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MICROSCOPIC INVESTIGATIONS ON THE EFFECT OF TEMPERATURE ON ONION SEED CELL DEGRADATION

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Abstract: The oil and fat industry is one of the leading sectors of Uzbekistan's food industry. Existing systems in the oil and fat production sector are designed to process large quantities of primarily homogeneous raw materials. However, there is currently no system for processing onion seeds. To process onion seeds, it is necessary to establish small-scale production lines and optimize the technological processes used in oil production. Methods such as drying and microscopic examination of oil-bearing raw materials, followed by comparative analysis, were employed. Locally grown onion seeds of the Qaratol variety from the Kashkadarya region of Uzbekistan were used as raw materials. Additionally, a B-510PH Biomolecular Microscope and a KERN DBS60-3 Moisture Analyzer were used in the experimental studies.

Keywords: onion, temperature, microscope, moisture, drying, press, ingredient, antioxidant.

Introduction. Processing fruit and vegetable seeds is one of the primary tasks in the global food industry today. Conducting research on onion seeds, which are among the most important vegetables used in human nutrition, offers opportunities to create new products rich in biologically active compounds beneficial to human health. Onions are not only a staple food but also their seeds are a valuable source of oil for applications in pharmaceuticals, cosmetics, and the food industry.

Onion (*Allium cepa*) is one of the most important spices cultivated globally and is consumed in various forms. It has been cultivated for over 4,000 years [1]. In the past decade, global onion production has increased by at least 25%, reaching approximately 44 million tons, making it the second most important vegetable crop after tomatoes [2].

The growing demand for onions is attributed to their nutritional and medicinal benefits, including hypocholesterolemic, thrombolytic, and antioxidant properties [3]. While onion seeds are consumed as food, they are not yet widely used for commercial purposes. It is likely that if consumers were better informed about the nutritional and functional properties of onion seeds, the demand for this product would increase [4].

One of the most extensively studied effects of onions is their anti-asthmatic activity, which is associated with their anti-inflammatory properties. Additionally, a patented pharmaceutical or veterinary product prepared from a mixture of onion and coconut (*Cocos nucifera*) has been developed to control brain parasites (nematodes) and/or flatworms (*Platyhelminthes*) in humans and animals [5-6].

The addition of functional ingredients to dairy products represents a new technological approach in the food industry. Onion seed oil, extracted through the cold-press method, is a functional oil distinguished by its health benefits. The presence of biologically active compounds in onion seed oil makes it suitable for inclusion in food products. This oil can be incorporated into dairy products like cheese, enhancing their functional properties. The antioxidant, anti-inflammatory, and other therapeutic characteristics of onion seed oil facilitate its wide application in the food industry [7].

Mechanical pressing (cold pressing) is a cost-effective and less labor-intensive oil extraction technique compared to other methods. The safety and simplicity of cold-press extraction make it advantageous over solvent-based extraction equipment. Additionally, products obtained through pressing generally retain their natural properties better, remain free from chemical contamination, and ensure a safer process [8].

Using supercritical fluid extraction, the yield of onion seed oil was found to be 12.08%. The extraction process was carried out under set conditions of 35–45°C temperature, 15–25 MPa pressure, and extraction times ranging from 30 to 90 minutes. Onion seed oil obtained through supercritical fluid extraction contained 41.7% linolenic acid and 37.3% oleic acid, with a linolenic-to-oleic acid ratio of 0.89 [9].

This article provides practical guidance on oil extraction processes and various pressing methods [10]. The cold-pressing method is conducted at low temperatures, preserving the properties of the oil [11]. Cold-pressed oils are increasingly gaining market interest because no solvents are used in their production process, and there are no additional processing steps beyond pressing and filtration. A critical factor in the cold-pressing process is the temperature of the oil as it exits the press [12-13].

Cold pressing is a safe and non-harmful method for extracting and processing edible oils, preserving bioactive components by eliminating heat, chemical treatments, and refining processes [14, 15, 16]. The consumption of cold-pressed oils (CPOs) is steadily increasing due to the presence of health-supporting compounds, such as polyunsaturated fatty acids (PUFA), tocopherols, sterols, and polyphenols. These oils are enriched with high-quality bioactive substances that are beneficial for the body. Oils can be extracted from all fruits using the pressing method [17-18].

