СЕКЦІЯ 1. СУЧАСНИЙ СТАН, ТЕНДЕНЦІЇ ТА ПЕРСПЕКТИВИ РОЗВИТКУ ІННОВАЦІЙНИХ ТЕХНОЛОГІЙ В АГРОПРОМИСЛОВОМУ КОМПЛЕКСІ

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SELECTION OF OPTIMAL MODES OF HEAT TREATMENT OF GRAIN

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Forage preparation is the most important technological process on farms, as 20–60% of all labor costs for production are spent on forage preparation. Mechanized preparation of feed on the basis of rational technology is an important condition for increasing labor productivity and reducing the cost of livestock products [1,2].

Mechanization of feed preparation significantly expands their range for different species of animals. Production and manufacture of briquettes, pellets, various types of canned food, creation of feed mixtures, selection of micro-ingredients to the required complexity, improving the availability of nutrients, requires the creation of high-tech equipment capable of replacing a range of machines and obtain high economic effect. The use of extrusion technology meets the above requirements. Press expanders provide a mechanical effect on the raw material, effectively destroying the structure of the material, thereby increasing the nutritional value and quality of feed. This treatment is associated with high temperatures up to 130^{o}C and pressures up to 3,0 MPa. However, the efficient operation of the expanders is prevented by the high energy consumption of the process. The study of the influence of a complex of different factors on improving the efficiency of the expansion process is an urgent task [3-5].

Fodder grain is the main component in the production of animal feed and poultry. However, when feeding grain in the usual form, the digestibility of its nutrients by animal food systems is not more than 40-60%. Cereal grain on a par with other types of nutrients contains a lot of starch, the assimilation of which when fed to animals and poultry is slow and at the same time productively used only certain forms and then in small quantities. According to a number of experiments, the digestibility of the nutritional potential of starch in its natural form does not exceed 20–25%, depending on the type of culture. Therefore, the task of new technologies of grain processing is to introduce such methods of processing raw materials, which allowed to translate starch into a form convenient for assimilation by animals. This is possible when the granular structure of starch is destroyed at the cellular level, which contributes to the rupture of natural bonds between the individual components and its conversion into simpler carbohydrates in the form of dextrins and sugars, ie Latinization of starch or dextrinization into simpler components [6].

Technological processes of heat treatment of grain are used to increase its feed value, and feed – to increase feed values and to prepare the feed for further granulation in order to reduce the specific energy consumption, increase the productivity of the press-granulator and give the granules the appropriate strength. It is also known that the use of pre-treatment of feed increases the yield of grits, which is obtained by grinding granules. Increasing the fodder value of grain and feed during heat treatment achieved by increasing the availability of nutrients, destruction anti-nutrients, improving the taste and reducing the total microbial count, which improves the sanitary quality of grain and feed.

Heat treatment of grain should be used in the production of feed for young poultry and animals, the digestive system of which is not yet able to produce the required amount of enzymes required for cleavage biopolymers of nutrients [7-9].

The use of heat-treated grain in the feed provides:

• for chickens – increase in average daily weight gain by 5–10% and reduction of specific costs of compound feeds by 5–7%;

• for piglets – increase of average daily weight gain by 10–15% and decrease of specific costs of compound feeds by 5–10%;

• for calves – increase in average daily weight gain by 5–10% and reduction of specific costs of compound feeds by 7–8%.

When choosing the optimal modes of heat treatment of grain and feed it should be borne in mind that stricter regimens can lead to almost complete destruction of anti-nutrients, maximize the availability of starch, but also lead to a decrease in the digestibility of such nutrients like protein, and to the loss of some biologically active substances. For example, at constant values of pressure (P) and temperature (t) the optimal duration of heat treatment should provide the maximum effect with minimal losses. Without special treatment, fiber, which is found in large quantities in grains and beans, especially in their upper protective layers and shells, is also difficult to digest. Therefore, development methods for in-depth processing of raw grain raw materials should contribute to the destruction of part of the cellulose-lignin formations of fiber in natural forms into simpler types of monosaccharides and amino acids [10,11].

