

FLAKE FEED

Cereal grains, which are known as starch-rich grains, are completely different from each other in terms of physical and chemical structure, and thus have different levels of digestibility in ruminants and monogastrics. Barley and corn are the most important grains used by livestock, poultry and aquatic animals in Iran. (Average annual amount) In terms of protein-starch matrix, these seeds have a resistant structure against microbial and animal digestive.

enzymes. In this sense, during the studies and application of animal nutrition science, there has been an attempt to change this structure by using physical and thermal methods. In physical and thermal methods, moistened grains have been exposed to heat sources at different times, which, while disintegrating the protein-starch matrix, increases the gelatinization potential of starch and, as a result, increases its digestibility per unit of time.

During nutritional studies, all animal nutrition experts believe that seed processing will bring many benefits such as the following in the livestock and poultry industry. These benefits include:

- Improvement of feed conversion ratio
- Improve feed intake
- Improving growth, milk and meat production
- Improving the quality of carcass and milk
- Reducing the excretion of undigested nutrients
- Reducing the cost of wasting nutrients in storage conditions
- Reducing the daily fees of milk and meat producing units
- Improvement in reproduction rate
- Improving general and metabolic health of ruminants
- Improvement in feed consumption under stressful conditions, such as heat and environmental stress
- Improve ration adjustment
- Improving the management of feed consumption
- Improve stool conditions
- Improving ruminal and small intestinal digestion and reducing fermentation in the large intestine in livestock
- Subtle improvement of conversion in poultry

Based on the above, increasing the nutritional value is perhaps the most important reason for the physical processing of cereal grains. Nutritional value is a conventional term in animal nutrition. But this word includes different dimensions such as the concentration of nutrients in the animal feed, and the ratio of production to consumption of nutrients. Therefore, it seems that the nutritional value of the feed depends on its chemical composition and physical form when used by the animal. These two features are important since they affect the rate of appetite and feed intake, digestibility and common conditions between the alimentary canal and feed. Therefore, in order for a feed to be able to show its characteristics in production indicators, in addition to optimal digestion in the animal digestion system, it must also prepare the conditions for optimal absorption and metabolism of nutrients. In such a situation, the economic effect of feed emerges in terms of reducing costs and increasing the profit of the production unit. Therefore, in ruminants, the most appropriate physical method should have features that, while not reducing the PH of

the rumen fluid, provide the conditions for post-ruminal digestion and increased absorption. So, the following conditions must be taken into account in any physical method.

- Particle size at the time of animal use
- Thermal processing and its conditions
- Storage conditions and how to use

The physical processing of grains, especially cereal grains, is divided into two major groups: hot and cold physical methods. In hot physical methods, generally, cereal grains are moistened by steam before processing. Hot physical methods include steam-flake, micronizing flake, roasting, pelletizing, and extruding methods. Cold physical methods mainly include grinding and flaking methods.

If the thermal-physical method is performed correctly, not only the nutritional value of the cereal grains will increase, but also its economic efficiency will be optimized in relation to production. The available evidence shows that the correct performance of a physical method of thermal processing increases the use of nutrients in the grain, reduces nutritional inhibiting factors, improves the use of fat, amino acids, improves feed efficiency for milk and meat production and finally improves usable metabolizable energy (ME) and its ability to generate energy.

In general, the objectives of physical processing of cereal grains can be stated as follows:

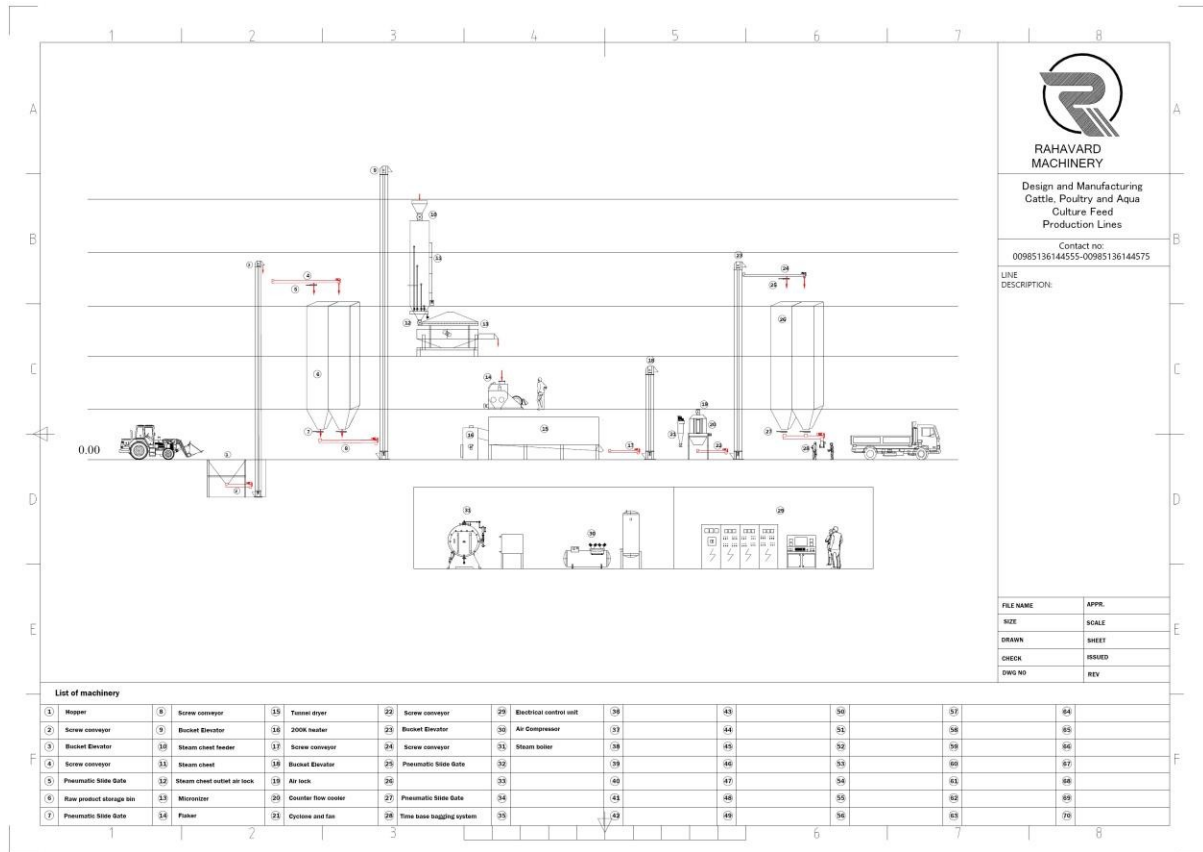
- Changing and improving the nutritional value of seeds, especially starch and protein
- Making starch available to rumen microbes and increasing the rate and amount of starch decomposition in the rumen.
- Processing to the optimum level (starch flow to the post-ruminal until the digestion in the entire digestive system does not decrease)
- Increasing the digestibility and palatability of grains
- Preventing wastage of grains
- Destruction of weed seeds and prevention of their multiplication
- Inactivating toxins and anti-nutritional factors

FLAKING COMBINED STEAM CURING AND DRY CURING WITH INFRARED WAVES (MICRONIZED FLAKE FEED)

In the new method of moisture-heat-wave processing of grains, while accelerating the cooking process and looking at polluting the environment in terms of waste, grains starch is gelatinized. In addition to these conditions, in terms of microbial and animal enzymatic digestion, especially in ruminants, it favors decreasing digestion in the rumen and reducing the harmful effects of digestion in the rumen and large intestine. Based on the published data as well as the information obtained from the experiments

conducted in the pilot micronized flake line by Ferdowsi University of Mashhad, which is made by the Rahavard Company, the digestibility of raw protein and starch and dry matter increases by 20%, 22% and 35% is reported. Based on this, it is predicted that at least 33% increase in the digestibility of the total nutrients compare to raw material can be achieved.

FLAKE FEED PRODUCTION LINE AND MACHINERY



Micronized flake feed production line is very important as a strategic product .

The design and manufacture of the micronizing device for the first time in the MiddleEast was carried out by Rahavard Company after a two-year research collaborationwith Ferdowsi University of Mashhad. During this research collaboration, all factors affecting the quality of feed were investigated and finally, two years ago, the first industrial project in Iran started operating.

