S. Afr. J. Anim. Sci. 4, 127–130 (1974)

THE INFLUENCE OF BREED AND PLANE OF NUTRITION ON THE CHRONOLOGY OF TEETH ERUPTION IN SHEEP

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OPSOMMING: DIE INVLOED VAN RAS EN VOEDINGSPEIL OP DIE KRONOLOGIESE OUDERDOM WAAROP SKAPE SE TANDE DEURKOM.

Die erupsie van die permanente snytande van Dorper- en Swartkoppersieooie en -ooilammers is weekliks aangeteken wanneer hulle geweeg is. Beide ooie en lammers is bedags op natuurlike weiding gehou maar saans in krale waar die groepe verskillende hoeveelhede katoensaadmeel as byvoeding ontvang het. Die permanente snytande van Persies het ongeag van voedingspeil, op 'n vroeër ouderdom deurgekom as dié van Dorpers. In beide rasse het die permanente snytande van diere wat katoensaadmeel ontvang het, op 'n vroeër ouderdom deurgekom as die tande van ooie wat nie gevoer is nie. Die groep waarvan beide ooie en lammers gevoer is, se permanente tande het op die jongste ouderdom deurgekom, gevolg deur die groep waarvan die ooie maar nie die lammers gevoer is nie en die laaste groep waarvan beide ooie en lammers nie gevoer is nie. Gemiddelde daaglikse toename is negatief gekorreleerd met ouderdom waarop tande deurkom. Swartkoppersies was minder geaffekteer deur 'n lae voedingspeil as Dorpers.

SUMMARY

Dorper and Blackhead Persian ewes and ewe lambs were grazed on veld during the day and fed varying amounts of cottonseed meal when kraaled at night. The teeth were examined weekly when the sheep were weighed and eruption of permanent incisors recorded. All the Blackhead Persians' permanent incisors erupted earlier than the corresponding pairs in the Dorpers regardless of the level of nutrition. Within breeds, supplementary feeding of cottonseed meal significantly decreased the time taken for eruption of all permanent incisors. The group in which both ewes and lambs were supplemented had the shortest eruption time, followed by that in which ewes were supplemented but lambs not, and the longest time was taken by that group receiving no supplements at all. Average daily gain is inversely related to eruption time, as shown by the negative (overall) correlation coefficients, and Blackhead Persians appear to be less affected by the level of nutrition than Dorpers.

In a comparison of the chronology of teeth eruption in indigenous and exotic cattle, Steenkamp (1970) found that the permanent incisors of indigenous, "Sanga-type" cattle erupted earlier than those of the Hereford, and also showed that the feeding of protein supplements reduced the time taken for the eruption of permanent teeth. Starke and Pretorius (1955) concluded that Blackhead Persian sheep tend to obtain their permanent incisors earlier than their crosses with the Dorset Horn, and the greater the amount of Dorset Horn blood the later the age at which permanent incisors erupted. Moreover, they add that there is a tendency for early-maturing mutton breeds to obtain permanent teeth later than unimproved breeds.

Tagle and Helman (1943) made observations on the teeth of 15 breeds of sheep to determine differences in the degree of maturity as judged by replacement of milk teeth by permanent teeth. They found that certain early maturing breeds such as the Southdown were slowest in developing adult dentition, and concluded that, contrary to popular belief, normal skeletal development was not directly correlated with incisor development. Data from growth and nutritional studies at Matopos Research Station, using Blackhead Persians and Dorpers, were used to investigate the chronology of teeth eruption in sheep in Rhodesia.

Procedure

Records were available from 141 mature ewes and ewe lambs born in October/November over a six-year period from 1965 to 1970 (Table 1). To minimise losses due to theft and predators, the sheep were herded by day and kraaled at night. Supplements were only fed to mothers from the 1st September until the onset of the summer rains in mid-November, and to lambs from the 1st June, also until mid-November.

