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FEATURES OF THE CHEMICAL COMPOSITION OF CORN GRITS AT THE DIFFERENT DEGERMINATOR MODES IN THE DENT CORN PROCESSING

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Abstract. This article is devoted to the study of transforming the chemical composition of corn grits at the different operation modes of degerminator in the dent corn processing. The experiment was conducted in industrial conditions on Skvyrskyi grain processing factory Ltd. during the processing of kernels using the degerminator of Bühler company. The operation modes of the degerminator were changed for 5 times during the experiment by means of the regulation of the gap between the shell and the drum. The study has shown that in terms of the low operation mode of the degerminator (the passage of the sieve Ø3.0 – 34.9%) there is a high output of fine fractions of the intermediate products, but the quality level of the overtail product of the degerminator is the best by fat content 1.81% and crude fiber content 6.72%, which indicates a minimal germ and bran content. In case of the increase of the gap (the passage of the sieve Ø3.0 – 12.4%), the output of fine fractions of the intermediate products, as well as the output of feed germ meal, declines, at the same time the overtail product has the high number of remnants of the germ and bran after the degerminator, as the fat content increases to 2.80% and crude fiber content increases to 9.82%. It was also found that the change of degerminator modes (increase in the passage of the sieve Ø 3.0 from 34.9 to 12.4%) leads to a decrease in the starch content from 79.36 to 75.43%, the protein content does not change. In order to provide the high quality of corn groats products, it is advisable to control the quality of the overtail products of the degerminator by the fat content. The fat content in the overtail product must not be higher than 2.2% – during the production of long shelf life products, and not higher than 2.5% – during the production of common corn products. For prompt regulation of the degerminator operation modes, it was offered to use release indicator, which can be determined by means of sieving of the 100 g of the overtail products using the Ø 3.0 sieve. In order to provide the fat content in groats within 0.6–0.8% and 0.8–1.0%, the general extraction of the fine products (release indicator) with the Ø 3.0 sieve use in the dent corn processing should vary within the range of 27–32% and 22–27%, respectively.

Keywords: dent corn, processing, degerminator, operation modes, grits, fat content, starch content, germ.

Introduction. Formulation of the problem

Groats – second product in terms of importance and quantity after the flour. The annual production in the world totals nearly 3 mln tonnes. In the human diet, groats cover nearly 8–13% of the general grains product consumption [1].

Corn is one of the eight grain crops in Ukraine, which is processed into groats of different size and flour. But it is considered to be feed grain rather than food grain, because its use in the food service industry totals 20% only, whereas it’s use for feed purposes reaches 70%

Corn as a botanic specie is divided into eight subspecies: flint corn (indurata Sturt.), dent corn (indentata Sturt.), semi-dent corn (semidentata Kulesh.), soft corn (amylacea Sturt.), pop corn (everta Sturt.), sweet corn (saccharata Korn.), waxy corn (ceratina Kulesh.) and pod corn (tunicata Sturt) [2]. To divide the corn into subspecies there are used such features as: inner structure of the kernel (location of the floury and horny endosperm), the development rate of the horny part, the form of the corn [3].

In Ukraine, there are three most common types of corn: dent corn (the large prolonged kernel), semi-dent corn and flint corn (roundish corn kernel). Dent corn is characterized by the presence of the corn kernel with the pressed top, yellow or white colour. The endosperm of the top is vitreous (horny) on the sides, and floury and fluffy on the other side. The main features of the kernel of this subspecies is a high rate of starch. The form of the semident corn kernel takes the in-between position between flint and dent corn. The kernels have small hole at the top, and the white or yellow colour. Flint corn has the kernels with round top, and the colour is yellow or white. The endosperm is floury in the center and vitreous on the outside. Flint corn differs from dent corn with the higher protein content, and has much lower share of the planted areas in the country, so dent corn is the basis in the processing operations on the domestic enterprises. Due to its anatomic structure and the lower hardness of the kernels, dent corn has the poorer processing behavior compared with flint corn, that is why the scientific background of the effective processing modes of this corn is relevant and important from the practical point of view.

The range of corn groats produced by the existing technologies includes the tally polished groats, coarse groats for the production of flakes, and fine groats for the production of corn puffs. Tally polished corn groat is the crushed particles of the corn kernels of the different shape without the bran covering and seed bud, which were polished with the rounded edges. The coarse corn groat for the production of corn flakes is the crushed particles of the corn germ of different hape, without the bran covering and germ, with the sharp edges, which represent the absence of polishing treatment during the processing. The fine corn groat for the production of corn puffs is the crushed particles of the corn kernel of different shape with the sharp edges without the bran covering and germ [4].

