Studies on Thermal Stability of Palm -Sesame oil blends during Deep Fat Frying

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Received 08 August 2012; revised 27 December 2013; accepted 28 January 2014

The effect of blending Palm oil (PO) with Sesame oil (SeO) in different ratios has been investigated to get blends with low cost and better nutritional advantage relative to SeO. The blend of PO with SeO is also prepared with Saturated Acid: Monounsaturated Acid: Polyunsaturated oil (S: M: P) in the ratios of 1:1:1 in view of its nutritional significance. Studies were conducted on individual and blended oils to determine thermal stability at 180°C in oven for 12 hours and during Deep Fat Frying (DFF) of dry potato chips at 180°C for 9 hours. The individual and blended oils were analyzed for physico-chemical properties and fatty acid composition and were then used to determine the thermal stability and DFF studies. The changes in fatty acid composition and physico-chemical characteristics of individual and blended oils at the end 12 hours for thermal stability and at the end of 9 hours for DFF studies have been reported.

Key words: Thermal stability, Deep Fat Frying, Sesame oil, Palm oil, S: M: P ratio, Fatty acid composition

Introduction

DFF is one of the oldest and most popular food preparation methods reported by Garaya et al. The economy of commercial DFF has been estimated to be $6 billion year in USA and at least twice that amount for rest of the world. Fried foods have a desirable flavor, color and crispy texture which make deep-fat fried foods very popular with consumers. Frying oils constitute a substantial part of human diet. These oils not only serve as important source of energy but also provide certain functional characteristics to regulate a metabolic activity. Therefore good compromise between nutritional and thermal stability of frying oils is essential. Consumers can offer a better quality product with respect to flavor and nutritive value. Blending reduces the demands for regional preferences of precise individual oil, there by indirectly helping in stabilizing edible oil price in a country.

The oils can be blended even to derive protective advantages due to the presence of explicit ingredients that offer protection against oxidation to improve frying recyclability. Over all blended oil has better physico-chemical properties and stability against oxidation during DFF. The oxidized products of fatty acids give off-flavors and hydrolytic rancidity to the frying medium and fried foods. PO was therefore blended with SeO in different proportions to improve its degradative stability, reduce cost and achieve fatty acid composition close to ideal. SeO blended with PO is expected to give blends rich with natural antioxidants and delayed deteriorating tendency. The present study has been undertaken to evaluate effect of blending of PO with SeO on its thermal stability during DFF.

Materials and methods

Refined PO and refined SeO were procured from local market. PO was blended with SeO in ratio of (80:20), (20:80) and also blended in ratio (52:48) to achieve S: M: P ratio closes to 1:1:1. The blends (1000gm) were prepared by mixing the oils in given ratio (wt/wt) in 2 Liters R B flask at 60°C for 20 minutes with nitrogen bubbling and mechanical stirring and cooled to room temperature. After blending, the blended oils were stored in stainless steel container under inert atmosphere a single batch of 1 Kg potato chips was also purchased locally in 500 gm packs. Dust and other impurities were removed from them before deep-frying trials.

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100 gm of individual oils as well as their blends were taken in 250 ml beaker and subjected to prolonged heating for 12 hours in oven maintained at
180°C. The samples were cooled to room temperature and analyzed for physico-chemical properties.

Deep-fat frying (DFF) trials

A deep fat fryer (vessel) with 1-liter capacity was used during experiment. The fryer was filled with 300 gm of oil for frying. The temperature was set at 180°C, and oil was kept heated at this temperature throughout the 9 hours trial. In order to assess the maximum deterioration possible in the heated oil, the oil was not replenished at any time during experiment. The individual oils and their blends were used for DFF of potato chips at 180°C for 9 hours. DFF of potato chips was conducted in 30 gm batches, at 1.50 hourly intervals. Each batch was fried for 3 minutes. Thus a total 6 batches were fried during 9 hours frying trial. After each batch of frying, an aliquot of 30 ml of the individual and blended oils was taken for physico-chemical tests. The recovered oil samples were stored in food grade 100 ml plastic bottles at room temperature away from direct sunlight.

