



UNIVERZITET U
Kragujevcu
AGRONOMSKI FAKULTET U
Čačku



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XXV SAVETOVANJE O BIOTEHNOLOGIJI

sa međunarodnim učešćem

- ZBORNIK RADOVA 1 -



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- Zbornik radova 1 -

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Osnovni cilj Savetovanja je upoznavanje šire naučne i stručne javnosti sa rezultatima najnovijih naučnih istraživanja, domaćih i inostranih naučnika iz oblasti osnovne poljoprivredne proizvodnje i prerade, kao i zaštite životne sredine. Na taj način Fakultet nastoji da omogući direktan prenos naučnih rezultata široj proizvodnoj praksi, pa pored naučnih radnika, agronoma, tehnologa, na ovogodišnjem Savetovanju biće i značajan broj poljoprivrednih proizvođača, stručnih savetodavaca, nastavnika, itd.

U Zborniku radova jubilarnog XXV Savetovanja o biotehnologiji sa međunarodnim učešćem, predstavljeno je ukupno 86 radova iz oblasti Ratarstva, povrtarstva i krmnog bilja, Voćarstva i vinogradarstva, Zootehnike, Zaštite bilja, proizvoda i životne sredine i Prehrambene tehnologije.

Pokrovitelj jubilarnog XXV Savetovanja o biotehnologiji sa međunarodnim učešćem je Ministarstvo prosvete, nauke i tehnološkog razvoja Republike Srbije, a materijalnu i organizacionu podršku su nam pružili grad Čačak, privrednici, dugogodišnji prijatelji Agronomskog fakulteta, kojima se i ovim putem zahvaljujemo.

U Čačku, marta 2020. godine

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MILK PROTEIN AND FAT RATIO AS AN INDICATOR FOR METHABOLITIC DISORDERS IN DAIRY COWS

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Abstract: Fat and protein content of milk are positively correlated within a population of dairy cattle. There are a lot of factors influencing on milk composition. The analyses of milk samples in 6 dairy farms of Holstein cows in the R. of N. Macedonia in 2019 shows average value from 1,18 till 1,31, with the variation of milk fats and protein ratio between 0,58 and 3,31. This ratio between milk fat and protein content telling us about the health status and occurring of some methabolitic disorders in dairy cows connected with rearing technology of cows, especially about there nutrition and selection.

Key words: dairy cows, milk fats, milk proteins.

Introduction

Milk production is one of the most important and most complex productions in animal production. It is a multidisciplinary connection from soil and forage production, through nutrition, selection, reproduction, zoohygiene, pathology, environmental protection, dairy processing and other industries connected with cattle husbandry.

In the world, cows milk takes over 90% of total milk production, but in the R. of Macedonia, it takes 88% (ASRM, 2019). The quality of milk according to the current legislation in many European countries, are determined by the parameters: milk fat content (in % and kg), milk protein content (in % and kg), milk yield (in kg), dry fat content in milk (in %), as well as the number of microorganisms and somatic cells per 1 ml of milk. Proper use of data from milk parameters, indicate some disorders and are indicators of some methabolitic diseases in cows. The ratio of protein and milk fat content in cows milk, indicates which cows have dietary mistakes according to the chemical composition of milk, which may help detect some metabolic disorders in cows (Duffield, 2004).

High productive cows have a negative energy balance after partus, because the amount of energy needed to maintain the basic methabolism and milk production exceeds the energy consumed by cows. The degree of negative energy balance in

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the early post-partum period is critical to health and productivity. Establishing an energy balance using certain indicators of the relationship of fat and protein content in milk is of great practical importance in monitoring nutritional status after parturition of high-fat cows.

The recommended values for the ratio of milk fat to milk protein are given in Table 1.

Table 1. Recommended values about the ratio of milk fat and milk protein in milk (Hawkey, 2016)

Milk fats %	Milk protein %	Ratio of fat and protein	Possible interpretation
4.20%	3.30%	1.27	Typical balance
4.40%	3.20%	1.37	Fibre-based fermentation Possible ketosis
3.80%	3.20%	1.18	Starch-based fermentation Possible acidosis

Material and methods of work

The material of investigation were 960 Holstein-Frisian cows from 6 (six) larger farms in the Republic of N. Macedonia, members of the National Breeding Organization - the Macedonian Holstein Association (MHA).

Our surveys have taken data from the book recording base for 960 cows in 2019 which were under the control of their production, reproductive, exterior, linear and degenerative traits. The controlled production traits were: milk production (in kg), milk fat and milk protein content (in %), and milk fat and protein yield (in kg). The whole lactations of cows are standardised on lactation of 305 days, on 3. lactation level and on 4% of milk fats. All the obtained parameters were statistically processed, with calculation of: the average value, standard deviation, coefficient of variation, as well as minimum and maximum values.

At the request of the farms, due to the anonymity of the analyzed parameters, the farms are numbered not by farm name but as Farm 1, 2, 3, 4, 5 and 6.