The important stage in the processing of corn grain is the removal of the germ because it contains high fat rate, which is unadvisable for the finished products, because the fat is subject to rancidifying, and therefore spoilage of the product. The majority of the plants during the dry basis milling of the corn grain remove the germ, using the machines of the mashing type – degerminators. Herewith, “The regulations of the technological process on the milling plants” [4] do not provide the recommendations concerning the operation modes of the degerminator, that is why the finished products usually have the exceeding fat content rate which provides the long shelf life of groats or other milling products (flakes, puffs, etc.). It is known that with accordance to the customers’ requirements, the fat content in groats must not exceed 0.8–1.0%, in baby food products – 0.6–0.8%, at the same time on the majority of the domestic plants the fat content in groats totals 1.0–1.2%.

Analysis of recent research and publications

The corn kernel consists of four anatomical parts: the endosperm, germ, pericarp and tip cap, and they generally make up 81–84%, 10–14%, 5–6.5% and 1–1.5% of the corn kernel, respectively [5,6].

The endosperm is mainly made up of thick-walled cells filled with starch surrounded by a protein matrix, while the large clear cells, which form its upper layer, are called aleurone cells. There are two types of endosperm and these influence grain hardness: floury (soft or mealy) or horny (hard or vitreous), which depend on the size and compaction grade of the starch granules and the nature of the protein matrix [5]. The flint part of the endosperm, corneous and semi-transparent, includes peripheral cells that are closely fit to each other, and densely filled with starch granules of angular shape, glued to each other with protein. The other part of the endosperm, which is more loosened and floury, includes the cells filled with round-shaped starch granules that are almost unconnected to each other. The ratios of floury and horny parts of the endosperm significantly vary, depending on the variety of corn and with type of proteins determine vitreousness of corn kernel [7]. Also, the chemical composition of the anatomical parts of corn is quite different. Starch is almost completely localized in the endosperm, lipids and minerals – in the germ, protein – in the endosperm and germ, and fiber – in the pericarp (shell) [8].

Separating of the germ from the corn kernel is considered as one of the most important technological operations, since its effectiveness has the significant impact on the quality indicators of the whole range of corn by-products. The need for the maximum germ separation is contingent on the high reactivity and lability of the compounds contained therein, also results in the high oxidability and hydrolyzability of the lipid complex. In turn, the reporting factor causes some reduction of the quality features of corn by-products, in terms of their further storage [6,9].

Dry-milling is the main milling procedure adopted in the corn food chain, and it produces refined endosperm products with various particle sizes and other by-products, such as germ and animal feed flour [10]. The reporting process could be carried out with or without a tempering step before degermination. Tempering is done adding water, in order to create differential swelling, resulting from the higher absorbing moisture of germ and pericarp, that lead to a loss of tissue connection between the germ and the endosperm, and a faster removal of these fractions [11].

There are many ‘brands’ of degerminators used around the world, with the majority of them being emulations or modifications of a few basic designs. The various degerminators in use can be classified into five categories: kernel-to-kernel Shear (Beall type), impact, multiple impact/shear, compression (Cereal Technologies, Inc.), compression and shear (mill roll). Various degerminators have quite different performance indices. So, in terms of presence of degerminators in the production line, the starch content in the produced germ usually does not exceed 25–26%, and fat content totals 25–30%, whereas in terms of germ separating at the rollers, the starch content in germ totals 28–30%, with significantly lower fat content (17–18%) [12].

The conical or Beall type is one of the most effective types of degerminators. The Beall-type degerminator is one of the oldest corn degerminators, but is still recognized as the best one when the objective is design for the Beall has been widely copied. When the germ is separated on this degerminator type that produces large grits with a low fat content. Therefore, they are better suited for obtaining cereals of various numbers, although further grinding and refining processes could be applied to these products, in order to obtain corn meal and flour. Otherwise, using the impact degerminator system, corn grains are broken by the impact degerminator, and this process is employed only for the production of corn meal and flour [13].

