The development of the Dorper, its nutrition and a perspective of the grazing ruminant on veld

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Abstract

The development of the non-woolled Dorper sheep breed is briefly reviewed. Despite the large number of Dorpers in South Africa, precious little research results have been published on its nutrition under harsh, arid grazing conditions, especially since this has been an objective for creating and developing the breed. Results from the limited number of trials with free ranging Dorpers on natural pasture (veld) regarding diet selection, voluntary feed intake and rumen variables are used in conjunction with production data to create a nutritional perspective of the free ranging ruminant. © 2000 Elsevier Science B.V. All rights reserved.

Keywords: Breed development; Diet selection; Voluntary feed intake; Rumen variables; Reproduction; Production

1. Introduction

The Dorper is numerically second only to the Merino as the largest sheep breed in South Africa. It is a synthetic, non-woolled, mutton breed which was created and developed by mating Dorset Horn rams and Blackhead Persian ewes, followed by matings between the F1 progeny. Upgrading also took place through the mating of Dorper rams with Blackhead Persian ewes and ewes of other indigenous breeds (Nel, 1993). The development of the Dorper, a robust sheep breed, yet which is quite appealing to the eye, has been described as a true South African success (Roux, 1980). On 11 December 1987, the Dorper was proclaimed as a mutton sheep breed in South Africa (R2732 in the Government Gazette No. 11063, as cited by Nel, 1993).

Despite its large numbers in South Africa, precious little research results have been published on the nutrition of Dorpers under harsh, arid grazing conditions, especially since this has been an objective in creating and developing the breed. The relative ease of conducting trials under controlled feeding conditions, compared to the more complex situation of grazing ruminants on natural pasture (veld), probably played a major role in this regard. Following on a brief review of the development of the Dorper, this paper concentrates on studies that have been conducted with Dorpers on veld. The history of the Dorper has been presented by Nel (1993), but some elements are considered essential to create the necessary
perspective of the nutritional focus given to the free ranging Dorper in this paper.

2. The origin and development of the Dorper

The need for a mutton producing sheep breed, such as the Dorper, arose in the mid to late 1930’s, partly as a result of the harsh, arid grazing conditions that prevail in most of the north-western South Africa. During the period 1930–1932, the meat market in South Africa was characterised by disorderly marketing procedure, irregular flow of slaughter stock to the urban centres which in turn led to price instabilities and a mutton supply generally consisting of relatively inferior carcasses (Schoeman, 1980). This situation was exacerbated by the global economic depression, surplus mutton and a sharp drop in the wool price (Nel, 1993). The Meat Board, which was established in 1932, had to regulate the supply of slaughter stock to the urban centres but also had to find an export market for surplus meat (Schoeman, 1980). Local breeds that were present in the arid north-western regions of South Africa, namely the indigenous fat-tailed Ronderib- and Namaqua-Afrikaner as well as the imported fat-rumped Blackhead Persian, produced slaughter lambs with poor carcass conformation and localised fat depots (Campbell, 1974; Nel, 1993). These carcasses were acceptable to local consumers, but could not compete in the UK (Smithfield meat market) with the high quality slaughter lambs produced at the time in Australia, New Zealand and Argentina, especially the renowned Canterbury lambs from New Zealand (Campbell, 1980a,b; Nel, 1993). This export had disastrous results with financial losses sustained by the Meat Board and ushered in an era of experimentation by government institutions on so-called fat lamb production (Nel, 1993).

In a desperate effort to address and rectify the situation, the Meat Board financed the importation of several British mutton sheep breeds during the period 1936–1941. Several hundred Dorset Horn rams and a smaller number of ewes were imported from England. Crossbreeding programs were conducted at several centres in South Africa. It needs to be emphasised that this fat lamb production crossbreeding program during the 1930’s and 1940’s also gave rise to the development of two other sheep breeds unique to South Africa, namely the dual purpose wool and mutton producing Dormer and the Dohne Merino (Nel, 1993).

At the Grootfontein Agricultural College in the Karoo, imported rams were mated to the local Blackhead Persian and Ronderib–Afrikaner ewes. A small number of farmers were also involved on a co-operative basis (Nel, 1993). Lambs from the different crossings were evaluated inter alia for growth rate and carcass quality. All the crosses produced lamb carcasses of improved quality compared to those of the local dam breeds. However, the Dorset Horn x Blackhead Persian progeny also showed the longest period of sexual activity, thus making it possible to mate the ewes in spring and early summer to lamb in autumn, a trait that was considered very important for South African conditions (Nel, 1993).

