

Ph. D. THESIS

**THE EFFECT OF AGE AND BODY CONDITION SCORE ON THE MILK
PRODUCTION AND REPRODUCTION OF SAANEN GOATS**

Myrtil Gráff

Supervisors:

Prof.Dr. András Jávör C.Sc.

Dr. habil. Sándor Kukovics C.Sc.



UNIVERSITY OF DEBRECEN
PHD SCHOOL OF ANIMAL HUSBANDRY
Debrecen, 2011

1. THE BACKGROUND AND THE OBJECTIVES OF THE RESEARCH

One essential tool to maintain and protect lawn areas as well as the environment is the sheep, the goat, and also the people who take care of them. They produce high-quality meat and milk. These small ruminants graze in areas where other domestic animals do not live, therefore they provide liveable conditions for the entire population and prevent the depopulation of areas. Over 4/5 of the available 1.1 million hectares of grassland including the flora of the national parks and reserves should be maintained by these animals. In addition, as they utilise disadvantaged, even the most disadvantaged areas, they provide working and living conditions for the people who live there, in this way for the whole society. In Hungary, the sheep industry (about 1 million ewes - today fewer than 900 thousand) gives approximately 1% of the agricultural products, while the goat industry (about 40 thousand she-goats, the latest estimated figures 35 to 38 thousand) gives less than 5 percent (KUKOVICS, 2008 b; KUKOVICS, 2011).

In order for the goat to be economical, there are many viewpoints to consider. Several authors describe the condition has close relationship with the milk production and proliferation of the animals. Regular body condition scoring (which is easy to learn), contributes to the increase of the efficiency of production (milk and offspring). However, the body condition with regard to production and reproductive phases is a constantly changing state, therefore it also changes in the different stages of lactation. Body condition is often considered as an energy reserve indicator of the animals, but it is related to the health, the feed utilization and the age of the animals as well. Only the animals with right body condition can be expected to produce the desired number of offspring and sufficient quantity of milk. However, body condition scoring is rarely used in practice, and if it is, then mainly in cattle breeding. In Hungary, the goat-farmers practically do not use this method to check the condition of their animals. In my paper I wish to highlight the significance of body condition scoring.

The first objective of the research was to develop a body condition scoring system for Saanen goats then, based on this, try to answer the following questions:

- How the number of offspring influences the condition of the mother-goats?
- Which BCS values provide the highest milk yield at different stages of lactation?
- In which lactation is the most milk produced? How long should mother goats be kept for breeding based on their milk production?

- In which lactation is the largest number of offspring? How long should mother goats be kept for breeding based on the litter-number?
- How does the BCS change with the increasing age? At what age are they in the best condition?
- At what age are they at their peak performance regarding milk production and prolificacy? Which BCS values are necessary to achieve this?
- What is the heritability of the BCS values like?

METHOD

• Introduction and description of the farms in the research

The examinations were performed on five Saanen goat farms, which were selected from the records of the Hungarian Goat Keepers and Breeders' Association

I examined 56 mother goats **on Farm 1.**

Grazing was the basis for nutrition, which was supplemented with 300-300 grams of feed mix (corn, wheat, barley, and triticale) at the milking in the morning and in the evening, and occasionally with potatoes. The animals could graze on good quality alluvial soil by the River Danube on a territory full of trees, shrubs, and grassy pasture. They got drinking water three times a day. They were milked twice a day with bucket milking machine. There were always two bucks with the mothers so that kidding was not concentrated only in early spring period, therefore kidding was virtually constant in the herd. This also meant that the young females got pregnant early, when they were 7-8 months old.

There were 17 mother goats and a buck **on Farm 2.**

The animals were grazing around the homestead, which was sandy, dry, sparsely covered with grass and with no bushy, wooded area. The pasture quality was acceptable only in May, in the rainy period. Their main source of food was the poor quality pasture grass. At the morning and evening milking the goats got 150-150 grams of corn meal, which did not satisfy their forage needs. The animals were given drinking water only once a day at the evening milking. The mother goats were milked by hand twice a day. The kidding period was concentrated in February and March.

There were 45 mother goats and 2 bucks kept for breeding **on Farm 3.**

They had a milk processing plant of their own, with HACCP quality assurance system, where they processed the milk they milked from their goats with bucket milking machine twice a day. The goat milk was used for producing several types of goat cheese, which were sold to shops and restaurants. The animals could graze on good quality native-grassland-type pasture on chernozem soil. Grazing was the basis of nutrition, however the goats were also given alfalfa and meadow hay as well as 300-300 grams of feed mix (wheat, bran, corn) at the morning and evening milking. Salt lick and water was placed in the barn and they could drink at any time during the day. The majority of kidding was in January and February.

17 mother goats and one buck were held **on Farm 4.**

The grassland around the farm was poor quality formed on salty soils. The animals could graze on burned out, sedge, sparse-grass field except in May, the rainy month.. Here the nutrition of the goats was also based on the pasture, but it was necessary to give supplementary feed due to its poor quality. During milking the goats were given 150-200 grams of feed mix (wheat, corn, barley, lime, salt), followed by grass hay and alfalfa. The animals got water to drink three times a day. Milking was done by hand in on the yard twice a day. Kidding was in late February and early March.

The number of goats was around 80 **on Farm 5.**

A pen and good quality native grassland with acacia, formed on meadow soil, belonged to the barn. The goats were grazing on this fenced pasture (9 ha) intermittently.. In addition to grazing, the goats were given 300-300 grams of feed mix (wheat, barley, maize) during milking. At the end of the grazing season, good quality alfalfa and meadow hay was placed ad libitum in their pen and salt lick was available for them as well. Milking was done by fixed milking machines in milking parlours twice a day. Milk was led from here to the milk processing unit through a pipe. Kidding concentrated around February and March.

- **The method and the system of data collection**

The examinations were carried out on Farms 1, 2, 3 and 4 from the beginning of May until the end of September, 2008, for five months. The data collection on Farm 5 lasted three years, from 2005 to 2007. I did body condition scoring on the animals on each farm on the very same day of each month. Body condition was determined by a 9-grade body condition scoring system we had developed during the examinations of goats on Farm 5. Wit regard to the fact that the development of this method is part of my scientific work, the method itself will be described in details in chapter "Results and Discussion" The essence of the method is that the loin, the rump, the chest, the flank and the haunch of the animals are examined concerning the muscles and fat saturation, visually and also with firm fingertip pressure. After summarizing the results the body condition score value (hereafter BCS) of the animal at the time of the examination will be determined.

On these same days, when defining body condition score values milk recording was done monthly. The quantity of goat milk was measured with Berango type ewe-milk measuring equipment in the morning and in the evening. Based on the daily (morning

and evening) measured milk production data I calculated the daily milk yield of each lactating goat in accordance with the requirements of the Goat Performance Test Code and the average values of lactating goats were made up from these data. The data were recorded based on the ear-number of the animals on the site. In addition, I recorded their date of birth, lactation number, the last kidding date and the number of offspring born

- **The method and the system of data procession**

The figures were uploaded and systematized on computer with Microsoft Excel 5.1 programme. For data processing SPSS for Windows 15.0 programme was used. The data were analysed with a single-factor analysis of variance method. The homogeneity was tested using the Levene test. For the comparison of the group-couples, the Tamhane test (in case of heterogeneity) and the LSD test (in case of homogeneity) was applied. The relationship between the variables was examined with correlation analysis (Pearson's phenotypic correlation coefficient). The biometric calculations and notations required to process the data were done in accordance with the statements of SVÁB (1981) and HUZSVAI (2004-2010).

The results obtained during the examinations were illustrated in tables or in charts and the element-number was also indicated. The significant differences ($P < 5\%$, $P < 0.01\%$) were marked with different letters, or illustrated in the form of a matrix in the Annex.

The term "body condition score" was occasionally used in a short form as "BCS" in the text of my paper.

