

The effect of age and litter size on milk production in Boer goat ewes

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Over a 12-week lactation period the influence of age and litter size on the milk production of Boer goat ewes was studied. The age of the ewes varied between two and six years while litter size was represented by singles, twins and triplets. Milk production increased with both age and litter size. The effect of age on milk production decreased with an increase in litter size although older ewes showed a less marked response to litter size than younger ewes. The group averages for daily milk yield, protein, fat, total solids and lactose content ranged between 1,47 and 2,47 l; 3,91 and 4,48 %; 6,38 and 9,41 %; 15,81 and 19,20 %, and 4,58 and 4,92 % respectively.

S. Afr. J. Anim. Sci. 1983, 13: 240–243

'n Onderzoek na die invloed van ouderdom en aantal lammers op die melkproduksie van Boerbokooie is oor 'n 12-week laktasieperiode onderneem. Die ouderdom van die ooië het gewissel tussen twee jaar en ses jaar terwyl die aantal lammers per ooi verteenwoordig is deur een-, twee- en drieling. Melkproduksie het toegeneem met ouderdom sowel as met die aantal lammers. Die invloed van ooi-ouderdom op melkproduksie was groter by ooië met eenlinge as dié met meerlinge terwyl die invloed van aantal lammers groter was by jong ooië as by ou ooië. Die groepsgemiddeldes vir daaglikse melkproduksie, proteïen-, vet-, TVS- en iaktose-inhoud het gevarieer tussen 1,47 en 2,47 l; 3,91 en 4,48 %; 6,38 en 9,41 %; 15,81 en 19,20 %, en 4,58 en 4,92 % onderskeidelik.

S.-Afr. Tydskr. Veek. 1983, 13: 240–243

Keywords: Goats, age, litter size, milk production

Introduction

It is well established that milk yield in goats is influenced by litter size and lactation number. Milk yield is proportional to the mammary alveolar surface area (Richardson, 1973). According to Hayden, Thomas & Forsyth (1979), the extent of mammary development depends in part on the number of foeto-placental units and on placental mass. In sheep, Alexander & Davies (1959) concluded that milk yield is either influenced by the number of lambs suckled or by the extent of the sucking stimulus. The amount of milk produced by goats increases during successive lactations (Prakash, Acharya & Dhillon, 1971). These workers concluded that increase in milk yield with increase in lactation number would be because of the growth and development of different body systems, especially the udder. It is however not known to what extent these factors may influence milk production under conditions of restricted nutrient intake which can be expected under extensive veld conditions. In addition to this, a large proportion of Boer goat kids (90 %) are the result of multiple births which impose further nutritional stress on the ewe. This is evident in the relatively slow growth rates of suckling kids under extensive grazing conditions (Raats, 1982). The aim of this study was to study the influence of age and litter size on the milk production of Boer goat ewes.

Procedure

A commercial Boer goat flock, consisting of 121 ewes, was maintained on natural veld. No supplementary nutrient source was provided during the experiment. Kidding commenced in late August, at which time 38 ewes were divided into three different groups according to age. These groups represented two-, four- and six- year-old ewes in their first, third and fifth lactations respectively. Each group was further subdivided into single-, twin- and triplet-suckled ewes. Ewes which subsequently lost a kid or developed mastitis were excluded from the experimental groups. As a result the final number of ewes allocated to the respective groups are presented in Table 1.

Table 1 Ewe age and suckling groups

Suckling group	Age of ewe and lactation number		
	Two yrs First lactation	Four yrs Third lactation	Six yrs Fifth lactation
Single	5	1	5
Twin	6	5	5
Triplet	1	0	4

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Received 2 December 1982

Three rested paddocks, with a total area of 26,2 ha, were used as grazing for the experimental animals during the first 12 weeks of lactation. These paddocks consisted of veld classified as False Thornveld of the Eastern Province (Region 21; Acocks, 1975). The dominant grass species were *Sporobolus fimbriatus* (26 %) and *Digitaria eriantha* (25 %). The dominant bush species acceptable to goats according to Trollope (1981), were *Acacia karroo* (274/ha), *Ehretia rigida* (167/ha), *Rhus lucida* (160/ha), *Xeromphis rudis* (141/ha) and *Grewia occidentalis* (122/ha).