The three planes of nutrition were as follows:-

High-High (HH)	Dams:	0,34 kg cottonseed meal/head/day
	Lambs:	0,23 kg cottonseed meal/head/day
High-Low (HL)	Dams:	as HH
	Lambs:	no supplements
Low-Low (LL)	Dams:	no supplements
	Lambs:	no supplements

Table 1

Animal numbers by breed and treatment

	Planes of nutrition			Total
	HH	HL	LL	
Dorper	34	39	28	101
Blackhead Persian	21	–	19	40
Total	55	39	47	141

The HL Group comprised Dorpers only, the other two groups including both Dorpers and Blackhead Persians. Tooth eruption was recorded at weekly intervals when the animals were weighed. The effect of rate of growth on the

Table 2

The average age at eruption (± standard error) of the permanent incisors of two breeds of sheep on three planes of nutrition (days)

Breed	Plane of nutrition	Teeth			
		2	4	6	8
Dorper	HH	438,3 ± 7,0	698,3 ± 11,2	909,7 ± 11,8	1109,0 ± 23,7
	HL	452,4 ± 5,8	734,2 ± 11,1	922,2 ± 11,4	1170,4 ± 27,2
	LL	471,0 ± 4,3	791,0 ± 9,8	971,3 ± 16,0	1229,5 ± 19,7
Difference HH – LL		32,7	92,7**	61,6**	120,5**
Blackhead Persian	HH	410,6 ± 5,8	610,1 ± 6,6	770,6 ± 9,5	940,6 ± 19,7
	LL	444,2 ± 5,7	658,4 ± 9,3	859,9 ± 9,9	1029,8 ± 21,4
Difference HH – LL		33,6	48,3*	89,3**	89,2**

* P<0,05 ** P<0,01

eruption of permanent teeth could only be determined to the two-tooth stage because gestation and seasonal variations influenced subsequent comparisons. The analysis of variance was carried out using the method described by Scheffe (1961) for non-orthogonal data.

Results and discussion

Table 2 shows the average time taken for the eruption of successive pairs of teeth for both breeds of sheep studied, on each plane of nutrition.

Differences between breeds

At all stages of tooth eruption except the two-tooth stage, the permanent incisors of Blackhead Persians erupted earlier than those of Dorpers (P<0,01) (Figure 1). The difference in the time of eruption between breeds increased as the ewes matured, being 16, 105, 119 and 183 days at two-, four-, six- and full mouth stages respectively. Blackhead Persians took, on average, 983 days to reach the full mouth stage, compared to 1 166 days for Dorpers.

Steenkamp (1970) concluded that incisor development is not directly correlated with normal skeletal development in cattle, as indigenous breeds, in which organ and tissue development are considered to be slow, obtained their first permanent incisors significantly earlier than the exotic Herefords. Steenkamp's conclusions are corroborated by the findings presented in this paper, from observations on slow-growing Blackhead Persians compared with the faster-growing Dorpers.

Effect of supplementary feeding on the chronology of eruption

The feeding of a protein-rich supplement to the dam during the latter part of the gestation period and early lactation, and the subsequent supplementation of the lamb after weaning, markedly influenced the time taken for the eruption of the permanent incisors. When supple-

