

RESEARCH REGARDING THE INFLUENCE OF LACTATION STAGE ON MILK PRODUCTION AT CARPATINA BREED

Constantin PASCAL^{1*}, Alexandru Marian FLOREA², Ionică NECHIFOR²,
Costică CRISTIAN³

¹“Ion Ionescu de la Brad” University of Agricultural Science and Veterinary Medicine of Iași,
Romania

²Research and Development Station for Sheep and Goat Breeding Popăuți, Botoșani, Romania

³Research and Development Station for Sheep and Goat Breeding Secuieni, Bacău, Romania

*Corresponding author email: pascalc61@yahoo.com

Abstract

Research aimed to enlighten the effect of age on milk production obtained from local goat populations. To limit the effect of some external factors on lactogen capacity the formed batches were maintained in permanent stabulation on the whole period of the respective lactation. Biological material belonged to local breed Carpatina, being represented by 7 batches differentiating by age from 2.5 years to 9 years, each of them being constituted by 10 females in lactation, all being subjected to the same experimental treatment. Evaluation of performances for milk production was based on some determinations accepted by experimental technique, using Nica method for lactation period and for period in which females were exclusively milked was applied the AT4 method respecting the technical specifications suggest by International Committee for Animal Recording. The obtained results were statistically processed by statistical analysis using REML (REstricted Maximum Likelihood) algorithm, which offers the obtaining of statistical estimating parameters in normal interval. Analyse of recorded performances with the occasion of applying of productive control highlight that at batch formed by females which have in the second and third lactation the age of four and five years was recorded a mean milk production higher with 14.38% and respectively 32% face to the ones in the first lactation. The obtained results are very important because, in Romania, the sector represented by goat rearing is into an advanced development and modernization stage as well regarding the applied technologies.

Key words: age, Carpatina goat, fat, milk production, protein.

INTRODUCTION

Nowadays, in European Union, goat rearing represents, for some countries, a traditional activity which dates since ancient times. Nevertheless, both sheep as well as goats enjoys a real interest, particularly in countries with large areas of pasturelands which couldn't be capitalized by other herbivorous breeds.

The realised research is important because aimed to show the influence of age on production performances, with positive effects on economical efficiency specific for basic productions obtained from goats.

Directly the main goal of the current studies was represented by evaluation of age at which are obtained the highest milk productions at Carpatina goat breed reared in the habitat representing by the North-East area of Romania. Knowledge of this aspect could contribute to the development of the sector,

based on application of a management adequate to the development level of the exploitation.

Function of this aspect farmer could establish an age structure which will allow the facilitation in obtaining of superior productions. Also, in the production nucleolus for farm animals, batches are formed by farmer function of its needs and criteria (Margetinová et al., 2003).

One of the criteria could be represented also by age structure which could contribute to obtaining of superior milk productions. In the effectuated research was observed that face to the level recorded at first lactation, at Carpatina breed milk production progressively increase with 15% at second lactation and with around 32% at the third lactation. After this moment the production level decrease and lactation curve on productive life decrease.

So, in conditions in which milk production represent the main reason for goat rearing, in

the structure of flock must dominate the goats which are in the first three lactations.

MATERIALS AND METHODS

Biological material was represented by adult goats from Carpatina breed constituted in batches function of age group, maintained on the whole duration of reproduction and production cycle in permanent stabulation. To study the effect due to age was established a batch of 70 females with age from 2.5 years to 9 years and with a homogenous corporal mass for each batch, all of them being subjected to the same experimental treatment.

The performance evaluation for milk yielded during the lactation submitted to the control was based on the application of successive productive checking, using for the lactation period the Nica method (this process takes into account the fact that 1 kg gain achieved by lambs in the lactating period is obtained with

4.5 kg milk until the age of 60 days), while for the period in which the females were exclusively milked the applied method has been AT4 respecting the technical specifications suggested by the International Committee for Animal Recording.

Under the applied system, the total duration of lactation was 205 days. For the period of lactation the first control was planned at 28 days from the moment of lambing and the second one during the 58th day of lactation. For the milking period after lamb weaning, controls were placed at regular intervals of 28 days.