Milk production was measured at weekly intervals using a method similar to that of McCance (1959), whereby an intravenous injection of 5 i.u. synthetic oxytocin was followed by hand milking. Three hours later the same procedure was followed. From this second milking, the yield was estimated and milk samples were obtained. The samples were analyzed on a weekly basis for protein, fat, total solids and lactose. Protein content was determined by the macro-Kjeldahl-technique (IDF, 1962). Fat content was determined by the Gerber method, using a 10,77 ml pipette on diluted milk samples. Lactose content was determined by the chloramine-T-method (IDF, 1974) and total solids content according to the procedure described by the AOAC (1975). Analyses of Variance were carried out for a simple random design and the means were tested by the Student - Newman - Keuls method (Cochran & Cox 1968).

Results

The mean daily milk production for each group over a period of 12 weeks is given in Table 2. It is evident from Table 2 that, regardless of the age group, milk production increased with an increase in litter size. However, this effect is only significant ($P \leq 0,05$) in the two-year-old group. Results in Table 2 indicate that the effect of litter size on milk production decreased with advancing age of the ewe. The differences in average milk yield between single- and twin-suckled ewes were 29 %, 8 % and 4 % for the two-, four- and six- year-old ewes respectively. The corresponding differences between single- and triplet- suckled ewes were 54 % and 18 % for the two- and six- year-old ewes respectively. This interaction between litter size and ewe age is also evident from the average lactation curves illustrated in Figure 1. These lactation curves also indicate that the effect of litter size on milk production decreased as lactation advanced. This effect was more marked in the old ewes.

During the first three weeks of lactation, significant differences ($P \leq 0,01$) in average milk yield were found between

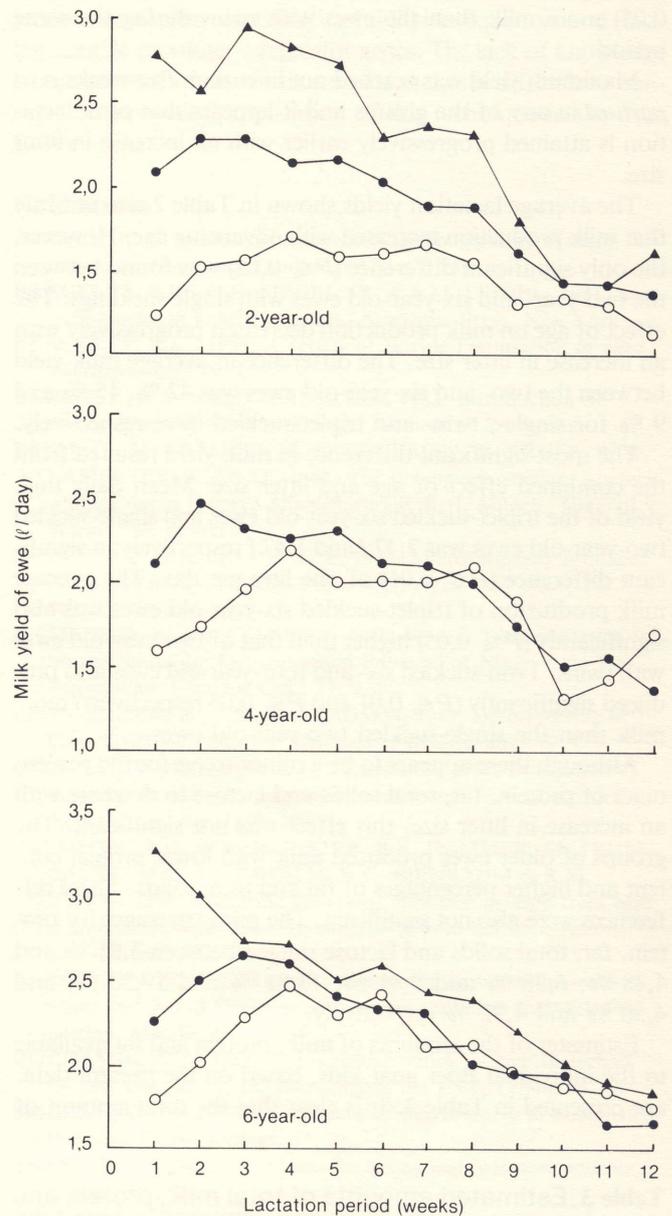


Figure 1 Lactation curves of single- (o—o), twin- (●—●) and triplet-suckled (▲—▲) ewes of different ages.