The dam breed of the Dorper, namely the non-woolled, fat-rumped Blackhead Persian, originated from Somalia in North Africa and surrounding areas in Asia Minor. According to Campbell and Hofmeyr (1972), the first ram and three ewes entered South Africa in 1870 by sheer luck, when a damaged sailing ship had to stop for repairs at Port Beaufort at the Breede River mouth at the Southern tip of South Africa. The fat-rumped sheep aboard the ship aroused the interest of local farmers and were traded for other slaughter sheep. Later, after 1900, more of these Blackhead Persian sheep were imported in several batches. The fat-rumped Blackhead Persian sheep proved to be well adapted to local conditions, especially to the harsh, arid grazing conditions and quickly grew in numbers. The Blackhead Persian became renowned for its ability to lamb throughout the year (Campbell and Hofmeyr, 1972).

The sire breed of the Dorper, namely the Dorset Horn which was imported from the UK and later also from Australia, was poorly adapted to the harsh environments where the local breeds could survive and produce (Nel, 1993). However, through cross-breeding with the Blackhead Persian the offspring inherited a sufficient complement of genes to overcome most of these shortcomings. The main contribution of the Dorset Horn to the Dorper breed was its good carcass conformation and uniform fat distribution, its tendency for multiple births and its high milk production leading to faster growth rates of the lambs (Nel, 1993).
The crossbreeding program brought temporary relief regarding the poor quality lamb carcasses of local origin. However, in addition to other difficulties encountered, the crossbreeding program had the major disadvantage of having to be continuously practised and separate flocks of the pure breeds had to be maintained. Therefore, a more permanent solution was required. After 1942 the limited numbers of the Dorset Horn × Blackhead Persian crosses were increased by matings among the F1 progeny. This phase in the development of the Dorper was conducted by co-operating farmers under Departmental supervision. At the founding of the breed society on the cold day of 19 July 1950 at Grootfontein Agricultural College (Campbell, 1980a,b), this new mutton sheep breed was officially named the Dorper. In the early days, prior to 1964, some breeders concentrated on white sheep and these animals were bred out of the Dorset Horn × Blackhead Persian and probably also with some infusion from Dorset Horn × Van Rooy crosses (Nel, 1993). Since 1964, two distinct colour variants or types are recognised within the breed (Campbell, 1980a,b), namely the Dorper, a white bodied sheep with a black head and the White Dorper, which is a completely white sheep but with sufficient pigmentation around the eyes and external reproductive organs (Anonymous, 1998).

Several people played an important role in creating and developing the Dorper (Nel, 1993), but two individuals deserve special mentioning. David Engela, a Departmental sheep and wool officer at Grootfontein, played a leading and visionary role in starting the ‘Dorper project’. He died prematurely in the prime of his life during September 1949, an event that sent ripples through the farming community (Nel, 1993). Hennie de Smidt, a young man who became involved as a result of his father being one of the first co-operators, became a leading Dorper breeder and, according to Nel (1993), was blessed with a good eye for an animal. This early accent on a visual appraisal of the Dorper apparently played an important and continuing role in the breed’s development. It has been suggested that, would he still have been alive, Engela would have applied a more scientific approach in the breeding of the Dorper and prevented the strong emphasis being placed on a visual appraisal in assessing merit for breeding purposes (Nel, 1993).

3. The Dorper standard of breed excellence and performance testing

The Dorper standard of breed excellence was implemented in the early 1950’s and has since often been amended. It consists of five basic elements, namely conformation, size or growth rate, distribution of fat, colour pattern and cover or fleece, from which an overall type is derived (Anonymous, 1998). In determining the type, emphasis is placed on conformation, size and fat distribution, while colour pattern and cover are of secondary importance (Anonymous, 1980b). There is little doubt that the majority of breeders paid much more attention to these characteristics than performance per se, i.e., reproduction and growth, probably because it is easier to cope with subjective phenotypic standards than recording of performance (Nel, 1993). Nevertheless, many breeders made phenomenal progress over the years with the breed just by relying on phenotypic selection, probably because the hereditability of these traits are all high (S.W. Bosman, as cited by Nel, 1993). However, these phenotypic traits have little to do with effective production such as adaptability, reproduction, milk production and growth (Nel, 1993).

