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The effects of using technological additives in feeding farm animals

Karol Radzikowski

Student Scientific Club of Agricultural Engineering, Faculty of Natural Sciences,
Siedlce University of Natural Sciences and Humanities, Siedlce, Poland

E-mail address: kradzikowski93@wp.pl

ABSTRACT

The increase in the genetic potential of livestock, enabling high yields of milk, meat and eggs, forces farmers to change the feeding system. Despite the availability of bulky and nutritious fodders characterized by high nutritional value, it is not possible to match the feed ration in a way that guarantees full coverage of the nutritional needs of high-yielding animals. Therefore, it is unavoidable to use specialized feed additives that allow you to raise the cow's profit that is obtained on the farm. The purpose of this work was the characteristics and effects of the use of technological additives in the nutrition of farm animals. This goal was achieved based on available foreign literature. Protection against metabolic diseases, improvement of breeding rates and increase in herd health are just some of the benefits that result from the introduction of specialized feed additives to animal feed doses. It should also be mentioned about the effects of preparations on production effects: production increase and improvement of physico-chemical parameters of milk, meat and eggs. The use of feed additives in feeding young animals improves the rearing results, through the impact on the growth and health of calves, piglets and chicks, thanks to which it is possible to produce high-production breeding material.

Keywords: technological additives, feed, farm animals, cows, pigs, chicken

1. INTRODUCTION

In recent years, we have witnessed an increase in the intensification of animal husbandry, which requires the production of high-quality feeds to be able to fully exploit the

genetic potential of cattle, pigs and poultry. To do this, you must give the animals specialized feed additives. Feed additives are substances added to animal feed, to supplement nutrients, minerals and vitamins. These include both chemical substances and specific microorganisms that do not occur in the basic components of feed and water. They are used in very small doses, so that their dosing and even mixing in the feed should be constantly monitored. They are produced by the pharmaceutical industry and feed producers with appropriate licenses [1,2].

The traditional nutrition of cows is not always enough to provide them with the right portions of all necessary vitamins and minerals. Their supply is necessary because deficiencies of individual components lead to a decrease in immunity, decreased fertility, an increased risk of many diseases and a decrease in milk yield [3]. Appropriate prophylaxis is much more profitable from the point of view of the economy of production than the subsequent treatment of diseases resulting from shortages. Therefore, it is worth giving feed additives to animals in the daily feed ration. Although it increases the expenditure on animal nutrition, it significantly improves their overall condition and maintains good health - reduces metabolic diseases, improves productivity and reproduction rates, and this translates into high productivity and greater profits from running the farm. There are many feed additives available on the market, and each manufacturer praises their products as the best [4]. However, it is good to keep common sense and when choosing a particular product, take into account both the composition and recommendations on the packaging as well as the needs of a specific herd and its individual individuals. Other feed additives will be needed for cows at the peak of lactation, and completely different for dry cows or perinatal period. Properly selected preparations, tailored to the individual needs of animals, allow not only to keep animals in good health, but also to increase their productivity.

Feedstuffs, due to their chemical and biological properties, create very good conditions for the development of bacteria, mold and fungi. This is a highly undesirable phenomenon. The danger of their development increases under unfavorable storage conditions, when the humidity is too high, temperature fluctuations are too large or simply remain in the feed. Preservatives and detoxifiers are designed to inhibit the development of these highly unfavorable organisms, and emulsifiers change the surface tension, which allows for thorough mixing of nutrients in the feed mixture.

The aim of the article is to characterize and assess the effects of using technological additives in feeding cattle, pigs and poultry [5].

2. RESULT

2. 1. Definition of feed additives

Feed additives are substances added to animal feed, to supplement nutrients, minerals and vitamins. These include both chemical substances and specific microorganisms that do not occur in the basic components of feed and water. They are used in very small doses, so that their dosing and even mixing in the feed should be constantly monitored. They are produced by the pharmaceutical industry and feed producers with appropriate licenses.

Feed additives are not substances necessary for animal life, but their use in feeding stuff has many benefits, i.e. [2,5 ,6].

- support and stabilization of digestive processes
- improving the nutritional value and digestibility of feed
- improved feed utilization, positively affecting animal productivity
- stabilization of the microbiological flora of the gastrointestinal tract
- supplementing feed mixtures with deficient nutrients and minerals
- improving the quality of preserved feeds
- improving the quality of products obtained from animals
- reduction of the negative impact of animal waste on the environment
- prevention of diseases

2. 2. Preservatives and ensiling agents

Preservatives are substances whose main task is to protect feed against deterioration and to inhibit the growth of bacteria, fungi and mildew developing in a favorable environment for animal feed. The group of preservatives includes short-chain organic acids or their salts and inorganic orthophosphoric acid.

