QUALITY EVALUATION OF RAW MATERIALS FOR MIXED
FEED PRODUCTION AND MIXED FEED AS FINAL PRODUCT
WITH THE REQUIRED STANDARDS IN R. MACEDONIA

Valentina Pavlova1*, Ljupka Necinova1, Gjore Nakov1, Elena Gjorgjevska2, Marija
Menkinoska1, Tatjana Blazevska1, Viktorija Stamatovska1

1Faculty of Technology and Technical Science, Veles, “Ss. Kliment Ohridski” University,
Bitola, Petre Prlickov 42, 1400 Veles, Republic of Macedonia
2AGRIA - Agroindustry Group, Veles, Factory of feeding stuffs Ovčepolka, Industriški pat bb,
2220 Sveti Nikole, Republic of Macedonia

*e-mail: valentina.pavlova2@gmail.com

Abstract
Mixed feed is the product obtained by mixing nutritional supplements and additives permitted, serving as a full or extra food for feeding animals. Raw material with good quality allows production of effective and qualitative animal feed, allows cultivating healthy animals, which will be basic raw material in the food industry. High quality raw material in the process of food production leads to production of final food products with good quality, which is helpful in the efforts for sustaining people wellbeing and health.

The aim of this paper is to evaluate the quality of raw materials for mixed feed production, as well as the quality of mixed feed, as final product according to the required standards.

Raw materials for feed production: corn, barley and sunflower meal and different types of mixed feed, were material used in our study. They were obtained from AGRIA. To evaluate the quality of these feed a lot of parameters have been tested: moisture, crude ash, crude protein, and crude fiber, minerals, such as Ca, NaCl and acidity degree.

The values of tested parameters are: moisture 10.4%; crude ash 5.6%; crude protein 18.8%, crude fiber 4.6%, NaCl 0.9% and acidity degree 5.8. These results are satisfactory and are in the range of the standard values, which means that the produced mixed feed from this factory is with high quality and meets the required standards.

Key words: Mixed feed, starter, grower, finisher.

1. Introduction
Feed industry has a duty to produce a larger variety of this type of food and by applying flexible technological processes to enable the use of a large number of materials with a wide range of dosing. The content of the ingredients in each sample must be as respectively as possible to match, with a target value that is optimal in terms of nutritional value that is regulated by a specific recipe. Feed millers must recognize their responsibility to provide quality products to their customers, and their intent should be to provide consistent quality products by implementing sound quality control procedures. Assuring quality is a direct responsibility of all feed mill employers and each of them is held accountable to follow ISO rules, and accepted procedures of GMP (Good Manufacturing Practice) and HACCP (Hazard Analysis Critical Control Points) for the production of compound feeds. Irrespective of the quality control system implemented in all factories, there are many processes (weighting, dosing, mixing, transporting, carry-over, segregation, storing, hydro-thermal and mechanical treatment) which can cause variations in additive content of compound feed [1].

Modern industrial compound feed production requires more than 50 various ingredients for feed mash-es production in order to improve the nutritive value and feed utilization, as well as for therapeutic and prophylactic effects. These products containing high concentration of mineral matters, vitamins, amino acids and other allowed agents are produced in the form of premixes [2].

Animal feed is every material or product as well as animal food additives, which are processed, partly processed or unprocessed, and used for animal nutrition, represented in form of:

1. Nutrients - products of vegetable, animal and mineral origin, produced naturally or industrial, which
2. Materials and Methods

Raw materials for feed production: corn, barley and sunflower meal and different types of mixed feed for starter, grower and finisher pigs, were material used in our study. They were obtained from factory for feeding stuffs Ovčepolka, Sveti Nikole, Republic of Macedonia that is a part from Agroindustry Group, Veles, (AGRIA). Basic criteria for selecting these types of mixed feed for porkers were age and different body weight of the animals.

To evaluate the quality of these feed a lot of parameters have been tested: moisture, crude ash, crude protein, and crude fiber, minerals, such as Ca, NaCl and acidity degree. The analysis of crude proteins was done by the method of Kjedahld, and other parameters were determined using analytical gravimetric methods.

During the analysis five measurements from each sample were made the results obtained were statistically processed in Excel and compared to the required values given in Table 1.

