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Quality changes of burnt aromatic coconut during 28-day storage in different packages

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Abstract

The shelf-life of unwrapped, film-wrapped and vacuum-packed burnt aromatic coconut was studied at 5 ± 1 °C and 80–90% relative humidity. Regardless of the packaging treatments, weight loss of whole burnt coconut increased with storage time. Transmittance and lightness (L*) values of coconut water decreased ($P < 0.05$) with longer storage time. The pH of coconut water and coconut meat from the vacuum-packed treatment decreased as storage time increased. Sensory analysis showed that, for all treatments, the yellowness intensity of coconut water increased whereas its transparency decreased with time. The sourness intensity of vacuum-packed coconut water increased on later days of storage. Only the film-wrapped coconut, having the shortest shelf-life, had mold on its shell and husk at the end of storage. This study showed that the unwrapped, film-wrapped and vacuum-packed burnt coconuts could be stored for up to 14, 18 and 28 days, respectively, under the conditions used in this study.

Keywords: Burnt aromatic coconut; Quality; Packaging; Storage

1. Introduction

Coconuts are economic plants in many tropical countries, and often called ''tress of life'' because a large amount of coconut fruit and its products are consumed and utilized by human (Child, 1974). The water from young or green coconut is consumed as refreshing drink which is popular in the world market (Banzon, Gonzalez, & de Leon, 1990). The meat or kernel from young coconut is soft, thus can be consumed fresh. The aromatic coconut variety is of importance in Thailand. Several parts of coconut are fragrant, such as coconut water, coconut meat and coconut shell (when heated). The aroma of coconut water and meat is similar to that of pandanus leave (Petpiroon, 2001). The natural volatile flavor components of fresh coconut meat and/or oil are mainly δ-lactones (Child, 1974; Lin & Wilkens, 1970).

Glucose and fructose in coconut water of either young or mature coconuts imparts sweet taste (Santoso, Kubo, Ota, Tadokoro, & Maekawa, 1996). Campos Souza, Coelho, and Gloria (1996) reported that the enzyme activities of polyphenoloxidase and peroxidase present in green coconut water at 32.1 and 114.3 unit/ml, respectively (a unit of enzyme activity was defined as the amount of enzymatic extract capable of increasing absorbance at 425 nm for polyphenoloxidase at a rate of 0.001 unit/min). The presence of these enzymes causes enzymatic browning reaction in many fruits, thus affecting the nutritive value, flavor and color (Richardson & Hyslop, 1985). Deterioration of coconut can also be caused by fungal infections occurred near the eyes and on the peduncle of the coconut (Consignado, Tabora, & Creencia, 1976).

The aromatic coconut (*Cocus nucifera* Lin.) is suitable to produce a burnt coconut having unique taste and aroma. The taste of burnt coconut is sweeter than fresh coconut, and its aroma is still present. However, a short shelf-life is a problem of burnt coconut as it can be stored without any packages at 30 °C for only 2–3 days. The quality and shelf-life of burnt coconut depend on various factors such as

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coconut age, storage condition and packaging material. If coconut is too young, the meat is mushy after the whole coconut has been burnt. If coconut is too old, coconut water after being burnt has a bland flavor. Puchakawimol and Jangchud (2003) studied the qualities of aromatic coconut at three different maturities (6, 8 and 10-month old) and reported that the 8-month-old aromatic coconut was most suitable to produce burnt coconut possessing quality that is acceptable to the consumers. However, the optimal storage condition of burnt aromatic coconut has not been investigated. The burnt aromatic coconut will have a higher market value if its shelf-life is extended. The objective of this study was to determine changes of physical, chemical, microbiological and sensory qualities of burnt aromatic coconut during 28-day storage in different packages.

