Bulgarian Journal of Agricultural Science, 24 (No 3) 2018, 450–459
Agricultural Academy

INVESTIGATION ON FEEDING LEVEL AND MILK PRODUCTION OF HOLSTEIN DAIRY COWS UNDER FARM CONDITIONS IN KOSOVO

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Abstract

Krasniqi, F., M.A. Kamberi, R. Kastrati, E. Emiri-Sallaku and M. Tafaj, 2018. Investigation on feeding level and milk production of Holstein dairy cows under farm conditions in Kosovo. *Bulg. J. Agric. Sci.*, 24 (3): 450–459

Feeding is one of the most influential factors behind profitable milk production of dairy cattle. A one-year study was carried out to evaluate the feeding level (characteristics of rations, nutrient supply) of Black and Red Holstein dairy cows and its effect on milk production under dairy farm conditions in Kosovo. During the study period the offered amount of feed, total dry matter (DM, kg/day), energy (NEL, MJ/day) and crude protein (CP, g/day) as well as chemical and sensory properties of feed were evaluated monthly. The roughage to concentrate DM ratio in offered rations was also calculated. The study involved 12 dairy farms in region of Dukagjini (6 farms) and Kosova Plain (6 farms) with 148 Black and 136 Red Holstein dairy cows. The amount of milk produced, milk fat and milk protein content was measured monthly. Body weight changes were recorded before and after calving, as well as after 100 d, 200 d and at the end of lactation. The results show that all dairy cow farms used rations composed on corn silage and compound concentrate feed. Grass and alfalfa hay was used in 67% and 50% of farms, while one third of the farms used mainly haylage as roughage ration and wheat straw. The mean chemical composition of diets was: 27.14% Acid Detergent Fibre (ADF), 48.81% Neutral Detergent Fibre (NDF), 11.07% crude protein (CP) and 6.66 MJ NEL/kg DM. Roughage/concentrate DM ratio averaged 74/26%. Farms offered in average 17.51 kg DM, 1804.6 g CP and 117.85 MJ NEL per day and cow. Average milk production was 14.35 kg/d/cow with a high feed energy and crude protein used per unit of milk produced respectively 8.39 MJ NEL and 128.7 grams of CP /kg of milk. This low utilisation of feed DM and nutrients is probably related to fluctuation on feeding level, lower roughage quality and digestibility compared with data taken from official feed tables on chemical composition and feeding values (energy, CP and other nutrients), as well as the application of rations and feeding level without consideration of lactation period in dairy cow farms included in this research. The regression analysis revealed that the variation in milk production cannot be fully ascribed to feeding factors.

Key words: Holstein; dairy cows; feeding level; milk production

Introduction

It is estimated that figures of cattle population decreased due to Kosovo War at year 1999 from 400.000 to 200.000. Milk production is considered to be a very important economic agricultural activity in Kosovo and from the total of 261 689 heads of cattle estimated to be bred in 66 589 agricultural households of Kosovo, about 51% is dairy cattle (KAS, 2015). Due to scientific advances, especially in nutrition and management, the overall productivity of dairy cattle has risen considerably in the last 100 years (VandeHaar et al., 2016). The milk yields of the best farm practice in Kosovo is not far from that in the EU and in the region, but in the majority of dairy farms, milk yields are still well below that (Nushi and Selimi, 2009).

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The proper feeding of dairy cattle is crucial factor directly influencing health and production. Excepting genetic potential and selection with 33-40%, feeds and feeding management contribute 60-67% of the overall production performance of dairy cattle (Hutjens, 1998).

It is well known that feed costs may contribute up to 60% of all costs in dairy farms and that the increase of feed utilisation, i.e. the amount of feed nutrients converted to milk, can have a significant impact on the profitability of dairy production. Nutrient supply depending on the level of production maximizes production, increases income potential of dairy herds and decreases the area of land needed per animal unit (NRC, 2001). Nonetheless, the evaluation of feed efficiency of dairy cattle remains a real challenge because of the large fluctuations in their energy balance that occurs throughout the lactation cycle, particularly the contribution of energy mobilized from body fat during early lactation (Connor, 2015). In order to properly fulfil requirements for certain level of production, dairy herds should be grouped in at least three groups: dry, lactating cows and replacement group. For lactating cows, special attention should be given in the critical transition period (60 before and 60 days after parturition) in order to minimise metabolic disorders (Hutjens, 1998).

