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Original Contribution

WELFARE AND HEALTH OF DAIRY CATTLE - EFFECT OF THE LEVEL OF NUTRITION AND BODY CONDITION AT THE END OF PREGNANCY AND EARLY LACTATION

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ABSTRACT

Forty cows of the Black-and-White breed at 2nd to 5th lactation were divided into 4 groups (10 in each group) and were fed according to 4 different regimes during the dry period and the first 84 days of lactation. Nutrition levels for both periods were: moderate-moderate (MM); moderate-abundant (MH); abundant-moderate (HM) and abundant-abundant (HH). The abundant feeding during the dry period that had resulted in BCS of 3.8 points of cows at calving had positive effect on milk production but relatively unfavourable effect on the calving process, placenta discharge, conception rate and occurrence of subclinical ketosis compared to moderate nutrition during the dry period and calving at BCS of 2.95 points. By feeding high-energy rations during the first 12 weeks of lactation less body reserves in the beginning of lactation can be compensated in cows with BCS of 2.95 points at calving and nearly the same milk production can be achieved, as in cows fed abundantly during the dry period and lactation with BCS of 3.8 points at calving. Concerning reproduction and health status of cows it is recommended for them to have BCS of about 3 points before calving. Milk protein yield is significantly higher ($p<0.05$) in abundant nutrition during lactation.

Key words: welfare, body condition, dairy cows, dry period, early lactation, health status, level of nutrition, reproduction.

INTRODUCTION

Broster (1971) (1) has made an extensive survey of earlier studies on effect of the level of nutrition during the dry period on milk production As a result he concluded that extra forage led to an increase of milk production during the following lactation. The effect was better in addition to originally scarce rations than to rations that provided high level of nutrition and was close to zero in an extremely abundant original ration.

Studies by McLeod and McLeod (2) returned similar results in which the cows in good body condition at calving produced more milk and at same time had rapidly reduced live weight compared to the thin ones. On the other hand, Frood and Groxton (3) reported higher milk production of cows, which were thinner during their dry period. Other studies also showed that scarce nutrition during the dry period had no favourable effect on milk production during the following lactation (4), even when cows lost weight during their dry period (5, 6, 7, 8).

Other authors suggested that losing weight at the end of the pregnancy period was not desirable due to the unfavourable effect on the calf and the health status of cows (9, 10, 11).

Holter et al. (12) did not find a significant difference in milk production of cows in medium and good body condition at the end of their pregnancy.

Jones and Garnsworthy (13) had concluded that when rations fed to cows postpartum were low in energy value, the fat and the thin cows took in approximately the same amount of food (consumption was regulated by the physical mechanism of filling up the rumen). Fat cows make up for the lack of energy by using their body reserves and produce their almost normal milk yield. When rations rich in energy were fed to thin cows, they took in more dry matter (consumption is regulated by physiological mechanism related to the need for energy other nutrition substances) and were able to maintain the same milk yield as cows that had grown fat before

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calving.

It is evident that published data about the effect of the level of nutrition at the end of pregnancy on milk production after calving are quite controversial. That made us to undertake the present study in order to find out the effect of nutrition level and body condition at the end of pregnancy and beginning of lactation on the calving process, milk productivity, following conception of cows, and on the rate of ketosis.

MATERIALS AND METHODS

Animals, nutrition and rearing

The experiment was carried out with 40 Black-and-White cows at 2nd to 5th lactation. Cows, expected to calve from November 1st to December 31st were chosen in order to conduct the entire experiment under winter type of nutrition. Animals were divided into two groups of 20 and each group was subdivided into 2 subgroups of 10 cows each. Groups and subgroups were matched for age (by the number of lactation), milk yield, and percentage of fat during the last completed lactation and live weight at drying.

The experiment started at different time for the different cows at termination of lactation. In fact, cows have been included in the experiment 60 days before the anticipated calving. The experiment lasted up to 84th day of the following lactation.

The two groups were under different nutrition schedules during the dry period in order to be able to reach BCS according to the five-point system of about three for the first group and about four for the second towards the end of the pregnancy period. The basic roughage ration was the same for the two groups and the difference in the level of nutrition was achieved by giving different amounts of compound feeds. Provisionally we named one of the levels of nutrition (with 6 kg/day compound feed) moderate and the other one – high. **Table 1** presents the nutrition plan.