2. Materials and methods

2.1. Sample preparation

The 8-month-old aromatic coconuts were purchased from the garden in Samutsachorn province, Thailand. Thirty coconuts were burnt in a top-loaded chamber ($100 \times 100 \times 30\,cm^3$) for 40 min using wood as fuel. The temperature was controlled and monitored by a thermocouple which was placed inside five coconuts during burning. The initial and final temperatures were 30 and 70 °C, respectively. The burnt coconut husks were then removed, except a small part of the husk left to cover the eyes of the coconut to protect the coconut water from leaking.

2.2. Experiment and sampling conditions

The burnt aromatic coconuts were stored in different packages at 5 ± 1 °C and 80–90% relative humidity. Three packaging treatments were used: (1) unwrapping, (2) burnt coconut wrapped with polyvinylchloride (PVC) plastic film having a thickness of 11 μm, WVTR of $210\,g/(m^2\,d)$ and OGTR of $8133\,cc/(m^2\,d\,bar)$ and (3) burnt coconut vacuum-packed in plastic bag made of Nylon (15 μm thickness) and linear low density polyethylene (120 μm thickness) having a WVTR of $5.1\,g/(m^2\,d)$ and OGTR of $73\,cc/(m^2\,d\,bar)$. Physical, chemical and sensory qualities of coconut water and coconut meat from three packaging treatments were evaluated up to 28 days. The unwrapped and PVC film-wrapped samples were sampled on Monday and Thursday while the vacuum-packed samples were sampled weekly until spoilage. Microbiological measurements, for all samples, were determined every 7 days for the first 2 weeks, and every 3 or 4 days thereafter until the day that samples spoiled. Prior to sampling for quality evaluation during storage, all samples were visually observed for any mold growth or microbial spoilage. Burnt coconut was considered "spoiled" when any mold growth was found on the husk or shell and, thus, excluded from the subsequence quality evaluation. When more than 30% of the initial whole coconut count were considered "spoiled", the samples from that treatment were not evaluated for quality, and this determined the shelf-life of the sample. If the spoilage was less than or equal to 30% of initial whole coconut count, the burnt coconuts in each treatment were sampled for quality evaluation. Moreover, when the coconut water inside burnt coconuts had a whitish turbid appearance, slimy viscosity, and off-odor, it was also considered "spoiled" and then excluded from the subsequence quality evaluation.

2.3. Physical determinations

Weight loss of the whole burnt coconut was determined by weight differences calculated in percentage. The colorimetric measurement of coconut water was determined using a spectrophotometer (CM 3500d, Minolta Camera Co., Ltd., Tokyo, Japan) and expressed as lightness (L*), chroma (C*) and hue angle. These parameters were determined in triplicate using 5 coconuts per treatment. The hardness of coconut meat (each piece with $25 \times 25 \times 5\,mm^3$) was measured using a Lloyd Texture analyser (TA 500, Intro Enterprise Co., Ltd., England) equipped with a 1 kg load cell with a 5 mm diameter cylinder probe. The operating condition was 10 mm/min speed penetrating through the sample with 15 mm distance. For each treatment, the hardness was determined on 15 pieces from 5 coconuts.

2.4. Chemical determinations

The chemical qualities of coconut water and coconut meat during storage were evaluated as follows. Titratable acidity was determined according to the AOAC method (2000). Total soluble solid and pH were determined with a refractometer (PR-101, Atago Ltd., Japan) and a pH meter (3320, Jenway Ltd., England), respectively. Transparency of coconut water was determined using a spectrophotometer (UV-160A, shimadzu Ltd., Japan) at 610 nm (relative to distilled water) as described by Campos Souza et al. (1996). Reducing sugar and total sugar of coconut water were analysed according to the Lane–Eynon method. All measurements were performed in triplicate using 5 coconuts per treatment.

2.5. Microbiological determinations

Total plate count and yeast and mold were determined according to the BAM method (1995). Lactic acid bacteria were determined by APHA method (2001). All examinations were determined in duplicate using 2 coconuts per treatment.

2.6. Sensory evaluation

The descriptive analysis (DA) was conducted to evaluate intensities of sensory attributes of the burnt coconuts.