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REVIEW ARTICLE

PROTECTED LIPIDS AND FATTY ACIDS IN CATTLE FEED RATIONS

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Abstract. Application of supplements of protected fats and polyenoic fatty acids of vegetable origin in a diet of different age and productive groups of cattle stimulates metabolism in the animals, increases their productivity and improves quality of milk and beef. Supplements of calcium salts of fatty acids, made of sunflower, soybean, rape, flax and palm oils are the most effective in a diet of young animals and cattle.

Key words: cattle, feeding, lipids and fatty acids

INTRODUCTION

Numerous investigations have proved that application of vegetable and animal fatty supplements in a diet of animals has a stimulating effect on metabolism, intensity of their growth and development, forage efficiency, slaughtering output, nutritional and biological quality of animal products [Vovk et al. 2011]. Such impact is caused by high-energy coefficient of fats, their nitrogen-keeping effect in a body, positive influence on metabolism regulation and accumulation of vitamins in tissues [Janovych and Lagodyuk 1991]. Modern intensive technologies of animals breeding usually include application of fatty supplements in diets.

Application of fatty supplements in diets of ruminants (in contrast to monogastric ones) is characterized by a set of substantial differences, that is caused

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by peculiarities of anatomy and functioning of digestive tract. In particular, fatty supplements in cattle diet demonstrate specific character because of forestomachs and important role of symbiotic microorganisms of a rumen in digestion processes and metabolism [Juchem et al. 2010].

It has been determined that increased level of vegetable and animal fats in cattle diet in the period of an active functioning of forestomachs inhibits metabolic activity of some rumen microorganisms. It is also demonstrated that intensive breakdown of alimental lipids and hydrogenation of polyenoic fatty acids in forestomachs of cattle by ferment systems of microorganisms results in degradation of a considerable number of essential (linoleic and linolenoic) and other fatty acids, that makes negative impact on metabolism processes in a body, intensity of growth and development of animals, nutritional and biological quality of milk and beef. Considering all mentioned above, lately countries with development animal breeding have intensively carried scientific researches to increase efficiency of application of fatty supplements in diets of different kinds of animals.

The article presents results of the own researches as well as analysis of domestic and foreign authors' publications of the recent years as to metabolic and productive effect of protected lipids and fatty acids while using supplements of them in diets of different age and productive groups of cattle.

MAIN MATERIAL

Results of experimental researches prove that increased level of fats and fatty acids in a diet of cattle inhibits processes of fiber fermentation in rumen, decreases digestion of organic matter in forestomachs and digestive tract in general [Martin et al. 2008, Beauchemin et al. 2009]. In spite of the fact that essential polyunsaturated (linoleic and linolenoic) fatty acids, which come into cattle organism, make 70-85 %, milk and beef contain only 4-8% of them [Alyev 1980]. It happens because in the animals' body polyenoic fatty acids are subjected to active hydrogenation under the impact of fermentation systems of rumen microorganisms. It results in a considerable decrease of their content in a small bowel and concentration of saturated acids increases [Juchem et al. 2010]. It is known that polyenoic (linoleic and linolenoic) and other unsaturated fatty acids in an animal's body can make anticarcinogenic, antisclerotic and anti-inflammatory effect [Dhiman et al. 2005, Lukyanchuk et al. 2007, Kelley et al. 2007, Suksombat et al. 2013]. Besides, the mentioned fatty acids stimulate reproductive functions in cows [Mattos et al. 2002, Jahanian et al. 2013], favor expression of reproductive genes, make substrates for synthesis of estrogens, progesterone and prostaglandins [Mattos et al. 2000, Staples and Thatcher 2005], activate metabolic processes in follicles [Zachut et al. 2008], oocytes [Zeron et al. 2002], help growth and development of embryo

[Thangavelu et al. 2007, Fouladi-Nashta et al. 2007]. Considering all mentioned above, different methods of protection of vegetable and animal fats are applied before feeding animals to decrease negative impact of alimental fats on metabolic activity of symbiotic microorganisms of cattle forestomachs, increase level of income of polyenoic fatty acids from intestine into bloodflow and rise share of polyunsaturated fatty acids in the content of milk fat and beef [Jenkins 1995, Fahey et al. 2002 a, Fahey et al. 2002 b, Lock and Bauman 2004].

