THE EFFECT OF THE ESSENTIAL OIL FROM *CITRUS AURANTIUM* AS A SOURCE OF NATURAL ANTIOXIDANT IN SUNFLOWER OIL

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ABSTRACT

Edible vegetable oils undergo the oxidation, e.g. oxygen in the air during storage or heat process and etc. As a result of the oxidation, undesirable rancid taste, changes in colour, losses of odour and flavour, deterioration of essential fatty acids and vitamins occurs in oil. In the manufacturing, oxidation occurs spontaneously in oils because of the physical and technological methods. The synthetic antioxidants like butylated hydroxyanisole (BHA) , butylated hydroxytoluene (BHT) and tert-butylhydroquinone (TBHQ) have been popularly used as the antioxidants in oils; however these chemicals show some undesirable effects on health. The aim of the present study was to determine the effect of the essential oil from C*itrus aurantium (*bitter orange) as a natural source of antioxidant, which is an alternative to widely used and known synthetic antioxidants in the sunflower oil. Different concentrations (0, 200, 400, 600, 800 and 1000 ppm) of the essential oil and BHT (200 ppm) were added to sunflower oil emulsion in uncapped vials and then incubated in darkness for 7 days at 60^0C. Samples were examined at 24 h intervals. The oxidative stability of the samples was evaluated by peroxide value (PV) and free faty acid (FFA). ANOVA results showed that the peroxide value and acidity of the oils in treated with essential oil of C. *aurantium* at the following concentration of 200, 400, 600, 800, 1000 ppm and BHT were significantly lower than those of the control groups. Nevertheless, peroxide and acidity values of these samples increased with increasing time.

Key words: Sunflower Oil, Essential Oil, *Citrus aurantium,* Natural Antioxidant, BHT

INTRODUCTION

Vegetable oils, are very important components of our diet, which undergo oxidation during storage and heating process because of many factors especially oxygen in the air. In vegetable oils, oxidation results in many undesirable consequences such as rancid taste and odours, reduction in the shelf life, decrease the nutritional quality (Sikwese and Doudu, 2007). Therefore, manufacturers prefer to utilize the antioxidants in order to prevent the oxidation.

According to the Turkish Standards, there has been some limitations for the uses of synthetic antioxidants in the oil. It has been previously reported that syntetic antioxidants such as butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT) and tert-butylhydroquinone (TBHQ) may cause many healthy risks, including cancer and carcinogenesis (Iqbal and Bhanger, 2007). Therefore, using natural antioxidants instead of synthetic ones has become popular in recent years., Today, essential oils are already

commercially available. Some of them are classed as generally recognized as safe (GRAS) food additives in the USA (Burt, 2004).

In recent years, uses of the plant extracts have received ongoing interest on the stabilization of the edible oils. For example, the pomegranate peels extract was found to be a potent antioxidant for the stabilization of sunflower oil (Iqbal et al., 2008); methanolic orange peel extract was reported more superior than that of BHT on the stability of crude peanut oil stored for twelve months at room temperature against oxidative rancidity (Arawande and Borokini, 2015). The essential oils of some medicinal and aromatic plants e.g. thyme, clove, orange peel, coriander, garlic and cumin have been tested for their antioxidant potential in different edible vegetable oils.

The aim of the study was to evaluate the antioxidative effects of the essential oil from bitter orange pell during the storage of sunflower oil. The hydrodistillated essential oil from the pell of *C. aurantium* at different concentrations ranging from 200 to 1000 ppm was tested in the sunflower oil. All treatments were stored at 60^0C during one week. The peroxide value and free fatty acid were analysed on each day. The results were compared with the synthetic antioxidant (200 ppm BHT) and that of the control groups.

MATERIALS AND METHODS

Preparing Essential Oil

The essential oil of the peel of *Citrus aurantium* was hydrodistillated for 3 h using Clevenger type apparatus. After distillation, essential oil was dried with anhydrous sodyum sulphate to remove the water from the distillate and then preserved in dark vials at +4°C for further analyses.

Addition of Additives to Sunflower Oil

The essential oil of the bitter orange peel at various concentrations ranging from 200 to 1000 ppm were separately added to sunflower oil in glass bottles and they were thoroughly shaken for proper mixing. Sunflower oil containing 200 ppm BHT and the one that had including no additive (also described as 0 ppm as the control groups) were also setup. Each glass bottle was appropriately labeled and stored in an open place at 60 ^{0}C.

Testing the Oxidative Stability

The stability of emulsions to oxidation was evaluated each 24 h over a 7-day period by analyzing the peroxide values (PVs) and free faty acid (FFA) levels.

PVs were measured on a daily basis. For this purpose, 2 g of oil was initially weigthed and then dissolved in chloroform (10 ml) and glacial acetic acid (15 ml). This was followed by adding 1 ml of saturated KI solution. The solution was throughly mixed for 1 min and then kept in the dark for 5 min. After addition of distilled water (75 ml), the mixture was titrated against sodium thiosulphate (0.01 N) using starch as an indicator. A blank titration was done parallel to treatment and PVs (meq of oxygen/kg) was calculated using the following formula:

$$\text{Peroxide value} = 1000\frac{SXN}{W}$$

In this formula, S is the volume of sodium thiosulphate solution (blank corrected) in ml; N is the normality of sodium thiosulphate solution (0.01 N) and W is the weight of the oil sample (g) (Anon., 1975).