Cold Pressing - Cold pressing is a mechanical process of extracting oil without the use of chemicals or high temperatures, resulting in oils that are natural and pure. The following stages are outlined in the source: Seed Cleaning and Sorting: Before cold pressing, seeds must be cleaned and sorted to remove impurities and contaminants. This step ensures the elimination of foreign substances and harmful impurities, which improves the quality of the oil. Crushing: The cleaned seeds are subjected to a crushing process, breaking them into smaller pieces. Crushing facilitates oil extraction and enhances the efficiency of the pressing process. Drying: The crushed seeds are dried, as excessive moisture can slow down the oil extraction process or degrade the quality of the oil. Drying optimizes the moisture content of the seeds for efficient oil extraction. Pressing: During this stage, the seeds are pressed under high pressure, resulting in the release of oil. The cold pressing method preserves the quality of the oil, as the process avoids the use of high temperatures [19]. Due to these advantages, large-scale reforms are being implemented in the oil production industry in our country. To supply the market with consumer goods, measures are being taken to activate oil production industries across all regions and establish new production facilities [20]. Based on the analysis of the above studies, we aimed to conduct research on extracting oil from onion seeds using the cold pressing method. The following experimental work was carried out: prior to extracting oil from onion seeds, the effect of temperature over time on the oil content and the changes in the composition of onion seeds were observed.

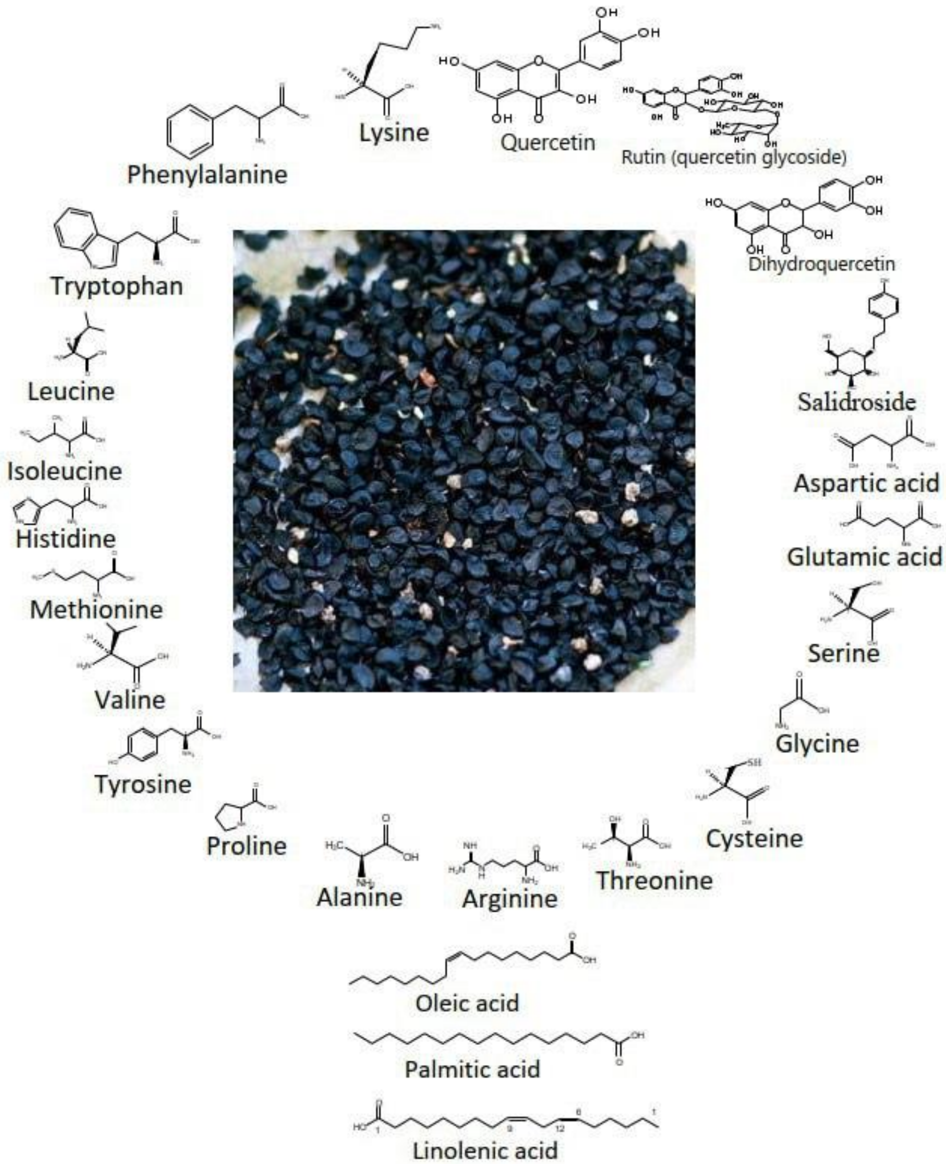


Figure 1. Functional Compounds in Onion (*Allium cepa*) Seeds

Materials and Methods. The onion (*Allium cepa*) seeds were purchased from the medicinal plant section of the Erqorgon market in Qarshi, Uzbekistan. The collected samples were cleaned of foreign impurities, washed, and air-dried. The onion (*Allium cepa*) seeds were stored in hermetically sealed bags.