The examination of BCS repeatability and heritability

I tried to find the answer for the question concerning the accuracy that can be expected with regard to the annual individual average BCS value the following year. The annual average BCS data of 39 mother goats in three successive years were taken into account for the examination. It was carried out on the farm where the method was developed (Farm No 5). The repeatability of the BCS value was determined by the method of ANTAL et al (1978).

Next I examined BCS heritability in mother-daughter female goat pairs on the same farm. In doing so the annual individual average BCS values obtained by the repeatability examinations were used. The BCS heritability examinations were carried out by using the data of 39 mother-daughter female pairs applying the method of ANTAL et al (1978).

The examination of milk yield heritability

The heritability of milk yield was examined in 39 mother-daughter female pairs, for which the annual individual milk yield data were taken into account. The method of ANTAL et al (1978) was used for this examination.

The examination of the relationship between BCS and offspring number

I was looking for the answer how the average body condition of the lactating goats changes in the examined lactation, depending on the number of offspring they had. On each farm the mother goats were divided into groups based on the number of their offspring and then the average body condition score of each group at the time of the examined lactation was calculated. The same process was performed from the combined data of the five farms altogether.

The examination of the relationship between BCS and lactation number

The mother goats were grouped according to lactation number (1-8) on each farm and then the average body condition score values of the given lactation were calculated. The same process was performed from the combined data of five farms altogether.

The examination of the relationship between BCS and milk yield

In this test, the lactation was divided into sections as follows: 0-30 day, 31-60 day, 61-90 day, 91-120 day, 121-150 day, 151-180 day, 181-210 day and 210 <.

Then the average daily milk yield and **body condition score** values were calculated for each period on each farm. Then the body condition score and milk production data of the five farms were compared.

The examination of the relationship between lactation number and milk yield

At the time of the test period the milk production performance of the goats in different (1-9) lactation was examined on the site than 4 + 1 farms in the frame of the given time. The mother goats were grouped according to lactation number on each farm and then the average daily lactation milk yield values were lactation for each group. The examinations were carried out from the combined data of the five farms altogether.

The examination of the relationship between offspring number and lactation

The mother goats were grouped according to their number of lactation on each farm and then the average litter size of each group was calculated. The examination was performed from the combined data of the five farms altogether.

The examination of the relationship between BCS and age

For the analysis the age of the goats was taken, and groups were formed ranging from 1 to 8 years on each farm. Differences in average lactation **body condition scores** were searched for between these groups on each farm.

The examination of the relationship between BCS, age and offspring number

Based on the total data from the five farms the mother goats were grouped by age. In these groups the average lactation **body condition scores** were examined as well as the litter size. Then the goats were grouped according to the number of their kids born at a time, (one-, two- and three-kid group). The **body condition scores** were examined with regard to the age of the mother goats in each group.

The examination of the relationship between BCS, age and milk yield

For the analysis the mother goats were classified into age groups based on the combined data from the five farms. Then the daily average lactation milk yield (kg milk / day / female) was defined for each age group as well as the average lactation **body condition score**. Changes of milk production (milk yield) and body condition were also analyzed according to age.

During these examinations the analysis of variance was performed to detect differences between the values, while to find tightness the correlation analysis was used.

3. MAJOR OBSERVATIONS OF THE PAPER

1. Developing a body condition scoring system for Saanen goats

Unlike other methods, ours examined not only the muscles and fat padding of the loin and rump but also the condition of the chest, flank, and haunch visually and also with firm fingertip pressure.

The scale is ranging from 0.5-4.5 increasing by 0.5. The essence of the classification could be summed up as follows:

With a 0.5 BCS the animal is „bone-and -kin”, its chance for survival is very little. A deep concavity can be seen clearly at the loin, between the spinal process and the transverse process of the femur. The flank is heavily carved.

Between 1.0 and 1.5 groin part (from the last rib to the pelvis) the exterior hip corner and the ribs are palpable as a sharp bulge, the flank is deep. The animal is very skinny.

2 BCS: the bones are palpable as less sharp bulges. On the groin part, from the spinal column onto two sides medium-sized muscle layer is palpable, contemplating a mild concavity from behind. There is no suet covering. The flank is determined.

2.5-3 BCS: the animal is in an average condition, neither too fat nor too thin. The muscles fill the space on both sides of the spine and only a slight bulge can be felt. The flank is not deep, the ribs are somewhat covered.

3.5-4.5 BCS: the thick muscle and a tallow layer give a round form to the groin part, the bone borderlands and the ribs are tallow-covered; the flank is hardly visible. The animal grew fat.

Considering the body condition scores of the examined three years the value of the repeatability coefficient is $(R) = 0.65$ ($P < 0.05$). That means the animals in the same keeping system are able to repeat their body condition score with good safety, year by year.

2. Correlation examinations by farms

• The relationship between BCS and offspring number

Based on the results of the Saanen goats in this research I concluded together with the increase in litter size the average body condition (BCS value) of the lactating goats decreased significantly. This finding was true both for the well-fed goats in good condition (Farms No 1, No. 3 and 5) and the undernourished poor conditioned goats (Farm No 2: $r = -0.37$, $P < 0.01$). Of course, in case of good condition the BCS decrease occurred in higher values. However, if the average body condition score of goats with one kid was very weak (1.70), the condition of the group of goats with two kids did not deteriorate further.

At more significantly lower rates the body is no longer capable of any kind of production (milk, offspring). The highest litter number was achieved on the farms where the goats had an average lactation body condition score values were: 3.20 to 2.65 in case of goats with one kid, between 2.8 and 2.25 in case of goats with two kids, and 2.38 to 2.00 for goats with three kids. On these farms the average litter number (1.99 to 2.03) was above the value typical for the species (1.8). On farms where the average lactation body condition values were under 2 BCS there was no triple kidding and the litter size typical for the species was not reached. MELLADO et al (1994),

LEGINBUHL (1996), Pryce et al (2000 and 2001) and GILLUND et al (2001) reported on such relationship of the body condition score and the reproductive traits..

- **The relationship between BCS and lactation number**

Considering the relationship between the lactation number and the average lactation BCS it could be observed that the lactation number affected the body condition of the animals (BCS value), that is with an increasing lactation number the body condition score of the mother goats decreased. This statement proved to be true in good average condition score (2.81) stocks ($r = -0.27$, $P < 0.01$) and poor condition (BCS 1.98) stocks as well ($r = -0,31$, $P < 0.01$). Where the animals were properly fed (Farms 1, 3 and 5), the stock was in good condition (BCS averages: 2.84, 2.38, and 2.30). The BCS values were the highest on Farm 1 considering each lactation number. The animals of Farms 2 and Farm 4 were in the weakest body condition (BCS= 1.96, 1.74). In this case, due to insufficient feeding, even the young mothers were in weak condition, not only the elderly.

- **The relationship between BCS and milk yield during lactation**

The body condition of the mother goats (BCS value) varied during the lactation on each farm. The highest milk production was observed on Farm 1, where the BCS value was 2.5 in early lactation (00-60 days), it was around 2.7 in mid-lactation (60-120 days), while in the last third of lactation it was 3 or somewhat higher (*Table 1*).

Table 1. BCS values with regard to lactation on five farms

Lactation interval (days)	$\bar{x} \pm s$				
	1. n = 56	2. n = 17	3. n = 45	4. n = 17	5. n = 80
0-30	2,50 ± 0,55 a	1,66 ± 0,62 b	-	-	1,65 ± 0,79 b
30-60	2,57 ± 0,56 a	1,75 ± 0,50 b	-	-	1,74 ± 0,69 b
60-90	2,58 ± 0,48 a	1,6 ± 0,56 b	-	2,16 ± 0,39c	1,79 ± 0,68 b
90-120	2,68 ± 0,68 a	1,69 ± 0,54 b	2,35 ± 0,61 a	1,68 ± 0,41 b	1,92 ± 0,76 b
120-150	2,77 ± 0,73 a	1,84 ± 0,50 b	2,26 ± 0,68 c	1,73 ± 0,49 b	2,29 ± 0,75 c
150-180	3,00 ± 0,80 a	2,12 ± 0,59 bc	2,31 ± 0,62 b	1,64 ± 0,45 c	2,35 ± 0,72 b
180-210	2,75 ± 0,72 ab	2,23 ± 0,53 b	2,46 ± 0,56 ab	1,56 ± 0,40 c	2,61 ± 0,77 a
210 <	3,07 ± 0,75 a	2,56 ± 0,67 abc	2,49 ± 0,52 a	1,50 ± 0,40 d	2,72 ± 0,70 c
Condition lact. av.	2,81±0,71	1,98±0,60	2,38±0,59	1,74±0,47	2,24±0,79

The values marked with various letters are significantly different ($P < 0.05$) within a lactation period.

