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Quality assessment of wheat grain should be based on its protein content

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Summary. *The modern state of quality assessment of soft wheat in respect of its gluten quality and quantity is discussed. International approach to this assessment is based on protein content determination, so the discrepancy between national and international approaches is discussed. Such discrepancy is believed to have adverse influence on the competitiveness of domestic products. Comparative analysis of physico-chemical methods of soft wheat protein determination is displayed. Authors suggest to use near-infrared spectroscopy (NIS) for quality assessment of cereal crops. Transfer to the single methodology of baking quality assessment of soft wheat may give significant economical effect both on internal and external markets.*

Keywords: *quality, gluten, soft wheat, protein, near-infrared spectroscopy (NIS), photometry, indicator of gluten deformation (IGD), standard, physico-chemical characteristics, storage, labelling, defects, market.*

Currently in our country baking properties of soft wheat are estimated mainly by the quantity and quality of wet gluten. It is considered to be dense rubber-like mass consisting of glyadine and glutenine produced by careful washing of dough with water. Quality of gluten, or its physical properties (elasticity and extensibility) are estimated by means of special device – indicator of gluten deformation (IGD). The principle of operation of all types of this device is based on measuring the force pressing the ball of gluten with a mass of 4 grams on the descending load. The gluten quality is expressed in IGD units (from 0 to 150). On the base of its gluten quality wheat may be divided into 3 groups: I – good (43-77 IGD units), II - satisfactory weak (78-102) and satisfactory hard (18-42), and III - unsatisfactory weak (103 and more) and unsatisfactory hard (17 and less) [1]. Depending on quality and quantity of wet gluten, soft wheat in respect of its baking properties may be classified into robust, medium (valuable) and weak (forage). Robust wheat contains not less than 28% of gluten, not less than 60% of vitreous grain and refers to the 2nd quality group. Wheat which produces flour giving bread with large volume, high porosity and dimensional stability, may be also referred as robust. Robust wheat's gluten is able to amend baking properties of weak wheat. Medium (valuable) wheat produces bread of standard quality, but it cannot be an additive to amend baking properties of weak wheat. Medium wheat should contain 23-28% of gluten and 40-60% of vitreous grain, its quality corresponds to not less than 2nd group. Weak (forage) wheat is not suitable for the manufacture of standard bread without addition of robust wheat, so it is mainly used to produce mixed fodder for animal farming [2]. According to the technical specifications [3], robust wheat refers to 1st and 2nd classes of quality, medium – to 3d, weak – to 4th and 5th classes...

Russia has recently joined the WTO and took a leading role in the exports of wheat (first place in the world in 2015/16, ahead of Canada and the United States) [4,14], so the system of assessment of wheat baking properties should be complemented according to the international practices. In international trade food grain is firstly assessed by mass percentage of protein. Namely protein content is the main factor for the formation of wheat consignments. In domestic practice the protein content in wheat is determined only at the request of the buyer, whereas in the EU countries this indicator is obligatory, and in the USA it is included in shipping documents. Besides this, restrictive rules on the mass fraction of protein are established in the international standard ISO 7970 [3,5,6,7]. Mass fraction of protein obviously can not be regarded as a measure equivalent to the quantity and quality of gluten, since gluten proteins account for only about 72% of all protein substances of wheat grain. Other proteins (albumins and globulins) are water soluble, they are not part of gluten and do not affect the baking properties of wheat. However, these proteins provide nutritional value of wheat [8]. Meanwhile, in international practice, the quantity and quality of gluten are determined solely in arbitration purposes. Thus, there is a mismatch between the domestic and international legal framework in the field of wheat quality assessment, that reduces the competitiveness of Russian products on the global market.

Currently in Russia the Kjeldahl method of protein content determination in wheat grain is standard. Though this technique is rather cheap and well automated, it is very laborious and time-consuming. Besides, this method it is not always satisfactory reproducible in different laboratories.

More effective is determination of protein content by photometric method. In this case optical density of dye Acid Orange 12 solution remaining in the sample after linking it with grain protein in the sample is measured. This method is approved by the American Association of Cereal Chemists (AACC, method 46-14A) and the Association of Official Analytical Chemists (AOAC, Method 16.037). Russian scientists have developed a software complex "SORBFIL-PROTEIN", automating this technique [9].

Domestic and foreign scientists proposed a number of new methods for the determination of protein content in the grain. Spectroscopy of diffused reflection in the near infrared range (NIR spectroscopy) is successfully used to determine not only the mass fraction of protein and grain moisture but also the gluten content in grain. The relationship between the reflection intensity of individual spectral bands and concentration of the individual components in the grain was established [10].

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Recently, new models of NIR analyzers appeared, recording transmission spectra, wherein the sample requires no preparation for the analysis, while registration of the spectra of diffuse reflection requires homogenization of the sample by grinding. In addition, a number of studies have shown the relationship of grain vitreousness with the parameters of the NIR spectra. Besides this, there is possibility of prediction of wheat flour baking properties on the base of thorough analysis of NIR diffuse reflection spectra [10,11]. However, it should be noted that the use of NIR spectroscopy is justified only for determination of protein and gluten content, because the relationship of NIR spectra parameters and gluten quality, grain vitreousness, dough parameters and yield of bread is not evident from the physicochemical positions.

Despite significant advances in the development of methods for determination of protein in the grain, the foregoing methods in Russia are still not standardized. This is largely due to the presence of objective constraints to wider dissemination of the proposed methods. The main disadvantages of photometric method that hinder its implementation, are the need to use a wide variety of chemicals with limited shelf life (glacial acetic acid, specific dye, potassium dihydrophosphate), as well as the role of human factor in the preparation of samples for analysis. Devoid of these shortcomings, the method of NIR spectroscopy requires the prior removal of defective grains from the sample (frost, sprouted, bugged,etc.). In addition, the method of NIR spectroscopy requires periodic recalibration, since the infrared spectrum is a comprehensive indicator of the chemical composition of the samples and, therefore, a clear reverse transcript of this spectrum is impossible. For example, the calibrations for wheat of various types and harvest years often differ significantly [12-19]. Thus, an important scientific and practical task is the search of optimum regimes of protein content determination in wheat of different botanical varieties and types using modern physical and chemical methods of analysis.

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