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UNIVERSITY OF AGRICULTURAL SCIENCES AND VETERINARY MEDICINE - IAŞI
FACULTY OF ANIMAL HUSBANDRY
SPECIALISATION: ANIMAL FEEDING

Doctoral Thesis Abstract:

RESEARCH ON OPTIMISING DAIRY COWS FEEDING ON PRIVATE FARMS LOCATED NEAR PAŞCANI, IAŞI COUNTY

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Cattle are of great economic importance, accounting for one of the largest and most diverse source of products and productions in the world. Thus, worldwide, cattle provide over 95% of milk production, about 30% of meat production and more than 96% of the production of hides used as raw material in the processing industry. To these, one must also add other products that are used in the light industry, or make up the recipes of various fodder concentrates.

The problem of dairy cattle management in private family holdings is a matter of national and international importance, since the achievement of increased milk and raw meat yield at the lowest cost per unit creates the possibility of increasing the standard of living.

The necessity of this thesis derives form the situation at national level in what breeding and managing dairy cows are concerned. In Romania, over 90% of the dairy herd is found in small private farms (1-2 cows), poorly technically equipped, applying unsatisfactory nutritional programmes that do not take into account the nutritional requirements of cows under different physiological stages, unbalanced diets in terms of energy-protein and vitamin-mineral content. The annual average milk production obtained in these conditions is about 3300 kg / cow being 50-60% lower than that obtained in the European Union.

The yields obtained have high seasonal profile and are destined almost exclusively to family consumption, only a small fraction reaching the market, or the centres for the reception and processing of milk in the area. These low yields are largely due to the improper management of dairy cows, inadequate professional knowledge of most farmers of the appropriate technologies (shelter, feeding and care).

The research carried out in three localities within Iasi County, nearby Pascani, namely Lespezi, Verşeni and Moţca respectively, aims to emphasize the fact that quantitative and

qualitative performance can not be obtained when feeding dairy cows with unbalanced ratios in terms of energy-protein content. Thus, traditional ratios consist of large amounts of fodder of low nutritional value that results in a waste of feed, whereas costs can not be fully covered by the production of milk. Therefore, nutritional diets are unsatisfactory in terms of the ratio between the productive and economic efficiency. We also intend to show small farmers, the role played by rational feeding in quantitative and qualitative milk production and hence the cost of milk production, knowing that feeding is the factor that directly influences milk production and the economic efficiency.

In order to achieve this goal, the first phase of research identified and analysed the nutritional resources each farm disposed of, determined the gross chemical composition of the forage used to feed the dairy cattle, and it also determined the calculation of the nutritive value of each fodder the part of food diet. Therefore, the samples that were taken from each fodder existent on the nine farms, were afterwards studied twice every year with a view to determining the gross chemical composition according to the Weende scheme, performed in the laboratories of "Nutrition and food animal" from the Faculties of Animal Husbandry and Agriculture.

The second phase hosted the characterization of the nutritional process applied to the studied dairy cattle throughout the span of an entire year, divided into two seasons, the summer and the winter. After having analysed the diets used on every farm, new ratios have been calculated in strict correlation with the body weight, physiological condition and potential milk production of each animal.

Thus, at first the research strategy focussed on the assessment of the various forage resources used to feed the dairy cows from the farms we have analysed, and the following conclusions could be drawn:

- at the beginning of the research, the fodder base consisted of the following categories of forage:

* green forage - pasture (all farms), alfalfa (farms M_1, M_3, V_1, V_2, V_3), maize (farms L_1, L_2, V_3)

* fibre forage - natural hay (farms L_2, L_3, V_2 and V_3), alfalfa hay (all farms except farm L_2), clover hay (farms L_1 and V_3)

* succulent fodder - fodder beet (all farms except L_3 and V_2)

* roughages fodder - corn cobs (all farms), wheat straw (farm L_1), oat straw (farms M_3 and V_1)

* concentrate fodder - grain maize, wheat bran, sunflower meal.