The following milk production values associated with it: 2.57 - 2.51 to 2.25 kg milk / day / female goat. These values were approached in two other farms in relation to both the body condition score and milk production (Farms 3 and 5).

The higher the difference from these BCS values was on the other farms, the higher the level of milk production decrease was (*Table 2*). According to my results when the body condition of the animals was poor (low BCS value) then the lactation peak was reached early, around the 20th day, therefore the milk production started to decrease significantly very soon (Farm 2: $r = 0.50$; $P < 0.01$). In case of good body condition (high BCS value) a small peak could be observed around the 50th day, after that the production decreased gradually and slowly (Farm 1 and 5). A significant decrease occurred only around the 200th day.

Table 2. Daily milk production with regard to lactation on five farms

Lactation interval (days)	$\bar{x} \pm s$				
	1. n = 56	2. n = 17	3. n = 45	4. n = 17	5. n = 80
0-30	2,36 \pm 0,67 a	3,63 \pm 0,84 b	-	-	2,45 \pm 0,46 a
30-60	2,52 \pm 0,82 a	3,20 \pm 0,53 b	-	-	2,74 \pm 0,87 a
60-90	2,42 \pm 0,77 a	2,84 \pm 0,60 a	-	1,33 \pm 0,45 b	2,57 \pm 0,85 a
90-120	2,49 \pm 0,75 ab	2,88 \pm 1,41 a	2,23 \pm 0,68 b	1,08 \pm 0,42 d	2,34 \pm 0,99 b
120-150	2,51 \pm 0,78 a	2,00 \pm 0,76 b	2,28 \pm 0,67 ab	0,79 \pm 0,43 d	2,37 \pm 0,92 ab
150-180	2,42 \pm 0,80 a	1,48 \pm 0,49 b	2,30 \pm 0,58 a	0,70 \pm 0,45 c	2,15 \pm 0,68 a
180-210	2,39 \pm 0,32 a	1,19 \pm 0,60 b	2,10 \pm 0,62 ac	0,45 \pm 0,35 d	1,97 \pm 0,60 c
210 <	2,25 \pm 0,69 a	0,89 \pm 0,35 b	2,06 \pm 0,58 a	0,36 \pm 0,19 b	2,09 \pm 0,91 a
Condition lact. av.	2,43 \pm 0,72	1,91 \pm 0,99	2,20 \pm 0,62	0,86 \pm 0,52	2,17 \pm 0,88

The values marked with various letters are significantly different ($P < 0.05$) within a lactation period.

In this case it was typical that a stronger negative correlation appeared between the body condition scores and the milk production only at the end of lactation. The decrease in the milk production resulted in the increase in the body condition scores ($r = -0.38$).

The poorer the BCS of the stock was, the stronger the affect of the BCS on the milk production became.

The animals are able to produce an adequate amount of milk if they are fed adequately and they are kept in a body condition in consistence with their lactation period.

My results confirm the statements of the publications in professional literature (PRYCE et al. 2000, 2001; FREDRICK 2004; MEYERS-RAYBON, 2004; SPAHR, 2005), although I found higher values at the beginning of the lactation while somewhat lower values at the end of it.

- **The relationship between milk yield and lactation number**

Varied by farms, the highest amount of milk was produced in the third, fourth and fifth lactation of the goats, then their production fell back as described in the publication by , VÁRKONYI and ÁTS (1984). In case of the goats with the best body condition (Farm 3: 2.38; and Farm 5: 2.81 average lactation BCS) the production values of the neighbouring lactations did not differ significantly from the peak production of the actual lactation, which means they are able to produce high throughout several years (Table 3).

Table 3. The relationship of the average daily lactation milk yield and the number of lactation by farms (milk kg/mother goat/year)

Lactation No	Farm 1		Farm 2		Farm 3		Farm 4		Farm 5	
	$\bar{x} \pm s$	n	$\bar{x} \pm s$	n	$\bar{x} \pm s$	n	$\bar{x} \pm s$	n	$\bar{x} \pm s$	n
1	2,06±0,62	50	1,93±0,86	30	-	-	-	-	1,67±0,47	140
2	2,53±0,66	65	1,85±0,89	15	-	-	-	-	2,00±0,66	175
3	2,67±0,69	35	2,20±0,93	20	2,20±0,50	105	0,86±0,48	10	2,15±0,85	205
4	2,54±0,71	10	1,60±0,87	10	2,45±0,54	65	0,76±0,42	25	2,75±0,56	205
5	2,29±0,89	40	2,56±1,15	5	2,07±0,48	25	1,70±0,62	30	2,20±0,68	100
6	2,45±0,38	15	-	-	1,39±0,78	15	-	-	2,37±0,44	20
7	-	-	2,65±1,12	10	1,18±0,16	5	0,52±0,35	5	-	-
8	2,15±0,96	10	1,30±0,54	5	3,16±0,61	5	0,69±0,36	15	-	-
9	-	-	-	-	1,63±0,10	5	-	-	-	-
Average	2,35	-	1,91	-	2,20	-	0,86	-	2,19	-

n = number of measurements

There was no significant difference in milk production from the third to the fifth lactation on Farm 3 and from the second to the sixth lactation on Farm 1. On the farms where the lactation average BCS was somewhat lower (Farm 5: 2.24), the fourth lactation peak was significantly different from the neighbouring values, however it is remarkable that the mother goats produced the highest amount here (2.75 kg milk/mother/day; $r = 0.31$; $P < 0.01$) in this period. The production of the animals with poor body condition due to poor nutrition fell back to far behind that of the animals with good body condition and the production was unbalanced. They were not able to fulfil the production that can be expected from them because of their genetic endowments and the lactation number (Farm 4: the peak production of the fifth lactation was only 1.70 kg milk/day/mother goat).

- **The relationship between litter size and lactation number**

During the first lactation the mother goats did not produce the litter number characteristic for the species (1.8) on either farm. The highest number of kids was born during the third, fourth and fifth lactations, however in this period the average litter number by lactation showed significant difference on each farm (1.5-2.52) (*Table 4*).

Table 4. The relationship between litter size and lactation number by farms

Lactation No	Farm 1		Farm 2		Farm 3		Farm 4		Farm 5	
	$\bar{x} \pm s$	n	$\bar{x} \pm s$	n	$\bar{x} \pm s$	n	$\bar{x} \pm s$	n	$\bar{x} \pm s$	n
1	1,73±0,45	14	1,71±0,48	6	-	-	-	-	1,65±0,48	49
2	2,00±0,51	15	2,66±1,15	3	-	-	-	-	1,83±0,58	43
3	2,14±0,37	7	2,00±0,81	3	1,66±0,65	21	1,50±0,70	2	2,06±0,55	57
4	2,00±0,00	6	2,50±0,70	2	1,85±0,68	13	1,40±0,54	5	2,40±0,85	39
5	2,00±0,66	8	3,00±0,00	1	1,40±0,54	5	1,50±0,54	6	2,52±0,48	21
6	2,00±0,00	4	-	-	1,33±0,57	3	-	-	2,00±0,00	11
7	-	-	2,00±1,41	2	2,00±0,00	1	2,00±0,00	1	-	-
8	2,00±0,96	2	3,00±0,00	1	2,00±0,00	1	1,33±0,57	3	-	-
Average	1,99		2,15		1,68		1,47		2,03	

n= number of mother goats

- **The relationship between age and body condition score**

When examining the changes in BCS with regard to the increasing age it was observed that the mother goats were in the best body condition in all age group on farm 1. Here together with the increase of the age the body condition score (BCS value) of the animals was gradually decreasing ($r = -0.31$; $P < 0.01$). Since on this farm the milk production was significantly higher compared to that of the other farms, we can conclude that the body condition score measured here by age groups are adequate in case of Saanen goats in Hungary. These values were approached by the mother goats of Farm 3 and Farm 5. The BCS values of the animals on Farms 2 and 4 were very low, especially from the age of 4 years. The 2-4-year-old animals were in the best condition, differing by farms. After the mother goats reached their best condition (between their age of 2-4) a continuous BCS decrease followed together with the advancing age.

