Performance of Special Quality and Standard Palm Olein in Batch Frying of Fish Nuggets

Karimah Ahmad*

INTRODUCTION

Fried food has grown in popularity despite the low fat/no fat health trend. Frying is a popular traditional domestic cooking process, now universally used in the food industry to produce snacks and convenience fast foods. It is a quick and convenient technique of food production compared to other traditional means of cooking conferring unique sensory properties such as colour, flavour, texture and palatability on the products which are highly appreciated by consumers in all age groups. However, when frying oil is heated in a deep-fat fryer, three chemical reactions occur simultaneously, *i.e*. oxidation, hydrolysis and polymerization, causing the frying fat to break down, foam, smoke and develop off-flavours and odours. The faster the oil degrades, the shorter the *fry life* of the oil (Watkins, 2005).

The fats or oils used for frying often determine the acceptability of the food prepared in them. Although the frying oil serves primarily as a heat exchange medium, it ends up constituting a significant portion of the final food product, often as much as 45%. Oils vary widely in their eating quality, functionality and rate of deterioration depending on their sources and processing or formulation. An ingredient specification combined with a total quality management perspective for the oil component ensures production of high quality frying oil and, subsequently the fried food.

Special quality palm olein (SQ POo) is an extra stable oil produced from stringent quality control of the harvesting and refining processes. It retains a high level of the antioxidants (tocopherols and tocotrienols, which have vitamin E equivalence) naturally present in palm oil. SQ POo is also less yellowish in colour compared to other types of oleins. This study was undertaken with the objective of comparing the frying performance of SQ POo with standard palm olein (POo) (*Table 1*).

*Malaysian Palm Oil Board,
P. O. Box 10620,
50720 Kuala Lumpur, Malaysia.
E-mail: karimah@mpob.gov.my

MATERIALS AND METHODS

SQ POo was supplied by Golden Jomalina Food Industries Sdn Bhd and POo purchased from a local supplier. Fish nuggets were purchased from Figo Foods Sdn Bhd. The fresh nuggets had an average weight of 38.75 g each, length of 10.5 cm, width of 6.0 cm and thickness of 1 cm.

Two commercial dual-unit electric open fryers (Frymaster, Shreveport, La., USA) with capacity of 11.5 litres unit^{-1} (fry pot) were used for frying. Frying was conducted for 10 consecutive days simulating the conditions in fast food outlets. The fryer was kept switched on for 8 to 9 hr a day. Fourteen batches of frozen fish nuggets, each batch consisting of six pieces and weighing about 242 g ± 5 g were fried in the oil at 175°C ± 2°C for 2.0 min at intervals of 30

TABLE 1. SPECIFICATIONS OF SPECIAL QUALITY PALM OLEIN (SQ POo) AND STANDARD PALM OLEIN (POo)

	SQ POo	POo
Free fatty acid (% C16)	0.02	0.06
Slip melting point (°C)	22.6	19.6
Colour (5.25" Lovibond)	1.2R 12Y	2.6R
Iodine value (Wij's method)	56.79	56.7
Moisture and impurities (%)	0.025	0.05

min. Each oil was subjected to a total of 80 hr frying. The frying oil in the fryer was replenished with about 15%-20% of fresh oil every day after filtration and sampling.

The oils were cooled to 120°C at the end of each day and filtered. About 500 ml of used frying oil (in duplicate) were withdrawn each day and collected in amber bottles, cooled, sparged with nitrogen and kept at -18°C before analysis. They were subjected to physical and chemical analyses such as free fatty acids (FFA), oxidative stability, oil colour, smoke point and polar components. Fried nuggets were analysed for changes in colour, oil absorption and sensory evaluation. The analyses were conducted according to the MPOB, IUPAC, AOAC and/or AOCS Official Test Methods. Sensory evaluation was evaluated by 10 trained panelists using the nine-point hedonic rating scale where 1 = extremely dislike, 5 = neither like nor dislike and 9 = like extremely, according to the acceptability of flavour, taste and overall quality. The attributes evaluated were colour, flavour, juiciness inside, crispiness outside, taste and overall quality. The degree of crispiness outside, 1 = soft and 9 = crispy, for juiciness inside 1 = dry and 9 = juiciness and for colour, 1 = dark brown and 9 = golden yellow.

RESULTS AND DISCUSSION

Both SQ POo and POo experienced a steep increase in FFA upon frying (*Figure 1*). The initial FFAs of SQ POo and POo were 0.03% and 0.06% rising to 0.61% and 0.84%, respectively on day 10. The FFA profiles of both oils were similar with a steady increase up to day 9 before plateauing on day 10. Production of FFA in large quantities is the result of hydrolysis, oxidation due to free radical formation and cleavage of double bonds during frying (Paul and Mittal, 1997). However, their FFA contents remained below the maximum discard point of 1%. The smoke points of SQ POo and POo before frying were 228°C and 208°C, respectively. However, after frying for 10 consecutive days, the smoke points of SQ POo and POo dropped to 208°C and 172°C, respectively (*Figure 2*). An inverse correlation was observed between FFA content and smoke point. Colour is an important parameter indicating the overall quality of the oil (Orthoefer, 1988; Takeoka *et al*., 1997).

