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The Stabilizing Effect of Three Varieties of Crude Mango Seed Kernel Oil on Tallow

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ABSTRACT: Considering the possibility of the harmful side effects of synthetic antioxidants, it is necessary to substitute the synthetic antioxidants by the natural ones, the antioxidants that have been consumed by man for years. The mango seeds were washed and air dried and the kernels were removed manually from the seeds. Mango seed kernel oil was extracted by hexane using soxhlet extraction apparatus. The results indicated that according to mango varieties, the seed represented 6 to 7 % of the whole fruit weight and this consists of 10.2% oil that contains approximately 55% and 45% saturated and unsaturated fatty acids, respectively. The induction periods of the mango seed kernel oil samples were 58.8 - 85.2 hours. Subsequently the antioxidant activity was investigated after adding 1, 5 and 10 percent crude mango seed kernel oil to tallow as a substrate free of natural antioxidants and determining the induction period and peroxide values at the predetermined temperatures. The addition of 1, 5 and 10 % of mango seed kernel oil to tallow caused significant increases in the induction periods of the treated oil. These results provide useful information on utilization of mango seed kernel oil as a natural antioxidant concentrate.

Keywords: *Antioxidant Activity, Induction Period, Mango Seed Kernel Oil, Peroxide Value.*

Introduction

Mango seed kernel, a waste from mango processing factories, is a byproduct rich in polyphenols, that might be employed as nutraceutical product or replaces the synthetic antioxidants in foods (Berardini *et al*., 2005).

The results of evaluation of the antioxidant activity and concentrations of phenolic compounds present in the edible part and kernel of mango indicates that mango seed kernel contains a high content of phenolic compounds and exhibit antioxidant activity as compared to the edible part (Soong *et al*., 2004). Isolation and identification of polyphenol present in the extract of mango seed kernel is carried out by high performance liquid chromatography. It was observed that tannin with 20.7 % and vanillin with 20.2 % had the highest proportions while gallic acid, cumarin, caffeic acid, mangiferrin, ferrolic acid and cinamic acid were present at lower concentrations. The nonsaponifiable matter namely squalene, sterols and tocopherols, were also present in considerable amounts (Abdalla *et al*., 2007).

It has been shown recently that mango seed kernel has a high antioxidant potency due to high content of phenolic compounds. Mango seed kernel is also a good source of phytosterols like compesterol, β-sitosterol and stigmasterol and also tocopherols (Soong *et al*., 2004). The antioxidant activity of mango seed kernel is attributed to

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mangiferrin and xanthon-C-glycoside. Mango is a rich source of antioxidants namely ascorbic acid, phenolic compounds and flavenol (Schieber *et al*., 2000).

It has been shown that the preventive characteristic of pure catechin mixture of mango seed kernel oil at concentrations of 1 to 3 % in delaying the oxidation of edible oils is greater than BHT at a concentration of 300 ppm (Zein *et al*., 2005).

Strong antioxidant activity of mango seed kernel is attributed to its phenolic content (Soong and Barlow, 2004).

Oxidative stability of refined sunflower seed oil after adding 1% crude mango seed kernel oil and placing it at 90°C incubator for 36 hours was equal to the antioxidant capacity of added 200 ppm BHT (Abdalla *et al*., 2007).

Oxidative stability of buffalo fat with the addition of 5% mango seed kernel oil was similar to sunflower seed oil with added 300 ppm TBHQ during 12 months of storage in darkness. Peroxide and anisidine values were at the lowest concentrations (Youssef, 1999).

Gallic acid present in mango seed kernel oil has been known as an anti-inflammatory, anti-mutant and antioxidative agent. Ellagic acid also present in the kernel oil has got antimutational, antiviral, anticarcinogenic, antitumoral, skin whitening and antioxidant properties. These compounds were determined and identified by the application of chromatography methods (Soong and Barlow, 2006).

It has been reported that various antioxidants and synergists namely tocopherols and phospholipids are present in mango seed kernel (Soong *et al*., 2004). The object of the present study was to evaluate the stabilizing effect of mango seed kernel oil on tallow as a substrate free of natural antioxidants.

Materials and Methods

Three varieties of mango that were cultivated in Minab and Azimabad regions of Iran were selected and coded according to table 1.

Table 1. Coding of samples

Code	Cultivation place	Variety of mango
A	Minab	Hybrid Pakistani
B	Azimabad	Abbaskhani
C	Azimabad	Cameron

The chemicals used were of analytical grade, purchased from Merck Chemical Company of Germany.

