

Milk Composition, Lactation and the Artificial Rearing of Red Deer

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During two lactation periods, the milk produced by three hinds of different age was investigated as to the variation in dry matter, fat, lactose, ash as well as calcium, magnesium, potassium, sodium and phosphorus contents. Besides, the content of fatty acids was determined in the milk fat and the proteins. The hinds were found to produce 1.2 or 2.85 litres of milk per day. The duration of the lactation period was found to depend on whether or not the hind was pregnant. Fawns were hand-reared during ten seasons. Of 32 fawns born, 30 were reared successfully. Using milk substitutes («Mlekopan») for fostering the fawns gave worse results than using fresh cow's milk. The best results were obtained when the fawn was taken away from its mother at the age of 2—3 days. Singly reared fawns were more tame than fawns reared in a group.

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INTRODUCTION

The taming of deer is possible by rearing calves artificially. To ensure a correct development of calves without the mothers, it is necessary to know the chemical composition of milk (dry matter, protein, ash, fat, microelements and the changes occurring during lactation). Because of the attempts of rearing deer calves on milk replacers it is also necessary to know the composition of the fatty acids in the milk of a hind, and especially the proportions between individual groups of acids. It is also necessary to know the milk production of a hind, frequency of feeding, length of lactation, etc.

As regards the milk composition of deer there exists several publications (Schultz, 1952; Bubenik, 1965; Ben-Schaul, 1962). while this investigation was in progress there appeared two large works on this theme (Arman *et al.*, 1974, Brüggemann *et al.*, 1973). One of them conducted on a subspecies occurring in Scotland (*C.e. scoticus* Lömnberg, 1906), the second one on the red deer (*C. e. hipelaphus* Erxleben, 1777), from central Europe.

Both these works, based on a large material and conducted over several lactations, record the milk composition in various stages of the lactation. Hitherto, the composition of fatty acids in the hind's milk has not been analysed, and it plays an important part in preparing milk replacers.

Artificial rearing of calves has been carried out many times. Among the most important works from this field one must mention Brüggemann *et al.* (1973), Youngson (1970), Dzieciołowski (1969).

The present work aimed at examining the milk composition, paying special attention to fatty acids; at examining the factors influencing the lactation length, at determining the optimum age for weaning the calf. Moreover, observations were conducted on factors influencing the degree of taming of calves and a comparison was made between the development of calves reared on domestic cow milk, on a Polish milk replacer »Mlekopan«, and reared by their mothers.

MATERIAL AND METHODS

The deer farm at Popielno is laying on the verge of a forest. The animals are kept throughout the whole year in pens 25×50 m — several animals in each pen. During the summer they receive about 10 kg of green forage per head, 1.5 kg of oat, 0.5 kg of a concentrate for cattle. In the winter they receive 1.5 kg of oat, 0.5 kg of concentrate for cattle, about 1 kg of hay and 2–3 kg of beet root in place of the green forage. Moreover in the summer they receive branches of deciduous trees and in the winter of pine trees as a supplement.

For experiments 5 hinds of various ages were used (body weight between 120 and 160 kg). Investigations on the milk composition and milk yield of hinds were conducted in 1973–75, and on the length of the lactation in 1973–77. Artificial rearing of 22 calves was conducted between 1969 and 1977 (excluding 1976). The milk for analyses was obtained after immobilizing the hinds with succinylcholine and administration of 15 ml of tranquiline¹ (producer Polfa) and 20 I.U. oxytocin intramuscularly. A total of 28 milk samples was obtained from 5 hinds (a majority from 3 animals).

The following determinations were made in the milk samples (Budziński, 1967): a) active acidity — pH — using Mera-Elmer pehametres, type 512; b) density using a picometre; c) dry matter content by drying at a temperature of 102–205°C; d) lactose content, polarimetrically, for milk defacation using the Carres I and II solutions; e) fat content by Gerber's method; f) content of crude protein, casein, and whey proteins — respectively by Kjeldahl's method, Schlossmann's method and by precipitation with a 20% phosphotungstic acid from the filtrate obtained after separating casein; g) content of the residual nitrogen — calculated from the N general minus N protein difference; h) ash content by burning in a muffle furnace at 600–650°C; i) Ca and Mg content by the complexometric method (Wojtowicz & Benedyktyńska, 1957); j) phosphorus content colourimetrically using colorimetres »Specol«, wave length 610 μm (S wartling & Mattson,

¹ The Polish drug Tranquiline contains per ml: chlorpromazine (25 mg), ascorbic acid (2 mg), sodium metabisulphite (1 mg) and sodium chloride (6 mg).

