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Blending Effect of Palm Oil on Physicochemical Properties of Rice Bran Oil

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Abstract

Rice bran oil was blended with double fractionated palm olein (DF palm olein) to examine the cooking performance of blended oil. A blended oil made with 80% or higher rice bran oil and 20% or less DF palm olein passed the cold test, and had a cloud point of -3°C. Blending of DF palm olein to rice bran oil lowered the smoke point, refractive index, and absorbancies at 232 and 268 *nm* of rice bran oil. Dielectric constant of oils was not affected by blending during heating. Blending of DF palm olein, however, increased the acids formation in rice bran oil, whereas it retarded polymer formation. The results of the analytical methods used in this study except dielectric constant measurement showed significant difference among the blended oils depending on the blending ratios.

Introduction

The total consumption of edible fats and oils in Korea has reached to 340,000 *M/T* in 1984 and the cooking and salad oils constitute about 40% of total fats and oils consumption.(1) The major cooking oils used are soybean oil, rapeseed oil, corn oil and rice bran oil. Palm oil, which has long been used as a cooking oil in tropical and subtropical regions, is currently used only for frying oil not for cooking and salad oil in Korea, since palm oil crystallizes or solidifies at room temperature. There have been several papers concerning frying performance of palm oil.(2,3) Recently, it is repoted that palm oil liquid fraction can be used as a cooking and salad oil in nontropical countries.(4,5) Rice bran oil, one of the major cooking oils in Korea currently, has a good oxidative stability comparing with other vegetable oils due to the presence of a large amount of natural antioxidant, oryzanol.(6)

It is well known that the blended oil may improve the physicochemical properties and oxidative stability of each oil which is used for blending. Because of these reasons, the blended oils are widely used as a frying medium in food industries even though the blended oil is not legally permitted to be sold as a final consumer product in Korea.(7)

The objectives of this research are 1) to evaluate the appearence of blended oils made with palm oil liquid fraction and rice bran oil for the cooking oil purpose, 2) to analyze the physicochemical properties of blended oil during heating under cooking condition, and 3) to compare the analytical methods for determination of the kind of oils used for blending, and blending proporton of component oils in blended cooking oil.

Materials and Methods

Sample preparation

The refined, bleached, deodorized (RBD), and winterized rice bran oil and DF palm olein were obtained from local refineries in Korea and Malaysia, respectively. Two oils were blended at desirable ratios by volume with through agitation under nitrogen atmosphere. All reagents used were of analytical grade unless otherwise specified.

Heating and sampling method

Oil was heated at 180°C for 50 hrs without forced agitation. Oil was not replenished after sampling. Heating and sampling methods are detailed in Yoon et al.(4)

Analytical methods

Smoke point, cloud point, cold test and acid value of oils were determined according to AOCS methods.[8] Color of oil was measured by Lovibond Tintometer (Model E) using 5 1/4" cell. Conjugated diene and triene contents in oils were determined by spectrophotometer (Varian Series 634) at 232 and 268*nm*, respectively. In UV spectroscopy, oil samples were diluted in isooctane to make a final concentration of 2*mg*/10*ml*. Dielectric constants of oils were measured by Foodoil Sensor NI-22 (Northern Instruments Corp.). Refractive indices were measured at 25°C using Abbe 2L refractometer (Bausch and Lomb Co.). Polymer content of oil was determined as the chloroform insoluble portion after methanolysis according to Peled.[9]

Results and Discussion

Appearence of cooking oil

Cooking oils have been known to have different physical appearence from those of frying oils. In other words, the cooking oil should remain clear and transparent at room temperature and sometimes at below 0°C during low temperature storage. In frying fats, clearness and transparency are not problems since frying fats are absorbed in the food after frying. To maintain rice bran oil and palm oil clear and transparent at room temperature and at 5°C, commercial RBD rice bran oil was winterized at 4°C, and RBD palm oil was fractionated at 25 and 15°C in series to obtain a real liquid portion of palm oil.

