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## SIGNS OF QUALITY OF LOCAL GRAIN VARIETIES AND METHODS OF THEIR DETERMINATION

**Abstract:** This article analyzes a number of sources and addresses the issue of methods for determining the quality of local varieties of grain. The quality of grain is of great importance for its further use for processing and storage.

**Key words:** grain, structure, shape, moisture, density, protein, starch.

**Language:** English

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### Introduction

Physicochemical and mechanical properties of local grain varieties are of great importance for their storage and processing. These properties characterize the basis of methods for determining quality, methods of moving, cleaning and processing of grain.

Physical properties of grain include: grain shape, linear dimensions and size, volume, performance and frailty, alignment, mass of 1000 grains, vitreousness, density, filminess and huskiness, bulk mass.

Structural and mechanical properties of grain link the structural features of material with its reaction to mechanical action. These properties determine process

of grain grinding, peeling, yield and quality of crushing products, energy consumption for grain grinding. Main criteria for evaluating the mechanical properties of materials are their strength and hardness.

Mechanical properties of bodies are detected when they are exposed to external forces, under the influence of which deformations of various kinds are formed. Usually whole deformation process is divided into three stages: elastic deformation, plastic flow and deformation. Correct assessment of "behavior" of local varieties of grain in all three stages allows you to get a clear idea of its overall strength.

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Ability of grain to resist deformation at the point of application of force is called hardness. This is the second evaluation criterion of structural and mechanical properties of grain. Hardness characterizes possibility of destruction of the material of separated anatomical parts of grain in the place of application of force [1,2,3,6].

**Chemical composition of grain** depends on botanical characteristics (species, variety, selection variety), growing conditions (climatic conditions, soil composition, fertilizers, watering), degree of maturation, etc.

Chemical composition of different types of grain may vary in content of protein, carbohydrates, fats, minerals, vitamins.

Chemical composition of the aleurone layer has following features. It contains a large number of proteins-38% or more, mainly related to albumins and globulins, unable to form gluten, 9-10% fat, 6% sugar (sucrose), 15% *fiber*, 9-10% ash, a significant amount of *hemicellulose*. Aleurone layer is rich in water-soluble vitamins: B1 and B2 and especially vitamin PP.

Weight of the aleurone layer is from 4 to 9 % of the grain weight. Ash content of the aleurone layer ranges from 8 to 11%.

Chemical composition of endosperm is different from composition of all other parts of grain. Endosperm contains all grain starch, amount of which is 78-82% by weight of endosperm, about 3% sucrose, 0.2-0.4% reducing sugars, 13-17% proteins, mainly gliadin and glutenin, forming gluten. Characteristic is the low content in the endosperm of ash (0.3-0.5%), fat (0.5-0.8%), pentosans (1-1.5%), fiber (0.07-0.12%). Products derived from endosperm contain least amount of ash elements (Ca, P, Fe, etc.) and vitamins.

Different grains and seeds are characterized by different forms:

1. Form of grain and seeds is very diverse. Grain and seeds of different crops can be distinguished several main varieties differ in shape. There are following forms of grain: spherical, lentil-shaped, ellipsoid, elongated with different sizes in length, thickness and width, triangular pyramid, characteristic of buckwheat, as well as other forms. Spherical shape has seeds of peas, millet, sorghum, some varieties of corn. With lentil-shaped, when width and length are almost equal with a much smaller thickness. Shape of ellipsoid of rotation differs in the same width and thickness, length is much larger. Seeds of many legumes have this form. Grain which closer in shape to an ellipsoid, but for research it is often applied to ball, has a higher bulk mass, gives a greater yield of flour [1,2,3,6,7].

2. Linear dimensions are length, width and thickness of the grain. Length is distance between base and top of grain, width is the greatest distance between the side and sides, thickness is between dorsal and abdominal sides (back and abdomen). Set of linear dimensions is also called coarseness. In study of linear

dimensions and grain size, two methods are used: measurement of individual grains with the help of special devices (micrometer, thickness gauge, hour projector, etc.) and sieve analysis, in which the grain is sifted through a set of sieves with holes of a certain shape and size. When measuring individual grains from the hinge, obtained data are processed by method of mathematical statistics. Large grain fractions give a greater yield of finished products. Grain sizes are taken into account when setting the mode of grain preparation for grinding and grinding itself. During storage and as a result of hydrothermal treatment, linear dimensions of grain and its volume may vary. Thickness most characterizes milling properties of grain from three dimensions (length, width and thickness). Was established high correlation between grain thickness and endosperm content [1,2,3,5,6].