The nutrients required to meet requirements are supplied from different fodder sources which are characterised by certain variations depending on many factors. The feeds used in dairy herds for intensive production should be of good quality to assure digestible DM, energy and nutrients in compliance with requirements (Stokes, 2002).

The aim of this survey is thus to assess the feeding level or feeding status and milk production in average market oriented Holstein dairy farms in Kosovo.

Material and Methods

The study took place in two regions of Kosovo: Dukagjini Plain and Kosovo Plain. Study was laid down throughout a year, from January to December 2015. The feeding level of dairy cows and milk production was studied in 12 Holstein dairy farms (6 Black Holstein farms and 6 Red Holstein farms). All the farms included in this survey were selected as having more than 10 cows, i.e. small and large-size dairy farms and integrated in the milk collection network, which makes a possible accurate measurement of delivered milk yield produced by each farm.

The data on farm size and characteristics of cow herds are presented in Table 1. Since the aim of the study was to evaluate the current status of feeding usually applied by the farm, no changes of feeding were undertaken. To compare the level of nutrients supply in farms, nutrient requirements for NEL (MJ/kg) and digestible crude proteins (g/day) were calculated (Obračević, 1990; NRC, 2001).

In six of the farms, TMR rations were used. The composition of the diets is given in Table 2. The sampling and the amount of each feed offered to the animals was done every month. To do so, 376 individual feed samples were taken and subjected to chemical analysis to evaluate their chemical composition and nutritive value. Chemical analysis using commercial calibrations of NIR technology (NIRS 6500 apparatus and ISI WIN III software) was done in the laboratory of Faculty of Agriculture and Veterinary of the University of Prishtina.

Since all the milk produced was delivered to milk delivering network centres, the exact amount was recorded every day and then calculated as a yield per month and year per farm. Cows within a farm were at different stages of lactation, hence producing different amounts of milk. To express production as a 305-day milk yield per cow, a correction was done by the division of total yearly milk produced with the factor 1.1967 (365/305). Samples of milk were taken every month (a total of 144 samples) and analysed for their chemical composition, total bacteria count (TBC) and somatic cell count (SCC). Milk analysis was conducted by Food and Veterinary Agency in Prishtina which is officially recognised agency for food quality and safety in Kosovo.

All feed samples were initially subjected to sensory evaluation of colour, smell, structure, impurity and botanical composition (DLG, 2006). After sensory evaluation, samples were dried and ground in 1 mm sieves diameter using Retsch Mill type SR3 Nr 31213 (GmbH, 5657 HAAN Germany).

Table 1
General data on studied dairy cow farms

Breed	Number of dairy farms	Total number of cows	Distribution of cows according lactation's year					
			I	II	III	IV	V	VI
Black Holstein	6	148						
Red Holstein	6	136						
Total	12	284	24	70	80	43	30	38
Mean body weight, kg			453	473	493	519	522	514

A mechanical animal scale was used to assess body weight changes of all animals. This was done before and at calving and three times during lactation (every 100 days).

Statistical analysis

The data was statistically analysed using JMP 7 (2007). One-way Analysis of Variance was used to find whether differences between means exist. Tukey-Kramer HSD post-hoc test was a tool to assess which means are used and to what extent do they differ, while alfa level of 0.05 was the borderline of significance. Backward regression analysis (Excel 2010 analysis tool pack) was used to test interdependence of variables and the extent to which variations of milk yield (dependent variable) may be explained by DM, CP and NEL intake (independent variables).

The regression model used was as follows:

$$Y = \alpha + b_1X_1 + b_2X_2 + b_3X_3$$

where: Y is the value of milk produced in kg/day/cow (Dependent variable), α (Alpha) is the Constant or intercept; X_1, X_2, X_3 is the amount of DM (kg/day), NEL (MJ/day) and proteins (kg/day) consumed and b_1, b_2, and b_3 is the Slope (Beta coefficient) for X_1, X_2, and X_3, respectively.

Results and Discussions

Diet composition

The six farms involved in this study applied separate feeding (NON-TMR) while TMR feeding was applied in six other farms. The composition of the ration is given in Table 2.