Table 2 Mean daily milk production and milk composition during the first 12 weeks of lactation

Age of ewes	Litter size	Milk yield litres/day	Milk composition			
			% Protein	% Fat	% Total solids	% Lactose
2	Singles	1,47 ± 0,11 ^{*aA***}	4,48 ± 0,08	7,52 ± 0,26	17,32 ± 0,20	4,70 ± 0,11
2	Twins	1,89 ± 0,12 ^{bAB}	4,41 ± 0,19	7,01 ± 0,68	16,84 ± 0,78	4,67 ± 0,07
2**	Triplets	2,26	4,24	6,38	15,81	4,58
4**	Singles	1,84	4,46	7,71	17,93	4,92
4	Twins	1,9 ± 0,16 ^{bcAB}	4,30 ± 0,12	7,41 ± 0,39	17,11 ± 0,50	4,83 ± 0,03
6	Singles	2,09 ± 0,09 ^{bcAB}	4,38 ± 0,07	9,41 ± 0,93	19,20 ± 1,08	4,73 ± 0,07
6	Twins	2,18 ± 0,07 ^{bcB}	4,12 ± 0,11	8,08 ± 0,47	17,41 ± 0,53	4,71 ± 0,09
6	Triplets	2,47 ± 0,10 ^{cB}	3,91 ± 0,07	7,63 ± 0,12	17,00 ± 0,08	4,69 ± 0,08

* Standard error of the mean.

** Data unreplicated and excluded from the overall analysis of variance.

*** Means in the same column with different lower and uppercase superscripts differ significantly at the 5 % and 1 % level respectively.

the single- and twin-suckled two-year-old ewes as well as between the single- and triplet-suckled six-year-old ewes. In the latter group, the ewes with triplets produced significantly ($P \leq 0,05$) more milk than the ewes with twins during the same period.

Maximum yield was reached not later than five weeks *post partum* in any of the groups and it appears that peak lactation is attained progressively earlier with an increase in litter size.

The average lactation yields shown in Table 2 also indicate that milk production increased with advancing age. However, the only significant difference ($P \leq 0,05$) was found between the two-year- and six-year-old ewes with single sucklings. The effect of age on milk production decreased progressively with an increase in litter size. The difference in average milk yield between the two- and six-year-old ewes was 42 %, 15 % and 9 % for single-, twin- and triplet-suckled ewes respectively.

The most significant difference in milk yield resulted from the combined effect of age and litter size. Mean daily milk yield of the triplet-suckled six-year-old ewes and single-suckled two-year-old ewes was 2,47 l and 1,47 l respectively; a significant difference ($P \leq 0,01$) of one litre per day. The average milk production of triplet-suckled six-year-old ewes was also significantly ($P \leq 0,05$) higher than that of two-year-old ewes with twins. Twin-suckled six- and four-year-old ewes also produced significantly ($P \leq 0,01$ and $P \leq 0,05$ respectively) more milk than the single-suckled two-year-old ewes.

Although there appears to be a minor trend for the percentages of protein, fat, total solids and lactose to decrease with an increase in litter size, this effect was not significant. The groups of older ewes produced milk with lower protein content and higher percentages of fat and total solids. These differences were also not significant. The group averages for protein, fat, total solids and lactose ranged between 3,91 % and 4,48 %; 6,38 % and 9,41 %; 15,81 % and 19,20 %, and 4,58 % and 4,92 % respectively.

Estimates of the amounts of milk, protein and fat available to the individual Boer goat kids, based on the present data, are presented in Table 3. It is clear that the total amount of

respectively of that available to single kids.

Discussion

In this study the total milk production of the ewes increased with litter size. For twins, this effect has been widely reported for both goats (Ueckermann, 1969) and sheep (Alexander & Davies, 1959; Gardner & Hogue, 1964; Peart, Edwards & Donaldson, 1972; Maxwell, Doney, Milne, Peart, Russel, Sibbald & MacDonald, 1979.) Peart *et al.* (1972) reported the same trend with triplet-suckled sheep ewes.

