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Oxidative Stability of Safflower oil by Comparing Natural and Synthetic antioxidants

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Abstract : This study showed the oxidative stability of safflower oil at elevated temperature with and without addition of natural and synthetic antioxidants. Safflower oil contains unsaturated fatty acids, which are prone to oxidation. Rancimat analysis at 120^0 C and Oven test at 60^0 C was used for analyzing oxidative stability of safflower oil. The oxidative stability of safflower oil with added natural antioxidants is compared with synthetic antioxidants added safflower oil. It has been observed that natural antioxidants at higher concentration showed same results to that of synthetic antioxidants.
Keywords : Oxidative stability, antioxidants, rancimat, safflower oil.

Introduction

Antioxidants are the substances that when present at low concentration compared to that of an oxidizable substrate would significantly delay or prevent oxidation of that substrate. Free radicals are continuously produced in the body either naturally or due to the exposure to stress that are common gateway to many diseases like cancer, anti-ageing and other various diseases. The antioxidants also protect cells from damage caused by free radicals. The body relies on obtaining its anti-oxidants from food and other supplements. There is a concern regarding the safety of synthetic antioxidant, hence consumer and scientific community has developed growing interest in natural antioxidants particularly from fruits and vegetables. Phenolic compounds are associated with flavour and colour characteristics of fruits and vegetables and are gaining considerable attention because of their potent antioxidant and health promoting properties[1].

Natural antioxidants or bio-active compounds from the plant or animal sources retard the lipid per oxidation, thus delaying the development of unpleasant flavours and odours. These are naturally present in most of raw food sources. But, processing removes or triggers the degradation of the antioxidants which are naturally present. For instance, vegetable oils with different degrees of unsaturation are prone to auto- oxidation reactions, and this necessitates the use of antioxidants as a mean to ensure oxidative stability. The refining of vegetable oils removes the tocopherol, which acts as natural antioxidants. Synthetic antioxidants such as butylatedhydroxyanisole (BHA), butylated hydroxyl toluene (BHT) are added to prevent lipid per oxidation.

The use of synthetic antioxidants has led to safety issues around the world. A small amount of these synthetic antioxidants are still a concern because of potential health problem from long term consumption. They could be promoting agents that target liver, lung and stomach issues to alter their gene expression [2]. The epidemiological studies have indicated that frequent consumption of natural antioxidant is associated with the lower risk of cardiovascular and cancer [3].

For this study we selected safflower oil to detect its oxidative stability as it contains higher amount of unsaturated fatty acids. For this purpose we selected Tocopherol a natural antioxidants and Butylated hydroxyl toluene (BHT) as synthetic antioxidants. This research work describes the effect of the natural and synthetic antioxidants on the oxidative stability of the safflower oil.

Materials and method

Materials

Refined safflower oil (RSFO) was procured from local Market. The oil did not contain any synthetic antioxidants. And Tocopherol was procured from Matrix fine Sciences.

Composition Analysis of Safflower oil

The determination of the fats and oils composition is important because the physical character and end-use performance of fats and oils are directly related to composition. All the analysis was carried out according the AOCS official Methods. The composition analysis of safflower oil is listed in the table 1.

Stability Test

Schaal Oven Test

The oxidative stability of the blend was determined by oven test at 60^0C. The blends of oil containing tocopherol and BHT with varying concentrations were prepared The oxidative stability of oil blends was checked at 60°C for 18days at regular interval of 6 days according to the AOCS Official Methods by peroxide value [4]. The control was oil with no additives.

Rancimat Test for oxidative stability

The oxidative stability of oil was determined by the rancimat assay. 4g of safflower oil was taken in the reaction vessel. Tocopherol was added in varying concentrations and BHT was taken at a concentration of 200ppm. The test was carried out at 120^0 C with airflow 20 $l.h^{-1}$. Secondary volatile reaction products which are formed are absorbed in the deionised water. The electrical conductivity of the water increases due to absorption of the reaction products. The induction time is the time until the secondary reaction products are detected and the graph conductance vs. time is recorded by Rancimat.The activity of Tocopherol was compared with BHTunder the same conditions.

