid in both raw and fermented seed oil being 77.7 and 80.7%, respectively, while, palmitic and stearic acids were present in appreciable quantities.

Key words: *Carica papaya* seed, fermented pawpaw seed, food seasoning, *daddawa* and papaya seed

INTRODUCTION

The pawpaw (*Carica papaya*) is a giant herbaceous plant widely grown throughout the tropics for its tasty edible fruit out of the 48 species of the genus *caricaceae* known, only *Carica papaya* is of importance (Subrahmanyan and Achaya, 1957).

The pawpaw seeds which are obtained from riped fruit account for about 14.3% of the weight of fresh papayas (Chan *et al*., 1978). Held and Curl (1944) reported that papaya seeds are edible and have a spicy, pungent flavour. The also reported that the seeds and peels residues have been used in poultry feed. The seed is used as a vermifuge (dewormer). The antifertility activity of papaya seed has been demonstrated in female rat, mice and man (Das, 1980). According to Farnsworth *et al*. (1975) the active substance responsible for the antiimplantation effect of papaya seed in female is 5-hydroxytryptamine.

The seed kernels constitute 49.7% of the whole seed with high lipid and protein contents of 50.1 and 29.2% respectively (Chan *et al*., 1978. Subrahmanyan and Achaya, 1957). The principal mineral composition of the papaya seed are calcium (1.66%), phosphorus (0.84%) and magnesium (0.67%) (Chan *et al*., 1978).

Fermentation of papaya seed to produce (food seasoning) has not been by documented. However, the production of *daddawa* fermentation of pawpaw seed might add value to it nutritionally and therefore enhance the utilization of the seeds instead of allowing it to waste away.

MATERIALS AND METHODS

Preparation of papaya seeds: The seed of rip pawpaw (*Carica papaya*) fruits weighing between 1-3 kg from Narict pawpaw garden were removed, cleaned and sun dried. The dried seeds were then dehulled and winnowed to obtained the seed kernel.

Fermentation of papaya seed kernel: The seed kernels were divided into 2 halves. Adopting the traditional method of fermenting locust bean (*Parkia biglobossa*) for the fermentation, pawpaw seed was used for the first half with some modification. The seed was boiled for 2 h and while, still hot, it was filtered and spread in a lined jute bag containing fresh pawpaw leaves. This was incubated at 37°C and allowed to ferment for 72 h. The second half was left unfermented. The flow chart for the fermentation is shown in Fig. 1.

Microbiological analysis: The detection and identification of *Bacillus* species from the fermented pawpaw seed '*daddawa*' was carried out using the method of Mitruka and Bonner (1976).

Proximate composition: The moisture, ash and crude fibre contents were determined by AOAC (1980) method on ground sample of the raw and fermented seed. Nitrogen content was estimated by micro-kjeldahl method and the crude protein was calculated (% N_2 x 6.25). The crude lipid was determined by soxhlet extraction of the ground seeds for 24 h using petroleum

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Table 1: Biochemical characters employed in identification of *Bacillus* Isolate from Pawpaw Seed *Daddawa* (PSD)

Source	*Bacillus* isolate	Biochemical test (Base on Gordon *et al.* (1973) and Mitruka and Bonner (1976)					
		Starch hydrolysis	Catalase test	VP* Test	Gelatin liquefaction	Growth in 7% NaCl	*Bacillus* spp identified
Pawpaw seed *Daddawa*	PSD_a	+	+	+	+	+	B. *subtilis*
	PSD_b	+	-	+	+	+	Unidentified
	PSD_c	-	+	+	+	+	B. *pumilus*
	PSD_d	+	+	+	+	+	B. *pubtilis*
	PSD_e	-	+	+	+	+	B. *pumilus*
	PSD_f	+	+	+	+	+	B. *subtilis*
	PSD_g	+	+	+	+	+	B. *subtilis*
	PSD_h	+	+	+	+	-	B. *licheniformis*

*VP = Voges Proskauer; + = Positive test; - = Negative test; PSD = Pawpaw seed *Daddawa*; Subscripts a, b, c, d, e, f, g and h represent different isolates from PSD

Table 2: Proximate composition of papaya seed Dry Matter Basis (DMB)