The effect of litter size on milk production was influenced by age of the ewe. Older ewes showed a less marked response to litter size than younger ewes. The lactation curves also indicate that the initial increase in milk yield because of multiple suckling was of shorter duration in the older ewes. No evidence of this trend has been found in hand milked Saanen goats which were fed concentrates throughout pregnancy and lactation (Hayden *et al.*, 1979). These workers reported that in ewes which had triplets or twins, mean 50-day milk yield was respectively 47 % and 27 % higher than in ewes with single kids and that this trend was not affected by age or lactation number. This increase in milk yield compares favourably with the corresponding figures in the present study for the two-year-old ewes, namely 54 % and 29 %. On the other hand, the differences in average milk yield for the four- and six-year-old ewes were considerably lower. The assumption is made that the diminishing response to litter size because of advancing age in the present study is possibly a result of limited nutrient supply. The initially higher milk production and the more rapid decline in milk yield of the triplet-suckled six-year-old ewes during the first three weeks of lactation could reflect the depletion of body reserves. It is likely that after depletion of this nutrient source, the natural grazing could not sustain the initial high level of lactation.

Milk yield increased up to the fifth lactation. This trend is similar to the results reported by Rønningen (1964) as well as the results reported by Horák & Pindák (1965) as quoted by Iloeje & Van Vleck (1978). However, the majority of reports suggest that maximum milk production is reached at an earlier age (Anuwar & Devendra, 1966; Prakash *et al.*, 1971; Iloeje, Rounsaville, McDowell, Wiggans & Van Vleck, 1980).

In this study the effect of age and of lactation number on milk production decreased with an increase in litter size. This trend may be also partly because of a limited nutrient supply as postulated previously. Corroborative evidence on this aspect could not be traced.

The stage at which peak lactation was reached contrasts with the results obtained by Ueckermann (1969) using Boer goats, but supports the findings of Peart *et al.* (1972) and Peart, Doney & Smith (1979) using sheep. The latter reported that multiple-suckled ewes reached their lactation peak at an earlier stage than single-suckled ewes.

With the exception of the African Dwarf and the Pygmy goat breeds, the mean values for protein, fat and total solids are generally higher than the values summarized by Parkash & Jenness (1968) and Jenness (1980). These differences may be partly attributed to the different methods used in obtaining milk samples. The composition of residual milk, which formed part of the milk obtained through the oxytocin technique, differs from milk obtained by normal milking methods in that the fat content is higher (Peart *et al.*, 1972). The use of the oxytocin technique on goats has also resulted in a decrease in the lactose content of the milk (Linzell, 1967).

Where litter-size was equal, the fat and total solids

Table 3 Estimated amounts of total milk, protein and fat available to individual kids during the first 12 weeks of lactation

Groups	Age of ewe (years)	Available nutrients		
		Milk (l)	Protein (kg)	Fat (kg)
Single	2	123,3	5,5	9,3
Twin	2	79,5	3,5	5,6
Triplet	2	63,3	2,7	4,0
Single	4	154,1	6,9	11,9
Twin	4	83,6	3,6	6,2
Triplet	4	—	—	—
Single	6	175,2	7,7	16,5
Twin	6	91,6	3,8	7,4
Triplet	6	69,1	2,7	5,3

milk, protein and fat available per kid, decreased with an increase in litter size. There are more nutrients available per kid from the older ewes than from younger ewes with the same number of kids. The total amount of milk available to individual twins and triplets is not more than 65 % and 51 %

lactose content of the milk showed a minor increase with advancing age. Supportive evidence for the increase in fat content was reported by Horák and Pindák (1965) as quoted by Iloeje & Van Vleck (1978). In the present study, the content of fat and total solids decreased as a result of an increase in litter size. This is in contrast to the results obtained with sheep (Gardner & Hogue, 1964; Peart *et al.*, 1972).

The determination of the milk yield using the oxytocin technique merely provides an estimate of the milk available for consumption by the suckling kid. Reports from Wright, Jones & Geenty (1974), and Doney, Peart, Smith & Louda (1979) indicated that the oxytocin method of sampling overestimates the milk intake of lambs during the first two weeks of lactation, especially in ewes suckling single lambs. The milk yields obtained in the present study are generally higher than the reported milk production of Boer goat ewes obtained through the kid-suckling method (Ueckermann, 1969). However, estimates of the amount of milk available to the kid, based on the present data, reveal that in many instances the additional milk yield as a result of multiple births is insufficient to promote the optimum growth of kids.

Acknowledgements

The authors thank Profs. E.J.B. Bishop and D.L. Brown for their willing assistance, Dr W.W.Q. Smith for the analysis of data and Mr E. Mxotwa and Mrs S.E. Raats for technical assistance.

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