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STUDIES ABOUT THE INFLUENCE OF SOME ANTIOXIDANTS OVER OIL'S AUTOOXIDATION REACTION USING LASER INTERFEROMETRY

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Abstract

This paper presents a study about the influence of ascorbic acid, zinc and tocopherols over mineral oils auto oxidation reaction, using laser interferometer techniques.

The principle of this method consists in determination of refractive index changes of oil - lipase biochemical system using a laser interferometer. The fringes of interference modification in time are acquired in real time by a C.C.D. camera. The image processing and analysis and also the drawing of the graphics are realised by using a computer program made by the authors.

I. INTRODUCTION

The oil's auto oxidation reaction realised by the lipoxidase activity, produced through metabolic pathways in common micro organism in the presence of air and small quantities of water [1] is undesirable in every industry. So, they are used antioxidants to prevent these reactions [2].

This paper presents the influence of ascorbic acid, zinc and tocopherols over the mineral oils and technical lipids oxidation reaction with lipoxidase, using laser interferometry techniques which allow the study of rate of oxidation reaction in real time.

To determine the rate of the lipoxidase activity, the authors had created and realised a device which function principle is based on the determination of the refractive index variations at the radical mechanism oleic acid oxidation with lipoxidase. At each reaction step it takes place a modification of the refractive index, variation that is determined in real time.

The system realised is one complete integrating. So, using a Michelson interferometer is determined the modification in real time of the interference fringes due to the refractive index variations of the biochemical starch-amylase system, modification that is acquired and processed in real time by a computer which had attached a CCD camera [3].

The Michelson interferometer used provides interference fringes, which are formed on a screen made by a white sheet of paper, and so, the visual sensor that is located on the opposite side of the screen, acquires the image in optimum conditions. On the screen appear successive images with interference fringes (Heideger rings).

The solution refractive index is changing in time, in the same way that the hydrolysis reaction occurs, so on the screen appear new interference maxims that correspond to the different reaction steps.

The CCD visual sensor acquires the image formed on the screen and sends it to the Matrox IP 8 data acquisition board. The CCD sensor used had a density of 10000

receptors/mm^2, uniform distribute, and the total number of the receptor is 640x480, that determine a high resolution of the system [4].

The program realised by the authors and elaborated in C++ language offers the possibility of acquiring and processing images, processing which consists in the determination of the number of changes in the interference fringes [5].

The principle schemes of the conceptual and realised are presented in figure 1.

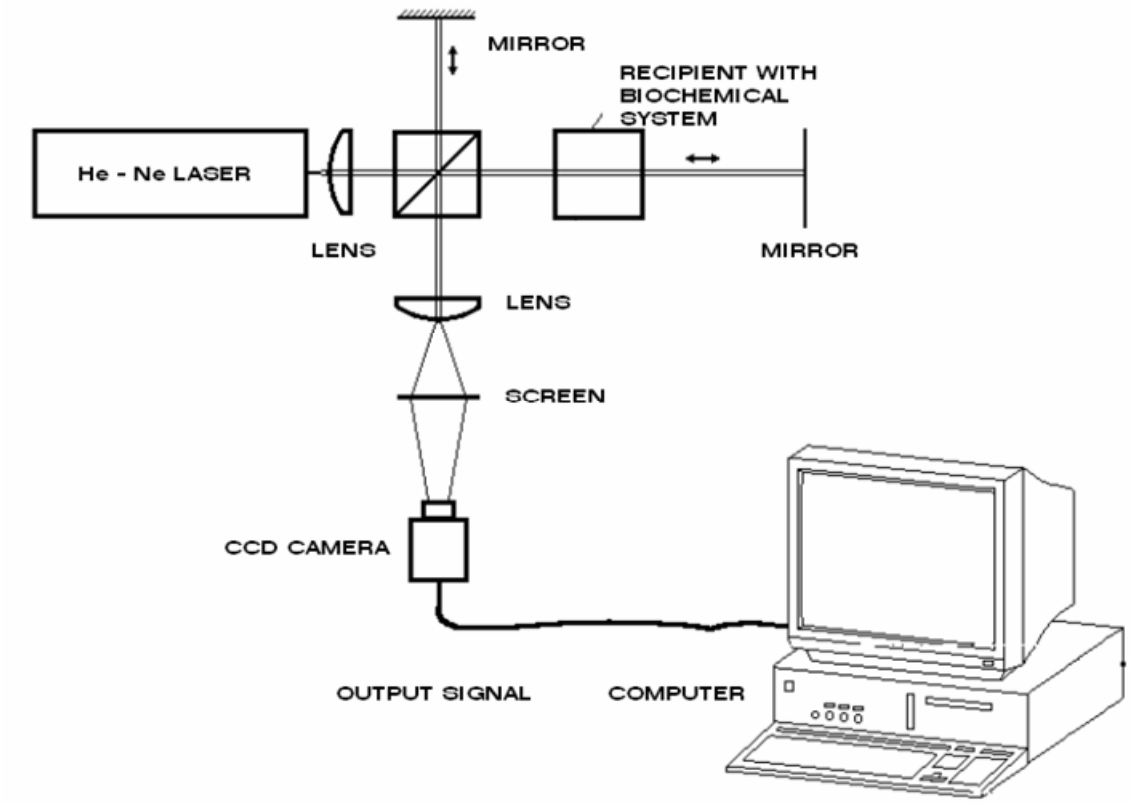

Figure 1. The principle scheme of the device

The component elements of the presented system in figure 1 are;

- He-Ne laser ;
- convergent lens;
- divisor plate;
- recipient with biochemical system;
- mirrors;
- divergent lens;
- screen;
- CCD camera;
- Computer with a data acquisition board.

