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Antioxidative Effect of Red Pepper Oil in Edible Oils

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Abstract: A research project was designed to study the effect of natural (Red pepper oil) and synthetic (BHT) antioxidant in sunflower and soybean oils. The efficiency of both antioxidants against auto- and photo-oxidative deterioration in different storage conditions for a period of five weeks was studied. Mean value of the data revealed that a significant increase in peroxide value and free fatty acid value during storage under fluorescent light, ambient and dark conditions. The addition of BHT and RPO reduced the PV from 9.20 to 299.30,148.30, 196.55 meq kg^{-1}, respectively. While FFA was found to be 0.128% which reduced by treatment of BHT and natural antioxidant to 0.165, 0.175, 0.270%, respectively. The result revealed that rapid development of rancidity happened under fluorescent light than dark conditions and applications of synthetic antioxidant and a natural antioxidant have markedly reduced the rate of per-oxidation in oils during exposure to light for five weeks storage. However, BHT was proved better antioxidant than RPO.

Key words: Antioxidant, BHT, red pepper oil, rancidity

Introduction

Edible oils play 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 problems in triacylglycerol is the development of rancidity. The quality deterioration of fats and oils is due to multiple environmental and storage conditions. The oxidized oils not only deteriorate the taste of foods to which they are added but are considered to create many health hazards i.e. diarrhea, poor rate of growth etc. (Sanders, 1983). The auto and photo oxidative deterioration of triacylglycerol is a complex process, leading to varied decomposition products (Ahmad ***et al.***, 1993). The overall effect of oxidation appears in unnecessary economic loss (Ahmad ***et al.***, 1994). The addition of antioxidants to fats and fatty foods is one of the most efficient ways to prevent oxidation of lipids (Haig, 1986). Phenolic antioxidants such as BHA, BHT, TBHQ and PG are used as synthetic antioxidants, in foodstuffs against rancidity (Cuvelier ***et al.***, 1992). Although the synthetic antioxidants 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). There is a great concern about the toxicity of food additives and their safety. BHA has been reported to have toxic and carcinogenic effect (Ito ***et al.***, 1986) and can cause changes in rat thyroids, stimulation of DNA synthesis and induction of enzyme. The anti-oxidative efficiency of ascorbic acid (Vitamin C), alpha-tocopherol, beta-carotene, chlorogenic acids, flavonoids and alkaloids found in many fruits and vegetables as natural preservatives has been reported (Jones ***et al.***, 1992; Farag ***et al.***, 1990). Many components of extracts isolated from plant materials have been proven as model system to be as effective as synthetic one (Hayase and Kato, 1984; Fukuda ***et al.***, 1985). Due to these facts consumers are being increasingly conscious of nutritional value and safety of their food and its ingredients (Farag ***et al.***, 1989). The pepper (Capsicum indicam) is very often used in insofar sub continent as a part of curry and other cooking as spices, but the effect of pepper as natural antioxidant has not been studied. The objective of this study was to compare the antioxidative efficacy of red pepper oil with a common synthetic antioxidant BHT in stability of sunflower and soybean oil under various storage conditions.

Materials and Methods

The Sunflower cooking oil, Soybean cooking oil and Vanaspatighee samples procured from local market was dried in desecrator. A synthetic antioxidant BHT (E. Merck quality) @ 0.02% as well as natural antioxidant, i.e. red pepper oil (RPO) @ 0.5 and 1% were mixed separately in 500 mL oils. The sample without any added antioxidant was considered as control. Oils samples were kept in glass beaker covered with muslin cloth. One set of samples was kept at ambient and dark conditions in the laboratory for further chemical tests during storage. Similarly another sets of oil Samples were taken in beakers and exposed to fluorescent light. An equal amount of oils and fats was taken to maintain a uniform surface area for each set of experiment. The chemical analysis that include peroxide value (POV), Free Fatty Acid (FFA) and photometric color (Absorbenc Density at 420 nm) were determined at beginning of the experiment followed by weekly analysis according to AOAC, (1990). The color of oils was measured, using 50% v/v solution oil in Iso-octane using UV Vis shimadzu spectrophotometer model 160 (Fritch, 1981).