As seen from Table 2, there are some differences in the use of feeds by the type of the ration. While in TMR rations all identified feeds were used, non-TMR rations were composed only of corn silage, hay (alfalfa and meadow) and concentrated compound mixture. The amount of feed differed too. More corn silage and hay (especially alfalfa) but less concentrate were used in non-TMR rations.

The majority (80%) of roughage feeds used in this study were produced by the farm (in-farm produced feeds), while almost all concentrates (ingredients or compound mixtures) were purchased from local suppliers.

The type, the amount and especially the quality of roughage used is a significant factor affecting the intake and utilisation of forage and for reducing the use of concentrates in ruminant feeds (Tafaj et al., 2005), which considerably influences milk production, the herd's health and feed costs (Linn and Kuehn, 1997). Being considered as two basic dairy feeds (Chase, 2009), maize silage and compound dairy mixtures were used in all farms.

It is well known that dairy cattle rations should be based on roughages, while concentrated feeds should be added as balance feed. The structure of ration dry matter (DM), especialy the ratio between roughage and concentrated (R/C) feeds is of high importance, not only for milk production but also for good rumen health and microbe performance. Physiologicaly optimal forage/concentrate ratio in dairy cattle diets should range between 60:40 to 40:60 (Mertens, 2009), which mostly depends on the amount of milk produced and the quality of feeds used. The results of the present study show that average total DM consumption was 17.49 kg/d (about 3.5% of body weight). As seen in Tables (1 and 2), on average, roughage took almost three quarters of the diets DM, with corn silage being the main feed. Roughages took 69-77% of total DM intake, where maize silage was the main contributor with 65.7% and 48.6% of roughage DM and total DM intake, respectively (Figure 1).

Table 2
The types and the amount of feeds used in farms during study period

	Corn silage	Grass silage	Meadow hay	Alfalfa Hay	Wheat straw	Compound concentrated feed
N=6			TMR			
Average	8.0	1.3	1.2	0.9	1.1	4.8
% of ration DM	46.24	7.51	6.94	5.20	6.36	27.75
Min	6.9	0.0	0.0	0.0	0.0	4.5
Max	9.7	2.6	2.6	3.0	1.7	5.4
SD	1.2	1.1	1.1	1.5	0.8	0.3
N=6			Separate feeding rations			
Average	9.2	0.0	1.4	2.8	0.0	4.3
% of ration DM	51.98	0.00	7.91	15.82	0.00	24.29
Min	7.7	0.0	0.0	0.0	0.0	4.0
Max	11.0	0.0	4.4	4.7	0.0	4.7
SD	1.2	0.0	2.1	2.2	0.0	0.3

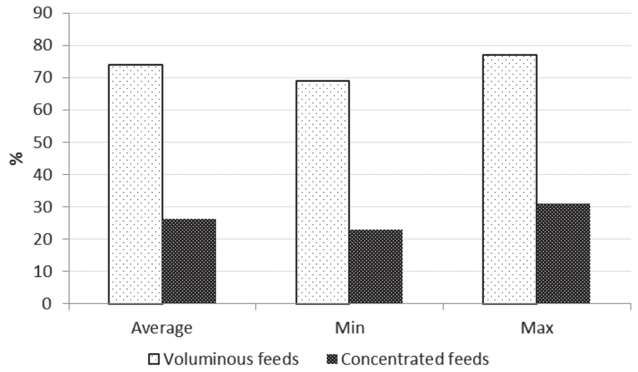

Fig. 1. Roughage to concentrate DM ratio, %

The use of concentrate in high-yielding dairy cow diets must be adjusted to take into consideration a sufficient amount of physically effective fibre (peNDF), to prevent ruminal disorders, especially subacute ruminal acidosis (Zebeli et al., 2006), since high concentrate level (usually >50%) and low fibre diets negatively influence the rumen stratification and microbial digestion (Tafaj et al., 2005). It is recommended that, depending on the amount and the quality of basic ration, and target high milk yield, the concentrate fed to dairy cattle should not exceed 2% of body weight of the animal and possibly range between 6.5-10.5 kg/d (Kavanagh, 2015). The amount and the protein source in concentrates are also very important issues to be considered (Yildiz et al., 2015).

