Fermented Foods and Beverages Series

Handbook of Indigenous Foods Involving Alkaline Fermentation

Edited by

Prabir K. Sarkar • M.J. Robert Nout

CRC Press
Taylor & Francis Group

Table 2.16 Amino Acid Profile of Unfermented and Fermented Mesquite Seeds

AMINO ACID (g/100 g PROTEIN)	UNFERMENTED COTYLEDON	OKPEHE
Lysine	6.60	13.43
Histidine	2.30	2.55
Arginine	12.15	11.33
Asparagine	6.53	10.04
Threonine	2.57	3.13
Serine	3.82	3.22
Glutamine	19.25	19.62
Proline	5.20	5.04
Glycine	3.13	3.44
Alanine	2.53	3.68
Cystine	13.60	20.23
Valine	5.45	4.15
Methionine	3.93	5.98
Isoleucine	3.01	4.04
Leucine	6.89	7.15
Tyrosine	1.46	2.01
Phenylalanine	2.07	1.45

Source: Odibo, F.J.C. et al., *Journal of Industrial Microbiology and Biotechnology*, 35, 947–952, 2008.

concentration of glutamine followed by aspartic acid, cysteine, and lysine in decreasing order was observed (Table 2.16) (Odibo et al., 2008). Flavor characteristics of condiments are mainly due to accumulation of glutamic acids. The mineral composition after fermentation was observed to include calcium, phosphorus, potassium, manganese, and zinc. Increase in calcium and iron was consistently observed in samples studied by Balogun and Oyeyiola (2012). However, the vitamin and anti-nutritional composition of okpehe is poorly reported in literature. It could be assumed that increased availability of phosphorus in the fermented product must have been due to hydrolysis of phytic acid in the cotyledon.

2.1.2.5 Otiru

Yemisi Adefunke Jeff-Agboola

The three major raw ingredients for otiru production are the seeds of African yam bean (AYB) plant (*Sphenostylis stenocarpa* (A.Rich.) Harms), water, and naturally occurring bacterial starter culture. AYB plant is grown in West Africa, particularly in Cameroon, Côte

d'Ivoire, Ghana, Nigeria, and Togo. In Nigeria it is found in localized areas of the Volta region, where peasant farmers grow it as a security crop for both its edible seeds and its tubers. Indeed, there AYB is preferred to other legume seeds (Njoku et al., 1989). This leguminous plant is an annual vigorous vine, which twines and climbs to a height of about 3 m and requires staking. It flowers profusely in 100 to 150 days, producing brightly colored flowers, which may be pink, purple, or greenish white. The slightly woody pods contain 20 to 30 seeds, are up to 30 cm long and mature within 170 days. The plant produces underground tubers that are used as food in some parts of Africa and that serve as organs of presentation in the wild (Porter, 1992; Ogbonna et al., 2001).

2.1.2.5.1 Traditional Process of Otiru Production The raw AYB (Figure 2.52a) must first be hand-sorted and cleaned, and then washed, soaked in water for 12 h, dehulled, washed, and boiled for about 1 h until soft. The cooked beans are wrapped in plantain leaves and left to ferment at ambient temperature for 5 days (Figure 2.53). However, there are differences in the procedures, and equipment employed in different areas and communities (Jeff-Agboola, 2007).

The formation of otiru is indicated by the appearance of a grayish brown color (Figure 2.52b), a mucilaginous substance, and a strong ammoniacal odor. Otiru is regarded as spoiled when it liberates a putrid or rancid smell or appears contaminated with mold or yellow-pigmented slimy material on the beans if stored under ambient conditions. Hence, to extend shelf life, the product is finely ground, added with salt, molded into balls or flat discs, and sun-dried, when it can be stored for several months.

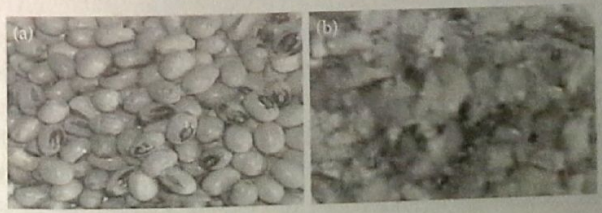

Figure 2.52 Raw seeds of (a) yeam bean tree and (b) otiru. (Modified from Jeff-Agboola, Y.A., *Research Journal of Microbiology*, 2, 816–823, 2007.)

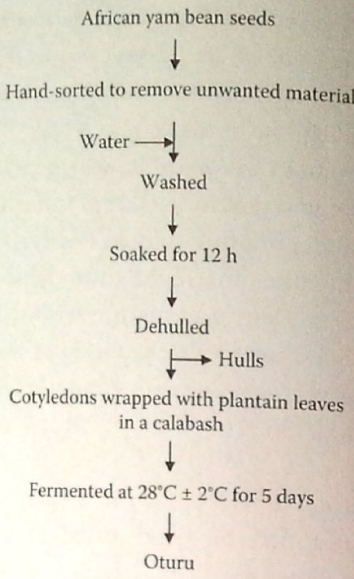

Figure 2.53 Processing of African yam bean seeds into otiru.

2.1.2.5.2 Microorganisms Traditionally fermented AYB were found to contain bacteria and yeasts, while raw beans contained bacteria, yeasts, and a mold, and boiled seeds contained bacteria only (Jeff-Agboola, 2007). The various types of bacteria and yeasts isolated from the fermenting seeds were *Lactobacillus jensenii*, *Bacillus coagulans*, *Aerococcus viridans*, *Pediococcus pentosaceus*, *Saccharomyces cerevisiae*, and *Candida vini*. *Aspergillus niger* was the only mold isolated along with bacteria (*L. jensenii*, *B. coagulans*, and *A. viridans*) and yeast (*C. vini*) from raw seeds. Seeds boiled for 1–2 h were found to contain *B. coagulans* only at a load of 2×10^2 cfu/g.

