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RESEARCH ON THE EFFECT OF SOME NUTRITIONAL SUPPLEMENTS ON QUANTITATIVE AND QUALITATIVE PARAMETERS OF GOAT'S MILK

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Abstract

The purpose of this study was to evaluate the influence of the administration of nutritional supplements on the quantity and quality of goat's milk. For this purpose, homogeneous groups of goats from the Carpathian breed, in the middle of the lactation period (n = 10), were created, to whom were administered in food, experimentally: hemp seeds (group 2), hemp seeds and mineral supplement (group 3), flax seeds (group 4), flax seeds and mineral supplement (group 5). Milk production and milk protein and fat percentages were monitored for 20 days, and the results obtained were compared with those of the control group (group 1). The obtained results showed that in terms of milk production, there were significant increases ($p<0.05$) between the control group and the experimental groups (with 6.95% for group 3 and by 5.42% for group 5). Regarding the percentage of proteins, significant increases were observed in the case of groups 3 (6.06%) and group 5 (9.09%). Regarding the percentage of fat, it increased in the case of all experimental groups, the increases being 4.65% ($p<0.05$) for group 2, 11.62% ($p<0.01$) for group 3, 6.97% ($p<0.05$) for group 4, and 9.30% ($p<0.01$) for group 5.

Key words*: flax, goat, hemp, milk, supplement.*

INTRODUCTION

Knowledge about the physiology of lactation has made significant progress recently, constituting a priority direction of research in the zoo veterinary field. This matter has been accentuated by the presence of milk in human nutrition and the food industry as a raw material (Savu et al., 2002; Răducuţă et al., 2008; Visoescu et al., 2015; Petcu et al., 2022). Therefore, the knowledge referring to humoral regulation of the lactation process has expanded, which led to the description of multiple hormones that intervene in physiological conditions, at well-determined moments, and have a capital role in mammogenesis, lactogenesis, and galactopoiesis (Codreanu, 2018), phyological processes closely related to the reproduction activity (Bociu et al., 2015), and to the milk composition variations, influenced by internal or external factors (Petcu et al., 2022). Furthermore, it has been proved the possible usage of some hormonal entities, like GH, LTH, estrogen, progesterone and placental lactogen, in the manipulation and optimisation of mammogenesis, lactogenesis, and galactopoiesis (Cotor at al., 2011). However, the possible adverse effects of artificially administered hormones or growth promoters and the negative implications they could have on the quality and sanitation of milk and derived products (Goncearov et al., 2004; Ionita et al., 2016; Petcu et al., 2020; Pogurschi et al., 2022a; Pogurschi et al., 2022b; Ghimpeteanu et al., 2022) and, implicitly, in human health, raised certain question marks on the feasibility of implementing such biotechnologies in animal husbandry. Currently, it is known that goat milk production is strongly influenced by the growth system (Răducuță et al., 2015), as well as the size of the flocks and the quality of individuals from a farm (Răducuță et al., 2010).

At the same time, research in the field of lactation physiology has highlighted the involvement of essential food components in the biosynthesis of milk components and their

importance in ensuring efficient galactopoiesis. In this sense, the importance of the protein content of the food ration and their quality (the presence of essential aminoacids in the food) in ensuring a decresed production of milk, with an improved protein content, has been demonstrated (Chilliard et al., 2002). It was also demonstrated the importance of cellulose in ensuring an optimal environment for the development of the cellulolytic flora, at the level of the ruminal microecosystem. This is involved in the synthesis of volatile fatty acids (VFAs), the raw material used in the pre-metabolic phases of the biosynthesis of milk lipids (biosynthesis of saturated, short-chain fatty acids) at the level of mammary acini (Cotor, 2015).

The administration of nutritional supplements based on oleaginous plants, which contain high levels of long-chain unsaturated fatty acids, especially linoleic acid in particular, have shown positive effects on the level of milk fat and its quality (Chouinard et al., 2001; Cotor et al., 2009). In this sense, research was undertaken on the effect of supplementing the food ration with: seeds, cakes and soybean oils, olive oil, sunflower oil, etc., on the level of ruminal synthesis of VFA and the balance of fatty acids in milk (Givens et al., 2003; Harvatine et al., 2006).

At the same time, a series of additives based on substances of mineral and animal origin are known that have an effect of inhibiting bacterial cellulase and implicitly reducing the concentration of resulting acetic acid, a fact that can lead to a decrease in the weight of short-chain fatty acids in the composition milk fat (Harvatine et al., 2005; Kholif et al., 2015; Morsy et al., 2015).

Research in this sense has been and continues to be carried out, trying to identify optimal ways of administering such additives, under conditions of economic profitability. An untested oleaginous ingredient for the purpose mentioned above is represented by hemp seeds (*Cannabis sativa*). Along with hemp, flax seeds (*Linum usitatissimum*) are noteworthy for their high content of unsaturated fatty acids, mentioned above.

