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STUDY ON THE EFFECT OF UV RADIATION OVER TIME ON THE OILY MACERATION OF HOT PEPPERS

BY

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Abstract. This study analyses the stability of hot pepper extract in time, but also under the action of UV radiation. The experimental data show that, after a long time (4 years), the oily macerated samples of hot peppers do not present major changes, being resistant to photochemical degradation. Moreover, it is more resistant to photo-degradation than the sunflower oil initially used for maceration

Keywords: extraction, hot peppers, oily maceration, photo-degradation.

1. Introduction

Hot peppers can be considered as part of the category of versatile vegetable products because, in addition to their composition rich in nutrients, they can also adapt very easily to environmental conditions, with very large crops being found on the territory of Romania (Bojor and Perianu, 2005). In the specialized scientific literature, there are numerous studies highlighting the therapeutic and nutritional properties of hot peppers from different varieties and regions (Cichewicz and Thorpe, 1996; Del Rosario García-Mateos *et al*., 2013;

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Gannon *et al*., 2016; Johnson 2007; Quinones-Seglie *et al*., 1989; Lujan *et al*., 2021; Mauricio-Castillo *et al*., 2017; Morán-Bañuelos *et al*., 2008; Peredo-Lovillo *et al*., 2019; Ruiz-Sánchez *et al*., 2022; Tsui *et al*., 2018).

Tam Jalapeno chili peppers are strongly flavoured, with a hotness level between 2500-8000 Scoville degrees and a composition rich in phenols, flavonoids, capsaicinoids, vitamin C and antioxidants (Alvarez-Parrilla *et al*., 2011; O'Neill *et al*., 2012). It also contains capsaicin and other essential elements with many applications in the food and cosmetic industry (Bojor and Perianu, 2005).

They can be preserved in different forms, in the specialized literature mentioning the fact that, through processing, preserved products are obtained with similar chemical compositions and higher energy value than those from which they came. In this regard, in a previous study, it was shown that hot peppers of the *Tam Jalapeno* variety retain their properties even after processing (Cobzaru *et al*., 2019).

One of the frequently encountered methods for preserving hot peppers is maceration in vegetable oil. However, a negative aspect of preserving vegetable products in vegetable oil is the phenomenon of degradation because, in the case of long-term preservation, it can lead to changes in appearance, quality and composition.

It is known that the degradation phenomenon occurs when products are exposed to light and it is confirmed by literature studies (Stoll *et al*., 2019; Vaskova and Buckova, 2022; Spatari *et al*., 2017; Sándor and Agachi, 2011; Mohd-Rus *et al*., 2009; Rus *et al*., 2008). Moreover, our previous studies (Cobzaru *et al*., 2016a; Cobzaru *et al*., 2016b; Cobzaru *et al*., 2021) on the degradation of sunflower and olive oils over time, have showed a change in the values of the quality parameters as a result of their oxidative degradation.

Taking into account these aspects, the main objective of the work is to analyse the stability of hot pepper extracts over time and also under the action of UV radiation. For the experiments, the oily macerates of hot peppers were subjected to photo-degradation, and the results were analysed by UV-Vis spectroscopy. We note that the hot pepper oil extracts were obtained in a previous study and are 4 years old.

2. Experimental

1. Preparing and preserving hot peppers

The preparation of plant material and its preservation in sunflower oil have been presented in a previous study (Cobzaru *et al*., 2019).

2. Photo-degradation of hot pepper oily macerates

The photo-degradation was carried out in the Inorganic Chemistry laboratory of the Faculty of Chemical Engineering and Environmental Protection "Cristofor Simionescu" Iași, and the working method is as follows: a sample of

50 mL was irradiated for 7 hours with ultraviolet radiation generated by a 18W Hg UVB lamp, with the incident radiation intensity of 2.1 W/m^2. The distance between the UV radiation source and the samples is 2 cm. After 1 hour time interval, samples were taken (approximately 4 mL) and analysed by UV-Vis spectroscopy (with LLG LABWARE spectrophotometer). The samples were continuously stirred (magnetically stirred). The intensity of the incident radiation was determined to be 2.1 W/m^2 (Hamamatsu C9536-01, detector H9958 for 310-380 nm, calibrated between 1µW/cm^2 and 100 mW/cm^2).

