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Extraction of oleuropein from olive leaves, in order to use as inhibitor against the corrosion of metals

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Abstract:

Oleuropein is the most abundant phenolic compound in olive leaves. This compound has been extensively studied for human health benefits. In recent years oleuropein, is proved to be an efficient inhibitor against the corrosion of metals and alloys. The use of chemical inhibitors has been limited, because of the environmental threat. The increasing ecological awareness among scientists have led to the development of "green" alternatives to mitigate corrosion. It is very important to choose cheap and safety handled compounds to be used as corrosion inhibitors.The extract of oleuropein from olive leaves, represent a great inhibitive action about 93%, against the corrosion of carbon steel in acidic media. Oleuropein, a natural product of the secoiridoid group, is a heterosidic ester of elenolic deteracid and 3,4-dihydroxyphenylethanol, containing a molecule of glucose, the hydrolysis of which yields elenolic acid glucoside and hydroxytyrosol. Oleuropein from the olive leaves was obtained by alcoholic extraction in room temperature using microwave irradiation. The extract was stored at 4^{o}C and in the dark. The product of extraction was analyzed with HPLC, and infrared (IR) spectroscopy, in order to define it's chemical structure. Also we defined the yield, density and molecular weight of the product. The product of extraction was oleuropein and we propose to use it as corrosion inhibitor.

Keywords: extraction, olive leaf, oleuropein, corrosion inhibitor.

1. Introduction

Corrosion is a naturally occuring phenomenon commonly defined as deterioration of metal surfaces caused by by the reaction with the surrounding environmental conditions. Corrosion can cause disastrous damage to metal and alloy structures with enormous economic sequences. Among the several methods of corrosion control and prevention, the use of corrosion inhibitors is very popular. Though many synthetic compounds showed good anticorrosive activity, most of them are highly toxic to both human beings and environment. Recent years, increasing of ecological awareness among scientists, have led to the development of "green" alternatives to mitigate corrosion [2]. Many plant extracts (leaves or seeds extract), were found to inhibit corrosion of carbon steeel in acidic media. These extracts can be obtained in a simple way and purification methods are not required [3]. Among the studied leaves extract, oleuropein extracted from olive leaves show great inhibition efficiency, that has been found about 93% [6]. Oleuropein, a very important phenolic compound, which is extracted from olive leaves, represents great inhibitor activity against corrosion of metals. Oleuropein is a heterosidic ester of elenolic deteracid and 3,4-dihydroxyphenylethanol, containing a molecule of glucose, the hydrolysis of which yields elenolic acid glucoside and hydroxytyrosol (Fig. 1). [2]

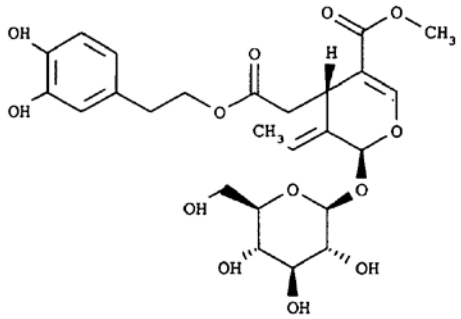

Figure 1. Molecular structure of oleuropein

The inhibition activity of oleuropein extracted from olive leaves, takes place through the adsorption of the molecules on the metal surface. The inhibition mechanism of this extract for carbon steel in acidic media, is supposed to occur occupying the molecules of inhibitor (oleuropein), more than one active site [1]. It is well known that the polar group of the molecule is directly attached to metal and the nonpolar end is oriented in a vertical direction to the metal surface, which repels corrosive species, thus establishing a barrier against chemical and electrochemical attack by

fluids on the metallic surface. (Palou et al.; licensee In Tech (2014) Chapter 19, 431-465.

