Researches on Feeding Behavior in Six Months of Age Calves from Romanian Black and White Breed Fed Using Different Feed Space Allowance

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Abstract
The aim of this paper was to measure the main aspects that characterize the feeding behavior in six months old calves fed using three different feed spaces allowance. During the experiments the following feeding behavior aspects were determined: number of feeding periods, the length of feeding periods and the total length of feeding periods. Results showed that calves spent feeding, on average, 292 minutes in the morning, 198 minutes in the afternoon and only 71 minutes during the night when the length of feeding space was 0.6 m per calf. Calves spent feeding 175 minutes during the morning, 193 minutes during the afternoon and 53 minutes during the night when the length of the feeding space was 0.32 m per calf. Calves spent feeding 255 minutes during the morning, 227 minutes during the afternoon and 30 minutes during the night when the length of the feeding space was 0.28 m per calf. The total time spent feeding by calves was 560 minutes when the length of feeding space was 0.6 m per calf, 421 minutes when the length of feeding space was 0.32 per calf and 512 minutes when the length of the feeding space was 0.28 per calf. There were significant differences ($p<0.05$) for total time spent feeding by calves between the first experimental variant (0.6 m feeding space per calf) and the second variant (0.32 m feeding space per calf) and between the second experimental variant and the third variant (0.28 m feeding space per calf).

Keywords: calves, feeding behavior, Romanian Black and White breed.

1. Introduction

The behavior of young cattle as well as the behavior of all domestic and wild animals is one of the most interesting biological processes that involve a large amount of endogenous and exogenous factors: the nervous system, sense organs and glands with internal secretion, microclimate factors, motivational factors, genetically factors, technological and social factors [1, 2, 3].
Nutrition is an important aspect of welfare, and in most recommendations for the welfare of animals adequate nutrition is a primary requirement [4, 5].

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2. Materials and methods

Researches were carried out during the autumn season in November 2010 at the university research farm, on a number of 5 six-month old calves from Romanian Black and White breed.
Calves were housed in 5.0 x 5.0 m pens bedded with straw.
The behavior of calves was video recorded continuously for 24 hours for each experiment.
To record the behavior of calves a surveillance video system was used. The system consisted in 4 CCTV (CC9622BIR) cameras with a 720 x 480 video resolution connected to a PC unit which had the capacity to store images at 125 frames per second. The video system recorded in a digital format and had software that allowed editing the recordings. The video system permitted to record

the date and hours in a mode that included minutes and seconds, which helped the timing process.
Calves were fed using three different feed spaces allowance 0.6 m per calf, 0.32 m per calf and 0.28 m per calf.
Calves were fed with 1 kg of concentrates mixture, 10 kg of corn silage and 3 kg of alfaalfa hay per head per day.
For a better interpretation the recorded material was divided in three periods for every 24 hours of surveillance: 07:00 to 15:00 (morning), 15:00 to 23:00 (afternoon) and 23:00 to 07:00 (night).
In the processing of recorded data, the feeding behavior was observed for calves by counting and timing the periods.

3. Results and discussion

The length of the feeding periods decreased from 61.1 minutes in the morning to 55.4 minutes in the afternoon and 46.9 minutes during the night when the maximum feeding space allowance was provided to calves (Table 1).
The number of feeding periods also decreased starting with 4.8 in the morning to 3.6 in the afternoon and 1.6 during the night. There were significant differences between all three day periods for the number of feeding periods.
The total time spent feeding by calves decreased from 292 minutes in the morning to 197.6 minutes in the afternoon and 71 minutes during the night.
There were significant differences between morning and afternoon ($p<0.05$), morning and night ($p<0.05$) and between afternoon and night ($p<0.05$) for the total length of feeding periods.
Calves fed themselves 560 minutes per day during 10 feeding periods with an average length of 56 minutes when the maximum feeding space allowance was provided (0.6 m per calf).
The length of the feeding periods increased from 65.0 minutes in the morning to 96.6 minutes in the afternoon and then decreased to 26.5 minutes during the night when the intermediate feeding space allowance was provided to calves (Table 2).
The number of feeding periods decreased starting with 2.8 in the morning to 2.0 in the afternoon and 2.0 during the night.
The total time spent feeding by calves increased from 174.8 minutes in the morning to 193.2 minutes in the afternoon and then decreased to 53.0 minutes during the night.
There were significant differences between morning and night ($p<0.05$) and between afternoon and night ($p<0.05$) for the total length of feeding periods.
Calves fed themselves 421 minutes per day during 6.8 feeding periods with an average length of 62.6 minutes when the intermediate feeding space allowance was provided (0.32 m per calf).
The length of the feeding periods decreased from 97.6 minutes in the morning to 89.1 minutes in the afternoon and to 30.0 minutes during the night when the minimum feeding space allowance was provided to calves (Table 3).
The number of feeding periods decreased starting with 2.8 in the morning to 2.6 in the afternoon and to 1.0 during the night.
The total time spent feeding by calves decreased from 254.8 minutes in the morning to 227.4 minutes in the afternoon and to only 30.0 minutes during the night.
There were significant differences between morning and night ($p<0.05$) and between afternoon and night ($p<0.05$) for the total length of feeding periods.
Calves fed themselves 512 minutes per day during 6.4 feeding periods with an average length of 81.7 minutes when the minimum feeding space allowance was provided (0.28 m per calf).
Table 4 presents the differences and their significance for the feeding behavior of calves when the three feeding space allowances were used.
There were significant differences between the experimental variant when the feeding space was maximal and when it was intermediate for the number of feeding periods in 24 hours ($p<0.05$).
There were also significant differences between the experimental variant when the feeding space was maximal and when it was minimum for the number of feeding periods in 24 hours ($p<0.05$).
There were significant differences between the experimental variant when the feeding space was maximal and when it was intermediate for the total time spent feeding in 24 hours ($p<0.05$).
There were significant differences between the experimental variant when the feeding space was intermediate and when it was minimal for the total time spent feeding in 24 hours ($p<0.05$).
There were significant differences between the experimental variant when the feeding space was maximal and when it was minimum for the length of feeding periods in 24 hours ($p<0.05$).