	Unfermented papaya seed (Raw decorticated)	Fermented papaya seed (processed)	Whole papaya seed (Husk + Kernel)
Moisture content (%)	10.57±0.31	9.21±0.23	4.93
Crude fibre (%)	0.57±0.23	0.59±0.19	33.62
Crude lipid content (%)	48.50±0.45	54.19±0.42*	28.73
Crude Protein (%)	21.72±0.37	23.56±0.33*	14.21
Ash content (%)	4.09±0.16	3.95±0.18	10.30
Total carbohydrate (by difference)	14.55±0.52	8.50±0.46*	6.21
Energy value (kJ/100g)	2430.00	2579.00	

Values are mean of triplicate determinations, *Values differ significantly (p<0.05) from unfermented seed values

ether (40-60°C). The total carbohydrate was obtained by difference.

Mineral analysis: Mineral was analyzed from the triple acid digested samples of both raw and fermented pawpaw seed using an Atomic Absorption Spectrophotometer (AAS) (Solar 969 unicam) (Isaac and John, 1975) for all elements except sodium and potassium which was determined using flame photometer.

Amino acid analysis: Finely hydrosis was carried out in dried samples using the method of AOAC (1980). Finely ground (30-50 mg) each of both raw and fermented pawpaw seed was placed in an ampoule, 7 mL 6 N HCl was added and the tube was then flushed with nitrogen sealed and placed in an oven at 110°C for 24 h. The tube was removed, allowed to cool, broken and the resulting suspension filtered under function. The filtrate was evaporated to dryness at 40°C under vacuum in a rotary evaporator.

The determination of the amino acid profile was carried out on the reconstituted samples with the column chromatographic techniques using the automated Technicon Sequential Multi-sample (TSM) amino acid analyzer model DNA 0209 (Spackman *et al.*, 1958). Known quantities of internal standard norleucine was included for the determination of acidic, basic and neutral amino acid acids, to enable the calculation of the quantities of other amino acid relative to their peak recovery.

Analysis of antinutritional factors: The antinutritional factors: Tannin (Burns, 1971) and Oxalate (Oke, 1969) were quantified. The colorimetric procedure of Wheeler and Ferrel (1971) was followed to estimate phytic acid. Trypsin inhbitor activity was determined by the enzymatic assay of Smith *et al.* (1980).

RESULTS AND DISCUSSION

During the 3-day fermentation, the pawpaw seed kernel changed in color from cream white to dark brown and became softer with characteristic strong ammonia- like smell characteristic of locust bean *daddawa*. Table 1 shows that the predominant microorganism responsible for the fermentation of pawpaw seed were found to include *Bacillus subtilis, B. pumilus* and *B. licheniformis,* as also detected in locust bean fermentation (Ogbadu and Okagbue, 1988).

The results of the proximate analysis of papaya seeds (fermented and unfermented) are shown in Table 2. The moisture content of the papaya seeds are within the normal range of 9-12 months storage of soyabean '*daddawa*' as reported by Karl (1987). The high value of crude fibre in the whole seed as compared to the raw and fermented seeds indicates that the bulk of the fibre is in the husk.

There was a significant increase (p<0.05) in the crude lipid and crude protein contents after fermentation. The total carbohydrate contents decreased significantly after fermentation from 14.55-8.50%. The decrease in carbohydrate could be as a result of the fermenting

Table 3: Mineral composition of papaya seed (mg/100g)

Element	Unfermented (raw)	Fermented (processed)	Seed husk
Calcium (Ca)	53.87±2.11	72.11±1.11*	1713±1.55
Sodium (Na)	45.60±0.07	44.50±0.03*	210.1±0.85
Potassium (K)	18.03±0.67	20.00±0.28*	103.3±0.55
Magnesium (Mg)	318.1±3.02	318.7±3.01	350.1±2.12
Manganese (Mn)	0.7800±0.11	0.5500±0.21	1.85±0.33
Iron (Fe)	7.080±0.17	4.748±0.55*	60.39±1.33
Copper (Cu)	2.87±0.07	1.948±0.06	4.961±0.07
Zinc (Zn)	3.672±0.08	3.766±0.09	3.196±0.35
Nickel (Ni)	0.450±0.02	0.119± 0.42	1.430±0.12
Lead (Pb)	1.400±0.07	0.8380±0.04*	2.060±0.01
Silver (Ag)	4.90±0.02	0.960±0.04*	10.34±0.18
Cobalt (Co)	0.11±0.03	0.413±0.04*	2.260±0.03
Cadmium (Cd)	0.030±0.01	0.000±0.00*	0.001±0.01
Chromium (Cr)	0.589±0.01	0.306±0.04	0.620±0.07

