

## RELATIONSHIP BETWEEN THE NUMBER OF MEALS PER DAY AND RUMINATION PROCESS IN DAIRY COWS

S. Acatincai, D. Gavojdian, N. Păcală, L.T.Cziszter

Faculty of Animal Sciences and Biotechnologies Timișoara, Romania  
e-mail: sacatincai@yahoo.com

### Abstract

*In this study rumination activity of ten lactating Romanian Black and White multiparous cows housed in total confinement in tied stalls was observed continuously 24 hours per day. Researches were carried out during two weeks, in February 2008. To record the behavior, four video cameras were used connected to a video capture device of 125 fps (frames per second) of CC9622BIR type. There were two experiments, first experiment (96 h) in which cows were fed two times per day, and in second experiment (96 h) three times per day. During the experimental period, cows were fed a diet consisted in 20 kilograms of corn silage; 8 kilograms of lolium hay; 3 kilograms of concentrates and 4 kilograms of brewer's yeast. During first experiment, cows spent ruminating on average in 24 hours 489.6 minutes, in 16 periods, with an average length of a rumination period of 30.7 minutes. During second experiment, cows spent ruminating on average per day, 545.5 minutes, in 18.7 ruminating periods and with an average length of each period of 29.8 minutes. Differences between the two experiments during 24 hours were registered to be 55.9 minutes for total time spent ruminating, 2.7 ruminating periods and 0.9 minutes for the average length of a rumination period. Thus, despite of same housing and feeding conditions, number of meals per 24 h influenced both duration of the rumination process and number of rumination periods ( $p < 0.05$ ).*

**Key words:** rumination, multiparous cows, Romanian Black and White, cattle behavior

### INTRODUCTION

Several studies are following nowadays cattle behavior, especially lactating dairy cows. However, in the current literature there are studies and data with present different and sometimes contrasting points of views. Erina et al 2005 asseverate total rumination process of 553 minutes, Fergonesi et al (1990) publishes a paper with 492 minutes and finally, Christensen and Fehr (2000) issue a study in witch reports 396 minutes. Factors that are influencing the rumination process and behavior are: the dry matter intake; cellulose percentage; particle size of the forages; number of meals per day; comfort of the animal; housing conditions; breed; age of the animal; milk yield and physiological status. Thereby, the multitude of data reported by different scientists, are explicable. This study was conducted to determine the differences in rumination time and intensity of cud chew while feeding the cows with two and three meals per day, during winter season.

### MATERIAL AND METHODS

Ten lactating Romanian Black and White multiparous cows were housed in a tie stanchion barn. Experiments were carried out during winter season, in February 2008. Cows monitored were in their first hundred days of lactation, and had an average daily yield of 15.4 liters of milk, with an average body weight of the cows of 617 kg. During the experimental period, cows were fed a diet consisted in 20 kilograms of corn silage; 8 kilograms of lolium hay; 3 kilograms of concentrates and 4 kilograms of brewer's yeast. Fresh feed was provided twice and three times per day, at 07:00 and 18:30, respectively 12:00. Cows were milked twice a day at approximately 05:00 and 17:00. Data regarding environmental temperature was recorded three times a day, at 07:00, 13:00 and 01:00. Average air temperature during the experiment was 8.5°C inside the barn, and 5°C outside. The barn was under continuous lightning. All the cows were treated as a single group and had free access

to water. Behavior was monitored 24 hours per day, using 4 video cameras (CC9622BIR) connected to a video capture device of 125 fps with four channels. Cameras were positioned immediately in front of the cows to give a clear view of the cow's head at all times. For a better interpretation, the recorded material was divided in three periods (segments) for every 24 hours of surveillance: 07:00 to 14:00, 14:00 to 21:00 and 21:00 to 07:00. Studied traits were: - time spend by the cows ruminating, on 24

hours and on daily segments; - number and average time length of rumination periods.

### RESULTS AND DISCUSSION

Averages and dispersion indices for the calculated parameters are presented in tables 1, 2 and 3.

Analyzing data from Table 1, it can be observed that cows spend ruminating per day, on average 489.60 minutes, with limits ranging between 378 and 543 minutes. Thereby, cows spent ruminating 34% of the entire 24 h interval, (8.16 hours/rumination process).

Table 1

Averages and dispersion indices for total duration and frequency of rumination, administration of forages in two meals per day (minutes)

Winter season		Total rumination	Rumination periods	Average length
Segment I 7-14	X±S <sub>x</sub>	88.80±6.40	3.70±0.30	24.56±1.38
	SD	20.25	0.95	4.36
	cv (%)	22.81	25.64	17.77
	Min	51	2	15.4
	Max	126	5	29.3
from 420 min		21,14%	-	-
Segment II 14-21	X±S <sub>x</sub>	98.30±7.27	3.40±0.42	31.43±3.11
	SD	23.01	1.35	9.84
	cv (%)	23.41	39.70	31.30
	Min	64	2	21.4
	Max	139	6	50
from 420 min		23,4%	-	-
Segment III 21-7	X±S <sub>x</sub>	302.50±22.04	8.90±0.56	33.87±1.51
	SD	69.70	1.79	4.79
	cv (%)	220.42	5.67	15.16
	Min	128	5	25.6
	Max	362	11	40.1
from 600 min		50,41%	-	-
Total on 24 hours	X±S <sub>x</sub>	489.60±17.23	16.00±0.57	30.76±1.14
	SD	54.51	1.83	3.63
	cv (%)	11.13	11.41	11.80
	Min	378	12	25.2
	Max	543	18	36.2
from 1440 min		34%	-	-

It can be observed that in between the segments of the day, duration of rumination is not equally distributed, most of the process taking place in the night segment (61.70%), respectively between 21:00 and 7:00.

