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Effect of light, natural and synthetic antioxidants on stability of edible oil and fats

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Abstract: Efficiency of natural oil i.e. red pepper oil against auto and photo-oxidative deterioration of sunflower and soybean oil was studied. The results showed a marked increase in peroxide value and free fatty acids during storage under fluorescent light, ambient and dark conditions. Applications of synthetic antioxidants i.e. butylated hydroxy toluene (BHT) and a natural antioxidant of red pepper oil have markedly reduced the rate of peroxidation in oils during exposure to light for five weeks storage. However, the BHT proved better antioxidation influence than red pepper oil. However, the effect of red pepper oil was also found acceptable in retarding rancidity occurred by per oxide value, free fatty acids and color value.

Key words: Natural and synthetic antioxidants, stability, edible oil, fats, light

INTRODUCTION

Edible oil plays a vital role in the economy of many countries especially Pakistan, which is facing serious shortage of edible oils. The domestic production meets only one third of the requirements, while two third is imported (Malik, 1991).

One of the major problem in fats and oil is the development of rancidity (oxidative) and deterioration of its quality due to multiple environmental and storage conditions. The overall effect of oxidation appears in unnecessary economic loss. Oxidation is said to be the off-flavor, quality, which results from reaction of atmospheric oxygen. The oxidised oils not only deteriorate the taste of foods to which they are added but are considered to create many health problems i.e. diarrhea, poor rate of growth etc (Sanders, 1983; Mecollum, 1956).

The addition of antioxidants to fats and oils or fatty food is one of the most efficient ways to prevent oxidation of lipids. Phenolic antioxidants such as Butylated Hydroxy Anisole (BHA), Butylated Hydroxy Toluene (BHT), Tertiary Butylated Hydroxy Quinone (TBHQ) and Propyl Gallate (PG), are used as antioxidants in foodstuff against rancidity. These synthetic substances have been shown to cause several diseases, i.e. enlarge the liver, reduced food intake, growth inhibition etc. Studies performed have shown that rats and mice fed high dose levels of synthetic antioxidants produced hyperplasia of the fore-stomach and showed growth retardation (Lehman *et al.*, 1995).

Natural antioxidants are found in many fruits and vegetables, which include ascorbic acids, α -tocopherole, β -carotene, chlorogenic acids and flavonols. Consumers

are becoming increasingly conscious of the nutritional value and safety of their food and its ingredients. Natural antioxidants are believed to be safer than artificial ones (Papadoulos and Soskou, 1991; Tian and White, 1994). It is hoped that the findings will help a lot to the vegetable oil and ghee industries as well as oil seed growers. Therefore, present study was carried out to determine the extent of deterioration of sunflower oil, soybean oil and vegetable ghee under different conditions like dark, ambient and light.

MATERIALS AND METHODS

Sunflower cooking oil, Soybean cooking oil and Vanaspathi ghee samples procured from local market and analysed for stability studies. The synthetic antioxidant, BHT was of E. Merck quality and for the sake of natural antioxidant red peppers were obtained from local market. Sample Preparation:

The red pepper was cleaned and ground in the grinder and 100 g was placed in a flask with double distilled water. A steam distillator was attached to the flask and content was boiled after steam distillation, the oil was collected and dried in dessicator.

A common synthetic antioxidant BHT @0.02% as well as natural antioxidant, i.e. red pepper oil @ 0.5 and 1% were mixed separately in 500 ml oils. The sample without any added antioxidant was considered as control.

Chemical analysis: The quality of oils was measured by determining the selected quality parameters. The quality parameters such as peroxide value (POV), Free Fatty Acids (FFA) and color (Absorbance Density at 420 nm by using Shimadzu Spectrophotometer model 160 fritch) were

determined at the start of experiment and by weekly intervals.

RESULTS AND DISCUSSION

The research work was conducted to determine the extent of oxidative deterioration of selected oils under fluorescent light condition. Influence of natural i.e. Red Pepper oil and synthetic antioxidants BHT regarding peroxide value of sunflower oil and soybean oils are presented in Fig. 1 and 2, respectively. The results revealed that oxidation of oils increased with increasing storage period up to five weeks. Natural and synthetic antioxidants (under fluorescent light condition) decreased the peroxide value in both oils studied. Among the antioxidants BHT gives better results than 0.5 and 1% Red Pepper oil (Red Pepper oil was used as natural antioxidants) in both Sunflower oil and Soybean oils. The initial peroxide value in sunflower oil was 9.2 meq kg⁻¹ and in soybean oil was 3.8 meq kg⁻¹. At the expiry of 5th week experimental period the peroxide value reached up to 299.30, 148.30, 196.55 and 172.20 meq kg⁻¹ in sunflower oil 106.93, 41.63, 53.55 and 67.35 in Soybean oil for control, BHT, 0.5 and 1% (RPO), respectively.

The over all results indicated that natural and synthetic antioxidants gave variable protection against light induced oxidation of these oils where as synthetic antioxidants gave better protection at all the treatment and storage period. The means of sunflower oil and soybean oil are significantly different from each other but the natural antioxidants i.e. 0.5 and 1% Red pepper oil mean values in case of sunflower oil the results are non significantly different from each other.

The free fatty acids values of Soybean and Sunflower oil in relation to the antioxidants under the fluorescent light are presented in Fig. 3 and 4, respectively. The data indicated a gradual increase in free fatty acids with advanced exposure to fluorescent light. Application of natural and synthetic antioxidants slightly reduced the development of free fatty acids. The BHT was found to be better in controlling the development of free fatty acids than red pepper oil used as natural antioxidants at different level. The initial value of free fatty acids in soybean oil kept under fluorescent light was 0.128% and the storage period of 5 weeks the value were 0.167, 0.165, 0.176 and 0.270% in control, BHT, 0.5 and 1% red pepper oil, respectively.

