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Evaluation of Potato Crisps Fried in Market Samples of Palm Olein, Corn Oil and Soya Oil

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ABSTRAK

Hanya penstoran kerepek ubi kentang yang digoreng di dalam minyak kelapa sawit olein, minyak jagung dan minyak kacang soya yang dibeli di Malaysia dinilai oleh panel penilaian deria. Ahli panel terdiri daripada orang tempatan Malaysia. Hayat penstoran kerepek yang digoreng dalam minyak kelapa sawit olein adalah lebih lama ($p < 0.05$) di bandingkan dengan kerepek yang digoreng dalam minyak kacang soya. Didapati bahawa tidak ada perbezaan bererti ($p < 0.05$) di antara hayat penstoran kerepek yang di goreng dalam minyak kelapa sawit olein dan minyak jagung. Dalam tiap-tiap sistem minyak, hayat penstoran kerepak yang digoreng berkurang dengan penambahan nombor penggorengan. Hayat penstoran kerepek yang digoreng dalam tiap-tiap minyak dipengaruhi oleh paras % komponen polar dan nilai asid minyak sewaktu penggorengan dibuat.

ABSTRACT

The shelf-life of potato crisps fried in market samples of palm olein, corn oil and soya oil was evaluated by a sensory panel comprising Malaysian panelists. The shelf-life of crisps fried in palm olein was significantly longer than those fried in soya oil ($p < 0.05$). There were no significant differences ($p < 0.05$) between the shelf-life of crisps fried in palm olein and those fried in corn oil. In each oil system, the shelf-life of the crisps fried in the oils decreased with an increase in fry number. The shelf-life of the crisps fried in each oil was infuenced by the level of % polar components and the acid value of the oil.

INTRODUCTION

The potato crisp industry uses large amounts of oil for frying. The choice of oils for the frying process becomes very important from a view point of quality of the fried product as well as the economy of the production process (Berger, 1984).

The quality changes of market samples of palm olein, corn and soya oils during frying have been studied (Augustin *et al.*, 1987). It was found that the extent of oxidation and polymer formation were less in palm olein than in corn and soya oils and that the change in acid value was highest in palm olein (Augustin *at al.*, 1987). It is also important to assess the keeping quality of the fried product. This paper reports the shelf-life of potato crisps fried in palm olein, corn oil and soya oil. These oils were chosen as they are the more readily available frying oils in the Malaysia market. In the USA, soyabean and other vegetable oils intended for frying are generally hydrogenated to reduce most or all of the linolenic acid but in other countries and in the Middle East, many of the cooking and frying oils are not hydrogenated (Frankel *et al.*, 1984).

Oil is picked up by the food during frying and forms an integral part of the deep-fried product. The type and quality of the oil used for frying have an influence on the quality and shelf-life of the fried product as the oxidative deterioration of lipids is one of the major limiting deteriorative reactions in fried food proucts (Quast and Karel, 1972). The aim of this study was to evaluate the keeping quality of potato crisps fried in market samples of palm olein, corn oil and soya oil in Malaysia.

MATERIALS AND METHODS

The experimental procedures except that of the sensory evaluation of crisps have been described before (Augustin *et al.*, 1987).

Materials

Random samples of refined, bleached and deodorized palm olein (RBD olein) (Batches 1, 2 and 3), corn oil (Batches 1 and 2) and soya oil (Batches 1 and 2) were obtained from local retail outlets. Batch 3 of soya oil was obtained directly from a local factory. Potatoes were bought from local shops and thus the same variety of potatoes could not be assured every time. The potatoes were cleaned and sliced to a thickness of 2 mm. The slices were blotted slightly with tissue before frying.

Frying

The frying of potato slices was carried out in Valentine fryers which initially contained 4 kg of oil. The temperature of the oil was raised to 180°C and frying was started half an hour after the temperature had reached 180°C. Each time, 100 g of slices were fried for 3.0 min. Fryings were carried out at half hour intervals. A total of 10 fryings were done per day for four consecutive days. At the end of each day, the fryer was switched off and 100 g samples of oil were removed from each fryer. The lid of the fryer was replaced and the fryings were continued on the next day. Fresh oil was not added to the frying vessel. Crisps from selected fryings were kept for sensory assessment.

