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Palm Sugars Improve Starch Digestibility of Bakery Products

Rumpai Thongta* **and Khongsak Srikaeo**
Food Science and Technology Program, Faculty of Food and Agricultural Technology
Pibulsongkram Rajabhat University, Muang, Phitsanulok 65000 Thailand
* Corresponding email: khongsak@psru.ac.th

ABSTRACT

Palm sugar has been used as a traditional sweetener for thousands of years in Asia. It is now gaining popularity globally because of its natural, occurrence, minimal processing requirement and health giving properties. This paper examins starch digestibility, physical and sensory characteristics of bakery products (breads and cookies) produced by using palm sugars from *Borassus flabellifer* (palm sugar) and *Cocos nucifera* (coconut sugar) in comparison with cane sugar (sucrose) and sorbitol. It was found that sorbitol provided the slowest starch digestion rate and consequently the lowest estimated glycemic index (GI) values. Palm and coconut sugars provided better starch digestion rate and lower GI values than those of cane sugar, indicating their nutritional quality over the cane sugar. However, sweeteners affected the physical and sensory characteristics of the products as evidenced by appearance, color, texture, a_w and sensory scores. This research suggests that palm sugars might be used to replace cane sugar in bakery products for lowering GI purposes but care must be taken as they induced changes in the properties of the products.

Keywords: Palm sugar, Coconut sugar, Bakery product

INTRODUCTION

Palm sugar has been used as a traditional sweetener for thousands of years in Asia. It is now gaining popularity globally because of its natural, minimal processed and healthy. One of the major health claims is its glycemic index (GI). Low GI foods play an important role in the dietary management of diabetes, weight reduction, peak sport performance and the reduction of risks associated with heart disease and hypertension (Jenkins et al., 2002). This paper examined the physicochemical properties and starch digestibility of bakery products (breads and cookies) produced by using palm sugars from *Borassus flabellifer* (palm sugar) and *Cocos nucifera* (coconut sugar) in comparison with cane sugar (sucrose).

MATERIALS AND METHODS

Wheat flour was analyzed for starch composition including total starch (TS), resistant starch (RS) and non-resistant starch (Non-RS) following the approved AACC Method 32-40. It was then mixed with four types of sugars (cane sugar, palm, coconut and sorbitol) at the same sweetness level. The sweetness level for cane sugar, palm and coconut sugars is 1.0 while the sorbitol is 0.6 (Whelan et al., 2008). The mixtures were analyzed for starch digestibility and

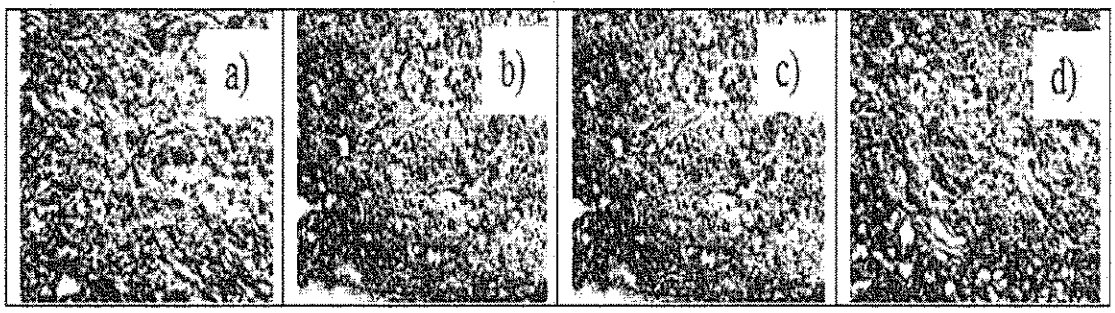

Figure 2 Appearances of the breads produced from a) cane sugar (control), b) coconut sugar, c) palm sugar and d) sorbitol

Table 1 Physical properties and average estimated glycemic index (GI) of the breads produced using different sweeteners

Breads	Color			a_w	Firmness (g)	GI_{AVG}
	L*	a*	b*			
Cane sugar	65.40 ± 0.71^{a}	3.15 ± 0.07^{b}	19.55 ± 0.21^{b}	0.94 ± 0.01^{a}	857.71 ± 1.03^{b}	81.34 ± 0.96^{a}
Coconut	61.60 ± 0.42^{c}	3.60 ± 0.14^{a}	20.55 ± 007^{a}	0.92 ± 0.00^{b}	$8\ 12.66 \pm 8.07^{d}$	65.67 ± 0.12^{b}
Palm	60.65 ± 0.07^{c}	3.70 ± 0.00^{a}	20.40 ± 0.00^{a}	0.89 ± 0.01^{c}	884.88 ± 7.87^{a}	63.92 ± 1.27^{b}
Sorbitol	62.45 ± 0.64^{b}	3.50 ± 0.00^{a}	19.55 ± 0.07^{a}	0.87 ± 0.00^{d}	833.18 ± 5.55^{c}	55.78 ± 0.14^{c}

Values with the same letters in column are not significantly different ($P > 0.05$).

Table 2 Sensory characteristics of the breads produced using different sweeteners

Breads	Color	Odor	Sweetness	Texture	Overall acceptability
Cane sugar	7.67 ± 0.71^{a}	6.67 ± 0.96^{ab}	6.80 ± 0.92^{a}	7.20 ± 1.03^{a}	7.40 ± 0.89^{a}
Coconut	7.40 ± 0.77^{a}	6.80 ± 0.89^{ab}	6.80 ± 0.96^{a}	7.03 ± 0.89^{b}	7.13 ± 0.90^{a}
Palm	7.60 ± 0.86^{a}	6.93 ± 0.69^{a}	6.67 ± 0.99^{a}	7.03 ± 1.07^{b}	7.00 ± 1.08^{a}
Sorbitol	7.77 ± 0.77^{a}	6.37 ± 0.96^{ab}	4.23 ± 1.07^{b}	4.47 ± 1.22^{c}	4.60 ± 1.30^{b}

Values with the same letters in column are not significantly different ($P > 0.05$).