1954); k) sodium and potassium content with a flame spectrometre (Shore & Mulder, 1957); l) chlorid content by Vohlard's method (Budslawski, 1967). The content of fatty acids was determined by way of gas chromatography, according to the method described by de Mann (1964).

The hinds were milked by hand and their milk yield was determined by milking all the milk twice or three times per 24 hours.

RESULTS

The milk of the red deer (Table 1) is much more concentrated than domestic cow milk. It contains, on average, about twice as much of dry matter, 2—4 times more fat, twice as much protein. The quantity of lactose, ash and mineral components is similar to that in cow milk. During the lactation the content of dry matter increased rapidly, exceeding 32% and the fat content reached a maximum of 17%. Table 2 and 3 presents the share of various fatty acids and of their groups in red deer milk.

The 24 hours yield of hinds oscillated between 1.2 and 2.85 litres, the highest yield occurred about a month after calving. When the hind is pregnant the lactation lasts until the end of December, at the most, until the end of March. In two barren (not sired) hinds milking their fawns in 1976, the lactation lasted until September 1977, and was ended only by separating their over one year old progeny.

Initially calves suckled their mothers 5—9 times per day and night 30—145 seconds each time. Later 4—6 times per day and night 20—95 seconds each time.

Calves designed for artificial rearing were separated from their mothers at the age of 2—21 days. It was observed that the age of 2—3 days is the best for weaning the calf, as older animals tamed with greater difficulty and the period of adaptation to new conditions lasted much longer, what was reflected in their weight gains. If the calves were weaned after finishing two weeks they were very wild and injured themselves against the fence what even could cause the death of the animals.

The mean daily weight gains in group I (on domestic cow milk) till the 50th day of life reached 0.25 kg for females and 0.29 kg for males. Between the 50th and 120th day of life the weight gains of females increased to 0.40 kg, and for males — to 0.46 kg. The increase of the weight gains after the 50th day of life is explained by the fact that at that age calves already consumed green forage and concentrates. In group II (reared by the hind) the weight gains until the 50th day of life were much higher and amounted to 0.43 kg for females and 0.67 kg for males. Between the 50th and 120th day of life the weight gains of females in this group amounted to 0.31 kg. In group III (receiving

Table 1
Changes of chemical

Kind of determinations	Hind No 30 ¹ (during period)					
	13 July 1973	16 July 1973	18 July 1973	20 July 1973	24 July 1973	30 July 1973
pH	—	5.95	6.25	6.00	6.65	6.65
Density, g/cm ³	1.0370	1.0376	1.0381	1.0386	1.0402	1.0400
Dry matter, %	20.00	21.57	20.07	22.95	21.56	23.43
Fat, %	8.5	10.0	9.6	11.4	9.4	6.6
Chlorid, %	61.57	68.42	61.73	68.68	54.55	88.65
Lactose, %	4.77	3.80	4.13	4.82	5.34	4.30
Total nitrogen, %	1.175	1.168	0.932	1.073	0.923	1.098
Nitrogen of casein, %	0.899	0.737	0.896	0.871	0.748	0.903
Nitrogen of whey proteins, %	0.051	0.078	0.094	0.098	0.118	0.132
Residual nitrogen, %	0.225	0.353	0.142	0.104	0.057	0.063
Ash, %	1.06	1.04	1.16	1.08	1.11	1.08
Calcium, mg %	249.88	198.42	249.10	250.15	321.23	305.36
Magnesium, mg %	23.39	19.21	29.45	31.19	20.77	19.19
Phosphorus, mg %	252.11	225.44	231.96	225.23	205.04	208.38
Sodium, mg %	—	40.15	36.01	29.67	29.90	31.16
Potassium, mg %	—	128.48	140.76	89.97	89.32	89.18

¹ Hind No 30 calved 13 July 1973, ² Hind No 25 calved 23 June 1974.