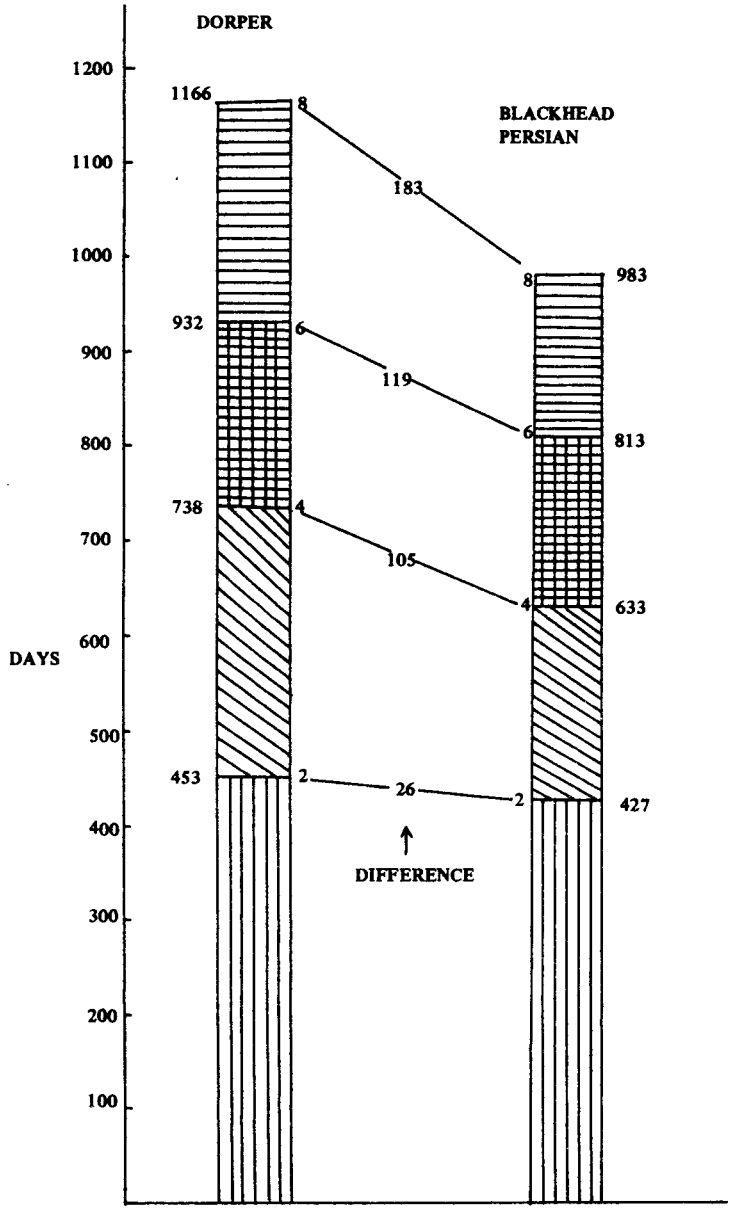

Fig. 1. *The average time taken for the eruption of the permanent incisors of high grade Dorper and Blackhead Persian ewes (days)*

ments were fed, the average age at which the central incisors erupted was reduced by 33 days. The difference in the time taken for the first and second intermediaries to erupt was, respectively, 73 and 70 days less when the sheep were fed supplements. The lateral teeth, on average, erupted 104 days later when the sheep received no supplements (Table 3).

There are three recognised stages of dental development: matrix formation, mineral (apatite) apposition and maturation. At birth, the central incisors are almost completely matured, the first intermediate incisors 60–70% matured (30–40% apposition), the second intermediates 30% matured and the laterals show matrix formation and some apposition. Thus feeding of a protein-rich supplement to the dam in the latter part of gestation will influence primarily foetal development of the central incisors only, giving the intermediate position of the HL lambs at the two-tooth stage. This supplementation will also increase the rate of development of the last six incisors of the ewe, as shown by the significant difference between HL and LL groups when these last incisors erupt, and the negligible difference between HH and HL groups.

The response of breeds to supplementation varied at different stages of tooth eruption. For example, at the full mouth stage the difference in eruption age between HH and LL for Blackhead Persians was 89 days and for Dorpers 120 days (Table 2). However, Dorpers on a high plane of nutrition obtained all eight permanent incisors 168 days later than Blackhead Persians, and on a low plane of nutrition 200 days later. Thus it seems that the eruption of the permanent teeth of Dorpers is more ressponsive to protein supplementation than that of the Blackhead Persian. Within the Dorper breed, the ages at which the permanent teeth of ewes in the HL Group erupted were, for all pairs of teeth, intermediate to the values of the HH and LL groups. There were no real differences between the HH and HL groups, but between HL and LL groups all differences were significant ($P < 0,05$) except that of the central incisors (18,6 days) (Table 2).

Differences in growth between breeds

As might be expected, HH lambs of both breeds grew considerably faster than lambs in LL groups, the difference in average daily gain up to two-teeth being 17,5 g for Dorpers and 18,6 g for Blackhead Persians. HH Dorper lambs gained an average of 10 g more per day than HH Blackhead Persian lambs and LL Dorpers 11 g per day more than LL Blackhead Persians ($P < 0,01$) (Table 4).

