



Comparison of the qualitative parameters of traditional feedstuff vs alternative feedstuff

Keti Gjeshovska, Ljupka Necinova, Gjore Nakov

Eng.technology's, Faculty of Technology and Technical Science Veles, Macedonia

keti.gesovska@t-home.mk

Eng.technology's Macedonia

ljupka.necinova@gmail.com

Eng.technology, Macedonia

gore_nakov@hotmail.com

ABSTRACT

Animal feed is a product of vegetable, animal or mineral origin, obtained naturally or in industrial process, as feed mixtures, concentrates and raw materials for the production of animal feed, which serve as food for animals, which are not harmful to their health. The animal feed can be processed, partly processed or unprocessed for animal nutrition.

Historically, feed costs have represented 65 -75 percent of the variable costs of swine production, but for many producers this figure is higher now. As a result, feed costs play a major role in determining the profitability of a swine enterprise. Feed costs are, and will continue to be, an ever increasing factor in determining the profitability of a swine enterprise.

Adopting ingredient alternatives seems like a logical step for pork producers.

The aim of this study is to compare the qualitative parameters of feed stuffs from different groups, traditional and alternative, point to their advantages and their disadvantages by their usage during the process of animal breeding and livestock production, and all that in order to prove that the traditional feedstuffs can be replaced with alternative, which will cost effectively and provide variety of benefits to the swine ratio including energy, protein and fiber.

The samples which were analysed were samples of corn and barley. The analyses were made in the laboratory of the Agro Industrial Association – AGRIA. Parameters which refer to the quality of the feedstuff and which were analysed were: moisture, ash insoluble in hydrochloric acid, raw proteins, raw fiber, acidity degree and the amount of substances that they shouldn't contain or should contain only in certain quantities (forbidden substances). The obtained results were compared to the standard parameters in order to compare the quality of the analysed feedstuffs.

The obtained values from the the tested samples are: moisture 10.4% and 10.58% for corn and barley respectively, proteins 8.06% and 11.27%; ash 1, 16% and 2.57%, fiber 2.61% and 3.84.

Keywords

Feedstuff; barley; qualitative parameters.

Academic Discipline And Sub-Disciplines

Feedstuff quality

SUBJECT CLASSIFICATION

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INTRODUCTION

Animal nutrition is made up of two words i.e. animal and nutrition. Dictionary means of animal is any living thing, other than a human being, that can feel and move or a creature with four legs, as distinct from a bird, a reptile, a fish or an insect. In dictionary terms, nutrition is "The series of processes by which an organism takes in and assimilates food for promoting growth and replacing worn or injured tissues". Therefore, nutrition involves various chemical reactions and physiological processes, which transform foods into body tissues and activities. It involves the ingestion, digestion, and absorption of the various nutrients, their transport to all body cells, and the removal of unusable elements and waste products of metabolism. So, animal nutrition is the science of nourishment of animals.

In 20th century various vitamins, minerals, amino acids, fatty acids and their role had been discovered. Various feeding standards indicating the requirements of various nutrients for various categories of livestock for different functions were established.

During 21st century further improvement has been made and new research were done in the field of animal nutrition which will benefit the society in many ways and full fill the objective to provide all essential nutrients in adequate amount and in optimum proportions at least cost of feeding to the animals.

Nutrition plays an important role in the animal production and health by following ways:

1. It exploits the genetic potentiality of the animal. For example if a cow has capacity to produce 30 litre of milk per day (by its genetic make up) but it can not be possible if the cattle is under fed.
2. It makes the animal production cheap and economical. Because cost of feeding and feeds accounts for 70-80% of total animal production cost. So it is the major means by which production system can be made economical.
3. It also minimizes the competition between human and animal for food by introducing non-conventional feed ingredients for animal feeding.
4. It also manipulates feed ingredients for effective utilization of nutrients. In this way nutrition play an important role in animal production and health. [1]

Feed accounts for 60-70 percent of total cost of livestock production.

Increasing feed grain and supplement costs and the potential for feed grain inventories to be depleted due to increased demand are significant issues for producers in the meat industry. Feed costs have represented 65 -75 percent of the variable costs of meat production, and for many producers this figure is higher now.