Tallow a fatty substrate free of natural antioxidants was obtained by rendering sheep tail fat in the laboratory. In order to extract mango seed kernel oil, the stones were separated from the pulp manually and then washed with cold water. The stones were first dried by hot air until their wooden cortexes were dried. The wooden cortexes were broken and the kernels were removed and crushed into small pieces. The crushed kernels were heated in an oven at 60°C for 43 hours until the moisture was removed and reached 5 % moisture content and then milled into a fine powder. The extraction of oil was carried out through soxhlet apparatus for 4 hours using hexane as solvent. The extracted oil samples were kept in clean dark glass containers in a refrigerator.

The fatty acid composition of mango seed kernel oil as well as tallow was determined by preparation of their methyl esters according to Christie (1973) followed by the application of the methyl esters to a Acme gas chromatography model 6000 equipped with a Cpsill 88 capillary column and flame ionization detector according to AOCS method CE 1e-91 (Firestone, 1999).

In order to evaluate the antioxidant activity of mango seed kernel oil, different concentrations of extracted oil were added to tallow. The induction period was measured by Metrohm Rancimat apparatus model 743 at 110°C with an air flow of 20 l/h. All the

samples were placed in the oven at 90°C and the peroxide values were determined at 0, 24, 48, 72, 96 and 120h according to AOCS method, cd8-53 (Firestone, 1994).

Results and Discussion

Comparison of the peroxide values of the tallow with tallow containing different concentrations of mango seed kernel oil indicated that the addition of crude mango seed kernel oil, reduced the oxidation process, and as the concentration of the mango seed kernel oil increased the oxidation chain reaction and consequently peroxide formation was reduced.

The preliminary peroxide value for tallow was approximately zero. This value increased to 63.52 meq/kg after 120h of heating at 90°C in an oven.

Figures 1-3 show the changes in peroxide values of tallow where different concentrations of mango seed kernel oils extracted from different varieties of mango were added.

The induction periods of tallow with and without added mango seed kernel oil have been shown in figure 4. The extracted oils have quite considerable effects on the induction period of tallow. The resistance against oxidation of tallow when mango seed kernel oil are added is mainly due to the high contents of phenolic and polyphenolic compounds present. Duration of resistance against oxidation was increased with increasing the concentrations of added mango seed kernel oil.

Considering the differences among peroxide values of different varieties examined as well as different levels of concentrations, significant differences were observed in respect of concentrations, however there were not significant differences in antioxidant capacities among the varieties tested.

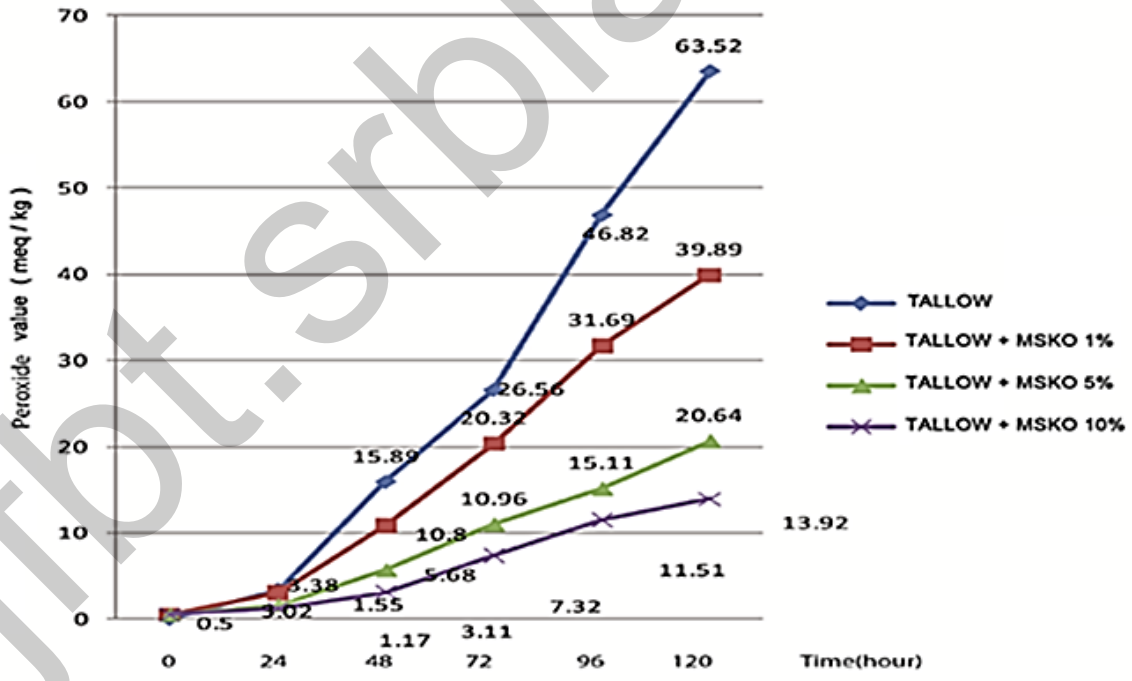

Fig. 1. Changes in peroxide values of tallow with and without added mango seed kernel oil (variety A) at different concentrations