The Beall-type degerminator consists of a truncated outer cone, which in top is covered with hemispheric nodules (knobby surface), and in bottom has screen surface. The inner cone covered by hemispheric nodules is driven counterclockwise. The distance between the cones (gap) can be adjusted by moving the inner cone (drum) along the horizontal axis.

The process of work of the degerminator is as follows: tempered corn is fed into the degerminator into the inlet, located at the top of the small end of the outer cone, and falls into the area between the cones. Action of deformation kernel-to-kernel shear leds to open the kernel, and releases the germ. Once the kernel is broken, the germ and pericarp are released, due to continued shearing action. Eventually, the broken particles reach the screen surface and go through the screen, while the large flaking grits and unbroken kernels are shoved out the tailgate (outlet). The thrus consist of whole and broken germ pieces, the pericarp, and smaller endosperm pieces [11].

Reducing of the working gap between the cones lowers the product's residence time in the degerminator, increases the number of fine fraction, as well as reduces the mass of untreated (uncrushed) grain. At the same time, it reduces the performance of the degerminator, the general production of groats, but increases its quality level (decreasing of the fat content).

The major **aim** is to study how the chemical composition of corn grits changes during processing in degerminator and to provide rationalization for operating modes of the degerminator of conical type in the industrial conditions, which are optimum for processing of dent corn to standard groats of common and long shelf life.

For the purpose, the **objectives** to be achieved are as follows:

1. Determining the chemical composition and content of the anatomical parts in the dent corn.
2. Determining the changes in the fractions yield and in the chemical composition of corn grits during changing operation modes of the degerminator.
3. Establishing the rational operating modes of the degerminator for processing of dent corn to standard groats of common and long shelf life

Research materials and methods

Milling and sieving procedure. The experiment was held out in the industrial conditions at Skvyrskyi grain processing factory Ltd. The process chart of the germ separation on the plant (fig. 1) includes the following technological operations: cleaning from light particles in the aspiration column (1), moistening of the grain (3), and separating the germ at the Bühler degerminator (5). According to results of grain processing in the degerminator, one should receive two by-products: thrus product – feed germ meal (grinded germ), and overtail product – the product, which is ready for further processing, and containing mainly endosperm of the grain with the small share of germ.

The degerminator modes were changed at 5 points of the experiment by adjusting the gap between the shell and the drum. Since the degerminator does not have the measuring scale, in terms of the overtail product, there was usually used extraction of the product through Ø3.0 sieve from the degerminator, to control its operation modes.

The particle-size analysis of the grinded products was determined by sieving on the laboratory sifter for 10 minutes, to receive the following fractions: –/Ø5.0 – upper overtail, which is formed by whole or partially crushed grain; Ø5.0/Ø4.0 – coarse grits; Ø4.0/Ø3.0 – medium grits; Ø3.0/Ø2.0 – fine grits; Ø2.0/067 and 067/0 – grinded groats and flour.

The mass share of the finished products, by-products and wastes was determined on the basis of material balance, in accordance with the company's form No. 117.

*Physical procedure***.** After measuring the weight of grains, pericarp, germ, and endosperm were isolated by hand-dissection of samples, previously soaked in water for 12 hours. Mass of each part of grain after drying was measured and their share of the whole grain weight was calculated.

The mass fraction of the free germ and the germ in form of clusters with endosperm particles was determined visually by manual analysis of the specific product's sample weight. The mass of the free germ was weighed and referred to the mass of product on a percentage basis, while the mass of germ in form of clusters was calculated with the coefficient of 0.2.

