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Technical Note

Thermal Stability of Sesame/Soybean Oil Blends

ABSTRACT

Soybean oil, roasted sesame oil, unroasted sesame oil and sesame/soybean oil blends were heated separately at 180°C for 8 h per day for 6 days. The thermal stabilities of these oil samples were compared by determining dielectric constant, viscosity, refractive index and the absorbance at 232 nm. Results showed that both roasted and unroasted sesame oils had greater thermal stability than soybean oil. The thermal stability of soybean oil was markedly increased after 48 h heating when blended with 20% of unroasted sesame oil.

INTRODUCTION

Deep fat frying is an important processing procedure used worldwide for the preparation and production of food (Weiss, 1983). During the frying process, the frying fat is heated or reheated over an extended period of time and quality changes occur in the frying fat that may adversely affect the flavour and nutritional value of foods (Smith *et al.*, 1986). Thus, maintaining quality of fats and oils used for deep frying is important in food preparation.

In order to reduce the detrimental effects of severely abused oil and prolong the useful life of frying oil, several methods have been studied to improve the quality of frying oil. These methods include the periodic addition of fresh fat (Thompson & Aust, 1983), the addition of antioxidant during the processing (Ahmad & Augustin, 1985), treatment with various adsorbents and/or additives (Mancini-Filho *et al.*, 1986; McNeill *et al.*, 1986), and blending with a good-frying oil (Berger, 1986).

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Sesame oil is known to be the most resistant to oxidative rancidity among the vegetable oils, due to the sesame oil containing natural antioxidants such as sesamol and *r*-tocopherol (Fukuda *et al.*, 1986). From the practical standpoint, the thermal stability of other vegetable oils would be improved by adding sesame oil, especially soybean oil which is the major edible oil consumed in Taiwan using various cooking methods including frying. However, there is no information dealing with extension of the useful life of frying oil by blending vegetable oil with sesame oil. Therefore, the purpose of this study was to evaluate the thermal stability of sesame/soybean oil blends.

MATERIALS AND METHODS

Materials

Soybean oil was purchased from President Co., Taiwan. Unroasted and roasted sesame oils were prepared by the procedure described by Yen and Shyu (1989). The physical and chemical properties of these oils are shown in Table 1.

Heating experiment

In the experiment, the oils (1·5 kg), including soybean oil, unroasted sesame oil, roasted sesame oil and soybean oil blended with 5 to 20% of unroasted sesame oil, were heated at 180°C for 8 h per day on six consecutive days. At the end of each day, a 50 ml sample was taken for chemical assessment of the oil quality, and the remaining oil was allowed to cool overnight at room temperature. The volume of the oil was not replenished to the original volume after any of the heating operations.

TABLE 1
Physical and Chemical Properties of Soybean Oil, Roasted and Unroasted Oils

Samples	*POV*[a]	*AV*[a]	*IV*[a]	*SV*[a]	*Fatty acid composition (weight per cent)*					
					16:0	*18:0*	*18:1*	*18:2*	*18:3*	*20:0*
Soybean oil	1·1	0·08	123	196	10·52	4·15	24·40	53·21	7·13	0·50
Roasted sesame oil	—	1·81	114	194	9·45	5·64	39·17	44·70	0·87	—
Unroasted sesame oil	0·4	2·80	115	195	9·63	5·13	38·72	45·61	0·92	—

[a] POV: peroxide value (meq/kg), AV: acid value (mg KOH/g), IV: iodine value, SV: saponification value (mg KOH/g).

Analysis of quality characteristics of oil

The Brookfield viscometer (Model RVF) was used to measure viscosity, and the viscosity was expressed, in terms of centipoises. The refractive index of oils was measured at 25°C using an Abbé refractometer (Shibuya Optical Co., Tokyo, Japan). Conjugated dienes of oils were determined spectrophotometrically (Shimadzu double beam spectrophotometer Model-220) at 232 nm, in which the oil samples were diluted in iso-octane to a final concentration of 2 mg/ml. The changes in dielectric constant were measured with the Foodoil sensor and expressed as Foodoil sensor (FOS) reading. The peroxide value, acid value, iodine value and saponification value were