Despite the strong emphasis on selection for phenotypic traits, some breeders were convinced that performance had to be recorded (Nel, 1993) and at their request the National Mutton Sheep Performance and Progeny Testing Scheme was implemented in 1964 (Campbell, 1980a,b). During the first year (1964/65), only 16 Dorper breeders participated and the data of 1 179 Dorper lambs were analysed. Participation grew steadily and in 1979/80, the data of 3 341 Dorper lambs from 34 Dorper breeders were analysed. This constituted 23% of all participating mutton sheep breeders in the country and 24% of all lamb data analysed under the scheme (Campbell, 1980a,b). However, in spite of the poor participation in official performance testing, many Dorper breeders conduct their own unofficial format of performance recording. The apparent lack of interest and participation by the majority of Dorper breeders in performance testing may partly be found in conditioning.
over years to a tradition of phenotypic judging, instilled both on the farm, in the show ring and during training at various institutions (Nel, 1993). Furthermore, performance testing is based on accurate record keeping which requires appropriate facilities and additional input on the farm. The extensive nature of many of the farms where Dorpers are producing is a serious impediment to the practices required for accurate record keeping and thus performance testing. As a result, other sheep breeds surpassed the Dorper in their participation in official performance testing (Nel, 1993). According to Hallowell (1996) there has been a slump in recent years in the participation by Dorper breeders in the official performance testing scheme, partly because these breeders are traditionally reluctant to record their animals, a situation that will hopefully change with the introduction of breeding value estimates.

Campbell (1974) concluded that daily gain is the most important trait affecting the income from Dorper slaughter lamb production. This is in sharp contrast to the importance, and sometimes even excessive emphasis, given by many breeders and producers to the subjective Dorper breed standard of excellence. Nevertheless, performance testing arguably played a part in improving the growth rate of sheep of the participating flocks. The 100-day adjusted mass of Dorper lambs, the longest participating breed since the performance testing scheme was introduced in 1964, increased over a period of 15 years (1964/65 to 1979/80) from 25.2 to 31.9 kg for ram lambs and from 24.1 to 29.0 kg for ewe lambs (Campbell, 1980a,b). During the period 1989 to 1997, the 100-day adjusted mass of Dorper ram and ewe lambs were 28 and 31 kg, respectively (G. Hallowell, 1998; personal communication). However, it should also be considered that the latter values were obtained from limited data and not all the data included in these values originated from Dorpers producing under natural grazing conditions on veld, conditions for which Dorpers are intended.

The objective to produce slaughter lambs locally that could compete with the renowned New Zealand Canterbury lamb, was achieved quite early in the development of the Dorper (Table 1). The data on the Dorper carcasses were obtained during 1979 at the University of the Orange Free State (Campbell, 1980a,b), while those of the export New Zealand Canterbury lambs (Southdown and Romney) were obtained earlier by Fourie (1974, as cited by Campbell, 1980a,b). These comparisons showed that despite the heavier carcasses of the Dorper lambs, their carcasses contained less fat than the Canterbury lambs.

However, it is ironic that the lucrative meat export industry that was envisaged by many in those early days, never realised. Instead, the Dorper became a major mutton producer for domestic consumption in South Africa (Nel, 1993).

### 4. Distribution of the Dorper

Roux (1980) and Nel (1993) gave the distribution of Dorpers in South Africa on veld types that are all arid to dry with grass, Karoo bush species, shrubs and low bushes predominating. These areas are in the central and north-western parts of South Africa where the mean annual rainfall varies from 200 to 400 mm and even less. Some districts in this broad arid geographical area have irrigation farming components. Similarly higher concentrations of Dorpers are also associated with other irrigation areas in South Africa (Roux, 1980). In an area such as the Albany district in the Eastern Cape, the presence of the Dorper is due to the extensive development of the Valley Bushveld, which is to a considerable degree limiting to woolled sheep because of its physical nature (Roux, 1980).

According to Roux (1980) the association of the Dorper with specific veld types is not accidental but arises from their suitability for this breed, the adapt-

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**Table 1**

Carcass composition of Southdown, Romney and Dorper lambs

<table>
<thead>
<tr>
<th></th>
<th>Cold carcass mass (kg)</th>
<th>% Bone</th>
<th>% Muscle</th>
<th>% Fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southdown</td>
<td>12.2</td>
<td>10.3</td>
<td>56.0</td>
<td>29.0</td>
</tr>
<tr>
<td>Romney</td>
<td>13.6</td>
<td>13.0</td>
<td>59.0</td>
<td>23.0</td>
</tr>
<tr>
<td>Dorper</td>
<td>14.2</td>
<td>13.4</td>
<td>64.7</td>
<td>21.8</td>
</tr>
</tbody>
</table>
ability of the Dorper, economic reasons and their partial limitation of the numbers of other livestock breeds by environmental factors such as, for example, the presence of shrub. Currently there are about 7.5 million Dorpers in South Africa (Nel, 1993; Campbell, 1995). In the process it has replaced most of the original indigenous and some other local breeds (Roux, 1980). The popularity of Dorpers also increased beyond South Africa and Namibia and breeding animals have been exported to Israel (Elias et al., 1985), Saudi Arabia, Zimbabwe, Zambia, Kenya, Mauritius and Malawi (Nel, 1993).