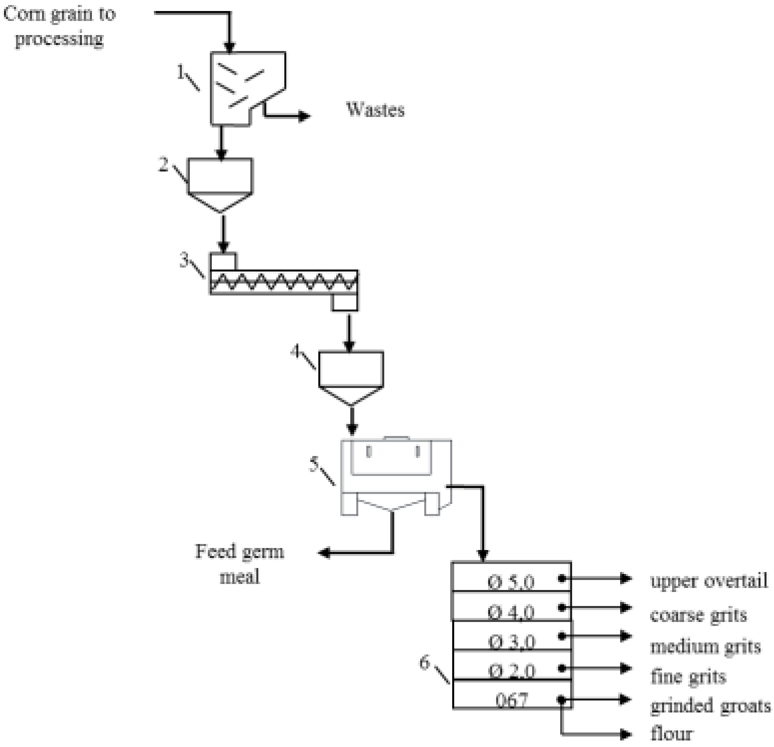

Fig. 1. The scheme of the corn germ separating in the degerminator and the following sieve analysis: 1 – aspiration column; 2, 4 – processing bin; 3 – moistening machine; 5 – degerminator; 6 – laboratory sifter

Analytical procedure. Quality indicators of corn by-products (moisture content, starch content, fat content, protein content, crude fiber content) was carried out by the standard methods: moisture was determined by drying in the drying oven at the temperature of 130°C in accordance with GOST 13586.5-93, starch content – by the Evers polarimetric method according to GOST 10845-98, fat content – by the Soxhlet method in accordance with GOST 29033-91, protein content – by the Kjeldahl method in accordance with GOST 10846-91, crude fiber content – by the enzymatic-gravimetric method [14].

Results of the research and their discussion

Within frames of the experiment, the company processed corn grain of dent type with the following indicators: the germ content – 11.9%, endosperm content – 81.5%, fat content – 4.9%, fat content in the germ – 35%, starch content – 73.1%, protein content – 9.7%, crude fiber content – 9%.

In order to set up the operating modes of all manufacturing machinery, and forecast the output of finished products, the ability to hold certain fractions of crushed products is the important characteristic in terms of milling of any grain type, which can be estimated by the particle-size characteristic of the grinded products. In terms of corn grain processing by the degerminator, there are received two products: overtail product of the degerminator, which in accordance with the scheme is provided for the further processing, and thrus product – feed germ meal, which is a by-product of corn processing for food purposes. In turn, in the structure of overtail product there can be distinguished three groups of product fractions by size:

– unprocessed grain that is concentrated in the overtail from Ø5.0 mm sieve;

– coarse, medium and fine grits that are generally possible to receive through Ø5.0/Ø2.0 mm sieves. Grits are the main by-products, which are then formed into the finished product (groats). They are basically formed from particles of the pure endosperm in mixture with separated particles of the germ and shells, as well as with clusters of various anatomical parts;

– grinded grits, feed meal and flour.

It is clear that in order to ensure the maximum economic results of the enterprise, it is important to receive the largest possible volume of grits and the minimum volume of feed germ meal after grain processing in the degerminator (Table 1, Fig. 2).

Analytical procedure. Quality indicators of corn by-products (moisture content, starch content, fat content, protein content, crude fiber content) was carried out by the standard methods: moisture was determined by drying in the drying oven at the temperature of 130°C in accordance with GOST 13586.5-93, starch content – by the Evers polarimetric method according to GOST 10845-98, fat content – by the Soxhlet method in accordance with GOST 29033-91, protein content – by the Kjeldahl method in accordance with GOST 10846-91, crude fiber content – by the enzymatic-gravimetric method [14].

Table 1 – Degerminator processing products yield

Mode	Degerminator processing products yield, %		Fraction yield, % on overtail product						Release (Ø3.0/--), %
	thrus	overtail	--/Ø5.0	Ø5.0/Ø4.0	Ø4.0/Ø3.0	Ø3.0/Ø2.0	Ø2.0/067	067/--	
Mode 1	36.2	63.8	15.7	20.8	28.6	16.0	12.8	6.1	34.9
Mode 2	34.7	65.2	18.2	21.3	31.5	14.8	7.9	6.3	29.0
Mode 3	33.2	66.7	20.0	23.7	33.7	11.5	5.0	6.1	22.6
Mode 4	31.9	68.1	22.5	25.2	34.1	10.9	3.5	3.8	18.2
Mode 5	30.7	69.3	24.5	27.1	36.0	9.5	2.0	0.9	12.4