Table 2
Percentage of fatty acids in the fat of red deer milk during lactation.

Kind of acid	Avg. for three red deer			Red deer nr 5 (1974)					
	Initial ¹	Middle ¹	Final ¹	25 June ² , 1980	25 June ² , 1980	26 June ² , 1980	20 Febr. ³	5 March ³	18 March ³
C ₄	3.63	4.26	4.21	4.21	4.09	4.24	3.93	3.93	3.67
C ₆	2.16	2.34	2.27	2.45	2.72	2.45	1.89	2.00	1.76
C ₈	1.73	1.91	1.53	1.68	1.88	1.51	1.10	1.16	1.25
C ₁₀	2.47	2.06	2.94	2.81	3.94	2.82	1.75	1.81	2.01
C _{10:1}	0.25	0.28	0.31	0.31	0.35	0.29	0.21	0.24	0.31
C ₁₂	2.98	2.31	3.78	3.62	4.29	3.60	2.70	2.48	2.61
C _{12:1}	0.44	0.39	0.37	0.66	0.53	0.58	0.43	0.42	0.45
C _{14 iso}	0.23	0.21	0.15	0.25	0.27	0.25	0.17	0.16	0.18
C ₁₄	13.61	15.40	14.17	12.19	12.66	12.30	12.82	11.25	13.61
C _{14:1}	1.46	1.50	1.37	1.21	1.37	1.22	1.54	1.42	1.38
C ₁₅	1.36	1.05	0.97	1.13	0.88	1.13	1.60	1.42	1.27
C _{16 iso}	0.65	0.51	0.56	0.80	0.69	0.80	0.53	0.64	0.59
C ₁₆	30.18	29.11	27.06	23.98	28.52	24.20	31.54	32.29	30.38
C _{16:1}	3.02	2.92	2.27	2.63	3.01	2.65	2.57	2.19	2.27
C _{17 iso}	1.55	1.25	1.29	1.23	3.09	1.24	1.64	1.53	1.55
C ₁₇	0.92	0.76	0.62	0.43	1.04	0.43	0.95	0.86	0.92
C _{17:1}	0.35	0.34	0.38	0.75	0.34	0.75	0.39	0.42	0.54
C ₁₈	11.75	11.01	11.76	15.70	9.82	15.78	11.79	12.14	12.33
C _{18:1}	18.66	18.68	21.16	19.95	16.86	19.83	19.94	21.14	21.61
C _{18:2}	2.05	2.37	2.08	1.58	1.19	1.58	1.90	1.84	2.21
C _{18:3}	0.63	0.74	0.75	2.43	2.46	2.36	0.64	0.66	0.65

¹ Period of lactation, ² Directly after calving, ³ At the end of lactation.

composition of hinds' milk.

of lactation)				Hind No 25 ² (final period of lactation)				
30	28	30	5	6	20	5	18	5
Aug.	Sep.	Oct.	Dec.	Febr.	Febr.	March	March	April
1973	1973	1973	1973	1974	1974	1974	1974	1974
6.65	6.30	6.60	6.35	6.35	6.30	6.65	7.05	7.15
1.0392	1.0389	1.0408	1.0414	1.0410	1.0414	1.0409	1.0410	1.0270
21.75	22.72	25.89	30.58	30.84	32.51	31.64	32.21	—
9.6	9.6	11.2	12.4	12.0	13.4	15.8	17.4	—
68.25	54.62	68.14	102.15	95.38	81.72	68.13	149.88	—
5.51	5.17	5.50	5.15	4.47	4.81	3.61	3.78	—
1.086	1.026	1.252	1.842	1.494	1.453	1.521	1.924	0.942
0.897	0.864	1.024	1.561	1.144	1.104	1.158	1.427	0.532
0.094	0.094	0.188	0.215	0.256	0.235	0.256	0.403	0.239
0.095	0.068	0.040	0.066	0.256	0.114	0.107	0.094	0.171
1.10	1.06	1.08	1.18	1.08	1.09	1.11	1.14	—
269.24	294.35	268.66	336.25	274.88	327.42	355.10	310.52	—
17.58	29.27	37.25	35.71	28.64	32.35	32.24	32.64	—
211.86	195.36	191.43	160.37	166.06	177.25	157.63	160.43	68.47
22.76	27.76	23.59	29.74	58.48	64.61	66.69	191.85	—
89.40	140.77	64.86	97.22	108.07	97.22	86.46	75.65	—

cow's milk until the 50th day of life and later a milk replacer) the weight gains of females reached 0.22 kg (until the 50th day of life) and next, dropped to 0.16 (between the 50th and 120th day of life when the calves received a milk replacer).