Results and discussion

Based on the studies of the ratio of milk fat and protein content in milk to the controlled farms, the results obtained on a farm-by-farm basis are presented in tables.

Table 2. Parameters for milk fat and protein content in cow's milk on Farm 1

Parameter	No of samples	X	SD	CV	MIN	MAX
Milk fat (%) MF	190	3,89	0,76	19,53	1,82	7,62
Milk protein (%) MP	190	3,05	0,31	10,16	2,30	3,93
Ratio: MF : MP	190	1,27	2,45	1,92	0,58	3,31

Table 3. Ratio values between fat and protein contents in milk of Farm 1

Ratio between milk fat and milk protein	No. of samples	Percentage (%)
>1,5	28	1,47
1,1-1,5	127	73,48
<1,1	35	24,42
Total	190	100

From the tab. 2 and 3 can be concluded that 24% of cows on farm 1 have a threat of acidosis (acid indigestion), and only 1.5% of cows have a risk of developing indigestion, and in the remaining 73% of cows the ratio of this indicator is within the average values for the percentage of fat and protein in milk.

Table 4. Parameters for values of milk fat and protein content on Farm 2

Parameter	No of samples	X	SD	CV	MIN	MAX
Milk fat (%) MF	700	3,93	0,31	7,88	2,86	5,07
Milk protein (%) MP	700	3,37	0,19	5,63	2,85	3,87
Ratio: MF : MP	700	1,16	1,63	1,40	0,80	1,76

Table 5. Ratio values between fat and protein contents in milk of Farm 2

Ratio between milk fat and milk protein	No. of samples	Percentage (%)
>1,5	2	0,28
1,1-1,5	512	73,15
<1,1	186	26,57
Total	700	100

From the tab. 4 and 5 can be concluded that 26.5% of cows on farm 2 are at risk of acidosis (acid indigestion), and only 0.3% of cows have a risk of developing indigestion, and the remaining 73% of cows the ratio of this indicator is within the average values for the ratio of fat and protein in milk.

Table 6. Parameters for milk fat and protein content on Farm 3

Parameter	No of samples	X	SD	CV	MIN	MAX
Milk fat (%) MF	12	3,99	0,26	6,51	3,61	4,56
Milk protein (%) MP	12	3,22	0,16	4,97	2,94	3,44
Ratio: MF : MP	12	1,25	1,63	1,31	1,16	1,37

Table 7. Ratio values between fat and protein contents in milk of Farm 3

Ratio between milk fat and milk protein	No. of samples	Percentage (%)
>1,5	0	0
1,1-1,5	12	100
<1,1	0	0
Total	12	100

From the tab. 6 and 7 can be concluded that from 100% of the number of cows on farm 3 are within the average values for the ratio of % of fat and protein in milk.

Table 8. Parameters for milk fat and protein content on Farm 4

Parameter	No of samples	X	SD	CV	MIN	MAX
Milk fat (%) MF	14	4,05	0,10	2,46	3,85	4,17
Milk protein (%) MP	14	3,49	0,22	6,30	3,18	3,84
Ratio: MF : MP	14	1,31	0,45	0,39	1,01	1,31

Table 9. Ratio values between fat and protein contents in milk of Farm 4

Ratio between milk fat and milk protein	No. of samples	Percentage (%)
>1,5	0	0
1,1-1,5	11	78,57
<1,1	3	21,43
Total	14	100

From the tab. 8 and 9 can be concluded that 21% of cows on farm 4 have a threat of acidosis (acid indigestion), and in the remaining 79% of cows the ratio of this indicator is within the average values for the ratio of % to fat and protein in milk.

Table 10. Parameters for values of milk fat and protein content on Farm 5

Parameter	No of samples	X	SD	CV	MIN	MAX
Milk fat (%) MF	19	4,03	0,18	4,47	3,69	4,27
Milk protein (%) MP	19	3,41	0,10	2,93	3,2	3,56
Ratio: MF : MP	19	1,18	1,80	1,52	1,07	1,26

Table 11. Ratio values between fat and protein contents in milk of Farm 5

Ratio between milk fat and milk protein	No. of samples	Percentage (%)
>1,5	0	0
1,1-1,5	16	84,21
<1,1	3	15,79
Total	19	100

From the tab. 10 and 11 can be concluded that 16% of cows on farm 5 have a threat of acidosis (acid indigestion), while in the remaining 84% of cows the ratio of this indicator is within the average values for the ratio of fat and protein in milk.