2. Materials and methods

After being collected, the leaves of olive tree, were washed, dried and stored at ambient temperature in the dark. Before the extraction processes, they were ground by an electrical mill into particles, whose average diameters were between 0,5 -1 mm. One gram of milled leaves and 8 mL of extracting mixture (80:20 ethanol - water) (C_2H_5OH -H_2O) were placed into the quartz extraction vessel and placed in the microwave-irradiation zone [5]. After extraction (8 minutes of microwave irradiation at 200 W), the suspension was centrifuged and the resulting solution was evaporated in a rotary evaporator at room temperature under vacuum to dryness. The extract were stored at room temperature and in the dark [5].

The product of extraction was analyzed with HPLC, in order to detect oleuropein as the major polyphenolic compound present in olive leaves extract. The chromatograms were collected at 280 nm. The mobile phases consisted at the following: A: acetic acid (CH_3COOH) 2,5%,; B: acetonitrile and the flow rate 1,0 – 1,2 mL/min; temperature was held 30^oC and pressure 120 – 130 bar [7].

Also the extract was analysed with spectroscopy (IR), in order to define it's chemical structure. Spectra were recorded in a spectrometer FT/IR – 4200 JASCO, between 4000 – 400 cm^{-1} [4]. For the product were defined the yield, density, melting point and molecular weight by mean of osmometer KNAUER MEMBRANE-OSMOMETER.

3. Results and discussion

The results of analysis of the product of extraction are given in the table 1. Representative chromatogram of the extract and IR spectra are shown in (Fig.2) and (Fig. 3). All these data, are very closed with them of the literature for the oleuropein. It confirm that the olive leaves, are a source of oleuropein.

Table 1. Data of analyses of extract of olive leaves

Extract (sample)	*Yield (%)*	*Density (g/mL)*	*pH*	*Melting point (^oC)*	*Molecular weight (g/mol)*
1	17,5	1,51	6,17	90	550
2	16,8	1,51	6,18	92	552
3	17,1	1,52	6,17	89	549