### Table 1. Required values for quality parameters for raw materials and mixed feed

<table>
<thead>
<tr>
<th>Examined parameters</th>
<th>Corn</th>
<th>Barley</th>
<th>Sunflower meal</th>
<th>Starter mixed feed</th>
<th>Grower mixed feed</th>
<th>Finisher mixed feed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture, %</td>
<td>max. 12</td>
<td>max. 11</td>
<td>max. 8</td>
<td>max. 12</td>
<td>max. 13</td>
<td>max. 13</td>
</tr>
<tr>
<td>Crude ash, %</td>
<td>max. 1.5</td>
<td>max. 2.5</td>
<td>max. 1.1</td>
<td>max. 8</td>
<td>max. 7</td>
<td>max. 7</td>
</tr>
<tr>
<td>Crude proteins, %</td>
<td>min. 8.9</td>
<td>min. 11.5</td>
<td>min. 21</td>
<td>min. 20</td>
<td>min. 15</td>
<td>min. 15</td>
</tr>
<tr>
<td>Crude fiber, %</td>
<td>max. 2.9</td>
<td>max. 5</td>
<td>max. 21</td>
<td>max. 4</td>
<td>max. 7</td>
<td>max. 9</td>
</tr>
<tr>
<td>Ca, %</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.8</td>
<td>-</td>
<td>0.7</td>
</tr>
<tr>
<td>NaCl, %</td>
<td>-</td>
<td>-</td>
<td>0.64 - 1.45</td>
<td>0.75 - 1.16</td>
<td>0.61 - 1.08</td>
<td></td>
</tr>
<tr>
<td>Acidity degree</td>
<td>max. 10</td>
<td></td>
<td>3.8 - 7.0</td>
<td>3.6 - 8.0</td>
<td>4.0 - 7.0</td>
<td></td>
</tr>
</tbody>
</table>

**Notification:** Parameters such as Ca% and NaCl% are not analyzed in raw materials.

### 3. Results and Discussion

Feed quality has been determined in accordance with the prescribed rules and specific requirements based on the instructions of the manufacturers of this type of feed, which are based on the specific nutritional needs of animals, given to race, age, gender and category of animals [4].

The results obtained for the analyzed parameters for raw materials and mixed feed are presented in Fig. 1 - 4. Since it hasn’t been written a rule book for quality of animal feed in Republic of Macedonia [5], the obtained results were compared to the standards from JUS WB 3.516 [6].

#### 3.1 Analysis of raw materials: corn, barley and sunflower meal

Moisture content in feed affects the physical properties such as weight, density, viscosity, electrical conductivity and nutritional value. Most natural products contain moisture, and plants that contain more water are less nutritious.

Water content shows whether the product has standard features such as: microbiological stability, viscosity,
nutritional value, maintenance and it’s in the line with legal compliance (regulations governing food) [7].

The analysis of raw material showed that corn contained 10.44% moisture, barley 10.58% and sunflower meal 7.48% (Fig 1), values that are in the range of the standard values.

In the inorganic part of feed, despite falling water and nutrients (Ca, Na, K, Mg, P, etc.) the amount of ash depends on the type and age of the plant, soil type and fertilization etc. The amount of ash in the compound feed differs from the amount of ash in plants. The amount depends on the type of feed that enters into the composition of the compound.

The amount of ash (Fig. 2), serves as a rough orientation for the content of inorganic components in food. With a detailed analysis of the ash, we can get a complete picture of the value of mineral substances [7].

Crude protein measurements use the Kjeldahl method of nitrogen analysis. Crude protein measurements also play a role in livestock feed. For animals such as ruminants, whose digestive bacteria are capable of processing feed products that your digestive system cannot, crude protein factors into their feed components. The nitrogen that ruminant livestock consume comes from proteins, nucleic acids, nitrates, nitrites, ammonia and urea. The bacteria in the ruminant’s gut then digest and metabolize these nitrogen sources, allowing the animal to use the nitrogen to pack on muscle or synthesize milk proteins. Therefore, the crude protein value of livestock feed determines how much feed the farmer makes available to the animal for a desired rate of growth [8].

From the results shown in Fig. 3 it is evident that crude protein values for corn is 8.06%, barley 11.27%, and sunflower meal 32.87%. These values compared with the values given in Tab.1 are in the range of the standard values.

Consulted literature from Senčić D. et al. (2011), reported that the increased crude protein level in forage mixtures had a very significant (p < 0.01) influence on the reduction of the fat tissue share (34.55% : 39.09%) and on increase in the muscle tissue share (47.10% : 46.11%) in pig carcasses, although not to a statistically significant extent (p> 0.05) [9].