Individual milk yields have been recorded alternated, during the morning milking and in the evening milking at the next control to, and so on. For each productive checkout was utilised the same experimental treatment and estimation of the average total production of milk was carried out using the Fleischmann method, in according with the model described below.

$$\text{Milk yield [kg]} = L_1 \cdot \text{int}_1 + \sum_{i=2an} \left(\frac{L_i + L_{i-1}}{2} \cdot \text{int}_i \right) + L_n \cdot 14$$

where:

L_1 = milk yield of the 1st monthly test;

L_i = milk yield of the i^{th} monthly test ($i = 1, \dots, n$);

L_n = milk yield of the last test;

int_1 = number of days from kidding to 1st monthly test;

int_i = number of days between monthly tests ($i-1$) and i ($i = 1, \dots, n$);

n = total number of monthly test for a specific animal.

Determination of raw chemical composition of goat milk was realised on samples gathered from total milk quantity obtained at each effectuated quantitative control using “Milko-Scan” and “Ecomilk” respectively, both devices based on spectrophotometry.

The achieved results have been input into the data base, used to run statistical analysis with the algorithm REML (REstricted Maximum Likelihood), which provides the achievements of the statistical parametric estimators within the normal range.

The REML estimator is the maximum likelihood estimate of the parameters which uses only the information not contained in the estimate of the regression vector, and thereby automatically corrects for the degrees of freedom which are lost in estimating the regression vector.

RESULTS AND DISCUSSIONS

The necessity of these types of research have as technical support the continuous development of the sector represented by goats rearing and the breeders interest on Carpatina breed which in comparison with other imported breed, have a very good adaptability to the local pedo-climatic conditions.

Quantitative control of total milk production in relation with lactation numbers represented the main target of the effectuated research. Based on the results was observed that, from quantitative point of view, milk production has some particularities determined by lactation month, age, individuality and other factors.

Also, through statistical processing of data recorded on the basis of applied controls on a certain lactation could be noticed the fact that

the higher milk quantities was obtained from goats which were in the third and respectively in the fourth lactation, belonging to the age groups of five and respectively six years (Table 1 and Figure 1).

In literature are many data which highlight the fact the age and number of products at calving influence the level of milk production at goats (Pascal, 2015). Others information sustain the fact that milk production increase with aging, because while animal's age increase, hormonal state of animal body, metabolic activity, secreting cells and intake of nutrients which are used in milk synthesis increase in intensity (Carnicela et al., 2008; Capuco et al., 2001). Analysis of mean milk production distribution in connection with age show an intense increase in the first three lactations after which the determined mean level has a slower decreasing. So, at batch formed by females which have at the second and third lactation the age of four years and five years was recorded a mean milk production higher with 14.38% and respectively 32% face to the ones which were at the first lactation (Table 1).

Based on the obtained results could be observed that age and respectively number of lactations is strongly connected to lactogen capacity of goats. In others studies effectuated on other breeds is highlighted the fact that those ones produce in the first lactation 65-

75%, and in the second around 75-85% from milk production obtained from goats with age between four and six years (Capuco et al., 2001; Mochnacs et al., 1978).

The statistical processing of the obtained data regarding total milk quantity obtained from local goats in relation with age show the fact that the highest difference was of 83,121 kg and was recorded from females which were into the third lactation and respectively into the seventh lactation. All the observed differences were statistically significant for $P < 0.5$.

This thing presents a remarkable practical importance because by control technical actions, effectuated in the first lactations, we could obtain quite quick information regarding productive level characteristic to goats, aspect which allow also the application of some earlier and more efficient selection on reproduction biological material.

The realised research confirms the fact that into local goats populations presented in the North-East area of Romania are nucleus and individuals with a superior productive potential. In these conditions, if those populations will be subjected to an intense selection process will be possible the prediction that into a certain not so far away time interval will take place a radical change of the quality of biological material, as well as a remarkable increase of productive performances.

Table 1. The level of milk production in correlation with age and lactation number

Lactation	Age	n	Total milk production (kg)		Difference face to the level recorded at first lactation				
			$\bar{x} \pm s_{\bar{x}}$	V (%)	absolute (kg)	relative (%)			
I st	2.5	10	157,534 ± 0.654	11.9	-	-			
II nd	4	10	183,974 ± 0.327	12.7	+ 26,440	+ 14.38			
III rd	5	10	232,098 ± 0.341	13.5	+ 74,564	+ 32.12			
IV th	6	10	218,987 ± 0.401	11.7	+ 61,453	+ 28.06			
V th	7	10	188,896 ± 0.243	12.5	+ 31,362	+ 16.60			
VI th	8	10	163,988 ± 0.189	9.2	+ 6,454	+ 3.93			
VII th	9	10	148,977 ± 0.274	9.3	- 8,573	- 5.43			
			L7	L6	L5	L4	L3	L2	L1
Tukey Test		L1	+ 8,557	- 6,454	- 31,362	- 61,453	-74,564	- 26,440	
		L2	+34,997	+19,986	+4,922	-35,013	-48,124		
		L3	+83,121	+68,110	+43,202	+13,111			
		L4	+70,010	+54,999	+30,091				
		L5	39,919	24,908					
		L6	+15,011						
		L7							