According to the Table 1, in terms of the smallest gap in the degerminator (mode 1), the output of feed germ meal reached the highest level – 36.2%, while the output of the overtail product reached the minimum level at 63.8%. The number of grits in the overtail product totaled 65.8%, while the medium grits formed the largest share in the structure (Ø4.0/Ø3.0) – 28.6%, although the mass fraction of other grits was slightly less – 20.8% of coarse grits (Ø5.0/Ø4.0), and 16% of fine grits (Ø3.0/Ø2.0). The mode was characterized by the most unlevelled particle-size composition of the grinded products, since the general extraction of two adjacent fractions did not even exceed the level of 50%, that is the number of all fractions was more or less the same.

Increasing of the gap (mode 5) led to changing of the particle-size composition of the grinded products: the general output of grits increased to 72.6%, due to significant increasing of the output of coarse and medium grits in 1.25–1.30 times. The output of the largest-sized fraction also increased – from 15.7% (mode 1) to 24.5%, in other words every fourth grain particle in the overtail product in the reporting mode was somewhat subjected to partial compression between the drum and the shell of the degerminator, but still retained its integrity. On the contrary, the output of other by-products decreased: fine grits – down 1.7 times, grinded groats (Ø2.0/067) – down 6.4 times, and flour (067/--) – down 6.8 times. But the general partition size of the overtail product and its quantity increased, while the number of feed germ meal gradually decreased to 30.7%, as the gap somewhat increased.

Since the largest redistribution of the grinded fractions in terms of changing of the operating modes of the degerminator was observed in the change of the general output of coarse and medium grits (Ø5.0/Ø3.0), and the change of the general output of fine by-products: grinded grits, feed germ meal and flour (Ø3.0/--), then extraction of the reporting fractions in the production conditions can serve as the indicative figure for setting of the operating modes of the degerminator by the technologist in the industrial conditions (Fig. 2).

In terms of estimating of the work of the degerminator at the enterprise in terms of processing of dent corn grain, then according to the material balance the output of feed germ meal reached 30.7–36.2%, which slightly exceeds the generally accepted recommendations (30%), which is probably developed, due to the low qualitative indices of the raw materials. The enterprise processed dent corn, which has the low kernel hardness, contains the higher share of the endosperm of the floury type, which is easier to grind, passes through the sieve of the degerminator, and come to feed germ meal. Taking into account the above mentioned data of the product outputs received after the degerminator processing, in terms of the output of feed germ meal at the level of 30–35%, then according to our estimations, the product receives nearly one third of the endosperm, as evidenced by the data of the chemical composition content of by-products of the degerminator (Fig. 3-6).

