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ANTIOXIDANT CAPACITY OF LOCAL BERRIES IN COMPLEX FOOD PRODUCTS

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Abstract: *Complex food degradation is caused by lipid oxidation process and as a result there may occur a rancid odor, colour change and texture may be modified, thus negatively influencing the sensory qualities of food. The results obtained through analysis of different methods of research has found that the oxidation process can be prevented or slowed down by using horticultural oily extracts fortified with natural antioxidants.*
The study determined whether the oily extracts enriched with antioxidants are characterized by a higher antioxidant capacity as compared to control samples and the highest value is characteristic for rosehip extract with 73,2%. In terms of sensory aspect, the products with high lipid content was appreciated positively, so we can conclude that products based on vegetable fat and enriched with natural antioxidants are an appropriate alternative to produce harmless and safe food products for consumers' health.
It was determined that oily extracts of sea buckthorn , hawthorn , rosehip berries show increased antioxidant capacity as compared to the control samples of sunflower oil. The highest value of antioxidant capacity is characteristic for rosehip extract with 73,2%.
We can conclude that lipid products enriched with natural antioxidants are an appropriate alternative to produce natural, harmless and safe food for consumers' health.

Keywords: *oxidation, rosehip, sea buckthorn, hawthorn, extracts, lipids, antioxidants.*

1. Introduction

A permanent pursuit of the modern food industry is to ensure an optimal storage term for food products. One of the main causes of the degradation of complex food products such as pastries (biscuits, waffles, creams) is the oxidation of lipids. Lipids are a slightly perishable fraction of food, so the storage term and conditions depend largely on their nature and concentration[1].

As a consequence of this phenomenon caused by the degradation of some fragile constituents of the lipid fraction in food, there may be the appearance of a scent, the colour change and, in some cases, the food texture change, which negatively influences the sensory qualities of food products. The nutritional value of foods may also be affected to a considerable extent because of oxidative degradation of the lipid fraction [2].

The most important risk is the ingestion of lipid oxidation products, as they present enormous toxicological risks and, if will be consumed for a longer term, can cause degenerative pathologies such as arteriosclerosis, cancer, and so on. In biological materials, the lipids are protected from oxidation by the presence of antioxidants and cell membranes, which diminish the access of oxidants to fragile fractions [3].

In complex foods, the impact reduction of lipid oxidation can only be ensured by appropriate packaging and antioxidants that block the propagation or decomposition of the hydroperoxides and is manifested by the inhibition of the oxidation process. The industrially manufactured complex food products usually contain antioxidants of synthetic origin (propyl gallate - E-311 or octyl-E-312, butylhydroxyanisole (BHA) - E-320, etc.) and their effect on health human is not very beneficial. So the purpose of the research is to obtain lipid rich food products enriched with natural antioxidants that will be safe and harmless for human health [4-7].

2. Materials and methods

Plant material of Moldavian origin was used. The vegetal material (fresh berries) was harvested from a local forest. As extracting solution was used refined sunflower oil which was purchased from a local market [8, 9].

All chemicals used were of analytical reagent grade.

Reagents used for analytical methods of analysis include: Hydrogen Peroxide (0,1 M), Ammonium Molybdate (3%), Sulfuric Acid (2M), Potassium Iodide (1,8M), Sodium Thiosulfate (5,09 mM), concentrated Nitric Acid, Hexane, Ethyl alcohol (70%), Phenolphthalein, glacial Acetic Acid, starch solution (50%).

For extraction procedure all berries were dried and finely grounded. Refined sunflower oil was used as extracting solution. The oily extracts of sea buckthorn, hawthorn and rosehip were obtained under laboratory conditions. The finely grounded plant material (sea buckthorn, hawthorn, rosehip) was exactly weighed in portions of 1g for each 20 ml of extracting solution. The extraction process took place at controlled temperature of 45°C. The decanted extracts were kept in dark glass vials and stored under reduced light and temperature (+2-4°C).

2.1. The antioxidant capacity of plant extracts

In order to determine the antioxidant capacity of plant extracts the Hydrogen Peroxide Scavenging Activity method were used [10].

For the determination of HPSA, in the titration flasks, was weighed with precision 1 ml of plant sample and was mixed with 1 ml of hydrogen peroxide solution (0,1 mM). Then 2 drops of ammonium molybdate, 10 ml of sulfuric acid (2M) and 7 ml of potassium iodide (1,8M) were added. The obtained solution was titrated with sodium thiosulfate (5,09 mM) until the yellow colour disappeared. The volume of sodium thiosulfate (V_1) used for titration was recorded.

Parallel to the basic determination, control titration is performed, without plant sample. The volume of sodium thiosulfate (V_0) used for titration was recorded.

