THE ANTIOXIDANT ACTIVITY OF SOME VEGETAL EXTRACTS

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Abstracts

Antioxidants are being used for stabilizing the plastic material used as food packing material. It is of high actuality to use natural antioxidants to stabilize some polymers instead of phenol or ammine type antioxidants which are obtained through synthesis and proved to be carcinogen. There are a lot of plants which contain compounds with antioxidant properties that can successfully replace the classical antioxidants used for polymer stabilizing, hence reducing the risk of contaminating food with these compounds.
Keywords: *packing food, antioxidants, chemiluminescence, infrared spectroscop, spectroscopy in UV – VIS.*

Introduction

In the plastic material used in packing food, there are some addition agents (antioxidants, plasticizers, colorants, etc.) that can dissolve and diffuse in that food, altering its composition and its conservation deadline.

Antioxidants are substances used for delaying the polymer degradation process by: self-oxidizing, thermo-oxidizing, photo-oxidizing and radio-oxidizing degradation. For the classical methods of polymer stabilizing, there are being used some phenolic antioxidants (phenolic compounds with chalcone-like structure for steric hidrance) and some aminic antioxidants (secondary aromatic ammines) – synthesis compounds that proved to be a carcinogen.

Using natural antioxidants for stabilizing some polymers used in packing food represents a modern, needed and actual preoccupation in order to obtain ecological food packing (EU recommendation). We mention some of the natural antioxidant compounds: carrotenoids, vitamin C and E, polyphenolic compounds (flavonoids, polyphenolcarboxilic acids, and tannins). There are a lot of plants in nature in which the ahead mentioned compounds are produced, compounds that play the part of capturing free radicals, hence stopping the degradation or aging process.

Experimental

1. Vegetal material and extraction process

The main plant species from which we obtained the extracts are presented in table 1, where we also mentioned the antioxidant compounds.

Table 1: Antioxidant compounds of plant species

No.	Extract type	Antioxidant compounds
1.	Petroselinum Crispum (Parsley)	flavonoids, vitamins A, C and E
2.	Anethum Graveolens (Dill)	Flavonoids
3.	Levisticum Officinale (Lovage)	vitamin C, tannins
4.	Apium Graveolens (Celery)	vitamin A and C

The extracts have been realized by maceration in ethanol (1 part – plant / 10 parts –solvent) for 5 days at room temperature – cold extraction. After being filtered, the solution has been dry evaporated using a vacuum-air pump. The oxidation substrate was paraffin. This was added with 0.25% w/w. The components were stirred by mixing them with ethylene trichloride. In order to compare the antioxidant effect, we used as etalon the phenolic compound TOPANOL-OC (2,6-di-t-butyl-4methyl-phenol).

2. Investigation techniques and instruments

- Chemiluminescence (CL instrument OL – 94);
- Infrared spectroscopy (FT-IR instrument JASCO 4000); range: 4000-400 cm^{-1};
- Spectroscopy in UV – VIS (JASCO V570).

Results and Discussions

1. Chemiluminescence

After evaporation, the samples have been used for measuring isothermal chemiluminescence in air (163°C).

Table 2 presents the kinetic parameters of the chemiluminescence from the paraffin sample stabilized with the Aspiaceae family plant extract.

Table 2: The kinetic parameters for the oxidation (163° C, air) of the paraffin added (with 0,25 % w/w) with Aspiaceae family plant extract. CL data

Extract	t_i(min)	$t_{1/2}$(min)	V_{ox}^{max} (u.r./g min)	I_{max} (u.r./g)	t_{max} (min)
NONE	22	56	958	56634	95
Petroselinum Crispum (Parsley)	214	256	738	54554	320
Anethum Graveolens (Dill)	120	164	343	30343	225
Levisticum Officinale (Lovage)	115	148	1023	57500	190
Apium Graveolens (Celery)	56	96	803	65673	180

Figure 1 presents the CL curves of the mentioned samples from which we obtained the data in table 2.