Results and Discussion

The triaceylglycerol were exposed to different storage conditions such as dark, ambient and light to determine the red pepper oil (RPO) and BHT effects on the oxidation or stability of Sunflower cooking oil and Soybean cooking oil. Mean value of the data (Table 1) revealed that initial peroxide value for the sunflower oil was 6.95 meq kg^{-1} and after five weeks experimental period the peroxide value reached up to 73.30, 119.60 and 136.90 meq kg^{-1} in dark, ambient and light conditions, respectively.

Likewise (Table 2) that the initial value of peroxide value was 3.80 meq kg^{-1} for Soybean oil which enhanced to 32.05, 52.95 and 73.60 meq kg^{-1} in dark, ambient and light conditions. The statistical analysis indicate that samples kept in dark showed better results than at ambient and light conditions. It is observed that different storage conditions for all the test samples have affected the peroxide value, which is also supported by Durance, 1986 and Sattar ***et al.***, 1976.

Table 1: Effect of different storage conditions on the stability of sunflower

	Peroxide value			Free fatty acids			Color (OD)		
Weeks	Dark	Ambient	Light	Dark	Ambient	Light	Dark	Ambient	Light
0	6.95	6.95	6.95	0.151	0.151	0.151	0.109	0.109	0.109
1	10.05	15.16	20.28	0.158	0.179	0.231	0.149	0.143	0.159
2	13.25	22.20	33.90	0.177	0.98	0.277	0.121	0.133	0.108
3	34.28	71.25	74.17	0.212	0.249	0.310	0.109	0.081	0.087
4	36.21	72.70	90.77	0.249	0.270	0.347	0.092	0.078	0.073
5	73.30	119.6	136.9	0.300	0.363	0.409	0.083	0.058	0.062

Table 2: Effect of different storage conditions on the stability of soybean

	Peroxide value			Free fatty acids			Color (OD)		
Weeks	Dark	Ambient	Light	Dark	Ambient	Light	Dark	Ambient	Light
0	3.80	3.80	3.80	0.127	0.127	0.127	0.159	0.159	0.159
1	5.45	8.75	13.00	0.163	0.192	0.218	0.108	0.151	0.159
2	16.28	21.15	26.45	0.190	0.200	0.232	0.102	0.102	0.127
3	28.32	34.55	40.70	0.210	0.222	0.269	0.110	0.101	0.078
4	29.08	40.40	56.25	0.259	0.263	0.308	0.082	0.091	0.067
5	32.05	52.95	73.60	0.282	0.310	0.367	0.080	0.061	0.022

Table 3: Effect of Natural and Synthetic antioxidant on Sunflower (at ambient conditions)

	Peroxide value				Free fatty acids				Color (OD)			
Week	Cont.	BHT	RPO (0.5%)	RPO (1.0%)	Cont.	BHT	RPO (0.5%)	RPO (1.0%)	Cont	BHT	RPO (0.5%)	RPO (1.5%)
0	9.20	9.20	9.20	9.20	0.148	0.148	0.148	0.148	0.102	0.102	0.260	0.271
1	4.45	24.28	25.27	25.65	0.163	0.157	0.168	0.167	0.087	0.088	0.238	0.259
2	61.56	37.23	4.49	46.46	0.213	0.168	0.181	0.181	0.071	0.081	0.212	0.241
3	106.46	67.62	74.52	72.03	0.252	0.190	0.229	0.240	0.059	0.061	0.148	0.172
4	156.50	99.53	71.45	102.40	0.307	0.199	0.242	0.290	0.031	0.049	0.108	0.120
5	299.30	148.3	196.55	172.70	0.353	0.269	0.322	0.343	0.019	0.031	0.071	0.088

Table 4: Effect of Natural and Synthetic antioxidant on Soybean (at ambient conditions)

