TECHNOLOGICAL AND PHYSICAL PROPERTIES OF PEANUT

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Abstract. This study presents a comprehensive analysis of the main physical–mechanical and technological properties of peanut (Arachis hypogaea L.) kernels. The geometric dimensions, mass, density, moisture content, surface characteristics, and mechanical strength of agricultural products play a crucial role in ensuring efficient cultivation, processing, and storage operations. During the experimental investigation, the kernel length, width, thickness, thousand-kernel weight, bulk density, true density, and porosity were determined. In addition, important technological parameters such as the coefficient of friction, angle of repose, and resistance to mechanical damage were evaluated under laboratory conditions using experimental methods. The obtained results provide a scientific basis for substantiating the design parameters of agricultural machinery used in peanut planting, sorting, transportation, and storage processes. In particular, these characteristics are essential for selecting the dimensions of seed-metering channels in seeding units, designing receiving hoppers, and determining optimal storage conditions in warehouses. The findings contribute to the improvement of peanut cultivation technology, enhancement of mechanization efficiency, and improvement of product quality.

Keywords: peanut, physical–mechanical properties, technological parameters, density, moisture content, coefficient of friction, porosity.

Introduction. Peanut (Arachis hypogaea L.) is one of the most widely cultivated food and oilseed crops worldwide. Its kernels contain approximately 45–55% oil, 20–30% protein, and various biologically active compounds, making it highly valuable for the food industry, processing sector, and livestock production. In recent years, population growth and increasing concerns related to food security have intensified the need to enhance peanut productivity and improve post-harvest processing technologies.

Efficient cultivation, sorting, transportation, and storage of peanuts require a comprehensive understanding of their physical and technological properties. Kernel geometric dimensions, bulk and true density, moisture content, porosity, coefficient of friction, and angle of repose are among the key parameters considered in the design of agricultural machinery. In particular, the reliable operation of seed metering devices, hoppers, sorting equipment, and conveying mechanisms largely depends on these characteristics [1].

Moreover, the resistance of peanut kernels to mechanical stress and their susceptibility to breakage significantly affect technological efficiency during harvesting and post-harvest operations. In the absence of accurate physical–mechanical data, mechanical damage, quality deterioration, and quantitative losses may occur during machine operation.

Therefore, the objective of this study is to experimentally determine the main physical and technological properties of peanut kernels and to evaluate their applicability in substantiating the design parameters of agricultural machinery.

Materials and methods. The research was conducted using peanut (Arachis hypogaea L.) kernels cultivated under the soil and climatic conditions of Uzbekistan. The samples were collected after harvesting and carefully cleaned from impurities and damaged seeds. Only uniform, undamaged kernels were selected for laboratory analysis. Prior to testing, the samples were stored under controlled laboratory conditions at a temperature of 20 ± 2 °C and relative humidity of 60–65% to ensure stable moisture equilibrium.

The moisture content of peanut kernels was determined using the standard oven-drying method. Representative samples were weighed and dried at a constant temperature of 105 °C for 24 hours. After drying, the samples were reweighed to determine moisture loss. All measurements were performed in triplicate, and the average value was recorded.

The principal dimensions of the kernels, including length, width, and thickness, were measured using a digital caliper with an accuracy of 0.01 mm. One hundred randomly selected kernels were measured to ensure statistical reliability. From these measurements, average geometric characteristics such as equivalent diameter and sphericity were evaluated to describe kernel shape and size distribution.

The experimental investigation revealed that the physical and technological properties of peanut (Arachis hypogaea L.) kernels significantly influence their handling, processing, and mechanical performance.

Result. The average moisture content of the tested peanut kernels was found to be within the optimal range for storage and processing. The measured moisture level ensured stable physical behavior and minimized the risk of structural damage during mechanical operations [2, 3]. The average kernel length ranged between 12.4–14.8 mm, width between 6.5–8.2 mm, and thickness between 5.8–7.1 mm. The calculated equivalent diameter demonstrated relatively uniform size distribution. The sphericity coefficient indicated that peanut kernels possess an elongated shape rather than a spherical one, which directly affects flowability and orientation during mechanical feeding. The thousand-kernel weight varied from 620 to 710 g depending on kernel size distribution. This parameter plays an important role in calibrating seeding equipment and determining planting rate accuracy. The bulk density of peanut kernels was determined within the range of 560–640 kg/m³, while the true density averaged around 980–1040 kg/m³. The calculated porosity ranged from 35% to 42%, indicating a considerable amount of void space within the bulk mass. These characteristics are critical for storage design, aeration systems, and hopper dimensioning. The measured angle of repose ranged between 27° and 31°, confirming moderate flowability of peanut kernels. This value is essential for determining hopper wall inclination angles and preventing bridging during storage and transportation. The coefficient of static friction varied depending on surface material. The lowest friction values were observed on smooth steel surfaces, while higher values were recorded on rubber surfaces. These differences directly affect conveyor system efficiency and the design of feeding mechanisms. Compression tests showed that kernel rupture force varied depending on kernel size and moisture content. Larger kernels demonstrated slightly higher resistance to compressive loading [4, 5]. The obtained data indicate the necessity of optimizing mechanical harvesting and post-harvest equipment to minimize kernel breakage. The obtained results demonstrate that peanut kernels exhibit stable physical characteristics suitable for mechanized handling and processing. However, the variability of density, friction, and mechanical strength parameters highlights the need for equipment calibration under specific regional conditions.

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