Table 1. *Plan of feeding of cows in the experiment*

Group	***Dry period (days)***	***Lactation period (84 days)***
I	Moderately (20 cows) - M	Moderately (10 cows) - MM Abundantly (10 cows) – MH
II	Abundantly (20 cows)- H	Moderately (10 cows) - HM Abundantly (10 cows) - HH

The ration composition for the first group, fed moderately during the dry period, is presented on **Table 2**. The ration for the second group was similar to that for the first one, but contained extra 3.3 kg of compound feeds per cow daily.

The energy and nutrient content of 1 kg compound feed was: 1.1 food units for milk, 180 g crude protein, 106.1 g protein, digestible in the intestines, 24.2 g balance of protein in the rumen, 6 g of calcium and 6.3 g of phosphate.

All cows of a given group received the same ration during the entire dry period. Cows from the first group with moderate nutrition were an exception; these were given 1.5 kg compound feed during the last but one week and 3 kg during the last week in addition to the ration showed on **Table 2.**

Table 2. *Ration for cows fed moderately during the dry period *#*

Forages	***kg***	***DM, kg***	***FUM***	***CP, g***	***PDI, g***	***BPR, g***	***Ca, g***	***P, g***
Maize silage	8	2.48	2.43	212	159	-46	10.2	6.7
Ground cornstalks	5.5	4.67	3.41	271	308	-204	23.6	5.5
Alfalfa hay	2	1.70	1.32	296	160	63	28.4	4.2
Sunflower oil meal	1.5	1.31	1.30	534	247	203	5.5	16.8
Total	17.0	10.16	8.46	1310	874	16	67.7	33.2

**abbreviations denote: DM – dry matter; FUM – food units for milk; CP – crude protein; PDI – protein, digestible in the intestine; BPR – balance of protein in the rumen; Ca – calcium; P – phosphorus.*
#the abundantly fed cows received the same ration plus 3.3 kg of compound feed per day.

After calving cows from the two groups were subdivided into 2 subgroups containing 10 cows each. The first group was fed moderate amount (6 kg/day) and the second one –high amount (10 kg/day) of compound feed (**Table 3 and Table 4**).

The chemical composition of the feeds is presented on **Table 5**.

During the lactation period of all cows alfalfa hay was fed ad libitum and over 10% of daily remains was maintained. The cornstalks cut on a machine with a sieve of 10 mm openings were mixed with the maize silage. First the cornstalks were laid in the through and on top of it – the maize silage. Both were manually mixed with a pitchfork.

The compound feed was fed in equal amounts to each group during the entire 84-day lactation period; hence the so-called "Flat feeding" was applied. Gradually, however, cows were accustomed to the complete rations, given on **Tables 2 and 3**. On the first day after calving 3.5 kg of compound feed was given to all cows. Afterwards the compound feed was increased by 0.5 kg each day. The subgroups on moderate nutrition received 3 kg of compound feed twice and the one on abundant nutrition – 2.5 kg of compound feed 4 times daily. Roughages were given twice daily (**Table 2** and **Table 3**) from the first to the last day of the study period.

Table 3. *Ration for the first 84 days post partum of moderately fed cows**

Forages	***kg***	***DM, kg***	***FUM***	***CP, g***	***PDI, g***	***BPR, g***	***Ca, g***	***P, g***
Maize silage	12	3.72	3.65	315	238	-68	15.2	10.0
Ground cornstalks	3	2.55	1.86	147	168	-112	12.5	3.0
Alfalfa hay**	6.5	5.51	4.29	961	519	206	92.3	13.7
Compound feed	6	5.22	6.60	1080	636	145	36.0	37.8
Total	27.5	17.00	16.40	2503	1561	171	156.0	64.5

**abbreviations are as in table 1.*
***alfalfa hay has been fed ad libitum. The quantity expected to be eaten by cows is given here.*

Table 4*. Ration for the first 84 days post partum of abundant fed cows**

Forages	***kg***	***DM, kg***	***FUM***	***CP, g***	***PDI, g***	***BPR, g***	***Ca, g***	***P, g***
Maize silage	12	3.72	3.65	315	238	-68	15.2	10.0
Ground cornstalks	3	2.55	1.86	147	147	-112	12.5	3.0
Alfalfa hay**	4.5	3.82	2.97	665	360	143	63.9	9.5
Compound feed	10	8.71	11.0	1800	1061	242	60.0	63.0
Total	29.5	18.80	19.48	2927	1806	205	151.6	85.0