Table 1. Feeding behavior of calves when the feeding space was maximal (0.6 m per calf)

Day period		07:00-15:00	15:00-23:00	23:00-07:00	In 24 hours
Feeding periods	X±SEM	4.8±0.37	3.6±0.25	1.6±0.25	10.0±0.32
	SD	0.84	0.55	0.55	0.71
	v%	17.4	15.2	29.3	7.1
	min.	4.0	3.0	1.0	9.0
	max.	6.0	4.0	2.0	11.0
Total length of feeding periods (min.)	X±SEM	292.0±30.0	197.6±10.2	71.0±7.2	560.6±32.5
	SD	67.2	22.9	16.1	72.7
	v%	23.0	11.6	22.7	12.9
	min.	216.0	164.0	49.0	497.0
	max.	376.0	223.0	93.0	646.0
	%*	60.8	41.2	14.8	38.5
Length of a feeding period (min./period)	X±SEM	61.1±5.06	55.4±2.93	46.9±5.16	56.2±3.37
	SD	11.32	6.56	11.54	7.52
	v%	18.5	11.8	24.6	13.4
	min.	46.8	49.2	35.5	47.9
	max.	75.2	66.3	65.0	64.6

Differences and their significance	I1 - I2	I1 - I3	I2 - I3
Feeding periods	1.2*	3.2*	2.0**
Total length of feeding periods (min.)	94.4*	221.0*	126.6*
Length of a feeding period (min./period)	5.7^{ns}	14.2^{ns}	8.5^{ns}

*-% from possible time (8 or 24 hours)

- I1 – time frame between 07:00-15:00, I2 – time frame between 15:00-23:00, I3 - time frame between 23:00-07:00
- ns = p>0.05, * = p<0.05, ** = p<0.01, *** = p<0.001
- positive values are in the advantage of the first compared segment and the negative values are in the advantage of the second segment

Table 2. Feeding behavior of calves when the feeding space was intermediate (0.32 m per calf)

Day period		07:00-15:00	15:00-23:00	23:00-07:00	In 24 hours
Feeding periods	X±SEM	2.8±0.37	2.0±0.0	2.0±0.0	6.8±0.37
	SD	0.84	0.0	0.0	0.84
	v%	29.8	0.0	0.0	12.3
	min.	2.0	2.0	2.0	6.0
	max.	4.0	2.0	2.0	8.0
Total length of feeding periods (min.)	X±SEM	174.8±13.2	193.2±15.0	53.0±9.6	421.0±23.0
	SD	29.5	33.4	21.4	51.5
	v%	16.9	17.3	29.3	12.2
	min.	140.0	146.0	25.0	342.0
	max.	206.0	240.0	75.0	477.0
	%*	36.4	40.2	11.0	29.2
Length of a feeding period (min./period)	X±SEM	65.0±5.93	96.6±7.48	26.5±4.78	62.6±4.57
	SD	13.26	16.72	10.68	10.21
	v%	20.4	17.3	29.3	16.3
	min.	51.5	73.0	12.5	48.9
	max.	83.0	120.0	37.5	75.8

Differences and their significance	I1 - I2	I1 - I3	I2 - I3
Feeding periods	0.8^{ns}	0.8^{ns}	0.0^{ns}
Total length of feeding periods (min.)	-18.4^{ns}	121.8*	140.2*
Length of a feeding period (min./period)	-31.6*	38.5*	70.1*