FFA of each oil sample was monitored each day using the standard method for 7 days (Anon., 2003). For this purpose, a known weight of oil sample (3 g) was dissolved in 95% ethanol (75 ml). The mixture was titrated against KOH (0.01 N) using phenolphthalein as an indicator. A blank titration was done parallel to treatment and FFA (%) was calculated using the following formula:

$$\text{FFA} = \frac{SXNX28{,}2}{W}$$

In this formula, S is the volume of KOH in ml; N is the normality of KOH solution (0.01 N) and W is the weight of oil sample (g).

Statistical Analysis

One-way analysis of variance (one-way ANOVA) was carried out on the results. Data was processed using SPSS for Windows 18.0.0 (SPSS Inc., Chicago, USA).

RESULTS AND DISCUSSION

Figure I. depicts peroxide value (PVs) of sunflower oil stored with the essential oil from bitter orange peel and butylatedhydroxytoluene (BHT) for 7 days. It was observed that sunflower oil containing 200 ppm to 1000 ppm essential oil and 200 ppm BHT had lower peroxide values than those of the control groups during storage.

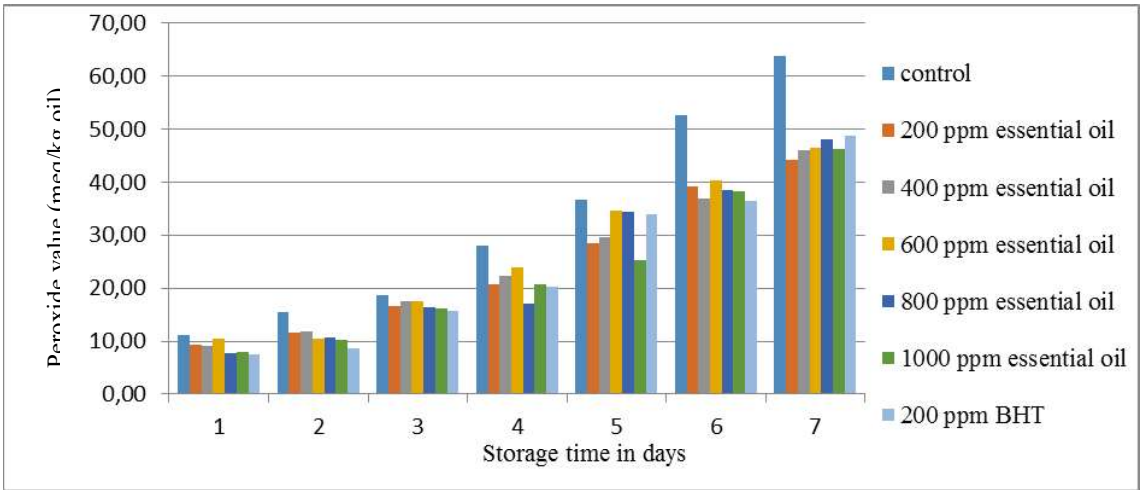

Fig. 1. Peroxide value (meq O_2/kg) of sunflower oil stored at 60^0C

This is in accordance with results of Kamkar et al. (2010) who reported that methanol and water extracts of Iranian pennyroyal in sunflower oil have better antioxidant activities than those of the control groups.

In a study of Shyamala et al. (2005), peroxide value of *M. pulegium* extracts was lowered than the control groups. The present values are in close agreement with findings of Shyamala et al. (2005) who found that extracts of four leafy vegetables which were added to refined sunflower oil conferred a protective effect on peroxide formation.

Figure II. depicts free fatty acid (FFA) of sunflower oil stored with bitter orange peel's essential oil and butylatedhydroxytoluene (BHT) under storage at 60°C for 7 days. It was observed that sunflower oil containing 200 ppm to 1000 ppm essential oil had lower FFA values than control groups during storage.