Of the four species of bacteria isolated from fermenting seeds, *L. jensenii* and *P. pentosaceus* were predominant (Table 2.17). They occurred even until 120 h of fermentation. While *S. cerevisiae* was present until the end of fermentation, *C. vini* could not be detected from the final stage of fermentation. In all the cases, there was a decrease in the cell count after 72 h of fermentation.

2.1.2.5.3 Changes in Proximate Composition During the production of otiru, the proximate composition of AYB seeds changed significantly (Table 2.18). After soaking, there was a 5 times increase in the

Table 2.17 Changes in the Microbial Load during Fermentation of African Yam Bean Seeds to Produce Otiru

MICROORGANISM	LOG cfu/g AT FERMENTATION PERIOD (h)					
	0	24	48	72	96	120
BACTERIA						
Lactobacillus jensenii	2.30	3.30	3.49	3.54	3.32	3.04
Bacillus coagulans	2.48	3.30	3.56	3.54	ND	ND
Aerococcus viridans	2.00	3.30	3.65	3.68	ND	ND
Pediococcus pentosaceus	ND	3.00	3.48	3.51	3.32	3.04
YEASTS						
Saccharomyces cerevisiae	ND	3.60	3.69	3.80	3.48	2.48
Candida vini	2.30	3.30	3.30	3.30	ND	ND

Note: ND, not detected.

Table 2.18 Changes in Proximate Composition during the Production of Otiru from African Yam Bean Seeds

PARAMETER	RAW SEEDS	SOAKED AND DEHULLED SEEDS	OTIRU
Moisture (g/100 g)	11.03 ± 0.06	50.05 ± 0.02	32.01 ± 0.50
Crude protein (g/100 g)	22.17 ± 0.24	22.12 ± 0.02	44.22 ± 0.07
Lipid (g/100 g)	4.17 ± 0.03	4.14 ± 0.03	0.99 ± 0.03
Carbohydrates (g/100 g)	54.53 ± 1.22	15.58 ± 0.09	13.85 ± 0.40
Crude fiber (g/100 g)	5.06 ± 0.04	4.10 ± 0.02	1.07 ± 0.01
Ash (g/100 g)	4.14 ± 0.06	4.02 ± 0	7.86 ± 0.01
pH	6.06 ± 0	6.47 ± 0.02	6.55 ± 0
Titratable acidity (mg/100 g)	0.28 ± 0.01	0.26 ± 0.01	0.35 ± 0.01

Note: Values are mean ± SD of three determinations.

moisture content of seeds; however, during fermentation there was 36% decrease in the moisture content. The crude protein content of the raw seeds increased 100% after fermentation (Jeff-Agboola, 2007). The result obtained on the crude protein of raw AYB is contrary to the observation of Njoku et al. (1989) (15.31g/100 g) but similar to that of Aletor and Aladetimi (1989) (21.91 g/100 g). The percent increase in crude protein content of AYB during fermentation to produce otiru compared favorably with the results of Njoku et al. (1989). On the other hand, with the increase in the period of fermentation there was reduction in the lipid, carbohydrates, and crude fiber contents of the sample (Jeff-Agboola, 2007). The reduction in the crude lipid content of the boiled seeds may be due to breaking down and leaching of the fat content and other metabolic activities taking place during

the fermentation (Kylen and McCready, 1975). Reduction in the fiber content of dehulled, boiled, and fermented seeds may be due to the dissolution effect on the fiber as well as enzymatic degradation of the fibrous material during fermentation (Ikenebomeh et al., 1986). The pH of naturally fermented samples increased with the increase in fermentation time. Ogbonna et al. (2001) recorded the pH of 5-day fermented AYB as 7.52. There was 35% increase in the content of titratable acidity during fermentation (Jeff-Agboola, 2007).

2.1.2.6 Oso

Olusola Bandele Oyewole and Adewale Olusegun Obadina

Oso is a fermented product of the seeds of *Cathormion altissimum* Hutch. (family Leguminosae). Oso is used as a condiment by incorporating it into soups and foods or eaten as a main course meal by the people of Yewa (Egbado) in Ogun State and those in parts of the Old Oyo province in southwestern Nigeria. The production of oso is similar to most other flavoring agents used in soups in Nigeria. It is usually prepared by the local communities using rudimentary utensils and techniques. However, the food is safe enough for consumption as there is no report of food poisoning or toxicity resulting from consumption of oso (Popoola et al., 2005).

2.1.2.6.1 Traditional Method of Production Traditionally, oso is produced (Figure 2.54) by washing a particular quantity of the *C.*

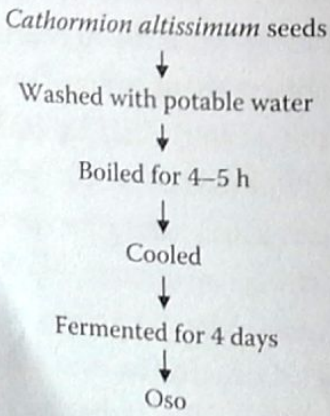

Figure 2.54 Traditional process of oso production. (From Popoola, T.O.S. et al., *Tropical Science*, 44, 187–189, 2004.)