The laboratory results of the produced product were completely consistent with the results of the pilot line, and as a result, the produced product was noticed by growersin a very short period of time.

WHY USE THE FLAKE PROCESS FROM AN ECONOMIC POINT OF VIEW?

In general, in the new moisture-heat-wave cooking method of seeds, while accelerating the cooking process and looking at polluting the environment in terms ofwaste, conditions are created during which starch gelatinization of seeds takes place.In addition to these conditions, in terms of microbial and animal enzymatic digestion, especially in ruminants, it favors increasing digestion in the rumen and reducing the harmful effects of digestion in the rumen and large intestine. Based on the published data as well as the information obtained from the tests conducted in the pilot micronized flake line by Ferdowsi University of Mashhad, an increase in the digestibility of raw protein and starch dry matter has been reported by 20%, 22% and

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Based on this, an increase of at least 14% in production efficiency is expected in connection with the daily production of milk or an increase in digestibility. For example, if the daily production of a cow is 36 kg of milk on average, as a result of using this seed, the production will increase by a factor of 1.14. (About 40 kg). In other words, based on the increase in efficiency of 14% and the increase in the digestibility of the dry matter of feed, at least 20% saving in the amount of import will be done.

In developed countries, the use of seeds processed by the moisture-thermal wave method is commonly used in cattle, poultry and aquatic feed. Considering the strong dependence of this industry on imported grains (especially corn) and based on the studies conducted, it seems that replacing these grains in the daily diet of cattle, poultry and aquatic animals is also an effective step in improving production efficiency and reducing the import of grain grains. Will be. According to experts in the aquaculture industry, the use of heat-moisture-wave processed grains will be a revolution in the fishery industry.

DIGESTIVE COMPARISONS OF CONVENTIONAL PROCESSING METHODS

It seems that the processing of grains by the flaking-heating method increases the digestibility of starch compared to raw whole grains, grinding and cold flaking. In this method, in addition to increasing starch fermentation in the rumen, it increases its digestion in the small intestine, for that part of the starch that has escaped from rumen fermentation. Also, this method has increased the digestion of starch in the entire digestive system along with the reduction of digestion in the large intestine compared to the method of grinding and cold flaking. In addition to increasing the digestibility of starch, the steam flaking method increases the digestibility of dry matter, organic matter, nitrogen and the amount and percentage of digestible grain energy in the entire digestive system compared to the grinding, whole grain and cold flaking method.

The comparison of these methods showed that the use of steam-flake method significantly increases the starch digestibility of corn kernels, along with the disintegration of starch granules. The most important effect of steam-flake method is the disintegration of the seed endosperm matrix. This happening in the seed will improve the rumen and post-ruminal digestion of the seed. Cereal grains have a relatively strong outer coating against pests and microorganisms. In terms of weight, this part of the grain is not significant, but almost half of the grain fiber concentration (NDF) is collected in this part.

This external coating of the seed will have a negative effect on its digestion in the digestive system of ruminants. Unless, during the process of rumination, the animal can destroy this coating and increase its contact level with the microorganisms in the rumen. Therefore, any pores in the outer shell of the seed will improve the rate and amount of its organic matter digestion in the digestive system.

The disintegration of the outer shell of cereal grains has different forms in different physical methods of grain processing. For example, in the cold roller method, the outer shell is broken, but because the eaten parts are still attached to the starch inside the grain, they will prevent access to this part of the starch, which results in a decrease in the amount of starch digested per unit of time.

This negative effect of the rolling method is mainly due to the slow formation of microbial colonies on the rolled grain. But in flake-heater processing, the physical dependence of the attached shell to the starch inside the grain is reduced due to the processing with moisture. This reduction in the dependence of the shell on the starch inside the grain will increase the rate and amount of starch digestion.

In cereals and pulses, the highest concentration of oil and ash is in the non-shell contents of the seed. Therefore, an increase in the amount of nutrients in the non-shell contents of the seed will increase their ratio to the weight and volume of the seed.