Other studies on Holstein dairy cows reported that a relatively high milk production level of about 6000 kg/year/cow can be achieved by feeding rations of high quality roughages (maize silage, hay, haylage) supplemented with up to 20% concentrate (Lang, 1995; Tafaj, 1996; Steingass et al., 2002). Average concentrate level of 4.56 kg/d or 27% of ration DM, used in the low milk level produced in the farms studied of 4377 kg/cow/year, means that concentrate possibly compensates for a low quality of roughages or insufficient roughage DM intake in feeding practice. This tendency was also observed by other studies carried out on similar farm conditions (Emiri-Sallaku and Tafaj, 2002). Compared with the recommandation given by NRC (2001) despite lower milk production of 4377 kg/cow/year in the dairy farms studied, the amount of feed used also differed since more silage (+2.65 kg) and grass hay (+0.85), but less alfalfa hay (–1.8 kg), was used.

Diet sensory characteristics

Sensory characteristics of the feeds such is taste and smell (Huhtanen et al., 2002) are also parameters of influence in feed selection and decreased consumption of the diet in dairy cattle. The results of the sensory properties of feeds (Figure 2) used in this study show that more than 50% of roughage feeds are of moderate to good quality and belong to second and third quality class, according to DLG (2006). Sensory evaluation has also shown that 60% of the hay and 50% of silages used by the dairy farms studied were of very good quality according to DLG (2006), but there were still feeds of lower quality.

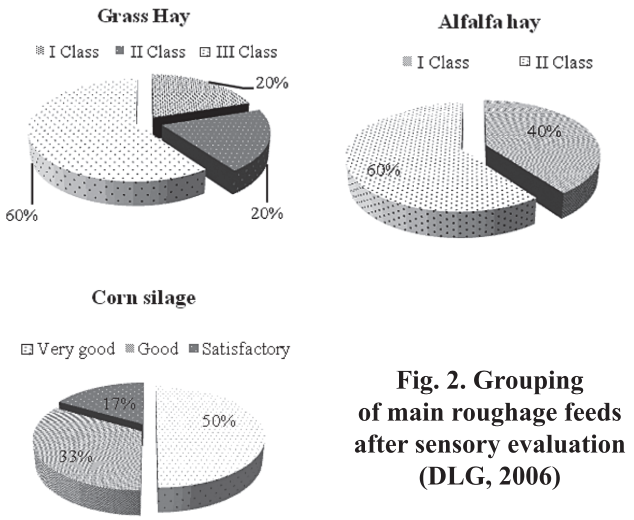

Fig. 2. Grouping of main roughage feeds after sensory evaluation (DLG, 2006)

Results of feed chemical composition, dry matter, NEL and protein intake

Dairy cows need to be fed according to their nutrient requirements to achieve their optimum performance. However, providing an adequate amount of nutrients in terms of energy, protein and other nutrients to dairy cows is a challenging task due to many complex factors (Rim et al., 2008).

In terms of chemical composition, there are differences between TMR and non-TMR diets. Results show that on average, the non-TMR diets used in this research were significantly higher ($P<0.05$) in cell wall content (30.6 vs 22.6% ADF and 51.97 vs 44.62% NDF) as well as in crude proteins (12.05 vs 10.10%), but lower in NEL (6.47 vs 6.93 MJ/kg) if compared with TMR ration (Figure 3). High fibre content in a diet may be used if it comes from high quality roughage, especially when concentrates cannot be easily supplied (Tafaj et al., 2005) and moderate milk yield is expected. However, Zebeli et al. (2006) have suggested that fibre adequacy for dairy cows based just in dietary NDF or forage NDF, is not as efficient as dietary physically effective fibre (peNDF) in TMR rations. A level of about 30 to 33% peNDF in TMR may be considered as the general optimal level of peNDF to minimize the risk of SARA without impairing production responses in high-yielding dairy cows (Zebeli et al., 2008).