Table 12. Parameters for values of milk fat and protein content on Farm 6

Parameter	No of samples	X	SD	CV	MIN	MAX
Milk fat (%) MF	25	4,08	0,15	3,68	3,87	4,62
Milk protein (%) MP	25	3,45	0,18	5,22	3,18	3,84
Ratio: MF : MP	25	1,18	0,83	0,70	1,01	1,40

Table 13. Ratio values between fat and protein contents in milk of Farm 6

Ratio between milk fat and milk protein	No. of samples	Percentage (%)
>1,5	0	0
1,1-1,5	22	88
<1,1	3	12
Total	25	100

From the tab. 12 and 13 can be concluded that 12% of cows on farm 6 have a threat of acidosis (acid indigestion), while in the remaining 88% of cows the ratio of this indicator is within the average values for the ratio of milk fat and protein.

Table. 14. Summary values for ratio between milk fat and protein at controlled farms

Farm	Average value for index of fatio MF/MP	Variation (min-max)
Farm 1	1,27	0,58-3,31
Farm 2	1,16	0,80-1,76
Farm 3	1,25	1,16-1,37
Farm 4	1,31	1,01-1,31
Farm 5	1,18	1,07-1,26
Farm 6	1,18	1,01-1,40

From the tab. 14 can be concluded that the average value for the ratio between milk fat and protein at controlled farms vary from 1,16 to 1,31, with the variation (min-max) from 0,58 to 3,31. The milk fat content at all controlled farms ranges from 3.89 to 4.08 and for protein content in milk varies from 3.05 to 3.49.

Richardt (2004) stated that the optimal ratio of milk fat and protein content should be from 1.1 to 1.5, while Cejna and Chladek (2005) state that the optimal relationship between these two parameters should be from 1.2 to 1.4. Lower values than 1.2 indicate subclinical acidosis of rumen in cows, which may cause reproductive disorders and metabolism problems in cows. A ratio of milk fat and protein content higher than 1.4 indicates an energy deficit and subclinical ketosis if ketone bodies are present (Hass and Hofirek, 2004).

Most cases of metabolic disorders occur at the beginning of lactation when the cow's physiological needs are higher. The period of 3 weeks before and 3 weeks after delivering as a critical period associated with the occurrence of nutritional disorders and infectious diseases.

Also, the quality of milk from cows with metabolic disorders is changed. In that case, the presence of subclinical mastitis is higher, there is a deviation in the values of some milk components from the normal values. This milk should not be mixed with the milk from healthy cows which is sending to dairy plants. Milk with a larger amount of ketone bodies has a bitter taste and burns during heat treatment (Kudrna, 1998).

Ketosis occurs when fat reserves degrade due to lack of food energy. These cases are most common in post-partum cows due to increased milk production.

Ketosis occurs especially in highly productive cows with adverse effects (Skyva, 2004).

In recent years, subacute rumen acidosis has also been a problem in larger, highly productive dairy herds. Therefore, monitoring cows for acidosis is very important. In the United States, subacute acidosis is present in 19% of cows in early lactation, and 26% in middle lactation (Bramley et al., 2005).

According to Hawkey (2016), the ratio of milk fat and protein number is high at risk in the months of January and February, because the content of food proteins tends to decrease.

Richardt (2004) states that the milk protein-fat ratio is useful indicator when it comes to individual results per cow not total (aggregate) results for the whole herd. These data give a rough picture of the nutritional status of dairy cows in terms of energy, protein, raw fiber and starch reserves in cow food. Certainly, these results for these indicators, upgraded by other analyze of crane and cows, give a complete picture of the milk production and metabolic status of the whole herd, as well as for each dairy cow.

Conclusions

The following conclusions can be drawn on the basis of the tests carried out and the results obtained:

1. The average value for milk fat content in the 6 controlled farms ranges from 3,89 to 4,08 and for protein content in milk varies from 3,05 to 3,49.

2. Values for milk fat and protein content in milk from the 6 controlled member farms of the Macedonian Holstein Association in 2018 range from 1,18 to 1,31, with a variation of 0.58 to 3.31.

3. The use of the index between the content of milk fat and protein in milk has a practical application pointing to the imbalance of energy and protein value of dairy cattle, which gives an orientation alarm for possible health disorder in cows and the occurrence of acid or basic indigestion.

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ODNOS PROTEINA MLEKA I MASTI KAO POKAZATELJ METABOLIČKIH POREMEĆAJA KOD MLEČNIH KRAVA

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Sažetak

Sadržaj masti i proteina u mleku u pozitivnoj je korelaciji u populaciji mlečnih goveda. Na sastav mleka utiče puno faktora. Analize uzoraka mleka na 6 farmi mlečnih Holstajn krava u R. S. Makedoniji u 2019. godini pokazuju prosečnu vrednost od 1,18 do 1,31, sa promenom odnosa mlečnih masti i proteina između 0,58 i 3, 31. Ovaj odnos između mlečne masti i sadržaja proteina govori nam o zdravstvenom stanju i pojavi nekih metaboličkih poremećaja kod mlečnih krava povezanih sa tehnologijom uzgoja krava, posebno o ishrani i selekciji krava.

Ključne reči: mlečne krave, mlečna mast, mlečni proteini.

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