The cloud points of several blended oils at certain ratios are shown in Fig. 1. The cloud point of fresh rice bran oil was -5°C, whereas that of DF palm olein was 3.6°C. The cloud points of oil blends decreased linearly with the increase of rice bran oil proportion with a correlation coefficient of 0.998.

100% rice bran oil and blended oil replaced with less than 20% DF palm olein passed the cold test and remained clear over 6 hrs. The cooking oil blended with more than 20% DF palm olein, however, did not pass the cold test. The experimental temperature of cold test was 0°C. At cloud point of 0°C, the corresponding rice bran oil proportion of blended oil was about 60%.However oil blended with 60% rice bran oil and 40% DF palm olein was not shown to be clear and transparent after 5.5 hrs stored at 0°C.

In addition to transparency of cooking oil, color is also an important apparent characteristics of oil. Fresh

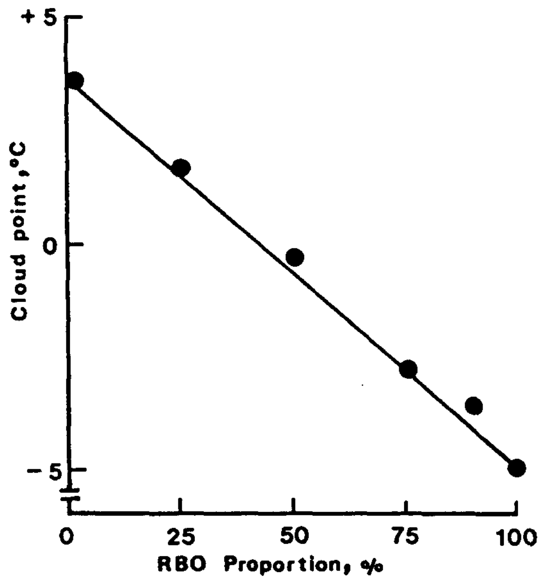

Fig. 1. Effect of rice bran oil (RBO) proportion on cloud point of blended cooking oil made with DF palm olein

rice bran oil had more red and yellow colors than DF palm olein. The color of blended oil became more reddish and yellowish with the increase of rice bran oil proportion (Table 1).

Smoke point of fresh DF palm olein was 213°C and that of rice bran oil was 224°C (Fig. 2). The smoke point of blended oil increased exponentially with the increase of rice bran oil proportion. The smoke point of oil was proportional to the concentration of accumulated volatile compounds such as free fatty acid and partial glycerides. DF palm olein possessed a higher free fatty acid content than rice bran oil (5) and this caused in part the lower smoke point of DF palm olein.

Refractive index of rice bran oil at 25°C was 1.4709

Table 1. Relationship between color and blending ratio of oil blended with rice bran oil and DF palm olein

Blending ratio		Color	
Rice bran oil, %	DF palm olein, %	Red	Yellow
0	100	3.1	30
25	75	3.2	30
50	50	3.6	40
75	25	3.9	40
90	10	4.2	40
100	0	4.3	40

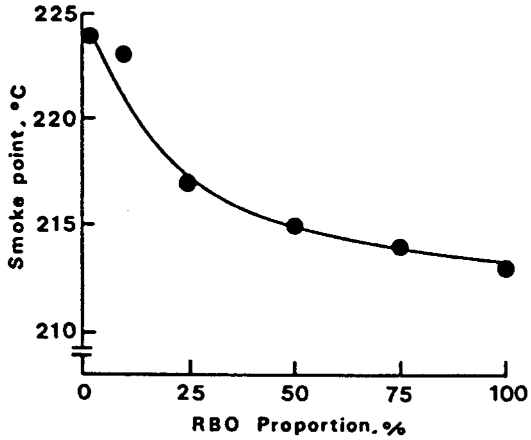

Fig. 2. Effect of rice bran oil (RBO) proportion on smoke point of blended cooking oil made with DF palm olein

and that of DF palm olein was 1.4650. The refractive indices of blended oils increased linearly with the increase of rice bran oil proportion (Fig. 3).