Results and Discussion

Composition Analysis of safflower oil

Table 1 Compositional analysis of Safflower oil

S.No.	Test	Safflower Oil
1	Free fatty acids	0.054%
2	Acid value	0.79
3	Iodine value	126.25
4	Peroxide value	0.62
5	Moisture & Insoluble impurities	0.0025%
6	Saponification value	186.32
7	Unsaponifriable matter	0.48%

Oxidative stability Study

Oven Test

The hydro peroxides which are the primary products of lipid oxidation and further play a role in auto oxidation of lipids, the inhibition of these species with the antioxidants can be used as a means for assessing the antioxidant activity. The natural antioxidants tocopherol was tested for the antioxidant activity in safflower oil at concentrations of 100 ppm, 200ppm, 300ppm, 400ppm and 500ppm. And synthetic antioxidants BHT was use in safflower oil at a concentration of 200 ppm.The peroxide values are shown in the Table 2. The stronger antioxidant activities are indicated by lower peroxide value with respect to control. Although not significant, overall the antioxidant activity of 400ppm tocopherol was nearly equivalent to that of BHT. The initial peroxide value of safflower oil (without added antioxidants) on starting day (0^{th} day) was 0.62. The tabulated data revealed that the rancidity was more pronounced in control sample reaching 49.2 after 18^{th} day. On 18^{th} day, the peroxide value for 400ppmtocopherol was 25.06 which is minimum than other concentrations oftocopherol. And 200 ppm BHT showed peroxide value 15.22 after 18^{th}day which is roughly close to activity of 400ppm tocopherol as compared to other concentrations of tocopherol.

Table 2:Effect of Tocopherol and BHT on oxidative stability of Refined safflower oil (RSFO) at 60^0C (Peroxide values)

Time (Days)	RSFO	RSFO+ 100ppm mixtoco	RSFO+200ppm mixtoco	RSFO+300ppm mixtoco	RSFO+400 ppm	RSFO+500 ppm mixtoco	RSFO+ 200 ppm BHT
0	0.62	0.62	0.62	0.62	0.62	0.62	0.62
6	20.5	19.6	17.69	19.5	9.21	21.12	4.68
12	35.8	31.82	28.34	30.57	16.96	36.64	7.55
18	49.20	45.53	40.14	40.57	25.06	43.15	15.22

Rancimate Method

The induction times for various concentrations of tocopherol and BHT in safflower oil are shown in table 3. 400ppm tocopherolconcentration exhibited activity nearly same as 200 ppm BHT.

Table 3: Antioxidant activity (Rancimate test) of tocopherol and synthetic antioxidantsBHT

Samples	Induction Time (hr)
RSFO Blank sample	**2.63**
RSFO+200ppm BHT	**9.76**
RSFO+100ppm tocopherol	**3.40**
RSFO+ 200ppmtocopherol	**3.53**
RSFO+ 300ppmtocopherol	**6.41**
RSFO+ 400ppmtocopherol	**7.18**
RSFO+ 500ppmtocopherol	**4.20**

