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Antioxidant potential of black pepper extract for the stabilization of sunflower oil

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Variable concentrations (500 ppm and 1000 ppm) of methanolic extract of black pepper were used for the stabilization of sunflower oil during ambient storage. Antioxidant potential of black pepper extract was evaluated by FFA (free fatty acid), PV (peroxide value) and IV (iodine value) parameters. The efficacy of the extract towards sunflower oil samples increased with increase in concentration. 500 ppm of black pepper extract added to control showed comparable values of FFA, PV and IV to that of 200 ppm of BHA or BHT added to control. However, stabilized sample of black pepper extract showed less increase in the PV and FFA values. The current study reveals that black pepper is a potent source of natural antioxidants that can be safely used to suppress peroxidation of lipids and to prevent them from getting rancid.

Keywords: Sunflower oil, Antioxidant potential, Stabilization, BHA, BHT, Black pepper.

INTRODUCTION

Since long time, synthetic antioxidants such as butyl hydroxytoluene (BHT) and butyl hydroxyanisole (BHA) are being used to prevent oils and fats from deterioration. But there are several safety and economic concerns associated with their usage [1]. In spite of their safety and other concerns, these antioxidants are widely needed for preventing deterioration of other oxidizable substances such as cosmetics, pharmaceuticals, plastics etc. [2]. These concerns, however, can be addressed and resolved by the introduction of natural antioxidants extracted from different spices which are used as food flavors. Some important contributions regarding the evaluation of the antioxidant potential of various herbs, spices and other natural substances in the literature are: Marja *et al*. (1999) [3], Esam *et al.* (2000) [4], Sharma *et al.* (2000) [5], Yu *et al.* (2002) [6], Javid *et al.* (2003) [7], Naz *et al.* (2004) [8], Zia *et al.* (2004) [9], Hinneburg *et al.* (2006) [10], Nedyalka *et al.* (2006) [11], Jinyoung *et al.* (2008) [12] and Kandlakunta *et al.* (2008) [13]. In this study a natural herb extract was used instead of synthetic antioxidants to check its efficacy to edible oils in comparison with synthetic ones.

We have selected black pepper, a common spice consumed on a daily basis in almost every part of the world. The purpose was to evaluate its antioxidant potential for the stabilization of refined, bleached and deodorized sunflower oil.

EXPERIMENTAL

Materials and instruments

Chemicals such as BHA, n-hexane, acetic acid, BHT, potassium iodide, iodine monochloride, sodium thiosulfate, chloroform, carbon tetrachloride, ethanol, phenolphthalein and HCl were of analytical grade and were used without further purification. The Pyrex made glass ware was immersed in 0.5% w/v EDTA overnight, rinsed with deionized water and finally dried at 150°C as per previous report [14].

Black pepper

Black pepper was purchased from a local market of Lahore. It is a cheap and easily obtainable spice that is used in many Pakistani and Indian dishes not only because of its nice flavor but also for its medicinal value.

Preparation of black pepper extract

The extract of finely ground black pepper was obtained in 80% methanol at room temperature [14]. The extract was evaporated to dryness under reduced pressure at 40-45°C in a rotary evaporator and was stored at −18°C for further analyses [14].

Stabilization of sunflower oil and antioxidant activity testing

Five 250 ml glass-stoppered flasks were taken. In each flask 5 g of the sunflower oil was added. One was labeled as control and in the other four 200 ppm BHA, 200 ppm BHT, 500 and 1000 ppm black pepper extracts, respectively, were added. Antioxidant potential of the control was measured immediately, while portions of the four samples were analyzed after intervals of 15, 30 and 45 days. IUPAC standard methods [15, 16] were used for the determination of free fatty acids (FFA), peroxide (PV) and iodine (IV) values during ambient storage of sunflower oil.

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RESULTS AND DISCUSSION

Effect of synthetic antioxidants and black pepper extracts on FFA

It is established in the literature that an increase in free fatty acid value will take place as fat deterioration proceeds; hence FFA is the best indicator of deterioration [17]. FFA was reduced from 0.214% to 0.188% with BHA and from 0.214% to 0.193% with BHT during 45 days of storage, Fig. (1). Similar findings have been reported by Kiyomi [17].

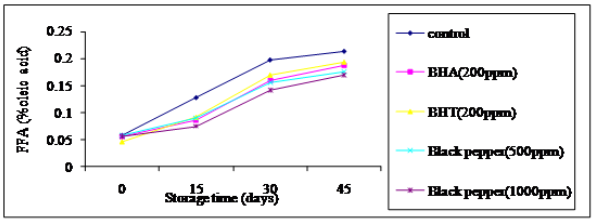

Fig. 1. Comparison of free fatty acid values with time.

Addition of 1000 ppm black pepper extract showed significant reduction in the FFA value of sunflower oil during 45 days of storage, as compared to BHA or BHT. Reduction of FFA by 500 ppm black pepper extract was comparable to BHA and BHT as it showed 0.176% FFA value at the 45th day of storage while 1000 ppm black pepper extract showed 0.170% FFA value at the same day of storage. These findings are comparable with related results of Frega *et al.* [18].

