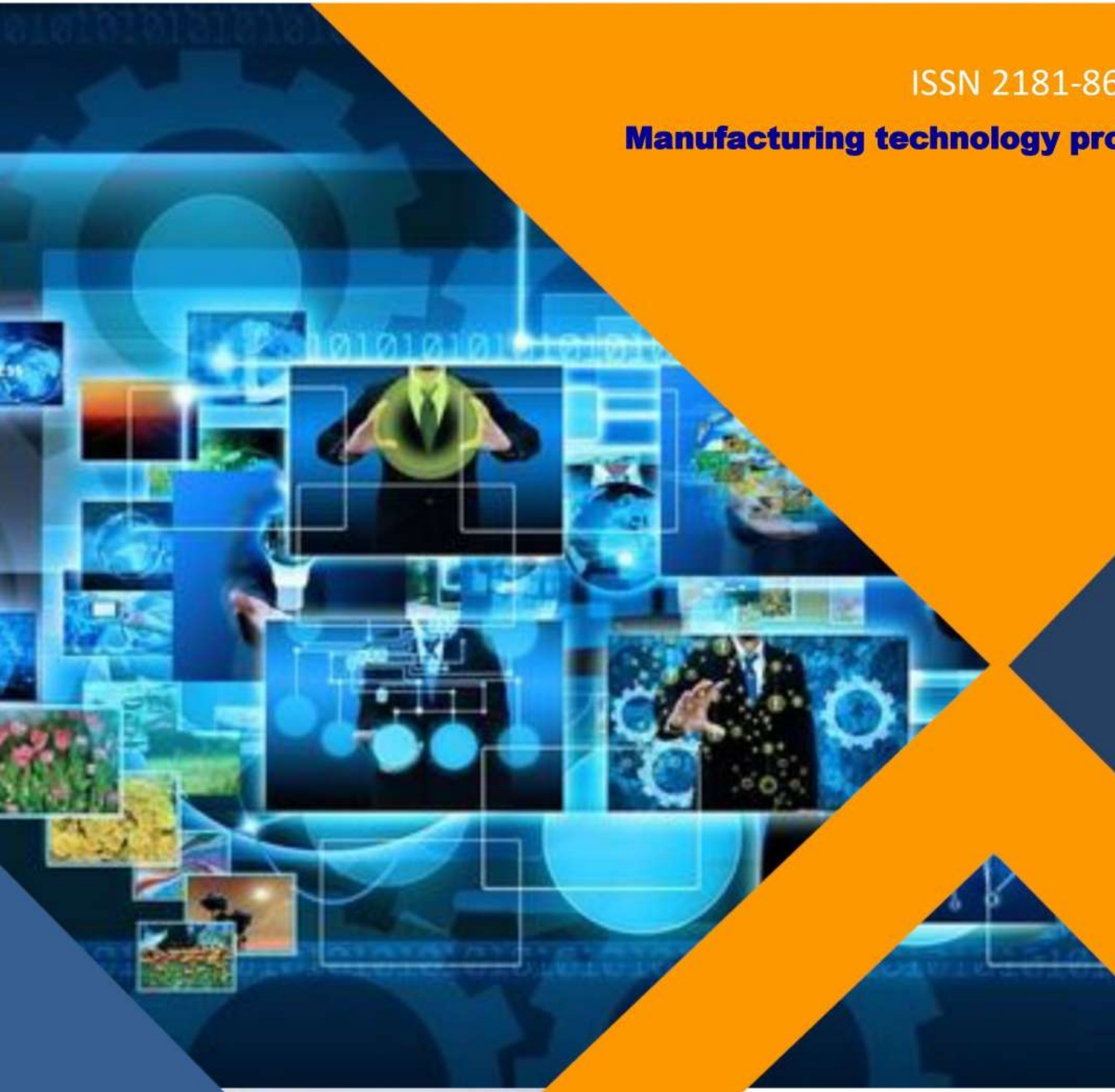
ISSN 2181-8622

Manufacturing technology problems



Scientific and Technical Journal Namangan Institute of Engineering and Technology

Volume 9
Issue 4
2024

PREPARING PEACH SEED FOR OIL EXTRACTION AND IMPROVING OIL EXTRACTION THROUGH PRESSING

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Abstract: This article discusses the technical technologies for preparing peach seeds for oil extraction before obtaining oil from peach fruit seeds. In other words, before extracting oil from peach seeds, the seeds need to be processed: cleaning the seeds, adjusting seed moisture, cracking the seeds, and grinding the seed kernel. The article also covers the methods of oil extraction from peach kernels using hot and cold pressing, explaining the processes of obtaining oil through both hot and cold pressing. The impact of hot pressing and cold pressing on samples of the same size and moisture content is also analyzed, with results shared.