Significant at the 0.05 level (w = 6,741);
n.s.: not significant

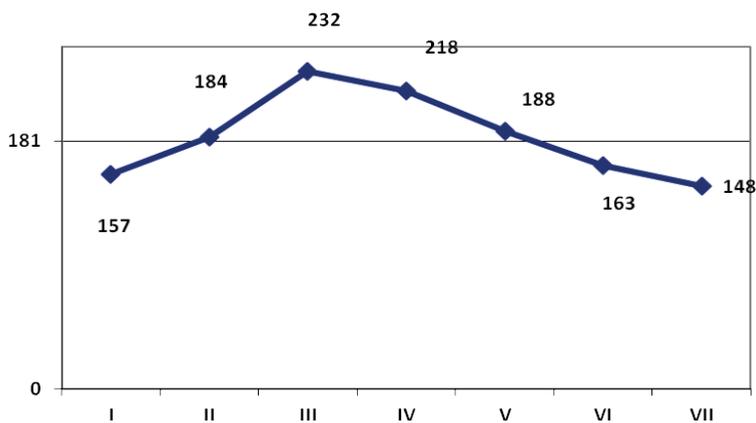


Figure 1. Milk production curve in relation with lactation number and age (kg)

The success could be complete if all those activities will be associated with others which aim to improve maintenance conditions, a foddering in according with nutritional demands specific for each physiological state, conducted rearing of goat youth, pastureland improvement, extension of maintenance in permanent stabulation, optimal dimensioning of age structure etc.

The role and influence of age on productive potential of goats were also studied in other countries but on different breeds (Alderson et al., 1980). All the effectuated research shown the fact that age influence the productive aptitude in the way of decreasing of milk production at the moment in which goats overpass the age of 4-5 years.

In Romania the studies effectuated on Carpatina breed reared in Moldova show that total mean milk production had close values (Zaharia, 2011a).

Evaluation of goat milk quality was realised on samples gathered from total obtained quantity at each of the productive checkouts

applied into lactation subjected to control. After gathering were realised samples which were analysed to determine fat and protein content.

Analysis of mean values shows differences of fat and protein content function of lactation's interval in which samples were gathered. So, evolution of fat rate from dry matter had an ascendant dynamic from 3.53% at checkout effectuated in the first 60 days of lactation till 5.22% at the samples gathered at the last checkout effectuated at the beginning of autumn. Practically, on the interval between first and last checkout, the total fat quantity from dry matter increased with more than 30% (Table 2).

Analysing the evolution of basic components which form the milk's dry matter, respectively protein and fat, we can observe that on the interval of the same lactation the recorded levels are different (Figure 2). So, while protein percent is situated almost at the same level at each checkout interval, fat content recorded higher mean values while the lactation is getting to its end.

Table 2. Evolution of fat and protein content in relation with checkout interval (% from DM)

Lactation stage	Fat		Protein	
	$\bar{x} \pm s_{\bar{x}}$	V (%)	$\bar{x} \pm s_{\bar{x}}$	V (%)
Checkout Ia 50 days of lactation	3.53 ± 0.07	11.13	3.22 ± 0.09	10.31
Checkout Ia 100 days of lactation	3.80 ± 0.21	14.23	3.31 ± 0.21	11.22
Checkout Ia 150 days of lactation	4.16 ± 0.11	14.82	3.42 ± 0.20	12.28
Checkout Ia 200 days of lactation	4.25 ± 0.28	15.85	3.47 ± 0.31	14.33
Checkout Ia 225 days of lactation	5.22 ± 0.13	13.97	3.61 ± 0.15	13.08
Total period	4.16 ± 0.80	-	4.11 ± 0.20	-