B-510PH

Observation mode: Bright field, phase contrast, and dark field (dry).

Head: Trinocular (fixed 50/50), 30° tilt, 360° rotation.

Interpupillary distance: Adjustable from 50 to 75 mm.

Diopter adjustment: Left eyepiece.

Eyepieces: WF10x/22mm, high point eyepieces, with rubber cups.

Nosepiece: Five-position rotating nosepiece, with ball-bearing rotation.

Objectives:

– IOS W-PLAN PH 10x/0.25

– IOS W-PLAN PH 20x/0.40

– IOS W-PLAN PH 40x/0.65

– IOS W-PLAN PH 100x/1.25 (oil immersion)

All objectives are antifungal treated.

Sample Stage: Two-layer mechanical stage without a stand, dimensions 233x147mm, X-Y range 78x54mm.

Focusing: Coaxial coarse (adjustable tension) and fine focusing mechanism with limiting stop to prevent contact between lenses and samples.

Condenser: Phase contrast condenser (10x/20x, 40x, 100x), dark field (dry) and bright field.

Illumination (Full Koehler type): 3.6 W (6300 K) white X-LED^3, diffused. Multi-pin external power supply 100-240V AC/6V DC.

Moisture Analyzer Composition:

Moisture content was determined using the KERN DBS60-3 analyzer, manufactured in the Federal Republic of Germany.

The KERN DBS60-3 analyzer is equipped with a scale with 0.001 precision, a thermometer, and displays the percentage change in moisture over time on the screen.

Experiment and Results

Microscopic Study of Heat Treatment on Onion (*Allium cepa*) Seeds

Research was conducted to investigate the effect of heat treatment on the disruption of oil cells in onion (*Allium cepa*) seeds. In section A of Figure 2, when the onion seed was not subjected to heat treatment, the oil within the cell remained intact, as observed under the microscope. In section B, after the onion seed underwent heat treatment, changes in the oil cell structure were observed under the microscope.

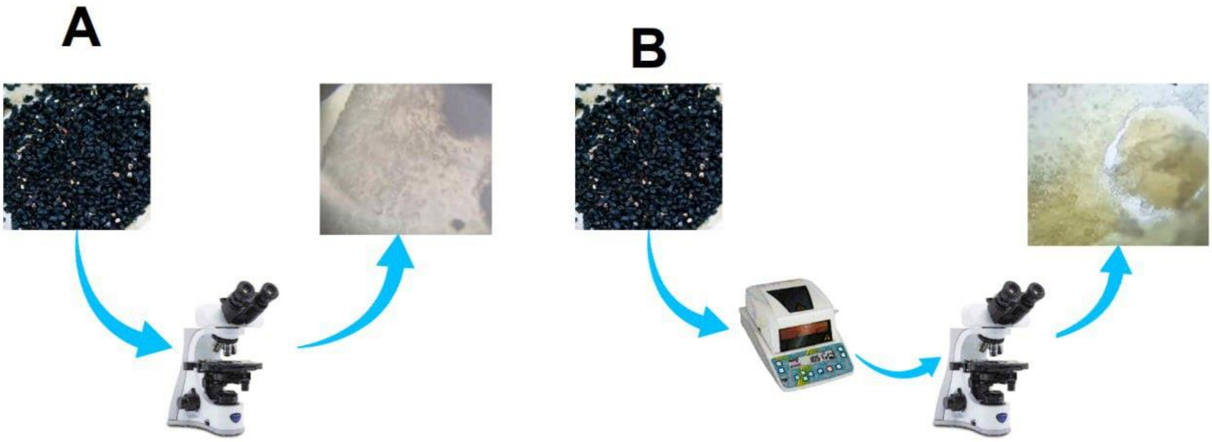
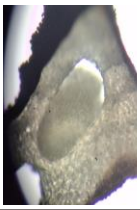
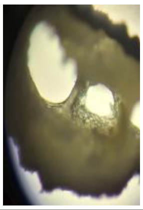
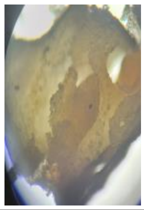
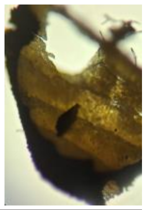


Figure 2. Microscopic View of the Effect of Heat Treatment on Onion (*Allium cepa*) Seeds

Table 1. Moisture Loss and Changes in the Onion Seed Core During 30 Minutes of Heat Treatment at Different Temperatures.