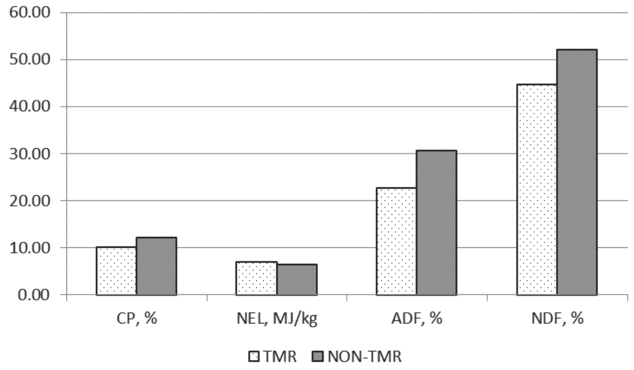

Fig. 3. Average chemical composition of rations by their type

In both types of rations, roughages were the main contributors of the dry matter representing more than 70% of it. Three-quarters of DM in non-TMR rations were composed of roughages, while in TMR diets their presence was 72.25%. Although dry matter consumption (Table 2) is about 3.5 % of body weight of cows (Table 1), which is within the range of 2-4% suggested by NRC (1989), offering DM, NEL, and CP in rations does not correspond with milk production.

The fluctuations in nutritive value of feeds used in dairy rations can be ascribed to many factors not fully studied here (the botanical composition, the maturity stage of harvesting, the post-harvest technology and storage conditions used during feed production) which generally affect their composition. The nutritive value of feeds (when used as information to formulate rations) is taken from literature sources, which in many cases are not produced in Kosovo. As seen from Table 5, there are no considerable differences in DM and NEL consumption during study period. This leads to an explanation that feeding was not fully adapted to the lactation stage of the dairy cow.

The results covering the effects of month show that there are similarities in the consumption of nutrients over the course year. The only possible explanation of this situation is that the formulation of rations is done by assuming the requirements of animals and nutritive value of feed ingredients. This is confirmed by the interviews with farmers who acknowledge that they don't use any modern tools, such as computer programs, to formulate rations. They have also admitted that do not consider requirements for specific groups of animals or lactation stages and do not analyse feeds for their composition.

They weigh the feeds given to animals approximately mainly by using packaging units as a measure (bales, sacks, buckets, etc.) and do not weigh feed refusals. They do not have a person to consult them regularly and rarely use the expertise of animal nutritionist or other providers of extension services, although they admit they have followed many training courses. It is also observed that farmers occasionally share experiences and use them without adapting to the real situation in their farm.

Body weight and milk production

According to Poncheki et al. (2015), the body weight of cows depends on factors like age, race (breed), physiological phase (stage) and feeding. The cows involved in this study were diverse in age and lactation number; therefore, body weight ranged between 453 and 561 (Table 1). The average dairy milk production recorded in this study is found to be very low based on the genetic potential of Holstein breed, well known for its high performance in milk, fat and protein. As reported by USA Holstein Association, during 2015, a mature Holstein cow weighs about 680 kg and produce 11320 kg of milk, 417 kg of fat and 322 kg of protein in a 305-day period of lactation which is far more than in our study where 4377 kg milk, 175 kg of fat and 140 kg of protein were produced (Table 3). This low yield can be related to feeding-related factors as well as animal-related factors (low body weight of cows and their advanced age, *i.e.* % of dairy cows at 4^{th}, 5^{th}, and 6^{th} lactation year).

Compared with NRC requirements results shows that higher daily DM (+3.49 kg/d), NEL (+10 MJ/d), and CP (+722 gr/d) intake. Nonetheless, average milk yield remained very low.

Table 3
Milk parameters and DM, CP, NEL, Ca and P contents in rations during the survey period in dairy farms

	Milk parameters			Ration DM and nutrients		
N=12	Milk, kg/d	Fat, %	Protein, %	DM, kg/day	NEL, MJ/day	Protein, g/day
Average	14.35	4.01	3.33	17.49	118.0	1791
Min	8.44	3.9	3.2	16.62	111.2	1629
Max	18.63	4.0	3.5	18.52	128.7	2063
SD	2.03	0.04	0.08	0.59	6.1	131
Requirements				14	108	1069

From Table 1**,** it can be seen that cows where much lighter in body weight, but anyhow milk production remains low (8 times body weight), which is far below the typical Holstein capacity (up to 15 times body weight).

Cows involved in this investigation were also diverse in terms of the number of lactations (61% in 1st, 2nd and 3rd; 26% in 4th and 5th; and 13% in 6th lactation year). This is a significant factor to be considered for its influence in average herds' milk production.