3. Correlation examinations on the five farms altogether

- **The relationship between BCS and litter size**

When looking at the analysis carried out by the combined results of the five farms it can be observed that the lactation average was the highest (BCS 2.54) in the group of mother goats with one kid (*Figure 1*). It was the expected result since it is natural that

bearing and feeding one kid as well as producing less milk do not load the body of the mother that much as that of the mothers having twins, triplets or more. The average body condition score of the goats having twins declined significantly (2.31) compared to that of the goats having one kid, and the BCS of the mothers of triplets also followed this tendency (2.03). Mother goats having 4 or 5 kids were in definitely deteriorated condition (1.40; 1.78).

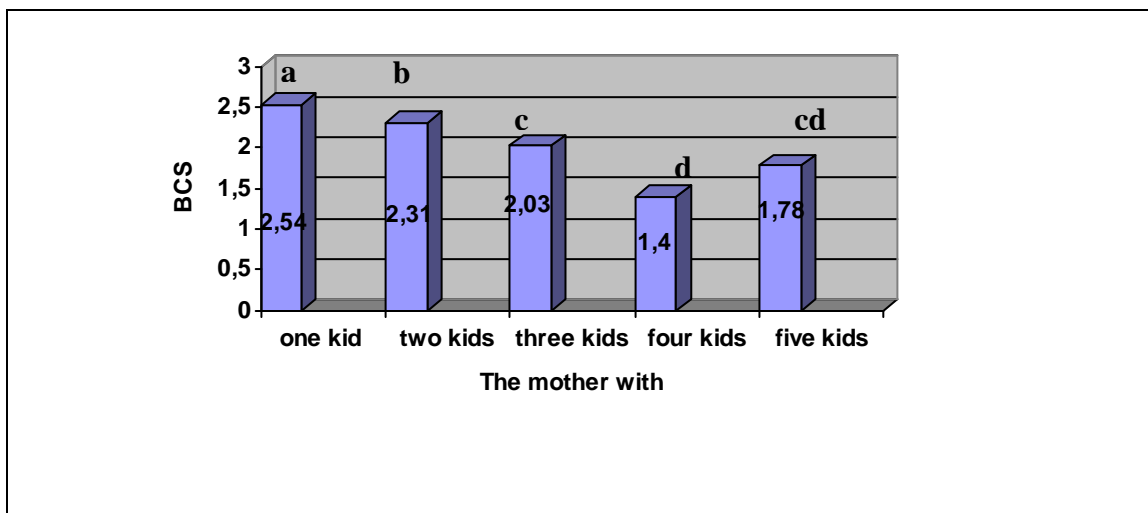


Figure 1. The lactation average BCS of mother goats according to the number of kids on the five farms altogether

The values marked with various letters indicate the significant differences between the adjacent and farther values ($P > 0.05$)

To sum up, it can be declared that together with the growing number of births the BCS decreased significantly. It was justified by the results of the correlation examination, which showed an intermediate strong negative correlation between the litter number and the lactation average BCS ($r = -0.27$; $P < 0.01$). It is natural that bearing more kids and consequently producing more milk exhausted the mother goats. It is necessary to endeavour the mother goats having more kids do not lose as much of their body condition compared to the mothers having only one kid. In practice it means that the quantity and quality parameters of their feed must be adjusted to their increased demand.

- **The relationship between BCS and lactation number**

In this examination, the relationship of the average body condition score of each lactation and the lactation number were compared based on the values of the five farms altogether. The animals had the best condition second scores in the second lactation (BCS = 2.52) (Fig. 2) with significantly higher values than in the first one (BCS =

2.32). This was probably because the female goats were inseminated when they were too young and they were not mature enough for pregnancy. Subsequently, the average value of BCS decreased significantly and in the fifth lactation it only reached 2.16. Surprisingly, the BCS value of the mother goats in their sixth lactation was slightly higher than the ones in their fifth lactation. This can be explained by the fact that there were no sixth-lactation mother goats on the two poorly performing farms (Farm 2 and Farm 4). The BCS value of the mothers in the seventh and eighth lactation was very low (1.57 and 1.74). The statement about the fact that together with the increasing lactation number and with the advancing age the BCS decreased ($r = -0.17$, $P < 0.01$) was also true for total rating of the five farms. Considering all the data of the five farms we found that the correlation was weaker than separately on each farm (Farm 1, 2 and 3). This can be explained by the effect of the farms, which influenced the relationship, especially in feeding, and significant differences were found on each farm.

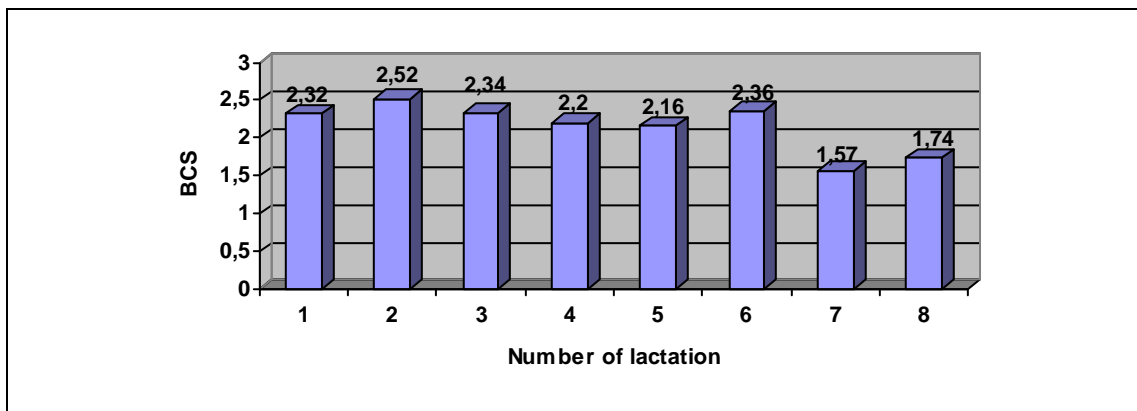


Figure 2. Body condition scores by lactation number on five farms altogether

The age/lactation number consistently influenced the BCS values until the fifth lactation, later, in the sixth lactation, an increase followed and then a significant decline. The influence of age/lactation number on the BCS is mentioned in the work of GYÖRKÖS at al. (2003) as well as MEYERS-RAYBON (2004). The body condition scoring and surveying was highlighted by ROCHE at al. (2004). My results confirm the findings of the above mentioned publications.

- **The relationship between milk yield and lactation number**

The total assessment of the data of all five farms covers the individual differences of the farms and the milk production tendency in the successive lactations was performed as expected (Figure 3). The milk production increased until the fourth lactation (2.46 kg

milk/day/mother goat) and then a decrease followed. MOLNÁR and MOLNÁR (2000) concluded the same results.

