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Urea concentration in sheep's milk

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Summary

Determining urea concentration in milk is a useful indicator for controlling supply of proteins to organisms, as well as the relationship of energy and protein in the food, thus it is finding more and more ways of practical use. The concentration of urea in milk, along with the feeding process, is influenced by a number of other factors such as: breed, stage and sequence of lactation, body mass, daily production and chemical structure of milk, number of somatic cells, season, milking. The goal of the research was to establish the influence of the breed (Island of Krk, East Frisian), lactation stage (beginning, middle and the end) and the herd (3) to the concentration of urea in milk during lactation. For each breed there has been established daily quantity of milk, protein share and the concentration of urea in milk. Statistical analysis of data was conducted by using General Linear Models procedure, SAS program system (1999). The breed of sheep considerably ($P<0.001$) influenced daily quantity of milk, protein share and the concentration of urea in the milk. East Frisian sheep produced on average almost double the daily quantities of milk (1070 mL) compared to the Krk sheep (588 mL). Protein share and the urea concentration in Krk sheep milk were higher (5.99 % and 35.97 mg/100 mL) then in the milk of East Frisian sheep (5.12 % and 33.31 mg/100 mL). For both breeds the significant influence of lactation stage to the daily milk quantity has been established ($P<0.001$), that is also for the urea concentration in the milk of Krk sheep ($P<0.001$), as well as protein share in the milk of East Frisian sheep ($P<0.001$). Herd influence significantly affected daily milk quantities ($P<0.001$) and concentration of urea in the milk ($P<0.05$). The defining of the urea concentration in sheep milk should be occasionally carried out in the Republic of Croatia to establish the standard physiological values typical for the particular sheep breed.

Key words: sheep milk, daily milk yield, proteins, urea, stage of lactation, breed, herd

Introduction

Urea is an organic molecule made up of carbon, nitrogen, oxygen and hydrogen, with a molecular mass of 60. This is a component of blood and other bodily fluids (milk, saliva, urine, gastric and intestinal juices). Urea is part of the non-protein nitrogen fraction, which includes compounds containing nitrogen, but which are not proteins (amino acids, creatine, creatinine, uric acid, some vitamins, biogenic amines, amino sugars, etc.). Normal urea concentrations in milk range from 10 - 30 mg/100 mL, or from 1.7 - 4.5 mmol/L (Marenjak et al., 2004), however, studies on urea concentrations in sheep's milk are scarce and less detailed than those for cow's milk. Urea is a normal decomposition product that arises from the decomposition of proteins and the bacterial digestion of proteins in food in the rumen. Food decomposition in the rumen is carried out with the help of the microorganisms found in the rumen. A carbohydrate rich and fibre poor meal will negatively impact the rumen microflora (Mioč, 2004). Digestible proteins from food are decomposed in the rumen, and ammoniac is created in the process. The rumen microflora uses this ammoniac as a nitrogen source, which they build into microbial proteins. These are synthesized

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in the liver through a series of reactions in the Krebs cycle. From the liver, urea passes into the blood, enters the kidneys and is extracted in the urine (van den Bijgaart, 2002). Urea synthesis removes all excess nitrogen and establishes a nitrogen balance in the body, by binding the ammoniac that is formed if the diet is excessively rich in proteins. The possibility of synthesising its own microbial proteins depends on the available energy levels in the animal. Microbial proteins and non-degradable proteins in food that were not degraded in the rumen are moved to the small intestine, where they are broken down into simpler components that can be reabsorbed. If the decomposition of microbial proteins is slow, the resulting excess ammoniac in the rumen enters the bloodstream and is transported to the liver, where metabolic processes turn it into urea, which in turn is transported to the kidney and excreted. When the concentrations of urea in the body exceed the renal threshold, its concentration in the blood will begin to rise. Bed et al., (1997) found a high correlation coefficient (r = 0.88) between urea concentrations in milk and in blood. Considering that blood also passes through the udder and urea easily passes through the cell membrane, its concentration in milk will also increase (Diagram 1).