Numerous scientific studies, as well as extensive production verification, have established that the negative impact of these barriers provided by nature for protection, especially seeds, as a biological source of constant production of most cereals and legumes, can be completely or largely suppressed. Due to the static and dynamic effects of external and internal pressure at the cellular and molecular level on protective membranes, temperature, osmosis and other factors, protein denaturation, destruction of anti-nutritional substances, dextrinization of starch, destruction of cellulose-lignin formations, almost complete sterilization of the final product from microorganisms and bacteria, the formation of a microporous structure in the finished product, the most favorable for the action of gastric juice, resulting in a more complete absorption of nutrients by the body of animals [12-14].

Scientists from many countries have conducted a number of studies proving the predominant properties of the expanda. One study concerned the splitting of starch during expansion. The breakdown of starch improves digestion in animals. The issue of starch cleavage is most relevant for piglets. A large proportion of broken starch allows piglets to digest the starch before it enters the colon – thus eliminating the cause of diarrhea, and stabilization of the gastrointestinal tract is especially important for small animals.

The main advantages of the exhibit:

- grit, unlike dirt, is not so hard, so it does not injure the esophagus and stomach of animals;
- the expander is coarse-grained, so it does not form dust and thus does not cause adhesion to the digestive and respiratory organs;
- the expander maintains stability and stability during transportation;
- the expander has a large surface area of particles and a porous structure that provides easier penetration of gastric juice and its own enzymes into the expander;
- when using expandable higher feed hygiene; when using the exhibit: feed consumption is reduced by 9%;
- coefficient of use of expanded feed per 1 kg. weight gain compared to loose feed increases by 9%; when using the exhibit: greater weight gain of animals;
- when using the exhibit: the best condition of the premises for keeping animals; when using the exhibit: low mortality of animals;
- when using exhibit: the best quality of meat; the process of expansion increases the shelf life of feed.

Short but intense exposure to heat, moisture and high pressure during expansion is effective in killing salmonella and other pathogenic bacteria, fungi and mold. The principle of disinfection is based not only on heat treatment, but also on the dynamic impact during the passage of the product through the working area of the expander. The process of expansion affects the preservation of biologically active substances introduced into feed with a premix or as monocomponents. This applies primarily to the vitamin complex. The residual activity of vitamins in the expanded feed is given below.

Table 1

Residual activity of vitamins after feed treatment,%

Vitamins	Expander		Expander + press granulator		Press granulator	
	101-105ºC	111-115ºC	80-90ºC	91-95ºC	86-90ºC	91-95º C
A encapsulated	97	95	93	90	94	91
D 3 - encapsulated	98	96	93	91	93	92
E acetate	97	95	92	90	93	92
К 3	82	78	63	58	75	72
B 1 - mononitrate	96	92	87	82	89	87
B 2 - riboflavin	92	88	84	78	89	87
B 6 – pyridoxine	94	91	85	79	87	85
B 12 - cobalamin	97	96	94	92	96	96
Pantothenic acid	95	92	86	82	89	87
Folic acid	94	91	85	81	89	87
Biotin	94	91	85	81	89	87
Niacin	93	89	85	80	90	89
C – ascorbic acid phosphate	98	96	92	89	93	92
Choline chloride	99	98	97	95	97	97

Evidence of high efficiency of expansion is the determination after the process of expansion of the stability of biologically active components (amino acids).

Table 2

Comparative amino acid content before and after expansion

Indicator	Amino acids		
	Lysine	Threonine	Methionine
Content in unprocessed feed,%	0,84	0,61	0,55
Content in expanded compound feeds (in%) during processing, º C 120 ºC	0,83	0,59	0,56
130 ºC	0,78	0,57	0,54

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