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Scientific Research

Investigating the effect of ultrasound pretreatment on the extraction of phenolic cpmpounds from Artemisia annua flowers oxidative stability of soybean oil containing the resulting extract

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ABSTRACT

Today, one of the problems of the food industry is the use of synthetic compounds as preservatives, the potential dangers of each of these compounds for human health have been proven. Currently synthetic antioxidants such as butyl hydroxyl anisole and butyl hydroxyl toluene are used in the oil industry. The purpose of this research is to investigate the effect of ultrasound pretreatment on the extraction of phenolic compounds from the herb flower on oxidative stability of the oil containing the resulting extract. In this research, from the extract of Artemisia annua flower with the help of ultrasound pretreatment with a fixed intensity of 24KHz and a fixed temperature of the laboratory and the application times of ultrasound waves is 10, 20 and 30 minutes and methanol solvent extraction by maceration method with a fixed time of 48 hours and it was used a stabilize soybean oil at a constant temperature in the laboratory (control). With the help of the response level method, the most appropriate ultrasonic pretreatment for 30 minutes. Then, different concentrations of 0,50, 100, 250, 500 and 1000 ppm were prepared after ultrasonic pretreatment for 30 minutes. The results showed that the pretreatment with a concentration 0f 1000 ppm with the highest amount of phenolic compound extaction (28/15) mg/g and DPPH free radical inhibitory power (53/30)% was the most suitable sample that was added to the oil and The tests related to the stability of soybean oil including: peroxide index, acid index and thiobarbituric acid index were performed, which according to the results of the tests had an upward trend and the most stabilizing effect was at a concentration of 1000 ppm.

1. Introduction

Oxidation of fats is one of the main economic concerns for food products. Oxidation of fat in food greatly reduces their preservation and causes unacceptable quality food to be presented to the customer. Also, since the oxidative stability of oils and fats is affected by several factors such as light, metal ions, oxygen, temperature and enzymes, the presence of food additives with antioxidant properties to prevent oxidation is necessary [1].

Food additives such as antioxidants are used in all kinds. Food additives such as antioxidants are used in all kinds of oils in order to increase shelf life, maintain safety and nutritional quality, functional properties and desirability of the product. Considering the ill-proven effects of many synthetic additives, such as the effect of artificial colors and antioxidants in causing developmental damage, reduction of concentration power, reduction of children's IQ, the effect of mutagenicity, toxicological and carcinogenic effects, and etc. Nowadays, the trend A lot has been created for the use of natural additives in industry and in research, and among them, effective compounds extracted from plant sources are very welcome have taken [2].

The food industry generally uses different types of synthetic antioxidants (BHT, BHA, TBHQ) to help preserve foods against the oxidation of fats. The mentioned synthetic antioxidants have carcinogenic properties, so the consumer demand for healthy and natural products has increased in recent years. Researchers are currently finding the potential of natural antioxidants obtained from different various agricultural materials (such as bark, roots, stems, leaves and fruits of plants) as an alternative to synthetic compounds. Polyphenols are the most important group of natural antioxidants found in plant based products [3].

The medicinal plant with scientific name is Artemisia annua. This plant is a shurb with wide branches the leaves are liner, hairy, sliver –white leaves, yellow flowers growing from the sides of the leaves at the ends of the branches, and the fruit is a hazelnut. The length of its leavers reaches 120 cm. The height of this plant is between 9 and 12 meters, which has numerous and dense branches that give the plant a keel shape [4].

The flower of Dermena plant contains chemical compounds such as artemisin, santotin, flavonoids, tri-terpenes, coumarins, adenines, amyrins, squalene, nerol, vulgarin and myrcene. Alsothe main essential oil of this plant contains compounds such as 1and 8 cineole (26/93 percent), camphor (16/97 percent), alpha-thujone(7/52 percent), berneol (7/47 percent) and alpha-tripineol (5/77 percent). Coumarin is a compound of the phenolic family common in plants, which is known as antibacterial and antiseptic compounds. Therefor, it is believed that can be used to increase the oxidative stability of soybean oil [5]. It is one of the sources of soybean vegetable oil, which due to its favorable agricultural characteristic, its high protein and oil quality valuable food is the most important source of oil seeds in the world [6].

Soybean oil is a potential source for providing essential fatty acids needed by the body due to its high. amounts of amounts of polyunsaturated fatty acids such as linoleic acid and to a lesser extent linolenic acid. On the other hand, these polyunsaturated fatty acids due to the high to their high chemical activity, it is oxidized faster and this is the reason for the instability of this oil, as a result of which the essential fatty acids are lost and the taste and

smell of the products resulting from undesirable oxidation [7].

In addition to changing the organoleptic properties of the food, the oxidation of oils reduces the nutritional value and shelf life of the oils, and due to the production of undesirable compounds in the oil that are harmful to the health of consumers. They have a negative effect, causing aging, heart diseases and cancer mutation. For this reason stabilization of oils under thermal and storage conditions is inevitable. There are various methods for oil stabilization is used, one of the most important of which is the use of antioxidants. In line with the application of herbal antioxidants, the extract of the flower sagebrush plant can be a suitable substitute for synthetic antioxidants are used in this research using ultrasound pretreatment with time:30 minutes, natural sources of antioxidants, herb extract sagebrush, Artimisinin, flavonoids, triterpens, coumarins, esculins, were extracted added to soybean oil for stability, and their stabilizing effects during storage conditions at a constant temperature in the laboratory of 20 degrees Celsius compared to will be compared to each other and also on soybean oil without antioxidants [8].

