# of Maturity on Quality and Chemical Composition of Coconut (*Cocos nucifera*)

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ds: coconut kernel, maturity stage, proximate analysis, sugar, press yield, ess

he objectives of this study were to investigate the effect of maturity stages and 9 months after flowering) on quality and chemical compositions of kernel (*Cocos nucifera* L.). Proximate analysis and quality parameters ield, pH and hardness) of the kernel were evaluated. The results showed that kernel at different maturity stages were not significantly different in protein %), fat (45.7-52.5%), ash (2.5-3.0%), press yield (43.1-47.2%) and pH (6.5-0.05) while moisture content, total carbohydrate, crude fiber and hardness nificantly different at p≤0.05. The 6-months coconut kernel contained the oisture content (58.5%), and total carbohydrate (18.7%). The 9-months kernel contained the highest crude fiber (34.7%) and hardness (126.9 N). rofiles were also determined using gas chromatography techniques with standards. The results showed that major sugar detected in coconut kernel ose and sorbitol while minor sugar was fructose, glucose and myo-inosital. onths coconut kernel contained the highest sucrose, sorbitol, fructose, and myo-inosital content at 22.7 and 2.5 g/100 g, and 83.7, 102.2 and 125.2 g, respectively. The 6-months coconut kernel contained the highest galactose 2.4 mg/100 g and trace amount of raffinose was also detected in coconut (0.003-0.03 mg/100 g).

RODUCTION

Coconut (*Cocos nucifera* Linn.) is widely known as the tree of life. Mature consists of 33% husk, 16% shell, 33% kernel and 18% coconut water. Copra ature coconut kernel) contains an average of 70% lipid (Rachel et al., 2010). kernel is extensively used in various products such as copra, coconut oil, coir, shredded coconut and coconut milk. Fresh kernel coconut could be mixed with edients to produce various desserts such as confectioneries, biscuits, cake and Coconut milk is an important export product of Thailand. It is widely used in and Pacific cuisine. In commercial practices, the coconuts used for coconut milk g are harvested by growers using external color as maturity index. There is cientific information regarding agricultural practices, pre-harvest factors and maturity on quality and chemical compositions of coconut kernel. Solangi and 2011) determined minerals/trace metals in the coconut kernel obtained from cultivars in coastal area of Pakistan. In 2007, Santoso et al. evaluated nutrient ion of young and mature coconuts and identified dietary fiber in coconut kernel. study examined the quality and chemical compositions of coconut kernel at different y stages.

RIALS AND METHODS

he coconut kernel at 4 maturity stages (6, 7, 8 and 9 months after flowering) vested from Prachuapkhirikhan Province, Thailand. The nuts were dehusked and g a knife. Then, the coconut kernel was scooped by a stainless steel spoon and ieces (1×1 inch). The samples were used for evaluation of hardness, press yield

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and pH. For proximate analysis and sugar analysis, coconut kernel was cut in pieces (1×1 cm), freeze-dried and stored at -18°C for further analysis. Proximate was performed for moisture, protein (5.38 × %N), ash, fat, crude fiber carbohydrate by difference using the standard method of AOAC (2005). The p samples was measured using a digital pH meter (Orion 2 Star, Beverly, U hardness of coconut kernel was evaluated using texture analyzer (model TA. Xt using Warner Bratzler blade with speed of 20 mm/min and distance of 25 mm. P was evaluated by pressing grated coconut kernel, in a muslin cloth bag, using press for 5 min to extract the liquid.

Sugar was extracted with methanol:water (8:2) and derivertization wi trimethylsilyl-trifluoroacetamide (Frank et al., 2007). The analysis was conduc gas chromatography (Hewlett Packard series HP 6890, USA) equipped with ionization detector. Capillary column DB-1 0.32 mm diameter, 0.25 µm film an length (Agilent technology, USA) was used as analysis column.

The data were subjected to analysis of variance (ANOVA) and comparisons were carried out using Duncan's multiple range test (DMRT).