Modern pig production faces two main challenges: maintaining health and securing consistently high performance. These two challenges sometimes contradict each other, but the balance of a healthy pig that is performing at its optimum level is often to be consolidated in the gut. Improving gut health can be assisted with the use of dietary fibre.

Crude fiber is the fiber that remains after feed is digested with alkali and acid, which destroys all soluble and some insoluble fiber. It is mainly lignin and cellulose. Cellulose cannot be easily digested by pigs because they lack the required enzymes to break it down [10].
The evaluation of other parameters shown that crude fiber for corn is 2.61%, for barley 3.84%, for sunflower meal 21.75% (Fig. 4). These values also are in the range of the standard values.

Research group of authors, Meier H. at all [11], shown that in experiments with fattening pigs, peas and lupines were used both pealed and unpealed, in order to investigate the influence of native crude fibres on the true digestibility of nitrogen and the amino acids in pigs. The results of the experiments allow the conclusion that native crude fibres, as long as they remain in the normal range between 3 and 7% in the ration does not cause a depression in the true digestibility of nitrogen and the amino acids in the feeding of fattening pigs. Only the increased content of native crude fibres in the ration has a negative effect on true digestibility.

3.2 Analysis of mixed feed

Calcium and phosphorus are important in skeletal structure development, but their presence in soft tissues is also vitally important. Both aid in blood clotting, muscle contraction, and energy metabolism. About 99 percent of the calcium and 80 percent of the phosphorus in the body are found in the skeleton and teeth. Therefore, deficiency of calcium and phosphorus will result in impaired bone mineralization, reduced bone strength, and poor growth.

Young pigs with a deficiency of calcium and phosphorus will have clinical signs of rickets. Mature pigs eating a deficient diet will remove calcium and phosphorus from the bone (osteoarthritis), decreasing bone strength. This can result in a condition called “Downer Sows” and can be prevented by proper diet formulation [12].

Cereal grains and most other ingredients are very low in Ca it is therefore necessary addition of calcium in mixed feed.

Percent of Ca that was added in starter mixed feed is 1.11 (Fig. 5), grower mixed feed 1.05 (Fig. 6) and finisher mixed feed 0.87 (Fig. 7) are in the range of the standard values.

Salt, a combination of sodium and chloride, must be added to all swine diets. Grains and plant protein supplements are low in sodium and chloride, but the needs of the growing-finishing pig can be met by adding 0.25 percent salt to the diet. When a diet deficient in salt is fed to growing pigs, depressed performance will be evident within a few weeks. Recent research suggests that for breeding stock, 0.5 percent added salt is adequate.

From the results shown in Fig. 5-7 it is evident that values of NaCl% (starter mixed feed 0.93%, grower mixed feed 0.84% and finisher mixed feed 0.76%) compared with the values of the Tab.1 are in the range of the standard values.

The addition of salt is very important to be in the range of prescribed limits because high levels of salt can be tolerated, if adequate drinking water is available. However, if water is restricted, as little as 0.2 percent dietary salt has resulted in toxicity symptoms [12].
The acidity is affected by the content of acid phosphate and organic and free fatty acids in feed. It increases the adverse storage conditions of feed, much more work to create microorganisms acid reaction, and thus an increase in the level of acid. Acidification to a certain extent is a natural process, and any excess can lead to production of unusable animal feed.

Figure 7. The values obtained for the analysis of Finisher mixed feed compared with the standard values

The values obtained for acidity degree for starter mixed feed is 8.36 (Fig. 5), for grower mixed feed 5.24 (Fig. 6) and for finisher mixed feed 3.96 (Fig. 7). Also these values are in the range of the standard values such as previous parameters.

4. Conclusions

Considering the results from this research study whose basic aim was to evaluate the quality of certain raw materials form animal feed production and certain types of animal mixed feed, with the required standards, we can make the following conclusions regarding the quality of animal feed:

- The obtained results from our analysis are in the range of the standard values, which means that the produced mixed feed from this factory is with high quality and meets the required standards;
- Quality control begins with purchase of feed ingredients, continues through the feed manufacturing process and does not end until pigs have consumed the feed;
- Producers who choose to manufacture feed also accept the responsibility for maintaining feed quality;
- The problem of quality assurance in the production of animal feed must be taken seriously having in mind that this production is one of essential links in the food chain, which depends from various external influences, and which is especially important for human population health;
- So, as a recommendation to achieve production of animal feed with higher quality, is to adopt already prescribed standards in the country and to introduce the rules for quality management of raw materials in feed industry, and for animal mixed feed, as a final product.

5. References