In a research, they investigated the antioxidant activity of senna leaves on the stability oil. The results showed that the concentration 750 ppm methanolic extract of senna leaves has a good effect in slowing down the oxidation process of soybean oil [9].

In the the quenching of other antioxidant properties of olive leaf extract in sunflower oil was investigated. The results showed that the methanolic extract of olive leaf at the level of 1000 ppm has been able to control the peroxidic index of thiobarbituric acid and replace the antioxidant(BHA) [10].

The aim of this research is to investigate the effect of ultrasound pretreatment on the extraction of phenolic compounds from the flowers of the Marmene plant on the oxidative stability of soybean oil containing it. The resulting extractis optimizing the process of extracting phenolic compounds and inhibiting free radicals from Marmene plant with the help of ultrasound waves through the response surface methodology test become. In the optimization of extraction process from central composite desing with two variables independent, including the time of applying ultrasound (0-30 minutes), of concentration (0-1000 ppm) in 5 levels, including 13 tests with 5 repetitions at the central point. The measurement of phenolic compounds was done using the folin sieve method in optimal conditions, the variable, duration ultrasound for 30 minutes and concentration 1000 ppm was set.

2-Materials and methods

1-2-Materials

Soybean oil without antioxidant was obtained from Segol vegetable oil factory in Khorasan and kept at 4°C until the experiment was carried out. Sagebrush plant flower was obtained from the local market of Sabzevar city and its waste parts were separated and dried immediately after cleaning and washing it was dried in the sun.Chemicals were prepared according to standard methods, include methanol, glacial acetic acid, ethanol, chloroform, folinic acid, DPPH, potassium iodide, sodium thiosulfate, sodium hydroxide, sodium carbonate, distilled water, starch glue, all the chemicals mentioned in this research are from Maerck and Sigma companies were purchased andprepared with a high purity percentage

2-2-Methods

1-2-2-Extraction

The flower of sagebrush plant was dried after cleaning and washing. Then, to extract the extract, the were crushed with an electric mill (CG100, Kenwood) and after sieving, it was mixed with methanol solvent at a ratio of 1:10 to prepare the extract using the masuration

method and placed in a hot plate with a revolution of 250 rpm for48 hours at ambient temperature. Then it was filtered under vacuum conditions by a Buchner funnel (Germany) with Whatman No. 1 filter paper. Then it was placed in a rotary evaporrate (LABORTA4001, Heidolph Company, Japan) at a temperature of 35°C and finally the flower extract of sagebrush palnt was dried by a flat bed vacuum dryer (UFE600A3, Memmert, Germany) was concentrated at a temperature of 40°C and kept in a closed and impermeable container until use. The temperature was kept at 4 degrees Celsius [11].

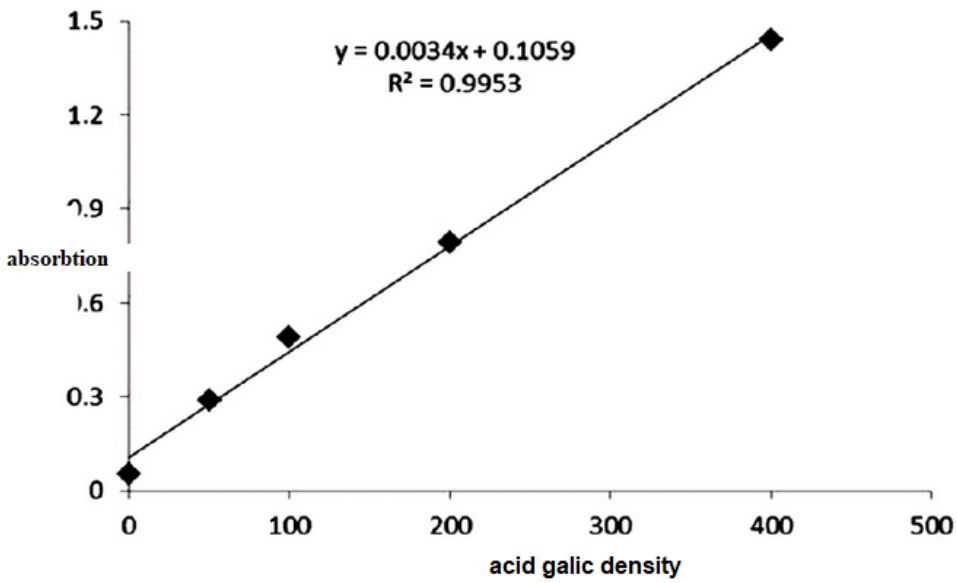
Extract tests

3-2-Dtermining the equation of galic acid

First, 0.4 g of dry gallic acid was dissolved in 10 ml of 96% ethanol and then the volume was brought to 100 ml with distilled water. In this way, the main solution was prepared, and for drawing the calibration curve for the values of 0, 5, 10, 25, 50, 100, milliliters of the mentioned solution were transferred to 100 milliliter flasks and each one was filled with distilled water to a volume of 100 milliliters. These solutions had concentration of 0, 50, 100, 250, 500, 1000 mg/liter of gallic acid, respectively. Then, 0.5 ml of prepared solutions of gallic acid, 2.5 ml of folin ciocalito reagent (to prepare concentrated folin ciocalito reagent was diluted with distilled water at a ratio of 1 to 10) were added to the foil test tubes, and after ten Minutes 2 ml of sodium carbonate 7.5% was added. After one hour at room temperature, its absorbance was read at a wavelength of 760 nm, and finally, the absorbance curve was calculated against the concentration of gallic acid (mg to ml) and equation (1) with the coefficient of explanation of 0.99 was obtained:

$$Y=0.0034X+0.1059 \qquad \text{Equation (1)}$$

X is the absorbance read at the wavelength of 760 nm and Y is the amount of phenolic compounds in mg/ml [12].