Table 3

A comparison of the average eruption time (± standard error) of permanent incisors of sheep on two levels of nutrition (days)

Plane of nutrition	Teeth			
	2	4	6	8
HH	427,7 ± 4,9	664,6 ± 7,1	856,6 ± 8,6	1044,7± 17,4
LL	460,2 ± 3,5	737,4 ± 6,8	926,3 ±10,4	1148,8 ± 15,0
Difference HH – LL	32,5*	72,8**	69,7**	104,1**

* $P<0,05$ ** $P<0,01$

Table 4

Average daily gains (± standard error) of Dorper and Blackhead Persian ewe lambs from birth to two-teeth (g)

Plane of nutrition	Difference	Dorper	Difference between breeds	Blackhead Persian	Difference
HH		85,28 ± 1,9	10,14**	75,14 ± 1,9	
	10,56**				18.56**
HL		74,72 ± 2,1		–	
	6,92*				
LL		67,80 ± 2,2	11,22**	56,58 ± 1,3	
Mean		76,36	10,04	66,32	–

* $P<0,05$ ** $P<0,01$

Feeding the dam only prior to, and shortly after, parturition (HL Dorpers), had less influence on lamb growth to the two-tooth stage (HL – LL = 6,9 g/day) than did feeding the dam together with subsequent winter supplementation of the lamb (HH–HL = 10,6 g/day) (Table 4). The reasons for studying the average daily gain from birth to the two-tooth stage only have been stated previously: however, it was observed that Blackhead Persian ewes on both high and low levels of nutrition had attained maximum body-mass by the time they had four teeth, as did HH Dorpers. However, the non-fed Dorpers continued to grow after the four-tooth stage, only reaching their maximum body-mass by the time they had six teeth.

Relationship between rate of growth and tooth eruption

Average daily gain was negatively correlated with eruption time. The negative correlation coefficients were significant (P< 0,05) for all groups of Dorpers. For Blackhead Persians, although the overall r-value of –0,47 was significant (P< 0,01), the correlation coefficients within treatments were not so (Table 5). This is a further indication that the eruption time of permanent incisors of Blackhead Persians is less responsive to environmental changes (rate of growth, via nutrition) than that of the Dorper.

Table 5

Correlation coefficients (r) between gains per day (x) and eruption age (y) of Dorper and Blackhead Persian ewes from birth to two-teeth

Breed	Plane of nutrition	r_{xy}
Dorper	HH	– 0,39*
	HL	– 0,33*
	LL	– 0,42*
Overall 'r' value		– 0,49***
Blackhead Persian	HH	– 0,24
	LL	+ 0,22
Overall 'r' value		– 0,47**

* P<0,05 ** P<0,01 *** P<0,001

Effect of eruption on body-mass

It was not possible to study in detail the effect of the process of eruption (i.e. emergence of teeth through the gingiva) on body-mass, as mass and teeth eruption were only recorded weekly. However, from the overall means (Table 6), and even within breeds it is evident that the emergence of the central incisors had the greatest effect on body-mass and that this adverse effect diminished with subsequent eruptions, because the already-emerged teeth provided incisal surfaces.

Table 6

Percentage animals showing a loss in body-mass at, or or immediately prior to, eruption of their permanent incisors

Breed	Plane of nutrition	Teeth			
		2	4	6	8
Dorper	HH	50	38	6	7
	LL	22	24	28	13
Blackhead Persian	HH	48	26	35	18
	LL	21	19	24	8
Overall Mean		35	26	23	11

Thirty-five per cent of the ewes lost body-mass when their central incisors emerged, compared with 26, 23 and 11 % when the next three pairs erupted. There did not appear to be any difference between breeds, but groups given supplementary feed showed a higher percentage of animals affected. A possible explanation for this difference may be that owing to the actual process of tooth emergence into the oral cavity occurring more rapidly amongst fed sheep, the teeth and surrounding gingiva were more tender.

Conclusion

This investigation has shown that indigenous-type sheep, in common with indigenous cattle (Steenkamp, 1970), show less response to varying levels of nutrition, and get their first permanent incisors at a much earlier stage of body development than do the more improved breeds such as Dorpers. Therefore, it would appear that in the more rigorous environments, natural selection favours early incisor development.

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