Feeding of cattle with certain amount of native seed of oil crops, containing lipids, being protected with seed cover, is the simplest and cheapest way to protect polyunsaturated fatty acids from biohydrogenation and prevent their negative impact on live activity of rumen microorganisms [Casutt et al. 2000, Ward et al. 2002, Kennel 2007]. It is determined that short-term application of supplements of flax seed in cow diet makes some increase of milk productivity [Petit et al. 2004, Moallem 2009], but does not influence content of fat in milk [Petit and Benchaar 2007], as well as protein [Petit and Benchaar 2007, Martin et al. 2008] and lactose [Raes et al. 2003], while its long-term application in the diet does not increase milk productivity [Petit et al. 2004]. It is noted that feeding of lactating cows with supplements of flax grain results in little increase of the share of unsaturated fatty acids in content of milk lipids [Glasser et al. 2008, Petit and Cortes 2010]. It is also proved that feeding with seed of cotton [Keele et al. 1989], sunflower [White et al. 1987] and rape [Murphy et al. 1987] practically does not protect unsaturated fatty acids from hydrogenation of them in rumen. It is demonstrated that feeding of young cattle with cut grain of oil crops increases level of polyunsaturated fatty acids in content of lipids in muscle and fatty tissues [Garcia et al. 2003, Raes et al. 2003, Gibb et al. 2004, Lake et al. 2006]. Other researchers observed poor increase of a share of polyenoic fatty acids in tissue lipids while feeding the animals with the mentioned feeding supplements [Lough et al. 1991, Cranston et al. 2006].

Some facts ground that level of hydrogenation of polyunsaturated fatty acids by fermentation systems of forestomachs microorganisms in ruminants can be decreased by extrusion of oil crops seed before feeding the animals. In particular, introduction of extruded flax seed into a diet of lactating cows results in some increase of the share of unsaturated fatty acids in milk fat [Fuentes et al. 2008, Moallem 2009]. However, according to other data, application of extruded seed of oil crops in a diet of cattle practically does not decrease biohydrogenation of unsaturated fatty acids in rumen [Grummer 1991].

According to the data of some authors [Hussein et al. 1996], application of complete rape seed, handled with hydric dioxide in a diet of milking cows, slightly increases income of unsaturated fatty acids into small bowel, comparing to application of unprocessed cut rape seed. However, according to the data of other authors [Aldrich et al. 1997], milk productivity, fat-acid content of milk fat and quality of milk experience the same impact in case of introduction of rape seed, handled with hydric dioxide, into a diet of lactating cows, as in the case of feeding with native cut rape seed.

It is noted [Glasser et al. 2008], that infrared irradiation (micronization) of flax seed before feeding of cows inconsiderably increases content of unsaturated fatty acids in milk fat.

Analysis of published data of the recent years proves that production of calcium salts, based on fatty acids is the most widely used and effective chemical protection of unsaturated fatty acids, presented in vegetable fats, fed to cattle [Wallace 1985, Palmquist et al. 1986, Chalupa et al. 1986, Sklan et al. 1991, Espinosa et al. 1995, Elliott et al. 1996, Drochner and Yildiz 1999, Pavkovych and Vovk 2002, Fahey et al. 2002, Fahey et al. 2002, McNamara et al. 2003, Martin et al. 2004, Vovk et al. 2005, 2006, Bilby et al. 2006, Vudmaska 2006, Fuentes et al. 2008, Santos et al. 2008, Cerri et al. 2009, Medeiros et al. 2010, Cortes et al. 2010, Vovk et al. 2011, Lopes et al. 2011, Reis et al. 2012, Vovk et al. 2013, Andrés et al. 2013, Renno et al. 2013, Renno et al. 2014]. Calcium salts of polyenoic fatty acids stay constant under conditions of rumen pH, practically are not subjected to hydrogenation by microorganisms in the chamber of digestive tract, and while transferring to rennet-bag and small bowel they get free from calcium ions and are absorbed by mucous membrane of small bowel and transported by blood to organs and tissues [Stevens 1990]. Some researches prove that introduction of calcium salts of fatty acids into cattle diet does not break fermentation processes in rumen, favors keeping of pH environment, does not prevent live activity of rumen microflora [Renno et al. 2014], does not slow down digestion of nutritional substances of the diet [Elliott et al. 1996], does not inhibit production of volatile fatty acids and support an optimal acetic and propionic correlation in rumen [Palmquist et al. 1986], increases calcium adsorption in digestive tract [Zinn and Shen 1996], positively influences health of animals [Chalupa et al. 1986]. Calcium salts of fatty acids are well digested in digestive tract of cattle and do not deteriorate digestion processes in general [Wallace 1985]. Application of supplements of calcium salts of fatty acids in cattle diet secure better production action in comparison to application of native fatty supplements, particularly vegetable oils [Drochner and Yildiz 1999].

