

EFFECT OF AEROBIC FERMENTATION OF CASSAVA ON THE NUTRIENT COMPOSITION OF ITS PRODUCT

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ABSTRACT

Aerobic fermentation of cassava was carried out to determine the nutrient quality of the final product with a view to optimizing its use in poultry diets. Two varieties of cassava TMS 30572 and OTA were peeled, chipped and heaped for fermentation. Samples were taken at days 0, 3, 5 and 7 for determination of moisture, crude protein, crude fibre, ether extract and cyanide levels. Fermentation was carried out in both dry and wet seasons. Results showed that major changes in composition were in the moisture content which increased with corresponding decreases in dry matter content with increasing period of fermentation for both seasons studied. Protein content increased up to a period of 3 days after which it declined. A similar trend was observed in both wet and dry seasons. However, it was noted that a higher moisture content with a correspondingly lower dry matter content was reported for all samples in the wet season when compared to their counterparts in the dry season. Cyanide content was reduced with increasing period of fermentation in all samples irrespective of variety and season. Further studies are recommended to investigate the possibility of increasing protein content by fermentation.

KEY WORDS: Cassava, Aerobic fermentation, Nutrient Composition.

INTRODUCTION

Fermentation of cassava prior to preparation for human foods is a common and well established practice. The mode of fermentation could be either acid or air fermentation (Westby, 1994) Acid fermented products are

more popular and could be prepared from grated roots or soaked roots. The air fermented products could either be by mould growth due to slow drying or by heaping the cassava and covering with leaves. Although several air fermented products are consumed in Africa the role of the microorganisms in these products need to be further understood. However, few microbial species bring about desirable changes in the final quality of the product while other species may not contribute to the product and may even lower the quality of the food or may represent a health hazard. (Bokanga, 1994)

Studies have been conducted on the protein enrichment of cassava by fermentation techniques (Muindi) and Hassen, 1987; Balagopal and Padmaja, 1988) Suchmann (1994) obtained satisfactory growth rate by feeding fermented cassava meal to broiler chicken. In all these studies the enhanced protein content was due to inoculation. This study was therefore conducted to determine the effect of chance inoculation of microbes during aerobic fermentation on the nutrient quality and cyanide content of cassava.

MATERIALS AND METHODS

Preparation of Samples

Cassava tubers approximately 12 months old of the varieties TMS 30572 and OTA were manually harvested early in the morning, washed gently, freed of soil particles and microorganisms. They were thereafter peeled and sliced into chips of approximately 1 cm thickness and each variety weighed into 4 samples units of 250 g each. They were surface dried for 1 - 2 hours in the open air to reduce

the water content and allow chance inoculation of microbes (Hahn1992) The chips were then heaped into their units, covered with leaves and left to ferment in the open air units for 0, 3, 5, and 7 days respectively. Chips before fermentation i.e 0 days served as the control. At the end of the specified period, the fermented mouldy chips were scraped of biomass terminating the further activity and oven dried for 24 - 48 hours at 70°C, cooled in a dessicator and weighed. The dried chips were milled and stored in nylon bags for further analysis. The entire process was carried out in the peak periods of the dry season. (January) and wet season (July) for both varieties.

Laboratory Analysis

Samples were analysed for proximate composition (AOAC) 1984.) Calculations were also made as follows for gross energy content by a regression equation (Weende analysis) as described by Wisemann (1984)

$$GE = 5.72 CP + 95.0EE + 47.9CF + 41.7NFE + Di$$

Hydrogen Cyanide Estimation

Hydrogen cyanide content was determined by the TOA TOB METER IM - 55 with an Ogwasaki cyanide ion-selection electrode as described by Zitnak (1973) In standardizing the instrument 25g of potassium cyanide salt was dissolved in 1 litre of distilled water to obtain 1000ppm stock solution. The electrode is re-activated for about 30 minutes by dipping inside 10ppm solution of potassium cyanide solution. For measurements, 2g of the milled sample was dissolved in 20mls of distilled water inside a small beaker attached to the instrument. Readings were taken when the deflection of the needle was stable.

RESULTS AND DISCUSSION

Physical Appearance

During the fermentation the chips were sticky within the first 24 hours and traces of fungi mycellia became visible from day 2 with release of fermenting odours. As fermentation progressed dense biomass covered the chips,

while the chips themselves were soft, tender and moist. Fluid released was coloured and sweet smelling. On completion of drying the chips were like baked biscuits. After milling it was observed that the texture of the flour was smoother and more powdery with increasing fermentation period. The powder itself changed from white to increasing shades of brown. Essers and Nout (1989) similarly observed darker coloured flours from fermented cassava produced in Mozambique. They also observed that darker flours (mold fermented) contain lower amounts of cyanide than lighter coloured flours, although the mechanisms involved have not been investigated.

Nutrient Composition

Table 1 gives the proximate composition of the 2 varieties of cassava fermented in the dry season. Moisture contents in both varieties showed progressive increases with corresponding decreases in dry matter as the period of fermentation increased. Several microorganisms have been associated with fermentation depending on the conditions employed during these fermentation

TABLE 1: PROXIMATE COMPOSITION OF CASSAVA FERMENTED IN THE DRY SEASON (DRY MATTER BASIS)