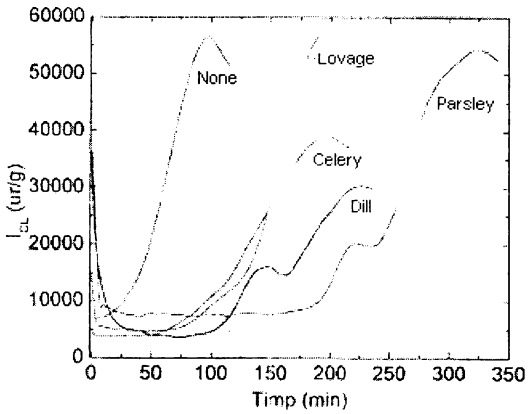


Fig.1: The CL curves (163°C, air) of the paraffin added (with 0,25% w/w) with Aspiaceae family plant extract

As can be observed a considerable increase in the time parameters (t_i, $t_{1/2}$, and t_{max}) by adding to the paraffin the mentioned extracts, and also lower values for the oxidizing rate.

These are clear proofs of the antioxidant effect of the analysed extracts. We must underline the remarkable antioxidant effect in Petroselinum Crispum (Parsley) shown by the large induction period (214 minutes). This parameter is superior to the one registered in the phenolic compound with steric hidrance TOPANOL-OC recommended as etalon in several other studies. (table 3 and figure 2)

Table 3: The kinetic parameters for the oxidation (163° C, air) of the paraffin added (with 0,25 % w/w) with TOPANOL - OC

The sample	t_i(min)	$t_{1/2}$(min)	V_{ox}^{max} (u.r./g min)	I_{max} (u.r./g)	t_{max} (min)
Clean paraffin	22	56	958	56634	95
Paraffin with TOPANOL-OC	133	164	285	20100	230

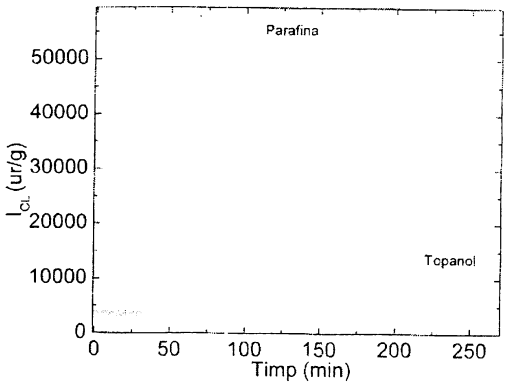
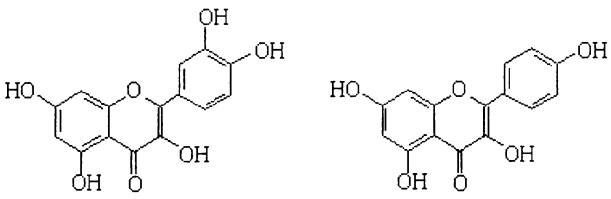
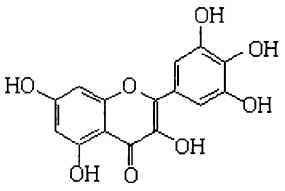


Fig. 2: The CL curves (163° C, air) of the non stabilized paraffin and of the stabilized paraffin (with 0,25 %) with TOPANOL - OC (2,6-di-t-butyl-4methyl-phenol)

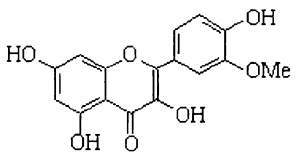
This remarkable antioxidant activity of the Petroselinum Crispum (parsley) extract can be due to several compounds which play and antioxidant part, such as the vitamins A and C, and also the flavonoids such as quercetin, kampherol, myricetin, izorhamnetin, apigenin, lutheolin, which contribute substantially to the antioxidant effect of the extract.

The first four flavonoids are found in this plant in a concentration of 5mg/100g, while the last two are in a concentration of more than 50mg/100g.

