Including of Field Beans as Protein Source in Feed Ration for Dairy Goat

Elita Aplocina, and Liene Veipa

Abstract—As soybean and rape cake is quite expensive protein sources, alternative protein sources like field bean seeds have been successfully used in diets for ruminants. The aim of the study was to evaluate the field bean feeding options and the impact on goat milk productivity and quality. The dietary treatments were as follows: 1st control group received concentrate which contained rape cake as the main proteinous feed; and 2nd trial group received concentrate 0.80 kg per day per goat, containing field beans as the main proteinous feed in substitution of rape cake. In basic ration for both the control and trial group was observed a relatively high energy (10.3 - 12.4% of requirement) deficit. Including of field beans in feed ration made it possible to optimize slightly feed ration. Including of beans in feed ration did not lead to an increase in goat milk productivity. Milk yield decreased in both groups, but in the trial group productivity decline was more rapid than in control group. Significant decrease in the number of milk somatic cells by 29% was observed in the trial group, where animals received field beans as protein source.

Keywords—field bean, goat, milk, protein.

I. INTRODUCTION

Feed costs account for more than 55% of dairy goat production costs. As a result, many producers have become engrossed in reducing costs to feed a goat per day rather than optimizing their feeding efficiency. The cheapest ration is not usually the most production-efficient ration. This statement may sound like a contradiction, but relates to the understanding of how the goat and her rumen interact from a nutrient requirement perspective [16].

Protein is the more expensive nutrient in feeding and therefore often limiting maximum productivity. Industry by-products often are less expensive sources besides the traditional major supplies of oil meals. However, as forages have higher fiber and lower protein contents with increasing maturity, the least expensive sources of protein are usually forages, alfalfa, clovers, well fertilized grasses, harvested at prebloom or immature stages. Protein supplies to the rumen in the form of degradable protein are necessary for optimum growth of rumen bacteria, but they require energy at the same time, without which some proteins will be wasted into ammonia in the rumen. A minimum of 7 percent crude protein in the diet dry matter is required for normal rumen function, and forage intake will be decreased at lower protein levels. The supply of some rumen protected protein has been effective in increasing milk yield. Excess protein feeding is not only wasting money but is stressing the goat by increasing her blood urea levels, increasing urine excretion and interfering with efficient reproduction. Protein deficiencies will reduce feed intake, rumen function and retard fetal development [17].

Improvement of the energy density of the ratio due to the supply of concentrate reduces the fat content and increases protein content of goat milk, but the effect of concentrate supply has little effect on milk composition when it comprises one-third of total dry matter (DM) intake [10]. El-Gallad [5] shown, that increasing dietary energy content did not affect milk yield and fat percent, but increasing the amount of roughage increased milk fat percent. This response was more pronounced in goats given high-energy than in those given low-energy diets. Increasing dietary energy increased solids-not-fat and protein content of milk, while increasing roughage content did not affect these variables. Dietary energy and roughage content did not affect milk ash content [5]. The tape of carbohydrate in the ration appears to have only an indirect effect on the composition on goat milk, through its impact on energy intake. Generally, fats added to rations result in an increased lipid secretion and the negative effect on protein content can be explained by an effect of dilution. Frequently, protein supplies and the type of protein sources have a very limited effect on milk composition. To produce goat milk with high fat and protein contents, the diet must be well balanced in terms of starch, lipid, and rumen degradable and non-degradable protein [10].

In the animal feed industry the use of home grown legumes as a source of protein is expected to increase further in the near future. The increased costs and supply shortage of conventional proteinous feed is a potential for proteinous seeds from locally available crops, especially from underutilized high-protein grains [7], [8].

Historically, the use of fava beans in animal feeds has been limited due to the presence of antinutritional factors (ANF). However, recent advances in plant breeding have helped to reduce the presence of ANFs, while advances in animal feed processing technology and the use of feed additives (such as exogenousenzymes) means that the presence of certain ANFs can be more effectively managed [18]. Rapid and extensive ruminal degradation of fava beans makes them unsuitable and/or inefficient for use in an unprocessed form. Authors found that pressure toasting of fava beans was an effective way of reducing ruminal protein degradation. Faba beans can be used in dairy rations at inclusion levels of up to 35% [7].