	Peroxide value				Free fatty acids				Color (OD)			
Week	Cont.	BHT	RPO (0.5%)	RPO (1.0%)	Cont.	BHT	RPO (0.5%)	RPO (1.0%)	Cont	BHT	RPO (0.5%)	RPO (1.5%)
0	3.80	3.80	3.80	3.80	0.128	0.128	0.128	0.128	0.158	0.151	0.290	0.312
1	12.95	7.74	8.56	9.25	0.443	0.116	0.178	0.220	0.149	0.151	0.270	0.280
2	20.30	10.43	11.67	12.84	0.255	0.192	0.245	0.289	0.137	0.122	0.200	0.261
3	15.28	18.66	21.53	24.34	0.211	0.200	0.239	0.196	0.090	0.089	0.188	0.202
4	28.38	21.73	25.32	27.10	0.301	0.266	0.257	0.504	0.053	0.059	0.136	0.166
5	106.93	41.63	53.55	67.35	0.167	0.165	0.175	0.270	0.189	0.052	0.092	0.102

Mean values of the data (Table 1, 2) regarding the Free Fatty Acids contents of sunflower oil and soybean under different storage conditions such as dark, ambient and light, increased with increasing storage period up to five weeks, respectively. The initial FFA values in case of Sunflower and Soybean oils were 0.151, 0.127, 0.091% and at the end of experimental period the FFA was found 0.300, 0.363 and 0.409% and 0.282, 0.310 and 0.367% in dark, ambient and light conditions, respectively. Analysis of the data (Table 1, 2) revealed that the initial Color Optical Density values in case of Sunflower oil and Soybean were 0.109, 0.159 and 0.279 and at the end of experimental period the optical density were found 0.083, 0.058 and 0.062 and 0.080, 0.061 and 0.022 in dark, ambient and light conditions, respectively. All the statistical analysis shows that the treatments and storage conditions are non-significantly different from each other's.

The action of light has been known to acts as a major catalyst in accelerating the development of rancidity in oils, fats or fat containing products (Sattar and DeMan, 1975). Production of FFA was the best predictors of fat deterioration and presence of FFA could be used to monitor the extent of oils abused. In fat determination, the first step-initiating step is the formation of fatty free radicals that are susceptible to oxygen's attack in the presence of light, resulting in formation of many organic compounds and free fatty acids (Akhtar ***et al.***, 1985). It was suggested that owing to the presence of subsidisers, antioxidants and others natural inhibitors, the degree of un-saturation of oils and fats might not be responsible for the readiness with which they are oxidised (Rawls and Vansanten, 1970).

Influence of natural i.e. Red Pepper oil and synthetic antioxidants BHT regarding PV, FFA and OD of Sunflower oil and Soybean oil was studied to determine the extent of oxidative deterioration under fluorescent light condition. The results (Table 3, 4) 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. The results revealed that the initial PV in sunflower oil was 9.2 meg kg^{-1} and in Soybean oil was 3.8 meg kg^{-1}. At the expiry of 5th week experimental period the PV reached up to 299.30, 148.30, 196.55 and 172.20 meg kg^{-1} in Sunflower oil 106.93, 41.63, 53.55, 67.35 in Soybean oil for control, BHT and 0.5 and 1% (RPO), respectively. Statistical analysis of the data (Table 4) revealed that the initial value of free fatty acids in Soybean oil kept under fluorescent light was 0.128% and after 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% reappear 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% reappear oil, 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 are non significantly different from each other. Several workers have reported earlier that natural substances do have a protective role in oils and fats (Satue ***et al.***, 1995; Chin and Duh 1995; Eldin and Appelquist, 1995). Among the natural antioxidants protective in finance of vitamin A and β Carotene /or other carotenoids against and

autoxidatian of oils and fats has already been established by Sattar ***et al.*** (1975) in related study. They 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 synthesised 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-peroxides produced during auto and photo oxidation Rawls and Vansanten (1970), Lundberg (1994) and Clements ***et al.*** (1973). In 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 the antioxidant (Chin and Duh, 1995).

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