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QUALITY AND SAFETY OF FEED USED IN FEEDING CATTLE

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ABSTRACT

This article addresses issues related to the quality and safety of feed and additives used in the feeding of cattle. The indicators characterizing the quality of feed - dry matter, energy, crude protein, digestible protein in the intestine, balance of protein in the rumen, calcium, phosphorus and raw fiber are described. Questions related to the requirements of dairy cows on their need for nutrients and levels of certain undesirable substances in feed (chemical, microbiological and physical) are reported. Legal norms and regulations concerning the quality and safety of food are considered and the influence of some genetically modified plants used as food for cattle are viewed.

Keywords: quality, safety, feed, requirements, pathogens, toxins, GMO – feed.

Introduction

Indicators characterizing the quality of feed are: chemical (moisture, crude protein, crude fat, crude ash and carbohydrates - crude fiber and NPN) physical form of feed crops, digestibility and consumption.

These key indicators determine the nutritional value expressed in dry matter content, energy, crude protein, digestible protein in the intestine, balance of protein in the rumen, calcium and phosphorus (Todorov et al. 2010, Simeonov et al. 2013 and Stoycheva et al. 2014).

On the basis of European regulations and directives is built the Bulgarian legislation related to the quality and safety of food.

Basic legal norms are: Feed low - last changed 13.02.2015, Regulation № 10 – 03.04.2009 from MAF for maximum levels of undesirable substances and products in feed and Law on GMOs – last changed 02.08.2013.

The purpose of this work is to summarize and analyze the indicators characterizing the quality and safety of feed used in cows and regulations affecting them.

Materials and methods

This study analyzed the literature related to indicators characterizing the quality and safety of feed and legal regulations of the Republic of Bulgaria on allowable concentrations of unwanted substances in them and the requirements concerning GMO products.

Discussion

The term "feed" feature all forage crops that are high in crude fiber. According to Morrison (1970) feed used for ruminants are rich in fiber, but low in other nutrients. To this group the author refers hay waste products from the production of corn-grain (cornstalks), the extraction of cereals (straw) and pastures with their variety in terms of botanical composition. This group includes waste from the milling industry (corn cob and bran) that are high in fiber and low at energy.

A comprehensive international classification is made (http://www.inra.fr/en), according to which feed is divided into 8 classes as follows: dry and coarse feed; green forage and pastures;

silages; high energy feed; protein and concentrated feed; mineral supplements; vitamins supplements and other additives.

The main indicators characterizing the nutritional feed are calculated based on the digestibility and chemical composition (Todorov et al. 2010). In high producing dairy cows it is very important the quality and utilization of rough feed. Many factors influencing consumption and utilization, more important are: health and physiological status, BCS and milk production, palatability of the feed, quantity and volume of ration and ambient temperature.

Appetite with which animals take feed determined amount of dry matter in feed (at libitum). The appetite is a factor influencing the uptake of large amounts of dry matter. In studies of Kirilov (2010) conducted with hybrid maize harvested during different phases of the growing season the dry matter content increases and is highest of waxed to full maturity. As a result, the author concludes that consumption is much higher in milky wax maturity to full maturity. Conservation of maize reduces consumption by 5-11% against the green corn. Differences in digestibility are not observed (Kirilov 2010).

In studies of Stoicheva (2015) with participation of grass mixtures fed through the various phases of the growing season has been found that increasing the DM (1 %) leads to a reduction of CP (0.55 %) at the expense of CF, which increased by 0.86 %.

Body condition scoring (BCS), milk production, pregnancy and technology are the main factors influencing the needs of nutrients in cattle. Raising the living mass in cows leads them to use more energy and protein to maintain life processes. The requirements to digestible nutrients and crude protein in the last three months of pregnancy are higher than previous ones. A similar trend is observed to the needs of crude protein and energy during lactation, as requirements increase with increasing milk production (Adams et al. 1996).

As a factor ambient temperature influencing the consumption of feed. In warm weather animals consuming small amounts of feed and vice versa, lower temperatures stimulate consumption (Todorov et al. 2007).

Feed with good quality indicators satisfy the requirements of cows for milk in terms of essential nutrients, which in turn provides a good health status through relevant physiological periods and productivity (Todorov et al. 2011).