3. Results and Discussions

As it was mentioned in introduction, light (especially through its UV component) is a determining factor in the degradation of products because the degradation reactions caused by it have a negative impact not only on the appearance and quality but also on their chemical composition. The interaction of a beam of ultraviolet radiation with a complex mixture of substances (with different structures and concentrations), as in the case of oil extracts, leads to multiple and difficult to predict photochemical effects, with the formation of intermediate products (isomerization products, photofragmentation, etc.) (Avila Orozco *et al.*, 2020). Moreover, in the case of oils or oily derivatives, there is a risk of rancidity, which, in addition to light, can be accelerated by temperature, packaging, ionizing radiation, catalysts, etc.

To test the resistance of pepper oil extracts obtained in a previous study, which are 4 years old, they were irradiated with ultraviolet radiation for 7 hours, and its effects were analysed by UV-Vis spectroscopy. Figure 1 shows the UV-Vis spectrum for the hot pepper oil extract subjected to irradiation.

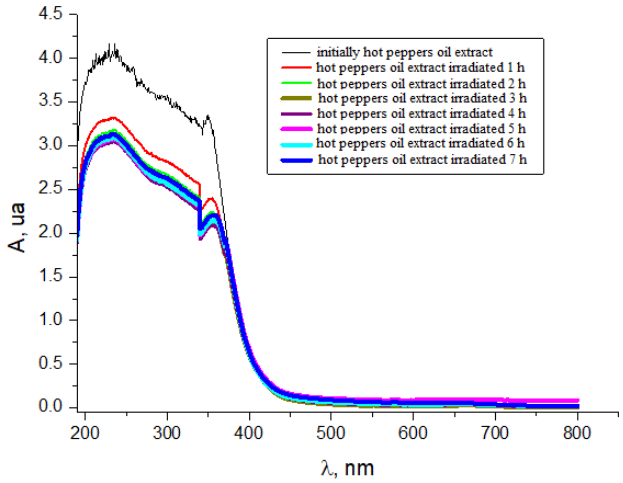

Fig. 1 − UV-Vis spectrum for the hot pepper oil extract irradiated with ultraviolet radiation for 7 hours.

All samples show approximately the same absorbance pattern with absorption maximum in the ultraviolet region, with absorption bands at approximately 240 nm and 360 nm, bands that are used for monitoring degradation products in vegetable oils. Capsaicin (200-350 nm), phenolic compounds (270-330 nm) and tocopherols (325 nm) absorb in this wavelength range, but the contribution of some fatty acids can also be taken into account (De Oliveira *et al*., 2019; González-Zamora *et al*., 2015; Mikołajczak *et al*., 2021).

As an observation, there is a big difference between the initial sample and the irradiated ones. This can be attributed to the fact that by exposure to UV radiation there is a decrease in the absorbance values justified by a great amount of destruction of the active compounds from the sample. However, for all 8 analysed samples, the absorption maxima are found at the same wavelength, fact that proves that in the macerate, even after a long time since obtaining it (4 years), there are fatty acids that absorb light in the ultraviolet range. But the oily maceration of hot peppers is not completely stable, this being observed after 5 hours of irradiation. Moreover, in the wavelength range 350-380 nm, a greater decrease in the absorbance value is observed, which proves that several active compounds in the chemical composition of the macerate have been damaged under the action of ultraviolet radiation, and therefore, the macerate cannot be further used. For a better understanding, the wavelength range of 350-380 nm is shown in detail in Fig. 2.

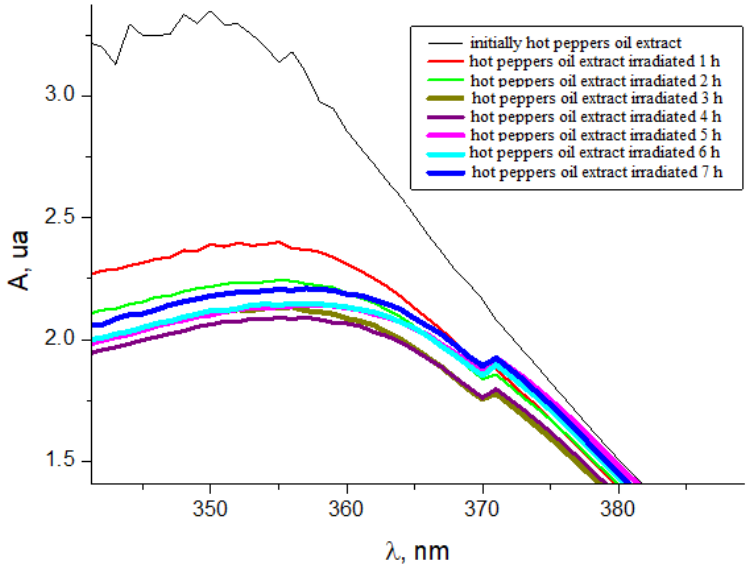

Fig. 2 − UV-Vis spectrum for hot pepper oil extract irradiated for 7 hours in the range of 350-380 nm.