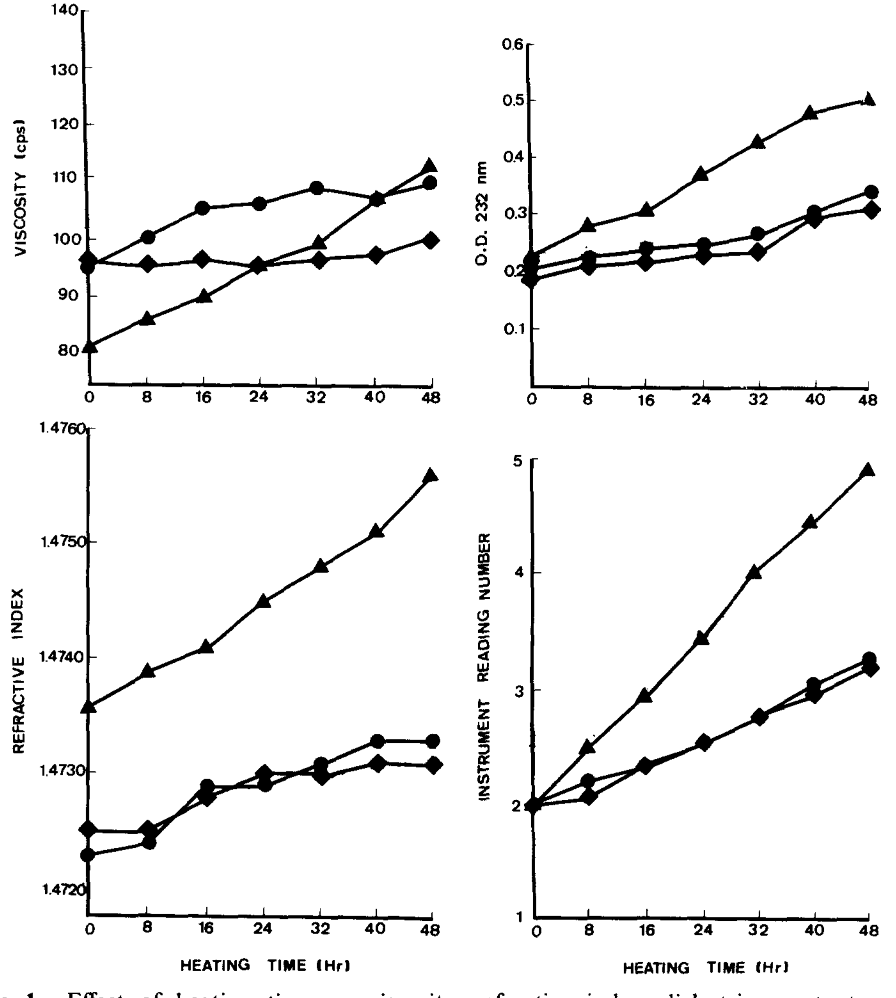

Fig. 1. Effect of heating time on viscosity, refractive index, dielectric constant and conjugated dienes (OD 232 nm) of three different oils. Soyabean oil (▲); Unroasted sesame oil (●); Roasted sesame oil (◆).

performed according to the AOCS Official Methods (1980). The determination of fatty acid content of oils was carried out by gas–liquid chromatography. All analyses were carried out in triplicate.

RESULTS AND DISCUSSION

The thermal stabilities of unroasted sesame oil, roasted sesame oil and soybean oil were evaluated by the determination of viscosity, refractive index, conjugated dienes and dielectric constant; the results are shown in Fig. 1. The increases in viscosity of both unroasted and roasted sesame oils were less than that of soybean oil during heating. The absorbance at 232 nm