Effect of synthetic antioxidants and black pepper extracts on peroxide values

The gradual increase in PVs of synthetic and 500 ppm & 1000 ppm black pepper extracts is shown in Fig.(2).

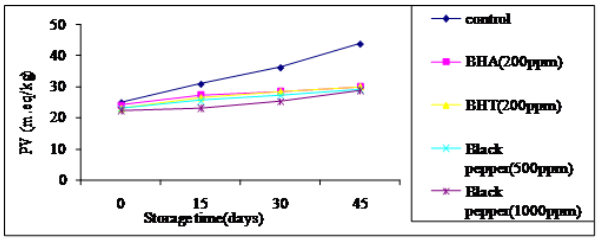

Fig. 2. Comparison of PV values with storage time.

Control showed a PV value of 43.8 m.eq/kg at 45th day of storage while the sample with added BHA showed a value of 29.88 m.eq/kg. Similarly, the sample with added BHT showed a PV value of 30.0 m.eq/kg at the 45th day of storage. The samples with added 500 ppm and 1000 ppm black pepper extracts appreciably controlled the peroxide value and a regular increase in PV as a function of storage time was observed for all samples at all intervals. The control sample showed a tremendous increase in PV as compared to the other samples. Stabilized samples showed a slower increase in PV as compared to control. PV of 500 ppm black pepper was comparable with that of the synthetic antioxidants BHA and BHT.

Effect of synthetic antioxidants and black pepper extracts on iodine values

Along with the increase in free fatty acid and peroxide values, a marked decrease in the iodine value was observed during storage of sunflower oil. Results are shown in Fig. (3).

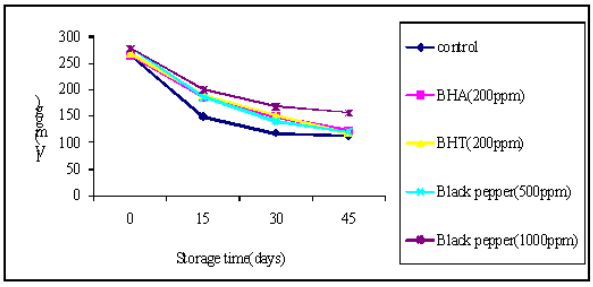

Fig. 3. Comparison of iodine values with time

These results showed that the addition of synthetic and natural antioxidants (BHA & BHT and black pepper extracts) retarded the decreasing trend of the iodine value in sunflower oil samples relative to control during storage for 45 days. The iodine value of the control oil sample at the 45th day of storage was 114.01 mg/g. Addition of BHA and BHT to sunflower oil resulted in iodine values of 123.22 mg/g and 117.99 mg/g, respectively, at the 45th day of storage. While the IV of 500 ppm black pepper stabilized extract was 120.85 mg/g at the 45th day of storage and for 1000 ppm black pepper stabilized extract was 155.98 mg/g at the same day of storage. Therefore, the iodine values of stored sunflower oil treated with synthetic antioxidant and black pepper extracts were distinctly higher than that of the control oil sample.

The gradual decrease of IV can be attributed to breaking of double bonds of unsaturated fatty acids of lipids that is consistent with the findings of Noor and Augustin [19].

CONCLUSIONS

The antioxidant activity of a methanolic extract of black pepper for the stabilization of sunflower oil is comparable with that of synthetic antioxidants such as butyl hydroxyanisole (BHA) and butyl hydroxytoluene (BHT). Rancidity of oil can safely be controlled using high levels of black pepper extract as compared to synthetic antioxidants (BHA & BHT) and thus can increase stability of oils and fats.

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АНТИОКСИДАНТЕН ПОТЕНЦИАЛ НА ЕКСТРАКТ ОТ ЧЕРЕН ПИПЕР ЗА СТАБИЛИЗИРАНЕТО НА СЛЪНЧОГЛЕДОВО МАСЛО

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(Резюме)

Използван е метанолов екстракт от черен пипер в различни концентрации (500 ppm и 1000 ppm) за стабилизирането на слънчогледово масло при съхранение при обикновени условия. Антикосидантният потенциал на черния пипер е оценен чрез анализа на свободните мастни киселини (FFA), пероксидното число (PV) и йодното число (IV). Ефикасността на екстракта спрямо пробите от слънчогледово масло нараства с нарастването на концентрацията му. Добавянето на 500 ppm от екстракта показват съпоставими стойности за FFA, PV и IV с тези при 200 ppm добавки от BHA или BHT. Обаче стабилизираните проби с екстракт от черен пипер показват по-слабо повишение на стойностите на PV и FFA. Настоящата работа показва, че черният пипер е потенциален източник на природни антиоксиданти, които може да се използват безопасно за подтискането на окислението на липидите и да се предотвратява гранясването им.