**abbreviations are as in table 1.*
***alfalfa hay has been fed ad libitum. The quantity expected to be eaten by cows is given*

Table 5*. Chemical composition of feeds**

Feeds	***DM, %***	***In percent of the dry matter***				
		CP	EE	CF	NFE	Ash
Maize silage	30.98	8.48	3.17	23.61	58.63	6.77
Ground cornstalks	85.07	5.77	1.74	34.07	50.87	7.55
Alfalfa hay	84.88	17.41	2.58	33.14	38.58	8.29
Sunflower meal	87.12	40.85	1.94	18.89	30.84	7.48
Compound feed	87.05	20.68	2.87	7.18	65.33	3.94

**abbreviations denote: DM – dry matter; CP – crude protein; EE – ether extract; CF – crude fibre; NFE – nitrogen free extracts.*

Cows were reared tied in a cowshed with feeders and drinkers. Every day they were exercised for 4 hours in yards adjacent to the barn. For the sake of convenience at feeding time cows of one and the same group (or subgroup during the lactation period) were tied next to one another (at one place in the barn).

Milking was performed with a milk pipeline system twice daily.

Controlled parameters

The live weight of cows was measured on a scale for cattle at the beginning of the experiment (60 days before the expected calving), 12 to 24 hours after calving and at the end of the experiment (84 days after calving). Weighing was done after the morning milking before giving the forages but after the morning ration of compound feed.

Body condition scoring was done according to the five-point system, described by Todorov and Mitev (14) simultaneously with the weighing of cows by two experts doing this independently. The mean scores were adopted.

Milk production was controlled on an individual basis once a week in the evening and in the morning. The proportional mean sample from the two milking was tested for fat and protein content on an infrared analyser MilkoScan (*Foss Electric A/S, Denmark*). Feed consumption was controlled in the groups for the forages. Remains were collected each day, weighed and subtracted from the respective feed. There were practically almost no remains from the maize silage and the ground cornstalks mixed with it. Only big pieces of corncobs and thick cornstalks remained. Because of their small quantity, no analysis of these remains was made for making correction of the

consumption.

Compound feed was given equally to all cows in the group (or subgroup) during the lactation period and it was measured individually for each cow before each feeding with a volume measure tested for weight.

Reproduction of cows was registered by recording the calving method as follows: easily (without help), with little help and with a lot of help. Placenta discharge was classified as normal if it took place spontaneously up to 12 hours postpartum or as retention when it has taken place either with medicines or with mechanical help after 12 hours.

All cows had been inseminated using same inseminator and insemination was recorded.

Sub-clinical ketosis was determined by a ketotest (*Ketostix, Ames Company, England*) for urine on the 7^{th} to 10^{th} and on the 14^{th} to 17^{th} day postpartum.

The chemical composition of feeds was determined by the Weende method (15).

The statistical data processing was made by the ANOVA method using the Statistica computer packet (16).

RESULTS AND DISCUSSION

Live weight and body condition score

Cows fed moderately during the dry period received 9 food units for milk (FUM) on the

Table 6. *Feed consumption, live weight, body condition score (BCS), reproduction and sub-clinical ketosis in the studied cows*

Level of nutrition during:	***Treatments:***			
- dry period	***Moderate – M***		***Abundant – H***	
- lactation	***Moderate - MM***	***Abundant - MH***	***Moderate - HM***	***Abundant - HH***
Consumed feed for a 60 day dry period, kg/cows				
Maize silage				
Ground cornstalks	478		465	
Alfalfa hay	329		320	
Sunflower oil meal	118		118	
Compound feed	90		90	
Dry matter	32		205	
FUM (total)	634		773	
FUM (per day)	541		721	
	9.02		12.02	
Consumed feed for a 60 day dry period, kg/cows				
Maize silage	1001	958	934	911
Ground cornstalks	250	239	233	228
Alfalfa hay	558	396	475	358
Compound feed	504	840	504	840
Dry matter	1436	1568	1330	1511
FUM (total)	1392	1625	1296	1579
FUM (per day)	16.45	19.35	15.43	18.80
Live weight, kg				
- at drying	589	582	586	578
- after calving	560	571	590	579
- 84 days after calving	557	564	577	586
Body condition score, points				
- at drying off	2.6	2.6	2.7	2.6
- after calving	2.9	3.0	3.8	3.8
- 84 days after calving	2.5	2.6	2.5	2.7
Reproduction:				
Calving with little help, number of cows	1	1	2	1
Caving with a lot of help, number of cows	1	0	1	2
Placenta retention, number	2	0	2	2
Open days (calving to conception)	92	90	102	98
Number inseminations per 1 conception	1.9	1.8	2.4	2.2
Subclinical ketosis, number	1	0	3	1