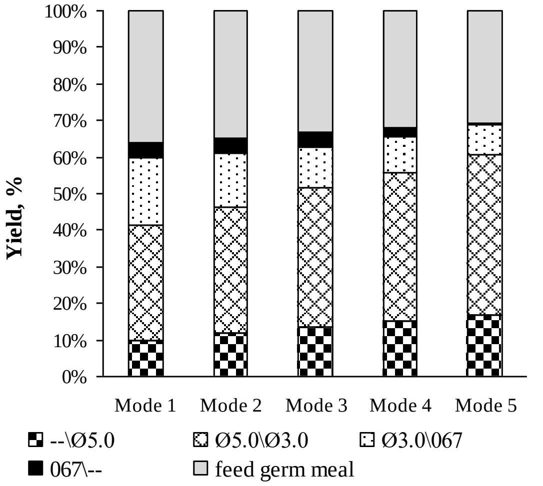

Fig. 2. Degerminator processing products yield, %

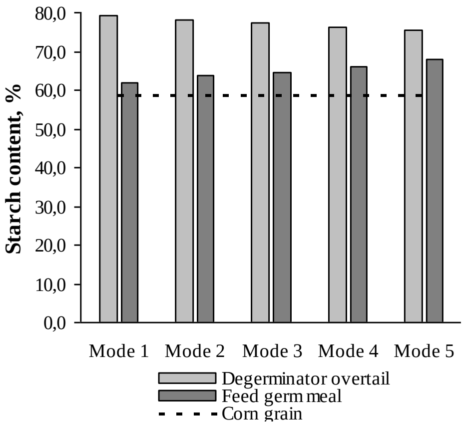

Fig. 3. Starch content in degerminator processing products, % on dry basis

In terms of the minimum gap in the degerminator, the starch content in the overtail product reached the maximum level, and the starch content in feed germ meal was the lowest. Increasing of the gap led to lowering of the starch content in the overtail product from 79.36% (mode 1) to 75.43% (mode 5), and the further increasing of its content in feed germ meal from 61.97% to 67.74%. Since starch is the main component of the endosperm – its content reaches 85–88% against 8.0–8.3% in the germ [8,15], the lower starch content in feed germ meal with the minimum gap indicates the larger share of the germ in feed germ meal. In terms of increasing of the gap, feed germ meal receives much less of the germ, and more of the endosperm, therefore the starch content in feed germ meal usually increases in the mode 5 (Fig. 3).

In the similar way, fat is the main component of the germ, so in terms of changing of the mode of the degerminator, the fat content in by-products also changes, but in terms of the reverse trend. With a minimum gap, the fat content in feed germ meal is maximum (the larger share of the germ is grinded), and in terms of increasing of the gap, the germ is grinded in much worse way, due to its plasticity properties, so the fat content in feed germ meal usually decreases from 10.3% to 9.58%, while increases in the overtail product from 1.81% to 2.8% (Fig. 4).

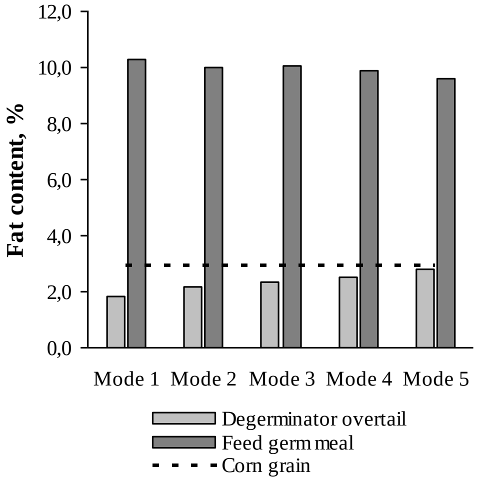

Fig. 4. Fat content in degerminator processing products, % on dry basis

As for the protein content, there are no any significant changes of its content in the by-products of the degerminator. In all modes, the protein content in the overtail varies within the range of 8.57–8.82%, while in the thrus (feed germ meal) – 11.61–11.68%. The reason for this is that the difference in the protein content is not so significant – 18.5–19.7% in the germ, 8.5–9.0% – in the endosperm, while the endosperm share exceeds the share of the germ in nearly 7–7.5 times (Fig. 5).

Changing of the crude fiber content is similar to changing of the fat content: in terms of increasing of the gap, the crude fiber content in feed germ meal reduces in 1.8 times, due to the significant reduction of its shells, which are more rigid, and in terms of decreasing of the compression in the degerminator the figures remain in the form of clusters with particles of the endosperm in the overtail product (Fig. 6).

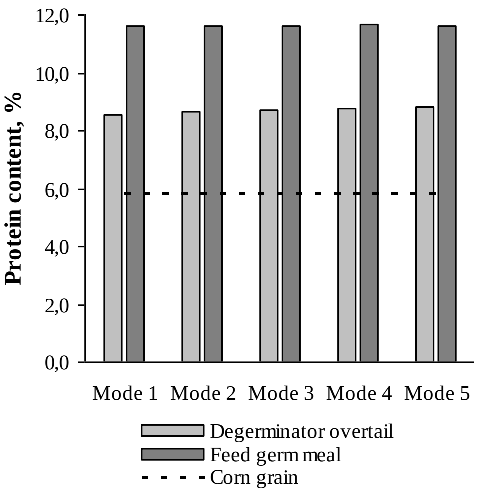

Fig. 5. Protein content in degerminator processing products, % on dry basis

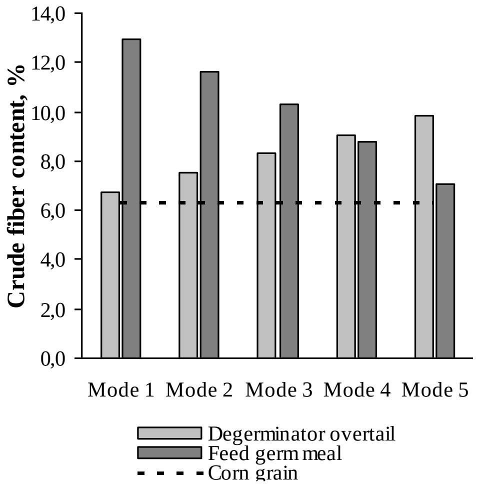

Fig. 6. Crude fiber content in degerminator processing products, % on dry basis

Since the study of the chemical composition of the products demonstrated its significant changes in terms of changing of the gaps in the degerminator, therefore we were interested what is the share of the germ, and how it is distributed among the fractions of the extracted products? (Table 2).