Fiqure1.Galic acid calibration curve

4-2-Measurement of phenolic compounds of the sample

First, standard solutions were prepared from the flower extract of sagebrush plant with the solvent used for extraction (methanol) with

different concentration in the range of 50, 100, 250, 500, 1000 ppm, and the control sample. Then, to twisted foil test tubes, 0.5 ml of the standard solution of the flower extract of sagebrush plant, 2.5 ml of 2% folin ciocaltio reagent (to prepare the concentrated folin ciocaltio reagent, it was diluted with distilled water at a ratio of 1 to 10) and then after ten minutes, 2 ml of 7.5% sodium carbonate was added. After one hour at room temperature, its absorbance was read at the wavelength of 760 nm, and the total amount of phenolic compounds based on gallic acid was determined as a percentage from the grading equation for gallic acid as a standard [13].

5-2-Measurement of free radical inhibitory activity (DPPH):

Evaluation of antioxidant activity was done by examining free radical inhibitory activity (DPPH). 2,2 diphenyl-1-picrylhydrazyl or (DPPH) is a stable radical compound with purple color that is reduced by electron or hydrogen donor elements (antioxidant compounds) turns into yellow diphenyl Picrylhydrazyl. The ability to give hydrogen atom or electron by different compounds and extracts was measured in this test by the amount of decolorization or reduction of the photo absorption rate of purple solution (DPPH) in methanol [14].

1-5-2-Measurement of free radical inhibitory activity (DPPH) of the sample

In this method, a substance (DPPH) was used as a stable radical compound as a reagent. In this way, 2 ml of different concentrations of 50, 100, 250, 500, 1000 ppm extract and the control sample in methanol were added to 2 ml of 0.004% (DPPH) solution in methanol. After 90 minutes of darkening at room temperature, the optical absorbance of the sample was read at a wavelength of 517 nm. The inhibition percentage of free radicals (DPPH) was calculated using equation (2):

(2) Equation

$$I\% = (A_{Blank} - A_{Sample} \div A_{Blank}) \times ١٠٠$$

In this formula A_{Blank} is the optical absorption of the control, which does not contain the extract, is shown, and A_{Sample} shows the optical absorption of different concentrations of the extract synthetic antioxidant [15].

Preparation of soybean oil samples

Based on extract tests, measurement of phenolic compounds, measurement of free radical inhibitory activity, optimal treatment containing a concentration of 1000 ppm of the extract was selected o soybean oil without antioxidants, and synthetic antioxidant (BHT) in the level of 200 ppm was added to the antioxidant-free oil that was poured into dark-colored jars and the lids of the jars were closed. Then, the samples were placed together with the control sample of soybean oil without antioxidants for 48 hours at a constant temperature in the laboratory. Then, during the storage period, oil tests were performed, including the peroxide value of Thiobarbituric acid and soybean oil samples containing the optimal extract with the soybean oil sample. Contains antioxidant (BHT) and soybean oil without antioxidant were compared and then the qualitative characteristics of oil samples were evaluated [16].

6-2-Oil tests

1-6-2-Peroxide index measurement

The method of measuring the peroxide index was according to the standard (A.O.A.C.) and at a constant temperature in the laboratory. In this method, the amount of 5 grams of soybean oil samples without antioxidant, soybean oil with antioxidant, oil soybean mixture with optimal treatment kept at a constant temperature in the laboratory and time of 48

hours prepared sample is weighed in a 250 ml Erlenmeyer flask and 30 ml of solvent (mixture of acetic acid and chloroform) is added to it, then about 0.5 ml of saturated potassium iodide is added to it and the mixture was left to stand for one minute and stirred occasionally, then about 30 ml of distilled water was added to it and left to stand for one minute, and a few drops of starch glue were added to the solution and with 0.02 normal thiosulfate solution. headlined When the color of the solution became transparent, the titration was stopped and the peroxide index was calculated in terms of meq/kg through equation (3) [17].

peroxide index = (Volume of titration consumed×normality×1000)/(Volume of sample) Equation (3)

2-6-2-Calculation of thiobarbituric acid index

To measure the thiobarbituric acid index, 5 grams of sample, one milliliter of 0.75% thiobarbituric acid solution and 2 milliliters of 35% trichloroacetic acid solution were added in a 250 ml erlenmeyer flask. Then the resulting mixture was placed in a boiling water bath for 20 minutes, after which the mixture was centrifuged for 3 minutes at a speed of 3000 rpm. The aqueous phase was taken out with a syringe and transferred to the spectrophotometer tube. Then, the absorbance of the sample was read with a spectrophotometer at a wavelength of 532 nm [18].

3-6-2-acid index measurement

20 ml of ethanol and 20 ml of diethyl ether were poured into an Erlenmeyer flask and mixed well with 5 drops of phenolphthalein. Then 5 grams of soybean oil sample (no antioxidant soybean, with antioxidant soybean oil, mixed with optimal treatment) kept at a constant temperature in the laboratory for 48 hours was weighed in another 250 ml Erlenmeyer flask and mixed with the above solvent. The above contents were titrated with normal sodium hydroxide or potassium hydroxide 0.1 or 0.01 until the appearance of a pale pink color that was stable for 15 seconds, and the amount of alkali consumed was recorded. The control sample of soybean oil without antioxidant) was calculated through titration and the amount of acid index through equation (4) [19].