Estimation of Free Fatty Acid (FFA), Peroxide Value (PV) and Color was carried out at 1.50 hourly intervals and Iodine Value (IV) was determined after every 3 hours of frying AOCS 7 methods. The Conjugated dienes content was calculated by PORM 8 methods. Changes in fatty acid profile of pure as well as blended oils before and after frying were studied by Perkin Elmer Auto system XL gas chromatograph with flame ionization detector (FID). The capillary column BP-225 (moderate Polar, 25 meters x 0.22 mm x 0.25 microns) with 50% Cynopropylphenyl Polysiloxane as stationary phase was used for analysis AOCS 9 methods.

Results and discussion

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The initial and final values of Acid Value (AV), IV, PV and Color are carried out at 1.50 hourly intervals and iodine Value (IV) was determined after every 3 hours of frying AOCS 7 methods. The Conjugated dienes content was calculated by PORM 8 methods. Changes in fatty acid profile of pure as well as blended oils before and after frying were studied by Perkin Elmer Auto system XL gas chromatograph with flame ionization detector (FID). The capillary column BP-225 (moderate Polar, 25 meters x 0.22 mm x 0.25 microns) with 50% Cynopropylphenyl Polysiloxane as stationary phase was used for analysis AOCS 9 methods.

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Using PO to get blends with SeO is expected to give blends with cost, health and performance benefits. The chemical characteristics studied during DFF showed steady increase in FFA for PO, SeO and their blends between 1hr to 9hr. The initial value of FFA of PO and SeO was 1.27% and 1.86% respectively. The final value of FFA of PO and its blend with SeO in ratio of 100:0, 80:20, 52:48, 20:80, 0:100 were 7.30%, 7.50%, 8.00%, 8.50% and 8.90% respectively. The increase in FFA was found to be more in SeO, PO: SeO blends in ratio of 52:48, 20:80 as compared to 80:20 and PO. Legislation in some countries specifies that the AV of fat used for frying must not exceed 2.5 (FFA 1.25). In the present study, oils and their blends crossed this limit after 9 hours of intermittent DFF with potato chips.

The IV data shows progressively decrease in unsaturation in oils and their blends. It was observed that IV of PO decreased by 4.39 units only while in case of SeO decreased by 5.85 units after 9 hours of drying. The IV for PO, SeO blends in ratio of 80:20, 52:48 and 20:80 after frying for 9 hours at 180°C were reduced by respectively 4.49, 4.95 and 5.30 units. The IV of PO does not indicate the position of the doubles or amount of olefinic carbon but rather provided over all status of unsaturation
from 9.00% in 20:80 blend of PO:SeO to 8.46% Unsaturated Fatty Acid (USFA) was 8.89% in SeO tocotrienol content in PO. PO and SeO clearly due to more tocopherol and was least for PO and highest for SeO indicating gradually in PO, SeO and their blends. PV increase 6.90, 7.80 and 8.00 units respectively. PV increased to oxidation. position of double bond(s) which are more susceptible of the oils. So it is not possible to point out the loss in (Table 2). It was observed that the loss in Unsaturated Fatty Acid (USFA) was 8.89% in SeO frying and 7.64 in PO frying. The loss decreased from 9.00% in 20:80 blend of PO:SeO to 8.46% in 80:20 blend of PO:SeO after 9 hours of heating with intermittent DFF. SeO showed slight loss of USFA than PO. A slight increase in conjugated dienes was observed after 9 hours of frying for SeO and PO and their blends indicating some degree of primary oxidation. Similar finding had been reported earlier by Singh et al. Conclusions It can be concluded that the blends of PO with SeO in different proportions are more stable to oxidative deterioration due to heating as compared to SeO. Addition of PO to the SeO means longer frying times for the latter, and could make the PO acceptable to the consumers who prefer foods with aroma and flavour imparted by SeO. The protection afforded by PO to SeO increased with increase in proportion of PO in blends. Apart from protection advantage blend with PO52:SeO48 due to ideal fatty composition of 1:1:1 of SUFA: MUFA: PUFA offers nutritional advantage as frying medium. The blending of the oils improves and enhances the nutritional and functional qualities of the oils by combining the two oils into one and accordingly improved commercial viability. Meanwhile, the presence of different kinds of natural antioxidants in oil blends confers synergistic effect to the blend.
Acknowledgement

Authors are thankful to Director, SICART, Vallabh Vidyanagar for providing sophisticated analytical instrumentation facility and take keen interest in these studies.

References