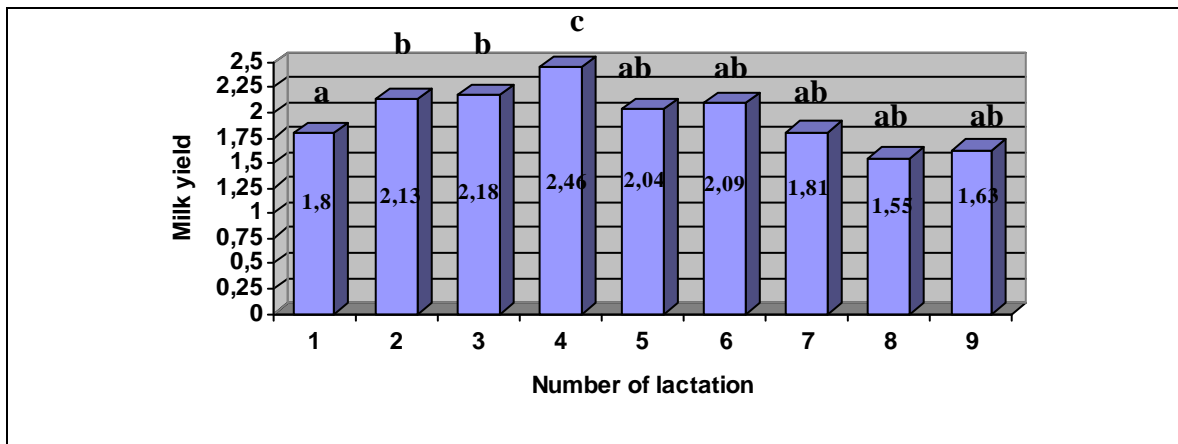


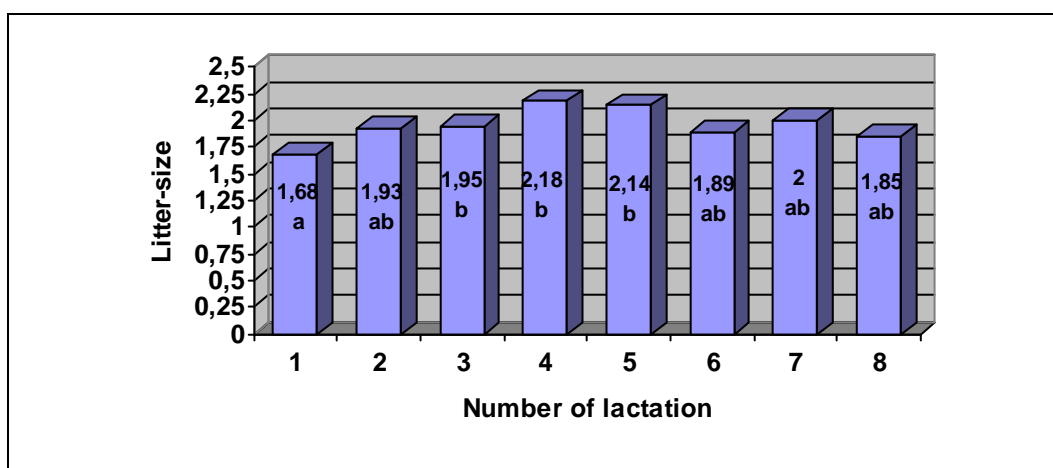
Figure 3. The relationship of the average daily milk yield and the lactation number on all five farms (milk kg/day/mother goat)

The peak production was significantly higher than the neighbouring values. Milk production decreased from the fifth lactation without significant differences. The milk production of mother goats in their seventh lactation was the same as that of the first-lactation mothers. The milk yield produced by mothers in their ninth lactation was hardly less than that of the first-lactation mother goats. Based on that we can conclude that it is worth keeping the 7.-8.-9-lactation mother goats in production when they perform these values. It must be noted though, that the rate of such animals was not high. Because of their high life-expectancy I suggest keeping their offspring in production as well. The correlation examination of the milk yield and the lactation number indicated a weakly intermediate, positive relationship from the first to the fourth lactation. ($r = 0.26$; $P < 0.01$), while the milk yield was growing. Later, together with the increase of the lactation number, the milk yield decreased and the relationship became negative ($r = -0.16$; $P < 0.01$).

- **The relationship between litter size and lactation number**

On the basis of the assessed data of the five farms, litter number was the highest with the mother goats in their fourth and fifth lactation, with a fourth-lactation peak 2.18 ($r = 0.16$; $P < 0.01$), however the litter size of the mother goats in the third and sixth lactation did not differ significantly. The highest litter size was experienced in the fourth and fifth lactation by SCHANDL (1947); SUBERIES et al, (1988); CHERIX, (1990);

NIZNIKOWSKI et al, (1994), as well as CREPALDI (1999). From the sixth lactation the decrease in litter number was gradual; however the change did not prove to be significant. The litter size of the mother goats in the second and third as well as in the seventh and eighth lactation was very similar, therefore no significant changes were experienced between them (Figure 4). Accordingly I concluded that it is also worth keeping 7 and 8-lactation animals in production in case they produce the litter size as found in the research. Since the number of kids was above the value typical for the species I suggest keeping their offspring in production as well.



The values marked with various letters are significantly different ($P < 0.05$)

Figure 4. Litter-size with regard to the lactation number on the five farms altogether

In the examination the litter size values by lactations were higher than that of the Alpine goats described in the publication of CREPALDI et al (1999). These results (except for the first lactation goats) exceed the litter size value (1.8) characteristic of the Saanen type as defined by MOLNÁR and MOLNÁR (2000).

- **The relationship between age, BCS and litter size**

Based on the total data the litter size of the 2-year-old mother goats (1.84) increased significantly compared to that of the one-year old goats. The BCS value also increased however not significantly (2.53). The increase of the litter size lasted until the age of five years, with a significant increase until the age of four years (Figure 5). Together with this the BCS value significantly decreased. The highest litter size can be seen with the four and five-year-old animals (2.19), and the values hardly differ from each other.

Besides, the BCS value did not change either (2.18). The litter-size of the six-year-old mother goats are smaller (2.03), however still on high level.

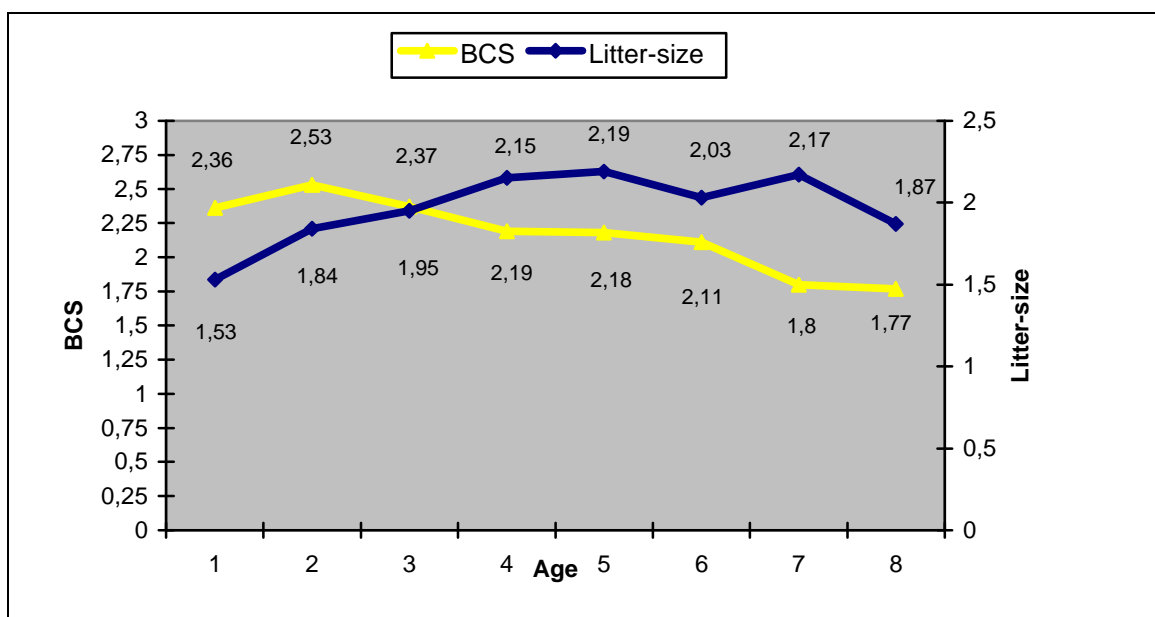


Figure 5. BCS and litter-size values with regard to age

Based on the above results I concluded that the 4-6-year-old mother goats were on the peak of their performance. In case of the 8-year-old mothers the litter size was already significantly smaller (1.87), but the values still somewhat higher than that of the two-year-old animals or the average value defined as typical for the species (MOLNÁR and MOLNÁR, 2000). With the advancing age the BCS value of the mother goats kept decreasing. The 7-8-year old mothers were able to perform well with very weak body condition (BCS = 1.8). Based on their results, however, it is suggested to keep them as well as their offspring in the production.