Acid index=(A-B)×N×56.1/W (4) Equation

A: volume of alkali used in sample titration (ml)

B: volume of alkali consumed in control titration (ml)

N: normality of consumed alkali

W: sample weight (gram)

7-2-Statistical analysis

In order to check the results RSM statistical design, due to time saving in this method, in the addition to the main effects between factors, it is possible to estimate interactive effects, including the concentration, time of application of ultrasound waves, and the interaction between factors (reciprocal effect) to quickly reach the optimum point was used. The data was analyzed using Expert Deign statistical analyzed using Design Expert statistical software, and the average comparison with the sample containing synthetic antioxidant. The optimal sample and with the control sample (the sample without synthetic) was also done using the minimum average comparison test at the alpha probability level of 0.05 or the minimum significant difference with the same software. Microsoft Excel software was used to draw graphs.

3-Results and Discussion

1-3-Phenolic compounds of the flower extract of Marmeneh plant

Figure (2) shows the effect of concentration on the extraction of phenolic compounds during different times. According to the results, the

change trend of phenolic compounds in response to time and concentration were linear. Increasing the time of application of ultrasound waves and concentration had a greater effect on the amount of phenolic compounds. The highest extraction of phenolic compounds (23/15 mg/g) with the application time of ultrasound waves of 30 minutes and concentration of 1000 ppm was observed. At 24 hours, although the increase in concentration was associated with an increase in the amount of phenolic compounds, but this increase. The concentration of phenolic compounds was less than1000 ppm.

Phenolic compounds such as flavonoids, phenolic acids and anthocyanin, which are known as hydrophilic antioxidants, are secondary metabolites that are abundant in plants. Features of Anti oxidative properties of phenolic compounds are directly related to their structure. These compounds having a or several hydroxyl groups are able to neutralize free radicals [20].

Phenolic compounds are able to give a hydrogen atom to free radicals and thus stop the chain reactions during the fat oxidation reaction process. Also, there is a possibility of intensifying effect between compounds containing oxygen and increasing antioxidant activity [21].

In the research in which the phenolic compounds of Marmeneh plant were identified. The result showed that there are 32 compounds in the essential oil of the species and there are (A. auuna) and camphor (48%), 1and 8 cineol (9.31%), camphene (6.98%) and spantheol (4.89%) the title of the main compounds was identified [22].

The another study, the killing rate of the methanolic extract of the aerial of the plant collected from different regions of East Azerbaijan was reported to be 1.4 to 2.3 micrograms/gram of the extract [23].

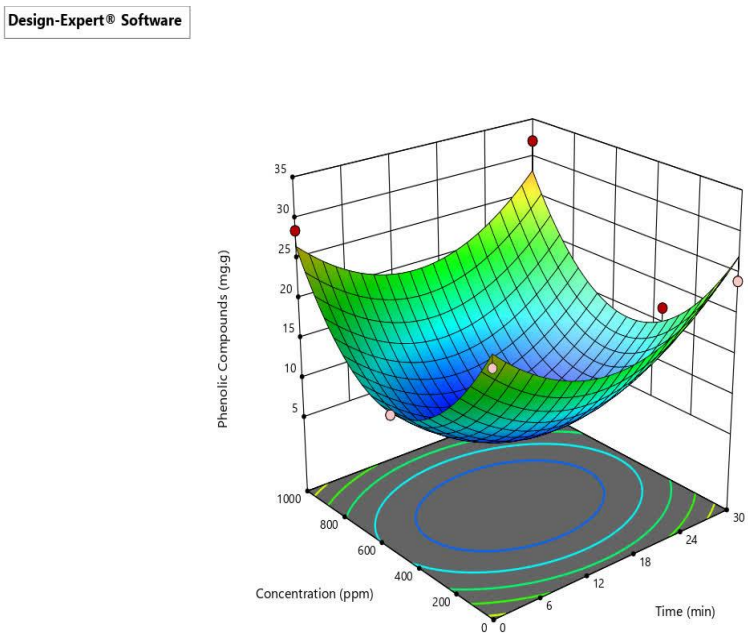


Figure2.The effect of sonication time and extract concentration on the amount of phenolic compounds

2-3-The power to inhibit free radicals (DPPH) of the extract of the flower of sagebrush plant

The results of free radical inhibition are shown in (Figure 3). The highest amount of free radical inhibitory power of the flower extract of sagebrush plant is 53.30% for a concentration of 1000 ppm and the lowest inhibitory power is 9.98% at a concentration of 50 ppm, the results showed that the concentration had a significant effect on the inhibitory power. It can be said that by using 200 ppm of synthetic antioxidant BHT and comparing its free radical inhibitory activity with different concentrations of the flower extract of sagebrush plant, it was found that the inhibitory activity of this antioxidant in the used concentration is compared to the concentration of 200 ppm extract and above was statistically at a lower level. The higher DPPH free radical inhibitory activity in higher extract concentrations can also be attributed to the phenolic content of the extracts. In general, increasing concentration of phenolic compounds directly increase the ability of different extracts to inhibit free radicals. The inhibitory power of different extracts largely depends on the number and position of hydroxyl groups and the molecular weight of phenolic compounds. In phenolic compounds with lower molecular weight, hydroxyl groups are more easily accessible [24].

In this study, it can be stated that due to the increase of phenolic compounds in high levels of the extract, it has caused an increase in the free radical inhibition power. Therefore, it can be concluded that probably, in the extraction method. The methonolic extract which was the control treatment with a time of 48 hours in which ultrasonic waves were not used due to the higher phenolic compounds, the release of hydroxyl compounds in the reaction environment is more likely in the methanolic extraction method, and the probability of hydrogen reduction to free radicals and the inhibitory power of the extract increases. Compared to extraction with organic solvents, the use of methanol substrate treatment method increases the extraction of released phenolic compounds. The reason for this can be attributed to the increase in the polarity of the solution and the swelling of the cell in this condition, which can be effective in extracting the released phenolic compounds. On the other hand, the presence of polar compounds and high dielectric conditions probably caused the penetration of the compounds into the cell and caused the hydrolysis of the polysaccharide wall of the seed coat. And as a result, it extracts phenolic compounds due to heating and degradation of lignin. Heat increases cell rupture in most plants and eventually leads to the destruction of polysaccharides, and in this way, some phenolic compounds can be released. freely in the environment and enter the extract in the next step [25].