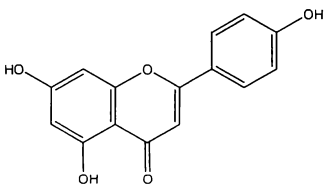




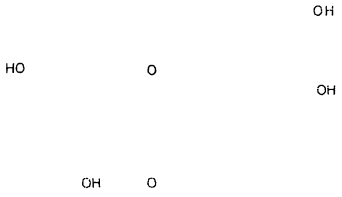
myricetin



izoramnetin



apigenin



lutheolin

Another plant in the Aspiaceae family which had an extract with a significant antioxidant effect was Anethum Graveolens (Dill). This extract led in the paraffin to an induction period of 120 minutes at 163^0C. This can be explained by the high flavonoids content (quercetin, kampherol, myricetin, izorhamnetin), 50mg/100g. In the case of flavonoids the antioxidant activity is proportional to the –OH groups number.

The stabilizing antioxidant mechanism is given in the following reactions (figure 3):

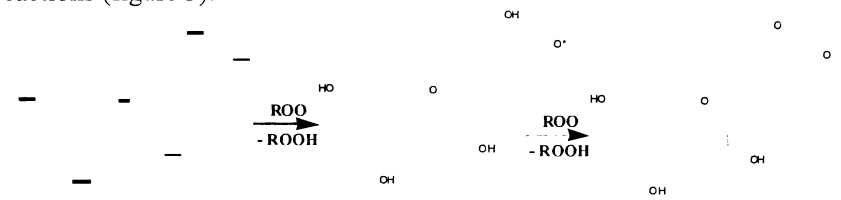


Fig.3: The stabilizing antioxidant mechanism

2. IR absorption spectra

The analysis in the IR spectra (4000 – 400 cm^{-1}) of the obtained extracts has been done in the solid state using ATR. Their spectra has been compared to that of some flavonoids and phenolic acids. The flavonoids have in the IR spectrum a large number of absorbtion, the most important being the following peaks (figure 4, 5):

- 3500 – 3330 cm^{-1} — ν_{OH} associated
- 1660 -1520 cm^{-1} — $\nu_{C=O+}$ different aromatic substitution
- 1500- 1300 cm^{-1} — $\nu_{C=O}$ and δ CHOH
- 1300 -1100 cm^{-1} — ν C-O (aromatic ether)+ Ar-OH
- 1100 - 1000 cm^{-1} — ν CH-O-O+γC-C
- 1000 - 700 cm^{-1} — different aromatic substitution

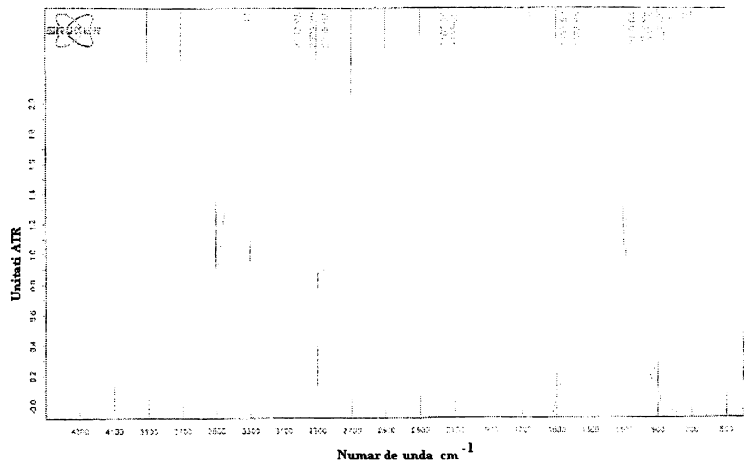


Fig. 4: IR(ATR) spectrum from Petroselinum Crispum extract (solid sample)

