Nasi Lemak Cooked with Palm-based *Santan* is Comparable to that Cooked with Coconut *Santan*

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INTRODUCTION

Santan is a Malay term for coconut milk. *Santan* is derived from the flesh of old coconuts. In recent years, there is high demand for coconut *santan* due to our increasing population and a higher standard of living among domestic consumers who prefer tastier food. At the same time, there is also high demand for fresh young coconut for drinks, *etc*. Thus, the domestic coconut production is not sufficient to fulfill both demands. Palm oil-based *santan* (hereafter referred to as palm-based *santan*) was developed as an alternative to coconut *santan*. Palm-based *trans* fat-free liquid *santan* has been in the market since 2010.

It has been shown that coconut *santan* contains higher fat and protein contents compared with palm-based *santan* (Zaida *et al.*, 2008). It has been claimed that the application of palm-based *santan* in food formulations has some health benefits. However, published articles on palm-based *santan* are very limited. Rafidah *et al.* (2013) reported on the physical properties of *nasi lemak* cooked with palm-based and coconut *santan*.

Foods that contain *santan* are perceived to be 'rich'. *Santan* gives a unique flavour and taste to the food. Among the popular local dishes that contain *santan* is *nasi lemak* (*Figure 1*). *Nasi lemak* is a popular Malaysian dish normally taken during breakfast, which is rice cooked with *santan* and eatan with fried anchovies, boiled egg and fried chili paste. Frozen *nasi lemak* has been introduced to the market as a ready-to-eat meal to cater to the urban community with a busy life style, who are looking for rapid and convenient ways to serve food.

MOISTURE CONTENT OF *NASI LEMAK*

Moisture content is an important criterion that has a significant effect on the freshness and quality of food. Rice is considered fully cooked when the final moisture content is in the range of 58% to 64% (Zheng and Lan, 2007). It was generally observed that the moisture content of *nasi lemak* increases as the ratio of *santan* to rice is increased from 1: 5 to 1.5: 5 (Rafidah *et al.,* 2013). Addition of *santan* reduces relative water content because the components in *santan* which are mainly oil lower the water activity of cooked rice (El-Bassiouny and Bekheta, 2005).

Generally, *nasi lemak* made with palm-based *santan* has a lower moisture content compared with that made with coconut *santan*, due to the fact that the moisture content of palm-based *santan* is lower than that of coconut *santan*. The moisture content for palm-

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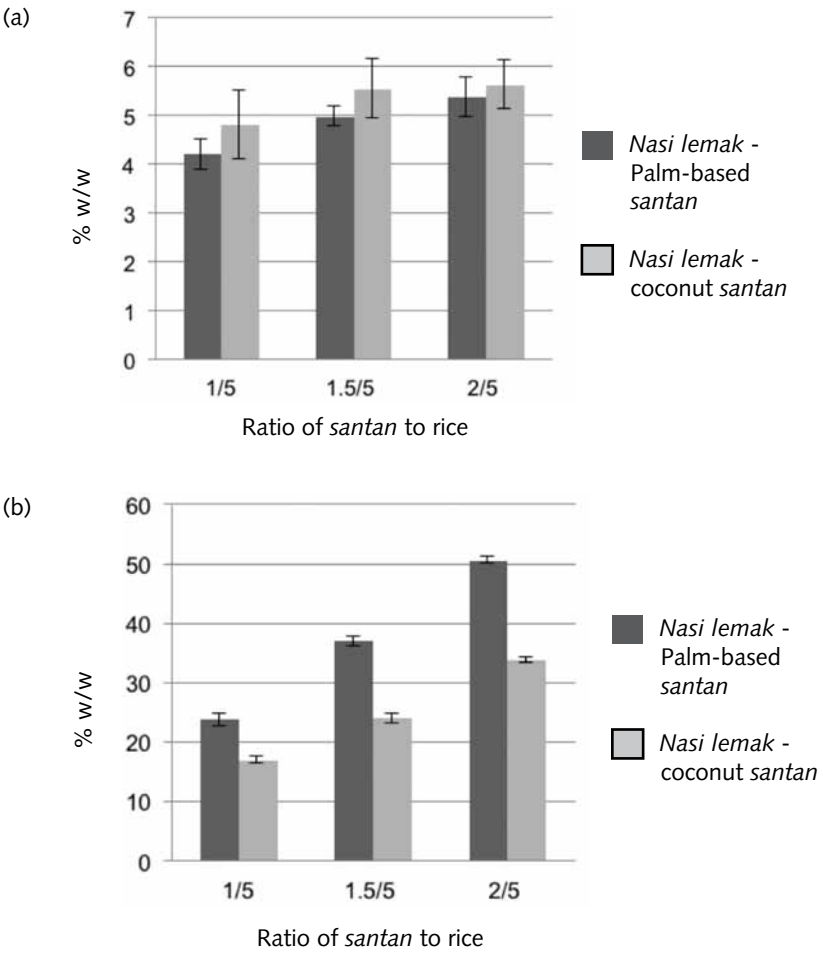
Figure 1. Nasi lemak.

