PALM-BASED *TRANS-FREE* LIQUID *SANTAN*

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Santan (coconut milk) is rich in fat and its consumption has been associated with increased plasma low-density lipoprotein cholesterol levels (LDL) and greater risk of arterial thrombosis due to its high contents of short chain saturated fatty acids such as lauric (C12:0) and myristic (C14:0). Therefore, the consumption of *santan* is discouraged. Palm-based *santan* has therefore been formulated to obviate the health risk (*Figure 1).* It has considerably lower C12-C16 saturated

Figure 1.

fatty acids, and its consumption, instead of normal *santan*, has been found to lower serum total cholesterol and cardiovascular risk (Ng and Tee, 1998). The additional benefits are that it is more resistant to deterioration (*e.g.* from oxygen, light, moisture), has better flavour and nutritive value, and is more stable to handling during storage and transport (Zaida *et al.*, 1997). The product is also *trans*-free. Coconut *santan* cannot keep more than 5 hr at room temperature (28°C-33°C) without noticeable deterioration – becoming rancid, discoloured and suffering phase separation.

The process for making the MPOB palm-based liquid *santan* involves emulsification and homogenization. Two types of palm-based liquid *santan* have been produced – artificial/natural coconut flavoured.

PRODUCT CHARACTERISTICS

Proximate analyses of the palm-based and coconut *santan*s were done using standard analyses (*Table 1*). Coconut *santan* has higher fat and protein than the palm-based *santan*. Nevertheless, the palm *santan* is rich as a source of energy as coconut *santan*, equally able to supply the bodily energy requirements.

The physicochemical properties of the two *santans* are shown in *Table 2*. *Table 3* shows that coconut *santan* has higher lauric (C12:0) and myristic (C14:0) acids.

STORAGE STABILITY

Both *santan*s were investigated for their stability during storage at different temperatures. At 5°C and 28°C, the palm *santan* was stable for 28 days without preservative. Coconut *santan*, on the other hand, turned rancid and deteriorated, being more susceptible to oxidation, and enzymatic and microbial attacks due to its preponderance of short chain fatty acids. It could not be kept for more than 5 *hr* without spoilage even in a refrigerator at 2°C-5°C.

MICROSCOPY

The particle size of the palm *santan* after storage for 24 *hr* at different temperatures was observed under light microscopy (*Figure 2*). There were noticeable effects of the different storage temperatures on the particle size distribution.

SENSORY EVALUATION

Various traditional Malaysian foods like *nasi lemak*, *bubur pulut hitam*, curry and sago were prepared using both the palm and coconut *santan*s, and evaluated by a sensory panel for appearance, aroma/odour, taste and overall quality on a nine-point scale (*Figure 3*). The palm *santan* (with and

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TABLE 1. PROXIMATE COMPOSITIONS (%) OF PALM-BASED AND COCONUT *SANTAN*S

Food component	Palm *santan*	Coconut *santan*
Fat	26.4 ± 0.1	29.4 ± 0.2
Protein	1.4 ± 0.1	2.2 ± 0.3
Moisture	63.1 ± 0.2	65.3 ± 0.1
Ash	1.2 ± 0.2	2.1 ± 0.1
Carbohydrate (by difference)	7.8 ± 0.2	2.3 ± 0.2
Energy (kJ / 100 g)	1133.2	1 164.3

Note: Values are the means ± standard deviation from triplicate determinations.

TABLE 2. PHYSICO-CHEMICAL CHARACTERISTICS OF PALM AND COCONUT *SANTAN*S

Characteristic	Palm *santan*	Coconut *santan*
Slip melting point (°C)	35.7 ± 0.2	22.4± 0.3
Iodine value (mg g^{-1} iodine)	52.8± 0.2	10.2± 0.1
Viscosity	22.2± 0.1	33.2± 0.2

Note: Values are the means ± standard deviation from triplicate determinations.

TABLE 3. FATTY ACID CONTENTS OF PALM AND COCONUT *SANTAN*S

Santan	Fatty acid (%)						
	Lauric C12:0	Myristic C14:0	Palmitic C16:0	Palmitoleic C16:1	Stearic C18:0	Oleic C18:1	Linoleic C18:2
Palm	0.25	1.0	41.7	0.2	3.7	42.0	10.7
Coconut	49.1	18.4	8.3	-	2.5	5.2	1.2

without flavour) scored better for appearance, but there was no significant difference in aroma except for *bubur pulut hitam* and *nasi lemak* ($P < 0.05$). The aroma of coconut *santan* was better in these two food products. There was a significant difference in taste for meat curry, sago and *nasi lemak* with palm-based *santan* being better. The overall quality showed that *nasi lemak* made from coconut *santan* was preferred. However, there was no significant difference in the other foods tested.