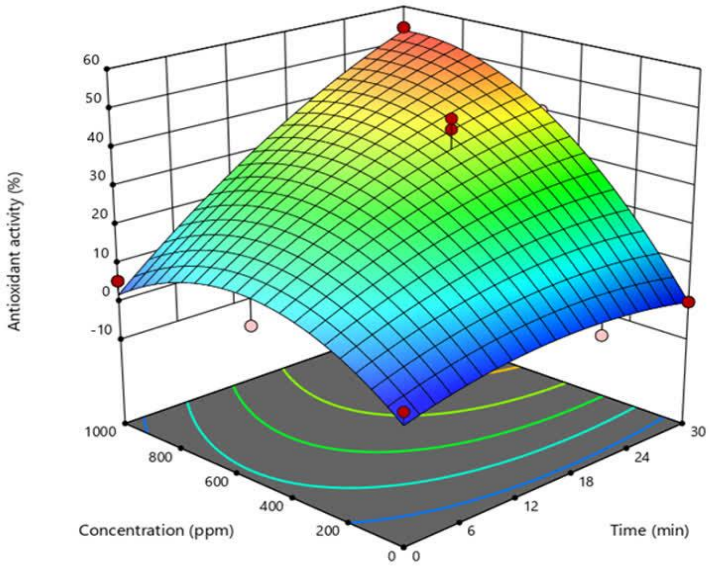


figure3.The effect of sonication time and extract concentration on the amount of DPPH

In line with the results obtained from the present research, after investing the effect of using orange peel essential oil on the with oxidative stability of soybean oil, they stated that the orange peel essential oil has anti-radical activity and compared to the control sample without antioxidants, it caused the oxidation stability of soybean oil [26].

3-3-Peroxide number

The results of the analysis of variance of the square root of the standard deviation showed that the change in the peroxide index of the herb extract. It was significantly influenced by the optimum point (P< 0.05). The results of comparing the average treatments in the LSD test for peroxide number are shown in Figure 4. According to the results, the highest number of peroxide is in the control treatment (soybean oil that does not contain synthetic antioxidants) compared to the BHT antioxidant and the optimum point (time 30 and concentration 1000), which had a statistically significant difference with the others. Also, BHT treatment has higher peroxide value compared to optimum treatment. According to the analysis of variance of the data. The optimum point of the oxidation rate has decreased, the optimum point was lower compared to the control sample and even the BHT antioxidant. Therefore, it can be mentioned that during the storage time at the constant temperature of the laboratory and at different times of 24and 48 hours, the highest, average and lowest amount of peroxide corresponding to the control sample (soybean oil without antioxidants), and BHT antioxidant, the optimum point to respectively (17.60 meg/kg), (5.66 meg/kg), (3.26 meg/kg). Standard deviation is one dispersion indices that shows how much of the average data is from the average are for Standard deviation of peroxide number in control sample, BHT sample and optimum sample, respectively (17.1±6.462), (5±66.416), (3.2±0.503). ± the values show the standard deviation.

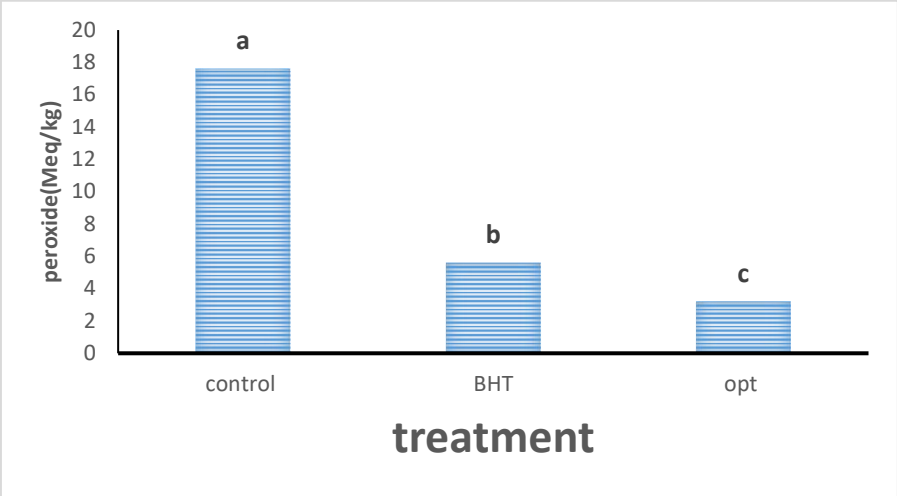


figure4. Comparison of the change in the peroxide number of soybean oil containing the control treatment antioxidant-containing treatment and the optimum treatment.

The peroxide number is considered as the primary indicator of oxidation, which is unstable at high temperatures and easily turns into a mixture of aldehyde compounds, so the peroxide number cannot be a suitable measure to determine the actual progress of oxidation. Considering that the antioxidant activity has an inverse relationship with the peroxide number, the higher the antioxidant activity, the lower the peroxide of the oil, so the optimum point is due to the increase in phenolic compounds in the extract, increasing the stability of soybean oil and reducing the oxidation rate in the extract. The amount of oxidation of the optimum point in soybean oil decreased and the peroxide index decreased, which was observed even compared to the synthetic antioxidant BHT [27]. In this research antioxidant activity of fennel seed extract on sunflower oil was investigated. The result showed that fennel seed extract has higher antioxidant activity than antioxidant BHT in sunflower is oil [28].