Rancimat graphs

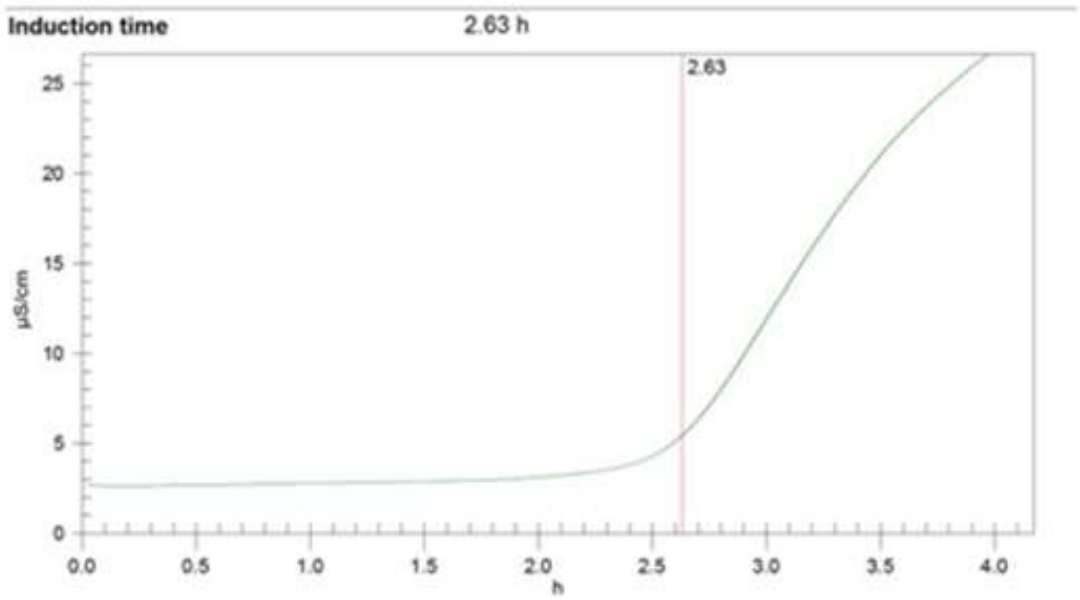

Figure 1: Electrical conductance vs. time graph for the refined safflower oil. The induction time recorded for the sample was 2.63 h at 120^{0}C.

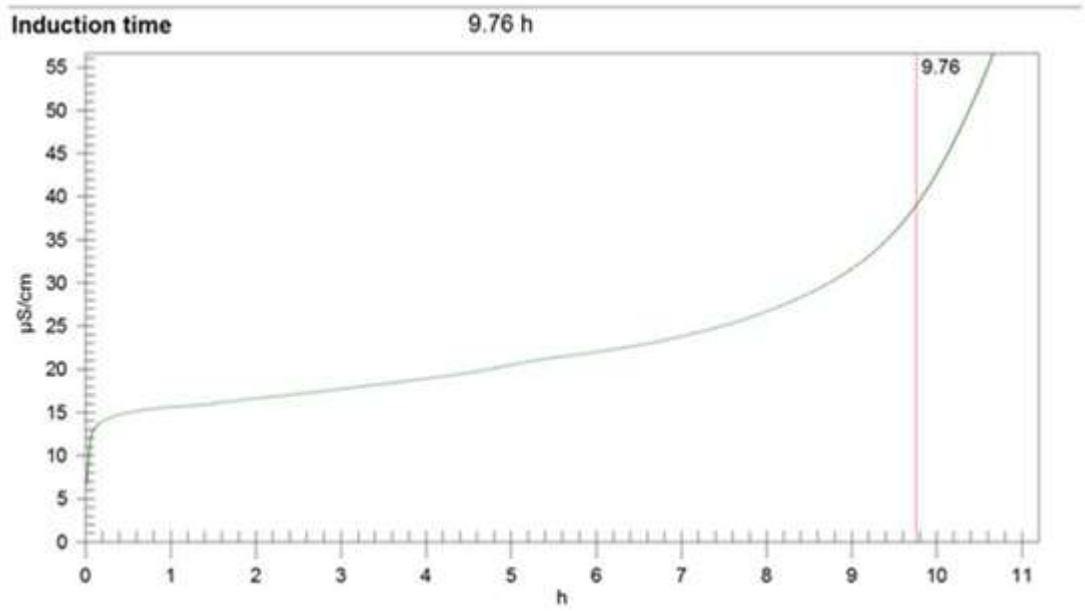

Figure 2: Electrical conductance vs. time graph for the refined safflower oil with 200ppm BHT. The induction time recorded for the sample was 9.76 h at 120^{0}C.