3. Volume of grain mass, expressed in appropriate weight units, is called "nature" of the grain. Nature of grain is expressed by weight of 1 liter of grain in grams. Nature characterizes mainly one of the properties of grain mass - its density (or fluidity). Density of packing of the grains, in turn, depends on many different reasons.

For the value and calculation of grain mass fluidity, volume mass (with all other things being equal, a larger volume of grains corresponds to a larger volume mass), determining the mode of cleaning and processing of grain, the output of finished product (larger volume – larger output) [1-5].

4. Performance of grain is an indirect indicator characterizing ratio of endosperm and shells in the grain, which is important in assessing the milling properties of grain. Endosperm in the grain usually adheres very tightly to shells, while fulfilling all space limited by shells. Hence term "fulfillment" was born. Such grain on the surface does not contain wrinkles and folds. In the case when by time of harvesting grain does not reach full maturity and endosperm contains a lot of moisture, wrinkles and folds appear on its surface, and the endosperm shrinks. This grain is called frail. Reason of frailty can be: the effect of drought, dry weather and frost, fungal diseases, bacteriosis, viral diseases, flower parasites, field pests and other adverse conditions of development and maturation. Completed full-weight grain, small, normally developed and frail grain differ in physical, biochemical and technological properties. Frail grain contains more shells and less endosperm, it is very small, sometimes consists of almost one shell, usually has normal dimensions in length, but reduced width and thickness. Therefore, characteristics of width and thickness are used to determine density of grain. Frail grain, in comparison with completed, has large external surface and, as a consequence, it is less resistant to storage and more susceptible to external factors. It is much more difficult to grind frail grains into flour, flour turns out to be darker and has a bluish tint. According to totality of above factors, frail grain is referred to as a grain

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impurity. According to standards, fine grain is determined by the amount of passage through a sieve with holes of certain sizes: for grain-1, 7x20 mm, rye-1, 4x20 mm, barley-2, 2x20 mm, etc. Normally executed grain has a coefficient of 1.11, frail - from 1.20 to 1.96. Coefficient of frailty due to the complexity of its determination is advisable to apply only in research [1,2, 3,6,7].

5. Evenness, or uniformity of grain size, is an important indicator of quality. The more homogeneous the grain in size, or the more it is aligned, the less there is a loss in processing and the better quality of products produced. This applies to processing of grain into flour and especially into cereals. First of all, it is important to equalize the humidity and size, i.e., linear dimensions or weight of 1000 grains, as well as the uniformity of grain color, vitreous, size, chemical composition and other indicators. The most important are equalization of humidity due to special role of moisture in storage and processing. This can lead to nesting self-heating of the grain.

Aligned glassiness increases amount of proteins contained in the grain, going to formation of gluten. Structure of the grain depends on the nature of exchange during loading and maturation. Main factors determining vitreous nature include: sowing material, agrotechnical conditions, soil and climatic conditions, composition of fertilizers, uneven ripening of grain in the ear.

High temperature, lack of moisture, short period of filling and ripening of grain increase the vitreousness. Excess phosphorus reduces, and excess nitrogen, on the contrary, increases glassiness. Although glassiness of grain is a varietal feature of the grain plant, but it can vary by region depending on soil and climatic conditions.

Glassiness is an important technological indicator of grain. Glassiness grain has a great resistance to crushing and chipping, in connection with which grinding requires more energy than for powdery grain. Higher yield of flour is obtained from the glassiness grain, than from the mealy. Glassiness grains are longer than powdery. Thus, sorting the substrate, it is possible to allocate glassiness grains. This is of great practical importance: it is possible to increase amount of grain going to production of flour for pasta, to prepare more valuable batches of grain for export, to improve quality of seed material. With inept storage and subsequent improper drying of the grain, endosperm turns glassy. Grains with such glassiness are difficult to grind and will be dark in color, giving the flour an overall dark color. [1,2,3,5].