The organic acids that are used as preservatives include [8,12,16]:

- lactic acid,
- propionic acid,
- formic acid,
- citric acid,
- fumaric acid.

The use of organic acids has many benefits for animals, ie they preserve fodder and reduce the pH of intestinal fluids, limiting and inhibiting the possibility of pathogenic bacteria development, among others *E. coli*. Individual organic acids also have additional properties. A frequently used preservative, which is propionic acid, supports the resorption of bioelements from the gut to the blood. Lactic, butyric and propionic acid have prebiotic properties that stimulate the development of normal intestinal microflora. Butyric acid is a very good preparation added to milk for calves. The addition of sodium butyrate accelerates rumen development in calves, multiplies the intestinal epithelial cells, increases the absorbent surface, and stimulates digestive enzymes for greater activity. As a consequence, young milk-raised supplements with sodium butyrate have a better developed digestive system, there is more efficient digestion and absorption of nutrients, which results in an increase in feed intake, higher increments and better condition of such calves [9].

The main advantage of using preservatives is to inhibit the occurrence of negative microbiological changes that lead to a deterioration in the quality of feed. They also have hygroscopic properties, thanks to which they can reduce feed moisture. The beneficial changes occurring in organisms of animals after administration of feed with preservatives are mentioned, among others increased absorption of nutrients, stabilization of intestinal microflora by changing pH and inhibiting the development of many strains of pathogenic bacteria [10,11].

Sowing is one of the basic forms of the preservation of roughage, which is based on lactic fermentation, which occurs under the influence of lactic acid bacteria. As a result of this process, the simple sugars contained in the plants are transformed into lactic acid, acidifying the feed environment, which limits the possibilities for the development of putrefactive

bacteria [12]. In order to obtain high quality fodder, you should use specialized silage additives which we divide into:

- microbiological additives - so-called inoculums, which are products that contain lyophilised lactic acid bacteria. Their influence on ensiling feed consists in the increase in the concentration of lactic acid, which leads to a decrease in the pH of ensiled material. They contribute to the improvement of the nutritional value of silage, by increasing the share of total protein and the decrease in the content of crude fiber. They are recommended for use in organic farms, to protect silage from contamination with pathogenic bacteria found in matriculation fertilizers,
- chemical additives - here include organic and inorganic acids and their salts. Inorganic acids are very rarely used due to the side effects they can cause in animals. The operation of these additives consists in limiting the development possibilities of microorganisms that cause spoilage of silage,
- carbohydrate supplements - include feed and additives, which contain a large number of simple sugars, which during the ensilage will be a substrate for the formation of lactic acid. Such preparations include, among others beet molasses, which should be added to high-protein bulky fodder, which have a small amount of sugars, necessary for the course of lactic fermentation.

However, due to the purpose of the application, silage additives can be classified into the following groups [13,14]:

- fermentation stimulators, whose task is to initiate the desired lactic fermentation in silage, e.g. molasses, sugar,
- fermentation inhibitors, products that have sterilizing properties, preventing development of pathogenic microorganisms, e.g. mineral acids and their salts,
- inhibitors of aerobic decomposition, aimed at improving the aerobic stability of silage,
- nutritional supplements, which are designed to improve the nutritional and nutritional value of silage, e.g. urea,
- absorbents - measures aimed at reducing losses during drying, eg. dry beet pulp, straw chaff.

Preservatives are irreplaceable formulations used to reduce losses during storage and to select silage. By securing the silages against the decrease of their nutritional value, they have a positive effect on the quality and quantity of milk obtained and beef livestock. However, you can forget about the correct handling of ensiled material during production, because no supplement will fix the mistakes made at that time [15].

Preservatives can be used in two ways: as raw material protection fodder grains, i.e. grains of increased humidity at unfavorable conditions, exposed to the formation of mycotoxins and mold or the addition of preservatives directly to the mixture. To obtain high effectiveness of preparations in cases of cereal grains or other feed materials, it is recommended to use a larger amount of additives in proportion to the amount of water specified by the producer. It should be added that supplementation of the preservative to the raw material, in which the breakdown of ingredients occurred, will not restore their properties, and can only stop the decomposition process [16]. The tasks of preservatives

include also water binding and limiting the condensation of water vapor in silos. The use of silage additives containing short-chain organic acids and their esters or salts, as well as mixtures of these compounds has a positive effect on the chemical composition of silage [17].