The changes of ideal body condition (BCS value) depending on age was observed by GYÖRKÖS et al (2003) (cows) and MEYERS-RAYBON (2004) (goats). To follow this according to age/lactation number helps the animals to perform corresponding to their age. (CHITTAPRIYA et al, 2004).

Based on all this I concluded that the BCS value of the mother goats decreased as their age advanced ($r = -0.22$; $P < 0.01$). The litter size increased until the age of five ($r = 0.31$; $P < 0.01$) while it decreased with mother goats older than five years ($r = -0.24$; $P < 0.01$). The body condition score value influences the number of litter ($r = -0.23$; $P < 0.01$).

The mother goats having one kid were in the best condition in each group; compared to them the BCS values were significantly lower with mothers having two kids in most age groups (Figure 6).

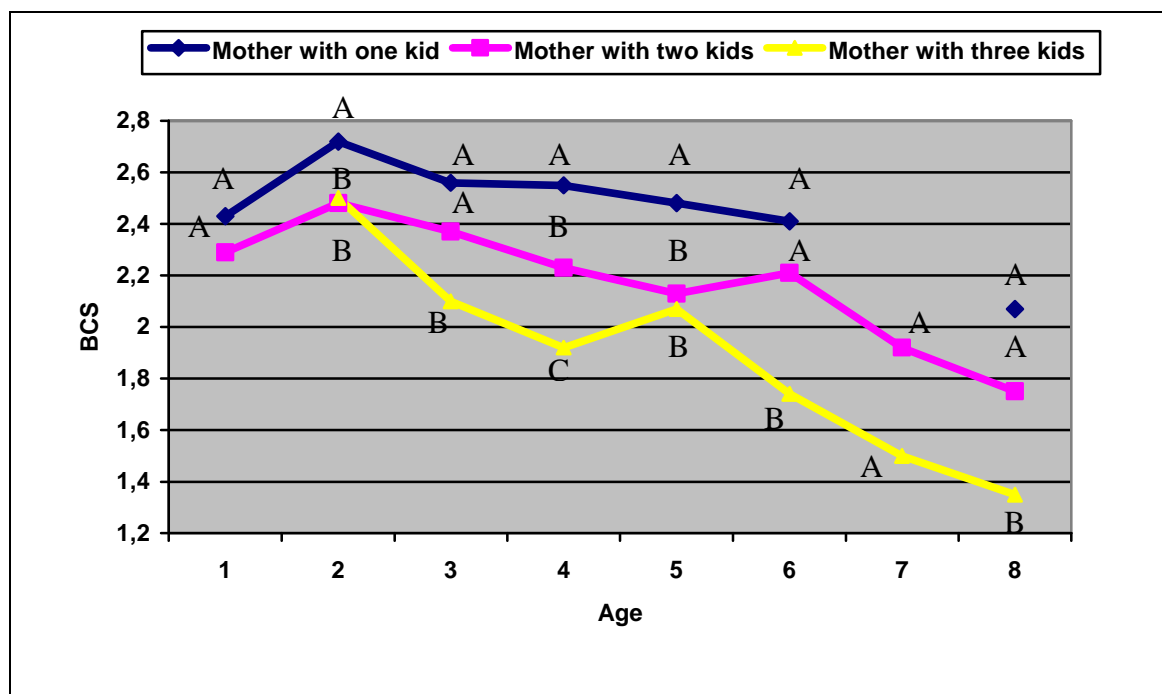


Figure 6. BCS values with regard to the age and the litter size

The values marked with various letters are significantly different within the given age (between groups)

The values of mothers having three kids were significantly poorer even to that of the mothers with two kids, in most age-groups (3-4-6 and 8-year-old). The strongest relationship between age and body condition could be observed in mother goats having three kids ($r = -0.22$; $P < 0.01$).

- **The relationship between age, BCS and milk production**

The milk production of the two-year-old mother goats was significantly higher than that of the one-year-old. The BCS value (2.53). was also the highest then. In this age together with an improving milk production the body condition improved as well (Figure 7). This milk amount did not exhaust the body of the mothers. The 3-to-five-year old mothers produced the most milk, with a peak at the age of four (2.49 kg milk/day/mother), a significantly higher value than that of the three-year-old mothers. That achievement was accompanied by a significant decrease in BCS value (2.19).

The process is understandable, as published by CABBIDU (1999), the milk production and fat accumulation trend are converse. The milk production and BCS value of the 6-

to-8-year-old mother goats decreased further with the advancing age, however the 7-8-year-old gave the same amount of milk as the 1-2-year-old, although along with a poor BCS value (1.8). Based on the above, I concluded that elderly mother goats performing these amounts are worth being kept in production.

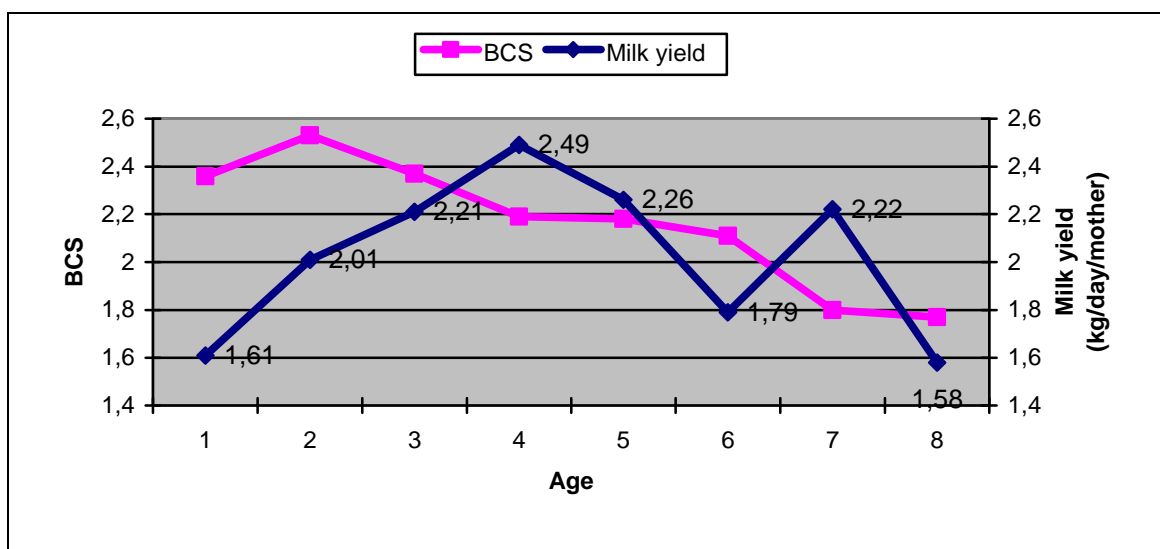


Figure 7. Milk yield and BCS values with regard to the age

The relationship between age and milk yield intermediate strong positive between the ages 1-4 years ($r = 0.33$), while above the age of 4 years, when the milk yield declined with the age, the relationship turned negative ($r = -0.21$); ($P < 0.01$). The four-year-old mother goats produce the most milk also according to BODÓ (1959), MELLADO et al (1991), CREPALDI et al (1999) as well as ZUMBO et al (2004). This period was put earlier than that by FINLEY et al (1984), MAVROGENIS and PAPACHRISTOFOROU (2000). Looser intervals were given by SCHANDL (1966). Based on my results, I concluded that the milk production and as we could see above, the litter number of the one-year old mothers were significantly lower than that of the two-year-old, at the same time their BCS value was lower as well. It could be explained by the fact that probably they were taken into production too early. In case of the two-year-old mothers the significant production increase was accompanied by an increase of their body condition (increasing BCS).