3-4-Acidic index

Acid number is one of the useful chemical criteria to determine the intensity of oil decomposition. Anyway, the acid number it is a free fatty acid indicator that these fatty acids are quickly oxidized and increase the oxidation of other unsaturated fatty acids through the activation and dissolution of metal catalysts [29]. The LSD test for acid number showed that the highest acid number was in the control treatment, which had a statistically significant difference with the others. The amount of optimal treatment has a higher acid value compared to the BHT synthetic antioxidant treatment. The results of the examination and comparison of acidity index are shown in figure 5, the average of the treatments in the LSD test for acidity showed that the highest acidity number was in the control treatment. The results of the analysis of variance showed that the acid value of the control sample (0.436 MgkOH/g) and the sample containing synthetic antioxidants (0.0567 MgKOH/g) and the optimum sample is (0.1794 MgOH/g). According to the comparison result of the LSD test, the standard deviation of the number Acidity the control sample (0.463±0.0341), the sample containing antioxidant (0.0567±0.456) and optimum sample is (0.1794±0.0296).

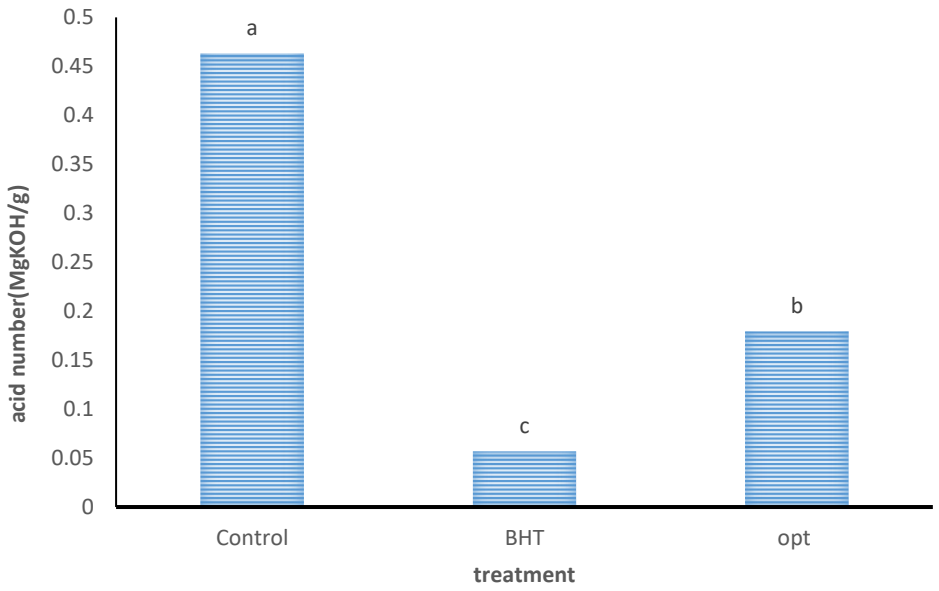


figure4. Comparison of the change in the acid number of soybean oil containing the control treatment antioxidant-containing treatment and the optimum treatment

In a research after examining the effect of fenugreek plant extract on canola oil stabilization, the results showed that the acid value of samples containing fenugreek extract was almost the same as the sample containing synthetic antioxidants. The storage period of the acid value of all samples increased [30].

3-5-Thiobarbituric acid index (TBA)

The results of the analysis of variance showed that the changes in the thiobarbituric index of the Marmeneh flower extract were significantly influenced by the optimum point (P<0.05). The results of comparing the average TBA index in the LSD test showed that the control sample (soybean oil without antioxidants) had an increasing trend compared to other treatments, which had a significant difference compared to other treatments (P<0.05). BHT also has a higher thiobarbituric index compared to optimal treatment. In fact, the reason for the increase in the amount of thiobarbituric acid during the storage time was failure Hydro peroxides and the formation of secondary lipid oxidation products were [37]. According to the comparison results of the mean test LSD standard deviation of the control sample (0.0020±0.412) sample containing antioxidant (0.0025±0.180) and the optimum sample is (0.0036±0.124).

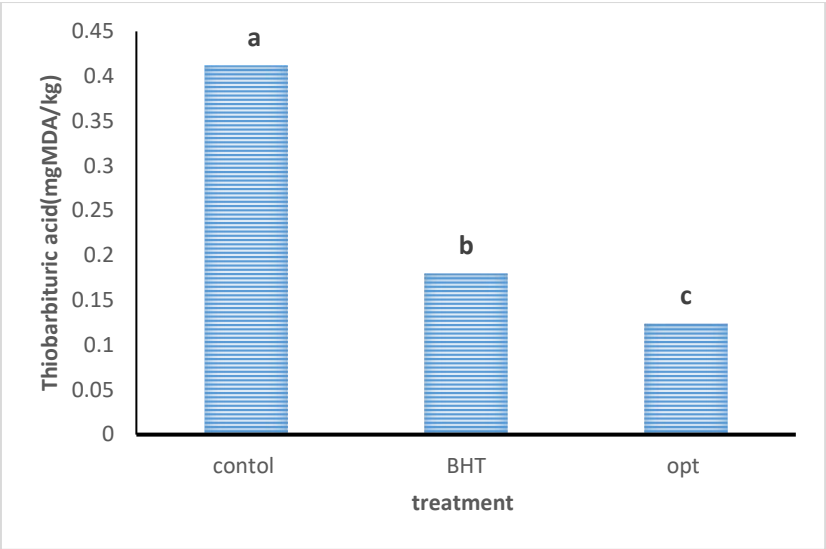


Figure6. Comparison of the change in thethiobarbituric acid index of soybean oil containing the control treatment, antioxidant-containing treatment and the optimum treatment.