Average, which was more than the quantity required for maintenance of live and foetus development (17). This has enabled cows to improve their body condition from 2.6 to 2.9-3 points or by 0.35 points on the average (**Table 6**).

Abundantly fed cows intake in 12 FUM on average daily reached BCS 3.8 at calving

(**Table 6**). They have increased their BCS during the dry period by 1.15 points on the average.

BCS of cows in both groups was within desired limits (14). Moderately fed cows, however, possessed the minimum desired BCS, and while abundantly fed ones were close to the maximum admissible score. Due to technical difficulties live weight of cows immediately before calving was not measured. If we assume that live weight loss at calving, which was relatively constant, was 79 kg on the average (18, 19) it could be presumed that during the dry period moderately fed cows had a growth of 49 kg or 817 g/day and the abundantly fed ones – 68.5 kg or 1142 g per day. For the extra 180 FUM taken in by the abundantly fed cows during the dry period (**Table 6**) compared to the moderately fed ones, BCS has additionally increased by 0.8 points (1.15-0.35). Therefore, for increasing BCS by one point during the dry period, about 225 FUM were needed. This value of the energy equivalent per point has been calculated by Wright and Russel (20).

After calving abundantly fed cows weighed 29 kg more than the ones fed moderately. On the other hand, during the dry period, moderately fed cows used to weigh more. The growth of abundantly fed cows is 32.5 kg more than that of the ones fed moderately during the dry period (**Table 6**). A kilogram of extra growth was obtained from 5.53 FUM.

At the end of the experiment only the group that had been fed abundantly, both during the dry period and the lactation period, had achieved the original live weight at termination of lactation (**Table 6**). Subgroups fed abundantly during lactation restored the live weight they had had immediately before calving on the 84th day of lactation, but not their BCS. The considerable discrepancy between the two parameters could be accounted for by the great differences in filling the digestive tract (which is undoubtedly much more 84 days after calving due to the consumption of more feed and water than in cows immediately after parturition) and the delay in the increase of BCS reported in other studies compared to the increase in live weight (18, 21, 22).

Our results confirm the concept that BCS was a better indicator of body changes than live weight (23).

Reproduction and subclinical ketosis

Better conditioned cows with BCS of 3.8 at calving as a result of abundant nutrition during the dry period had more difficult parturition compared to moderately fed cows with BCS of 2.95. The number of calving with help was 6 in abundant feeding during the dry period versus three in moderate feeding group (**Table 6**). The situation with placenta retention was similar – 4 vs. 2.

Conception of cows with BCS of 3.8 at calving required greater number of inseminations – 2-3 versus 1.85 per conception in cows with BCS of about 3. As a result the service period was 9 days longer in better-conditioned cows than in those with BCS of 2.95 on the average at calving.

The data about parturition and the following conception were in line with previous studies of ours (19), as well as with the more difficult parturition and conception of fat cows reported by other authors (24) (**Table 6**). The results of the study reveal that, as far as reproduction and occurrence of sub-clinical ketosis were concerned, it was better for cows to calve at BCS of about 3 instead of at BCS of 3.8.

Milk production and feed utilization

During the first 3 weeks postpartum there were no significant differences in the daily milk yield of cows irrespective of the level of nutrition before and after calving (**Table 7**). During the following weeks cows fed moderately during both study periods revealed lower milk yield than the other subgroups.

Cows fed moderately during the dry period with high-energy ration postpartum revealed milk yield that did not differ significantly from the milk yield of cows fed abundantly during both periods of the experiment (**Table 7**).

During the first 8 weeks postpartum cows fed abundantly during the dry period and moderately during the lactation period did not show considerably lower milk yield than cows fed abundantly during lactation (**Table 7**). Obviously that had been achieved at the expense of utilising the big body reserves stored up during the dry period. After finishing these reserves, however, their milk yield was decreased after the 10th week (**Table 7**).