In the case of Sunflower oil the initial value for a period of 5 weeks under fluorescent light were 0.353, 0.296, 0.322 and 0.343% in control, BHT, 0.5 and 1% red pepper oil, respectively.

As for the color value for Sunflower oil and Soybean oil exposed to fluorescent light, which were measured as

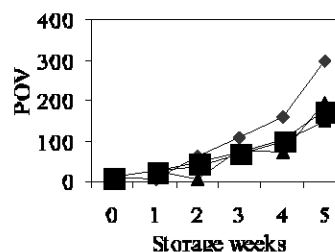


Fig. 1: Effect of light, natural and synthetic antioxidants on per oxide value of sunflower oil exposed to fluorescent light

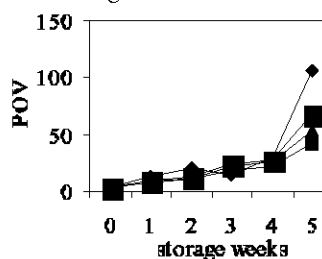


Fig. 2: Effect of light, natural and synthetic antioxidants on per oxide value of soybean oil exposed to fluorescent light

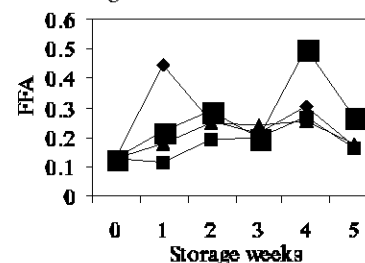


Fig. 3: Effect of light, natural and synthetic antioxidants on Free Fatty Acid of soybean oil exposed to fluorescent light

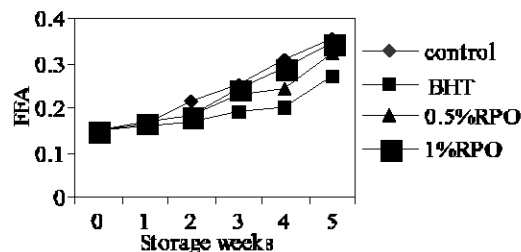


Fig. 4: Effect of light, natural and synthetic antioxidants on Free Fatty Acid of sunflower oil exposed to fluorescent light

an optical density (O.D 42 nm) in Fig. 5 and 6, respectively. The results revealed gradual and slight decrease in the optical density of both the oils studied with fluorescent light exposure. Almost similar trend was noted with BHT and 0.5 and 1% red pepper oil treated. The initial color value of Sunflower oil was 0.125 in control and BHT and 0.26 and 0.271 in 0.5 and 1% red pepper oil

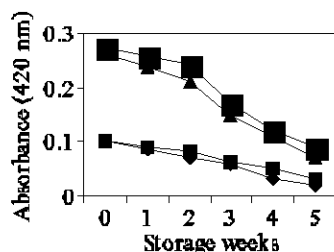


Fig. 5: Effect of light, natural and synthetic antioxidants on O.D. of sunflower oil exposed to fluorescent light

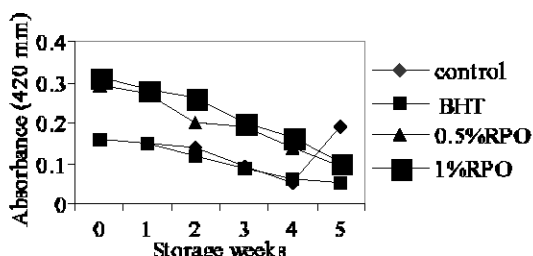


Fig. 6: Effect of light, natural and synthetic antioxidants on O.D. of soybean oil exposed to fluorescent light

treated. After 5 weeks exposure to fluorescent light the value decreased to 0.019, 0.013, 0.071 and 0.088 in BHT, 0.5 and 1% red pepper oil, respectively.

In case of Soybean oil color value (optical density) was 0.15 in control and BHT treated while 0.29 and 0.312 and 0.5 and 1% Red pepper oil, respectively.

As result of 5 weeks exposure to fluorescent light the values were reduced up to 0.189, 0.025, 0.092 and 0.102 in control, BHT and 0.5 and 1% Red pepper oil, respectively. All the treatment and storage mean values of Sunflower oil are significantly different from each other (Fig. 5) while the treatment and storage period means of Soybean oil are slightly significantly different. But in few exceptional cases where they are non significantly different in treatment of storage period means (Fig. 6).

In view of some likely ill effects of synthetic antioxidants, some efforts are being made to add natural substance or their extracts to control or lessen the oxidative deterioration. The results of our studies clearly indicate that there is a possibility of achieving useful effect of natural antioxidants. Several workers have reported earlier that natural substance do have a protective role in oils and fats, Satue *et al.* (1995), Chin and Duh (1995) and Eldin and Appelquist (1995). Among the natural antioxidants protective in finance of vitamin A and β carotene or other carotenoids against an

autoxidation of oils and fats has already been established by Sattar *et al.* (1975) in related study. Sattar *et al.* (1975) further observed that β carotene provides strong protective effect against photochemical reaction in oils and fats. It may be noted that β carotene is naturally present in several plant species and it can be synthesized as well. The ability of β carotene to act against photo dynamics damage lies in its ability to quench singled oxygen. Which is considering the primary source of original hydro-peroxide produced during auto and photo oxidation Rawls and Vansanten (1970). In a number of studies including the present investigation, the data shows a significant retardation of per-oxidation by anti-oxidants, although the extent of retardation varies depending upon the oil or fat and the antioxidant used.

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