№	1	2	3	4	5	6	7
Heat Treatment Temperature, °C	No Heat Treatment	60	70	80	90	100	110
Moisture Loss, %	-	4,1	4,3	4,8	5,5	5,8	6,4
Seed Core Appearance Under Microscope							

The effect of heat treatment on onion seeds over a 30-minute period and moisture loss was studied in the temperature range of 60°C to 110°C, as shown in part B of Figure 2. At 60°C, the seed moisture content decreased by 4.1%, at 70°C by 4.3%, at 80°C by 4.8%, at 90°C by 5.5%, at 100°C by 5.8%, and at 110°C by 6.4% (Table 1). As seen in the microscopic appearance of the seed core in Table 1, direct heat treatment of the onion seeds at 80°C resulted in a 4.8% reduction in seed moisture, with the seed cell structure being disrupted and maximum oil yield observed. This is also reflected in Graph 1, where an increase in temperature leads to the occurrence of burning in the seed core, causing the breakdown of bioactive compounds present in the seed.

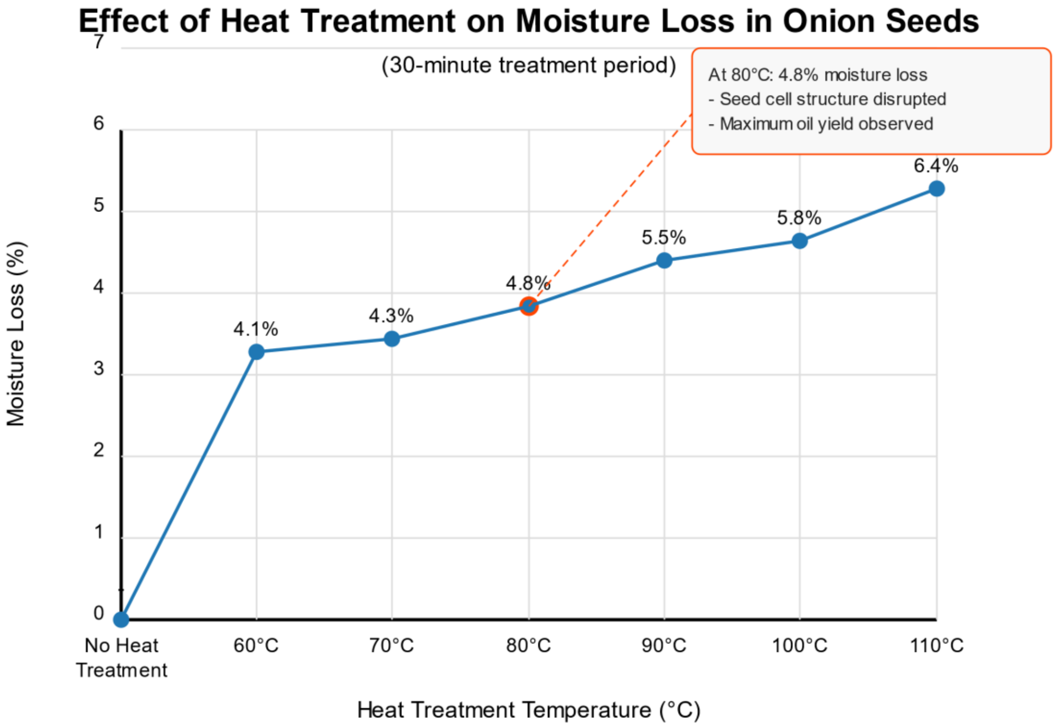


Figure 1. The effect of heat treatment on onion seeds over a 30-minute period and moisture loss

In our future research, we plan to extract oil from onion seeds by subjecting them to heat treatment at 80°C for 30 minutes using a laboratory apparatus.

Conclusion. This paper provides information on onion (*Allium cepa.*) seeds and the beneficial components contained within them. Several experiments were conducted to investigate the effects of heat treatment on the disruption of seed cells, and positive results were achieved. The study focused on the moisture loss during heat treatment and the impact of heat treatment temperature on seed cell disruption. The process of heat treatment in the temperature range of 60°C to 110°C over 30 minutes was explored. When onion seeds were directly subjected to heat treatment at 80°C, the moisture content decreased by 4.8%, and seed cell disruption resulted in maximum oil extraction, which was considered the optimal condition.