Analyses of the Oils

The analyses of peroxide value (AOCS, 1974) and p-anisidine value (IUPAC, 1979) were carried out before the start of the frying trials. Other analyses on the frying oils were carried out within three weeks. The percentage polar components of the oils were determined by column chromatography (Billek *el al.*, 1978). The IUPAC methods were used for the determination of acid and iodine values (IUPAC, 1979). The oils were screened for the antioxidants BHA, BHT and TBHQ (Kirleis and Stine, 1978; Page, 1982).

Sensory Evaluation

For each trial, crisps from selected fryings (1st, 10th, 20th, 30th, and 40th) in palm olein, corn oil and soya oil were taken for sensory evaluation. Crisps from each of these fry numbers were placed in 10 glass sample bottles with screw-capped lids with each containing 2 potato crisps. The samples were stored at room temperature (21–23°C) and presented at weekly intervals to a sensory panel comprising 10 judges with previous experience on sensory panels for fat and fat-based products. The panelists were instructed to take short sniffs of the samples on removing the lids from the sample bottles. The time for the onset of rancidity was taken when five or more of the panelists judged that the product had an unacceptable odour. This period is taken as the shelf-life of the product.

RESULTS

The characteristics of the fresh oils are given in Table 1. The quality changes of market samples of corn, soya and palm olein during frying have been described in detail elsewhere (Augustin *et al.*, 1987). BHA, BHT and TBHQ were not found in any of the samples of palm olein, BHA was found in all samples of corn oil while TBHQ was found in batch 1 and 2 of soya oil. TBHQ was not detected in soya oil (Batch3) which was obtained from the factory. Although there were differences in the initial oxidation values of the oils and antioxidants were found in market samples of corn and soya oil but not in palm olein, the samples were nevertheless used as the aim was to compare market samples of these oils. Soya oil (Batch 3), which was obtained directly from the factory was also used for comparison.

Quality of Potato Crisps

Crisps obtained from all fryings in all types of oils were of acceptable quality immediately after frying. Off-odours, resulting from deterioration of oil in the crisps developed during storage.

TABLE 1

Characteristics of the fresh oils

Type of oil	Batch	Peroxide value (meg/kg)	p–Anisidine value	Acid value (mgKOH/g oil)	Iodine value
Palm olein	1	0.83	1.89	0.15	58.3
	2	1.48	1.61	0.20	58.2
	3	0.84	1.05	0.34	58.5
Corn oil	1	3.55	6.80	0.16	130.0
	2	3.74	7.57	0.16	128.1
Soya oil	1	14.16	2.70	0.21	136.5
	2	2.14	2.23	0.33	141.5
	3	0.87	0.74	0.22	135.2

Each value is the average result of duplicate analyses. The average standard errors of the mean for duplicate analysis were 0.25 meq/kg for peroxide value, 0.5 for p–anisidine value, 0.02 for acid value and 0.2 for iodine value.

All oil samples except Batch 3 (soya oil), were random samples obtained from retail outlets. Batch 3 (soya oil) was obtained from a local factory.

The results in Table 2 showed that the shelf-life of crisps fried in market samples of palm olein was significantly longer than that of crisps fried in market samples of soya oil ($p < 0.05$). A separate trial on the comparison of shelf-life of crisps fried in soya oil with low oxidation values (Batch 3) and that of crisps fried in palm olein confirmed that crisps fried in soya oil had a shorter shelf-life. In the latter trial, the shelf-lives of crisps fried in soya oil were 17 weeks, 15 weeks, and 11 weeks respectively for crisps obtained from the 1st, 10th and 20th fryings while the corresponding shelf-lives for those fried in palm olein (Batch 3) were > 17 weeks > 17 weeks and 14 weeks respectively. Although the shorter shelf-life of crisps fried in soya oil (Batch 1) compared to palm olein may in part be attributed to the high initial oxidation state of the soya oil, the results of trials with Batch 2 and Batch 3 of soya oil showed that the type of oil (i.e. soya oil or palm olein) also influenced the keeping quality of the fried product.