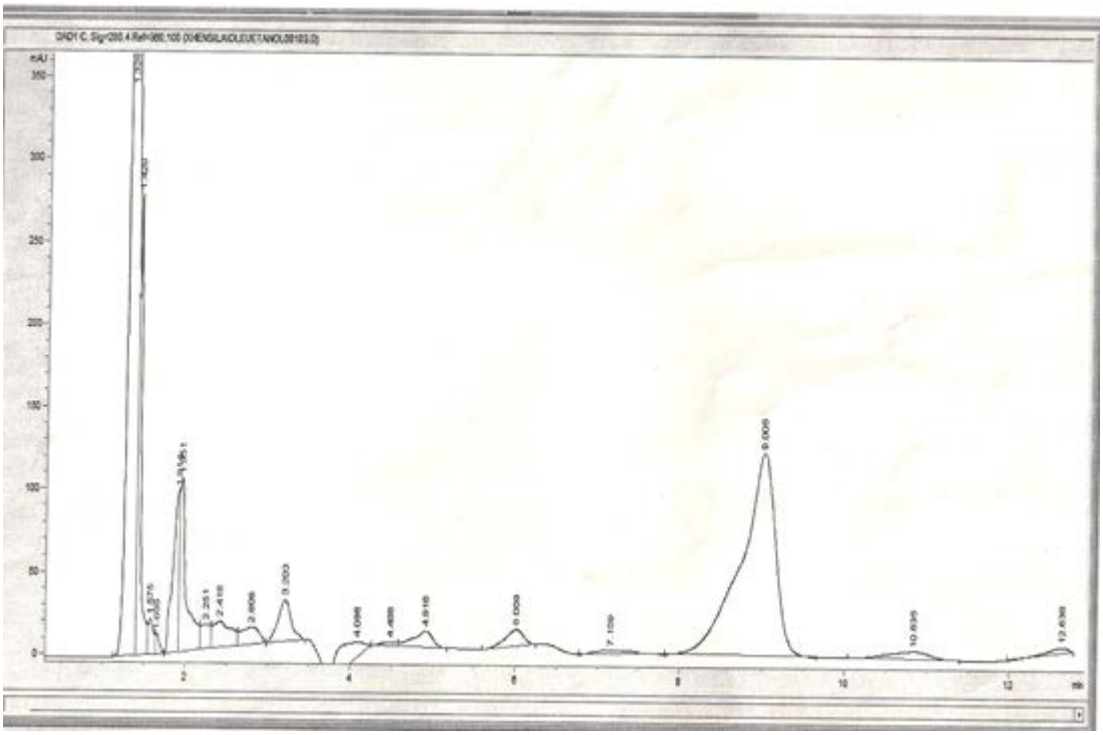

Figure 2. Chromatogram of the extract from olive leaves

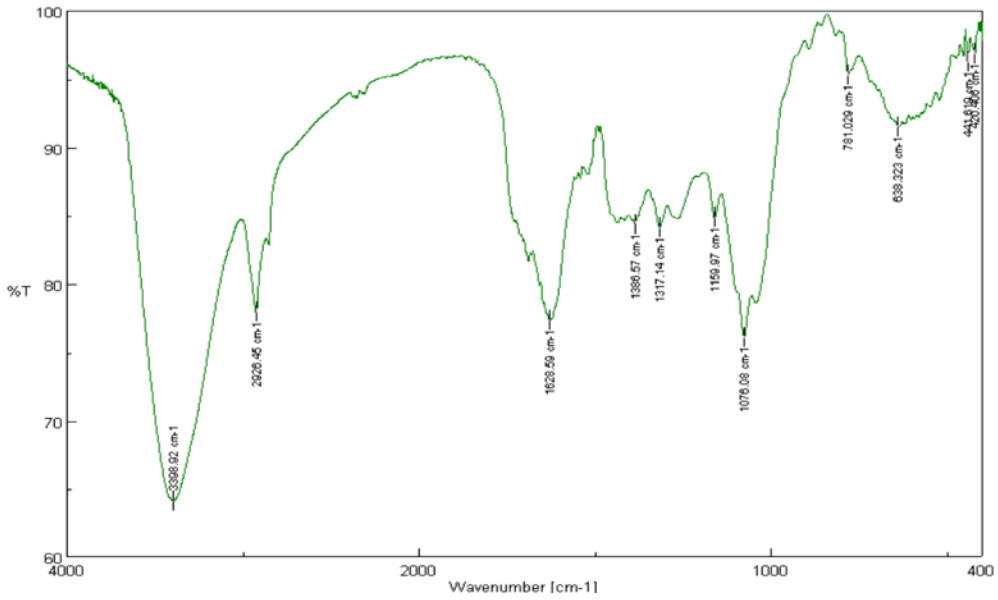

Figura 3. IR spectra of extract from olive leaves

This sharp pick is characteristic for oleuropein and is similar with the chromatograms of other studies. It seems that oleuropein is the major compound in the extract of olive leaves, as reported by many authors.

Also IR spectra of extract, give bands that are characteristical bands of oleuropein.

4. Conclusion

1. Oleuropein can be easily obtained from the olive leaves, by extraction method. Performed extraction with mixture ethanol-water (C_2H_5OH - H_2O) in microwave at 200W, was stored at low temperature and in the dark.
2. Oleuropein extraction yield of oleuropein from olive leaves was studied and the degree of purity of the products of the extraction, was good in this temperature without degraded the product.
3. The measurements of density, pH, melting point and molecular weight for the product of extraction show values which are much closed with them of the literature.
4. Analysis of the final product of extraction, and especially by means of HPLC and IR spectroscopy, show that is performed a good extraction of oleuropein contained at olive leaves. By comparison of these spectra with those of the literature, is concluded that the structure of the extract is very similar with that of oleuropein.
5. It's concluded that the oleuropein extracted from olive leaves, may be a good inhibitor of corrosion.

5. References

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