When white rice is boiled at 100°C, starch gelatinisation starts from the outer region of the kernels, where an early layer of starch gel is formed. This gelatinisation progresses inwards towards the core and is sustained by the diffusion of water (Riva *et al.*, 2000). Most probably along with the water, oil from *santan* is diffused into the kernels. As a result of gelatinisation, the volume and texture of the kernels are modified, and, after a given cooking time, both attain the desired level that is dictated mainly by sensorial requirements (Riva *et al.*, 1994).

based *santan* is 63.1% while for coconut *santan*, it is 65.3% (Zaida *et al.*, 2008).

OIL CONTENT OF *NASI LEMAK*

The oil content of the palm-based *santan* is 28.0% w/w while the coconut *santan* contains 19.7% w/w of oil. There is a significant difference in the total oil content of these two *santan*. Coconut *santan* has 8.31% less oil content than palm-based *santan*. It was recorded that there is only 6% to 8% of oil present on the surface of the *nasi lemak* while the remaining oil is actually absorbed by the rice kernel during cooking. The oil content of the rice kernel of the *nasi lemak* is significantly increased when the quantity of *santan* added increases. The oil content of the rice kernel ranges from 14% to 24% when ratio of *santan* to rice is 1: 5. However, it ranges from 33% to 51% when the ratio of *santan* to rice is 2: 5. Rice cooked without *santan* contains only 0.015% w/w of oil (*Figure 2*).



Source: Rafidah *et al.* (2013).

Figure 2. Amount (%, w/w) of oil extracted from, a) surface of rice, and b) rice kernels of nasi lemak *when using both types of* santan *at three different ratios of* santan *to rice (1: 5, 1.5: 5 and 2: 5).*

The fatty acid ratio of *nasi lemak* is highly influenced by the type of *santan* used in the formulation. *Table 1* shows that ratios of monounsaturated/saturated (M/S), polyunsaturated/ monounsaturated (P/M) and polyunsaturated + monounsaturated/ saturated {(P+M)/S)} in all the samples. The ratios of various fatty acids in food influence lipid metabolism in humans. It was observed that palm-based *santan* has a higher M/S ratio than coconut *santan*. Thus, the M/S and P/M ratios for all the *nasi lemak* samples made with palm-based *santan* also follow the same trend. Both types of *santan* (palm-based and coconut) are generally comparable.

It was also observed that palm-based *santan* and *nasi lemak* made with it have a similar ratio of saturated-to-unsaturated fatty acids of 1: 1. On the other hand, coconut *santan* and *nasi lemak* made with it have a higher saturated-to-unsaturated fatty acids ratio. Heat during rice cooking does not seem to alter the fatty acid ratios of palm-based and coconut *santan*.

WATER ACTIVITY (Aw) OF *NASI LEMAK*

The addition of *santan* increases the water activity of the rice kernels. It was observed that the range of water activity of *nasi lemak* is from 0.994 to 0.998 at 25.0 ± 0.7°C. Water activity ranges from 0 to 1. Values near to 1 place *nasi lemak* in the perishable foods category. Theoretically, the range of water activity for perishable foods is 0.95 to 1.00. Perishable foods need to be handled with extra care because they can easily spoil due to microbial contamination supported by high water availability. Water activity is a very useful parameter to determine the possibility of microbial growth (Subramaniam, 2000). As water activity gets higher, shelf-life becomes shorter. Perishable foods should be kept hot (>70°C), or cold (<5°C), to ensure they are safe for consumption.

HARDNESS OF *NASI LEMAK*

Hardness is related to the hydration process which takes place in starch granules. During cooking, rice starch granules absorb moisture and swell, resulting in the increase in volume of cooked rice. While starch granules expand, cells will rupture and cause amylose to leach. This may affect the rice texture. Hardness is generally related to the level of the amylose content. Generally, high amylose rice has high hardness and tensile values (Lu *et al*., 2009).

Cameron and Wang (2005) reported that the cooked rice texture has a stronger correlation with the amount of insoluble amylose than with the apparent amylose or leached amylose. They concluded that the higher the amount of leached amylose, the harder the final cooked rice texture. This could explain why rice cooked without *santan* has higher hardness values. Generally, as the amount of *santan* increases, the hardness of rice gradually decreases.

