EFFECTS OF NATURAL AND SYNTHETIC ANTIOXIDANTS ON CHANGES IN RBD PALM OLEIN DURING DEEP-FAT FRYING

Y.B Che Man, C.P. Tan, J.Irwandi, J.L. Liu, S. Jinap, H.M. Ghazali, B. Jamilah and M.S.A. Yusof

Faculty of Food Science and Biotechnology
Universiti Putra Malaysia, 43400 UPM, Serdang, Selangor, Malaysia

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Introduction

Deep fat frying is one of the most commonly used procedures for preparation and manufacture of foods throughout the world. Lipid oxidation is one of the major deteriorative reactions in frying oils and fried foods, and often results in a significant loss of quality. Antioxidants are added to fats and oils and foods containing fats to inhibit the development of off-flavours arising from the oxidation of unsaturated fatty acids. However, the commercial use of synthetic antioxidants is strictly controlled and increasing consumer awareness of food additives and safety has prompted increased interest in the use of natural antioxidants as alternatives to synthetic compounds. Extract of many plants have been reported to have varying degrees of antioxidant activities in fats and oils, with rosemary (*Rosemarinus officinalis* L.) and sage (*Salvia officinalis* L.) being the most potent (Zhang et al. 1990). Therefore, the objective of this study was to assess the frying performance of RBD palm olein treated with natural antioxidants, oleoresin rosemary and sage extract, in comparison with synthetic antioxidants, butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT).

Materials and Methods

The effect of antioxidants on the changes in quality characteristics of RBD palm olein during deep fat frying (at 180°C) of potato chips for 3.5 h/day for 7 consecutive days in five systems were compared in this study. The systems were RBD palm olein without antioxidant (control), with 200 ppm butylated hydroxytoluene (BHT), 200 ppm butylated hydroxyanisole (BHA), 200 ppm oleoresin rosemary and 200 ppm sage extract. The oil (4.5 kg) was put into a Valentine batch fryer and was stirred for 10 minutes to ensure dissolution of antioxidant. In the case of system I (control), the oil also was held for 10 minutes at 60°C, although no antioxidant was added. The temperature was then raised to 180°C in 20 minutes. Frying started 20 minutes after the temperature had reached 180°C. A batch of 100 g raw potato chips was fried for 2.5 minutes at every 17.5 minutes interval. Fried oil samples were analyzed for peroxide value (PV), thiobarbituric acid (TBA) value, iodine value (IV), free fatty acids (FFA) content, polymer content, viscosity, $E^{1\%}_{1cm}$ at 232 and 268 nm, color, fatty acid composition and C18:2/C16:0 ratio.

Results and Discussion

The oil system in the absence of antioxidants (System I) experienced a greater degree of deterioration than oil systems with the presence of antioxidants (Systems II, III, IV and V). The PV rose and fell during frying which is the same pattern observed for peroxides in most deep fat frying studies. Since high heat (180 ± 5°C) was used on these systems, peroxides formed during oxidation may have decomposed to secondary oxidation products (15). RBD palm olein with the addition of antioxidants (Systems II, III, IV and V) had PVs that were significantly ($P<0.05$) lower than those of the control throughout the duration of the study. Judging from the PVs, the oxidative stability was decreased in the order oleoresin rosemary ≈ BHA > sage extract ≈ BHT > control. TBA values of all systems increased progressively with the frying time. The control (System I) consistently had the highest TBA values among the five systems throughout the 7 consecutive days of frying. The other treatments in order of the level (highest) of TBA value were BHT ≈ sage extract > BHA > oleoresin rosemary. The changes in iodine value over 7 days of frying were 15.15, 13.73, 14.08, 13.04 and 13.13 g of I_2/ 100 g oil for Systems I, II, III, IV and V, respectively. The changes in iodine value showed that both oleoresin rosemary and sage extract were comparatively more effective in protecting oxidation of unsaturated fatty acid that BHA and BHT. At the end of frying period, FFA contents were 0.81, 0.80, 0.77, 0.76 and 0.79 % for Systems I, II, III, IV and V, respectively. The FFA content increases were highest for the oil system without antioxidants (System I). The increment of FFA content in oil systems with antioxidants was in the order: oleoresin rosemary ≈ BHA < sage extract < BHT. Polymer content of all systems increased slowly over the first 5 days of frying followed by a marked increase over the last 2 days of frying. The oleoresin rosemary had the strongest effect in retarding formation of polymers during frying, followed by sage extract, two synthetic antioxidants (BHA and BHT) and control. The significant ($P<0.05$) changes in viscosity over 7 days of frying were 37.50, 34.59, 32.50, 31.50 and 33.91 centipoise for Systems I, II, III, IV and V, respectively. The effects of each system in controlling viscosity increases were considered in order as follows: oleoresin rosemary > BHA > sage extract > BHT > control. The red and yellow colour of oil systems increased significantly ($P<0.05$) throughout the 7 consecutive days of frying. The results showed that System IV (200 ppm oleoresin rosemary) was significantly ($P<0.05$) darkened at a less rapid rate than four other systems. The changes in $E^{1\%}_{1cm}$ at 232 and 268 nm of a given substance can be used as a relative measurement of oxidation. The stabilising effect of antioxidants on RBD palm olein was in the order: oleoresin rosemary > sage extract ≈ BHA > BHT. The decreases in C18: 2 across 7 consecutive days of frying were 7.07, 3.57, 4.23, 3.63 and 4.03% for Systems I, II, III, IV and V, respectively. The overall rate of oxidation of C18: 2 was reduced in the presence of antioxidants. However, oleoresin rosemary showed greater activity than three other antioxidants throughout 7 consecutive days of frying.

Conclusions

The addition of antioxidants to RBD palm olein improves its oxidative stability when used as a deep fat frying oil. Generally, in the oil, oleoresin rosemary was superior to control and three other antioxidants. The order of activity found for antioxidants in RBD palm olein during deep fat frying of potato chips was oleoresin rosemary > BHA > sage extract > BHT, although some variation from this order was found depending on the method of assessment.

References

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