The changes in colour of both oleins are shown in *Figure 3*. The initial colour (Lovibond 5.25" cell) of SQ POo and POo before frying was 0.9R and 2.5R respectively. SQ POo has an extremely low red value unlike standard or double fractionated POo. On frying, the increase in colour (redness) of POo almost double that of SQ POo from day 1 to day 10. The final colour of SQ POo and POo on day 10 were 10.25R and 15.8R, respectively. Palm olein has a very low resistance to browning and tends to degrade in colour almost twice the rate of SQ POo. As the frying time increased, darkening of oil occurred from particles of food that had

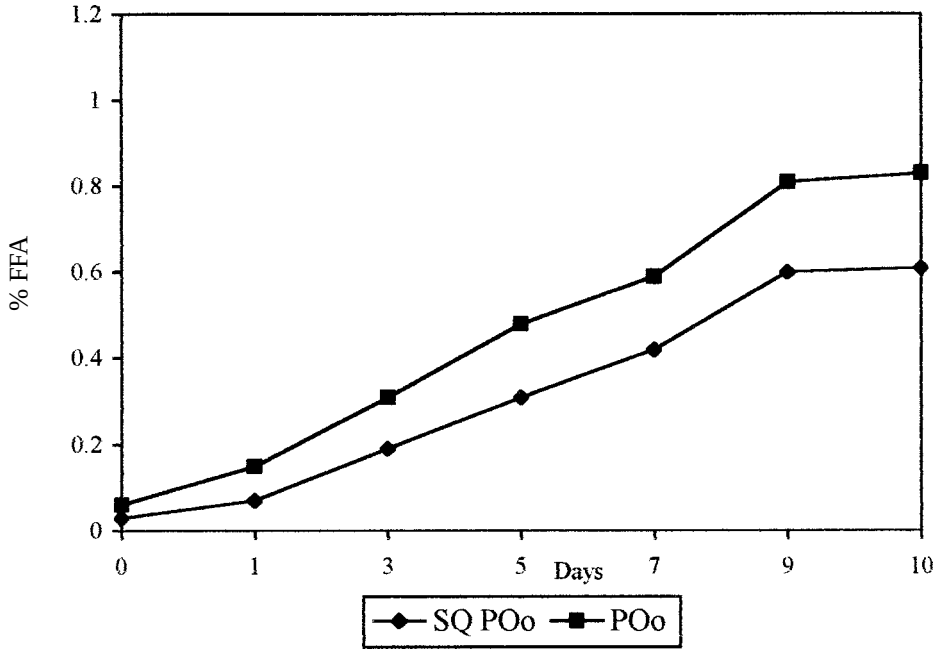

Figure 1. Free fatty acids (FFA) contents of special quality palm olein (SQ POo) and standard palm olein (POo).

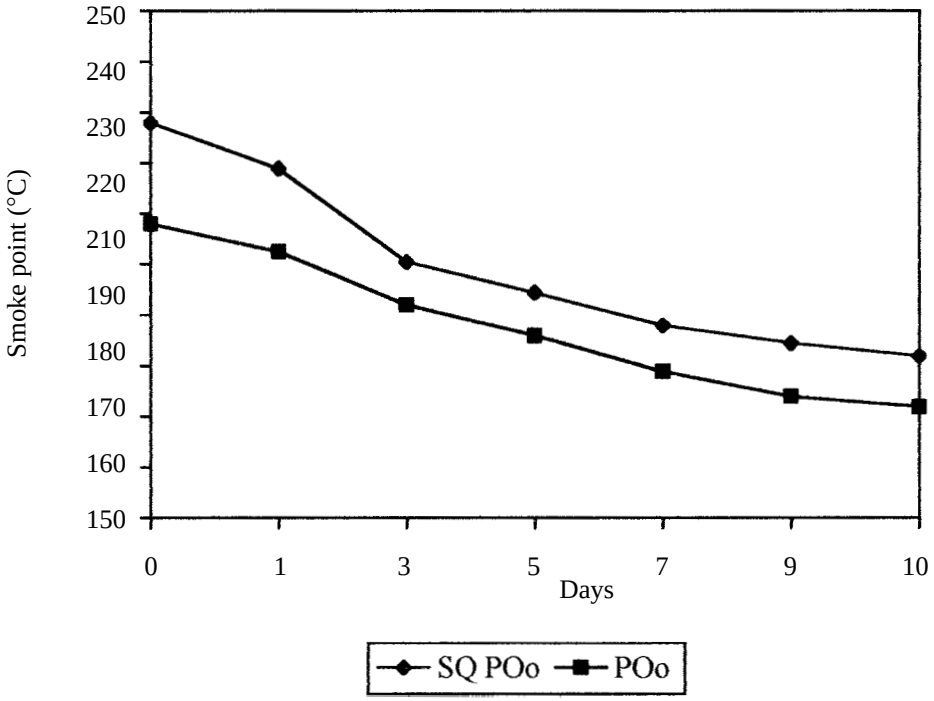

Figure 2. Smoke point of special quality palm olein (SQ POo) and standard palm olein (POo).