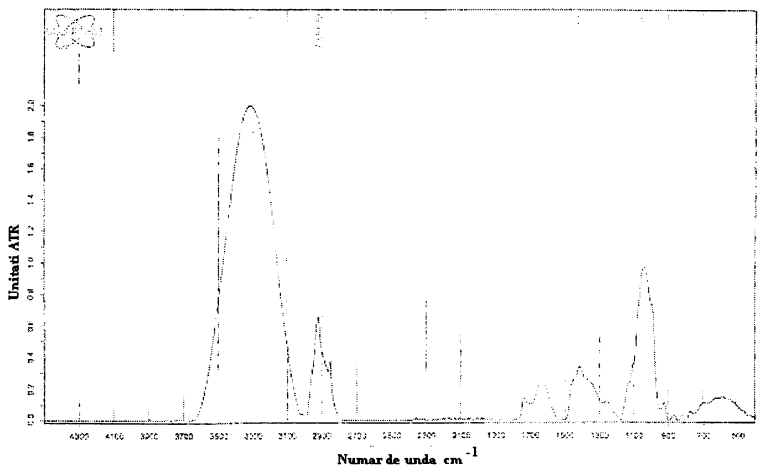


Fig. 5: IR (ATR) spectrum from Anethum Graveolens extract (solid sample)

3. UV-VIS absorption spectra

The absorption spectra in UV–VIS range from the investigated plant extracts are presented in figure 6 and 7:

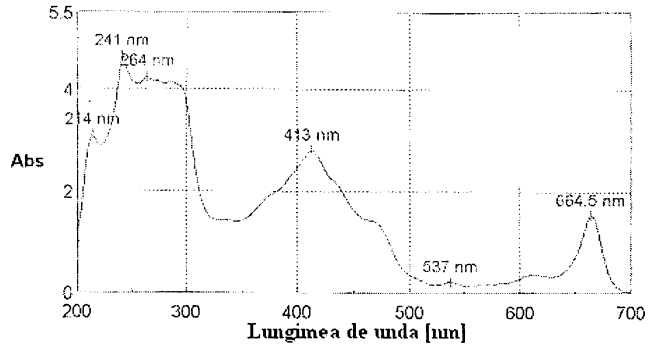


Fig. 6: UV – VIS spectrum from the alchoolic extract of Petroselinum Crispum (1:24)

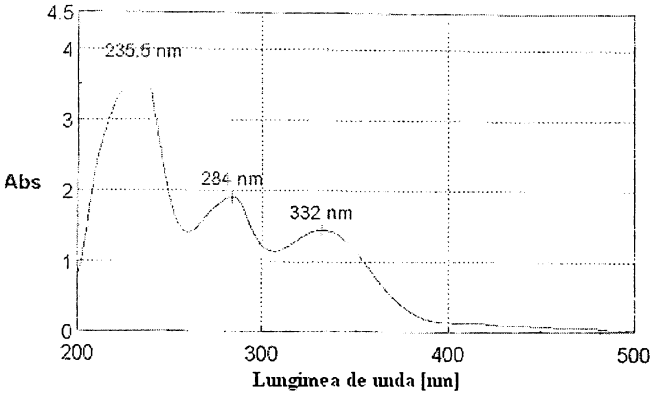


Fig. 7: UV – VIS spectrum from the alcoholic extract of Anethum Graveolens (1:24)

These spectra have been compared to those of the flavonoids and some phenolic acids considered as standard, evidenced the aromatic structures (255 – 270 nm) and the chromopherous groups >C=O and the –OH groups (280 – 370 nm).

Therefore the peaks in the 210 – 310 nm range are due to the phenolic group, and those in the 255 – 280 nm range are specific to the flavonoids.

The 660 nm peak is due to the chlorophyll *a* structure.

Conclusions

- There has been done the characterization of some alcohol extracts from different plants by using the isotherm CL, the IR and UV-VIS absorption spectroscopy, and the fluorescence spectroscopy;
- The obtained results underline the significant part played by the polyphenolic vegetal structures in obtaining significant antioxidant effects upon polymeric substrates used in the food packing industry;
- The natural antioxidants introduced in the polymers which are being used in making the food packing films avoid contaminating food with the traditional phenolic antioxidant used in packing, antioxidants which migrate by diffusion at room temperature;

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