According to the results, the TBA number in the control treatment was 0.412. BHT synthetic antioxidant treatment and optimum point had values of 0.180 and 0.124, respectively. By adding the point containing the extract of sagebrush flower plant (optimum), the amount of TBA decreased and the amount of stability increased during the storage period, which is probably due to the ability of antioxidants to inhibit oxidation, which was consistent with the optimal point. So that the increase in stability to oxidation was more than the sample containing synthetic antioxidant. The increase in the antioxidant power of phenolic compounds as a result of concentration can probably be attributed to the increase in the number of active sites of these compounds to react with free radicals. The result obtained in the amount of oil oxidation inhibition was consistent with the results of free radical inhibition tests and the amount of phenolic compounds. also confirmed the effectiveness of essential oils and natural plant extracts in preventing the oxidation of edible oils compared to synthetic antioxidants. be which was consistent with the results of this study [32].

4-Conclusion

Nowadays, the use of a wide group of medicinal plants and their aromatic compounds as natural sources that have antioxidant properties has attracted the attention of researchers. Therefore, in this research, in line with the application of plant antioxidants, the extract of the flower of the sagebrush flower was used as a suitable substitute for synthetic antioxidants in soybean oil. Based on the results, it was observed that the concentration of 800 and especially 1000 ppm of the extract of the flower of sagebrush compared to other concentrations of the extract including 400, 200 and the control sample due to having higher amounts of antioxidant compounds, phenolics and in terms of free radical scavenging activity was more effective in the stability of soybean oil and compared to the synthetic antioxidant BHT at a concentration of 200 ppm had a greater effect. Also, the results obtained from the oil containing different concentrations of the extract showed that the concentration of 1000 ppm of the extract of the seeds of the sagebrush plant in the reduction of peroxide index, TBA index and acid number had a greater effect than other concentrations. Naturally, the higher antioxidant capacity of the 1000 ppm concentration of the extract compared to other concentrations during the thermal process can be attributed to the remaining amounts of phenolic compounds during the breaking of the cell wall, as well as the high amount of these

compounds in the extract. Therefore, the extract of the flower of the sagebrush plant can be used in the industry as a natural substitute for synthetic antioxidants such as BHT in appropriate concentrations.

5-Reference

[1] Christie, W. W., & Harwood, J. L. (2020). Oxidation of polyunsaturated fatty acids to produce lipid mediators. *Essays in biochemistry*, *64*(3), 401-421.

[2] Carocho, M., Morales, P., & Ferreira, I. C. (2015). Natural food additives: Quo vadis?. *Trends in food science & technology*, *45*(2), 284-295.

[3] Amarowicz, R., & Pegg, R. B. (2019). Natural antioxidants of plant origin. In *Advances in food and nutrition research* (Vol. 90, pp. 1-81). Academic Press.

[4] Zidvand, Sima and Mohed, Sara, (2018), Dermaneh, magical medicinal and aromatic plant, 3rd International Congress and 26th National Congress of Food Sciences and Industries of Iran, Tehran, https: //civilica.com / doc / 957247.

[5] Bati, Maleeha and Rostami Cherati, Faramarz and Akbari, Reza and Seyedalangi, Seyedah Zahra, 2016, Identification of chemical compounds in Darmena plant by water distillation method, National Congress of Chemistry and Nanochemistry from Research to National Development, Tehran, https: / / civilica.com / doc / 718303.

[6]Johnson, L. A., White, P. J., & Galloway, R. (Eds.). (2015). *Soybeans:* chemistry, production, processing, and *utilization*. Elsevier.

[7]Assefa, Y., Purcell, L. C., Salmeron, M., Naeve, S., Casteel, S. N., Kovács, P., ... & Ciampitti, I. A. (2019). Assessing variation in US soybean seed composition (protein and oil). *Frontiers in Plant Science*, *10*, 298.

[8]Bubonga-Sonje, M., Giacoetti, J.,& Abram, M.(2011). Antioxidant and antilisterial activity of oliveoil, cacao and rosemary extract polyphenols-7. *Food Chemistry, 127(4), 1821-7.*

[9]Parizan, T., Elhamirad, A.H., Estiri, S.H., &Armin, M. (2011). Assessing antioxidant activity methanol extract of senna leaf and its effect on the stability of soybean oil. *Inovations in Food Science and Technology,1(7), 51-59.* (In Persian)

[10]Rafiei, Z., Jafari, S.M., Alami, M., & Khomeiri, M. (2011). Antioxidant properties of olive Leaf extract and its application in sunflower oil. *Journal of Food Research (University of Tabriz), 21(1),* 11-23. (In Persian).

[11]Ebrahimzadeh,M.A., Hosseinimehr, S.J., Hamidinia,A. and Jafari,M.(2008). Antioxidant and freeradicalscavennging activity of Feijoa sallowiana fruits peeland leaves. *Pharmacology online, 1*:7-14. (In Persian)

[12]Esmaelzadeh Kanari, R., Ezni Ashari, m. (2017), the effectof the extraction methodon the antioxidant property and some secondary metabolites of Oji plant extract, *Food Sciences and industries, No. 81, Volume 15.* (In Persian)

[13]Ebrahimzadeh, M.A., Pourmorad, F., & Hafezi, S. (2008). Antioxidant activities of Iranian corn silk. *Turkish Journal of Biology*, *32*, 43-49.