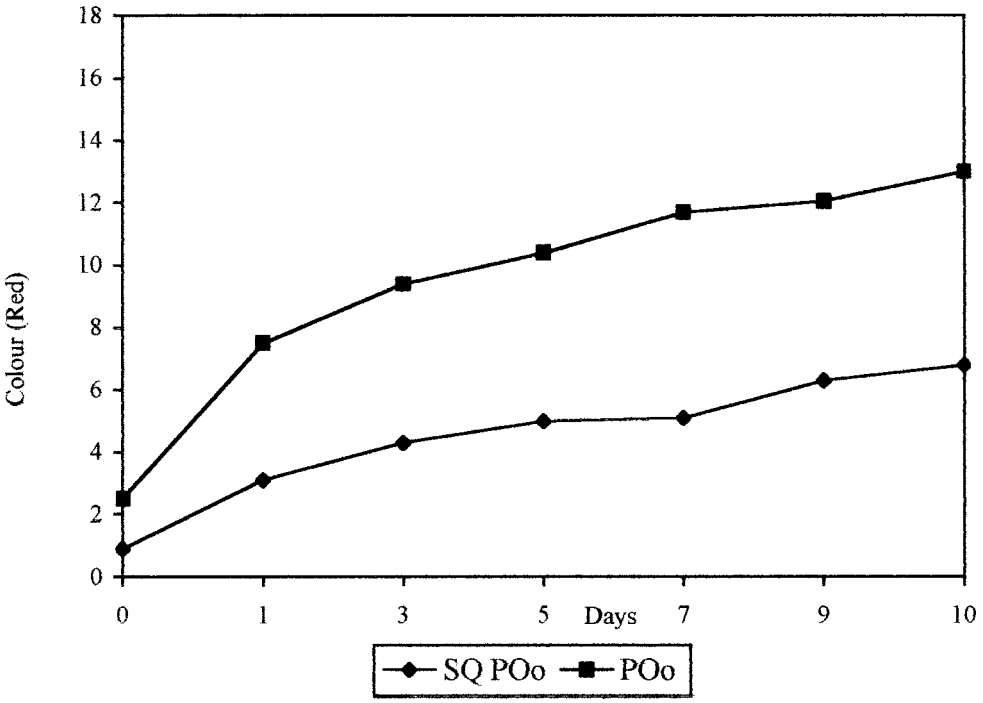

Figure 3. Changes in Lovibond colour of special quality palm olein (SQ POo) and standard palm olein (POo).

caramelized and released soluble compounds into the fat (Vijayan *et al*., 1996).

Figure 4 shows the changes in colour of the fish nuggets fried in these two oleins. The colour in L-value before frying was 70.17. The lower the L-value, the darker the product. On day 1, the L-value of the fish nuggets fried in SQ POo and POo dropped to 57.42 and 57.44 respectively. The changes in L-value of the product throughout the frying period were similar and the final L-values for SQ POo and POo on day 10 were 55.09 and 54.27, respectively. Comparison between the colour of the oil and fried product indicated that the former did not influence the latter. Therefore, this study does not support the findings of Lawson (1995) that the colour of frying oil darkens with use and eventually affects the colour of the fried product. *Figure 5* shows the colours of both the frying oils taken on days 1, 3, 7 and 10. The Rancimat oxidative stabilities (110°C) of SQ POo and POo before frying were 24 hr and 22 hr, respectively.

Sensory evaluation of the fish nuggets showed that the panelists preferred the colour, flavour, juiciness, taste and overall quality of the product fried in SQ POo (*Figure 6*). The absorption of oil in the fish nuggets fried in SQ POo and POo was 20.3%-28.64% and 20.4%-27.37%, respectively. The polar components from day 1 to day 10 in SQ POo and POo were 5.77%-17.4% and 6.07%-17.51%, respectively. The polar components in the frying oils increased to approximately half the limit (25%-27%) set in the official regulation (Plessis and Meredith, 1999).