- The structure of the forage base of the studied private farms lacks in, or is severely deprived of fodder beet, cultivated only on small areas, though it is known the fact that fodder

beet is one of the fodders specific for dairy cows during the winter period. Fodder beet is grown on seven of the nine studied farms, on areas ranging between 0.04 and 0.15 ha, a fact reflecting itself on the impossibility to provide for the basic requirements of juicy fodder throughout the cold season.

Optimizing the structure of the fodder base meant to increase the areas cultivated with fodder beet on all the studied farms (0.13 to 0.6 ha), setting up four clover fields, used as green mass or hay, on the L_1, M_1, M_3 and V_1 farms, and it also meant to apply the appropriate crop technologies with a view to increasing the yields obtained per hectare.

In order to optimize the feed ratios we have first determined the chemical composition and the nutritional value of all the fodders used to feed the dairy cows from the nine farms studied throughout the year. Analysing the gross chemical composition of the feed samples from the private holdings taken into study, we can conclude that:

The grassland areas from Lespezi, Verşeni, Moţca have the characteristic values of an average quality meadow.

The values of the harvested green mass alfalfa samples from the eight private holdings were within the values presented in the scientific literature with some exceptions; namely, the protein content of the samples analyzed in the year 2007 - C_3 on the V_1 and V_3 holdings, registered values below 12% and 17%, respectively, compared to the data presented by the INRA for the growing phase "in full bloom" - C_3.

The values obtained for the clover green mass samples did not differ from those presented by the INRA, with the exception of the M_3 private holding, where the values of crude protein content ("start button" – C_1, the year 2006) are higher by almost 20% to those submitted by the INRA (1988); the values we have analytically determined ranged from 2.71% CP at a 11.58% DM concentration of dry matter to 2.50% CP to a 12.80% DM content.

The green mass maize samples taken form all farms contain less crude protein than the values recorded by the scientific literature, whereas the crude fibre values are higher. For example, the M_1 private holding (throughout the year 2006), during the "first flowering" phase, registered a protein content 10% lower than the value presented by Burlacu (2002) namely, a 1.52% CP to a 14.18% DM content, in relationship to 1.79% CP to a 15.00% DM content.

Like all the other analysed fodders, fodder beet too had crude protein content lower than the values presented by the scientific literature. Thus, in the case of the L_1 farm (2004), the protein content was lower by 17% compared to the value presented by Burlacu (2002) and 25% of that presented by the INRA (1988).

Some samples of hay harvested from the studied farms, presented some protein content values that were 11% lower and those of cellulose content were about 12% higher than those

presented by the studied literature. These values may be due to the way of drying, handling and transportation of hay and also to the fact that a large amount of leaves is lost, taking into account the fact that straws account for a large mass of the hay.

Analysing straw and corn cobs samples form the studied farms, as well as all the other fodders our study is focused on, we have obtained a considerable lower content of protein than that presented by the studied literature. The biggest difference is the one recorded by corn cob samples taken from the M_1 farm in April 2006, where the value of the protein content was approximately 23% lower, while the cellulose content was 24% higher than the values presented by the INRA (1988).

The values obtained from the maize grains samples harvested from the nine studied farms were within the limits set by the studied literature. Exceptions are the samples taken from the L3 private holding in November 2004, when the protein content was 14% lower than that presented by the INRA. The M_1 farm, in March 2007, recorded a protein content that was 11% higher than that presented by the INRA (1988).

The results of the chemical determinations on wheat bran samples show that they fall within the limits set by the studied literature. The protein content ranged between 14.12 and 15.38% and the pulp ranged between 9.74 to 11.79%.

The chemical analyses of the sunflower meal samples presented values that fall within the limits provided by the INRA. Thus, the crude protein ranged between 32.51 to 34.58% and crude fibre of varied between 20.14 to 21.57%.