TABLE 1. SATURATED (S), MONOUNSATURATED (M) AND POLYUNSATURATED (P) FATTY ACIDS IN *NASI LEMAK* TOGETHER WITH M/S, P/M AND (P+M)/S RATIOS

Item	Saturated (S) %	Monounsaturated (M) %	Polyunsaturated (P) %	M/S	P/M	(P+M)/S
Palm-based *santan*	50.64	39.19	10.17	0.774	0.260	0.975
Coconut *santan*	94.69	4.6	0.71	0.049	0.154	0.056
Nasi lemak (palm-based *santan* 1: 5)	50.34	39.24	10.42	0.779	0.266	0.986
Nasi lemak (palm-based *santan* 1.5: 5)	50.46	39.23	10.31	0.777	0.263	0.982
Nasi lemak (palm-based *santan* 2: 5)	50.56	39.16	10.27	0.775	0.262	0.978
Nasi lemak (coconut *santan* 1: 5)	92.37	6.13	1.53	0.066	0.250	0.083
Nasi lemak (coconut *santan* 1.5: 5)	92.72	6.01	1.28	0.065	0.213	0.079
Nasi lemak (coconut *santan* 2: 5)	94.31	4.77	0.92	0.051	0.193	0.060
Plain rice (without *santan*)	36.87	36.11	27.02	0.979	0.748	1.712

According to Kaur and Singh (2000), the addition of fatty acids into food that contains starch will alter the physical and chemical properties of the food because starchy food will tend to form complexes between amylose and lipids. These complexes also affect the hardness value. Cameron and Wang (2005) reported that protein and crude lipid contents have a negative correlation with the hardness of cooked rice.

STICKINESS OF *NASI LEMAK*

Stickiness is another important criterion when describing the physical characteristics of cooked rice. Amylose content is not directly related to stickiness but when amylose content is high, stickiness tends to be low (Ayabe *et al*., 2009). Rice without *santan* has the lowest stickiness value followed by *nasi lemak* made with palm-based *santan* and that made with coconut *santan*. The stickiness of rice is increased as more *santan* is added. Thus, the amount of *santan* significantly influences stickiness. This applies to both types of *santan* used in making *nasi lemak*.

SENSORY EVALUATION

Results from the sensory evaluation shows that frozen *nasi lemak* cooked with coconut *santan* had higher scores compared to frozen *nasi lemak* made with palm-based santan for all attributes except for oiliness, hardness and stickiness, where they are comparable (*Figure 3*). Significant differences were observed for colour, odour and overall taste between the samples.

CONCLUSION

The ratio of palm-based *santan* to rice at 1: 5 is sufficient to provide the desired texture to *nasi lemak*. Palm-based *santan* has a higher M/S and P/M ratios compared with coconut *santan*. *Nasi lemak* made with palm-based *santan* is comparable to that made with coconut *santan* in terms of its stickiness, oiliness and hardness.

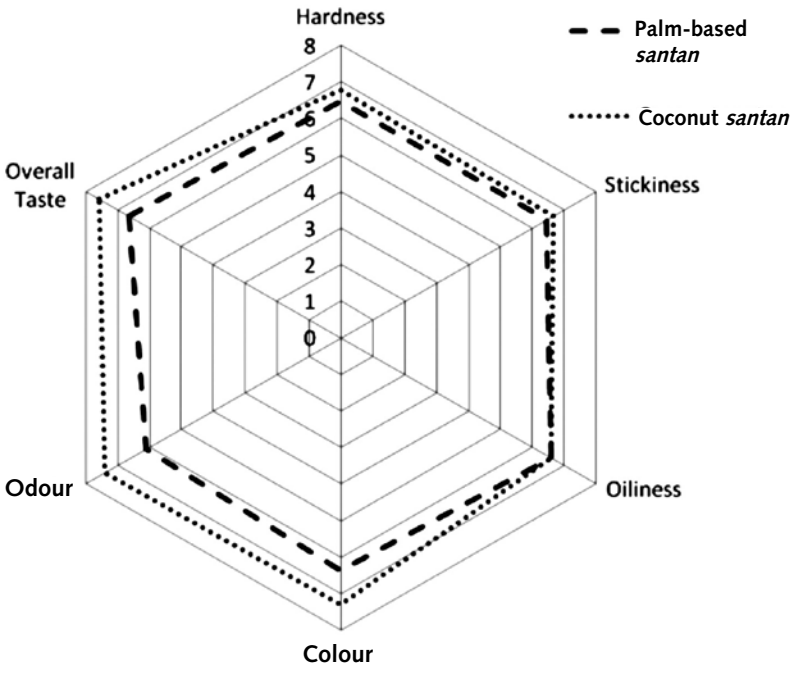


Figure 3. Mean values of hardness, stickiness, oiliness, colour, odour and overall taste of frozen nasi lemak *cooked with palm-based and coconut* santan.

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