ECONOMIC FEASIBILITY OF PALM *SANTAN* PRODUCTION

The commercial production of palm *santan* is expected to require a fixed investment of RM 98 000.

At various sale levels, namely, 50 000, 53 000 and full operation of 55 000 litres a year, and at a long-term price of RM 6.50 $litre^{-1}$ (in 200 ml packets), palm *santan* production will generate a pre-tax income of RM 325 109 to RM 357 500.

The unit cost of production is estimated to be at a range of RM 4.98 to RM 5.65, depending on production level. Using a 10% discount factor and price of RM 6.50 $litre^{-1}$ with a total sales 50 000 litre, the production of palm *santan* is attractive with a payback period of just 4.4 years (*Table 4*).

The venture is expected to yield a benefit:cost ratio (B:C) of 1.07, net present value (NPV) of RM 119 599 and internal rate of return (IRR) of 33.92%. If sales increase to 55 000 litre a year, the NPV will increase to RM 166 225 and IRR to 42.49%. At this sales level, the B:C is 1.09 and just 2.5-year (*Table 5*) are needed to recover the establishment and operation costs. However, if the sales decrease to

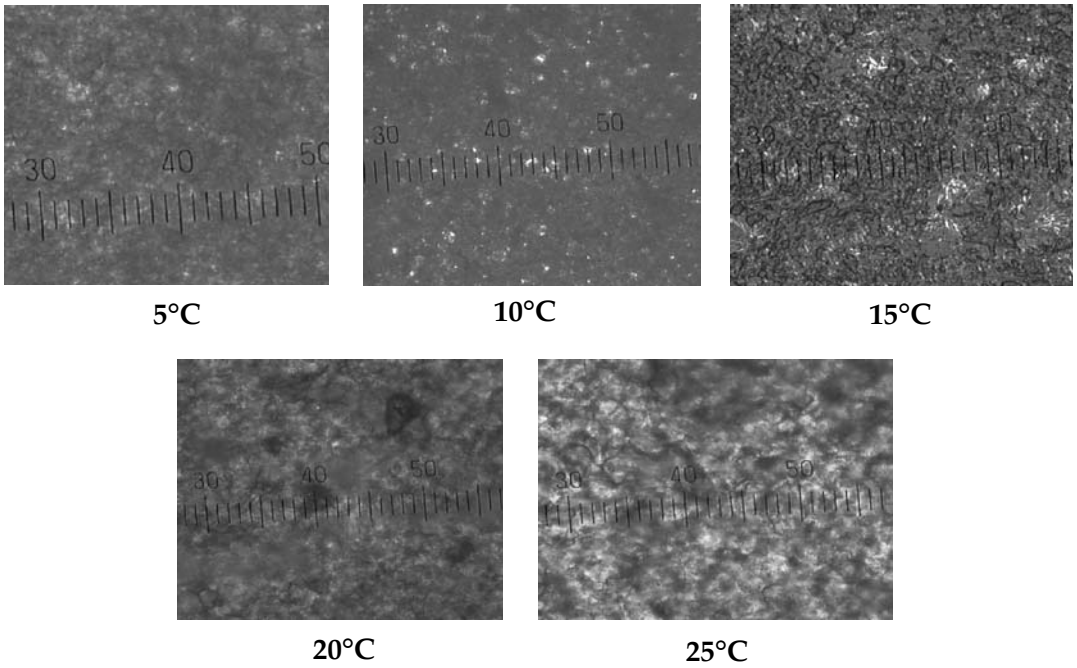

Figure 2. Micrographs of palm santan *(without flavour) after storage for 24* hr *at 5°C, 10°C, 15°C, 20°C and 25°C. Magnification, 400X.*