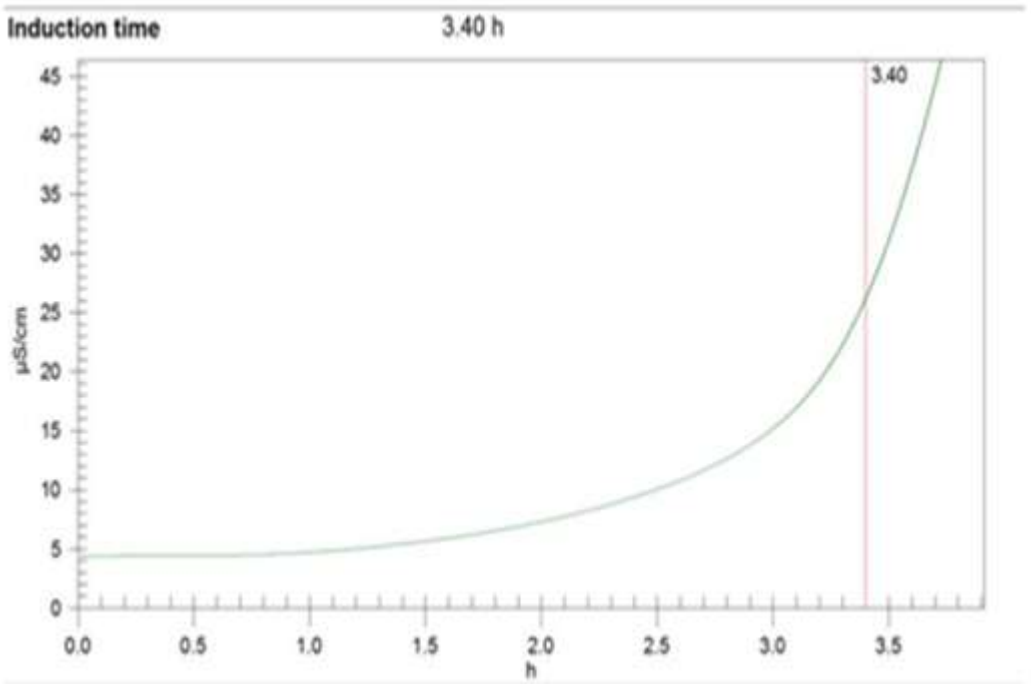

Figure 3: Electrical conductance vs. time graph for the refined safflower oil with 100ppm tocopherol. The induction time recorded for the sample was 3.40 h at 120^{0}C.

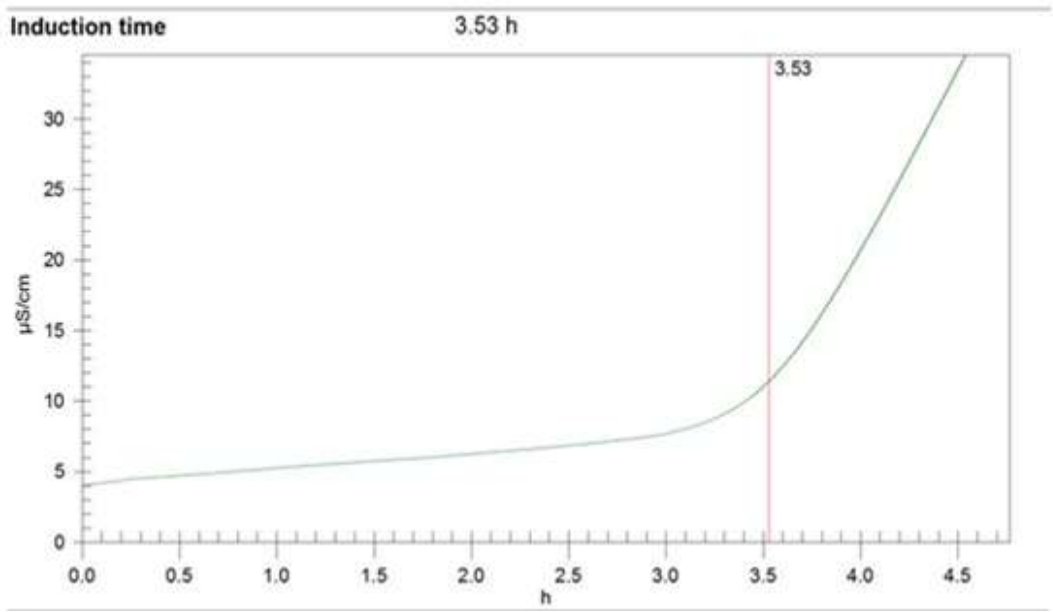

Figure 4: Electrical conductance vs. time graph for the refined safflower oil with 200ppm tocopherol. The induction time recorded for the sample was 3.53 h at 120^{0}C