There were no significant differences ($p < 0.05$) between the shelf-life of crisps fried in palm olein and corn oil. The shelf-life of crisps fried in soya oil was generally shorter than that of crisps fried in corn oil. Significant differences ($p < 0.05$) were found between the shelf-life of crisps fried in corn and soya oils from Batch 1 only and this may in part be due to the higher initial peroxide velue of soya oil from Batch 1. A separate trial on the comparison of shelf-life of crisps fried in market samples of soya oil (peroxide value 11.9 meg/kg, p-anisidine value 2.46) and corn oil (peroxide value 3.65 meg/kg,p-anisidine value 6.62) also showed that the shelf-life of crisps fried in market samples of soya oil was shorter than that of crisps fried in corn oil. The shelf-lives of crisps fried in soya oil were 6 weeks, 5 weeks and 3 weeks for the 1st, 20th and 40th fryings, whereas the corresponding shelf-lives for crisps fried in vorn oil were 9 weeks, 9 weeks and 6 weeks respectively.

In each frying system, there was a decrease in the shelf-life of the crisps with increase in fry number (Table 2). The decreasing shelf-life of crisps of later fryings might be expected as the quality of the frying oil deteriorates with an increase in frying time and this has an influence on the shelf-life of the fried product (Asap and Augustin, 1986). The effect of frying oil quality on shelf-life in each of the systems can be demonstrated by plots of shelf-life against % polar components (*Figure 1*) and shelf-life against acid value *(Figure 2)*. The % polar components is a reliable criterion for determining the quality of frying oils (Billek *et al.*, 1987). It is generally believed that acidity of the frying medium also affects the storage stability of a fried-product. The plots of

TABLE 2

Shelf–life of crisps fried in market samples of palm olein, corn and soya oils

Batch	Fry Number	Palm Olein	Corn Oil	Soya Oil
1	1	15	15	12
	10	15	15	9
	20	13	14	8
	30	11	12	3
	40	10	9	1
	Mean (n = 5)	12.8a	13.0a	6.6b
2	1	16	18	11
	10	15	15	9
	20	13	13	8
	30	12	10	6
	40	8	6	4
	Mean (n = 5)	12.8a	12.4ab	7.6b

The shelf-life is taken as the time when 50% or more of the panelists judged that the product had an unacceptable odour Different letters within a row indicate significant differences at $P < 0.05$. The L.S.D.'s at the 5% level are 4.50 and 4.92 for Batches 1 and 2 respectively.

shelf-life against acid value indicate a decrease in shelf-life with increasing acidity. However, these results do not allow us to differentiate between the relative importance of each of these quality parameters, % polar components and acidity, on product stability.

DISCUSSION

Sensory evaluation of crisps by Malaysian panelists showed that crisps fried in market samples of palm olein without antioxidants were more resistant to the formation of off-odours and off-flavours during storage when compared to those fried in market samples of soya oil containing TBHQ and a factory sample of soya oil without TBHQ. The evaluation also showed that there were no significant differences ($p < 0.05$) between the shelf-life of crisps fried in market samples of corn oil containing BHA and palm olein without antioxidants. Furthermore, the study showed that the shelf-life of crisps fried in market samples of corn oil containing BHA was generally longer than those fried in market samples of soya oil containing TBHQ.

Although this study may be of limited applicability because of the nature of choice of starting oils and the use of Malaysian panelists who were most familiar with products fried in palm olein, it is nevertheless of potential practical significance in Malaysia. The study showed that the type of oil bought from the market in Malaysia and used for frying had an influence on the shelf-life of the fried product. It showed that, despite the presence of antioxidants in market samples of corn and soya oil and the absence of antioxidants in palm olein, the keeping quality of the product fried in palm olein was comparable to those fried in corn oil and better than those fried in soya oil. The susceptibility of crisps fried in soya oil to rancid offodour development may be due to the resence of linolenic acid in the oil. About 7.5% linolenic acid is present in market samples of soya oil (Augustin *et al.*, 1987).