Feed safety is determined by the presence or absence of adverse health of animals and humans substances. More important for cattle, respectively, the received productions are:

The alkaloids contained in plants affect physiological processes in the animal organism, as well as on the production. In most cases, their presence has a harmful effect on animals. Example is the pyrrolizidine alkaloids, which are a normal ingredient in some plants widespread in pastures and meadows. Although their main function is a protection against insects. This alkaloid cause liver disease and in some cases neoplasias on animals fed in larger amounts of plants which has it. Such plants prevalent in grass feed leads to a huge number of poisoning in livestock. Selection of grass fodder on pasture (contains the alkaloid) at grazing prevent the danger of poisoning, but feeding hay or silage can be dangerous (Stegelmeier et al. 1999 and Fu et al. 2001). The spread of pyrrolizidine alkaloid is the most widely in families Asteraceae and Leguminosae, where its concentration is highest. Complete descriptions of plant species containing it is given by Hartmann and Witte (1995). While some species contain only pyrrolizidine alkaloid, others may contain other alkaloids as well. The high concentration of the alkaloid is mainly in the seeds of plants which contain it. The most widespread is the alkaloid in the following plant species Heliotropium lasiocarpum, H. popovii and

H. europaeum, found in wheat crops and when harvest the grain mixed with them (Prakash et al. 1999).

Lactating ruminants, including cows received feed with the participation of the alkaloid secrete it with milk (Panter и James 1990).

According to Prakash et al. (1999) consequences of sub lethal doses were observed in cows reared on pasture in the presence of plants containing high amounts of alkaloids. The authors suggest that continued intake of alkaloids, but in small doses is not always fatal. The primary pathology that causes the alkaloid is on the hepatic veins that are blocked by growing connective tissue and lead to obstruction of the vessels.

Participation of ergot in feed animal feed also can lead to fatal consequences. Bush et al. (1997) suggest that feeding with forage containing alkaloids of ergot (Claviceps purpurea) can cause toxic effects in both animals and humans. Regulation 10 from MAF – April 3, 2009 describes the requirements for feed containing ergot.

The term "mycotoxin" is derived from the Greek word for fungus "mykes" and the Latin word for poison "toxicum". This concept means substances produced by fungi colonized the crops in the field and other feed. They represent a potential threat to animals and humans when used as food.

Each forage crop stored for more than a few days without proper conservation (drying or using chemicals) presents a danger expressed by mold predisposing to formation of mycotoxins. They are widespread in plants around the world and affect important crops such as cereals, nuts, dried fruits, spices, oil seeds and dried beans. Once formed remain very stable in structure, and therefore the best way to do something against them is prevention.

Mycotoxins as toxic metabolites produced by fungi have a wide range of chemical and physical properties that are toxic to animals and humans. Twenty – thirty of them have been studied by contaminated food of animal and human (Watson 1985).

The presence of mycotoxins in animal feed poses a risk to human health if they or their toxic metabolites pass in significant quantities in the production (Smith and Henderson 1991). The effect of various mycotoxins in different directions, some of them are carcinogenic, mutagenic or teratogenic, as well other affect negative on the immune system.

According to Douwes et al. (2003) mycotoxins can occur in the form of fungal spores in the atmosphere, which is considered as the cause of their spread in wetlands or barns.

Keith (2008) considers that the main types of fungi of the genus Fusarium, Alternaria and Aspergillus are most important. Also Penicillium can lead to contamination of crops after harvesting. The author describes the most important mycotoxins, which are: Aflatoxins B1, B2, G1, G2 (affect nuts, dried fruit, corn etc.); Aflatoxins M1, M2 (affect milk and milk products); Deoxynivalenol, nivalenol, T-2 toxin, HT-2 toxin и Zearalenone (affecting cereals) and Fumonisins B1, B2, B3 (affecting maize, maize products, etc.).

Field crops and those that are harvested for storage are very difficult to be decontaminated by contamination of mycotoxins. The prevention of the presence of fungi and their toxins is important to apply best practices in the cultivation, harvesting and storage of feed. It is also necessary to apply good practices and procedures of the system for analysis of dangerous and critical control points (HACCP) in the production of compound feed. Unfortunately, in countries with humid climate, there is an excellent environment for the development of these fungi and molds, with the result that produced contaminated feed pose a major problem for animal health and production received from them.