The results of studies on the effect of these preparations on the number of yeasts and molds are very diverse. Most authors believe that they reduce their number, but there are suggestions that the addition of chemical preparations containing organic acids may cause more intensive growth of fungi or increased production of mycotoxins, as a reaction of mold to environmental stress. This phenomenon was observed with the suboptimal participation of formic acid, during the ensiling of wet cereal grains. Proper feed ensiling process can prevent the formation of mycotoxins, but it will not completely inhibit the development of previously produced metabolites under field conditions [18].

2. 3. Antioxidants

So-called substances are added that are added to industrial feeds to protect ingredients that are susceptible to oxidation. To compounds sensitive to oxidation include among others Vitamin A, carotenes and fatty acids. Thanks to the use of antioxidants, the time of storage and storage of many feeds increases without decreasing their nutritional value. Using antioxidants, better results are obtained by using preparations that are a mixture of several substances, the action of which is similar to each other. It should also be remembered that the effectiveness of these preparations decreases over time, due to the reactions that occur between them and free radicals. They should therefore be given to fodder protected as soon as possible, in an amount of 150g mg per 1 kg of feed mix [6]. The role of antioxidant lies in:

- limiting the distribution of vitamins and preventing the oxidation of unsaturated fatty acids contained in feedingstuffs,
- counteracting the self-oxygenation processes of these compounds in animal cells,
- increasing the storage time of many products without changing their nutritional value,
- preventing the formation of substances harmful to the animal body.

Antioxidants must be used when for the production of mixtures we use components rich in unsaturated fatty acids, i.e. vegetable fats, fishmeal, oats, and corn. Synthetic antioxidants are then used: L-ascorbic acid, butylhydroxytoluol and ethoxyquine. In feeding dairy cows, antioxidants are important, which are contained in the fat of green fodder and silage from grasses. Their tasks include the protection of unsaturated acids contained in milk against oxidation, thanks to which they can maintain a high biological value. It has been proven that thanks to antioxidants it is possible to obtain milk from cows with a high content of unsaturated fatty acids, which have a positive effect on human health [19].

2. 4. Emulsifiers

Emulsifiers are substances that have the task of reducing the surface tension of water, which allows for thorough mixing of ingredients that are not soluble in aqueous solutions. As a result of the addition of these preparations, solutions of two liquids are mixed, which naturally do not combine into liquid substances. Emulsifiers are used primarily in the production of milk replacers for calves, in which this lean milk is combined with vegetable oils. For this process, emulsifying substances are used, e.g.

- glycerol esters
- lecithin
- agar
- dextrin
- arabic gum
- pectin

The use of emulsifiers is limited only in milk replacers, where their concentration can not exceed 5g in 1 kg, it has been milk replacer for calves.

It has been shown that the use of an emulsifier in the feed mixture for piglets contributed to a reduction in feed consumption per kilogram of growth without affecting the daily increments of the control group. In addition, the feed mixture containing the Lysoforte emulsifier showed a higher digestibility of nutrients, which, according to the author, may reduce pig fattening costs by 5% [9-11].

2. 5. Benefits and effectiveness of using preservatives as feed additives

The addition of preservatives increases the obtained production effects, i.e. weight gains, picking and use of feed. Animals fed with fodder with the addition of preservatives put down more protein with a tendency for less degreasing. The use of preservatives improves weight gain by an average of 7%, and also reduces feed consumption by 5% [20]. These indicators are characterized by high variability and depend mainly on the type and amount of added preservative. Other benefits of preservatives are the reduction or complete removal of pathogenic microorganisms in the gastrointestinal tract, reduction in the occurrence of diarrhea, and limiting the number of piglets' deaths. The use of preservatives in the feeding of pigs in feeding pigs improves the digestibility of the dose, decreases the level of ammonia in the gut and biogenic amines and reduces the carcass degreasing as well as increases the nitrogen retention [21,22].