The administration of inorganic alkalizing substances (sodium bicarbonate, MgO), in parallel with fats of vegetable origin, reduced the negative effects on milk production and the percentage of proteins implied by supplementing the feed ration with fats, in ruminants (Martini et al., 2004). Thus, a mineral supplement, with a recipe (75% sodium bicarbonate, 10% magnesium oxide and 15% calcium carbonate) that will quantitatively and qualitatively improve the lipid content of milk, without affecting at the same time, in a way significant, protein content and milk production as a whole, was constituted in an objective approach of the present work.

Nowadays, the administration of mineral supplements is a common practice in many areas of animal husbandry (Ghiță et al., 2021).

MATERIALS AND METHODS

A number of 50 lactating goats, from the *Carpathian breed*, aged between 3 and 5 years, in the same phase of the lactation period, were used for the experiment. The animals came from the same holding, benefiting from identical maintenance conditions. It was also considered that the animals in the experimental group have the same state of maintenance, because the excess development of adipose tissue can affect the functions of lymphocytes (Ghiță et al., 2021), making the animals susceptible to diseases. The experiment took place over a period of 20 days, on healthy animals that were not administered any medication, as the effect of anti-inflammatory medication on milk production (Codreanu, 2018) and the immune system (Ghita et al., 2015) is known.

Five experimental groups (of 10 animals each) were organized, which were treated in the manner described in Table 1. Food additives (hemp seeds, flax seeds and mineral supplement) were administered daily and individually, being incorporated into the food portion. Daily milk production per goat was measured throughout the experiment. On days 1, 5, 10, 11, 15 and 20, milk samples were collected in order to determine the protein and fat concentration.

Table 1. The method of administration of the tested additives, in the experimental groups

Group number	Hemp seeds g/goat/day	Flex seeds g/goat/day	Mineral supplement (75% $NaHCO_3$, 10% MgO and 15% $CaCO_3$) g/goat/day
Group 1 (n=10)	-	-	-
Group 2 (n=10)	200	-	-
Group 3 (n=10)	200	-	100
Group 4 (n=10)	-	200	-
Group 5 (n=10)	-	200	100

The protein and fat content were determined using a Lactoscan 60 LCD Milk Analyzer (IR spectrophotometry).

The statistical analysis consisted in calculating the mean and the standard error.

At the same time, in order to determine the significance of the differences between the experimental groups, the t-test (Student test) was applied.

RESULTS AND DISCUSSIONS

The results obtained in the present study indicate that the groups that received only hemp and flax seeds in the ration (groups 2 and 4) did not have higher milk production than the control group, in the two experimental stages.

The average daily production of milk per lot is presented in Table 2.

Table 2. Average daily milk production per group and the experimental phase

Group	Average daily milk production/group, in the first 10 days of the experiment (ml)	Average daily milk production/group, in days 11-20 of the experiment (ml)
Group 1 (n=10)	1420	1438
Group 2 (n=10)	1452	1468
Group 3 (n=10)	1461	1538*
Group 4 (n=10)	1452	1454
Group 5 (n=10)	1494	1516*

*P<0.05

In the first period of the study (days 1-10), the average values obtained did not show significant increases in milk production, while, in the second period of the study (days 11-20), groups 3 and 5, whose ration of was supplemented with flax or hemp seeds and mineral supplement, showed an intensification of milk production, compared to the control group, namely, group 3 with 6.95% and group 5 with 5.42%, the differences being significant in terms of statistical view (P<0.05).

Studying the specialized literature (Martínez et al., 2011; Kholif et al., 2015) it is found that the results obtained in the present study were similar to the results of other scientific researches. Nutritional supplements were administered in the present study in order to study their effect on milk quality. The slight increase in milk production in the case of groups 3 and 5 can be explained by the influence of the mineral supplement that buffered the ruminal pH facilitating the activity of the symbiont flora at that level. In this way, the digestion processes were influenced in a positive way, which can also lead to an increase in milk production.

The average protein concentration of the milk samples, collected from the experimental groups, is presented in Figure 1.

The obtained results indicate that the groups that received only hemp and flax seeds in their rations (groups 2 and 4) did not have much higher protein concentrations than the control group, in any of the two experimental stages.

Groups 3 and 5, whose ration was supplemented with flax or hemp seeds and mineral supplement, showed an increase in the milk protein concentration (group 3 with 6.06% and group 5 with 9.09%) compared to the control group, the differences being statistically significant (P<0.05).