Urea concentration in milk is an indicator of the balance of energy and protein in the diet. Higher urea concentrations in milk suggest excessive protein concentrations in feed. As such, the diet must contain the appropriate quantity and quality of protein and energy, and this must be balanced. In addition to routine milk analysis and determining the share of milk fat and protein and the number of somatic cells and total microorganism counts, determining urea concentrations in milk can also serve to control the dietary supply of protein to milk-producing animals (Kampl and Stolla, 1995; Bed et al., 1997; Marenjak et al., 2004, Jilek et al., 2006). Based on the results of urea concentrations in milk, it is possible to diagnose problems caused by an imbalanced diet (ratio of available energy and protein in food), which can also reflect on the production and health status of milk-producing animals. Determining urea concentrations in cow's milk has practical applications in EU Member States in terms of health control, and as a method of monitoring the dietary status of animals. However, this is not regularly carried out in Croatia (Kuterovac and Dakić, 2004).

The present study provides an analysis of urea concentrations in sheep's milk. This study should be continued so as to establish the standard physiological values, while taking the basic factors influence their values into account: diet, breed, stage and number of lactation, season, milk sampling, time of milking, manner of keeping, body mass, production and chemical composition of milk (Velazquez, 2000; Godden et al., 2001; Marenjak et al., 2004; Prpić

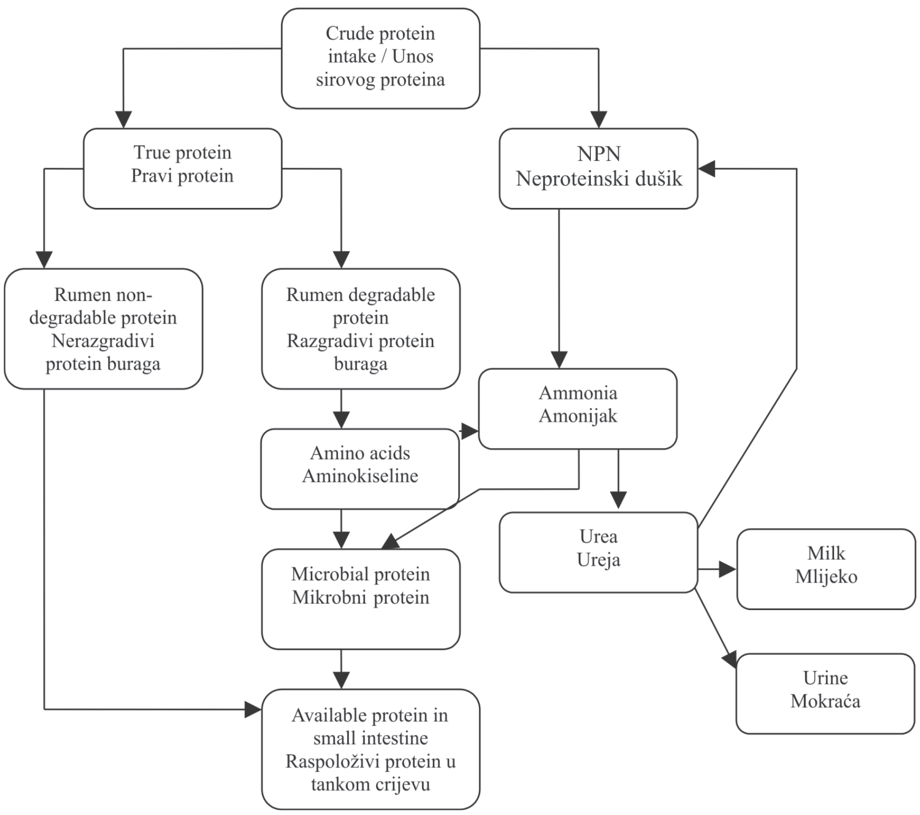

Diagram 1: Metabolism of proteins in rummen (Bijgaart, van Den, 2002)
Dijagram 1: Metabolizam proteina u buragu (Bijgaart, van Den, 2002.)

et al., 2005; Jilek et al., 2006; Antunac et al., 2007b; Kuchtik et al., 2008). If urea concentrations in milk are higher than the allowed standard values, then it is necessary to make the appropriate dietary corrections to ensure that the animals health is not jeopardized. The objective of this study was to establish the concentration of urea in milk from ewes on the island of Krk and East Friesian ewes. A second aim was to establish whether there are significant differences in urea concentrations in milk between the studied breeds and between the studied herds, and the influence of lactation stage on urea concentrations in milk.