Feeding of cows with calcium salts of fatty acids, made on the base of vegetable oils, improves milk productivity, share of fat and lactose in milk [Fahey et al. 2002 a, Fahey et al. 2002 b, Andrés et al. 2013], while share of protein decreases, but general production does not fall [Wu et al. 1993]. Besides, application of calcium salts of fatty acids in a diet of lactating cows allows decrease of the share of saturated fatty acids and increase of the level of unsaturated ones, including linolenoic acid in milk fat [Martin et al. 2004, Vovk et al. 2005, 2006, Vudmaska

2006, Medeiros et al. 2010, Cortes et al. 2010, Vovk et al. 2011, Renno et al. 2013].

It is determined that application of supplements of calcium salts of fatty acids, made on the base of palm oil and fish-oil, in cow diet activates metabolic processes in an organism, stimulate wish and fertilization, optimizes luteolysis, increases level of progestin and prostaglandin F2a in blood [Lucy et al. 1991, Sklan et al. 1991, Espinosa et al. 1995, McNamara et al. 2003, Bilby et al. 2006, Santos et al. 2008, Cerri et al. 2009, Lopes et al. 2011, Reis et al. 2012, Vovk et al. 2013].

Feeding of cattle with calcium salts of fatty acids, made on the base of vegetable oils, increases share of unsaturated fatty acids in the content of tissues in a body [Gassman et al. 2000, Pavkovych and Vovk 2002, Scollan et al. 2003, Gillis et al. 2004, Vovk et al. 2005, 2006, 2011].

Coating with protein-formalin membrane is another chemical way to protect lipids and polyenoic fatty acids from degradation and biohydrogenation in rumen of ruminants [Doreau et al. 1997, Mansbridge and Blake 1997, Zinn et al. 2000]. Protected membrane is destroyed in acid environment of rennet-bag, released protein is broken up by digestive ferments, and fatty acids, including polyenoic ones, are actively absorbed into mucous membrane of small bowel [Banks et al. 1990], that considerably increase share of them in organism tissues and thus, in animal products (milk, beef) [Faichney et al. 1972].

At the same time, some authors say that protection of vegetable fats in a form of protein-formalin complexes sometimes is of poor effect because of physical breakup of the product while chewing in mouth cavity and also in case of unsatisfactory control over the process of a determined processing [Knight et al. 1978]. It is noted that production of such lipid-protein-formalin feeding supplements is of high expenses [Chilliard et al. 2000].

It is shown that application of rape seed, handled with formalin, in cow diet does not influence level of milk productivity and share of protein in milk, while share of unsaturated fatty acids in milk lipids increases [Ashes et al. 1992]. However, recently application of formalin in animal breeding has been forbidden in many countries because of its tumor response [World Health Organization 2004].

It is determined that encapsulation of lipid-fat-acid feeding supplements with calcium alginate before feeding cattle is of low efficiency [Ekeren et al. 1992].

CONCLUSION

Making conclusions of the presented data one should confirm that application of supplements of protected fats and polyenoic fatty acids of vegetable origin in a diet of different age and productive groups of cattle demonstrates positive metabolic and productive effect in that kind of animals. One should also stress that application of supplements of calcium salts of fatty acids, made on the base of vegetable oils, in a diet of young animals and adult cattle is the most widely used and effective practice.

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CHRONIONE LIPIDY I KWASY TŁUSZCZOWE W DAWCE PASZOWEJ DLA BYDŁA

Streszczenie. Stosowanie suplementów w postaci chronionych tłuszczy i wielonienasyconych kwasów tłuszczowych pochodzenia roślinnego w diecie bydła w różnym wieku i grupach produkcyjnych pobudza przemianę materii u zwierząt, zwiększa ich wydajność i poprawia jakość mleka i wołowiny. Suplementy soli wapniowych kwasów tłuszczowych, wykonane z oleju słonecznikowego, sojowego, rzepakowego, lnianego i palmowego są najbardziej skuteczne w diecie młodych zwierząt i bydła.

Słowa kluczowe: bydło, żywienie, lipidy, kwasy tłuszczowe

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