DM - dry matter

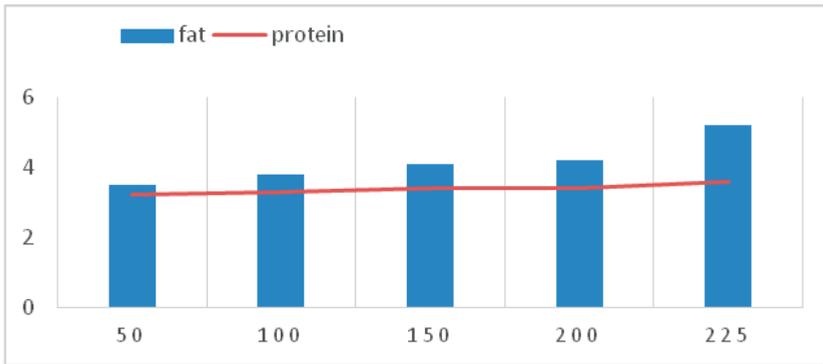


Figure 2. Evolution of fat and protein content in relation with lactation stage

In the case of determination which aimed the appreciation of protein content in relation with lactation phase, analyzing the mean data could be observed the fact that the mean values are lower in comparison with the ones determined for fat, but, also in this case could be noticed a progressive increase of total protein content as we approach to the moment of goats weaning.

Fat represent an important criterion in expressing milk quality because from its total, triacylglycerols constitute the greatest group (almost 98%), including a high number of esterification fatty acids, which are fats with very complex structures. In addition to them, into the fat matter from goat milk could be found other simple fats (diacylglycerols, monoacylglycerols and esters of cholesterol), complex lipids (phospholipids) as well as liposoluble compounds (sterols, esters of cholesterol, hydrocarbures) (Zaharia, 2011b). Fat from milk is presented and the shape of globules, characteristic for ovine and goats being that the majority of those globules (at goat, 65% less than 3 μ) had dimensions smaller than 3.5 μ (Park and Haenlein, 2006).

The lowest protein content was determined on the samples of milk gathered from total milk obtained at first checkout ($3.22 \pm 0.09\%$ from DM) and the maximum value was of $3.61 \pm 0.15\%$ determined on the sample gathered at the last productive checkout. Goat milk contains a higher quantity of non-protein nitrogen and lower rate of nitrogen tied in casein. From this reason, goat milk had a lower efficiency regarding cheese production and weak structure and texture of yogurts, while sheep milk had a very strong coagulation power (Guo et al., 2003; Călin et al., 2015).

The highest value of variability showed the lack of homogeneity for both characters as well as the fact that by selection the rate of the basic milk components which determine the nutritive value to be upgraded to a superior level.

In the realised research could be observed that for fat and protein content weren't recorded significant statistical differences for the considered statistical levels.

Also regarding milk quality in numerous studies is shown that milk gathered from young goats had a better quality because have a higher fat content in comparison with the one gathered from other goats with an older age (Jaafar et al. 2018; Pascal, 2006; Taftă et al., 2006; Gall, 1986; Pearl et al., 1973; Jenness, 1980).

Into an ample study effectuated on goats reared and exploited in the North-East region of Romania it was observed that in the debut months of lactation, when also the milk quantity was greater, fat percent had mean values of around 3.5%, value recorded at the checkout effectuated in May, progressively increasing to the end of lactation up to 5.85%, maximal value which was recorded at the checkout from October.

In the same study is mentioned that not even in the case of milk quantitative production, nor in the case of fat content from milk recorded on the whole checkout period weren't observed significant statistical differences ($P < 0.05$) between the studied goat populations (Zaharia, 2011b)

CONCLUSIONS

Statistical processing of data recorded on the basis of applied controls on a certain lactation

show the fact that the higher milk quantities was obtained from goats which were in the third and respectively in the fourth lactation, belonging to the age groups of five and respectively six years.

Study of milk mean production distribution in correlation with age show that at batch formed by females which have in the second and third lactation the age of four and five years were recorded a mean milk production higher with 14.38% and, respectively, 32% face to the ones in first lactation.

The practical importance of realised research highlights the fact that by control technical actions, realised in the first lactations, could be obtained information regarding goats' productive level, aspect which allow application of a more efficient selection on reproductive biological material.

Fat and protein recorded increases of mean values, while lactation is getting to the end showing a direct correlation with milk quantity.