The share of the germ was visually determined in the large-sized products of the overtail of the degerminator: --/Ø5.0, Ø5.0/Ø4.0, Ø4.0/Ø3.0. At the same time, the free germ particles and germ particles in the form of clusters with the endosperm were selected separately, and the latter ones were recognised with the coefficient of 0.2, as well as determined their mass fraction. The studies demonstrated that the free germ particles are concentrated in the product Ø5.0/Ø4.0 – from 2% to 7.3% to the weight of the fraction in the modes 1 and 5 respectively, and the germ in the same modes in the form of clusters is concentrated in the product --/Ø5.0 – from 1.2% to 8.2% to the weight of the fraction (taking into account the coefficient 0.2). In medium grits (Ø4.0/Ø3.0), the share of the germ compared with the mass of the fraction is quite small – from 4.8% to 1%, but since the output of the fraction is quite high, then in terms of the low gaps (modes 1 and 2), the share of the germ in medium grits dominate compared with other fractions; in the mode 3, the germ was distributed between coarse and medium grits in almost similar way; in the modes 4 and 5, the germ moved to the larger fractions. Taking into account the germ content in the grain (11.9%), we calculated its mass share in the large-sized products of the overtail of the degerminator: in the mode 1, these products received the range from 11.3% (mode 1) to 25.9% (mode 5) of the germ share from its content in the grain, which certainly affected the qualitative features of the finished product (Table 3).

Table 2. Germ content in the by-products after the degerminator

Mode	Germ content, % on grain mass				The share of germ, % on germ content in grain			
	--/Ø5.0	Ø5.0/Ø4.0	Ø4.0/Ø3.0	**Σ --/Ø3.0**	--/Ø5.0	Ø5.0/Ø4.0	Ø4.0/Ø3.0	**Σ --/Ø3.0**
Mode 1	0.12	0.35	0.87	**1.3**	1.0	2.9	7.3	**11.3**
Mode 2	0.31	0.54	0.87	**1.7**	2.6	4.5	7.3	**14.4**
Mode 3	0.43	0.76	0.71	**1.9**	3.6	6.4	5.9	**15.9**
Mode 4	0.70	1.09	0.58	**2.4**	5.9	9.2	4.9	**20.0**
Mode 5	1.39	1.44	0.25	**3.1**	11.7	12.1	2.1	**25.9**

Table 3. Dent corn processing efficiency under industrial conditions

Mode	Products yield, %				Fat content, %	
	Feed germ meal	Corn grit	Corn meal	Other products	Degerminator overtail	Corn grit
Mode 1	36.2	45.07	11.32	7.41	1.81	0.64
Mode 2	34.7	47.24	11.02	7.04	2.16	0.78
Mode 3	33.2	49.74	10.54	6.52	2.32	0.91
Mode 4	31.9	51.12	10.23	6.75	2.53	0.98
Mode 5	30.7	52.52	10.10	6.68	2.80	1.11

The best results on the quality of corn groats were received in the operating modes 1 and 2 of the degerminator. The fat content in groats did not exceed 0.8%, therefore the reporting groats were suitable for long shelf life, or the production of baby food products. However, in terms of the reporting modes the output of groats developed at the minimum level, according to the material balance of the enterprise – 45.07% and 47.24% respectively, although it exceeded the basic level (40%). Using the modes 3 and 4 allowed producing the groats with satisfactory quality parameters, with the fat content of less than 1%, but with the significantly higher output – 49.74–51.12%, which can be applied in the production of common groats products. Using the mode 5 for dent corn processing in the reporting enterprise will not allow producing the high-quality finished products, so it is not recommended.

Taking into account the quality assurance (the minimum fat content in groats), in terms of the maximum possible output during processing of dent corn, we recommend using the following modes at the enterprise: mode 2 (extraction by the sieve Ø3.0–29%) – in the production of long shelf life products and baby food; mode 3 (extraction by the sieve Ø3.0–22.6%) – in the production of common corn products.