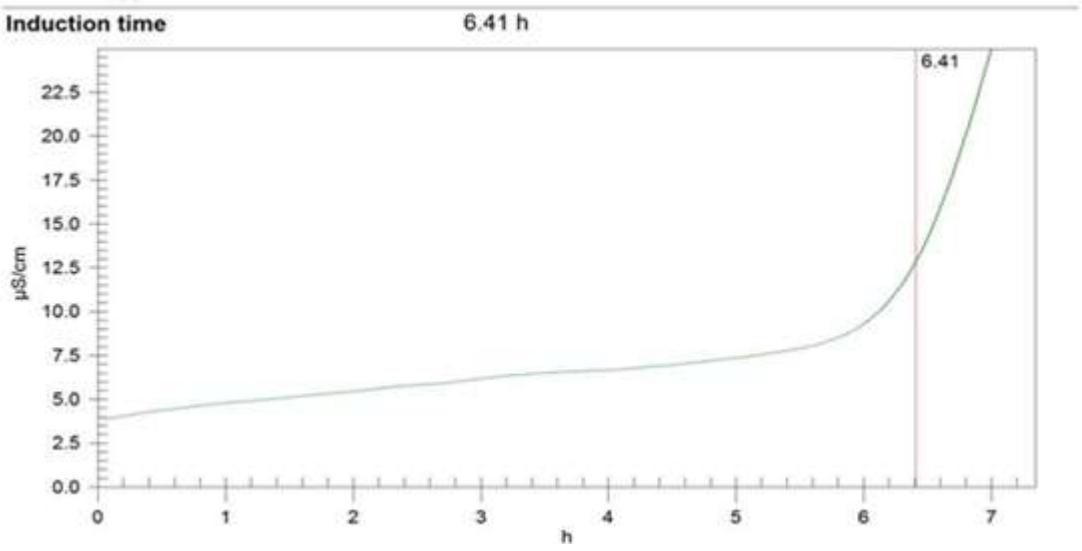

Figure 5: Electrical conductance vs. time graph for the refined safflower oil with 300ppm tocopherol. The induction time recorded for the sample was 6.41 h at 120^{0}C

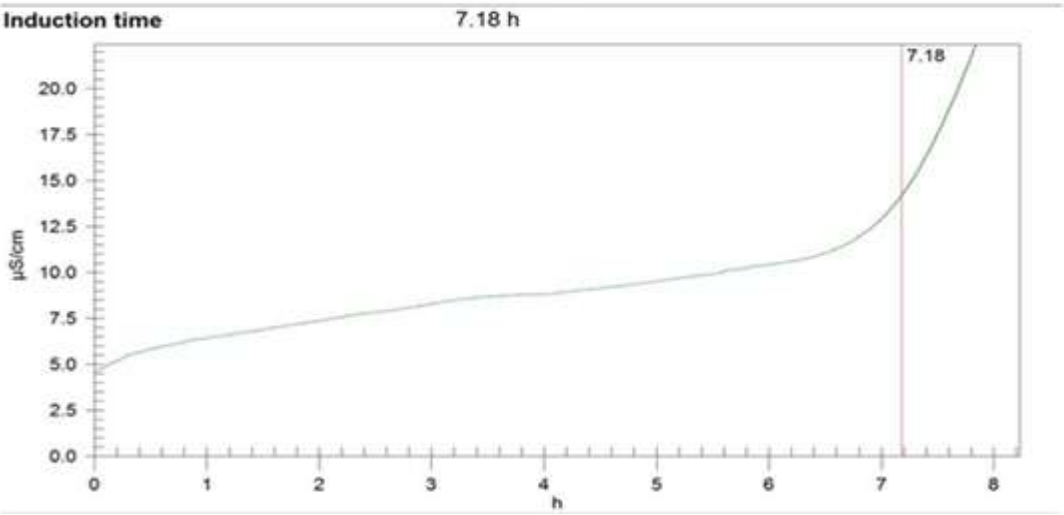

Figure 6: Electrical conductance vs. time graph for the refined safflower oil with 400ppm tocopherol. The induction time recorded for the sample was 7.18 h at 120^{0}C