Figure 3 shows the UV-Vis spectrum for a simple sunflower oil sample that was initially used to obtain the hot pepper oil macerate and was irradiated for 3 hours.

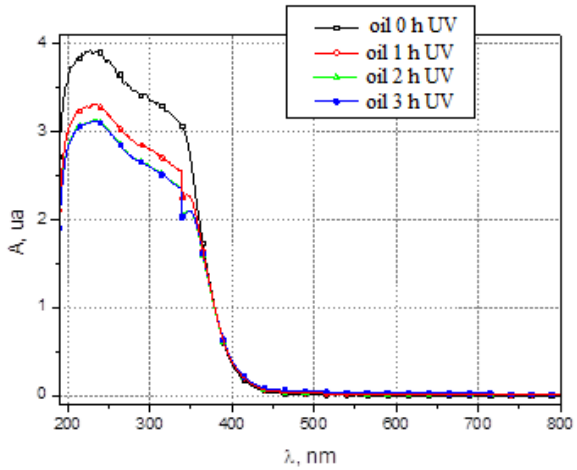

Fig. 3 – UV-Vis spectrum of sunflower oil irradiated for 3 hours.

It can be observed, that the sunflower oil sample presents a behaviour similar to that of the hot pepper maceration extract when it is irradiated. The absorption maximum peaks are found at the same wavelength range, indicating that the sample contains fatty acids that absorb light in the ultraviolet range. It can also be seen that the plain oil sample was deteriorated after 3 hours of exposure to UV radiation. For a better understanding, Fig. 4 shows the UV-Vis spectrum for the simple oil sample irradiated for 3 hours in the range of 400-500 nm.

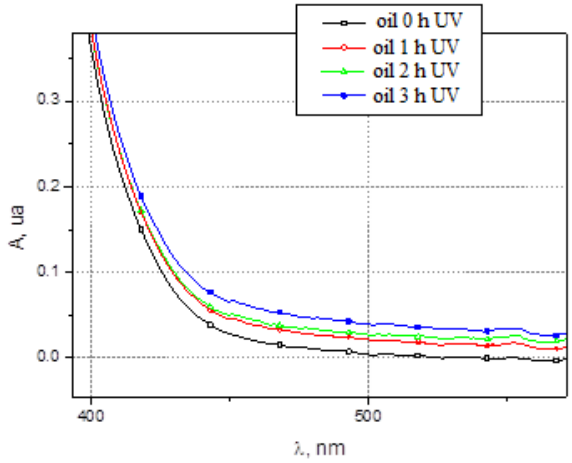

Fig. 4 − UV-Vis spectrum for the simple oil sample irradiated for 3 hours in the 400-550 nm range.

Compared to the oily macerated samples of hot peppers, which under the action of ultraviolet radiation deteriorated after about 5 hours (figure 1), we can say that a simple oil sample is deteriorated much faster than one in which various active compounds are found.

4. Conclusions

This study highlights the stability of the hot pepper oil extract in time, but also under the action of UV radiation. The experimental data show that, after a long time (4 years), the oily maceration extracts of hot peppers do not present major changes, being resistant to photochemical degradation, possibly due to the contained active compounds. Moreover, it is more resistant to photo-degradation than the sunflower oil initially used for maceration.

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STUDIU PRIVIND EFECTUL RADIAȚIEI UV ÎN TIMP ASUPRA MACERATELOR ULEIOASE DE ARDEI IUTE

(Rezumat)

Acest studiul analizează stabilitatea extractului de ardei iute în timp dar și la acțiunea radiațiilor UV. Datele experimentale arată faptul că, după un timp îndelungat (4 ani) maceratul uleios de ardei iute nu prezintă modificări majore, acesta fiind rezistent la degradarea fotochimică. Mai mult, acesta este mai rezistent la fotodegradare decât uleiul de floarea soarelui folosit inițial la macerare.