Materials and methods

The study to determine urea concentrations in milk was conducted on a part of a population of Krk and East Friesian ewes. The herd of Krk ewes (1) is located in the village of Kornić on the island of Krk, while the herds of East Friesian ewes (2 and 3) are located in the Varaždin and Požega areas. Herd 1 was comprised of 30 ewes, in stages II, III and IV of lactation. Herd 2 consisted of 30 ewes in stages I and II of lactation, while Herd 3 consisted of 38 ewes, in stages I to V of lactation. During the year, the Krk ewes were let out to pasture dominated by clover and sage, such that they exclusively grazed in pasture during the summer months. The winter diet consisted of meadow hay and corn grits. The East Friesian ewes (herd 2) were fed with green grass (lucerne) during the lactation period, with an addition of about 1 kg concentrate per head daily, with 15% raw protein and a vitamin/mineral supplement. The concentrated part of the diet consisted of corn, barley, sunflower and soy pellets and wheat husks. The sheep of herd 3 were fed a green blend during the lactation period, consisting of lucerne, sorghum, forage legumes, meadow hay and 1.5 kg of concentrate per head.

The control of milk-production of the Krk and East Friesian ewes was conducted once a month during lactation, at 30-day intervals. Ewe lactation was divided into 2 periods: the lamb suckling period and the milking period, which began after weaning of the lambs. The milking period was divided into three stages: start, middle and end of lactation.

Herd 1: the lactation of Krk ewes lasted an average of 160 days, with suckling for 50 days and milking for 100 days. The start of lactation included the 1st control (from the 51st to 80th day), the middle included the 2nd and 3rd control (from the 81st to the 140th day), and the end included the 4th control (from the 141st day to drying out). The first control of milk production was conducted in March, and the last (4th) in June 2007. Individual milk samples were taken by hand-milking the ewes at the morning or evening milking session.

Herd 2**:** the lactation of East Friesian ewes lasted an average of 223 days, with suckling for 40 days and milking for 183 days. The start of lactation included the 1st and 2nd control (from the 41st to 100th day), the middle included the 3rd, 4th and 5th control (from the 101st to the 190th day), and the end included the 6th and 7th control (from the 191st day to drying out). The first control of milk production was conducted in April, and the last (7th) in October 2007. These sheep are milked by machine, though the control milking was carried out by hand-milking.

Herd 3: the lactation of East Friesian ewes lasted an average of 213 days, with suckling for 70 days and milking for 143 days. The start of lactation included the 1st and 2nd control (from the 71st to 130th day), the middle included the 3rd and 4th control (from the 131st to the 190th day), and the end included the 5th and 6th control (from the 191st day to drying out). The first control of milk production was conducted in April, and the last (6th) in September 2004. These sheep are milked by machine, though the control milking was carried out by hand-milking.

The milking of each individual sheep was prohibited when the total daily quantity of milk was less than 200 mL. The number of milk samples per individual analysis varied throughout lactation and depended on the health of the animal and the number of sheep in each individual control.

The daily quantity of milk for each individual ewe was established by measuring the quantity of milk in a graduated cylinder. Milk samples were always taken at the same time, from 6 to 8 a.m. (morning milking) and from 6 to 9 p.m. (evening milking). Protein share analysis (P) in milk was determined using infrared spectrometry (HRN EN ISO 9622:2001) on a Milkoscan FT 120 instrument. Urea concentrations (U) in milk were established using a continual measuring method on a spectrophotometer according to a modified method of the manufacturer Herbos Diagnostica and using the Urea Slow (RU 4.2.1-KA-10) kit. Milk analysis was carried out in the Reference laboratory of the Department of Dairy Science, accredited with the HRN EN ISO/IEC 17025:2007 and included in European interlaboratory comparison.