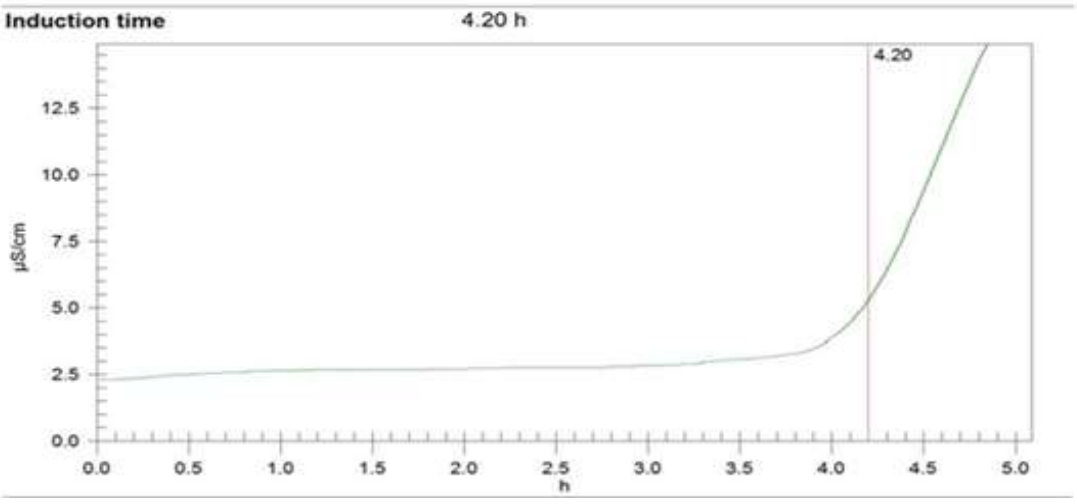

Figure 7 Electrical conductance vs. time graph for the refined safflower oil with 500ppm tocopherol. The induction time recorded for the sample was 4.20 h at 120^{0}C

Conclusion

The work suggests that the tocopherol and BHT have a strong antioxidant activity. The addition of tocopherol increased the stability of refined sunflower oil used at a concentration of 400ppm upto induction 7.18 hours in refined safflower oil compared with that induction for 9.76 hours in refined safflower oil with 200 ppm BHT. At 400ppm concentration, tocopherol exhibited activity higher than that of other concentration of tocopherol in oil. Similarly 200ppm BHT in safflower oil exhibited activity significantly higher than that of Mix tocopherol. Synthetic antioxidants such as BHT could lead to potential health problems. On other hand, the antioxidants from natural sources are considered generally recognized as safe and tocopherol at a concentration of 400 ppm showed slightly less antioxidant activity to that of 200ppm BHT.Thus, the present work demonstrates that tocopherol could replace synthetic antioxidantsBHT at a concentration of 400ppm..

References

1. Kaur, c., Kapoor, H.C. Antioxidants in fruits and vegetables-the millenium'shealth. *International journal of food science and technology*, 2001, 36(7), 703-725.
2. Pitot, H.C. III ;Dragon, Y.P. Chemical carcinogenesis in food toxicology. In:Casarett & Doull's Toxicology (Klaassen, C.D., Ed.). McGraw-Hill, New York, USA, 2001, 241–319.
3. Chalise JP, Acharya K, Gurung N, Bhusal RP, Gurung R, Skalko-Basnet N, Basnet P. Antioxidant activity and polyphenol content in edible wild fruits from Nepal. International Journal of Food Sciences and Nutrition, 2010, 61(4), 425–432.
4. AOCS Official Method Cd 8-53 (2003) Peroxides in fats and oils. American OilChemists Society, Champaign, Illinois, USA.

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