As soybean is very expensive protein source in Latvia, alternative protein sources like pea and bean seeds have been...
successfully used in diets for ruminants. Field beans have relatively high crude protein level and contain a considerable amount of energy in the form of starch (NRC, 2006), which makes them a unique feed that can be substituted for higher-priced protein and energy commodities like soybean meal (SBM) and partly the corn in dairy goat formulations.

The aim of the study was to evaluate the field bean feeding options and the impact on goat milk productivity and quality.

II. MATERIAL AND METHODS

The study was carried out in a dairy goat farm located in north-west part of Latvia, for 16 weeks and involved 90 dairy goats in the first phase of lactation - Latvia native, Saanen, Alps and Thuringia breeds. The trial included a 2-week adaptation period to the diet followed by 14 weeks of feeding the two experimental diets. The goats (50 kg body weight (BW); 63-88 days in milk at the beginning of the trial) were managed according animal welfare requirements. Goats were housed in barn and pastures during the experimental period and had free access to fresh water. Goats (n = 45 per treatment) were randomly allocated to two dietary treatments. The dietary treatments were as follows: 1st control group received concentrate 0.75 kg per day per goat, which contained rape cake as the main proteinous feed (oat 53% + barley 27% + rape cake 20%); and 2nd trial group received concentrate 0.80 kg per day per goat, containing field beans (oats 50% + barley 25% + field beans 25%) as the main proteinous feed in substitution of rape cake (Table I).

The diets fed in this trial were formulated [12] to provide similar amounts of dry matter (DM) and crude protein (CP). The chemical composition of the feedstuffs were estimated in accredited laboratory: Dry matter (DM) according Forage Analyses met. 2.2.1.1:1993; neutral detergent fiber (NDF) according LVS EN ISO 16472:2006; acid detergent fiber (ADF) according LVS EN ISO 13906:2008; crude protein (CP) according LVS EN ISO 5983-2:2009; calcium (Ca) according LVS EN ISO 6869:2002; phosphorus (P) according ISO 6491:1998; fat according ISO 649:1999; ash according ISO 5984:2002; Net energy for lactation (NEL) and digestibility were calculated.

Goats were milked twice daily. Once per month milk samples (totally 270 samples) were analyzed in independent milk laboratory. The following measurements were made: protein, fat and lactose content according ISO 9622, somatic cell count (SCC) according LVS EN ISO 13366-2.

III. RESULTS AND DISCUSSION

Goat nutrients requirement was determined by goat live weight (average 50 kg) and milk yield (average 2.1 kg), according to the Latvian and the US agreed normative rules [12]. Animals in control group were fed according usual scheme (Table II).

Analyzing the existing ration in farm "Berzi", we found that animals are not provided with sufficient energy level with an impact on the productivity of dairy goats. In basic ration for both the control and trial group was observed a relatively high energy (10.3 - 12.4% of requirement) deficit, which could be explained by the low pasture forage quality. Including of field beans in feed ration made it possible to optimize slightly feed ration.

At the beginning of the study goat milk fat, protein and lactose content did not differ between groups. In milk of control group at the end of the study slightly increase the number of somatic cells, but it could be explained by the extremely hot weather in mid-summer and colder and wetter weather accession to the end of August.

The average milk yield in farm „Berzi” during the trial for both groups of animals is only 2.1 kg of milk per day from the goat (Table IV). Including of beans in feed ration did not lead to an increase in goat milk productivity. Milk yield decreased in both groups, but in the trial group productivity decline was more rapid than in control group. It should be noted that in the trial group was observed a significant decrease in the number of milk somatic cells.

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1. Includes only two groups of animals.
In literature the goat breed is mentioned as a key factor affecting milk yield and composition [3], [15]. In the study were included different breeds of goats and crossbreeds, which are very different in productivity indices. Scientists also found that milk yield is positively correlated with feed protein - energy balance in ratio and negatively correlated with NDF content in feed ration [1], [2], however these associations were not found in our study.

IV. CONCLUSIONS

In basic ration for both the control and trial group was observed a relatively high energy (10.3 - 12.4% of requirement) deficit, which could be explained by the low pasture forage quality. Including of field beans in feed ration did not lead to an increase in goat milk productivity. Milk yield decreased in both groups, but in the trial group productivity decline was more rapid than in control group. Significant decrease in the number of milk somatic cells by 29% was observed in the trial group, where animals received field beans as protein source.

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