[14]Paez, Vincent, et al. "AOAC SMPR® 2016.002." Journal of AOAC International 99.4 (2016): 1122-1124.

[15]Yao, X., Zhang, D., Zu, Y., Fu, Y., Luo, M., Gu, C., Li, C.M.F., & Effeat, T.(2013). Free radical scavenging capability, antioxidant activity and chemical constituents of Pyrola incarnate Fisch. Leaves. *Industrial Crops and Products*, *49*, 247-255.

[16]Buta, N., Popa, N., Roman, L., Bordea, G., Brodea,A., Bordea, N.(2013). The antioxidant effect of Meliss officinalis extract regarding the sunflower oil used in foodthermal aplications. Agroal. Proc. Technol., 19(2), 276-279

[17]Selmi, S., Limam, Z., Batista, I., Bandarra, N.M., & Nunes, M. L. (2011).Effects of storage temperature and a tocopherol on oil recoverd from sardine minic. *Internationnal Journal of Refregeration , 34(*5*),* 1315-1322.

[18] Selmi, S., Limam, Z., Batista, I., Bandarra, N.M., & Nunes, M. L. (2011).Effects of storage temperature and a tocopherol on oil recoverd from sardine minic. *Internationnal Journal of Refregeration , 34*(5*), 1315-1322.*

[19]Esfandiarifard, M., & Ziaoihagh, S.(2021). Study on the antioxidant activity of propolis extract and its effect on the oxidation ofsunflower oil. *Biochemistry and Forensic, 17*(107), 119-130

[20]Ahmadi, F., Kadivar, M., & Shahedi, M. (2007). Anioxdant activity of kelussia odoratissima moza, in model and food systems. *Food Chemistry, 105,* 57-64. (In Persian).

[21]Kulisic, T., Radonic, A., Katalinic, V., & Milosa, M. (2004). Use of different methods for testing antioxidative activity of oregano essential oil, analytical, nutritional and clinical methods. *Food chemistry, 85,*633-640

[22]Williams, R.J., Spencer, j.p. and Rice-Evans, C. (2004). Flavonoids: antioxidants or signaling molecules? Free Radic Biol Med, 36(7): 838-849

[23]Mahmoudi, M., Ebrahimzadeh, M.A., Ansaroudi, F., Nabavi, S.F. and Nabavi, S.M. (2009). Antidepressant and antioxidant activities of Artimisia absinthium L. at flowering stage . Afr J Biotech.8(24): 7170-5. (In Persian).

[24]Molyneux, P.H. (2004). The use of the stable free radical diphenyipicrylhydrazy (DPPH) for estimating antioxidant activity. *Songklanakar in Journal Science Technology, 26,* 21-9.

[25]Dordevic, S., & Petrovic, S. (2007). Animicrobial , anti-inflammatory, anti-ulcer and antiocidant activites of Carlina acanthifolia root essential oil. *Journul of Ethnopharmacol. 109,* 458-63.

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بررسی اثر پیش تیمار فراصوت براستخراج ترکیبات فنولیک گل گیاه درمنه (*Artemisia annua*) بر پایداری اکسایشی روغن سویا حاوی عصاره حاصل

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چکیده

امروزه یکی از مشکلات صنعت غذا استفاده از ترکیبات سنتزی به عنوان نگهدارنده می‌باشد که خطرات بالقوه هر کدام از این ترکیبات جهت سلامتی انسان‌ها به اثبات رسیده است. در حال حاضر در صنعت روغن از آنتی‌اکسیدان‌های سنتزی مثل بوتیل هیدروکسی آنیزول و بوتیل هیدروکسی تولوئن استفاده می‌گردد. هدف از این تحقیق، بررسی اثر پیش تیمار فراصوت بر استخراج ترکیبات فنولیک گل گیاه درمنه بر پایداری اکسایشی روغن حاوی عصاره حاصل می‌باشد. در این پژوهش از عصاره استخراجی گل گیاه درمنه *Artemisia annua)* با کمک پیش تیمار فراصوت با شدت ثابت۲٤کیلوهرتز و دمای ثابت آزمایشگاه و زمان‌های اعمال امواج فراصوت ده، بیست و سی دقیقه و استخراج حلال متانول به روش ماسراسیون با زمان ثابت ٤۸ ساعت ودر دمای ثابت آزمایشگاه (شاهد) به منظور پایدارسازی روغن سویا استفاده شد. با کمک روش سطح پاسخ مناسب‌ترین پیش تیمار فراصوت با زمان ۳۰ دقیقه انتخاب شد. سپس از پیش تیمار فراصوت با زمان ۳۰ دقیقه غلظت‌های مختلف صفر، ۵۰، ۱۰۰، ۲۵۰، ۵۰۰، و ۱۰۰۰ تهیه شد. نتایج نشان داد که پیش تیمار با غلظت ۱۰۰۰پی‌پی‌ام با بیشترین میزان استخراج ترکیبات فنلی (۲۸/۱۵) میلی‌گرم برگرم و قدرت مهار کنندگی رادیکال آزاد DPPH (۵۳/۳۰) درصد مناسب‌ترین نمونه بود که به روغن اضافه شد و آزمون‌های مربوط به پایداری روغن سویا شامل: اندیس پراکسید، اندیس اسیدی و شاخص تیوباربیتوریک اسید انجام گرفت که بنابر نتایج آزمون‌ها روند صعودی داشته و بیشترین اثر پایدار کنندگی عصاره درمنه در غلظت ۱۰۰۰ پی‌پی‌ام بود.