Table 1. Benefits of preservatives as an additive in feed for fattening pigs [23,24]

Name and dose	Effects of the action presented in %	
	increments	feed consumption
Acetic acid 0,9 %	-2,0	+0,6
Acetic acid 2,7 %	+4,0	-2,9
Propionic acid 0,3%	-11,5	+ 0,5
Propionic acid 1,0%	+13,8	+ 1,5
Fumaric acid 0,5%	+11,2	-1,9
Fumaric acid 1,5%	+11,5	-3,4

The use of preservatives may be the only safety option in feed feeding, in which the level of acceptable microorganisms has been exceeded. As a result, the risk of transferring toxic compounds to products of animal origin is reduced. In addition, the beneficial effect of the use of organic acids is also the higher absorption of calcium and iron ions, due to the formation of soluble salts of calcium and iron in the aquatic environment [25]. Organic acids are fully absorbed and metabolized in the body of animals. The addition of acidifiers for feed causes that they have a better taste, which affects the animal's willingness to download. It is also very important to use organic acids in feeding stuffs prepared for piglets, because during the first day after weaning, excessive feed intake may occur, which causes slight acidification of the stomach. As a consequence, the pH of the gastrointestinal tract increases, which causes a weakening of the protective function of the gastric barrier and multiplication of pathogenic bacteria.

Table 2. Effectiveness of using organic acids in weaned piglets [26]

Used organic acids or their salts	Growth increase	Reducing feed consumption	Other effects
Formic acid, lactic acid and sorbic acid	8- 27%	2-8%	Lower frequency of diarrhea
Fumaric acid, citric acid and malic acid	4-19%	5-9%	-
Salts of formic acid	5-23%	5-8%	-

The studies showed an increase in the absorption of zinc by including 1% citric acid piglets in the feed ration. Eckel et. all [1992] reported the effect of reducing the concentration of biogenic amines of cadaverine, putrescine and spermidine in the intestine after the use of acidifiers in pigs. There was a significant decrease in the concentration of putrescine and cadaverine as well as the concentration of ammonia in the intestine (by approx. 25%), when 2% propionic acid was administered in pigs.

This author also found a significant improvement in digestibility in the small intestine of some essential amino acids as a result of the addition of propionic acid. Administration of citric acid to mixtures for fattening pigs increased the digestibility of nutrients and their mineral balance. In the case of the use of formic acid or sorbic acid additive, an increase in daily piglets' increments by more than 20% was observed in relation to animals of the control group. In the experiment carried out on weaned piglets and fatteners with the addition of formic acid, fumaric acid, citric acid and potassium digasate to blends, a significant increase in body weight gains and feed intake was found in the groups where formic acid and potassium diformate were used.

These additives are especially recommended for young animals due to the stabilizing effect on the gastrointestinal microflora [28,29,31,33].

Table 3. Effects of using preservatives in feeding pigs [31,32]

Name and dose	Effects of action
Propionic acid 2%	Reduction of ammonia concentration in the small intestine by 25%, reduction of amine concentration
Citric acid 2,5%	Reducing the thickness of backfat
Formic acid 0,6%	Weight gain from 2.5% to 11% and a comparable reduction in feed consumption per kg of growth
Propionic acid 2,5%	Increased dry matter digestibility

Feed additives to support the ensiling process are being used more and more often. In general, these are preparations that contain formic, lactic, propionic, benzoic acid or also live cultures of lactic acid bacteria. Organic acids and their salts used in the production of feed additives also have a visible effect on digestive processes in the digestive tract of animals. Used immediately before consumption, they reduce food intake, activate enzymes, increase digestibility, nutrients and improve the composition of the microflora in the gastrointestinal tract. The addition of acidifiers can also be used in poultry feeding. Patten and Waldroup [1988] showed a significant increase in broiler growth after using the additive in the fumaric acid blend (0.5 and 1.0%) [25-27].

3. CONCLUSIONS

The growing demand of breeders for more and more modern feed and feed additives, forces feed companies to introduce into their assortments technological mixtures and substances that will cause the possibility of longer feed storage, reduction of feed contamination and the possibility of easy feeding to animals. Such technological additives include preservatives, antioxidants and emulsifiers, which are increasingly used in the production of feed.

We use these additives both during the production of high quality silage from grass and maize and during the production of feed for young animals whose digestive system is not immune to many pathogens that may arise during improper storage of feed. It is also worth remembering that the use of even the most effective additives does not guarantee obtaining good silage and fodder if the individual stages of production technology are carried out incorrectly. Additives are only intended to facilitate and direct fermentation in ensiled material. They should not be treated as a factor that eliminates all mistakes made in the production of roughage.

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