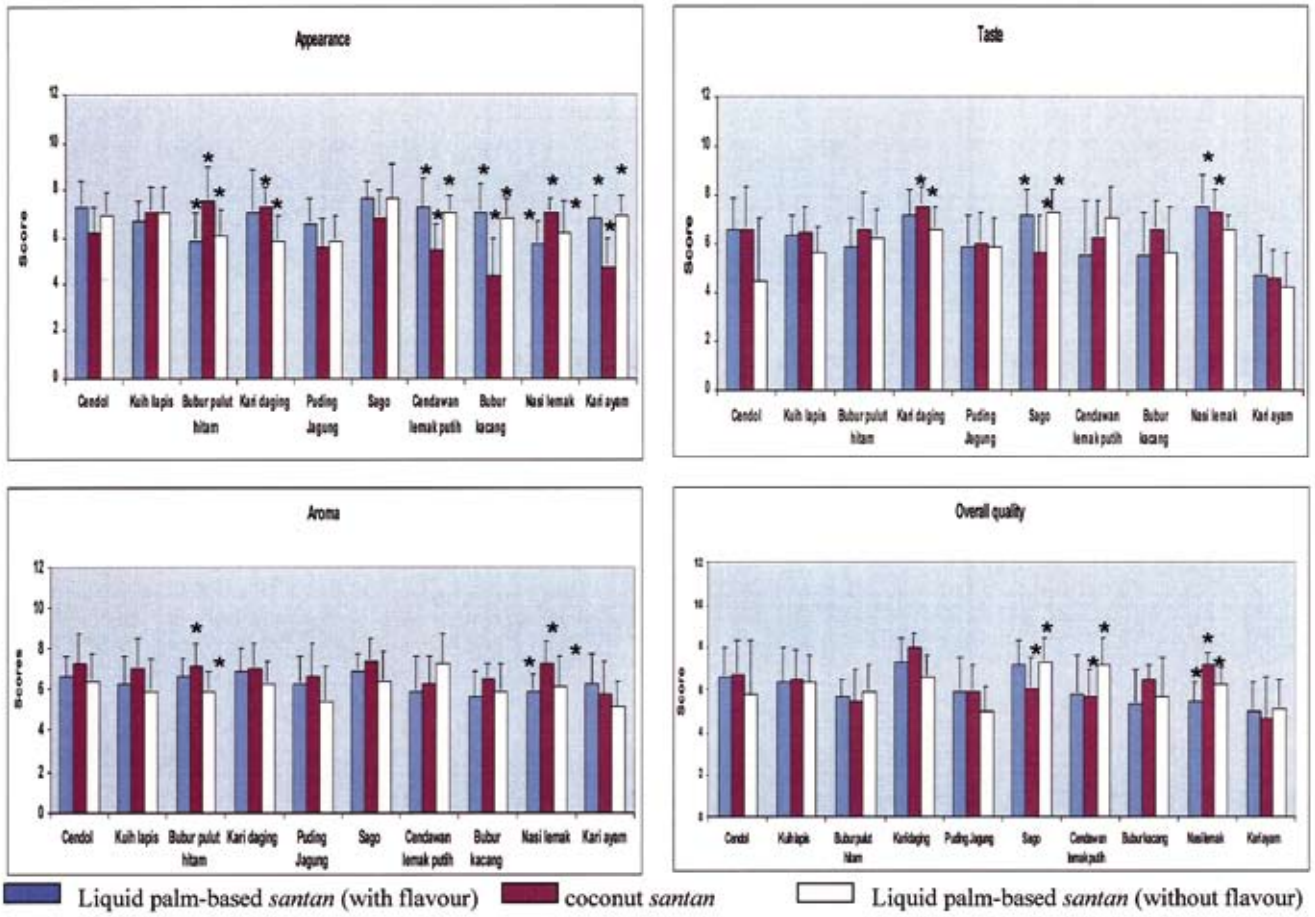

Figure 3. Mean scrores from evaluation of food products made from palm-based trans*-free liquid* santan *(with and without flavour) and coconut* santan*. The means ± S.D. (n=10) are shown. Significant difference was taken at p<0.05 using the t-test. *Significant different from the control at (p<0.05).*

TABLE 4. STORAGE STABILITY OF PALM *SANTAN* (with and without flavour) AND COCONUT *SANTAN* AT 5°C AND 25°C

	Stability at 5°C				Stability at 25°C			
Santan	**Day 1**	**Day 7**	**Day 14**	**Day 28**	**Day 1**	**Day 7**	Day 14	Day 28
Palm *santan* with coconut flavour	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
Palm *santan* without flavour	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
Coconut *santan*	Stable for only a few hours.	Emulsion separated into 2 phases, colour change, rancid smell.	Emulsion separated into 2 phases, colour change, rancid smell.	Emulsion separated into 2 phases, colour change, rancid smell.	Emulsion separated into 2 phases.	Emulsion separated into 2 phases, colour change, rancid smell.	Emulsion separated into 2 phases, yellowish colour, rancid smell.	Product turned brown, 'faulty' odour.

TABLE 5. FINANCIAL ANALYSES FOR INVESTMENT IN PRODUCING PALM *SANTAN*

Sales (litre)	**Discount rate at 10%**			**PBP (yr)**
	NPV (RM)	**IRR (%)**	**B:C**	
50 000	49 660	20.49	1.03	4.4
53 000	119 599	33.92	1.07	3.1
55 000	166 225	42.49	1.09	2.5

50 000 litres a year (250 000 packets), the NPV and IRR will decrease to RM 49 660 and 20.49%, respectively. At all three production/sales levels, the investment is viable with the B:C ratio greater than unity, the NPV positive and IRR above the opportunity cost of capital.

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