Such a phenomenon happens in different varieties of seeds and even different hybrids. Even the increase in the non-shell content of the seed can be influenced by the stage of growth and maturity of the seed. It seems that the increase in the volume and amount of the non-shelled part of the seeds and the decrease in the amount of fiber and ash in them is the best reason for increasing their digestibility and energy generation. Based on the results of the researches, the largest amount of amino acids of cereal grains and legumes lies in the non-shelled part of the grain. Such an event will increase the volume and amount of this part of the seeds, even increasing the ability to use the amino acids of the seeds. However, there is still no credible data regarding the use and contribution of these nutrients due to the increase in ruminal microbial colonies. In some cereal grains, especially corn, the largest amount of starch is found in the endosperm of the grain along with protein matrices. The amount of starch and its combination with protein in the seed is completely influenced by the type and hybrid of the seed. According to the studies, about 25 to 80% of starch in corn is combined with protein matrix.

The rest of the starch in these seeds is mainly in the form of floury and soft starch inside the seed. The ratio of non-matrix starch to matrix starch has the greatest effect on the outcome of starch digestion in ruminants.

Therefore, the higher the non-matrix starch in the seed, the higher its digestion rate in the rumen per unit of time. The results related to the comparison of the physical processing methods of seeds and especially corn seeds, indicate the fact that the method of moisture cooking with steam heat or infrared waves due to the change in the starch-protein matrix and also the improvement of protein digestion in the

seed.

The amount of amylose in the grain is another influencing factor on the digestibility of the grain starch, as well as the effect of physical processing on it. In cereal grains, there is mainly starch in the form of amylopectin (branched strands) and amylose (single strand). Compared to amylopectin, amylose has a lower digestibility potential in domestic animals. The concentration of amylose is strongly influenced by the type and hybrid of the seed. For example, in waxy corn hybrids, the concentration of amylose is at a minimum, and in amylose-rich hybrids, its amount reaches about 70%.

In the steam-heat physical processing method, the surface of starch granules increases and appears in the form of jelly. This phenomenon is called starch gelatinization. During this process, fibers that are rich in nuclear amylopectin have a better potential for gelatinization than those that have the most amylose.

In ruminants, digestion of nutrients takes place in the rumen, small intestine, and large intestine. Digestion in the rumen and large intestine is mainly by microorganisms, and digestion in the small intestine is mainly by animal enzymes secreted in this model. The use of different physical methods changes the place of starch digestion and its relative amount. In the conducted research, the effects of dry roller mill, powder mill, low heat moisture grain roller, high heat moisture grain roller with respect to the location and amount of digestion were investigated. The obtained data proved the fact that, firstly, the methods are significantly different from each other and (the methods used can change the place of starch digestion. Soft grinding reduces ruminal digestion and increases the moisture content of the grain caused the maximum digestion in the rumen. Using the Steam - Flake method, while increasing rumen digestion, improved intestinal digestion and the entire digestive system. This positive effect of Steam - Flake is noticeable in many grains.

The effect of physical processing of cereal grains on growth characteristics and daily weight gain as well as milk production and composition has been done in different researches (Stock et al., 2003 & 1987). Some published data between 1987 and 2020 (Lu et al., 2006; Corona et al., 2005; Groscia and Lorch, 2005) were considered. In most of the conducted researches, dry grinding and rolling methods have been compared with the flake-heater methods with direct and indirect heat. The reviewed data indicate the fact that the growth rate, daily weight gain, milk production and milk composition are improved by using the flake-heater method with water source and heat or waves. However, the improvement rate is completely dependent on the processing conditions including temperature, pressure, heat, time, wavelength, drying method, volume density and flake thickness. Therefore, optimization of processing conditions will be one of the main and most important factors affecting the state of grain starch digestion and as a result, the production performance of the animal. In addition to the above factors, other factors such as biotic and abiotic contamination of the seed also have an effect on the results of the Steam - Flake method. Among biological factors, seed contamination with aflatoxin and abiotic factors such as the presence of dust, pebbles and metals are important in this regard.

Therefore, it seems that in the physical methods of cereal grain processing, biological and non-biological contaminations should be separated. Therefore, dusting and washing the seeds before cooking and dehumidifying the surface of the seeds as well as before flaking can prevent the transfer of biotic and abiotic pollutants along with the flaked seeds to the animal.