Statistical data analysis was carried out using the GLM procedure (General Linear Models), and the SAS programme (1999). The following were calculated: Least Square Means (LSM), Minimal (Min) and Maximal (Max) values, Standard Error (SE) and Coefficient Variation (CV) for individual parameters. Correlation coefficients between the production characters and individual parameters were calculated using the CORR procedure *(SAS, 1999)*.

Research results and discussion

The influence of lactation stage on the daily quantity of milk produced by Krk ewes was significant (P<0.001) and a gradual decline of milk quantity was recorded from the start (711 mL) to the end of lactation (485 mL) - (Table 1).

The share of protein in the milk of Krk ewes (5.99 %) was significantly higher (P<0.001) than in the milk of the East Friesian ewes (5.12 %), which is in line with the results of Mikulec et al. (2008) and the HSC Annual Report (2008). The study conducted by Oravcova et al. (2007) also determined a smaller share of milk fat and protein in the milk of local (native) breeds, in comparison to typical milk breeds of sheep. While the influence of lactation stage on the protein content in milk in Krk ewes was not significant, a higher share of protein was detected at the end of lactation in the East Friesian ewes than at the start of lactation. Somewhat higher values of proteins (from 4.69 % to 6.66 %) in the milk of East Friesian ewes during lactation was also reported by Anifantakis (1986), Bed et al. (1997) and Kuchtik et al. (2008). Bencini and Pulina (1997) reported that a higher share of protein in the diet also results in a higher share of protein in the milk.

At the start of lactation, the concentration of urea in the milk of the Krk ewes was significantly less (P<0.001) than during the remainder of the lactation, which is likely due to the diet, the milk sampling time and the quality of the protein (Velazquez, 2000). Lower urea concentrations in cow's milk during the start of lactation as compared to the end of lactation has been reported by many authors (Bruckental et al., 1980; Ng-Kwai-Hang et al., 1985; Carlsson et al., 1995; Marenjak et al., 2004).

The quantity of milk obtained from the Krk ewes was significantly higher (P<0.001) during the morning milking than during the evening milking. Also, the share of protein in milk was higher in the morning (6.03 %) than in the evening (5.95 %), though the difference was not significant. One of the factors influencing the concentration of urea in milk was the time of milking. In Krk ewes, the concentration of urea was lower in the morning than in the evening, though the difference was not significant (Table 2). The literature (Ferguson, 2000; Godden et al., 2001) also reports lower morning concentrations of urea in milk than in the evening. The reason for this could be due to the different time intervals between feeding and milking (Prpić et al., 2005). Bed et al. (1997) also reported a significantly higher urea concentration in goat's milk during the evening milking than in the morning, while significant differences were not found for sheep.

Similar to the Krk ewes, a significant difference (P<0.001) in the quantity of milk produced by the East Friesian ewes was found for the start (1440 mL), middle (1019 mL) and end (784 mL) of lactation (Table 3). Virtually identical daily quantities of milk in East Friesian ewes were reported by Bed et al. (1997) in Hungary and Kuchtik et al. (2008) in Czech Republic, while higher values for

Table 1: Influence of stage of lactation on average daily milk yield, proteins content and urea concentration in milk of Krk ewes (Herd 1)

Tablica 1: Utjecaj stadija laktacije na prosječnu dnevnu količinu mlijeka, udio proteina i koncentraciju ureje u mlijeku krčkih ovaca (Stado 1)

Stage of lactation Stadij laktacije	n	Daily milk yield Dnevna količina mlijeka (mL) LSM ± SE	n	Proteins Proteini (%) LSM ± SE	n	Urea Ureja (mg/100 mL) LSM ± SE
Beginning Početak	30	711±37.82^{A}	30	5.96±0.08	30	26.61±1.20^{A}
Middle Sredina	53	564±38.28^{B}	54	6.02±0.09	54	40.29±1.27^{B}
End Kraj	20	485±46.32^{C}	20	6.05±0.10	20	39.65±1.47^{B}
P-value P-vrijednost		**		NS		**

$^{A, B, C}$Means within the same column and not sharing the same superscript letter are significantly different (**P<0.001) / $^{A, B, C}$Vrijednosti u istoj koloni označene različitim slovima značajno se razlikuju (**P<0,001)
NS; non significant / NS; nije značajno