Considering the density of the black/white pixels in Figure 2, the appearances as determined by image analysis techniques (Srikaeo et al., 2011), gave acceptable results. The porosity as indicated by percentages of the white pixels in the images was found to be 57.14±0.91%, 57.41±1.23%, 56.03±2.21% and 56.92±1.61% for the breads made with cane sugar, coconut, palm and sorbitol respectively. The color and texture including water activity changed in according to the sugars used.

In terms of cookies, the appearances of the cookies are shown in Figure 3. The physical properties and sensory characteristics are shown in Tables 3-4 respectively. Unlike breads, the appearances of cookies made using different types of sugars gave different appearances. Sorbitol gave the lowest sensory scores when compared to those from the other sugars.

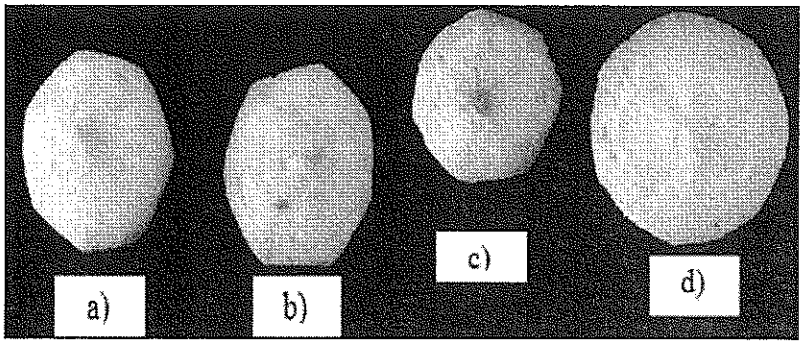

Figure 3 Appearances of the cookiesproduced from a) cane sugar (control), b) coconut sugar, c) palm sugar and d) sorbitol

Table 3 Physical properties and average estimated glycemic index (GI) of the cookies produced using different sweeteners

Cookies	Color			a_w	Expansion ratio (mm)	Break strength (g)	GI_{AVG}
	L*	a*	b*				
Cane sugar	66.43 ± 0.21^b	5.33 ± 0.06^c	29.47 ± 0.50^c	0.33 ± 0.01^c	0.78 ± 0.03^b	764.21 ± 3.29^a	86.14 ± 1.73^a
Coconut	61.20 ± 0.35^d	8.83 ± 0.25^b	31.07 ± 0.57^b	0.36 ± 0.01^b	0.81 ± 0.05^b	768.85 ± 0.80^a	49.39 ± 0.08^b
Palm	62.10 ± 0.00^c	9.47 ± 0.06^a	32.40 ± 0.00^a	0.38 ± 0.01^b	0.82 ± 0.04^b	764.34 ± 1.23^a	48.14 ± 0.87^b
Sorbitol	67.40 ± 0.10^a	5.33 ± 0.12^c	29.63 ± 0.38^c	0.40 ± 0.00^a	0.90 ± 0.00^a	664.23 ± 4.31^b	28.31 ± 0.18^c

Values with the same letters in column are not significantly different ($P > 0.05$)

Table 4 Sensory characteristics of the cookies produced using different sweeteners

Breads	Color	Odor	Sweetness	Texture	Overall acceptability
Cane sugar	7.33 ± 0.88^a	6.80 ± 1.03^b	6.47 ± 1.20^a	6.93 ± 0.20^a	7.23 ± 0.85^a
Coconut	7.53 ± 0.73^a	6.80 ± 1.12^b	6.77 ± 1.25^a	6.93 ± 0.26^a	7.37 ± 0.78^a
Palm	7.37 ± 0.81^a	6.47 ± 1.04^b	6.47 ± 1.11^a	6.93 ± 0.11^a	7.23 ± 0.86^a
Sorbitol	7.50 ± 0.82^a	7.13 ± 0.89^a	4.70 ± 0.70^b	6.10 ± 0.76^b	6.57 ± 1.01^b

Values with the same letters in column are not significantly different ($P > 0.05$)

This research highlights the findings from coconut and palm sugars. As mentioned earlier, very few published works have proved that palm sugars were low in GI values and suitable for low GI foods. Only one recent published work has reported that the GI of coconut sap sugar was in low category (Trinidad et al., 2010). The estimated GI values of the breads and cookies made using coconut or palm sugars were found to be significantly lower than those of cane sugar. The major components of palm sugars are sucrose (~70-80%) with glucose (~3-9%) and fructose (~3-9%) (Purnomo, 1992). Although, the major sugar component in palm sugars are sucrose, similar to cane sugar, palm sugars are minimally processed and their natural forms are complex and contain other ingredients rather than sugars. Palm sugars were reported to contain significant amounts of dietary fiber, especially inulin (Trinidad et al., 2010; Vayalil, 2012). These could play an important role in lowering the GI values.

CONCLUSION

Sweeteners influenced the starch digestibility, physical and sensory characteristics of the wheat based food products breads and cookies in this study. This paper highlights palm and coconut sugars as alternative healthy sweeteners as they provided benefits in terms of GI values. In this study, palm and coconut sugars can be used to produce breads and cookies with lower GI properties than those made from cane sugar. Although palm and coconut sugars could influence the physical and sensory properties of the products they have milder effects than those of sorbitol.

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