RESULTS AND DISCUSSION

The results showed that coconut kernel at different maturity stages significantly different in protein, fat, and ash ($p>0.05$) (Table 1). The 6-months kernel contained the highest moisture content and total carbohydrate, while the coconut kernel contained the highest fiber and hardness (126.9 N). The moistur were in agreement with Rachel et al. (2010) which reported that durin development water content decreased. Increase in fiber content (mainly cell coconut kernel develops was also reported by Balasubramanism (1976). Althou were no significant difference in fat content among different maturity stages, th increasing trend of fat contents as maturity stages increased. The decreasing carbohydrate content might be due to changing of starch into sugar and the sy fatty acid using glucose as precursor (Rawsthorne, 2002). There were no s differences in press yield and pH among coconut kernels at different matur ($p>0.05$) (Table 2). Hardness of the 9-months coconut kernel was highest among maturity stages ($p\leq0.05$). The results were different than those reported by Sa Iqbal (2011), who determined the mineral content of coconut kernel at maturity 6-7 months and 11-12 months and reported that as maturity increased ash moisture content of coconut kernel decreased. The differences of results may b variation of cultivars, maturity stages, seasons and planting locations. Sugar p coconut kernel are shown in Figure 1. Major sugars detected in coconut kernel a stage of 6, 7, 8, and 9 months were sucrose and sorbital while the minor sug fructose, glucose, galactose myo-inosital and raffinose. The results showed the to content, sucrose and sorbital increased and reached the maximum at 7 mo decreased as the kernel develops (Fig. 2A). Fructose and galactose decreased as increased while glucose and myo-inosital increased until maturity stage of 7 mo decreased (Fig. 2B). The 7-months coconut kernel contained the highest sucrose fructose, glucose and myo-inosital content at 22.7 and 2.4 g/100 g, and 83.7, 138.6 mg/100 g, respectively. However, galactose content was the highest in coconut kernel (62.4 mg/100 g). Trace amount of raffinose was also detected i kernel ranging from 0.003-0.03 mg/100 g (data not shown). The results agreement with those reported by Rachel et al. (2010), who reported that majo coconut kernel were non-reducing sugars. Santoso et al. (1995) also identified glucose and fructose in 12 months coconut kernel.

CONCLUSION

Protein, fat, ash, press yield and pH were not significantly differenc different maturity stages. The 6-months coconut kernel contained the highest total carbohydrate content, while the 9-months were the highest hardness and cr

ugar detected in coconut kernal was sucrose and sorbitol. The 7-months coconut ad the highest total sugar, sucrose, sorbitol, fructose, glucose and myo-inosita.

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roximate analysis of coconut kernel at maturity stage of 6-9 months.

Moisture (%)	Protein (%)	Fat (%)	Crude fiber (%)	Ash (%)	Total Carbohydrate (%)
58.5±3.7^{a}	3.7±1.4^{a}	45.7±4.7^{a}	22.4±3.0^{b}	3.0±1.0^{a}	18.7±4.6^{a}
51.6±2.4^{b}	4.2±1.3^{a}	50.7±3.4^{a}	30.5±2.3^{a}	2.5±1.2^{a}	9.0±2.4^{b}
50.0±1.7^{b}	4.5±1.4^{a}	51.2±0.8^{a}	32.5±2.7^{a}	2.6±1.1^{a}	5.1±3.2^{b}
46.6±1.8^{b}	4.3±1.3^{a}	52.5±2.3^{a}	34.7±2.2^{a}	2.7±1.0^{a}	3.8±1.1^{b}

letters indicate significant differences according to Duncan's multiple range test at $p \leq 0.05$

ress yield, Hardness and pH of coconut kernel at maturity stage 6-9 months.

tage (months)	Press yield (%)	Hardness (N)	pH
	47.2±1.8^{a}	67.4±18.7^{c}	6.9±0.3^{a}
	46.8±1.6^{a}	91.7±13.2^{bc}	6.8±0.1^{a}
	43.2±1.6^{a}	103.9±17.4^{b}	6.7±0.3^{a}
	43.1±2.0^{a}	126.9±21.7^{a}	6.5±0.5^{a}

letters indicate significant differences according to Duncan's multiple range test at $P \leq 0.05$