Table 2: Influence of milking on average milk yield, proteins content and urea concentration in milk of Krk ewes
Tablica 2: Utjecaj mužnje na prosječnu količinu mlijeka, udio proteina i koncentraciju ureje u mlijeku krčkih ovaca

Milking Mužnja	n	Milk yield Količina mlijeka (mL) LSM ± SE	Proteins Proteini (%) LSM ± SE	Urea Ureja (mg/100 mL) LSM ± SE
Morning Jutarnja	54	335.37±13.79^{A}	6.03±0.06	34.65±1.26
Evening Večernja	50	254.08±14.48^{B}	5.95±0.07	37.39±1.31
P-value P-vrijednost		**	NS	NS

$^{A, B, C}$Means within the same column and not sharing the same superscript letter are significantly different (**P<0.001) / $^{A, B, C}$Vrijednosti u istoj koloni označene različitim slovima značajno se razlikuju (**P<0,001)
NS; non significant / NS; nije značajno

the same breed in Hungary were reported by Mioč et al. (2004). The reasons for smaller milk production of the East Friesian ewes in Croatia is likely due to poorer adaptation to new conditions, diet and varying age of the ewes. However, the share of protein in the milk of East Friesian ewes was inversely proportional to that of the Krk ewes. At the end of lactation, the share of protein in milk was significantly higher in comparison to the start and middle of lactation. Unlike the Krk ewes, urea concentrations in milk were uniform throughout the lactation period, though the mean value was smaller (Table 3).

Lactation stage did not significantly influence the concentration of urea in milk in East Friesian ewes. Bed et al. (1997) confirmed that the highest urea concentrations in milk were during stage II of lactation, followed by a reduction and a new increase in the last month of lactation. High urea concentrations in milk arise in the summer months, when the share of total nitrogen and real proteins (primarily casein) in milk are reduced and the content of non-protein nitrogen increases (Prpić et al., 2005). For that reason, the correlation coefficient of the protein share and urea concentration in milk was very low (0.02).

Within the same sheep breed (East Friesian), significant differences in the average quantity of milk (P<0.001) and urea concentration (P<0.05) in milk were detected between the two herds, while the difference in protein share was

Table 3: Influence of stage of lactation on average daily milk yield, proteins content and urea concentration in milk of East Friesian ewes (Herd 2 and 3)
Tablica 3: Utjecaj stadija laktacije na prosječnu dnevnu količinu mlijeka, udio proteina i koncentraciju ureje u mlijeku istočnofrizijskih ovaca (Stado 2 i Stado 3)

Stage of lactation Stadij laktacije	n	Daily milk yield Dnevna količina mlijeka (mL) LSM ± SE	n	Proteins Proteini (%) LSM ± SE	n	Urea Ureja (mg/100 mL) LSM ± SE
Beggining Početak	84	1440±30.25^{A}	133	4.77±0.04^{A}	140	32.13±0.95
Middle Sredina	149	1019±26.17^{B}	189	4.78±0.03^{A}	150	34.46±0.82
End Kraj	142	784±29.52^{C}	149	5.84±0.04^{B}	149	32.80±0.92
P-value P-vrijednost		**		**		NS

$^{A, B, C}$Means within the same column and not sharing the same superscript letter are significantly different (**P<0.001) / $^{A, B, C}$Vrijednosti u istoj koloni označene različitim slovima značajno se razlikuju (**P<0,001)
NS; non significant / NS; nije značajno

Table 4: Influence of herd on average daily milk yield, proteins content and urea concentration in milk of East Friesian ewes (Herd 2 and Herd 3)

Tablica 4: Utjecaj stada na prosječnu dnevnu količinu mlijeka, udio proteina i koncentraciju ureje u mlijeku istočnofrizijskih ovaca (Stado 2 i Stado 3)

Herd Stado	n	Daily milk yield Dnevna količina mlijeka (mL) LSM ± SE	n	Proteins Proteini (%) LSM ± SE	n	Urea Ureja (mg/100 mL) LSM ± SE
Herd 2 Stado 2	150	961±26.93[A]	247	5.07±0.04	253	30.75±0.67[a]
Herd 3 Stado 3	225	1193±28.45[B]	224	5.17±0.05	186	36.21±0.73[b]
P-value P-vrijednost		**		NS		*