No significant differences in the fat content of milk have been recorded in cows from the various groups and subgroups (**Table 8**).

There was a tendency towards higher protein content of milk in cows fed abundantly during lactation compared to the

ones fed moderately irrespective of the level of nutrition during the dry period (**Table 8**). Similar data have been established by Grainger et al. (25).

Table 7. *Milk yield of cows weekly*

Level of nutrition during:	***Treatments:***			
- dry period	***Moderate - M***		***Abundant – H***	
- lactation	***Moderate – MM***	***Abundant - MH***	***Moderate - HM***	***Abundant - HH***
Weeks after calving	Average daily milk yield, kg			
1	18.5a	19.1a	20.4a	20.2a
2	24.8a	25.0a	26.4a	26.5a
3	27.0a	27.3b	27.9a	28.8a
4	25.3a	28.4b	28.3b	29.6b
5	24.0a	28.5b	28.7b	29.0b
6	22.4a	28.3b	27.2b	29.0b
7	21.2a	27.3b	25.8b	28.3b
8	20.3a	26.4bc	24.6b	27.7b
9	19.5a	26.0b	23.3c	26.4b
10	18.8a	25.4b	22.2c	25.9b
11	17.9a	24.6b	21.0c	25.1b
12	16.9a	23.4b	20.0c	24.3b

a, b, c – means with different letters within the same row differ at P<0,05

Table 8*. Fat and protein content of milk by weeks*

Level of nutrition during:	***Treatments:***			
- dry period	***Moderate - M***		***Abundant - H***	
- lactation	***Moderate - MM***	***Abundant - MH***	***Moderate - HM***	***Abundant - HH***
Weeks after calving	*Average percentage of milk fat*			
1	4.42	4.46	4.51	4.53
2	4.28	4.31	4.34	4.33
3	4.05	3.94	4.02	4.01
4	3.88	3.79	3.93	3.87
5	3.75	3.72	3.85	3.85
6	3.72	3.67	3.74	3.68
7	3.66	3.60	3.75	3.58
8	3.59	3.61	3.72	3.67
9	3.63	3.63	3.76	3.69
10	3.68	3.72	3.79	3.75
11	3.76	3.73	3.82	3.78
12	3.81	3.77	3.80	3.79
	Average percentage of milk protein			
1	4.00	3.94	3.98	4.01
2	3.28	3.34	3.26	3.36
3	3.17	3.32	3.09	3.28
4	3.10	3.32	3.12	3.24
5	3.12	3.37	3.10	3.21
6	3.15	3.30	3.11	3.22
7	3.17	3.30	3.14	3.24
8	3.14	3.32	3.15	3.28
9	3.15	3.34	3.17	3.33
10	3.19	3.35	3.17	3.36
11	3.22	3.34	3.20	3.37
12	3.24	3.36	3.26	3.38

**Differences in framework of one week are not significant (P<0.05)*

Protein yield was significantly higher (p<0.05) in cows fed abundantly during lactation compared to the ones fed lightly (**Table 9**). The effect was a result of the higher milk yield as well as of the higher percentage of milk protein.

Table 9. *Average daily milk yield and expenses of feed units for milk (FUM) per 1 kg of 4% fat corrected*

milk (FCM)

Level of nutrition during:	***Treatments:***			
- dry period	***Moderate - M***		***Abundant – H***	
- lactation	***Moderate - MM***	***Abundant - MH***	***Moderate - HM***	***Abundant - HH***
Milk yield, kg/day	21.38a	25.81b	24.65b	26.73b
Milk fat, %	3.86a	3.81a	3.92	3.86a
Milk protein, %	3.23a	3.36a	3.21a	3.34a
Fat yield, g/day	825a	983b	966b	1024b
Protein yield, g/day	691a	867bc	791ab	893c
4% FCM, kg/day	20.63a	24.5b	24.15b	25.60b
Consumed FUM/cow/day during lactation	16.45	19.34	15.43	18.79
FUM per 1 kg of 4% FCM	0.80	0.79	0.64	0.73
Consumed extra FUM/day at abundant feeding during the dry period	0	0	3.00	3.00
Consumed FUM during lactation + the extra FUM during the dry period FUM FUM/kg 4% FCM	16.45 0.80	19.34 0.79	18.43 0.76	21.79 0.85
Live weight difference on the 84th and 1st day post partum, kg	-13	13	-2	7

a, b, c – means within the same row with different letters are statistically significant at P<0.05

Fat content was significantly higher during the first 4-6 weeks and protein content – during the first 2-3 weeks– than the later weeks of the experiment.