6. Density of grain as a whole and its anatomical parts is of great technological importance. As a rule, well-poured grain has a higher density than unripe. Density of grain and its parts depends on their chemical composition. The highest density have starch and minerals, so with an increase in their proportion increases density of the grain, and, conversely, increase

in the amount of protein (1,34-1,37) and lipids (0,89 - 0,99) reduce density of the grain. Significant differences in chemical composition cause large fluctuations in grain density ( $g / cm^3$ ): wheat-1,33-1,53; rye-1,26-1,42; corn-1,23 -, 27; barley-1,23-1,28; oats-1,11-1,15. Density can be considered as a complex characteristic, which reflects such indicators of physical and chemical properties of grain as structure, chemical composition, weight of 1000 grains. Inverse of density is the specific volume. Grain density correlates with other indicators. Density of the whole grain is on average-1,336, its endosperm-1,471, corcule-1,290, shells-1,066. The whole grain processing technology is based on these differences at present, as the milling properties of higher density grain are better.

Grain density is determined by formula

$$\rho = \frac{m_1}{m_2 - m_3} \rho_E$$

in which  $m_1$  is the mass of the filler in the dry state,  $m_2$  is the mass of filler after saturation with water, which is calculated by weighing it in air,  $m_3$  is the mass of filler when weighing it in water.  $\rho_E$  – is density of water, which is applied, equal to one gram per cubic centimeter. This method allows you to set the average density of grains. Grain density is significantly affected by humidity, temperature and other factors. Figure 1 shows typical graphs of changes in density ( $kg / m^3$ ) of local grain varieties I, III and IV types under the influence of humidity. Data obtained by pycnometric method. For grain types I, II and III there is an area of humidity in which density decreases especially sharply. Density of type IV grain decreases almost straightforwardly. At a humidity of 15...16% rate of change in density decreases, this is especially noticeable in wheat grain type I. The study of this phenomenon showed that decrease in density at 15...16% humidity is due to structural transformation of the endosperm and to a lesser extent - swelling of shells and grain as a whole. At higher humidity, the latter factor becomes predominant [1,2,3,5-7].

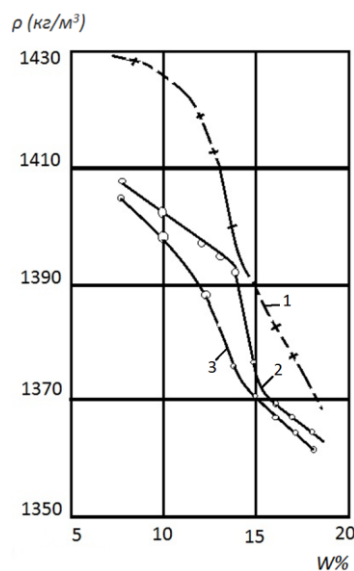
7. When harvesting part of grain gets mechanical damage. These damages are divided into two groups: grain crushing and micro-damages. Also, mechanical damages of grain are a consequence of interaction of grain with working parts of cars and the equipment. As a result, grain is crushed, flattened and acquires various macro and micro damages. Micro-damages include such damages as ruptures of the membranes or endosperm near corcule, as well as the loss of corcule itself by the grain [1,2,3,6,7]. One type of mechanical damage is grain fracture. Fracturing occurs when improper use of harvesting apparatus, transportation, storage and drying of grain or other influences on it. As a result, cracks on the grain can be large, immediately noticeable or very small. Small cracks are detected with a diaphanoscope. During transportation, grains are damaged and partially turn into broken ones, which are further destroyed faster than whole ones. Grains

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with different types of damage are less resistant to storage, they breathe intensively, easily absorb moisture from the environment, are more accessible to grain pests, microorganisms develop faster on their surface. Mechanical damage reduces milling, cereal and baking quality of grain, reduce the yield of finished products, contribute to formation of large amounts of crushed cereals. During processing in the elevator,

flour mills and cereal plants, grain damage increases. So, micro-damage turns into macro-damage. In grains with micro-damage, germination is reduced, and plants grown from them are less productive. And also, all kinds of mechanical damage resulting from the harvesting, primary processing and storage, adversely affect quality and condition of grain.



**Fig. 1. Influence of humidity to density of wheat grain: 1- III type; 2- I type; 3- IV type.**

To fight against mechanical damage, it is necessary: to improve the scheme of technological processes of grain processing; to develop machines and equipment in which the speed of the working bodies is regulated and the fall of grain from a great height is not allowed; to cover the working bodies with elastic materials, etc. It is also important to develop new varieties of grain and legumes with strong shells.