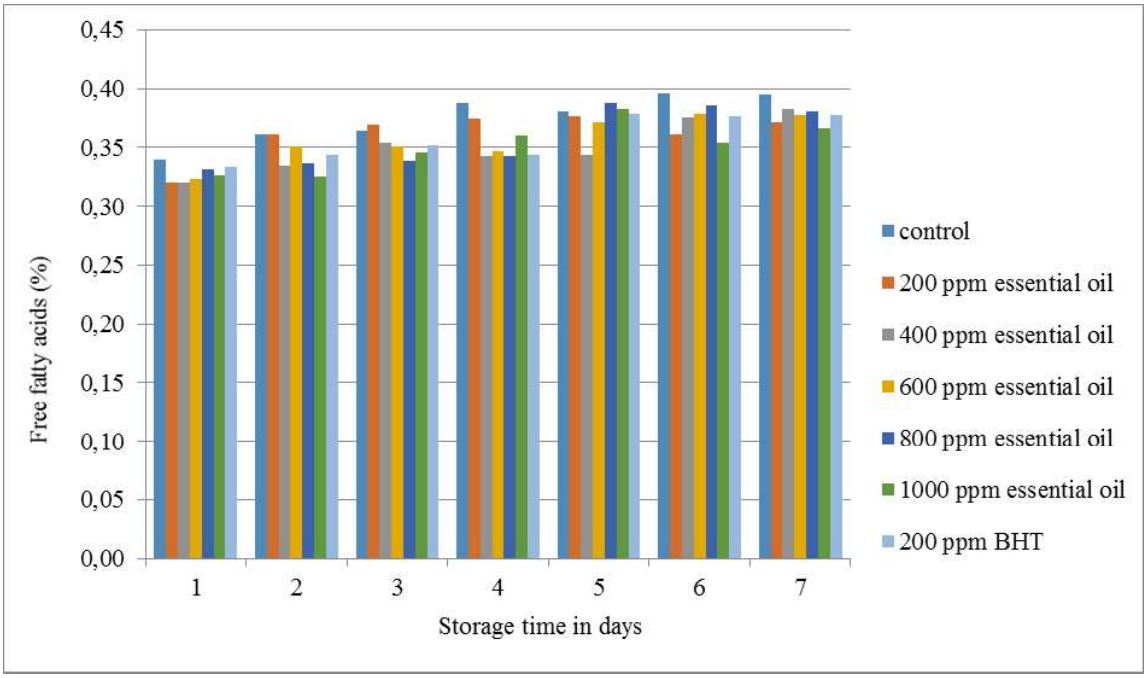

Fig. 2. Free fatty acid content (FFA) of sunflower oil stored at 60^{0}C

These results are in accordance with results of Arawande et al. (2014) who reported that the FFA of oil containing orange peel extract and 200 ppm of BHT was lower than the control groups.

Rehman (2006) also reported that after 6 months of storage, corn oil containing citrus peel extract showed lower FFA contents, and peroxide value levels than the control.

The present results show that all concentrations of the essential oil of *C. aurantium* showed more oxidative stability than that of the control groups. Furthermore, there were no significant differences among the oil groups which include essential oil ranging from 200 to 1000 ppm.

CONCLUSION

The results of the present study apparently indicated that essential oil distillated from bitter orange peels had significant antioxidant activity. It has been widely accepted that the stabilization of the sunflower oil is very difficult because of its high content of linoleic acid.

Two fold concentrations of the essential oil ranging from 200 to 1000 ppm were shown to be strong protective effects against lipid oxidation in the sunflower oil during the storage period. The findings of this study indicated that bitter orange peel exract could be suggested as a potential antioxidant for the stabilization of sunflower oil.

LITERATURE

Anonymous, 1975. TS 894, Methods of Analysis for Edible Oils of Vegetable Origin, Turkish Standards Institution, 17 p, ICS 67.200.10, Ankara.

Anonymous, 2003. TS 342, Methods of analysis for edible olive oils, Turkish Standards Institution, 19 p, ICS 67.200.10, Ankara.

Arawande, J.O., Amoo, I. A., Lajide, L., 2014. "Influence of methanol and water extracts of orange peel on stability of refined palm kernel oil", Bangladesh J. Sci. Ind. Res., 49(4), 249-254.

Arawande, J.O., Borokini, B.F., 2015. "Comparison of antioxidative effects of methanol orange peel extract and butylatedhydroxytoluene on stability of crude peanut oil", Nigerian Food Journal 33, 35–38.

Burt, S., 2004. "Essential oils: their antibacterial properties and potential applications in foods - a review", International Journal of Food Microbiology 94 (2004) 223 – 253.

Iqbal, S., Bhanger, M.I., 2007. "Stabilization of sunflower oil by garlic extract during accelerated storage", Food Chemistry, 100, 246–254.

Iqbal, S., Haleem, S., Akhtar, M., Zia-ul-Haq, M., Akbar, J., 2008. "Efficiency of pomegranate peel extracts in stabilization of sunflower oil under accelerated conditions", Food Research International 41, 194–200.

Kamkar, A., Javan, A.J., Asadi F., and Kamalinejad, M., 2010. "The antioxidative effect of Iranian Mentha pulegium extracts and essential oil in sunflower oil", Food Chem. Toxicol., 48: 1796-1800.

Rehman, Z,. 2006. "Citrus peel extract – A natural source of antioxidant", Food Chemistry, 99, 450–454.

Shyamala, BN., Gupta, S., Lakshmi, A.J., Prakash, J., 2005. "Leafy vegetable extracts antioxidant activity and effect on storage stability of heated oils", Innov. Food Sci. and Emerg. Technol., 6: 239– 245.

Sikwese, F.E., Duodu, K.G., 2007. "Antioxidant effect of a crude phenolic extract from sorghum bran in sunflower oil in the presence of ferric ions", Food Chemistry, 104, 324–331.