Yet there are also many non-feeding factors that need to be considered for their influence in milk production. Such factors involve genetic variation within the breed, health status, and reared environment (Linn, 1988). As stated by DeVries (2013), field studies suggest that housing and management play as large a role as nutrition does in the performance of dairy cow. This observation is reinforced by Bach et al. (2008) who found that the presence of more than 50% of variations in milk production was explained by non-dietary factors, such as the presence or absence of feed refusals free stall stocking density and whether feed was pushed up in the feed bunk or not.

The effect of farm and the month in milk production, DM, CP and NEL consumption

Farm effect

There are many aspects that affect milk production (Bach et al., 2008) of which feeding management and especially the nutrient supply is surely the most important and directly under man control on everyday basis. As seen from Table 4, there are highly significant differences ($p<0.01$) between farms in terms of DM, CP, NEL and CP to NEL ratio consumed as well as average milk yield.

The effect of time

The effect of time was characterised by monthly differences in feeding parameters. No significant differences were found in intakes of DM, and NEL in different months of the study period. Nonetheless, there is significant difference ($P < 0.05$) in protein consumption and mean milk production. However, there is a borderline effect ($P = 0.049$) of months of the investigation in terms of a protein to energy ratio.

Regression analysis

The backward regression analyses for all farms and for each farm are done. The results are summarised in Table 6 and Table 7, where the output of regression statistics and ANOVA is presented. Regression analysis reveals that although some interdependence of the amount of milk produced and feeding factors measured is observed, in general the variations in milk production cannot be fully explained from the amount or the ratio of nutrients consumed by animals. From the results of regression statistics (correlation coefficients) shown in Table 6, it may be seen that there is quite high variation in the strength of correlation between milk production and feeding variables. However, in 9 out of 12 farms, values of R^2 exceed 0.5 showing relatively strong correlation between measured parameters.

Table 4
Effect of farm on nutrient supply (DM[1], CP[2], NEL[3]) and milk production (Mean±SEM[4])

FARM	DM, kg/day	CP, g/day	NEL, MJ/day	CP/NEL, g/MJ	Milk, kg/day
F-1	17.01±0.15^{cd}	2060.9±32.65^{a}	122.56±1.50^{abc}	16.83±0.28 ^{ab}	16.55±0.23^{a}
F-2	16.68±0.26^{d}	1711.9±82.60^{b}	111.41±1.72^{d}	15.44±0.85 ^{abc}	14.61±0.25^{ab}
F-3	18.37±0.27^{ab}	1692.6±92.05^{b}	127.87±1.85^{a}	13.23±0.69 ^{d}	13.74±0.16^{b}
F-4	17.44±0.29^{abcd}	1661.8±103.94^{b}	121.54±2.87^{abc}	13.61±0.71 ^{cd}	14.69±0.3^{ab}
F-5	17.91±0.25^{abc}	1755.8±69.71^{ab}	125.30±1.97^{ab}	14.01±0.52 ^{bcd}	13.19±0.25^{b}
F-6	17.91±0.32^{abc}	1828.5±89.91^{ab}	117.12±2.58^{bcd}	15.71±0.87 ^{abcd}	15.16±0.85^{ab}
F-7	18.52±0.28^{a}	1986.9±42.64^{ab}	122.27±2.46^{abc}	16.34±0.53 abc	15.49±0.33^{ab}
F-8	17.69±0.18^{abcd}	1778.2±74.78^{ab}	114.71±1.53^{cd}	15.47±0.56 ^{abcd}	14.3±0.91^{ab}
F-9	16.84±0.24^{cd}	1891.4±67.29^{ab}	111.18±1.92^{d}	17.07±0.69 a	14.14±0.71^{ab}
F-10	17.22±0.19^{cd}	1747.1±45.86^{ab}	115.09±1.19^{cd}	15.18±0.36 ^{abcd}	13.98±0.65^{b}
F-11	17.23±0.12^{cd}	1804.3±53.74^{ab}	111.74±1.70^{d}	16.17±0.49 ^{abcd}	13.29± 1.73
F-12	17.33±0.16b^{cd}	1735.9±58.16^{ab}	113.46±1.43^{cd}	15.28±0.43 ^{abcd}	13.10±1.93
P value	<.0001	0.002	<.0001	<.0001	0.0002

[1] DM = dry matter, [2] CP = crude protein, [3] NEL = Net Energy for Lactation, [4] SEM = Standard Error Mean,
Means with different letters in superscript differ significantly ($P < 0.05$)

Although R squared coefficients varied substantially, they are quite high for the majority of farms, which may lead to the conclusion that the variation of milk production may be ascribed to feeding parameters included in a model. However, since more than one independent variable is used in a model, the adjusted R square can be a better parameter to be used to estimate the rate to which feeding factors are involved in the variations in milk production. The results of this study show that this is only true in six farms (1, 5, 6, 9, 10, and 12). This finding is also supported by the results of the ANOVA test (Table 7).