CONCLUSION

Special quality POo showed better frying performance than POo. The FFA contents after frying for 10 consecutive days showed a difference of 27%. The smoke point of SQ POo was 10°C higher than that of POo. The type of product fried in the oil influenced the changes in colour of the frying oils, especially POo. The fish nugget that had a dark yellowish colour darkened the colour of POo. Although the colour of POo was almost double that of SQ POo on day 10, it did not affect the colour of the fried product. Thus, SQ POo has a better resistance towards degradation and a longer frying life.

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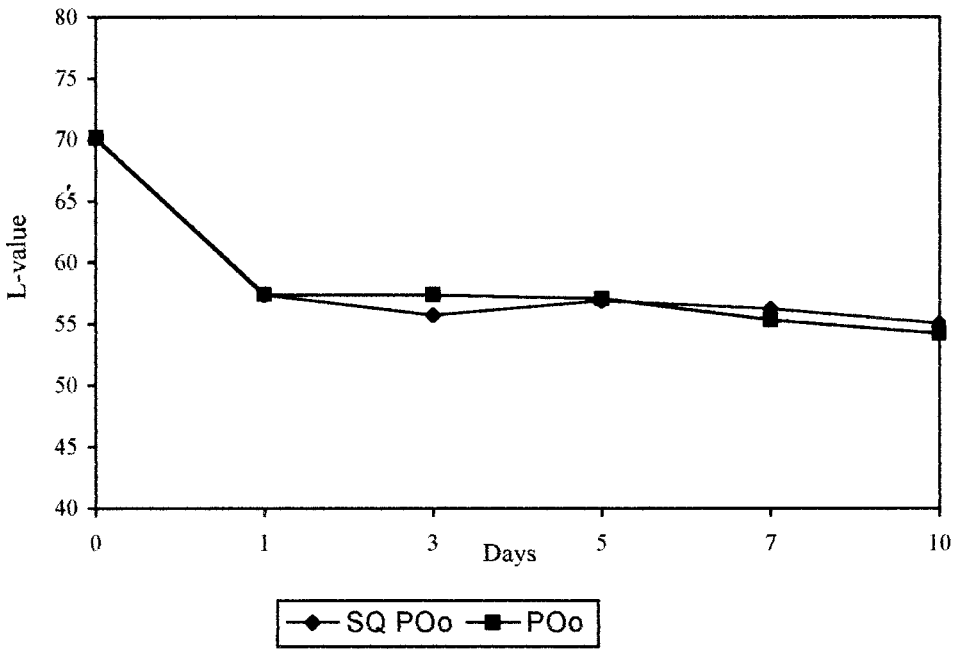

Figure 4. Changes in colour of fish nuggets with frying.

Figure 5. Changes in colour of special quality palm olein (SQ POo) and standard palm olein (POo) during frying.

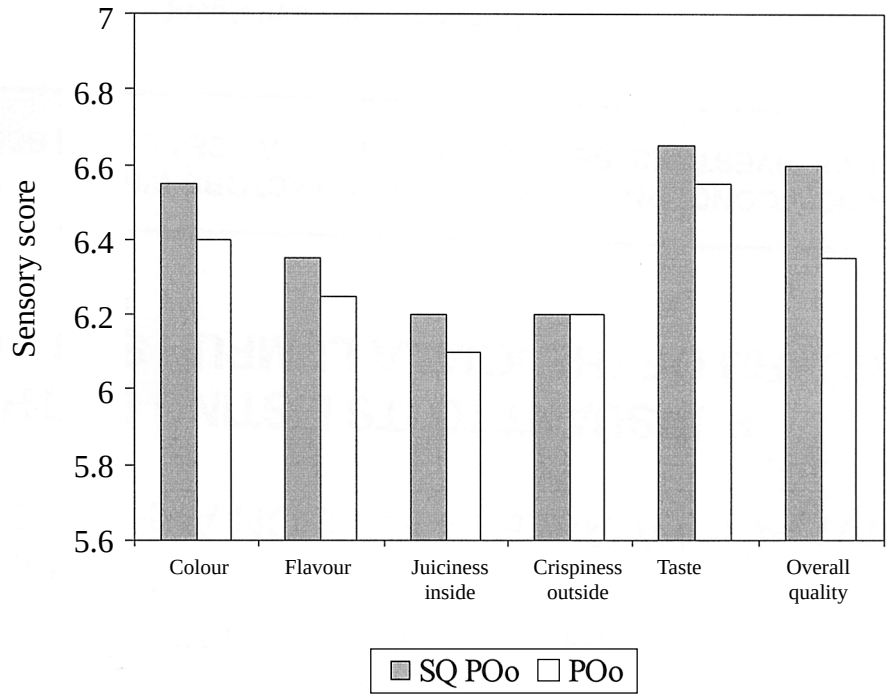

Figure 6. Sensory evaluation of fish nuggets fried in special quality palm olein (SQ POo) and standard palm olein (POo).

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