To calculate the antioxidant capacity of plant extracts the following formula (1) was used:

$$\%H_2O_2 = \frac{V_0 - V_1}{V_0} \times 100\%, [\%] \qquad (1)$$

2.2. Peroxide Value

In order to determine the peroxide value for plant extracts, the following method were used [11, 12].
In the titration flask was weighed 3 g of the investigated vegetable plant extract, then added 10 cm^3 of hexane, the sample was quickly dissolved, then poured 15 cm^3 of glacial acetic acid and 1 cm3 of potassium iodide, then the flask was closed and stirred for 1 minute and left for 5 minutes in a dark place. Then added 75 cm^3 of distilled water, stirred and added 1 ml of starch solution until a pale blue tint appeared and the released iodine was titrated with sodium thiosulfate solution until a white colour appeared and it was stable for 5 seconds. The volume of sodium thiosulfate (V_{sample}) used for titration was recorded. Parallel to the basic determination, control titration was performed, and the sodium thiosulfate volume (V_{ref}) used for titration was recorded.
To calculate the Peroxide Value for plant extracts the following formula (2) were used:

$$PV = \frac{(V_{sample} - V_{ref}) \times N_{thios} \times 1000}{m_{sample}}, [mol_{peroxide} / kg_{fat}] \quad (2)$$

2.3. Acid Value

In order to determine the Acid Value for plant extracts, the following method were used [13].
In a 50 ml conical flask, was weighed 1 g of the plant extract with a precision of 0,01 g. Then 5 ml of hexane and 5 ml of ethyl alcohol was added to the sample. The flask content was stirred and after added a few drops of phenolphthalein. The analyzed sample of plant extract was titrated by stirring continuously with potassium hydroxide solution with a molar concentration of 0,1 mol/dm^3 until a pale pink colour appeared and was stable for 30s. The volume of potassium hydroxide (V_{KOH}) used for titration were recorded.
To calculate the Acid Value of plant extracts the following formula (3) were used:

$$AV = \frac{V_{KOH} \times N_{KOH} \times 5{,}611}{m_{sample}}, [mg_{KOH} / 1g_{sample}], \quad (3)$$

3. Results and discussion

Series of experiments have shown that antioxidant capacity is considerably higher in the case of rosehip extract, and for sea buckthorn and hawthorn extracts it exceeds nonessential the antioxidant capacity value for the control sample, being within the range of certainty.
It has therefore been established according to the results obtained (Figure 1) that the rosehip extract is characterized by the highest capacity to resist to oxidation process which can take place in the food products with an antioxidant capacity of 73,2%. Sea buckthorn and hawthorn extracts are also characterized by a higher antioxidant capacity compared to the control sample. Thus, plant extracts present great interest for the food industry in order to replace synthetic antioxidants with natural antioxidants obtained from local horticultural resources [14, 15].

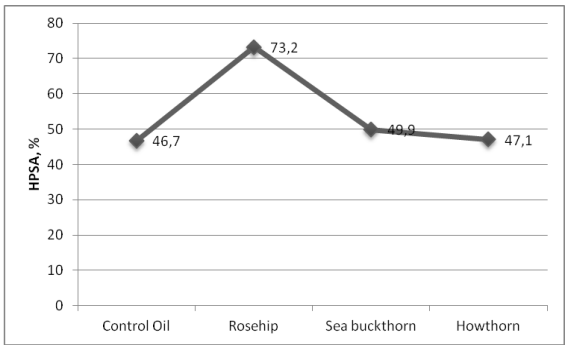

Fig. 1. Content of inhibited hydrogen peroxide (%): HPSA confidence interval ± 1,2%

The acidity value (mg KOH / g) for the control sample is within the permitted limits (0,6 mg KOH / g) according to

normative documents for the refined oil [8].

In the case of rosehip and sea buckthorn extracts, the acidity value exceeds the value of the control sample and the hawthorn extract shows a nonessential drop. The obtained values are within the permitted limits according to the normative documents (Figure 2).

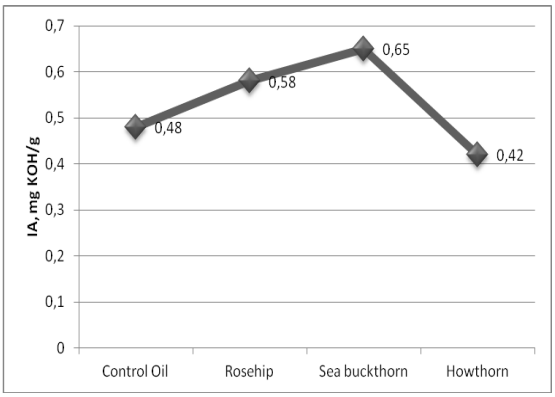

Fig. 2. Acidity Value (mg KO /g): The confidence interval AV ± 0,04 (mg KOH/g)

The acidity value for the analyzed samples (Figure 2) exceeds the acidity value of the control sample, which is explained by the increase of the amount of free fatty acids in the plant extracts. The acidity value of the hawthorn extract is lower than the acidity value of control sample, because of the active substances from the horticultural sources with which the extract has been enriched, the process of formation of fatty acids occurs slower and the oxidation process is slowed down.