Aflatoxins are group of about 20 fungal metabolites. Only some of them (Aflatoxins B1, B2, G1, G2 and M1) affect forage used by animals. The main fungi producing aflatoxins are Aspergillus species and are found in grains, nuts, dried fruits and more. These kinds of fungus are found in cultures grown in countries with warm and humid climate.

Aflatoxin M1 and M2 are metabolites of aflatoxin B1 and B2, which are produced from cows or other ruminants fed with feed containing them. They are secreted with milk and can infect the dairy products. Smela et al. (2001) describes chemical and biological activity of aflatoxin B1, and Abbas (2005) the role of aflatoxins in safety and food quality. Aflatoxins are stable in foods that are contaminated. They are relatively resistant to the decontamination methods (Smith et al. 1994, Park 2002 and Scudamore 2004).

Climate is a major factor from which depends the development of aflatoxins. "Stress" at the plants associated with drought followed by heavy rainfall adversely affects them. From cereals corn is most vulnerable to infection. Other cereals used in the brewing industry also can become infected respectively to contaminate beer (Mably et al. 2005).

In the literature besides the described toxins are indicated much more: ochratoxin A; deoxynivalenol; trichothecenes; zearalenone etc.

Over the past 20 years was spoke wide about genetically modified organisms and GMO feed. There are a number of studies related to GM plants that are used as fodder.

Views of most researchers about GMO feed and the effects of their use are controversial.

Some authors (Flachowsky et al. 2006) describe studies of GMO feed crops and their relationship to food. There were 18 studies involving (16 of them) cultures from the first generation - Bt-corn, Pat-corn, Pat-beet, Gt-soy, Gt and Bt-potato and (2) with second-generation crops with altered chemical composition. The authors found that cultures of first generation do not modify noticeably the nutritional value of feed and there is not apparent transfer of recombinant DNA from plants to animals. Regardless of the results the authors reported negative attitudes in the public field on GMO products.

Research on the impact of GM crops in mammals and especially their reproductive function are limited. This provoked a number of researchers to conduct large-scale studies of their effects on reproduction, mortality in newborns and their weight development.

In studies with cross calves of Holstein-Friesian breed involving GMO corn (Bt11) Shimada et al. (2006) do not establish a negative effect on growth, hematology, blood biochemistry and function of rumen in calves.

In experiments with ruminants and their descendants held for three years, fed with participation of genetically modified maize (Bt176) not indicate harmful effects on health and productivity, as well as gene transfer to ruminal micro flora or tissues of animals. There were no differences in reproductive and hematological signs (Massimo et al. 2008).

The analysis of the data shows that the quality and safety of feed is crucial to the health and productivity of animals including cows. To comply with the indicators characterizing the quality and safety regulations and legislation are made (applying to all EU countries).

The legislation of the Republic of Bulgaria on the quality and safety of feed and permitted substances in them is regulated by Feed low - last changed 13.02.2015, Regulation 10 from MAF - April 3, 2009 and Law on GMOs – last changed 02.08.2013. Bulgarian legislation regulates the feed safety requirements and regulates the feed business (art. 25. (1) from Feed low). For performing them are developed guidelines and procedures for the implementation of best practices and follow the principles of the system of hazard analysis and critical control points (HACCP). According to

art. 26. (1) of the same low feed business operators must have sufficient and accurate information on feed and must be aware of their effects on animal health.

The maximum permissible concentrations of undesirable substances and products in feed are regulated in Appendix № 1 to Art. 2 para. 2 of Regulation 10 from MAF - April 3, 2009.

Law on GMOs - last changed 02.08.2013 regulates work release, marketing, transport, import, export and control of GMO products in order to protect human health and environment from possible adverse effects from them.

Conclusions

Quality of feed used to feed cattle depends on a number of factors and determined by many indicators, more important of which are: composition, digestibility, appetite and consumption.

The content of undesirable substances in feed can cause a number of diseases and toxic effects in animals, and affect the production.

Bulgarian legislation regulates the requirements and benchmarks of undesirable substances with a view to quality and safety feed.

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