[A, B]Means within the same column and not sharing the same superscript letter are significantly different (**P<0.001) / [A, B]Vrijednosti u istoj koloni označene različitim slovima značajno se razlikuju (**P<0,001)

[a, b]Means within the same column and not sharing the same superscript letter are significantly different (*P<0.05) / [a, b]Vrijednosti u istoj koloni označene različitim slovima značajno se razlikuju (*P<0,05)

NS; non significant / NS; nije značajno

not significant (Table 4). The share of protein in milk did not differ, from 5.07 % (Herd 2) to 5.17 % (Herd 3). Urea concentrations in the milk from ewes of Herd 3 (36.21 mg/100 mL) was significantly higher (P<0.05) than in Herd 2 (30.75 mg/100 mL). Urea concentrations in milk was much more uniform in the milk of East Friesian ewes than in Krk ewes, which may be due to the manner of keeping the sheep, i.e. the East Friesian sheep were primarily kept in the barn, while the Krk sheep spent most of the time at pasture. Fox and McSweeney (1998) report urea concentrations twice as high in milk from cows at pasture as compared to cows fed dry food. Carlsson et al. (1995) report that urea concentrations in milk during lactation was much more uniform in dairy cows kept in barns than those held at pasture. One reason could be the high content of easily digestible raw proteins in grass, which are relatively energy rich. However, other studies did not report a significant influence of lactation stage on urea concentrations in milk (Hoffman and Steinhöfel, Schepers and Meijer, cited in Velazquez et al., 2000). One reason for the higher urea concentrations in the milk of Krk ewes as compared to the East Friesian ewes could be the difference in overall body mass. The Krk ewes are smaller (approx. 35 kg) than the East Friesian ewes (>50 kg). Oltner et al. (cited in Velazquez

Table 5: Influence of breed on average daily milk yield, proteins content and urea concentration in milk of Krk (Herd 1) and Eeast Friesian ewes (Herds 2 and 3)

Tablica 5: Utjecaj pasmine na prosječnu dnevnu količinu mlijeka, udio proteina i koncentraciju ureje u mlijeku krčkih (Stado 1) i istočnofrizijskih ovaca (Stado 2 i Stado 3)

Breed Pasmina	n	Daily milk yield Dnevna količina mlijeka (mL) LSM ± SE	n	Proteins Proteini (%) LSM ± SE	n	Urea Ureja (mg/100 mL) LSM ± SE
Krk ewe Krčka ovca	150	588 ± 26.32[A]	247	5.99 ± 0.04[A]	253	35.97 ± 0.72[A]
East Friesian ewe Istočnofrizijska ovca	225	1070 ± 16.35[B]	224	5.12 ± 0.03[B]	186	33.31 ± 0.62[B]
P-value P-vrijednost		**		**		**

[A, B]Means within the same column and not sharing the same superscript letter are significantly different (**P<0.001) / [A, B]Vrijednosti u istoj koloni označene različitim slovima značajno se razlikuju (P<0,001)

Table 6: Coefficient of correlation between daily milk yield (DMY), proteins content and urea concentration in ewe milk
Tablica 6: Koeficijenti korelacija između dnevne količine mlijeka (DKM), udjela proteina i koncentracije ureje u ovčjem mlijeku

	DMY / DKM (mL)	Proteins / Proteini (%)	Urea / Ureja (mg/100mL)
DMY (mL) DKM (mL)	-	**-0.43****	0.06
Proteins (%) Proteini (%)	**-0.43****	-	**-0.14***

*P<0.05
**P<0.001

et al., 2000) report an inversely proportional relationship between body mass and urea concentrations in milk. They explained that in large animals, the area for distribution of urea is naturally larger than in smaller animals, though the same quantity of urea is formed in the liver, and as such, blood and milk concentrations will obviously be smaller. Furthermore, the literature reports that the milk of small-production dairy cows contain higher urea concentrations than high-production cows, due to the reduction of dry matter and the reduced intake of protein in feed.