Keywords: peach seed, seed cleaning, seed moisture adjustment, cracking the seeds, grinding the seed kernel, peach kernel, peach oil, hot pressing, cold pressing, moisture, seed preparation, oil extraction.

Introduction. Developing and implementing highly efficient technologies for processing non-traditional oilseed plants to obtain medicinal natural oils is of great importance for expanding the range of vegetable oils in the Republic of Uzbekistan. The most optimal solution to this issue is the establishment of small enterprises focused on obtaining non-traditional oils. The peach is a fruit tree, often cultivated in countries such as Italy, Spain, the United States, China, Greece, France, Russia, Japan, and Mexico. Its origin is China. It is one of the most popular stone fruits, suitable for direct consumption. According to reports, the European Union (EU) accounts for approximately 6.7% of total agricultural products, with peaches ranking third after apples and oranges. This fruit is perishable and is usually discarded after the seeds are harvested. Despite peach seeds constituting more than 60% of the fruit's weight, they are often discarded during the food processing process (such as beverages, preservatives, marmalades, etc.), turning into waste products. Given that the seeds and kernels account for approximately 5% to 60% of the fruit's weight, depending on the variety, tens of thousands of seed waste are produced annually. The peculiarity of this raw material is that the fruit seeds typically arrive at oil extraction plants as mixed assortments from various fruit varieties. Before extracting oil from peach kernels, the product undergoes specific preparatory technologies, which are discussed below. Initially, the required portion of the peach fruit kernels is separated for experimental purposes (Figure 1), and the process continues step by step.

The technological characteristics of peach kernels are described by the following indicators: Length (mm): The length of peach kernels ranges from 20 to 31 millimeters. This means that the size of peach pits can vary, which may be related to the specific characteristics of different peach varieties. Width (mm): The width of peach kernels ranges from 17 to 25 millimeters. The amount of width can vary depending on the growing conditions and the fruit-bearing process of peaches of the same variety. Thickness (mm): The thickness of peach kernels ranges from 12 to 17 millimeters. This indicator plays a key role in determining the fullness of the pits and their resistance to damage. Kernel content (%): The kernel content in peach pits ranges from 10 to 15%. This is important in determining the ratio of nutrients in peach kernels and how they are used in processing. Lipids in the kernel (%): The lipid content in peach kernels ranges from 35 to 46%. These lipids are valuable as an energy source and are important in the production of bioactive substances and oily compounds. Amygdalin content (%): The amygdalin content in peach kernels ranges from 1.8 to 3.6%. Amygdalin is a compound that is considered in certain chemical processes and medical research. Its presence must be taken into account from both a technological and safety perspective. These indicators help determine the use of peach kernels in various industrial and technological fields. Taking their specific characteristics into account allows for achieving the best results in the processing stage.

Table 1. Technological Properties of Peach Pits

Indicators	Peach seed
Length, mm	20–31
Width, mm	17–25
Thickness, mm	12–17
Kernel content in the seed, %	10–15
Lipids content in the kernel, %	35–46
Amygdalin content, %	1,8–3,6

Cleaning of Seeds. Contamination of seeds that directly enter production negatively impacts product quality, increases oil loss, accelerates the wear of machines and equipment, reduces their productivity, and creates unsanitary working conditions. The cleaning of seeds primarily relies on the difference in the basic physical properties of the crop seeds being cleaned and the contaminants that accompany them. These contaminants can differ in size and shape, density, aerodynamic, and magnetic properties. Therefore, various cleaning principles and technical tools are used to clean seeds from impurities. Depending on the location of the cleaning machines, the warehouse (raw material) should be cleaned before sending oily seeds for storage and production should be cleaned before sending the seeds for processing.

