Spectrum Journal of Innovation, Reforms and Development
Volume 15, May, 2023 | ISSN (E): 2751-1731
Website: www.sjird.journalspark.org

# CAPSAICIN EXTRACTION FROM HOT PEPPERS

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**ABSTRACT:**
The article studied the extraction process from hot pepper crop to develop a method for the analysis of capsaicin. Effects of extractant, hydromodulus and particle sire on carsaicin extraction rate and frequency were studied.

**Keywords**: Capsaicin, hot pepper, extraction, extractant, hydromodulus.

## Introduction

Pepper is an ancient cultural plant of tropical Central and South America. Mexico and Guatemala are his homeland. Sweet pepper began to be grown 700 years before our era, as well as hot pepper 2000 years ago. China, Mexico and Turkey produce 70% of the pepper developed in the world. In 1998-2007, the share of hot pepper in total world imports to European countries was 43.8%, including Germany - 18.9%, England - 7.2%, France - 6.9%, Netherlands - 4.8%, Italy - 3.6%, Czech Republic - 2.4%.

The hot pepper crop contains a biologically active substance called capsaicin. Oleorezin capsicum (OC) (lot. Oleoresin Sapsicum) is an exstrakt of hot pepper, made up of resin and concentrated capsaicinoids. It is widely used as an irritant in the preparation of special tools.

To develop a method for analyzing capsaicin, the process of extraction from the crop of hot peppers was studied. The effect of the size of the extracent, hydromodule, particles on the rate and carality of capsaicin extraction has been studied. Liquid extraction of capsaicin was carried out by constant mixing of the dry crop of hot peppers and changing the hydromodule to a ratio of 20:1 to 50:1. Methanol, ethanol and their aqueous solutions were used as an extract. The effectiveness of the extraction was assessed by the total amount of extractive substances and capsaicin. Analysis of the extracts was carried out by spectrophotometry, high-performance thin-layer and liquid chromatography methods. A study of the extraction rate showed that the establishment of capsaicin concentration balance would not depend on the extraction hydromodule and the type of extract. Grinding raw materials into pieces smaller than 2 mm will reduce the balance setting to 60 Minutes. Extraction in five steps is necessary to bring capsaicin levels up to 99%. It is not advisable to Grind raw materials to sizes less than 1 mm. This does not lead to a reduction in extraction time, and also makes it difficult to filter extracts.

Many plants contain substances that have antioxidant properties. Such substances also include capsaicin and its derivatives, which are formed in spicy varieties of red pepper. At the same time, hot pepper is a crop that is the only source of capsaicinng [1].

It is capsaicin and its derivatives (capsaicinoids) that strongly affect the upper respiratory tract, skin coatings and mucous membranes. Therefore, they are widely used in gas guns and aerosol devices [2]. When taken through the digestive tract, capsaicin has acute toxicity ($LD_{50}$) of 47.2 mg/kg mouse weight, while acute toxicity ($LD_{50}$) when exposed to the dermal mass is 512 mg/kg mouse weight.

A test was proposed in 1912 by American chemist scientist Wilbur Scovill to measure the bitterness or pungency of peppers. The bitterness of pepper named the unit of measure after him - Scovill (scoville). Capsaicin has a bitterness of 16 mln. skovill is equal to a unit, pepper ballonkin bitterness-from 2 to 5 million. up to Scoville, cayenne pepper has bitterness - 50 thousand units, while sweet paprika – 0 Units [3].

Capsaicin ($C_{18}H_{27}NO3$)-8-methyl-n-vanylyl-trans-6-nonenamide, molar mass 305.41 g/mol, liquefaction temperature 0.01 mmHg at pressure 210 to 220°C. Capsaicin is practically insoluble in aqueous solutions, but dissolves well in organic solvents, ethyl alcohol and oils. When capsaicin is hydrolyzed, vanilylamine and desylene (methylnonen) are broken down into acid. The structure of capsaicin was determined in 1920 and confirmed in 1930 by synthesis from the chloranghydride of vanilylamine and desilenic acid (Figure 1).