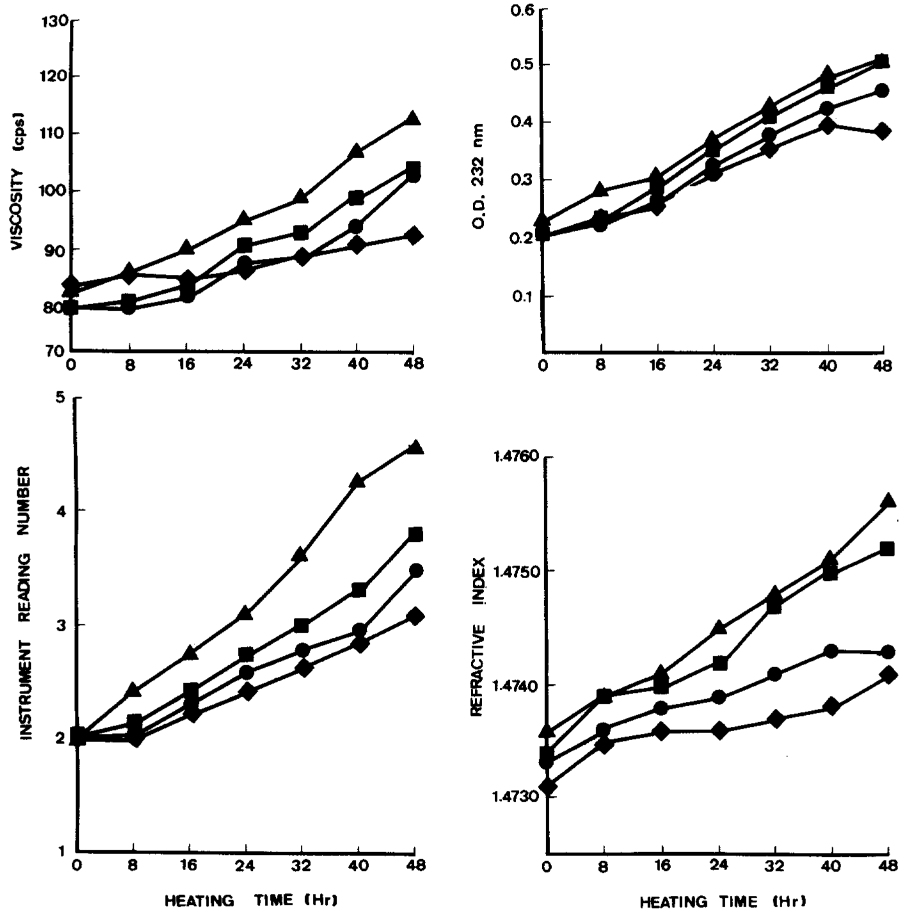

Fig. 2. Effect of heating time on viscosity, refractive index, dielectric constant and conjugated dienes (OD 232 nm) of sesame/soybean oil blends. (▲); Unroasted sesame oil–soybean oil (0:100); ■, Unroasted sesame oil–soybean oil (5:95); ●, Unroasted sesame oil–soybean oil (10:90); ◆, Unroasted sesame oil–soybean oil (20:80).

of these oils increased with heating time; the soybean oil especially increased more significantly. The result of changes in refractive index also indicated that soybean oil was more unstable than sesame oils during heating. The trend of changes in dielectric constant of oils during heating was similar to the results of viscosity, refractive index and absorbance at 232 nm. From these data, it can be concluded that the thermal stability of unroasted and roasted sesame oils was better than that of soybean oil. In addition, there is also no great difference in thermal stability between unroasted and roasted sesame oils during heating. Because the colour of roasted sesame oil became darker during heating and because its strong flavour might affect the quality of the frying product, the unroasted sesame oil was chosen for the blending study.

The soybean oil was blended with 5 to 20% of unroasted sesame oil to study the effect of blending ratio on the thermal stability of soybean oil. Figure 2 shows the changes in viscosity, refractive index, dielectric constant and absorbance at 232 nm of unroasted sesame/soybean oil blends during heating. It clearly shows that changes in the test values of soybean oil during heating could be reduced in proportion to the addition of unroasted sesame oil. This indicates that the thermal stability of soybean oil was improved by the blending with unroasted sesame oil. The thermal stability of soybean oil could be significantly enhanced after 48 h heating when blended with 20% of unroasted sesame oil.

From the results described above, it can be concluded that either unroasted or roasted sesame oil has greater thermal stability than soybean oil. The thermal stability of soybean oil was also enhanced by blending with sesame oil. This result will have an important implication for food preparation.

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