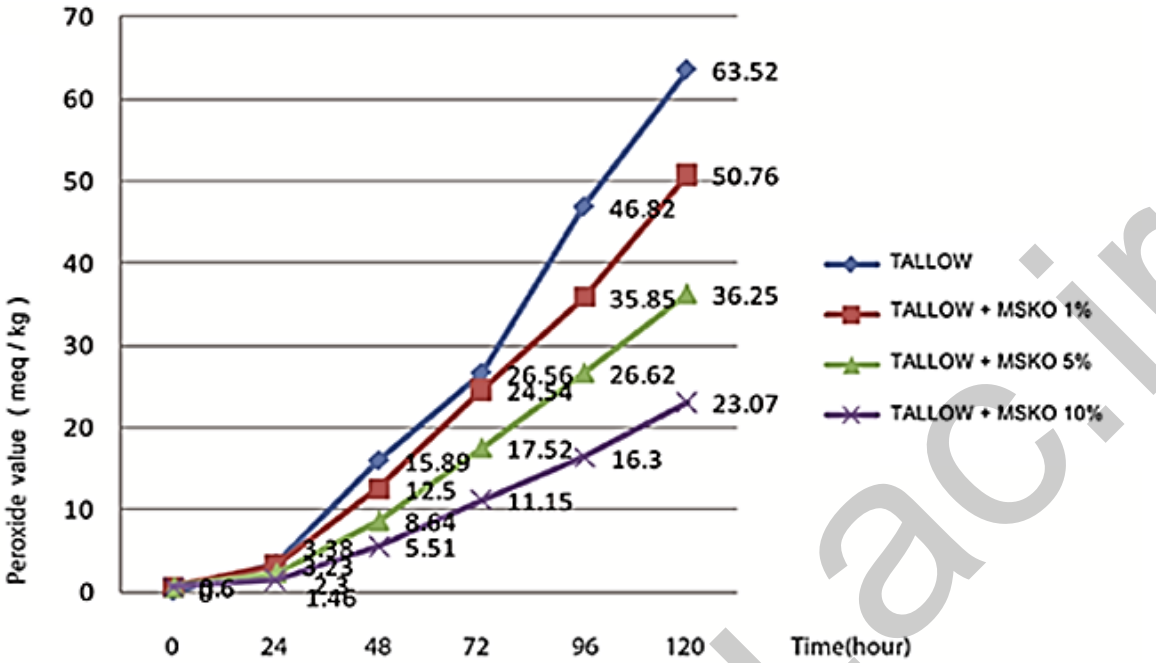

Fig. 2. Changes in peroxide values of tallow with and without added mango seed kernel oil (variety B) at different concentrations