The cloud point, color, smoke point and refractive index discriminated clearly between rice bran oil and DF palm olein, and they changed significantly depending on the blending ratio of the two oils. In other words, these

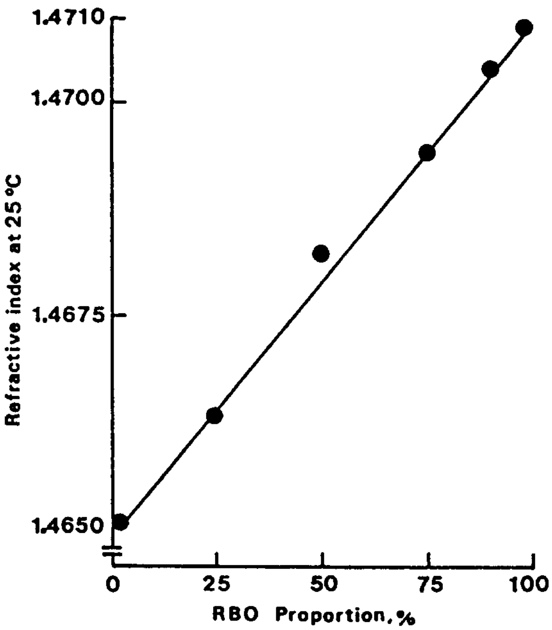

Fig. 3. Effect of rice bran oil (RBO) proportion on refractive index at 25°C of blended cooking oil made with DF palm olein

analytical methods could be used as useful tools to analyze the blending proportion and/or to detect adulteration in the blended oils.

Changes in properties of blended oil during heating

It was reported that conjugated diene and triene contents increase as heating of oil proceeds. Absorbancies at 232 and 268*nm* (A232 and A268) of blended cooking oils which measured the conjugated diene and triene content, are shown in Fig. 4 and 5, respectively. The value of A232 of fresh rice bran oil (0.27) was higher than that of DF palm olen (0.06). A232 of both oils increased rapidly for the first 20 hrs of heating, and the rates of increase decreased thereafter. The triene contents were also increased, but very slowly in both oils. A232 and A268 of blended oils ranged being intermediate between those of pure rice bran oil and pure DF palm olein as expected.

Dielectric constants of pure and blended cooking

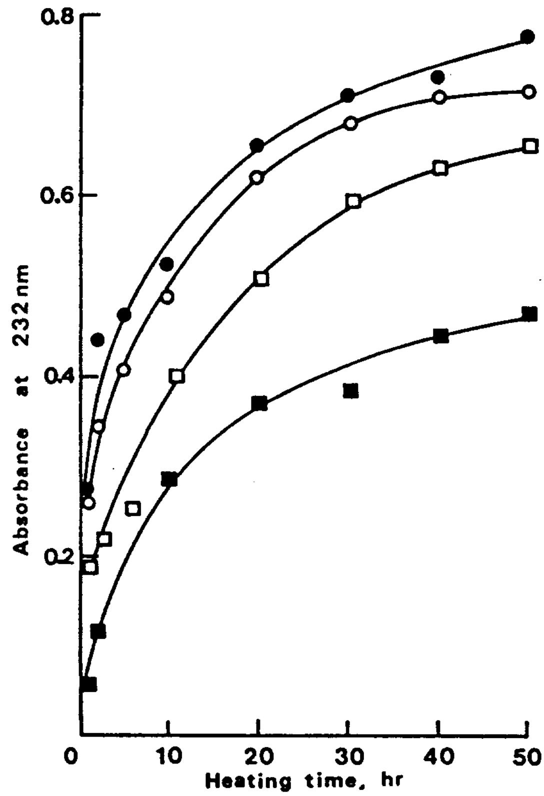

Fig. 4. Effect of heating time on absorbance at 232 *nm* of blended cooking oil
(●), 100% RBO; (○), 90% RBO & 10% DF palm olein; (□), 50% RBO & 50% DF palm olein; and (■), 100% DF palm olein