Conclusion

Due to its anatomical structure and lower kernel hardness, dent corn has the worse processing characteristics in comparison with flint corn, so the scientific substantiation of effective modes for its processing is quite relevant and important from a practical perspective.

Corn processing in the degerminator is the important stage in the technology of the grain treatment, because operating modes of the machine mainly determine the output and qualitative indices of the finished product. In terms of the low mode, the degerminator provides the high output of fine fractions of the intermediate products, but the qualitative features of the overtail product of the degerminator demonstrated the best level by fat content. In terms of increasing of the gap the extraction of fine fractions of the intermediate products and the output of feed germ meal continues decreasing, but the overtail product after the degerminator still keeps a large number of the germ: in the large-sized overtail products, the share of free germ and germ in the form of clusters total nearly 25.9% of its content in the grain.

In order to ensure the high quality of corn groats products, we recommend to monitor the qualitative level of the overtail product of the degerminator: the fat content should not be more than 2.2% – in the production of long shelf life products and baby food; no more than 2.5 % – in the production of common corn products. For real-time regulatory approach, we recommend to use the release indicator, which can be specified by sieving of 100-gram sample weight of the overtail product at the sieve Ø 3.0. In order to ensure the fat content of groats at the level of 0.6–0.8% and

0.8–1.0%, the general extraction of fine products (release indicator) in the processing operation of dent corn should vary within the range of 27–32% and 22–27%, respectively.

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ОСОБЛИВОСТІ ХІМІЧНОГО СКЛАДУ КУКУРУДЗЯНОЇ КРУПИ ЗА РІЗНИХ РЕЖИМІВ РОБОТИ ДЕЖЕРМІНАТОРУ ПРИ ПЕРЕРОБЦІ КУКУРУДЗИ ЗУБОПОДІБНОГО ТИПУ

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Анотація. Статтю присвячено вивченню зміни хімічного складу кукурудзяної крупи за різних режимів роботи дежермінатору при переробці зерна кукурудзи зубоподібного типу. Експеримент проведено у виробничих умовах на Сквирському комбінаті хлібопродуктів при обробленні зерна на дежермінаторі компанії «Бюлер». Режими дежермінатора змінювали у 5 точках експерименту шляхом регулювання зазору між обичайкою та барабаном. У результаті досліджень встановлено, що при низькому режимі роботи дежермінатору (прохід сита Ø3,0 – 34,9%) здійснюється високий вихід дрібних фракцій проміжних продуктів, але якість сходового продукту дежермінатору за вмістом жиру та харчових волокон є найкращою – 1,81% та 6,72%, відповідно, що свідчить при мінімальну кількість зародка і оболонок. При збільшенні зазору (прохід сита Ø3,0 – 12,4%) вилучення дрібних фракцій проміжних продуктів, так і вихід кормової зародкової мучки, зменшується, але у сходовому продукті після дежермінатору залишається велика кількість зародка та оболонок, так як вміст жиру та харчових волокон збільшується до 2,80 та 9,82%. Також встановлено, що зміна режимів дежермінатору (збільшення проходу сита 3,0 з 34,9 до 12,4%) призводить до зменшення вмісту крохмалю з 79,36 до 75,43%, вміст білка практично не змінюється. Для забезпечення високої якості кукурудзяних круп'яних продуктів рекомендовано контролювати якість сходового продукту дежермінатору за вмістом жиру. Вміст жиру у сходовому продукті після дежермінатору повинен бути не більше 2,2% – при виробництві продуктів довгострокового зберігання та для дитячого харчування; не більше 2,5% – при виробництві звичайних кукурудзяних продуктів. Для оперативного регулювання режимів дежермінатору запропоновано використовувати показник загального вилучення, який можна визначати просіюванням 100-грамової наважки сходового продукту на ситі Ø3,0. Для забезпечення вмісту жиру у крупі на рівні 0,6–0,8% та 0,8–1,0% загальне вилучення дрібних продуктів проходом сита Ø3,0 при переробці кукурудзи зубоподібного типу повинно бути у межах 27–32% та 22–27%, відповідно.

Ключові слова: зубовидна кукурудза, переробка, дежермінатор, режими, крупа, вміст жиру, вміст крохмалю, зародок.

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