The peroxide value for control sample is within the permitted limits (max 10 m_{echiv} O_2/kg) according to normative documents [8]. In the examined extracts the peroxide value is considerably lower - in the case of rosehip extract - by 0,5 m_{echiv} O_2/kg, and in the case of sea buckthorn and hawthorn extracts - by about 1,0 units less (Figure 3). It has been found that samples enriched with natural antioxidants are characterized by a lower peroxide value compared to the peroxide value of the control sample, which means that the active substances in the horticultural sources considerably slow down the formation of the peroxides, respectively slowing down the oxidation process of the investigated product. The sea buckthorn extract shows the lowest value of the peroxide index (3,66 m_{echiv} O_2/kg), the hawthorn and rosehip extracts also have a low value compared to the control sample, demonstrating that they are slowing down the oxidation process.

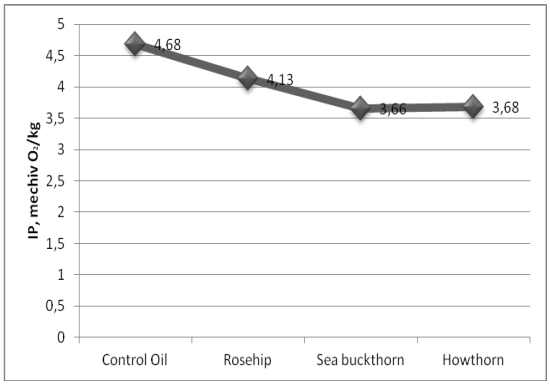

Fig. 3. Peroxide Value (active O_2 mechiv/kg): The confidence interval PV ± 0,13 (m_{echiv} O_2/kg)

4. Conclusions

According to the experiments made and the results obtained can be motivated the possibilities of using the horticultural oily extracts as components for the production of food products with high lipid content and enriched with natural antioxidants. It has been established that sea buckthorn, hawthorn and rosehip oily extracts present an increased antioxidant capacity compared to the control sample, and the highest antioxidant capacity value is characteristic for the rosehip oily extract with 73,2%.

There was highlighted that the effect of the active substances in horticultural extracts are slowing down the formation of primary and secondary oxidation products, the free fatty acids, so therefore the oxidation process of lipid rich food is slowing down too.

5. References

[1]. Wasowicz E., Gramza A., Hes M, Oxidation of lipids in food, Faculty of Food Science, *The August Africultural Universitz of Poznan*, Poland, 2004, Vol. 13/54, SI 1, pp.87-100.
[2]. F.M. Maries, Research on sensory and physicochemical changes during storage of animal fat, *PhD thesis resume*, Cluj-Napoca, 2010.
[3]. M. Repetto, J. Semprine, A. Boveris; Lipid Peroxidation: Chemical Mechanism, *Biological Implications and Analytical Determination*; Chapter 1; 2012.
[4]. M. Gomez, Syntetic Antioxidants: Role, Function and uses in foods; *FSTC 605: Chemistry of foods*, April 21, 2016.
[5]. S. Cartofeanu, G. Musteata, P. Tatarov, Antioxidants in vegetal raw material and evaluation of stabilization methods in food products, Chisinau; *Tehnica, UTM*, 1996.
[6]. C. Popovici, P. Alexe, E. Dmitrieva, O. Deseatnicova, The influence of natural and synthetic antioxidants on the oxidation stability of heated treat walnut oil, Proceedings of International Conference, *Modern Technologies in the food Industry*, Volume I, Chisinau, 2014.
[7]. S. M. Djilas, M. Jasna, Antioxidants in food; Faculty of Technology; University of Novi Sad; *Review Paper*; 2002.
[8]. Government Decision nr. 434 from 27.05.2010 on technical regulation „Edible vegetable oil“;
[9]. A.M Câmpău; C.R Cristian.; Production technology of vegetable oil; North University, Baia Mare, 2012.
[10]. Z. Sroka, W. Cisowski, Hydrogen peroxide scavenging antioxidant and antiradical activity of some phenolic acids, *Food and Chemical Toxicology*, Volume 41, Issue 6, Jume 2003.
[11]. Peroxide value, Acetic Acid – Chloroform Method, AOCS Official Method 8-53, *Sampling and analysis of commercial fats and oils*, 2003.
[12]. SR 13531, Food Products, Peroxide Value determination, July 2008.
[13]. AcidValue, AOCS Official Method Cd 3d-63, *Sampling and Analysis of commercial fats and oils*, 1999
[14]. D. Ciobanu, R.C. Ciobanu, Food products chemistry, Part I, *Tehnica-Info*, Chisinau, 2001.
[15]. D. Ciobanu, R.C. Ciobanu, Food products chemistry, Part II, *Tehnica-Info*, Chisinau, 2001.