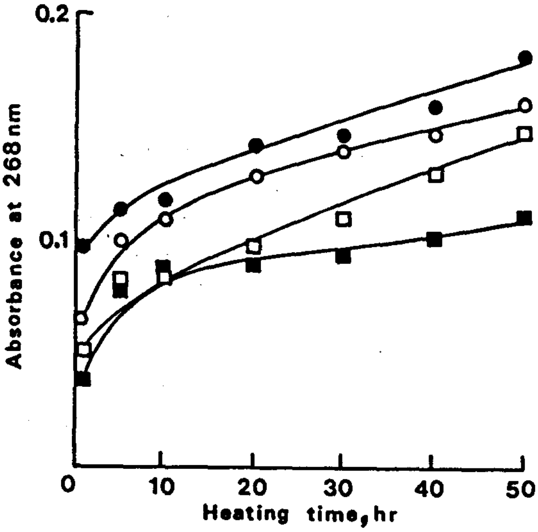

Fig. 5. Effect of heating time on absorbance at 268 nm of blended cooking oil
Legends are the same as Fig. 4

oils, which were correlated well with oxidized lipids content[4], are shown in Fig. 6. The dielectric constant of

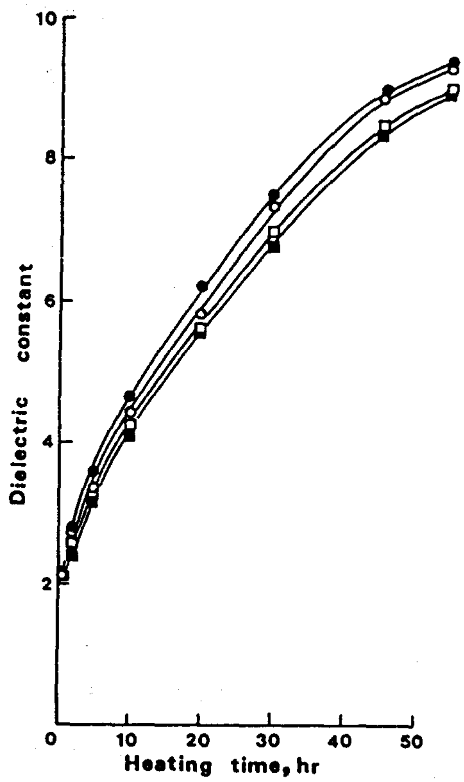

Fig. 6. Effect of heating time on dieletric constant of blended cooking oil
Legends are the same as Fig. 4

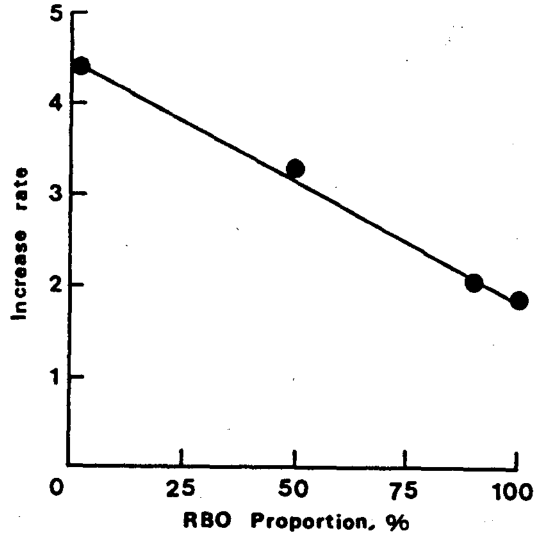

Fig. 7. Relationship between rice bran oil (RBO) proportion and rate of acid value increase of blended cooking oil

fresh oils were near 2 and increased to 9 or higher after 50 hrs heating. The dielectric constant, however, could not discriminate the kind and blending proportion of oils even at the absolute abuse level.