While corn and soybean meal have been industry standards for supplying energy and protein, there are many suitable alternatives that meet nutritional requirements while reducing the cost of the diet and these may be included cost effectively as demand for corn and soybeans increases or as actual inventory shortages develop. Energy and protein are the main nutrient components in a swine diet.

Grains such as corn, barley, wheat, sorghum and oats have traditionally supplied energy, while protein has come from meals produced from oilseeds such as soybeans and canola.

Price relationships between traditional and alternative feed ingredients vary greatly depending on season, availability, and global and local markets. Pork producers must be able to evaluate the cost effectiveness and nutritional value of all available feed ingredients to supply a nutritionally-balanced diet at a minimal cost.

Cost is one of the most difficult factors to determine when considering the use of alternative feeds. A producer must take into account the amount of nutrients supplied by the replacement feed. This can be extremely difficult because most feeds cannot be directly compared due to nutrient variability. As a result, relative values are often used for comparison purposes. However, the ultimate cost of any diet change also must consider other factors such as transportation, special processing needs and storage.

This is particularly important when evaluating high moisture products. The value of alternative ingredients should be based on their actual contribution of digestible energy and nutrients to the diet. Historically, rations were least-cost balanced based on protein levels because protein was the most expensive nutrient in the diet.

The relative value of a feed ingredient is used to compare the value of that feed to the price of the industry's standard energy and protein-supplying ingredients.[2]

Important considerations to take into account when using alternative ingredients are determining accurate nutrient values; accounting for ingredient variation; formulating on a digestible amino acid basis; and, valuing the energy impact on the diet. These factors must be accurately determined to predict growth performance changes that may impact the economic analysis.[3,4]

A numerous studies have been made in order to point out the positive effects of using alternative feedstuffs as a replacement of the traditional ones.

Historically, corn has been the meat industry standard for supplying energy in a diet. But many other alternatives can easily meet the animal's dietary nutritional requirements with proper formulation. Among the most common cereal grain substitutes used are grain sorghum (milo), wheat and barley. [3,4]

For the purposes of this study were carried out analyses of alternative as well as traditional feed i.e. some of their representatives. Therefore the main subject of this study were analyses of corn samples, from the group of traditional



feedstuffs, and barley samples, from the group of alternative feedstuffs. The obtained results were compared in order to be pointed out the positive effects of using alternative feed in animal nutrition, which will minimize the cost of the animal production process.

Materials and methods

As below said, for the purposes of this study were analysed samples of traditional and alternative feedstuff, corn and barley.

- **Corn** – Corn commonly is used as a feed grain. Corn is the major energy feed fed to animals. Other energy feeds are priced relative to corn and often are more variable in their quality. [5]

Compared with other feed grains, corn is lower in protein and slightly higher in energy. Corn contains approximately 70 percent starch on a dry-matter basis. Other important fractions in the corn kernel include protein, fiber and minerals.

The protein in corn is approximately 55 to 60 percent escape or bypass protein. Escape protein is protein that is not fermented or degraded by the ruminal microorganisms, but is digested and absorbed by the animal in the small intestine. The remaining 40 to 45 percent of the protein in corn is rumen-degradable protein. Ruminant microorganisms require rumen-degradable protein for use in growth and protein synthesis.

Most research with corn indicates a substantial benefit to providing rumen-degradable protein in diets containing corn. Backgrounding or finishing diets containing high levels of corn require supplemental rumen-degradable protein in the form of nonprotein nitrogen (urea or biuret), natural protein sources such as sunflower meal, canola meal or soybean meal, or a combination of nonprotein nitrogen and natural protein.