Figure 1: Peach seeds designated for the experiment

Adjusting the moisture content of the seeds. Drying is a necessary technological operation in preparing oilseeds for processing because its efficiency is directly related to the optimal moisture content. The technological drying regime is considered optimal if it is as short as possible, and during this process, the seed quality and oil content are preserved or even improved, and the technological properties of the seeds are enhanced. The choice of technological drying regimes is determined by the chemical composition and physical-mechanical properties of the seeds, as well as the design of the drying equipment. In production, seed calibration and conditioning can be carried out in different sequences: first, the seeds are conditioned with moisture, and then they are calibrated. Seeds of the same plant may have different linear sizes (length, width, thickness), which are related to other physical-mechanical indicators, such as the hardness of the fruit shell. Therefore, it is recommended to calibrate the seeds (sort them by size) before removing the shell. When calibrated seeds are crushed, the fruit or seed shell is completely destroyed, the kernel remains intact, and losses are minimized.

Cracking the seeds. The dried seeds enter the seed cracking process, which is designed to remove the seed coat (shell) and then separate it from the kernel, which contains the main amount of oil. In industrial plants, whip and centrifugal handling mechanisms, which operate based on impact principles, are mainly used. These include seed crushers such as MNR, A1-MCR, MB-500, and others, where the kernel is extracted intact when the seed coat is separated.

Crushing the seed kernel. The main task of crushing the seed kernel is to maximize the destruction of cell structure, as well as to provide a specific external structure that facilitates the subsequent technological operations for oil extraction. Crushing can be done using a laboratory mill. The crushing process is necessary when extracting oil via the extraction method. In some cases, oil can be extracted from peach seeds by cold pressing or hot pressing; in these cases, we may not crush the seed kernel and instead use the whole seed in its uncrushed form for experimentation.

Determining the moisture content. Drying is a necessary technological operation when preparing oily seeds for processing, as its efficiency is directly dependent on the optimal moisture content. The technological drying regime is considered optimal if it is as short as possible and, during this process, the quality of the seeds and the oils within them are preserved or even improved, and the technological properties of the seeds are enhanced. The selection of technological drying regimes is determined by the chemical composition and physical-mechanical properties of the seeds, as well as the design of the drying equipment. In production, seed calibration and conditioning can be performed in a different sequence: first, seeds are conditioned with moisture, and then calibrated. Seeds from the same plant may have different linear dimensions (length, width, thickness), which are related to other physical-mechanical indicators, such as the strength of the fruit shell. Therefore, it is recommended to calibrate the seeds before shelling (sorting by size). Calibrated seeds, when crushed, have their fruit or seed shell completely removed, the core remains intact, and losses are minimized."

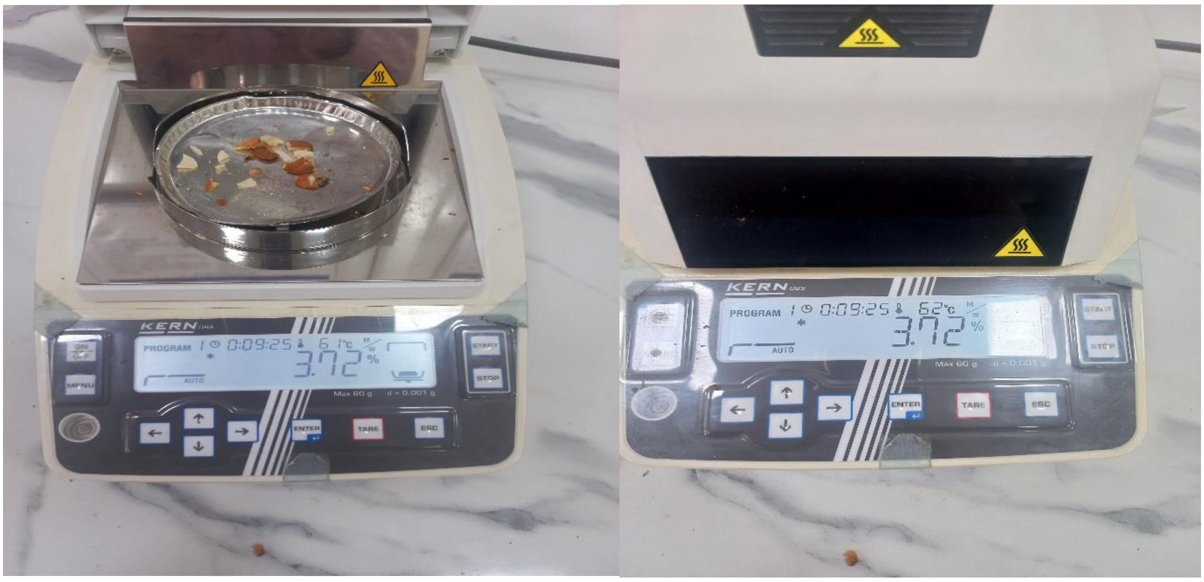

Figure 2. Checking the moisture content of the peach pulp

This method is one of the most accurate and widely used. It is based on the process of weighing and drying the sample to calculate the moisture content of the peach pulp.