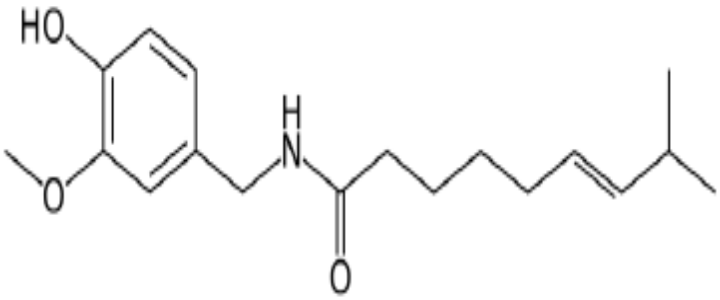


Figure 1. Structure formula of capsaicin

Capsaicinoids have high biological activity - antioxidant, anticancerogenicity, anti-inflammatory properties [4]. The different varieties of peppers are known to differ greatly from each other in their morphological characteristics and biochemical composition in relation to the genotype, as well as the conditions of cultivation of the crop. The medicinal substances that contain capsaicin are widely used to treat inflammations of various etiologies.

One of the actions that determines the reliability of the analyzes consists in preparing the target substance or a sample that provides a clear separation of the group of substances from the Matrix being analyzed. One common method of extracting biologically-active substances from plant raw materials, including capsaicin, is extraction. Extraction uses ethanol, aqueous solutions of ethanol, methanol, acetonitrile, and acetone. To speed up the extraction process, grinding raw materials, cavitation processing, microwave and ultrasonic (UT) exposure are applied to it. But the data on the indicators of the extraction process, which ensure the complete extraction of capsaicin from plant raw materials, are not presented in the sources of the

literature, so the study of capsaicinoid extraction is an urgent task. For the study, a dried (fresh) sample of Hot Pepper of the Margilon 330 (spicy) variety, an analytical standard Sigma-Aldrich, containing at least 99% capsaicin, was used.

To extract biologically-active substances from plant raw materials, an ultrasonic bath of Sonorex DK 255 p with an effective power of 160 W and an ultrasound frequency of 35 kGs, as well as a mixing (shaking) device WU-4 (Poland) were applied. Ethyl alcohol with a mass content of 94%, as well as aqueous solutions of ethyl and methyl alcohols, were used as an extract. The extracted extracts were filtered. The whole pepper crop was ground in a mechanical grinding method, sifted with holes of 5; 2 and 1 mm.

Extract analysis is carried out in a spectrophotometric way, at a characteristic wavelength of 280 nm, using a two-beam scanning Shimadzu UV - 1800 spectrophotometer, with a spectrum range of 190 to 1100 nm and with data software processing software; with the VEJX method in the Varian 920-LC chromatograph; with an external standard method of quantifying capsaicin; with a highly efficient thin-layer chromatography method; with chloroform and conducted in ethanol eluting systems.

An analytical standard spectrogram of capsaicin (Figure 2) and a comparison of spectrograms obtained using various extracents (Figure 3) showed maximum absorption in the ultraviolet area of the spectrum, which was specific to capsaicin and was also recorded in extracts regardless of the type of extracents used. A relatively large amount of extractive substances was obtained in the extraction of an extractive mixture with a 90% solution of ethanol in water (79 ± 1) in conditions of heating to a temperature of°C (Figure 3, curve 4).