II. EXPERIMENTAL

Reagents

Oleic acid supplied by Merck, Darmstadt was used as standard substrate and as enzyme it was used an enzymatic preparate of fungic lipoxidase supplied by Worthington USA.

As antioxidants were used solutions 0,05N of $ZnCl_2$, ascorbic acid, and alpha-tocopherol supplied by Merck.

Interferometer analysis

In the recipient located on the interferometer it was introduced 5 ml substrate, 0,2 ml enzyme, 0,1 ml $ZnCl_2$ 0,05N (sample 1), 0,1 ml ascorbic acid 0,05N (sample 2) and 0,1 ml alpha-tocopherol (sample 3) and 1 ml acetate buffer ph 4,7 as shown in table 1.

Table 1. Lab techniques

	Control	**Sample 1**	**Sample 2**	**Sample 3**
Oleic acid	5ml	5ml	5ml	5ml
Lipoxidase	0,2ml	0,2ml	0,2ml	0,2ml
Acetate buffer pH 4,7	1ml	1ml	1ml	1ml
Antioxidants	0,1 ml DW	0,1ml $ZnCl_2$ 0,05N	0,1ml ascorbic acid 0,05N	0,5ml alpha-tocopherol 0,05N

For the samples was made a control, identically with the tests, except that in the control there was no ion solution.

When the lipoxidase is introduced in tube, the oxidation reaction started and the rate of oxidation is expressed as the numbers of changes of refractive index in time.

III. RESULTS AND DISCUSSIONS

The graphics (numbers of changes vs. time) were realised by using a computer program made by the authors and are shown in figure 2.

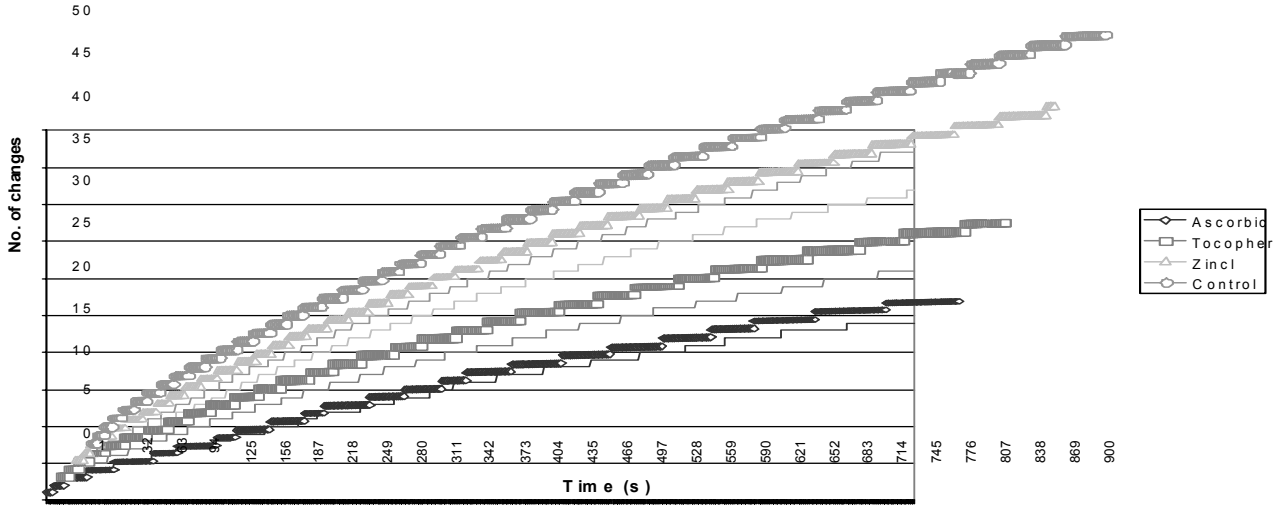

Figure 2. *The influence of Zn^{2+}, ascorbic acid and α- tocopherol over the lipid oxidation with lipooxidase*

All antioxidants decreased the rate of enzymatic reaction. The greatest antioxidant activity had ascorbic acid, followed by alpha-tocopherol and the zinc ions. They interacted

with the free radicals formed in the mechanism of the biochemical oxidation and interrupted the chain of radical reactions.

IV.CONCLUSIONS

Using antioxidants as ascorbic acid, tocopherols and zinc, even in very small quantities, the rate of biochemical auto oxidation reaction decreased in a large manner. So these antioxidants preserved the chemical properties and the lifetime of the technical lipid materials and oils.

The laser interferometer techniques used in the determination of hydrolysis reaction allowed the study of the kinetic reaction and required very small reagent quantities and a very short time for analysis. The CCD visual sensor and the computer program realised by the author offers the possibility of acquiring and processing images and the 'visualisation' of the chemical reaction in real time. This method can be used successfully in many research domains and industrial sectors.

V.REFERENCES

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