The nutritive value of forage analysed from the nine farms was influenced by the chemical composition of the taken samples. Thus, we noticed that the protein levels of the analyzed forage samples were generally lower than those presented by the studied literature for the appropriate vegetation phases. In V_1 farm, the average protein value obtained from the alfalfa green mass sample (2006 – C_1 "early buds") was 142 g PDIN and 98 g PDIN/ kg DM, higher values than those from the scientific literature, namely, 129 g PDIN and 95 g PDIE/ kg DM.

In the case of the M_3 and V_2 farms, the energy value of alfalfa green mass is lower than that presented by the INRA; in 2006, during the 30 cm vegetation phase, the recorded values were 0.92 UFL and 0.86 UFC compared with 0.96 UFL and 0.92 UFC / kg DM (INRA).

The nutritive value of clover green mass of the V_3 farm in 2007 (C_3-flowering) was 0.87 and 0.80 UFL that UFC 114 g PDIN and 98 g PDIE/ kg DM, lower values than those presented by the INRA (0.88 UFL, 0.83 UFC, 140 g PDIN and 101 g PDIE / kg DM).

The green corn mass samples collected from the studied farms showed that the energy values are lower than the ones recorded by the scientific literature we have studied. For example,

the V_1 farm, in 2006 (milk grain stage), recorded energy values that ranged between 0.86 and 0.80 UFL/ kg DM and 0.83 to 0.90 UFC / kg DM (INRA).

The energy value of the fodder beet varied between the nine studied farms, namely from 1.09 -1.14 UFL and 1.10 to 1.15 UFC/ kg DM, and the protein ranged from 43 to 62 g PDIN, and 94-101 g PDIE / kg DM, respectively.

The natural hay from the L_2 farm the (2004 – C_2 the earing phase) recorded the following series of nutritional values, 0.71 UFL, 0.62 UFC, 70 g PDIN and 76 g PDIE / kg DM, lower values in comparison with those presented the INRA (0.79 UFL, 0.71 UFC, 83 g PDIN and 86 g PDIE / kg DM).

In all nine studied farms, the grain maize recorded energy values that ranged from 1.22 to 1.28 UFL, respectively, from 1.23 to 1.30 UFC/ kg DM, whereas the protein value was within the limits of 68-86 g PDIN and 114 - 136 g PDIE/ kg DM, respectively.

The energy content of wheat bran samples ranged between 0.82 to 0.91 UFL and from 0.75 to 0.85 UFC / kg DM, respectively, while the protein value depicted values ranging between 109-114 g PDIN and 90 - 98 g PDIE/ kg DM.

As far as sunflower meal samples are concerned, the energy content varied between the limits 0.72 to 0.82 UFL and 0.62 to 0.74 UFC/ kg DM and the protein recorded values that ranged between 233-249 g PDIN and 118-129 g PDIE/ kg DM, respectively.

As a direct result of an entire set of analyses and tests that we have rigorously performed, our recommendation is that farmers should pay more attention to optimal time of harvest of crop plants and hay meadows, linking the phenophase of the flora of the vegetal canopy to the raw chemical content and nutritional value. Thus, the best time to harvest meadows is the earing phase when the crude protein content is high and the cellulose content is low.

Likewise, the studied grasslands could be improved with a view to increasing their pastoral value through maintenance and overseeding, in order to reduce the weight of those forage species with zero value and to promote some valuable species.

In order to reduce the losses of organic matter and to obtain high-quality hay, more attention should be given to the preservation and storage technology, the optimal timing of harvesting, the drying of hay in furrows or hayricks up to a humidity of 14-15%, and it is also important to know that transportation should be avoided during the hottest moments of the day.

After having determining the chemical composition and the nutritive value of the fodder used to feed the dairy cows on the nine private farms that we have studied, we have initiated the second stage, namely the feed optimization stage by making food ratios meet their nutritional requirements.

In estimating the nutritional standards for the dairy cows from the nine studied farms, we have used the food standards proposed by the INRA (1988), also taking into account the weight of cows, milk production and their physiological state.

The process of feeding of the dairy cows from the studied private farms has a seasonal and fluctuating profile throughout the summer or winter season, due to insufficient feed resources; therefore, we recommend a constant diet throughout the year in order to avoid nutrition deficiencies.