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REFERENCES

- Alderson, P., Pollak, E.J. (1980). Age - season adjustment factors for milk and fat of dairy goats. *J. Dairy Science*, 63, 148–151.
- Carnicela, D., Dario, M., Consuelo, M., Ayres, C., Laudadio, V. (2008). The effect of diet, parity, year, and number of kids on milk yield and milk composition in Maltese goat. *J. Small Rumin. Researches*, 77, 71–74.
- Capuco, A.V., Wood, D.L., Baldwin, R., Mcleod, K., Paape, M.J. (2001). Mammary cell number, proliferation and apoptosis during a bovine lactation: relation to milk production and effect of BST. *J. Dairy Science*, 84, 2177–2187.
- Călin, I., Răducuță, I., Dărăban, S., Vlad, I., Prișceanu, H.I., Pascal, C., Pădeanu, I. (2015). Research on quantitative skills in meat production direction at youth goats from Carpathian breed in relation with the rearing system. *Agriculture and Agricultural Science Procedia*, 6, 191–196.
- Gall, C. (1996). *Goat breeds of the world*. Technical Centre for Agricultural and Rural Cooperation, Wageningen, The Netherlands, p. 186.
- Guo, M., Aston, C., Burchett, S.A., Dyke, C., Fields, S., Rajarao, S.J., Uetz, P., Wang Y., Young, K., Dohlmán, H.G. (2003). The yeast G protein alpha subunit Gpa1 transmits a signal through an RNA binding effect on protein Scp160. *Mol. Cell*, 12(2), 517–524.
- Jaafar, S.H.S., Hashim, R., Hassan, Z., Arifin, N. (2018). A Comparative study on physicochemical characteristics of raw goat milk collected from different farms in Malaysia. *Trop Life Sci Res.*, 29(1), 195–212.
- Jeness, R. (1980). Composition and characteristics of goat milk: Review 1968-1979. *J. Dairy Sci.*, 63, 1605–1630.
- Margetinová, J., Brouček J., Apolen D., Mihina Š. (2003). Relationship between age, milk production and order of goats during automatic milking. *Czech J. Anim. Sci.*, 48(6), 257–264.
- Mochnac, M., Taftă, V., Vintilă, I. (1978). *Genetics and breeding of sheep*. Bucharest, RO: Ceres Publishing House.
- Norris, D., Ngambi, J.W., Benyi, K., Mbajjorgu, C.A. (2011). Milk production of three exotic dairy goat genotypes in Limpopo Province, South Africa. *Asian Journal of Animal and Veterinary Advances*, 6, 274–281.
- Park, Y.W., Haenlein, G.F.W. (2006). Overview of milks of minor species. In: *Handbook of Milk of Non-Bovine Mammals*. Blackwell Publishers. Ames, Iowa and Oxford, England. p. 3–10.
- Pascal, C., Nechifor, I., Cristian, C., Florea, A.M. (2018). The influence of technological factors on the lactogen potential at goats. *Magyar Allatorvosok Lapja*, 140, 432–439.
- Pascal, C. (2015). *Treated by raising sheep and goats*. Iași, RO: Ion Ionescu de la Brad Publishing House.
- Pascal, C., (2012). The main diseases of sheep and goats, specific to the cold season. *International congress of Hungarian Association for Buiatrics, Proceedings* ISBN 978-963-87942-5-3. Budapest, Hungary, 188–198.
- Pascal, C. (2006). Researches concerning at the quantitative and qualitative milk production at the indigenous goats growed and exploited in the North-Eastern area of Romania. *IGA World, Proceedings, Goat in Central and Eastern European Countries: present and future*, Constanța, Romania.
- Park, Y.W., Haenlein, G.F.W. (2006). *Goat Milk - Chemistry and Nutrition*. Iowa and Oxford, UK: Blackwell Publishing House, p. 34–58.
- Pearl, S.L., Downey, H.F., Lepper, T.L. (1973). Intramammary pressure and mammary blood flow in lactating goats. *J. Dairy Science*, 56, 1319–1323.
- Sandu, Gh. (1993). *Engineering in the operation of sheep*. Bucharest, RO: Alutus Publishing House.
- Taftă, V., Vintilă, I., Zamfirescu, S. (1997). *Production, improving and reproduction of sheep*. Bucharest, RO: Ceres Publishing House.
- Taftă, V., Machidon, N. (2006). Comparative researches regarding the fattening of goats and sheep youth in industrial system. *Proceeding of the International Symposium "Goat Farming in Central and Eastern European Countries: Present and Future"*. Constanța, Romania.
- Torres-Vázquez, J.A., Valencia-Posadas, M., Castillo-Juárez, H.M., Hugo H.M. (2009). Genetic and phenotypic parameters of milk yield, milk

- composition and age at first kidding in Saanen goats from Mexico, *Livestock Science*, 126 (1-3), 147–153.
- Zaharia, N. (2011a). The study of some goat populations raised in the North-East part of Romania. *PhD thesis*, UASVM Iasi.
- Zaharia, N., Salamon, R., Pascal, C., Zaharia, Roxana (2011b). Changes in fatty acid composition and cholesterol content of goat colostrums, *Biotechnology in Animal Husbandry*, Belgrade, 27, 1201–1209.