If local onion seed processing is implemented, it will lead to the creation of a new type of biologically beneficial product that can replace imports, providing economic efficiency.

References

1. Peter K.V. "Handbook of herbs and spices". United Kingdom: Woodhead Publishing. 2001, Vol. 1.

2. Yang C., Li L., Yang L.G., Lu H., Wang S.K., Sun G.J "Anti-obesity and Hypolipidemic effects of garlic oil and onion oil in rats fed a high-fat diet". *Nutrition & metabolism*. 15 (2018): 1-8.

3. Thirusendura Selvi D., Saraswathy S. "Seed viability, seed deterioration and seed quality improvements in stored onion seeds: a review". *The Journal of Horticultural Science and Biotechnology*; 2018, 93(1): 1-7.

4. Yalcin H., Kavuncuoglu H. "Physical, chemical and bioactive properties of onion (Allium cepa L.) seed and seed oil". Journal of Applied Botany and Food Quality; 2014, 87.

5. Preedy, Victor R., ed. "Essential oils in food preservation, flavor and safety". Academic press; 2015.

6. Vazquez-Armenta F J., Cruz-Valenzuela M. R., Ayala-Zavala J. F. "Onion (Allium cepa) essential oils". *Essential oils in food preservation, flavor and safety*. Academic Press, 2016. 617-623.

7. Mohichehra S., Rifky M., Dissanayake K., Farmonov J., Boynazarova Y., Meyliyev A., Samadiy M. "Technology Development to incorporate Onion (Allium cepa L) oil as a functional ingredient in Cheese spread". BIO Web of Conferences. Vol. 95. EDP Sciences, 2024.

8. Thanonkaew A., Wongyai S., McClements D. J., Decker E. A. "Effect of stabilization of rice bran by domestic heating on mechanical extraction yield, quality, and antioxidant properties of cold-pressed rice bran oil (Oryza saltiva L.)". *LWT-Food science and technology*; 2012, 48.2: 231-236.

9. Hou X. L., Zhang Y. S., Wang J. Q. "Method for extracting onion seed oil by supercritical carbon dioxide". China. 2008, CNA2008101237697A.

10. Ochilovich, B. G., Khudoyshukurovna, K. N., Anvarovna, B. Y., Mahmudovna, S. A. "Grape Seed Functional Substances and Seed Processing Experiment". Telematique; 2022. 7293-7296.

11. Chandra S., Kumar M., Dwivedi P., Shinde, L. P. "Functional and nutritional health benefit of cold-pressed oils: a review". *Journal of Agriculture and Ecology*. 2020, 9: 21-29.

12. Chew S. C. "Cold-pressed rapeseed (Brassica napus) oil: Chemistry and functionality". *Food Research International*. 2020, 131: 108997.

13. Rabrenović, B. B., Dimić, E. B., Novaković, M. M., Tešević, V. V., Basić, Z. N. "The most important bioactive components of cold pressed oil from different pumpkin (Cucurbita pepo L.) seeds". *LWT-Food Science and Technology*. 2014, 55.2: 521-527.

14. R.M. Fawzy, ed. "Cold pressed oils: Green technology, bioactive compounds, functionality, and applications". Academic Press; 2020.

15. Szydlowska-Czerniak A., Tymczewska A., Momot M., Wlodarczyk K. "Optimization of the microwave treatment of linseed for cold-pressing linseed oil - Changes in its chemical and sensory qualities". *LWT–Food Sci. Technol.* 2020, *126*, 109317

16. Rombaut N., Savoire R., Thomasset B., Castello J., Hecke E.V., Lanoiselle J. "L. Optimization of oil yield and oil total phenolic content during grape seed cold screw pressing". *Ind. Crops Prod*. 2015, *63*, 26–33

17. Rabiej-Kozioł, D., Momot-Ruppert, M., Stawicka, B., Szydłowska-Czerniak, A. "Health benefits, antioxidant activity, and sensory attributes of selected cold-pressed oils". *Molecules*. 2023, *28*(14), 5484.

18. Bockisch M. (Ed.). "*Fats and Oils: Formulating and Processing for Applications*". Academic Press and AOCS Press. 1998, ISBN: 978-0-9818936-0-0.

19. Boynazarova Y.B., Farmonov J.B. "Microscopic studies on the effects of temperature on black cumin seed cell degradation". Innovative Technologies. 2024, 1(53): ISSN 2181-4732.

20. Berdiev A. K., Farmonov J. B., Rasulov K. K. "Efficiency of processing oilseeds: Problems and solutions". Bulletin of Science and Education. 2020, (13-3 (91)), 6-12.

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