The results of this study are not consistent in terms of explaining milk production with feeding parameters. Generally, there is correlation between DM consumption and milk production. As seen in Table 7, there are only two farms (9 and 12) where variations in milk production can convincingly be explained by dry matter consumption. In the majority of farms, there is a tendency that, with the increase of DM intake, an increase in milk can also be expected. However, there are six farms (especially farms 5 and 10) where milk production decreased when the quantity of DM consumed increase. As regards proteins, 67% of farms cows tend to produce less milk with an increase in CP intake, while in just two farms increased milk production was observed with the increase of protein consumption. The absence of milk dependency in two farms indicates that production can be seen as related to protein consumption.

Table 5
Time differences on nutrient supply (DM[1], CP[2], NEL[3]) and milk production (Mean±SEM[4]) during the survey period

Month	DM, kg/d	CP, g/d	NEL, MJ/d	CP/NEL, g/MJ	Milk, kg/d (305d mean)
M-1	17.67±1.29	1845.45±64.20	113.68±2.54	16.28±0.57	12.08±0.65^{c}
M-2	17.05±0.92	1935.44±59.11	117.20±2.81	16.56±0.50	13.61±0.63b^{c}
M-3	17.45±1.16	1966.79±97.14	119.46±3.18	16.68±1.08	12.05±0.55^{c}
M-4	17.44±0.76	1917.97±86.92	119.17±2.11	16.14±0.74	14.03±0.45^{abc}
M-5	17.33±0.86	1820.01±60.18	116.84±2.55	15.63±0.56	14.00±0.36^{abc}
M-6	17.96±0.88	1903.88±71.65	123.12±1.17	15.52±0.68	14.47±0.38^{ab}
M-7	17.55±0.80	1780.59±58.62	120.56±2.08	14.78±0.44	14.36±0.38^{ab}
M-8	17.32±0.91	1714.94±75.50	118.06±1.80	14.52±0.58	14.48±0.45^{ab}
M-9	17.44±0.86	1647.84±88.96	116.44±2.34	14.12±0.63	15.61±0.43^{ab}
M-10	17.47±0.96	1651.39±80.46	115.22±3.07	14.38±0.74	15.45±0.47^{ab}
M-11	17.93±1.12	1750.33±51.99	118.59±2.77	14.83±0.54	16.12±0.45^{a}
M-12	17.53±0.97	1720.78±55.66	115.91±2.49	14.90±0.51	15.97±0.38^{a}
P value	0.6297	0.0114	0.394	0.049	<.0001

[1] DM = dry matter, [2] CP = crude protein,[3] NEL = Net Energy for Lactation, [4] SEM = Standard Error Mean, Means with different letters in superscript differ significantly ($P < 0.05$)

Table 6
Regression statistics

	Multiple R	R^2	Adjusted R Square	Standard Error	Observations (n)
FARM 1	0.890	0.791	0.713	0.423	12
FARM 2	0.354	0.126	-0.202	0.953	12
FARM 3	0.605	0.366	0.128	0.528	12
FARM 4	0.318	0.101	-0.236	1.167	12
FARM 5	0.787	0.619	0.476	0.628	12
FARM 6	0.853	0.728	0.626	1.807	12
FARM 7	0.658	0.433	0.221	1.010	12
FARM 8	0.436	0.190	-0.113	3.342	12
FARM 9	0.895	0.800	0.725	1.288	12
FARM 10	0.906	0.821	0.754	1.120	12
FARM 11	0.625	0.391	0.163	1.586	12
FARM 12	0.875	0.766	0.678	1.097	12

Table 7
Results of ANOVA (P values[1]) on the effects of feeding variables in milk production