The studies performed on organising the feeding process during the span of time of November 2004- October 2005 highlighted a disruption of access to fodder resources throughout the year. In the summer season, we have noticed that the majority of the surveyed farms administered two types of ratios, the only given juicy fodder being the pasture. Subsequently, the pasture was supplemented with other green fodder (alfalfa or corn). In the case of the L_3 private farm, the grassland is supplemented throughout the whole summer only with a mixture of feed concentrate (grain maize and wheat bran). It was also noticed that when they introduced other green feed ratio (second version), some farms ceased to use hay or cobs.

Throughout the winter season, most farmers would use a large share of coarse and fibrous fodders, namely 76% of the DM of the diets, while juicy fodder accounted for only 7% of the DM, the rest being provided by the fodder concentrate (17%), respectively. Feeding dairy cows in the studied farms failed to adjust itself to the body weight, ingestion capacity, milk production, physiological state of the dairy cows.

The analysis of dairy cows feed ratios used in all nine studied farms accounts for the following conclusions:

- the nine farms that we have studied use unbalanced winter ratios in terms of the energy-protein level; thus, the protein level exceeds by approximately 111g PDIN, and 113 PDIE the recommended values.

- of all the nine private farms, it is only the M_3 private holding the one that managed to adequately cover the food ratio requirements; thus, the provided energy met the standard requirements, and excess protein was in excess by only 78 g PDIN and 69 g PDIE.

Throughout the following period, we have calculated new, optimised ratios, with a view to improving the capitalisation of the fodders available during the whole year, besides other fodders available only seasonably. Meanwhile, we have sought to fully cover the requirements estimated for each cow individually. Thus, during the summer we recommend a single ratio in order to ensure the nutrition consistency. The weight of the pasture of the feed ratio was reduced to 35% in the case of the summer diets, supplementing the difference with 30 % fodder plants.

All ratios included hay, with a view to providing for the necessary cellulose content, vital for the proper functioning of the ruminant microorganisms in the rumen.

Throughout the winter season winter, we have recommended the increase of the proportion of fodder beet within the ratio op to an average content of about 27%, concomitant to a decreased proportion of coarse fodder, namely by 18%. Concentrate feed mixture was calculated according to the nutrient requirements that any basic ratio fails to cover.

After having applied the optimized ratios, we have to followed their effect upon the milk production as well as upon costs and revenue growth in dairy cows private farms, respectively. Thus, the milk production in the nine studied farms increased on average by 27% between 1 November 2006 - October 30, 2007, averaging 4169 kg milk/ cow/ year. A larger increase of milk production was witnessed by the dairy cows during their first lactation period (PI), offering an average 1030 kg milk / cow / year.

The quality of the milk fat and protein indices has also improved. Fat percentage has improved by 4.5% from P III to the PI when the farmers used traditional ratios; during the PI the average value of EE was 3.54%, whereas during P III it was of about 3.70%.

The protein percentage has improved since the administration of the optimised feed ratios, increasing by 3.9%, since during the PIII period the CP content was 3.16% in comparison with 3.04 CP during the PI period.

The considerably higher milk production in terms of quantity and quality was reflected in the economic efficiency of the studied private farms. The revenues obtained throughout the PI stage have averaged approximately 5,770 RON/ holding, further increasing to 8812 RON/ holding during the PIII period, which means an increase of 52%. Gross margin/ farm has grown on average to 5,200 RON P III, being 1,800 RON higher compared to the PI when traditional ratios were used.

Profit/ kg milk reached an average value of 0.47 RON in the period P III, which is 0.10 RON more than PI, the average increase being of 27%. The lowest results were obtained by the L3, M_2 and V_2 private farms, which have only a single dairy cow, case in which the increase was only of 17% throughout the whole period of study.

Therefore, we can strongly affirm that our study has focused on farms whose size is so small that they can not obtain any economic performance expressed in terms gross margin and profit comparable to the European Union, since the results are extremely poor in terms of assessing the economic size of farms within the Community area (ESU).