Acid values of fresh rice bran oil and DF palm olein were 0.17 and 0.4, respectively, and reached to 1.29 and 2.6 after 50 hrs heating. The more the DF palm olein

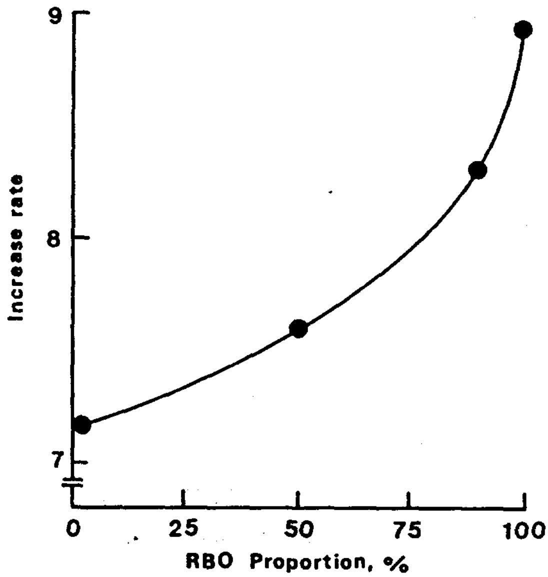

Fig. 8. Relationship between rice bran oil (RBO) proportion and rate of refractive index increase of blended cooking oil

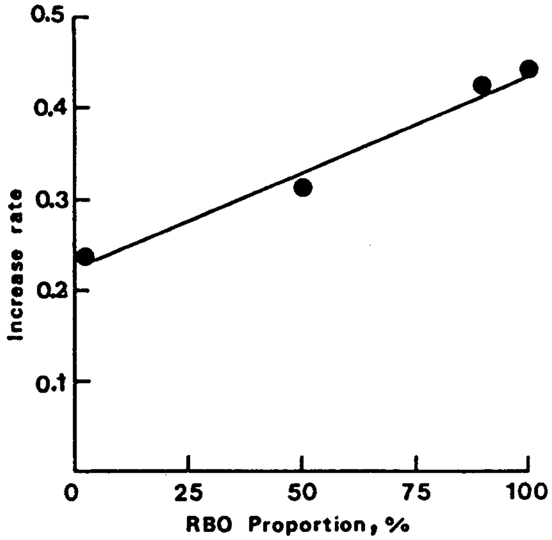

Fig. 9. Relationship between rice bran oil (RBO) proportion and rate of polymer content increase of blended cooking oil

was added to oil blends, the higher the final acid values were, and the faster acid value increased. As shown in Fig. 7, the rate of acid value increase of blended oil obviously increased as the ratio of DF palm olein to rice bran oil incresed. The lowering effect of rice bran oil on acid value increase was appeared to be due to its lower initial acid value.

Addition of DF palm olein clearly lowered the increase rate of refractive index of blended oil, and are elucidated in Fig. 8.

It was reported that, as oxidation of oil proceeds, the polymer content increased.[10] The polymer contents of both fresh oils were near zero, and increased slowly until 10 hrs, and more rapidly after 10 hrs heating. After 50 hrs heating pure rice bran oil contained 20% polymers and DF palm olein had 9%. The polymerization rate of blended oil incresed linearly as the ratio of rice bran oil increased (Fig. 9).

It is concluded that the blending of DF palm olein into rice bran oil improved color, and retarded the formation of conjugated dienes and trienes, and the polymer formation in rice bran oil. However, it accelerated acid formation, and decreased the smoke point, and increased the cloud point of rice bran oil.

Based on the experimental results, the blending proportion of a certain oil in another oil could be revealed by use of a combination of several analytical methods.

The desirable blending ratio of cooking oil could be obtained according to the purpose, and be controlled if appropriate analytical tools were applied. As an examle, the smoke point of blended oil with each half of rice bran oil and DF palm olein was 215°C which is much higher than usual cooking or pan frying temperatue, 180°C. With respect to only smoke point of cooking oil, the blended oil made with equal amount of DF palm olein and rice bran oil could be used without any smoking problems. Therefore the blending ratio of cooking oil should be determined considering all the possible physicochemical characteristics as well as the organoleptic acceptability which can be rationalized by organoleptic evalution.

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