	ALL	DM, kg/d	CP, g/d	NEL, MJ/d	CP/NEL
FARM 1	0.0043	0.5360	0.0016	0.2409	0.1100
FARM 2	0.7683	0.9389	0.3980	0.9917	0.2947
FARM 3	0.2776	0.7004	0.6375	0.2117	0.4316
FARM 4	0.8248	0.3950	0.5185	0.4401	0.7695
FARM 5	0.0432	0.0715	0.9062	0.4600	0.7975
FARM 6	0.0119	0.5629	0.0082	0.9941	0.0008
FARM 7	0.1868	0.7679	0.6888	0.1723	0.2004
FARM 8	0.6179	0.4065	0.8448	0.2896	0.6768
FARM 9	0.0036	0.0084	0.1157	0.1715	0.0373
FARM 10	0.0023	0.1092	0.2535	0.0174	0.4152
FARM 11	0.2414	0.3410	0.1055	0.1108	0.0794
FARM 12	0.0066	0.0055	0.9674	0.1020	0.0528

[1]Alfa level of 0.05 was the borderline for significance

After individually analysing performance in each farm, the results show that, to some extent, milk production is also dependent on energy intake. Similar to the DM intakes, in 50% of farms milk production tends to be lower with the increase of NEL. In other farms, there is either a slight increase (25% of farms) or no effect (the other 25% of farms) of NEL intake in milk production. With the exception of farms 6, 9 and 12, the results show no dependence of milk production from the CP/NEL ratio supplied through the diet.

From the statements of Bach et al., (2008) and the inconsistency of the dependence of milk production from measured feeding factors herein, it may be suggested that there are other non-dietary factors such as housing and management (not studied here) that explain the important part of yield and variation in milk production.

Implications

Special attention to feeding should be considered to have a profitable milk production. Dairy cattle pass through several physiological production stages which differ in requirements for nutrients. Proper feeding cannot be done without knowing the exact content of nutrients in feedstuffs used to formulate ration and adjustment of requirements to real needs of animal. According to St-Pierre, (2001), consumption of DM by dairy cattle between 16-19 kg/d may result in lower milk yield and should only be used in last weeks of lactation. The estimated organoleptic results of DM from roughage included in studied rations of dairy cattle show low quality. Even when cows consumed 17.49 kg DM per day it seems that, due to poor digestibility, the nutrient supply was not satisfactory to support higher milk production.

ADF and NDF concentration in researched rations were higher than requirements reported by NRC, (2001) for dairy cattle rations, while proteins and minerals were lower, which has influenced diet digestibility and milk production. According to Mertens (1997) high fibre concentration in dairy cattle rations may limit intake of DM by 50–60% which may have a direct influence in milk production. Fibre content of the ration (NDF and forage NDF) as well as non-fibre carbohydrates to NDF ratio are also factors to be considered (Tafaj et al., 2007) since they affect animal performance. The intake of nutrients based on maintenance and production requirement (NRC, 2001) was higher than response with milk production which suggests the limited digestibility of nutrients.

As reviewed by Connor (2015), gross feed efficiency (GFE) is the simplest tool to measure feed efficiency in lactating dairy cows and is expressed as the ratio of milk output to feed input (or vice versa). In this study, it is hard to explain that despite the surplus of DM, energy and protein intake, low milk yield and the weak body weight response of animals was observed. It may be assumed that this is due to low roughage quality and high NDF and ADF content in forages. This is also due to differences in the lactation status of animals within and between farms.

Conclusion

Regression analysis of the results of this investigation show that in half of the farms studied, milk production can be ascribed to feeding factors (R2 higher than 0.5). However, when looking at individual factors (DM, CP and NEL or their ratios), there is inconsistency in the dependency of milk production with these factors. The increase of milk production was observed in 42%, 25% and 16.7% of farms as the effect of DM, CP or NEL intake.

From the results of this study, it may be suggested that the average Kosovo dairy farmer is feeding their animals by assuming their nutrient requirements and nutritive value of feeds. Another finding is that diets were very similar amongst farms and animals within a farm during the entire study period. Although TMR was used, due to small number of cows per farm, no grouping was performed meaning that the supply with nutrients was not in accordance with requirements. Therefore, there is plenty of room to treat this issue more seriously to balance nutrients in a diet properly and convert them more efficiently into milk.

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Received September, 7, 2017; accepted for printing May, 18, 2018