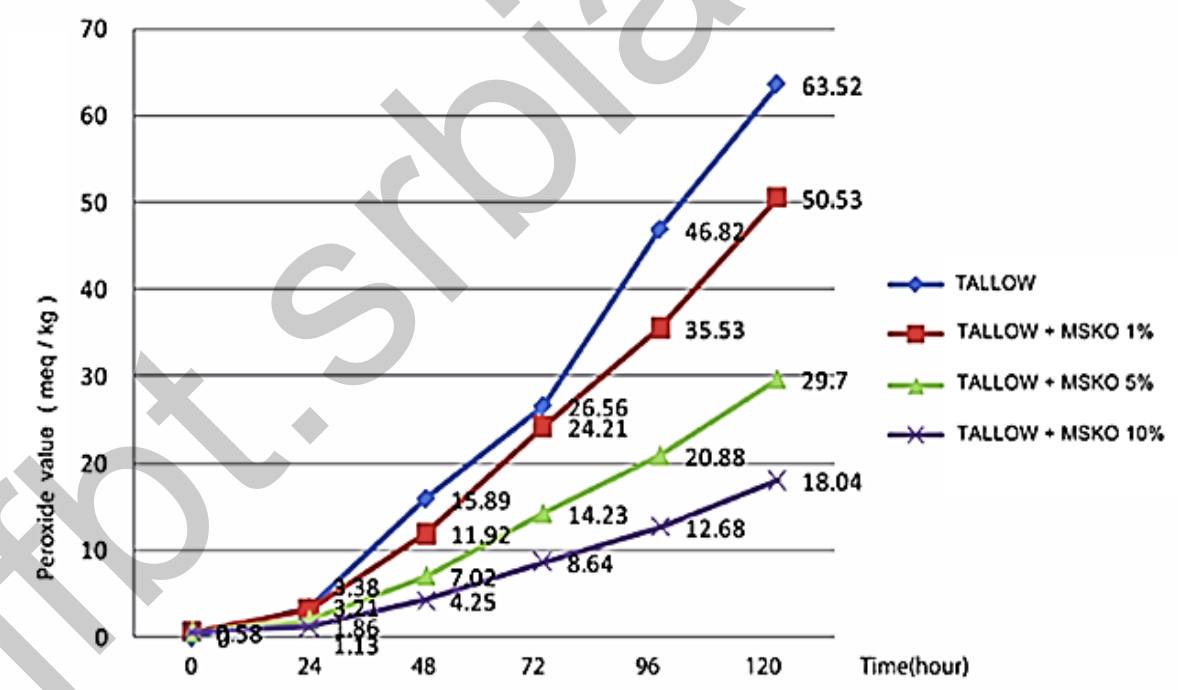

Fig. 3. Changes in peroxide values of tallow with and without added mango seed kernel oil (variety C) at different concentrations

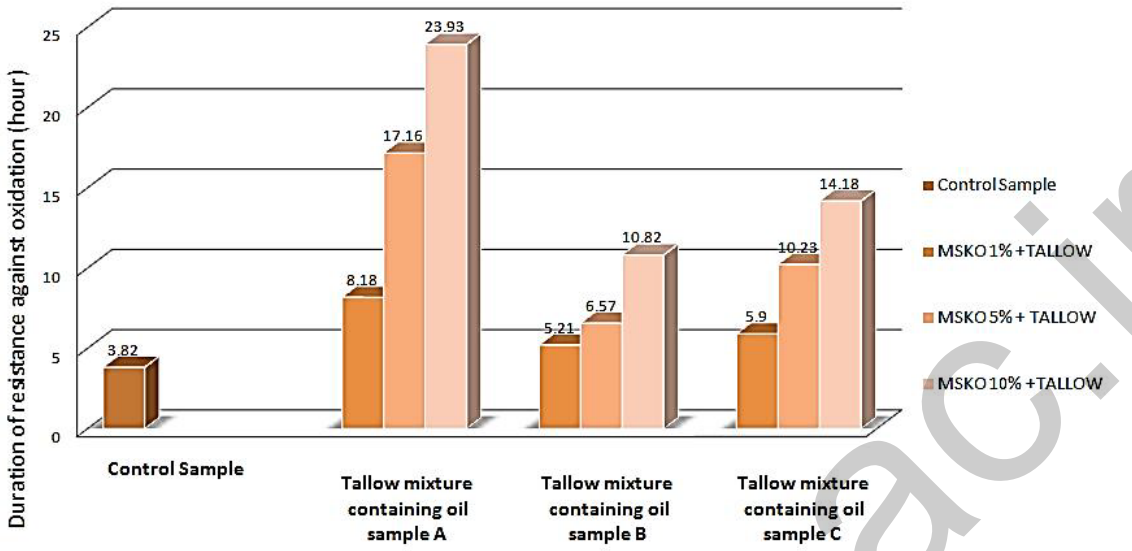

Fig. 4. Changes in induction period of tallow with and without added mango seed kernel oil at 110°C

Table 2. Fatty acids composition of mango seed kernel oil isolated from different varieties of mango cultivated in Iran

Fatty acids (%)	A	B	C
Myristic (C14:0)	0.02	0.03	0.03
Palmitoleic (C16:1)	-	0.25	0.21
Palmitic (C16:0)	7.25	6.82	7.06
Stearic (C18:0)	47.78	46.92	46.59
Oleic (C18:1)	37.79	38.12	37.31
Linoleic (C18:2)	6.68	7.25	7.90
Linolenic (C18:3)	0.27	0.27	0.34
Other fatty acids	0.21	0.34	0.56
Total saturated fatty acids (SFA)	55.05	53.77	53.68
Total unsaturated fatty acids (USFA)	44.74	45.89	45.76
SFA/USFA	1.23	1.17	1.17

The antioxidant property of mango seed kernel oil is attributed to some extent to its richness in saturated and mono -unsaturated fatty acids as well as fractions present in the nonsaponifiable matter of oil namely tocopherols, sterols, their esters and other phenolic compounds (Abdalla et al., 2007).

The fatty acid composition of mango seed kernel oils are presented in table 2. Present results also indicate that there are similarities between mango seed kernel oil and tallow.

Conclusion

Mango seed kernel is a byproduct of mango processing factories and the oil extracted from it is a potential by product that might be employed and used in the formulations of food products such as chocolate and biscuits as a natural nutritional additive due to its fatty acid composition and antioxidant activities.

Mango seed kernel oil contains some nonsaponifiable matter composed of different chemical components namely tocopherols, tocopherol dimmers, sterols, their esters and hydrocarbons. Some of these natural chemical compounds such as tocopherols are strong antioxidants that

prevent the oxidation chain reactions.

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