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Effect of thermal softening on the textural properties of palm oil fruitlets

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Abstract

Instrumental texture profile analysis (TPA) of palm oil fruitlets were measured to observe the effects of thermal softening during the sterilization process. Different forces were applied to mesocarp, abscission layer, and kernel shell nut of the palm oil fruitlets and the effect of sterilization on the textural properties of the fruitlets were recorded. The textural parameters measured were fracturability, hardness, adhesiveness and cohesiveness. A single bite with a P2 plunger probe with a 25 kg maximum force load cell gave the best results for the textural properties of the abscission and mesocarp layers where fracturability, hardness and adhesiveness were measured. On the other hand, double subsequential compression bites of a 75 mm platen, again using a 25 kg maximum applied force, was best for the textural properties of the kernel shell nut where hardness and cohesiveness were measured.

Keywords: Thermal softening; Oil palm; Sterilization; Textural properties; TPA

1. Introduction

Palm oil, produced from the fruit of oil palm, generic name *Elaeis Guineensis*, has been used for more than 5000 years. The oil palm, West Guinea origin, was introduced to Malaysia (then Malaya) in 1870 as an ornamental plant, and in 1917, the first commercial planting was undertaken. Owing to the government encouragement to diversify the crops from rubber to oil palm, the planting was expanded rapidly (Ministry of Primary Industry, 1986, 1997). The palm oil fruitlets, which are oval and pointed at the apex, vary in length (2–4 cm), diameter (0.5–2 cm) and weight (3–25 g) with the average weight of about 6–8 g. Matured color (yellow, orange, reddish brown, or nearly black) is also varied depending upon variety of the palm trees. Two types of oils are obtained: palm oil from mesocarp (fleshy covering) and palm kernel oil from nut (endosperm). The oil to bunch ratio, depending upon variety and age, is approximately 25–28% (Gunstone, 1987). To ensure good yield, most of the oil is synthesized in the last two weeks before ripening. Over-ripeness, bruises and lengthy post-harvest delay will lead to bio-deterioration, high free fatty acid (FFA) content, poor quality oil and lower mill efficiency (Mahidin, 1998). Palm oil fruitlets are usually subjected to sterilization as a first step of the milling process. The sterilization cycle is adjusted according to the ripeness standard of the fresh fruit bunch (FFB). Using saturated steam at 40 psi (140 °C) for 75–90 min (Mahidin, 1998), the sterilization process is currently carried out in batch mode to deactivate the biological factors that are responsible for quality deterioration (Let, 1995). Another objective of sterilization is to soften the palm fruitlets to encourage the detachment of fruitlets from bunches. Heat also helps to break up the oil bearing cells of the fruit mesocarp to release the oil during the digestion process (Mahidin, 1998).

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In food process engineering, textural properties can be considered as an expression of the rheological properties of a food (Pomeranz & Meloan, 1994). It is a significant characteristic since it affects processing techniques and handling procedures (Charm, 1962). Many textural studies have been done primarily to obtain one or more mechanical tests with the ability to substitute for human sensory tests and to provide an instrument to estimate food texture and quality (Peleg, 1983). A study on the firmness of dates as a function of maturity days was recently reported (Myhara, Al-Alawi, Karkalas, & Taylor, 2000). It was found that the food firmness progressively decreased when the dates reached maturity. Instrumental texture profile analysis (TPA), developed by Szczesniak (1963) based on the detection of textural parameters as a multi-parameter characteristic, is helpful in quality control and developing products with appropriate rheological characteristics. Recently, the instrumental TPA of date flesh as a function of moisture content was studied using two-cycle compression. It was reported that hardness, resilience and chewiness increased exponentially with the decrease of moisture content, whereas cohesiveness, adhesiveness and springiness showed a peak at around 21.5% moisture content (Rahman & Al-Farsi, 2005).

Upon subjecting to heat, there are clear changes in the rheological behaviour of palm fruitlets, and this information may be useful in optimizing the heating parameters of sterilization process. Very limited work on the instrumental TPA of palm fruitlets has been reported in open literature. The objective of this study was to measure the instrumental TPA attributes of palm fruitlets before and after sterilization.

2. Materials and methods

2.1. Materials

A few types of palm oil fruitlets species are delivered to the mill-dumping yard. Dura, one of the main species, consists mainly of a thick-shelled variety with a thin mesocarp. On the other hand, Tenera species with a much thicker mesocarp and a thinner shell is more favorable for breeding and planting programs and have a much higher content of palm oil than the native Dura species.

The palm bears its fruit in bunches as shown in Fig. 1, varying in weight from 10 to 40 kg. The individual fruit, ranging from 6 to 20 g, consists of an outer skin (the exocarp), a pulp (mesocarp) containing palm oil in a fibrous medium, a central nut consisting of a shell (endocarp), and a kernel, which itself contains oil, quite different from palm oil but similar to coconut oil. Fig. 2 illustrates the palm oil fruitlets structure and Fig. 3 shows the fresh fruit after cutting. The fresh fruits used are reddish in color, and is about the size of a large plum. Palm oil fruitlets samples, Tenara species, were collected from Dengkil area. The fruitlets have an average dimension of 40 mm in length and 25 mm in cross-section. Each fruit contains a single seed (the palm kernel). In milling practices, oil is extracted from both the pulp of the fruit (palm oil) and the kernel (palm kernel oil).

Fig. 1. Fresh fruit bunch.

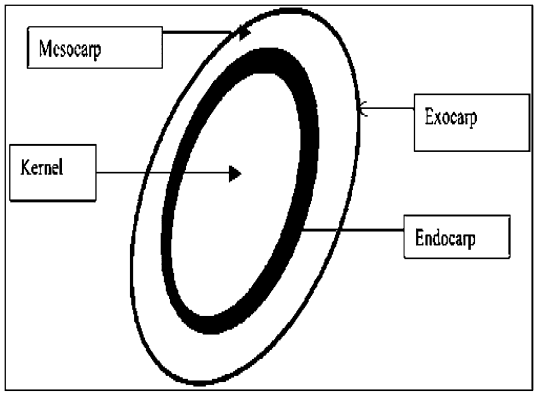

Fig. 2. Structure of the palm fruit.

Fig. 3. Fresh fruit (on the left is a cut fruit).