Like all cereal grains, corn is low in calcium and relatively high in phosphorus. Diets containing high levels of corn should include a supplemental calcium source, such as limestone, to prevent urinary calculi. The recommended calcium-to-phosphorus ratio in backgrounding and feedlot diets is a minimum of 2-to-1 (two parts calcium to one part phosphorus). [6]

- **Barley** – Small grains such as barley are the most common alternative energy grains. This crop is harvested earlier than corn, allowing manure to be spread on fields before corn harvest. [3,4] Barley is typically produced in regions where corn production is not agronomically feasible. Barley is well adapted to areas with shorter growing seasons and lower rainfall. For these reasons, barley is a major feed ingredient and it is often used as the sole grain source. Barley is also available as a byproduct of malt barley production in some regions when protein levels are too high for malting. Barley can be either a partial or complete replacement for corn in most swine diets. The keys to successfully feeding barley to swine are in diet formulation and feed processing. Barley contains more crude protein, lysine and available phosphorus than corn. Because of the greater lysine and available phosphorus concentration, less soybean meal and inorganic phosphorus will be needed in the diet. Hulless varieties of barley have approximately 8 percent greater energy and, therefore, greater economic value than hulled barley. Hulless barley contains 1,475 Kcal of digestible energy and 0.54 percent lysine. Differences between grains in feeding value are often a reflection of starch content, rate and extent of starch digestion in the rumen, and how completely the starch is digested by the animal. A large part of the differences in starch digestion between grains can be explained by differences in processing. Grains prone to shattering during processing result in more fines, more rapid rates of digestion, and potentially more digestive problems accompanied by low and/or fluctuating feed intake. [7]

In table 1 are given the differences between corn and barley in their nutritional composition.

Grains	Crude protein %	Starch %	DE ^a Mcal/kg	ADF ^b %	Ruminal Starch Digestion % Total Starch ^c
Corn	10.3	75.7	401	3	65
Barley	12.7	64.3	3.7	7	87

Table 1. Average Nutrient Composition of Grains, Dry Matter Basis

^aDigestible Energy

^bAcid Detergent Fibre

^cAll grains were steam rolled, except corn which was cracked.

Information on protein levels, DE, and ADF were compiled from references 8, 9, and 10.

During these analyses, were examined parameters which determine the quality of the animal feed. These parameters were: moisture, crude ash insoluble in hydrochloric acid, raw proteins, raw fiber, and the amount of substances that the product or the raw material shouldn't contain or it can contain only in certain quantities (forbidden substances, strange smell etc).

The content of moisture and crude ash in the analysed samples was determined by gravimetric method. The method of Kjeldahl was used for determination the content of crude proteins. During the analyses, in the examined samples was determined the content of possible impurities, which might decrease the nutritive value of the feed.

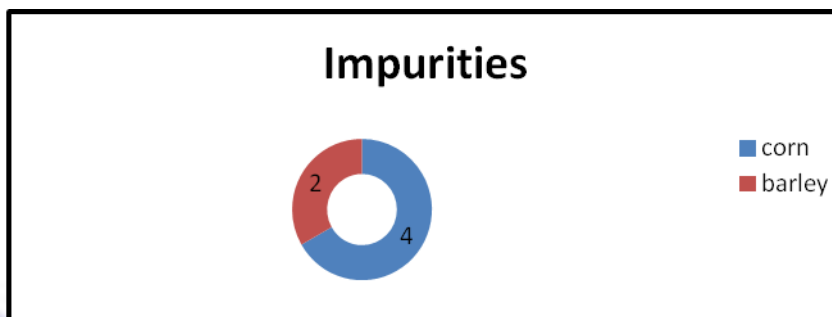
Results and discussion

Under impurities are understandable all components of a grain sample which differ from the normal basic variety. [11,12]Here are included:

- organic white impurities (broken grains, permeate grains, grains damaged from artificial drying)
- inorganic impurities (sand, stone, glass, dust)
- impurities from animal origin (insects and parts from insects).

Having impurities in the analyzed samples is decreasing the quality of the raw materials.

The results that show presence of impurities in the examined samples are shown in picture 1.



Picture 1.

It can be clearly seen that barley is more suitable as feed than corn, since it has less impurities in the grains.

In tables from 1 - 4 are shown the average results from five consecutive measurements of the samples for moisture, crude ash, crude proteins and crude fiber, and the standard values for these parameters.

Most feedstuffs have water as part of their weight.