Though the East Friesian ewes produced almost twice the average daily quantity of milk as compared to the Krk ewes, the share of protein in the milk of Krk ewes was significantly higher (P<0.001). This is particularly important in the processing of sheep's milk, as in Croatia, this milk is almost exclusively used for cheese production. It is also interesting to note that the urea concentrations in the milk of Krk ewes was significantly higher (P<0.001) than in the milk of the East Friesian ewes (Table 5). Antunac et al. (2004) found similar urea concentration (36.56 mg/100 mL) in the milk of sheep on the island of Pag. Kuchtik et al. (2008) found significantly lower urea concentrations in the milk of East Friesian ewes during lactation. Considering that the Krk ewes spent virtually the entire period outdoors, i.e. at pasture, it can be assumed that their protein intake was high, and the share of concentrate insufficient, thereby resulting in higher urea concentrations in milk.

A negative, though significant (P<0.001) correlation coefficient (-0.43) was found between the daily quantity of milk and the share of protein in milk of both sheep breeds (Table 6).

Conclusions

Based on the research results, the following can be concluded:

- Sheep breed significantly (P<0.001) influenced the daily quantity of milk, share of protein and urea concentration in the milk.
- Lactation stage significantly (P<0.001) influenced the daily quantity of Krk and East Friesian ewes, and had a significant (P<0.001) influence on urea concentrations in milk only on the Krk ewes, and on protein share only in the East Friesian ewes.
- The herd had a significant (P<0.001) influence on daily milk production and urea concentrations in milk (P<0.05) of the East Friesian ewes, targeted at a precise assessment of balancing meals with energy and protein.

Koncentracija ureje u ovčjem mlijeku

Sažetak

Određivanje koncentracije ureje u mlijeku koristan je pokazatelj opskrbljenosti organizma proteinima, kao i odnosa energije i proteina u obroku preživača, tako da nalazi sve veću praktičnu primjenu. Na koncentraciju ureje u ovčjem mlijeku osim hranidbe utječe niz čimbenika, kao što su: pasmina, stadij i redoslijed laktacije, tjelesna masa, dnevna proizvodnja i kemijski sastav mlijeka, broj somatskih stanica, sezona, mužnja i drugo. Cilj istraživanja bio je utvrditi utjecaj pasmine ovaca (krčka i istočnofrizijska), stadija laktacije (početak, sredina i kraj) i tri stada na koncentraciju ureje u mlijeku tijekom laktacije. Za svaku pasminu utvrđena je dnevna količina mlijeka, udio proteina i koncentracija ureje u mlijeku. Statistička obrada podataka izvršena je primjenom procedure General Linear Models, programskog sustava SAS (1999.). Pasmina ovaca značajno (P<0,001) je utjecala na dnevnu količinu mlijeka, udio proteina i koncentraciju ureje u mlijeku. Istočnofrizijske ovce proizvele u prosjeku gotovo dvostruko veću prosječnu dnevnu količinu mlijeka (1070 mL) u odnosu na krčke ovce (588 mL). Udio proteina i koncentracija ureje u mlijeku krčkih ovaca bili su veći (5,99 % i 35,97 mg/100 mL) nego u mlijeku istočnofrizijskih ovaca (5,12 % i 33,31 mg/100 mL). Za obje pasmine ovaca utvrđen je značajan utjecaj stadija laktacije na dnevnu količinu mlijeka (P<0,001), odnosno na koncentraciju ureje u mlijeku krčkih (P<0,001) te udio proteina u mlijeku istočnofrizijskih ovaca (P<0,001). Stado je imalo značajan utjecaj na dnevnu količinu mlijeka (P<0,001) i koncentraciju ureje u mlijeku (P<0,05). Određivanje koncentracije ureje u ovčjem mlijeku trebalo

bi sustavno provoditi i u RH, kako bi se utvrdile standardne fiziološke vrijednosti karakteristične za pojedinu pasminu ovaca, u cilju procjene izbalansiranosti obroka energijom i proteinima.

Ključne riječi: ovčje mlijeko, dnevna količina mlijeka, proteini, ureja, stadij laktacije, pasmina, stado

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