Figures

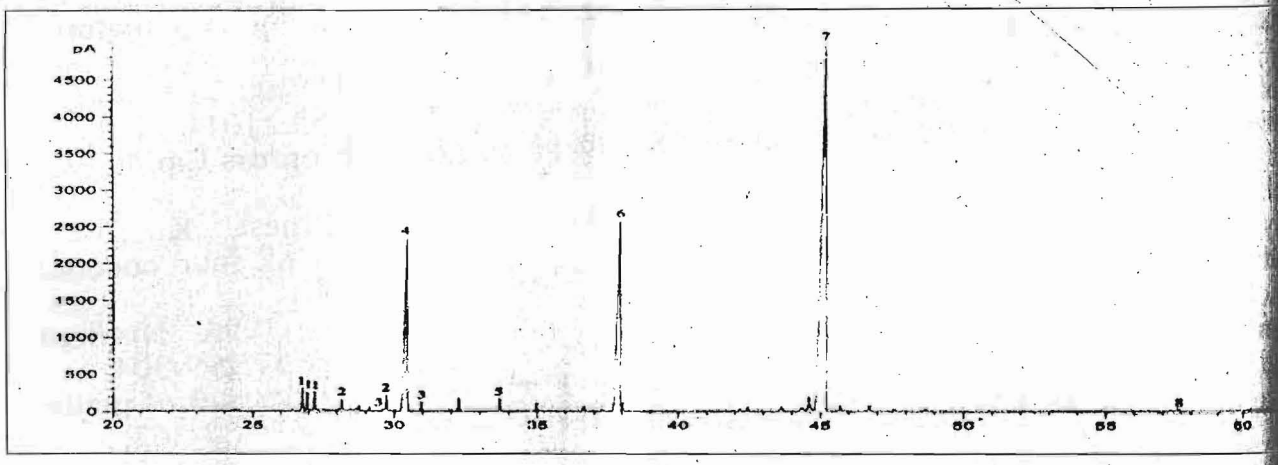

Fig. 1. Sugar profiles of coconut kernel by GC-FID and capillary DB 1 colu
fructose, (2) galactose, (3) glucose, (4) sorbitol, (5) *myo*-inositol, (6) phen
glucopyranoside (Internal standard), (7) sucrose, (8) raffinose.

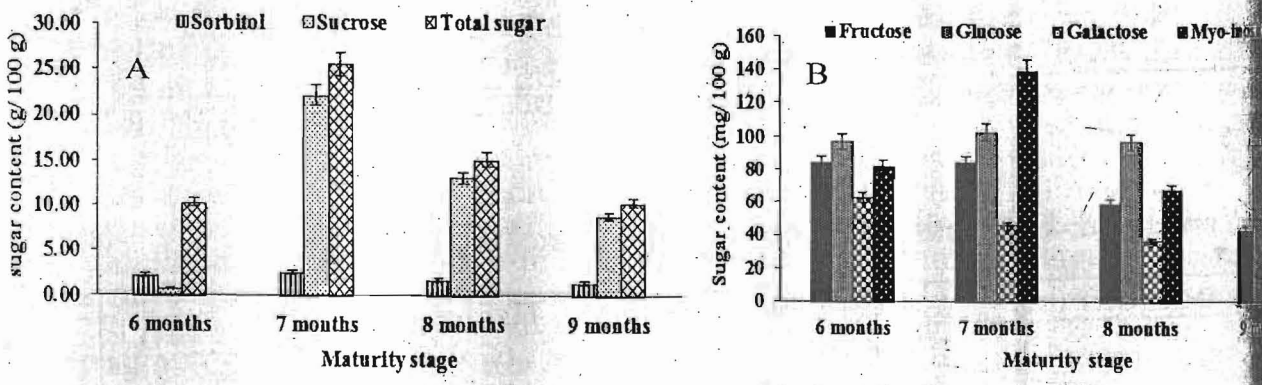

Fig. 2. Major (A) and minor (B) sugar content of coconut kernel maturity st
months.