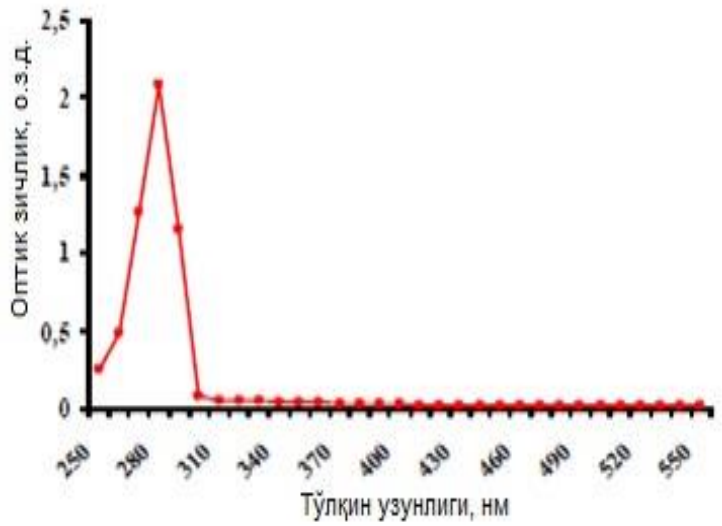


Figure 2. Spectrogram of solution of Sigma-Aldrich capsaicin analytic standard in methanol

When researching the component composition of extracts using a mixture of chloroform and ethanol in different proportions as an eluent with a highly effective thin-layer chromatography method (after making chromatograms later visible with iron chloride and potassium ferracianide), it was confirmed that capsaicinoids are only present in the entire pepper crop extract.

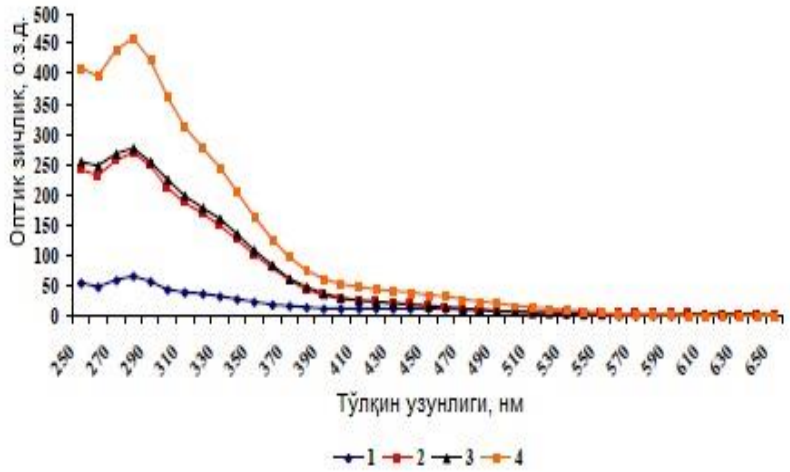


Figure 3. The whole pepper crop is obtained using various extracents-extract spectrograms: 1 - ethanol; an aqueous solution of 2 - 70% ethanol; an aqueous solution of 3 - 70% methanol; an aqueous solution of 4-90% ethanol (79 ± 1)°C temperature.

**Conclusion**

The results of multifactor experiments gave the opportunity to determine the Basic Laws of extraction, as well as confirm that extraction of crushed raw materials and ethanol in a 70% solution of Water provides a complete extraction of capsaicin from the hot pepper crop.

The properties of the extracted extracts were studied and the extraction parameters were based on: the duration of the extraction is 30 minutes; the use of a 70% solution of ethanol in water as an extract; three-step extraction with 1:50 hydromodules; grinding the raw materials in a size of 2 mm > d > 1 mm; holding the raw materials in distilled water for 1:5 When the above parameters are observed, the release of capsaicin is more than 99%, while the extraction time is reduced twice (from 5 hours to 2.5 hours). This allows the extraction to be selected as a method in extracting capsaicin from the hot pepper crop. In the course of research, methods are developed for the rapid and effective detection of capsaicin using the highly effective liquid chromatography method.

The Academy of Sciences of the Republic of Uzbekistan for its practical assistance in preparing the experimental part of the article. We express our gratitude to the management of the Institute of plant substance chemistry.

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