- **The heritability of BCS and milk yield**

In the examined stock (Farm 5), a BCS heritability of $h^2 = 0.20$ ($P < 0.05$) was found, which is a low value (poor heritability) under the values described in the work of other authors. VEERKAMPF et al (2001) found $h^2 = 0.38$ value in goats. GALLO et al (1999) determined the BCS heritability values in a wider range ($h^2 = 0.24-0.45$).

When considering milk yield a value of $h^2 = 0.22$ ($P < 0.05$) was found in the given stock, which means the heritability of this parameter also indicated a poor heritability, according to my results. BOICHARD et al (1989) found a value of $h^2 = 0.31$ in Saanen goats. The values given by KENNEDY et al (1982) were rather different by species and types (0.19-0.68).

The deviation from literature data suggests that the environmental impacts have a much larger role in the development of body condition and of milk production. The two effects can be considered together during the breeding work.

- **The issue of age and/or lactation number**

Based on the age and the lactation number comparison I concluded:

- The whole number values of the ages of the mother goats in the same lactation were the same as the number of lactation;
- The mother goats were in the best body condition at the age of 2 years and in lactation 2;
- The highest litter number was achieved when the goats were at the age of 4-5 years and in the 4-5 lactation;
- The highest amount of milk was produced at the age of 4 and in the fourth lactation.

The examinations were carried out with the Saanen goats in the research by counting with both parameters (age – lactation number) and I got the same conclusions. According to that I concluded that it can be sufficient to count with only one of the prolificacy and milk production influencing parameters when examining the stock.

NEW SCIENTIFIC RESULTS OF THE RESEARCH

During my examinations based on Hungarian Saanen goat stocks I found the following new and novel scientific results:

1. I worked out a body condition scoring system for Saanen goats (body condition score – BCS value), which facilitates the assessment and judgement of the body condition and milk production features of the animals as well as the decision whether the animal is suitable to be involved in the production and breeding. The value of repeatability coefficient is stronger than the medium one ($R= 0,65$).

2. I found that the highest amount of milk was produced on the farms where the BCS value was 2.5 at the beginning of the lactation (0-60. day), 2.7 in the middle of the lactation (60-120. day) and in the last third of the lactation 3 or slightly more. They were associated by 2.57 – 2.51-2.25 kg milk /day/mother milk production values during the lactation. The highest the difference was from these BCS values on the other farms, the higher the level of the decrease in milk production was. **If the average lactation body condition score of a stock was lower than 2 BCS value, the animals were not able to perform the milk yield and litter number expected from them due to their genetic endowments and type traits.** In this case they reached the lactation peak very early, on around the 20th – 30th day; later the milk production decreased significantly, while in a stock with good body condition the peak production was achieved around 60th day followed by a slight decline only.

3. On the basis of my results I concluded that the highest litter number was achieved by mother goats in their a 4th-5th lactation at the age of 4 or 5 (2.18 by lactation number, and 2.19 by the years of age); this litter number increase was achieved beside a significant BCS decline (2.19).

It was confirmed that the mother goats in their fourth lactation or in their age of four years produced the highest amount of milk (2.46 and 2.49 milk kg/day/mothergoat), and the **peak production was reached beside the significant fallback of the BCS** (2.20 and 2.19). On the basis of my results **I concluded that the mother goats in their second lactation and in their second year of age had the best body condition** (BCS value 2.52 and 2.53), while their milk production significantly exceeded that of the mothers in their first lactation and first year of age.

4. I found that the BCS heritability is weaker than the average, and their value can be significantly affected by the environmental factors (feeding according to needs).

PRACTICAL USABILITY OF THE RESULTS

Considering the present situation of goat farming and goat-milk production in Hungary as well as the possibility of the development I concluded that my results are suitable to introduce and use in everyday practice

Based on my results I concluded the body condition system developed for Saanen goats can be applied well and if the results of the examinations are taken into account that may serve the improvement of the milk production as well as the prolificacy.

Based on my results I suggested at which BCS the mother goats should be kept in the different periods of lactation in order to reach an optimum of milk production.

In my paper I pointed out the significant decrease of the body condition score of the goats, beside a growing litter size. That is why a special care must be taken in the nutrition of the mother goats with more kids. I made a suggestion at which BCS the mother goats should be kept when having 1, 2 or 3 kids at a time.

The elderly, 7-8-year-old mothers (and their offspring) are also worth keeping in production if they are able to achieve the results (milk yield, litter size) as experienced during the research, which means they reach the production of the 1-2-year-old.

I pointed out that the average lactation body condition score of the animals must not fall under 2 BCS value, because they will not be able to achieve the milk yield and litter size that could be expected from them due to their genetic endowments and type traits.

I concluded which year / lactation the mother goats produce the highest amount of milk (in the 4th) and, compared to that, how many % of production can be expected in the following lactations.

I concluded which year / lactation the mother goats produce the greatest number of kids (4.-5.) and what BCS values belong to them.

I called the attention upon the fact it would be sufficient to count only with the lactation number or the age (as a factor influencing prolificacy and milk production). I carried out the examinations with both parameters and I concluded the same.

The milk production and litter size of the 2-year-old /2nd-lactation mother goats was significantly better than that of the 1-year-old /1st lactation mothers. At the same time they reached this significant production growth beside an increasing BCS value. It suggests the possibility that they were taken into production too early; the body of the one-year-old animals are more exhausted by the pregnancy, birth and milk production, even at lower values.

6. PUBLICATIONS IN THE RESEARCH THEME

• BOOK, CHAPTER

1. **Kocsisné Gráff M.-Jávor A.-Kukovics S.:** Két szánentáli kecsketelep tejtermelésének és kondíciójának elemzése. In: Kukovics S. és Jávor A. (szerk.: 2008): A juhtenyésztés jelene és jövője az EU-ban; Kiadó: Magyar Juhtejgazdasági Egyesület – Debreceni Egyetem Agrár- és Műszaki Tudományok Centruma, Herceghalom-Debrecen, 2008.; ISBN 978-963-8030-58-0; 303 p-316. p.

• PUBLICATIONS IN SCIENTIFIC JOURNALS

1. Mucsi I. – **Kocsisné Gráff M.** – Benk Á. – Mikóné Jónás E.: Szánentáli kecske kondíciójának meghatározása. 1. Közlemény: A módszer ismertetése. (A scoring system of the body condition of Saanen goats. 1st Paper. Body condition scoring system). Állattenyésztés és Takarmányozás. English summaries. Vol. 55. 4. 2006. 343-353 p. HU ISSN: 0230 1814.
2. **Kocsisné Gráff M.** – Mikóné Jónás E. (2007): A szánentáli kecskék kondíciójának és életkorának hatása a termelékenységre. Tessedik Sámuel Főiskola, Szarvas. Tudományos Közlemények. 2007. Tom. 7. No. 1. 2. kötet. 353-358p p. + CD. HU ISSN: 1587 6179.
3. **Kocsisné Gráff Myrtil:** A kondíció, az életkor és a szaporaság összefüggései szánentáli kecskéknél. Agrár- és Vidékfejlesztési Szemle. a SZTE MGK tudományos folyóirata. 2. évf. 2007/2. 151-154 p. ISSN 1788-5345.
4. **Kocsisné Gráff Myrtil** (2008): A különböző kondíciójú és életkorú szánentáli kecskék tejtermelése és szaporasága. Debreceni Egyetem Agrártudományi Közlemények 31. 49-51 p. HU-ISSN 1587-1282.
5. **Kocsisné Gráff M.** – Kukovics S. (2008): Két szánentáli kecsketelep összefüggés vizsgálata. Agrár- és Vidékfejlesztési Szemle. A SZTE MGK tudományos folyóirata. 3. évf. 2008/2. sz. 113-120 p. ISSN 1788-5345.
6. **Kocsisné Gráff Myrtil** – Jávor András – Kukovics Sándor (2009): Két szánentáli kecsketelep tejtermelésének és kondíciójának elemzése. Debreceni Agrártudományi Közlemények 37. 53-59. HU-ISSN 1587-1282.
7. **7. Kocsisné Gráff Myrtil - Hódiné Szél Margit** – Jávor András – Kukovics Sándor (2011): Body condition and milk production on saanen goats as economic factors. University of Agricultural Sciences and Veterinary Medicine of the Banat Timosiara – Romania. Scientific Symposium. Timisoara. Lucrari Stiintifice 2011. Seria I., vol. XIII (2) 209-216. ISSN: 1453-1410. E-ISSN 2069-2307.
8. **Kocsisné Gráff Myrtil** – Jávor András – Kukovics Sándor (2011): A kondíció pontszám, a tejtermelés és a szaporaság kapcsolata szánentáli kecskeállományokban. Állattenyésztés és Takarmányozás. Vol. 60. 2:107-121. HU ISSN: 0230 1814.