1. **Sample preparation:**
   - Select a sample of 3-10 grams of peach pulp. The sample should be free from excess and unnecessary parts of the pulp.
2. **Weighing the initial sample:**
   - Use a highly accurate electronic balance to determine the initial weight of the sample. This weight will be labeled as M1.
3. **Drying process:**
   - The sample should be dried at 105°C in a room or a special drying oven. Avoid raising the temperature too high, as it could alter the composition of the pulp. During the drying process, moisture will evaporate.
4. **Weighing the dried sample:**
   - After drying, weigh the sample again (M2). The weight of the sample will decrease after drying because the moisture has evaporated during the process.

5. **Calculating the moisture percentage:**

○ To determine the amount of moisture that evaporated during the drying process, the following formula is used:

$$Moisture\ Percentage\% = \frac{\text{M1} - \text{M2}}{\text{M2}} \times 100$$

Here:

• **M1** — initial sample weight,

• **M2** — weight of the dried sample.

The moisture percentage provides precise information about the dryness or moisture content of the peach pulp.

$$Moisture\ Percentage\% = \frac{10 - 8}{10} \times 100 = 20\%$$

This means that 20% of the peach kernel is water. The gravimetric method provides the most accurate results when determining the moisture content of peach kernels, but in the absence of laboratory equipment, household methods can be applied. The moisture content determines the shelf life of the product, so accurate measurements enhance the effectiveness of storage.

Oil Extraction Process: In some cases, heaPressing: The peach kernel must be placed in a special press or oil extraction press. The presses compress the kernel under high pressure, separating the oil. The pressing process can be done using either cold or hot methods. Cold pressing is preferred to obtain the highest quality and most natural form of oil.

Hot Pressing: Hot pressing — this is a method of oil extraction where high temperature and pressure are applied together. The hot pressing method for peach kernels includes the following steps: Preparation of the Peach Kernel: The peach kernel is washed and divided into the required size (usually into small pieces or crushed form). This is necessary for effective oil separation. Heating the Kernel: It is recommended to heat the kernel before hot pressing. This process softens the kernel and prepares it for oil extraction. During the heating process, the temperature is usually in the range of 50-80°C. This temperature helps the oil separate more and effectively. Hot Pressing: The heated peach kernel is placed into the hot press. Hot presses apply both high temperature and pressure at the same time to extract the oil. During the pressing process, oil is released from the kernel and collected in liquid form. Oil Separation: The oil obtained through hot pressing is usually clean and of good quality, but in some cases, additional filtration may be required. In the filtration process, fine residues and other impurities from the oil are removed. Oil Filtration: The oil extracted during the pressing process is collected in liquid form. It can be passed through a filter to obtain clean and refined oil.

Figure 3. The process of hot pressing of peach pulp in its entirety

Methods: In the hot pressing process, 100 g of peach pulp with a moisture content of 3.9% was used. After pressing, 3.30 ml of oil was extracted from the pulp. During the process, the press roller made 20 rotations, indicating the efficiency of the pressing and the pressure and temperature conditions under which the process was carried out. The presence of moisture in the pulp before pressing, due to its 3.9% moisture content, could affect the oil extraction. The heating process of the pulp to reduce moisture helps improve the quantity and quality of the extracted oil. The extraction of 3.30 ml of oil during the pressing process demonstrates the high efficiency of oil separation from the peach pulp. The 20 rotations of the press roller indicate the intensity of the process, leading to effective oil separation under high pressure. In such conditions, the oil extraction process is considered to have been carried out at optimal pressure and temperature, enhancing the quality of the extracted oil. The hot pressing process is an effective method for extracting oil from peach pulp, and the relationship between moisture content and pressing intensity contributes to high-quality results.