Values are means and standard deviation of duplicate determination; *Values that differ significantly ($p<0.05$) from the corresponding values in the unfermented seed

Table 4: Amino acid composition of papaya seed meal

Amino acid	Unfermented seed (g/100g protein)	Fermented seed (g/100g) protein
Lysine	4.21	4.01
Histidine	2.21	2.48
Arginine	6.44	5.40
Phenylalanine	3.38	2.64
Methionine	1.30	1.13
Threonine	2.85	2.69
Leucine	7.78	8.08
Isoleucine	3.09	2.80
Valine	2.25	1.94
Aspartic acid	7.05	7.22
Glutamic acid	12.39	13.40
Serine	3.01	2.09
Proline	2.13	2.10
Glycine	4.26	4.57
Alanine	3.22	4.60
Cystine	1.14	0.85
Tyrosine	2.06	1.82

Values are means of duplicate determinations

microorganism that might have used it as nutrients or convert it to fatty acids and amino acids as indicated by the increase in crude lipid and crude protein content respectively, after fermentation. The mineral analysis are shown in Table 3. The mineral elements analyzed were found to be higher that those reported by Chan *et al.* (1978), probably due to geographic, climatic or analytical technique differences. The results reveal that the seeds of *Carica papaya* are a rich source of magnesium, calcium and iron when compared to locust bean and soyabean (Abu, 1995). The amino acid content of unfermented and fermented papaya seed '*daddawa*' is shown in Table 4. The amino acid content of unfermented and fermented *daddawa*' appears to be very similar. Like many dry beans, papaya seed are low in the sulphur-containing amino acids cysteine and methionine (Fetuga *et al.*, 1973). Eka, (1980) reported that *daddawa* is low in the essential amino acids leucine, isoleucine and phenylalanine as observed in papaya seed. The deficiency of *daddawa* in some of the

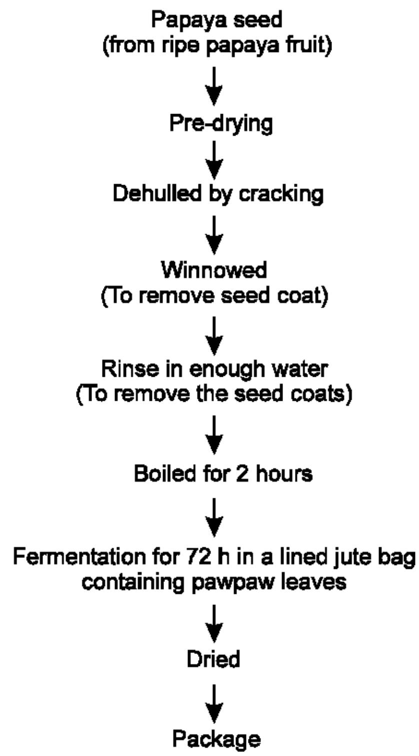

Fig. 1: Flow chart for the fermentation of papaya seed

essential amino acids detracts from the value of *daddawa* as a source of high quality protein. However, *daddawa* is not consumed alone, but added to soup and other vegetables as a flavouring agent. The results of some antinutritional factors in papaya seed are shown in Table 4. The level of toxic substances such as oxalate, phytic acid, tannin and trypsin inhibitor were high in unfermented papaya seed. However, these toxic substances were reduced during cooking and fermentation of *daddawa*' as reported by Rackis *et al.* (1986). The decrease observed in the phytic acid and oxalate contents would therefore make more mineral elements available for utilization.

In view of the overall chemical assessment, the authors believe the seeds of *Carica papaya* may be adopted as food sources otherwise the seeds are inedible.

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