Moisture %	Corn sample	Barley sample
I measurement	9.43	10.35
II measurement	11.59	9.82
III measurement	10.11	10.69
IV measurement	10.78	11.52
V measurement	10.27	10.52
Average value	10.44	10.58
Standard value	Max.12%	Max.11%

Table 1. Obtained results for moisture in samples

The content of moisture is undesirable because it is connected with the quality of the stored feed. From table 1 it is clearly seen that the obtained values for moisture for corn and barley are within the range of standard values for feedstuffs for moisture. Therefore, rapid feeding is required or molding and spoilage of the mixed feed will occur due to moisture content of complete feed.

All valuable feed substances are contained in the dry matter. If the DM% in a feed is known, it is possible to calculate how many kg DM an animal obtains from the feedstuff (and how many kg concentrate is needed as a supplement according to the norms for the production level). The DM of a feedstuff can be divided into two groups:

- Organic Matter (OM)
- Inorganic Matter (IOM). [13]

IOM is also called ash. IOM content is determined by burning samples until no carbon is left.

Crude ash %	Corn sample	Barley sample
I measurement	1.02	2.36
II measurement	0.99	2.96
III measurement	1.17	2.53



IV measurement	1.44	2.93
V measurement	1.19	2.78
Average value	1.16	2.71
Standard value	1.5%	2.5%

Table 2. Obtained results for crude ash in samples

Ash contains the minerals. Minerals are very important for building-up the body as in the bones and teeth. Minerals are needed as a part in proteins to make-up the soft tissues of the body. Further more, numerous enzyme systems and osmotic regulation of the body require minerals.

From table 2 is noticeable that the amount of minerals in the barley sample is higher than in the corn sample, 2.71% and 1.16% respectively. So, we can freely say that barley is richer in minerals and more suitable as feed than corn.

The value of protein is usually expressed as crude protein (CP) or digestible crude protein

(DCP) The CP value is measured by determining the amount of N in a feedstuff. The organic matter is consisted mostly of crude proteins. In reality, not all N compounds are CP, but it is convenient and almost universal for the N requirements of animals in the N status of foods to be stated in terms of protein. 30-40%

Proteins are the building blocks in an animal. Protein is needed for growth, maintenance, reproduction and lactation. In general, every animal must have a constant supply of protein in order to remain healthy.[13]

Crude proteins %	Corn sample	Barley sample
I measurement	8.39	11.33
II measurement	7.95	11.47
III measurement	8.11	11.68
IV measurement	7.94	10.42
V measurement	7.92	11.46
Average value	8.06	11.27
Standard value	8.9%	11.5%

Table 3. Obtained results for crude proteins in samples

Protein quality refers to the amino acid concentration and balance of the feed ingredient. Because lysine usually is the most limiting indispensable amino acid in corn - based diets, it is important to consider lysine when valuing alternative ingredients.

Diets for animals should be balanced according to the level of lysine instead of crude protein. However, because the animal has a need for all indispensable amino acids, if just one amino acid is present in a concentration that is below the requirement of the pig, performance will be impaired. Diets should therefore, be formulated based on all indispensable amino acids.[2]

From the obtained results of the analyses, it can be clearly seen that the amount of crude proteins in the barley sample is higher than in the corn sample, which makes barley more suitable material for feed production.

Properly adjusting diets take into account barley's higher lysine and available phosphorus concentrations and lower energy content than corn is essential to maximize the economic benefit of feeding barley. The amino acid profile of barley also will allow for higher inclusion of synthetic amino acids in diets containing barley.[13]

One of the main functions of a dairy ration is to provide energy to an animal. The term "energy" includes the actual physical energy an animal needs, the heat to maintain its body temperature, the energy required for production and the nutrients for laying down its own energy reserve. The so-called energy contents of a feedstuff can be subdivided into two groups:

- Carbohydrates

- Lipids (fats), and possible proteins.

If there is not enough energy from carbohydrates and fats in the food to meet its daily requirements, part of the available proteins is converted into energy-use.