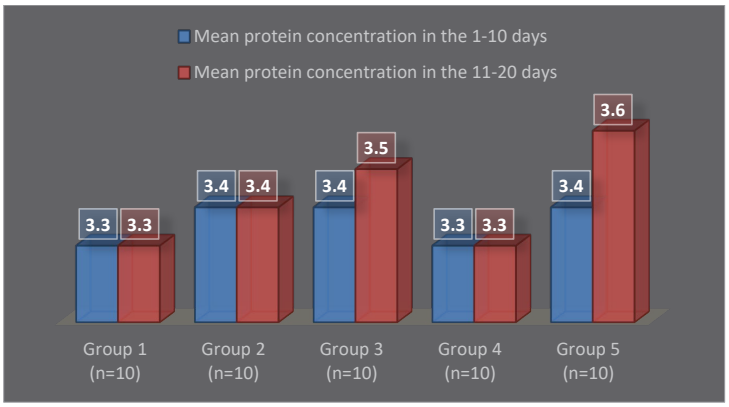

Figure 1. Average protein concentration in milk samples, per group and the experimental phase

In the specialized literature (Martínez et al., 2011; Kholif et al., 2015) results similar to those of the present study are reported. The explanation is represented by the fact that the nutritional supplement administered in the present study had a buffering effect on the ruminal pH, offering better conditions to the proteosynthetic microbial flora at the ruminal level. In this way, the protein level of the ruminal content increased, implicitly leading to an increase in aminoacidemia and finally in milk proteins.

The average fat concentration of the milk samples collected from the experimental groups is presented in Figure 2.

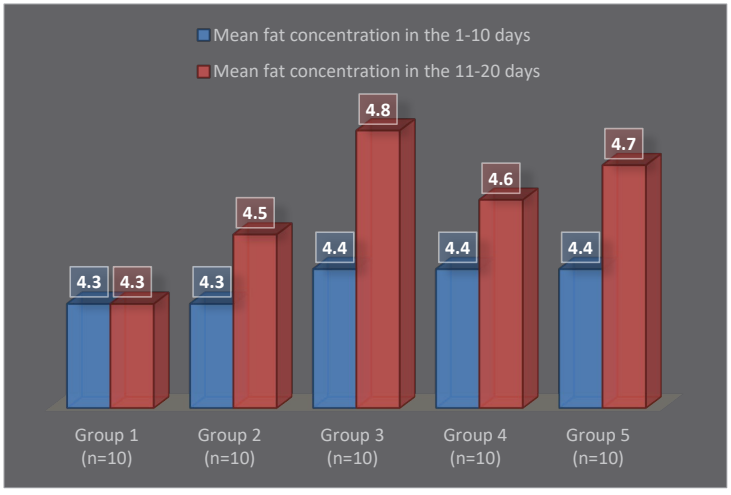

Figure 2. Average fat concentration in milk samples, per group and the experimental phase

The obtained results indicate that the groups that received only hemp and flax seeds in the ration (groups 2 and 4) recorded higher lipid concentrations than the control group, by 4.65%, in the case of group 2 and by 6.97%, in the case of group 4, the differences being statistically significant ($P<0.05$).

Groups 3 and 5, whose ration was supplemented with flax or hemp seeds and mineral supplement, showed an increase in the lipid concentration of milk (group 3 with 11.62% and group 5 with 9.30%) compared to the control group, the differences being distinctly significant from a statistical point of view ($P<0.01$).

In the specialized literature (Reklewska et al., 2002; Chilliard et al., 2002; Martínez et al., 2011; Morsy et al., 2015) similar results to those

of the present study were reported. The increase in milk fat percentage is due to the increased food intake, the experimentally administered oilseeds being rich in unsaturated fatty acids. Also, the experimentally administered mineral nutrient supplement prevented the acidification tendency of the rumen pH (due to the production of VFAs), providing optimal conditions for the action of the symbiotic microflora in the rumen.

CONCLUSIONS

The groups that received only hemp and flax seeds in the ration, did not record milk production superior to the control group.

The groups whose ration was supplemented with flax or hemp seeds and mineral nutritional supplement showed an intensification of milk production (group 3 with 6.95% and group 5 with 5.42%) compared to the control group, the differences being statistically significant.

The groups that received only hemp and flax seeds in the ration did not record higher protein concentrations than the control group.

The groups whose ration was supplemented with flax or hemp seeds and mineral nutritional supplement, showed an increase in the milk protein concentration (group 3 with 6.06% and group 5 with 9.09%) compared to the control group, the differences being significant from statistical point of view.

The groups that received only hemp and flax seeds in their ration recorded higher lipid concentrations than the control group, by 4.65%, in the case of group 2 and by 6.97%, in the case of group 4, the differences being statistically significant. Groups 3 and 5, whose ration was supplemented with flax or hemp seeds and mineral nutritional supplement, showed an increase in the lipid concentration of milk (group 3 with 11.62% and group 5 with 9.30%) compared to the control group, the differences being statistically significant.

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