COMPONENT	OTA VARIETY				TMS 30572			
	0days	3days	5days	7 days	0days	3days	5days	7days
Water	61.40	64.20	67.20	69.40	56.00	59.60	61.20	62.00
Dry Matter	38.60	35.80	32.80	30.60	44.00	40.40	38.80	38.00
Crude Protein	2.27	2.63	1.99	20.0	1.28	1.35	1.22	1.23
Ether Extract	0.26	0.25	0.24	0.31	0.27	0.23	0.24	0.14
Crude Fibre	2.24	2.37	2.50	2.30	2.26	2.37	2.28	2.25
Total Ash	1.64	2.08	1.63	1.82	1.79	1.66	1.61	1.60
Nitrogen	93.59	92.67	93.64	93.67	94.40	94.39	94.65	94.6
Free Extract								
GE Kcals/kg Calculated	4164	4152	4161	4166	4144	4149	4149	4144

TABLE 2: PROXIMATE COMPOSITION OF CASSAVA FERMENTED IN THE WET SEASON (DRY MATTER BASIS)

COMPONENT (%)	OTA VARIETY				TMS 30572			
	0days	3days	5days	7days	0days	3days	5days	7days
Water	63.00	63.80	65.20	71.00	60.20	63.60	67.20	68.00
Dry Matter	37.00	36.20	34.80	29.00	39.80	36.40	32.80	32.00
Crude Protein	3.46	3.77	3.48	3.27	3.78	4.01	3.71	3.39
Ether Extract	0.16	1.01	0.34	0.22	0.23	0.82	0.50	1.70
Crude Fibre	12.47	12.21	11.82	12.06	11.62	11.92	10.91	10.87
Total Ash	1.63	1.69	1.94	1.63	1.62	1.51	1.94	2.41
Nitrogen	93.59	92.67	93.64	93.67	94.48	94.39	94.65	94.6
Free Extract	82.27	81.32	82.60	82.83	82.77	81.74	82.94	81.63
GE Kcals/kg Calculated	4242	4288	4228	4239	4245	4287	4241	4242

TABLE 3: CYANIDE CONTENTS OF FERMENTED CASSAVA IN DRY AND WET SEASONS (mg/Kg)

VARIETY	0	3	5	7
DRY SEASON				
OTA	10.00	1.90	1.30	0.70
TMS 30572	40.00	4.00	2.00	1.40
WET SEASON				
OTA	9.00	1.80	1.60	1.40
TMS 30572	14.00	2.20	1.90	1.10

Ihekoronye and Ngoddy (1985) observed biochemical changes in cassava due to microbial activity during fermentation. The variety TMS 30572 had slightly higher dry matter content in all stages of fermentation when compared to the OTA variety. This could be due to a varietal difference in the composition of the cassava. Noomhorn *et al* (1992) observed that metabolism of carbohydrates and respiration of microorganisms result in increased moisture content during the solid state fermentation of cassava.

Crude protein contents in both varieties increased by day 3 of fermentation in both seasons, (Tables 1 and 2)

Increase in protein synthesis as a result of microbial fermentation has also been reported by Muindi and Hansen (1987) and Balagopalan and Padmaja (1988). However, on further fermentation to 5 and 7 days there was a decrease in protein content. The formation of additional metabolic by-products by day 3 may have inhibited fungal growth thus preventing further protein formation (Cochrane, 1958). Ether extract and crude fibre values were low throughout the fermentation period. The low crude fibre was due to the early stages of maturity of the tubers selected (~ 1 year in both varieties. The NFE values were lowest in both varieties at day 3 corresponding with the highest protein levels recorded. Noomhorn *et al* (1992) reported increased protein content during solid state fermentation of cassava. However, the calculated gross energy values for all samples were within a narrow range of 4144 -4166 kcal/kg indicating that the gross energy contents of the cassava samples still remained relatively unchanged.

Table 2 shows the proximate composition of the fermented cassava in the wet season. An increase in moisture content was observed as fermentation period was prolonged with corresponding decreases in dry matter contents. The higher dry matter contents in the TMS30572 variety when compared to the OTA variety may be due to varietal differences. Gomez (1982) reported varying dry matter contents in different varieties of cassava samples.

As in the dry season, protein content once again recorded the highest value at day 3 and declined thereafter by days 5 and 7. Corresponding with the increased protein content at day 3 was a decrease in NFE value. The overall low NFE values in the wet season 81.32 - 82.94 when compared to those in the

dry season (92.67 - 94.68) is due to the higher crude fibre content in the wet season samples. Crude fibre increase is due to conversion of soluble sugars to cellulose and hemillulose (McDonald et al. 1987). Ether extract values were low for all samples except at day 3 for both varieties and day 7 for TMS30572 variety. The reason for this increase is unknown. Ash content was low in all samples while calculated Gross Energy contents of the different samples ranged from 4220 - 4288 kcal/kg. The highest energy value at day 3 of fermentation was related the high ether extract values at this stage.

The cyanide content of the cassava samples (Table 3) showed a lower cyanide content initially in the OTA variety when compared to the TMS 30572 variety. As fermentation progressed in all cases the cyanide content reduced with the lowest values recorded at day 7. Fermentation has been assumed to be a key process in cyanide elimination (Westby, 1994) and this has been supported by ability of microorganisms to hydrolyse linamarin (Okafor and Ejofor, 1986). The remarkable reduction in the levels of hydrogen cyanide, shows that the microorganisms are very effective in the detoxification of this compound during aerobic fermentation especially by the third day, after which, the level of a cyanide continues to decline. Bokanga (1994) noted that the major benefit of cassava fermentation is the detoxification of their final products. The exact role of these microorganisms is currently being further investigated at ARI (Westby, 1994). From the above studies it is observed that fermentation does bring a change in nutrient composition of the cassava products. By day 3, there was a slight increase in protein content of the fermented cassava irrespective of the season. It is also obvious that the cyanide content of cassava is considerably reduced with progressive fermentation. The advantages of fermentation can thus be made use of in developing further studies to significantly increase the protein content of cassava with a

view to using it satisfactorily in rations for poultry.

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