A part of the carbohydrates is crude fibre (CF), the remaining is nitrogen-free extract (NFE). The latter consists of sugars, starches and sugar-like substances. Sugars and starches are much easier to digest than CF. CF is very important for the functioning of the rumen and for production of milk rich in butterfat. Food for dairy cows should therefore contain a good

quantity of CF. In total, the ration should contain at least 30 % roughage (on DM base).[13]

In this study was examined the content of crude fiber, and from the obtained results, which are shown in table 4, it is clearly that barley has higher content of crude fiber than corn. According to previously made studies because of its high fiber



content, barley may not be suitable as the sole energy source in starter pig and sow lactation diets – depending on test weight.

On the other hand, it makes an excellent feed for gestating sows as long as daily feed amounts are adjusted to account for the lower energy content. Therefore, barley is particularly well suited in growing-finishing diets because even though barley-based diets are lower in energy than corn-based diets.

Crude fiber %	Corn sample	Barley sample
I measurement	2.92	3.20
II measurement	2.34	4.07
III measurement	2.73	3.87
IV measurement	2.45	4.01
V measurement	2.63	4.06
Average value	2.61	3.84
Standard value	2.9%	5%

Table 4. Obtained results for crude fiber in samples

Conclusion

The conclusion of this study is based on the obtained results from the analyses which were made to a representative of the traditional group feedstuffs, corn, and a representative of the alternative group of feedstuffs, barley. The analyses were made in order to point out that the feed manufacturers should turn into direction of using additional raw materials for feed production, which will lower the production costs on one hand, and from another, they will produce a product which will have better nutritive characteristics than the traditional raw materials.

Small grains, such as barley, can be useful feedstuffs in animal feeding programs. In many instances, animals fed well-balanced small grain-based diets can perform as well as those fed corn-based diets. Nutritionally, small grains are similar to corn in some aspects. Small grains are higher in crude protein than corn and, more importantly, they are higher in lysine, the first limiting amino acid in cereal grain based swine diets. Small grains contain more crude protein than corn and greater levels of several essential amino acids, including lysine, threonine, and tryptophan.

The higher lysine concentration in small grains is especially important since lysine is the first limiting amino acid in many swine diets. Balancing the diet on the basis of lysine content usually provides adequate levels of the other essential amino acids. Compared to corn, small grains contain 30 to 50 percent more lysine, which reduces the need for soybean meal in small grain-based finishing diets by about 100 lb/ton. This increases the feed value of small grains relative to corn by 5 to 7 percent. Balancing a diet on crude protein alone is often ineffective because the amount of lysine relative to protein varies among small grains and corn. If lysine concentration is unknown, substituting small grains for corn on an equal weight basis would be a conservative approach for constituting swine diets. Small grains are lower in fat, higher in fiber, and typically contain less metabolizable energy than corn. Small grains tend to be lower in energy concentration. But these differences do not appear to have negative effects on average daily gains when fed in finishing diets. In many studies, these grains have successfully replaced 100 percent of the corn used in control diets. The lower energy has affected feed efficiency in some instances because animals on small grain diets tend to eat more than animals on corn-based diets. When palatable, animals generally consume higher amounts of small grains to meet their energy requirements. Barley has higher fiber content than other small grains because the kernels are encased in a hull. The higher fiber content of barley does not appear to negatively affect gains in growing-finishing animals if plump, high-test weight grain is fed.

Barley also has relatively high heat increment content. Heat increment is the increase in heat production from digestion of feed. High heat increment of a feedstuff can help keep an animal warm in cold environments, hence feeding barley during the winter may be advantageous.

When viewed in the context of an integrated crop and livestock system, several additional attributes also make small grains attractive. Addition of an extra crop to the corn-soybean rotation typical of the U.S. Corn Belt can reduce costs, improve distribution of labor and equipment, improve yields of corn and soybeans, provide better cash flow, and reduce weather risks. Lengthening the time between the same crops on the same ground can decrease

the prevalence of some pests, most notably soybean cyst nematode and corn rootworm. Small grains also provide environmental benefits, such as erosion control and improved nutrient recycling. Proper grain testing and diet formulation are important aspects of maximizing the performance of small grains as animal feed. Growing and harvesting conditions can greatly influence the nutritional composition of small grains even within the same variety.



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