It was interesting to note that there were differences in shelf-life of crisps fried in different types of oil with the same level of % polar components *(Figure 1)*. Apart from differences in the level and presence of antioxidants in the different oils at the time of frying which influence keeping

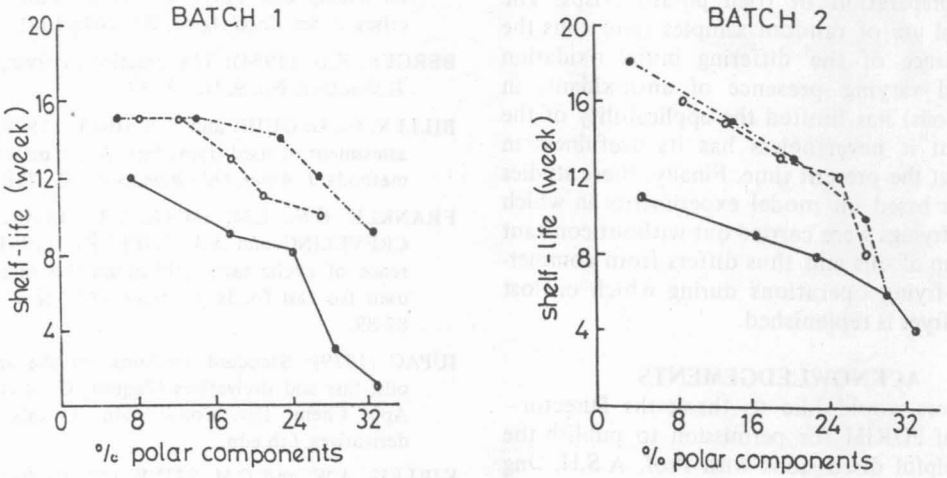

Fig. 1: Shelf-life of crisps versus % polar components of the oil at the time of frying. (palm olein; corn oil; soya oil).

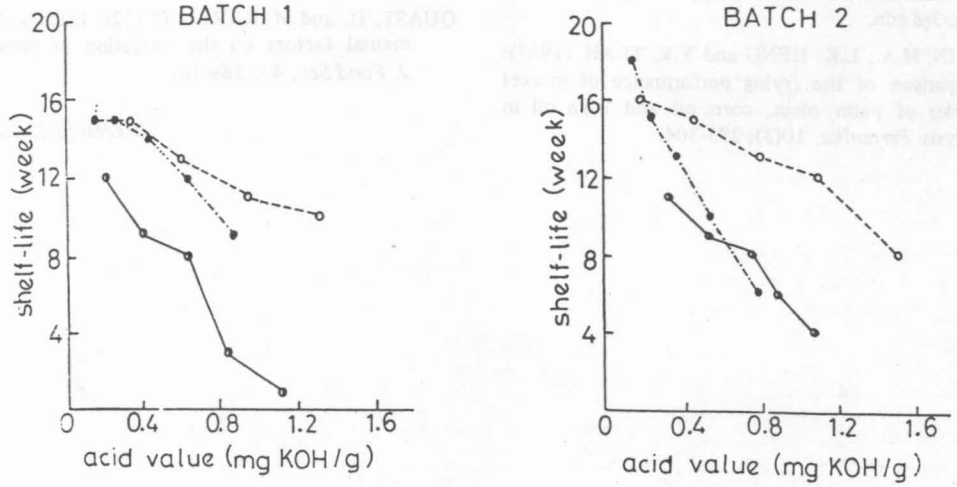

Fig. 2: Shelf-life of crisps verus acid value of the oil at the time of frying (palm olein; corn oil; soya oil).

quality of the fried product, it may be expected that oils with the same level of % polar components contain differing levels and types of individual breakdown products and different types of unchanged triglycerides which exert differing influences on product stability. Thus although % polar components is regarded as a reliable indicator of frying oil deterioration, prediction of the comparative shelf-life of products fried in different oils cannot be based on % polar components. However, within each oil system, there is a general trend of decreasing shelf-life with increase in % polar components in the oil.

CONCLUSION

These results indicate that market samples of palm olein are comparable to or better than mar-

ket samples of corn oil and soya oil respectively for the preparation of fried potato crisps. The intentional use of random samples (and thus the non-avoidance of the differing initial oxidation levels and varying presence of antioxidants in different oils) has limited the applicability of the results but it nevertheless has its usefulness in Malaysia at the present time. Finally, these studies have been based on model experiments in which repeated fryings were carried out without constant topping up of oils and thus differs from commercial deep-frying operations during which oil lost from the fryer is replenished.

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