The average milk yield for the entire experimental period was significantly higher - 1796 kg/cow or 21.38 kg per cow daily at moderate nutrition during the dry period and lactation versus 2071 to 2246 kg in the other subgroups (**Table 9**). The highest milk yield was achieved by cows fed abundantly during the dry period and lactation, 2150 kg, 4% fat corrected milk for 84 days of lactation or 25.6 kg per day. Second in milk yield were the cows fed moderately during the dry period and abundantly during lactation. Third in rank were cows fed abundantly during the dry period and moderately during lactation. The differences between the three groups, however, were not significant ($p<0.05$) (**Table 9**).

The results of the experiment show that calving of cows in good body condition was an important prerequisite for obtaining high milk yield following lactation. With abundant nutrition and high-energy intake at the beginning of lactation cows with BCS of about 3 points at calving were able to achieve high milk yield that does not differ significantly from the milk yield of cows with BCS at calving 3.8 points and fed abundantly thereafter. Hence, the effect of BCS at calving on milk production depends on the type of ration during lactation as well. Good body condition at the end of lactation (BCS of about 3.8) was favourable for milk production during lactation, but its effect on the calving process, conception rate and the occurrence of sub-clinical ketosis was unfavourable compared to cows with BCS of about 3 points at the end of pregnancy.

The data on **Table 6** show that small quantities of compound feed in cows' rations have almost no effect on forages intake, as was during the dry period in the experiment. At 1.5 or 4.8 kg of compound feed the quantity of intake of forages was practically the same.

When high quantities of compound feed were fed (10kg/day/cow) forage consumption was reduced compared to rations with moderate quantities of compound feed (6 kg/day/cows). Each kilogram of compound feed (0.87 kg of dry matter) reduced intake of dry matter from the forages with – 405 g on the average (from 332 to 478 g) in our experiment.

With cows fed abundantly during the dry period, which calved in good body condition (BCS 3.8) there was a tendency of intake of less forage in the beginning of lactation compared to cows that calved with BCS of about 3 points. For a total of 84 lactation days cows with BCS 3.8 points at calving consumed from 0.68 kg to 1.2 kg less dry matter than cows with BCS 2.95 at calving. Obviously during the first weeks postpartum differences were greater and with the progress of lactation they decreased.

Reduced feed consumption of cows with BCS 3.6 to 3.9 points has been recorded by Thatcher (10) and Garnsworthy and Jones (26).

Great FUM expenses per 1 kg of 4% FCM at abundant nutrition during the dry period and lactation were observed compared

to the other subgroups when considering feed intake during both periods of the experiment (**Table 9**).

The data about feed outlay per 1 kg of 4% FCM on **Table 9** should be regarded as provisional since no differences in the live weight and BCS at the end of the experiment have been recorded. Cows with higher milk yield up to the 84th day of lactation will probably continue to produce more milk later, even with equal nutrition due to the so-called "consequence" (27).

On the other hand in cows with better body condition and higher live weight at the end of experiment it was expected consequently to save feed for obtaining equal desired BCS before for following parturition.

CONCLUSIONS

The 4 nutrition schemes, moderate-moderate (MM); moderate-abundant (MH); abundant-moderate (HM) and abundant-abundant (HH) during the dry period and the first 84 days of lactation, were tested in the present study. And the following observations were made: High feeding level during the dry period resulted in BCS of 3.8 points of cows at calving and had positive effect on milk production but had relatively unfavourable effect on the calving process, placenta discharge, conception rate and occurrence of sub-clinical ketosis compared to moderate nutrition during the dry period and calving at BCS of 2.95 points. Furthermore, the following observations were made:

1. by feeding high-energy rations during the first 12 weeks of lactation less body reserves in the beginning of lactation can be compensated in cows with BCS of 2.95 points at calving and nearly the same milk production can be achieved, as in cows fed abundantly during the dry period and lactation with BCS of 3.8 points at calving.
2. in terms of reproduction and health status it was recommended for cow to have BCS of about 3 points before calving.
3. milk protein yield was significantly higher ($p<0.05$) in abundant nutrition during lactation. The effect is achieved due to higher milk production and the higher percentage of milk protein.

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