Calves fed on domestic cow milk until six months of age gained weight only slightly better than those receiving domestic cow milk for three months. Very important in taming was the first month of life. Calves reared individually among people tamed much easier than those reared in a group.

Table 3
Changes of the groups of fatty acids in the fat of red deer milk during lactation (average values for three red deer).

Group of acids	Period of lactation		
	Initial	Middle	Final
Total volatile acids	9.99	10.57	10.95
Total higher saturated	63.17	62.21	60.36
Total monoenes	24.18	24.11	25.16
Total polyenes	2.68	3.11	2.83

DISCUSSION

The chemical composition of the red deer milk and its changes during the lactation obtained in the present work are similar to those recorded by other authors (Arman *et al.* 1974; Brügge mann *et*

al., 1973). The percentage of fatty acids in the fat of the hind's milk is similar to that observed in the fat of domestic cow's milk. Slight differences occur in the group of the lower fatty acids and higher saturated acids, of which there is rather more in the hind's milk. Moreover, it was recorded that in the fat of hind's milk there was slightly less (by about 5—10%) of unsaturated acids.

The milk yield of hinds is dependent to a considerable degree, on their age and body weight. The results obtained are similar to those recorded by Arman *et al.* (1974) and Brüggemann *et al.* (1973), but are much lower than those given by Bubenik (1965).

The length of the lactation depends on the hind's subsequent pregnancy. If the hind is barren it may last even for two years. Thus the method of estimating barren hinds as being without udders, used in hunting literature, is absolutely false.

The best period for weaning calves from their mothers is the age of 2—3 days. Calves born with a very small body weight are extremely difficult to rear artificially and thus ought not to be separated from their mothers. Calves reared by hinds develop much better than those reared artificially, and reared on cow's milk develop better than those fed a milk replacer »Mlekopan«.

The milk replacer causes often diarrhoea what inhibits the growth rate. This seems to be caused among other factors, by the fact that the fat from this milk replacer is not assimilated as the composition of its fatty acids is not suitable for deer calves. It seems that the calf may be weaned at the age of 3—4 months, as the calves fed milk until 6 months old have slightly better weight gains than calves fed until 3 months.

Calves ought to be tamed intensively during the early days of life (first month) as this period is crucial in this respect. During this period the calves ought to be kept in the smallest possible groups, preferably individually.

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SKŁAD MLEKA, LAKTACJA ORAZ SZTUCZNY ODCHÓW CIELĄT
JELENIA SZLACHETNEGO

Streszczenie

Podczas dwóch okresów laktacji badano skład mleka od pięciu łąn. Określano ciężar właściwy, suchą masę, tłuszcz, laktozę, białko, składniki popiołowe (Tabela 1) oraz zawartość kwasów tłuszczowych (Tabela 2, 3). Łącznie pobrano 28 próbek mleka w różnych okresach laktacji.

Łanie produkowały od 1.20 do 2.85 l mleka dziennie. Ustalono, iż długość okresu laktacji zależy od terminu pokrycia łąni (laktacja kończył się w 3—4 miesiące od chwili zacielenia). W przypadku jałowienia łąni w danym roku, laktacja trwa nieprzerwanie nawet ponad półtora roku mimo, że młode są już całkowicie dorosłe.

Odchów cieląt prowadzono przez 10 lat; łącznie z 32 cieląt odchowano 30. Karmienie preparatem mlekozastępczym — „Mlekopan”, w porównaniu z mlekiem krowim, powodowało znacznie gorsze przyrosty cieląt. Najlepsze rezultaty odchowu i oswojenia uzyskano, gdy cielę odbierano od matki w wieku 2—3 dni. Cielęta odchowywane pojedynczo znacznie lepiej oswajały się niż trzymane w grupie.