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Biochemical changes associated with the fermentation of baobab seeds in Maari: An alkaline fermented seeds condiment from western Africa

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ABSTRACT

Chemical changes during the fermentation of baobab seeds for production of Maari, a food condiment used in West Africa, were studied. Results showed a wide variety of free amino acids including essential amino acids in the unfermented seeds. Fermentation led to an increase in the concentration of total free amino acids from 16.03 nmol/mg in unfermented seeds to 113.24 nmol/mg after 60 hours of fermentation followed by a decrease thereafter. Fluctuations in the concentrations of each compound were observed during the fermentation period. Differences were also observed in the final products from different production sites with the Gorgadji sample showing the highest content in free amino acids. The output of the oil extraction was 11.5–25.8%. A total of seven fatty acids were identified, with oleic acid being quantitatively the major fatty acid. The results showed a much higher concentration of unsaturated fatty acids than saturated fatty acids. The preponderant fatty acids were oleic, linoleic, palmitic, and stearic acids. These four fatty acids constitute approximately 90% of the composition of Maari. The transformations of amino acids and fatty acids revealed during the fermentation of the seeds during this study will contribute to understanding its contribution to the nutrition of its consumers.

1. Introduction

In Africa, fruits from wild trees constitute an important part of the populations' diets and are also an important source of income for these populations [1]. The products of these trees are generally consumed in crude form, or traditionally processed before consumption. Traditional processing of the seeds from these trees usually involves fermentation, which improves the nutritional value, sensory properties, and functional quality of the seeds [2,3]. The baobab tree (Fig. 1) is one of the most widely used wild trees and has provided food, medicine, and fodder for many centuries [4]. Indeed, baobab leaves are used to prepare sauces, the pulp is used to make beverages, and the seeds are particularly used in the preparation of local sauces as thickening agents after pounding or as flavour enhancers when fermented [5–7]. Maari is one of the numerous products produced from the baobab tree. Maari is a fermented food condiment obtained by the spontaneous fermentation of baobab seeds in Burkina Faso. It is also found under several names in Benin, Burkina Faso, Mali, and Nigeria among other West African countries [3,8,9]. Maari is known in Nigeria as Dadawa Higgi or Issai and in Benin as Dikouanyouri [8,9]. For utilization, Maari is first steeped in water (preferably warm water) for a few minutes, then, the steeping water is used to prepare stews, soups, sauces, and other foods as desired by the consumer.

Differences in the traditional processes for Maari production occur among ethnic tribes and these differences presumably influence the quality of the final products. In addition, microbial investigation of Maari revealed a diversity of microorganisms associated with its fermentation [10]. As reported elsewhere, the microorganisms associated with the fermentation may strongly affect the biochemical composition of the final product [11]. However, little information is known about the biochemistry of the Maari fermentation process. Therefore, the aim of the current work was to investigate the biochemical changes associated with the fermentation of baobab seeds into Maari.

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Fig. 1. Baobab (*Adansonia digitata*). (A) Tree. (B) Leaves. (C) Flower on the tree. (D) Fruits on the tree. (E) Pods broken showing seeds embedded in pulp. (F) Cleaned seeds.

2. Materials and methods

2.1. Maari processing and sampling

Maari samples were obtained from a traditional processor. The processing method used to produce the samples was as follows (Fig. 2): baobab seeds were cleaned and boiled for approximately 36 hours. During boiling, after 24 hours, ash lye (alkaline) solution was added to aid in the softening of the seeds. At the end of the boiling period, the seeds were drained and transferred into a basket and left to ferment spontaneously (i.e., 1st fermentation) for 48 hours at room temperature. The fermenting mash was pounded and moulded with further addition of alkaline ash lye solution. It was left to undergo a second spontaneous fermentation for approximately 24 hours at room temperature. The fermented product was moulded, steam cooked, and sun dried. Samples of raw seeds, fermenting seeds, and the final dried Maari were collected during processing and stored at −20°C for analysis. Other