Methods: In the cold pressing process, 100 g of peach pulp with a moisture content of 3.9% was used. After pressing, 3.09 ml of oil was extracted from the pulp. During the process, the press roller made 17 rotations, indicating the efficiency of the pressing and the intensity of the pressure applied to extract the oil. The moisture content of 3.9% in the peach pulp may have influenced the oil separation during the pressing process, as moisture content can somewhat aid in oil extraction. The cold pressing method does not use high temperatures, allowing the oil to retain its natural qualities. The main advantage of this method is its ability to preserve the nutritional properties of the oil. The extraction of 3.09 ml of oil during the pressing process indicates that a good amount of oil was separated using the cold pressing method. The 17 rotations of the press roller represent the intensity of the process, which facilitates effective oil separation. The cold pressing method is an effective technique for extracting oil from peach pulp while preserving its quality. The moisture content of the pulp and the intensity of the pressing both influenced the success of the process and helped achieve high-quality results.

Figure 4. Hot and cold pressing process

Results: In the hot pressing process, 100 g of peach pulp with a moisture content of 3.9% was used, and 3.30 ml of oil was extracted after pressing. During this process, the press roller made 20 rotations. In the cold pressing process, 100 g of peach pulp with a moisture content of 3.9% was also used, and 3.09 ml of oil was extracted after pressing. During this process, the press roller made 17 rotations. Although the mass and moisture content of the peach pulp were the same in both processes, the amount of oil extracted in the hot pressing was slightly higher, and the number of rotations of the press roller was also greater. The following table presents the results.

Table 2. Results of Hot and Cold Pressing of Peach Pulp

Process	Moisture Content (%)	Pulp Mass (g)	Oil Extracted (ml)	Press Roller Rotations
Hot Pressing	3.9	100	3.30	20
Cold Pressing	3.9	100	3.09	17

Oil Extraction Efficiency: In the hot pressing process, 3.30 ml of oil was extracted from 100 g of peach pulp, which is slightly higher compared to the cold pressing process (3.09 ml). This indicates that the oil extraction in hot pressing is more efficient. The high temperature in hot pressing helps in the oil separation. Press Roller Rotations: In hot pressing, the press roller made 20 rotations, which is more than the 17 rotations in cold pressing. This can be explained by the higher intensity and pressure in the pressing process, leading to more oil being separated. Moisture Content: In both processes, the moisture content of the peach pulp was the same—3.9%. This moisture content affects the oil extraction process, but the main difference lies in the pressing method and its intensity.

Conclusion: In conclusion, the preparation methods for oil extraction from peach seeds include cleaning the seeds, soaking, sizing, shelling, separating the kernel from the shell, crushing, and roasting. In hot pressing, 3.30 ml of oil was extracted from 100 g of peach pulp with a moisture content of 3.9%. During this process, the press roller made 20 rotations. In cold pressing, 3.09 ml of oil was extracted from 100 g of peach pulp with the same moisture content. The press roller made 17 rotations in this process. Although the mass and moisture content of the peach pulp were the same in both processes, the amount of oil extracted in hot pressing was slightly higher, and the number of press roller rotations was also greater.

References

1. Z.T. Madaminova, A.M. Khamdamov, A. Xudayberdiyev. Investigation of the impact of various technological factors on oil extraction in the production of non-traditional oil from peach seeds. Universum: технические наукивыпуск: 9(126) Сентябрь 2024
2. Z.T. Madaminova, A.M. Khamdamov, A. Xudayberdiyev. "Technology Processing Relevance of Unconventional Oilseeds in Uzbekistan," in Materials of the International Scientific-Practical Conference "New Opportunities for Sustainable Development of Mountain Regions: Innovations and Cooperation," dedicated to the 60th Anniversary of the Osh Technological University named after M.M. Adyshev, October 7, 2023, pp. 93-96.
3. Z.T. Madaminova, A.M. Khamdamov, A. Xudayberdiyev. "Varieties of Peach Fruits Growing in Uzbekistan," in Proceedings of the Republican Scientific-Practical Conference on "Relevant Issues in Education, Science, and Production," November 7, 2023, pp. 35-38.
4. Z.T. Madaminova, A.M. Khamdamov, A. Xudayberdiyev. "Preparation of Peach Fruit Seeds for Oil Extraction," in Collection of Materials from the International Scientific-Practical Conference on Innovative Solutions to Problems in Chemical Technology, Chemistry, and Food Industry under the Conditions of Integration of Science and Production, Namangan, 2023, pp. 542-544.
5. Z.T. Madaminova, A.M. Khamdamov, A. Xudayberdiyev. "Technology for Producing Oil from Peach Seeds Grown in Namangan Region," in Collection of Materials from the International Scientific-Practical Conference on Innovative Solutions to Problems in Chemical Technology, Chemistry, and Food Industry under the Conditions of Integration of Science and Production, Namangan, 2023, pp. 537-541.

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