Cows had ruminated on average in 16 sessions, wit limits ranging between 12 and 18. As well as in the case of total duration of the rumination process, most rumination periods occurred during night time, 8.9 periods, value that represents 55.6% from entire rumination periods per 24 h.

Average length for a rumination period registered was 24.5 minutes during first segment, 31.3 during second segment and 33.8 minutes during night segment. On 24 h, the average value registered was 30.76 minutes.

In table 2 are presented averages and dispersion indices for total duration and frequency of rumination, during winter season, administration of forages in three meals per day, values which are presented in minutes and frequency.

Table 2

Averages and dispersion indices for total duration and frequency of rumination, administration of forages in three meals per day (minutes)

Winter season		Total rumination	Rumination periods	Average length
Segment I 7-14	X±S <sub>x</sub>	96.40±5.18	3.70±0.26	28.00±2.15
	SD	16.40	0.82	6.82
	cv (%)	17.01	22.25	24.35
	Min	75	3	16.2
	Max	134	5	36
	from 420 min	22,95%	-	-
Segment II 14-21	X±S <sub>x</sub>	105.00±4.79	4.50±0.34	24.32±1.93
	SD	15.16	1.08	6.11
	cv (%)	14.44	24.00	25.13
	Min	75	3	18.7
	Max	124	6	35.6
	from 420 min	25.00%	-	-
Segment III 21-7	X±S <sub>x</sub>	344.10±8.39	10.50±0.80	34.81±3.13
	SD	26.54	2.55	9.90
	cv (%)	7.71	24.28	28.45
	Min	307	6	20.4
	Max	388	15	53.3
	from 600 min	57,35%	-	-
Total on 24 hours	X±S <sub>x</sub>	545.50±12.87	18.70±0.97	29.85±1.68
	SD	40.71	3.09	5.31
	cv (%)	7.46	16.54	17.79
	Min	482	14	21.9
	Max	613	22	39.1
	from 1440 min	37,88%	-	-

During this experiment, cows spent ruminating per day, on average 545.5 minutes, with limits ranging between 482 and 613 minutes. Thereby, cows spent ruminating 37.8% of the entire 24 h interval, (9.09 hours/rumination process). Most of the rumination process had place during night, respectively 63% (344.10 minutes).

Rumination process was divided in 18.7 periods, from witch 56.1% (10.5 periods) occurred during night time.

Average length of a rumination period, during three meals per day registered was 28 minutes during first segment of the interval, 24.3 minutes during second segment and 34.8 minutes during night segment. Per 24 h, average length registered was 29.8 minutes.

During second experiment (with three meals per day), total rumination process and number of rumination periods was greater, comparing with the first experiment (two meals per day), but the average length of a

rumination period is shorter during second experiment (adversely affected).

Differences and their significance for total duration and frequency of rumination during winter, with the administration of forages in 2 and 3 meals (in minutes and periods) are presented in Table 3.

For rumination process during segments of day, in between the two experiments, it can be observed differences for the rumination behavior, but the differences are statistically insignificant ( $p>0.05$ ). Greatest difference was registered between night segments (41.6 minutes).

For whole rumination process per 24 h, differences registered were of 55.9 minutes ( $p<0.05$ ).

Differences registered between periods of rumination for the 24 h interval, were 2.7 ( $p<0.05$ ), in favor of the three times per day experiment. While, per days segments differences registered were statistically insignificant ( $p>0.05$ ).

Table 3  
Differences and their significance for total duration and frequency of rumination, with the administration of forages in 2 and 3 meals (minutes)

	Total rumination	Rumination periods	Average length
Two meals per day	Segment I-II	- 9.50 <sup>ns</sup>	0.30 <sup>ns</sup>
	Segment I-III	- 213.70 <sup>***</sup>	- 5.20 <sup>***</sup>
	Segment II-III	- 204.20 <sup>***</sup>	- 5.50 <sup>***</sup>
Three meals per day	Segment I-II	- 8.6 <sup>ns</sup>	- 0.80 <sup>ns</sup>
	Segment I-III	- 247.70 <sup>***</sup>	- 6.80 <sup>***</sup>
	Segment II-III	- 239.10 <sup>***</sup>	- 6.00 <sup>***</sup>
2 - 3 meals per day	Segment I	- 7.60 <sup>ns</sup>	0.00 <sup>ns</sup>
	Segment II	- 6.70 <sup>ns</sup>	- 1.10 <sup>ns</sup>
	Segment III	- 41.60 <sup>ns</sup>	- 1.60 <sup>ns</sup>
	Total	- 55.90 <sup>*</sup>	- 2.70 <sup>*</sup>

As regards to the average length of a rumination period, this parameter was unaffected by the number of meals per day, during 24 h interval and during segments of the day ( $p < 0.05$ ).

### CONCLUSIONS

Number of meals per day has an important influence on the rumination behavior, affecting total time devoted to this process by cows, and also the number of rumination periods. While, average time length of the rumination periods remain unaffected by the number of meals offered per 24 h.

Rumination plays a major role in cow health and productivity, and effects of

management on this must be understood, considerably more research is required.

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