*-% from possible time (8 or 24 hours)

- I1 – time frame between 07:00-15:00, I2 – time frame between 15:00-23:00, I3 - time frame between 23:00-07:00
- ns = p>0.05, * = p<0.05, ** = p<0.01, *** = p<0.001
- positive values are in the advantage of the first compared segment and the negative values are in the advantage of the second segment

Table 3. Feeding behavior of calves when the feeding space was minimal (0.28 m per calf)

Day period		07:00-15:00	15:00-23:00	23:00-07:00	In 24 hours
Feeding periods	X±SEM	2.8±0.37	2.6±0.25	1.0±0.0	6.4±0.4
	SD	0.84	0.55	0.0	0.89
	v%	14.0	21.1	0.0	14.0
	min.	2.0	2.0	1.0	5.0
	max.	4.0	3.0	1.0	7.0
Total length of feeding periods (min.)	X±SEM	254.8±14.2	227.4±21.9	30.0±4.3	512.2±24.9
	SD	31.7	49.0	9.6	55.6
	v%	12.4	21.6	28.9	10.9
	min.	223.0	170.0	21.0	455.0
	max.	297.0	284.0	44.0	597.0
	%*	53.1	47.4	6.2	35.6
Length of a feeding period (min./period)	X±SEM	97.6±14.6	89.1±8.27	30.0±4.29	81.7±7.41
	SD	32.6	18.5	9.6	16.6
	v%	29.4	20.7	28.9	20.3
	min.	69.5	62.7	21.0	65.0
	max.	148.5	114.0	44.0	99.5

Differences and their significance	I1 - I2	I1 - I3	I2 - I3
Feeding periods	0.2^{ns}	1.8*	1.6*
Total length of feeding periods (min.)	27.4^{ns}	224.8*	197.4*
Length of a feeding period (min./period)	8.5^{ns}	67.6*	59.1*

*-% from possible time (8 or 24 hours)
- I1 – time frame between 07:00-15:00, I2 – time frame between 15:00-23:00, I3 - time frame between 23:00-07:00
- ns = p>0.05, * = p<0.05, ** = p<0.01, *** = p<0.001
- positive values are in the advantage of the first compared segment and the negative values are in the advantage of the second segment

Table 4. Differences and their significance for feeding behavior

Day period	Specification	MFS	IFS	MinFS	Differences		
					MFS-IFS	MFS-MinFS	IFS-MinFS
I1	Feeding periods	4.8	2.8	2.8	2.0*	2.0*	0.0^{ns}
	Total length of feeding periods (min.)	292.0	174.8	254.8	117.2*	37.2^{ns}	-80.0*
	Length of a feeding period (min./period)	61.1	65.0	97.6	-3.9^{ns}	-36.5*	-32.6^{ns}
I2	Feeding periods	3.6	2.0	2.6	1.6*	1.0^{ns}	-0.6^{ns}
	Total length of feeding periods (min.)	197.6	193.2	227.4	4.4^{ns}	-29.8^{ns}	34.2^{ns}
	Length of a feeding period (min./period)	55.4	96.6	89.1	-41.2*	-33.7*	7.5^{ns}
I3	Feeding periods	1.6	2.0	1.0	-0.4^{ns}	0.6^{ns}	1.0*
	Total length of feeding periods (min.)	71.0	53.0	30.0	18.0^{ns}	41.0*	23.0^{ns}
	Length of a feeding period (min./period)	46.9	26.5	30.0	20.4*	16.9*	-3.5^{ns}
In 24 hours	Feeding periods	10.0	6.8	6.4	3.2*	3.6*	0.4^{ns}
	Total length of feeding periods (min.)	560.6	421.0	512.2	139.6*	48.4^{ns}	-91.2*
	Length of a feeding period (min./period)	56.2	62.6	81.7	-6.4^{ns}	-25.5*	-19.1^{ns}

- I1 – time frame between **07:00-15:00,** I2 – time frame between **15:00-23:00,** I3 - time frame between **23:00-07:00**
- ns = p>0.05, * = p<0.05, ** = p<0.01, *** = p<0.001
- Positive values are in the advantage of the first compared segment and the negative values are in the advantage of the second segment
- MFS – maximum feeding space, IFS – intermediate feeding space, MinFS – minimum feeding space

4. Conclusions

Calves fed themselves 560 minutes per day during 10 feeding periods with an average length of 56 minutes when the maximum feeding space allowance was provided (0.6 m per calf).
Calves fed themselves 421 minutes per day during 6.8 feeding periods with an average length of 62.6 minutes when the intermediate feeding space allowance was provided (0.32 m per calf).
Calves fed themselves 512 minutes per day during 6.4 feeding periods with an average length of 81.7 minutes when the minimum feeding space allowance was provided (0.28 m per calf).

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