• HUNGARIAN CONFERENCES

1. **Kocsisné – Mucsi – Mikóné – Benk:** A szánentáli kecske kondíciópontszám rendszerének kidolgozása. Fiatal kutatók az agráriumban. SZTE MFK. 2005. okt. 1.
2. Mucsi Imre- **Kocsisné Gráff Myrtil** – Benk Ákos – Mikóné Jónás Edit (2005): A szánentáli kecske kondíciójának hatása a laktációra. Poszter. Wellmann Oszkár Tudományos Tanácskozás. SZTE Mezőgazdasági Főiskolai Kar. Hódmezővásárhely.
3. Mucsi Imre- **Kocsisné Gráff Myrtil** – Benk Ákos – Mikóné Jónás Edit – Szórádi Tibor (2005): A szánentáli kecske takarmányozásának vizsgálata az SZTE Mezőgazdasági Főiskolai Kar Tanüzemében. Poszter. Wellmann Oszkár Tudományos Tanácskozás. SZTE Mezőgazdasági Főiskolai Kar. Hódmezővásárhely.
4. **Kocsisné Gráff M., Mikó Józsefné Jónás E.** (2006): A kondíció, a laktáció és a szaporaság összefüggései tejelő kecskéknél. XII. Ifjúsági Tudományi Fórum. Pannon Egyetem Georgikon Mezőgazdaságtudományi Kar Keszthely, 2006. április 20. CD kiadvány.
5. **Kocsisné Gráff Myrtil**, Mucsi Imre, Benk Ákos, Mikóné Jónás Edit (2006): Szánentáli kecske kondíciójának meghatározása. Kérődző állatfajok mai helyzete és perspektívái az Európai Unióban c. tudományos konferencia. Szent István Egyetem, Mezőgazdaság- és Környezettudományi Kar, Gödöllő. 2006.04.10. 04.11. 128 p. CD kiadvány (Állattenyésztés és Takarmányozás Különszám); HU ISSN: 0230 1814.
6. **Kocsisné Gráff Myrtil**, Mucsi Imre, Mikóné Jónás Edi, Benk Ákos: A szánentáli kecske kondíciójának, tejtermelésének és szaporaságának összefüggései. Kérődző állatfajok mai helyzete és perspektívái az Európai Unióban c. tudományos konferencia. Szent István Egyetem, Mezőgazdaság- és Környezettudományi Kar, Gödöllő. 2006.04.10. 04.11. 128 p. CD kiadvány (Állattenyésztés és Takarmányozás Különszám); HU ISSN: 0230 1814.
7. **Kocsisné Gráff M.** (2007):: A szánentáli kecskék kondíciójának és életkorának hatása a termelékenységre. Európai Kihívások IV. Nemzetközi Tudományos Konferencia. Szeged., 2007. okt. 12. Szeged.
8. **Kocsisné Gráff M.** (2007): A szánentáli kecskék kondíciójának és életkorának hatása a tejtermelés a szaporaságra. Magyar Biológiai Társaság Szegedi Csoportjának 397. ülése. 2007. okt. 26. Szeged
9. **Kocsisné Gráff M.** (2007): A szánentáli kecskék kondíciójának és életkorának hatása a tejtermelés és a szaporaságra. A jövő tudósai, a vidék jövője doktorandusz konferencia. Debrecen, 2007. nov. 21.
10. **Kocsisné Graff M.** (2008): Correlation examination between the body condition and body weight of Saanen goats. Agrár- és Vidékfejlesztési Szemle. A SZTE MGK Tudományos folyóirata 3. évf. 2008/1. 17 p. (Összefoglaló). ISSN 1788-5345. Teljes anyag: Multifunkcionális mezőgazdaság c. nemzetközi tudományos konferencia előadásai és poszterei CD-n. ISSN 1788-5345.
11. **Kocsisné Gráff M.-Jávor A.-Kukovics S.** (2008): Szánentáli kecsketenyészetek összehasonlítása. A jövő tudósai, a vidék jövője doktoranduszok konferenciája. Debrecen, 2008. november 20.
12. **Kocsisné Gráff Myrtil** (2008): Szánentáli kecskeállományok összehasonlító elemzése. A Magyar Biológiai Társaság Szegedi Csoportjának 403. ülése. Szeged, 2008. október 31.
13. **Kocsisné Gráff Myrtil** (2009): A kondíció és a tejtermelés alakulása négy szánentáli kecsketelepen. A Magyar Biológiai Társaság Szegedi Csoportjának 410. ülése. Szeged, 2009. október 30.

14. **Kocsisné Gráff Myrtill** (2010): Öt szánentáli kecsketelep tejtermelésének és kondíciójának elemzése. A Magyar Biológiai Társaság Szegedi Csoportjának 417. ülése. Szeged, 2010. október 28.

• **INTERNATIONAL CONFERENCES**

1. **Kocsisné Gráff Myrtill** – Mucsi Imre– Benk Ákos – Mikóné Jónás Edit – (2005): Body condition scoring of Saanen milking goats. University of Agricultural Sciences and Veterinary Medicine of Bánát, Timisuara. Temesvári Agrártudományi Egyetem Tudományos Szimpóziuma 2005. május 26-27. Angol nyelvű előadás, angol nyelvű, teljes terjedelemben megjelent konferencia kiadvány ISSN: 1453 1410.
2. **Kocsisné Gráff M.** – Mikóné Jónás E. – Benk A. – Mucsi I. (2006): A tejelő kecskék kondíciójának hatása a laktációra és a szaporodásra. X. Nemzetközi Agrárökonómiai Tudományos Napok. Károly Róbert Főiskola, Gyöngyös. CD kiadvány. ISBN: 963 22- 6230.
3. **Myrtill Gráff Kocsisné, I. Mucsi, Edit Jónás Mikóné, Á. Benk** (2006): Correlation examination between the body condition, reproduction and milk production of saanen goats. University of Agricultural Sciences and Veterinary Medicine of the Banat Timosiara – Romania. Faculty of Farm Management Facultatea de Management Agricol. Scientific Symposium. Timisoara. Lucrari Stiintifice 53-60. ISSN: 1453 1410.
4. **Kocsisné Gráff Myrtill**: A szánentáli kecskék kondíciójának hatása a szaporodásra és a laktációra. The effect of condition on the reproduction and lactation of Saanen goats.) Európai Unió Kutatási és Oktatási Projektek Napja. c. konferencia. SZTE MFK Hódmezővásárhely. 2006. okt. 6. CD kiadvány. ISBN 963-06-1269-0; ISBN 978-963-06-1269-2.
5. **Myrtill Gráff Kocsisné, Edit Jónás Mikóné** (2007): The body condition and age of milking goats as economic factors. University of Agricultural Sciences and Veterinary Medicine of the Banat Timosiara – Romania. Scientific Symposium. Timisoara. Lucrari Stiintifice 2007. Seria I., vol. IX.(1) 329-334. ISSN: 1453 1410.