8. When processed into flour, grain is subjected to various types of mechanical impact. Intensity of these effects, their technological effect, quantity and quality of products produced are closely related to mechanical properties of grain. Mechanical properties of grain can be estimated only on the basis of mass observations with subsequent processing of materials by methods of mathematical statistics. When processing grain into flour, the main process is its grinding, which consumes from 50 to 70 % of all energy, consumed at grain processing enterprises of the Republic of Uzbekistan. The most important property of grain, which should be taken into account when grinding it, is strength, i.e. resistance to mechanical destruction [1-3, 5-7].

Strength can also be estimated by value of destructive force or stress. It is necessary to take into account type of deformation, as resistance to shear, compression, tension and torsion for the grain. Strength

of the grain depends on its structure, humidity, temperature, varietal and species composition, soil and climatic conditions of growth and other factors that are still not well understood. Humidity has a very strong effect on the strength of grain and related indicators of specific energy consumption, percentage of extraction and productivity of the mill. F. Adra has determined that if conditional tensile strength of grains of the coarse fraction is equal to 7.5...At 8.5 MPa, then for grain of the fine fraction it will be raised to 9.5...11.5 MPa.

Dry grain has properties of brittle and wet plastic body. Increasing humidity abruptly worsens technological effect. Increasing the temperature increases strength of the grain. When the temperature decreases, the grain becomes more brittle, will be more easily destroyed. Influence of humidity and temperature on the mechanical properties of grain is associated with colloidal-chemical changes in its polymers colloidal properties (proteins, carbohydrates). At high humidity (17-20%), microhardness of the shells is leveled and becomes approximately the same regardless of the structure, variety and growing area (20 MPa) [1-6].

9. Aerodynamic properties of grain are features of its behavior in an air stream. Moving grain in the air meets resistance (pressure), which depends on a

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number of factors. Pressure of air flow on the body in it, depends on mass of the body, its size, shape, surface condition, relative speed and location of the grain, as well as the state of the air environment. With a vertical air flow, particles (grains, impurities) can either fall, or be carried up by the air, or be in a suspended state. The soaring velocity (m / s) is the air flow velocity at which the gravity of the particle is balanced by the air resistance force. The rate of soaring is inversely proportional to the square root of the windage coefficient. Aerodynamic properties of grain and its impurities are used in cleaning and sorting of grain mass. Air flow from the grain mass emit organic sweepings (pieces of straw, chaff, empty glume). Secondary passage through the air stream allows you to select many seeds of weeds. Speed of soaring of grain and its impurities is set experimentally in pneumatic classifiers of different designs. Value of the speed of soaring is different for grain and seeds of different cultures and depends on their shape and size. For example, for grain it is 9-11 m/s, for millet-6-8 m/s, for peas-15-17 m/s.

10. Grain contamination means presence of live pests of grain stocks – insects or ticks at any stage of development – between the grain space or inside individual grains. Based on the biological characteristics of individual species of insects, there are pests infestation of grain in explicit and implicit forms. Explicit form is characterized by the presence of live pests of grain stocks in the boundary grain space, and hidden form - presence of pests within individual grains. Various types of insects and ticks can

exist in grain mass. Many of them develop only in storage and are not found in nature (barn weevil, crustaceans, barn moth). Others are able to reproduce in nature and in storage (rice weevil, grain moth, bean seed, mites). The third breed only in natural conditions and get to storage together with a crop (a pea grain, a grain scoop, nematodes, etc.) [1, 4, 5, 7].

Pests of grain stocks cause great damage in the currents and storage facilities of agricultural enterprises, in the food industry processing grain, as well as in the system of trade and public catering. Under favorable conditions, many of them multiply intensively, feeding on grain, flour or cereals. Their development is accompanied by large losses of grain products in weight (5-6%) and a decrease in quality. Seed germination is reduced, as insects are partially or completely eat away corcule and endosperm. Contaminated grain produces contaminated flour, while reducing its yield and increasing waste. The ash content of individual fractions of flour increases. Flour becomes dark in color. Dark and with increased ash fractions of flour go to lower grades, the yield of flour of higher grades is reduced.

### Conclusion

Present article analyzes physico-chemical and mechanical properties of local grain varieties. Also matter on methods of determining the quality of local grain varieties was viewed. Quality of grain is of great importance for its further use for processing and storage.

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