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Effect of Different Soaking Time and Boiling on the Proximate Composition and Functional Properties of Sprouted Sesame Seed Flour

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ABSTRACT
The effect of soaking time on the proximate composition and functional properties of sprouted sesame seed flour were investigated. Sesame seed samples were cleaned and pretreated by soaking in clean water for 8, 10, 12, 14 and 16 h. One batch was sprouted for 36 h and another portion was sprouted and then boiled (100°C for 20 min), dried, milled into flours and subjected to further analysis. The raw (unsprouted) sample was used as control. The proximate composition and the functional properties were determined for each of the samples and the result showed deviations in nutrient content from the raw seed flour. Moisture and protein content was increased by soaking and sprouting but reduced after boiling from a value of (4.99% and 47.64%) to (4.92% and 42.06%) respectively, for the 10 h soaked sample. Fat, crude fibre, ash and carbohydrate contents were reduced by soaking and sprouting while boiling of the sprouted seeds increased the fat and carbohydrate content. Soaking, sprouting and boiling significantly affected the functional properties of the flour ($p < 0.05$). Soaking and sprouting reduced the bulk density and dispersion of the samples from an initial value of (0.83% and 67.50%) for the unsprouted seed flour to a value of (0.71% and 59.00%) in 10 h soaked samples but increased slightly in most of the soaked sprouted-boiled samples. Thus, soaking of sesame seeds for 12 – 14 h before sprouting can be used to improve the proximate composition and functional properties of sesame seeds, hence, increase the utilization of the flour.

Keywords: Sesame seed, soaking, sprouting, proximate composition, functional properties.

Introduction
Sesame *(Sesamum indicum L.)* is one of the most important oilseed crops worldwide, and has been cultivated in Africa, Middle East, and Asia since ancient times for its edible oil and seeds used in traditional foods (Park *et al*., 2010). It is an erect tropical annual flowering plant in the family *pedaliaceae*. They are flat, tiny, oval seeds with a rich nutty flavour. Their colour ranges from creamy white to charcoal black. It is one of the oldest cultivated oilseed crops in the world (Langham, 1985). Due to its relatively low productivity, sesame ranks ninth among the top thirteen oilseed crops which make up 90% of the world production of edible oil (Kamal *et al.*, 1995). The widespread and long-standing tribute to sesame lies in its high oil content, nutritious protein, and savoury roasted flavour (Namiki, 1995).

Sesame has a high nutritive value with respect to high amount of proteins, lipids and important minerals and vitamins (Abu-Jdayil *et al*., 2002). Sesame contains approximately 20% protein (Namiki, 1995). Apart from the high protein content, sesame seeds have many other essential nutrients needed for the maintenance of human health (Namiki, 1995) such as manganese, copper

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and calcium; vitamin B_1 (thiamine) and vitamin E (tocopherol). In addition, they are particularly noted for imparting better functional properties to food system (Bernard–Don *et al*., 1991; Chang *et al.*, 2002).

Sesame seeds, much like other nuts, seeds and legumes can be milled into a fine powder or flour and used as a substitute with many baking recipes for those trying to avoid wheat. Hence, they have nutrient quality favourably comparable with other oilseeds and legumes. Processing methods, such as soaking, sprouting and cooking have been reported to improve the nutritional and functional properties of plant seeds (Jirapa *et al.*, 2001; Yagoub and Abdalla, 2007). This processing techniques can also reduce malnutrition by making micronutrients available for easy absorption; hence, increasing the utilization of sesame seeds.

Consumption of seed sprouts, which has been known for many centuries in oriental culture, has been growing in global popularity over the past 30 years (Robertson *et al.,* 2002). Bean sprouts, rich in dietary fibres, various nutrients, and bioactive components, are important vegetables consumed in Asian countries, and, nowadays, they have become more popular in the United States and European countries (Liu *et al.*, 2008). Although the most popular bean sprouts are cultivated from mung bean and soybean, sesame seeds are also a good source of bean sprouts (Liu *et al.,* 2011). Sesame sprouts have been consumed as vegetables in China for hundreds of years (Liu *et al.,* 2011).

Sprouting has been used as a technique to minimize disadvantages of undesirable flavour and odour in soybean and its products (Agrahar-Murugkar *et al.,* 2013). Sprouting triggers a sequence of metabolic changes resulting in improvement of nutritional quality of legumes and reduction of the anti-nutritional factors such as trypsin inhibitor and phytic acid (Agrahar-Murugkar *et al.*, 2013). Therefore, the main objective of this study is to determine the soaking time that is best suited for the sprouting of sesame seeds to give good quality flour in terms of nutritive value and functional properties.

Materials and Methods

Sesame seeds were purchased from Sabo market, Ikorodu, Lagos State, Nigeria.

Preparation of sprouted and de-bittered sesame seed flour

Cleaned sesame seeds were transferred into big transparent plastic pails and covered with twice as much water as the quantity of the seeds and were soaked at different time intervals (8, 10, 12, 14 and 16 h). The seeds were sprouted at room temperature in a fairly lit environment for 36 h and rinsed every 4 h during sprouting. After sprouting, the seeds were divided into two portions. The first portions were properly rinsed, put in a cooking pot, covered with water and boiled to a temperature of 100^{o}C for 20 min in a covered container to remove bitterness. The water used in boiling the seeds was drained off and the seeds rinsed again with clean water. The sprouts were sun-dried and milled into flour. The second portions were properly rinsed, sun-dried and milled into flour.

Determination of proximate composition of pretreated sesame seed flour

Moisture, fat, crude protein, crude fibre and ash contents of the flours were determined by using AOAC (2000) method. The carbohydrate was calculated by difference between 100 and total sum of the percentage of moisture, protein, fat and ash.

Determination of functional properties of sesame seed flour

Bulk density

This was determined by the method of Wang and Kinsella (1967). A known amount of sample (10 g) was weighed into 50 ml graduated measuring cylinder. The sample was packed by gently tapping the cylinder on the bench top from a height of 5 cm. The volume of the sample was recorded