5. The free ranging situation

South Africa is primarily a pastoral country. An estimated 68.4 million ha veld, or 80% of the land available for agricultural purposes, can only be effectively utilized by grazing ruminants (De Waal, 1990). The veld types are extremely diverse in terms of botanical composition (Acocks, 1988), dry matter (DM) production potential and therefore nutritive value, i.e., the ability to sustain animal production. Variation in DM yield of veld, primarily due to variation in rainfall, occurs between years at any specific site and is reflected in animal performance. Negative aspects of continuous overstocking and overgrazing on the DM production potential and stability of veld and, inevitably, on animal production, must also be considered.

Grazing ruminants exist in highly dynamic situations where performance in terms of growth, milk and wool production, is determined not only by changes in nutrient requirements, but also by the physical environment as well as quantity and quality of available pasture (De Waal, 1994). The distribution of Dorpers in Southern Africa (Rayner, 1989; Nel, 1993) is testimony of their ability to adapt and produce in greatly varying and often harsh environmental conditions. However, Dorpers also became increasingly important in more intensive production areas (Roux, 1980; Schoeman and Burger, 1992). Thus, a substantial part of the national Dorper flock has to varying degrees access to improved levels of nutrition, i.e. better quality planted and, often, also irrigated pastures and/or fairly high daily levels of supplementary feeding.

In pastoral situations, rainfall has a profound effect on DM yield and quality of veld and thus animal production (De Waal, 1990, 1994). As an example, the long-term monthly rainfall at Glen (mean annual rainfall of 551.9 mm; 1929–1992), with the resulting monthly DM production of veld, are presented in Fig. 1. From Fig. 1 it is evident that, for Glen, the bulk of the rainfall in summer is received from October to April, while the bulk of the DM yield of the veld is produced from December to March. De Waal (1990) suggested that these periods should be the focus for high levels of animal production from veld where grass predominates. However, the specific time frame for this period of optimum veld production may

![Fig. 1. The long-term monthly rainfall (1929–1992) and the resulting monthly DM production of veld at Glen.](image-url)
change somewhat between sites, depending on rainfall patterns and veld type, especially those with substantial shrub components.

The nutritive value of a feed depends largely on its chemical composition, digestibility of the ingested nutrients and the voluntary intake per unit of time by the animal (Blaxter, 1964). Thus, the rate of animal production is a function of the digestible nutrient intake. It presupposes that animals, such as Dorpers, must be able to walk long distances to select plant material and ingest sufficient nutrients, often on sparse veld and in very hot climates. Ostensibly Dorpers are able to select and ingest sufficient nutrients from a wide range of pastures, commensurate with the various animal production functions during the cyclical production year of the plant populations in different veld types. However, despite evidence to the contrary, it is often claimed that Dorpers are unselective grazers (Anonymous, 1980a; Rayner, 1989), thus accounting for the perceived better utilization of veld. Obviously, the selective grazing behaviour of ruminants, i.e. diet selection from the available herbage, and their ability to ingest sufficient quantities of herbage and thus nutrients on veld, i.e., voluntary feed intake per day, are confounded in the minds of many. Furthermore, the nutritional factors governing animal production under free ranging conditions differ markedly from those under controlled feeding conditions (De Waal, 1986).

Du Toit et al. (1995) and Du Toit and Blom (1995) studied the botanical composition of the diet selected by oesophageally fistulated (OF) sheep and goats. The plant species contained in the OF extrusa selected by OF animals at two sites were examined microscopically and identified. At the Carnarvon Research Station in the Arid Karoo (veld type 29; Acocks, 1988), dry females and castrates of Afrino and Dorper sheep and Angora goats were compared (Du Toit et al., 1995). It was concluded that the 4–5% difference in diet selection between the different species and physiological classes during the growing season suggests that Afrino and Dorper sheep and Angora goats of both sexes selected similar diets under comparable grazing conditions. At the Jansenville Research Station in the Noorsveld (veld type 24; Acocks, 1988), dry females and castrates of Merino and Dorper sheep and Angora and Boer goats were compared (Du Toit and Blom, 1995). Gender differences within breeds were insignificant. The Merinos and Dorpers compared well with Angora goats, while Boer goats differed substantially from both sheep breeds and Angora goats in their diet selection. The diets of the sheep breeds differed between 40 and 50% compared with Boer goats during the growing season. Du Toit and Blom (1995) stressed that their conclusions were based on the ratios in which plant species occurred in the selected diets relative to the forage on offer and that intake was not considered. These two studies also did not report on feed quality, i.e., the protein content and digestibility of the selected diets.

In the Valley Bushveld (veld type 23; Acocks, 1988) of the Eastern Cape, Aucamp (1980) showed that Dorpers and Boer goats differed markedly in their preference of plant material. As was to be expected, the Boer goats, being browsers, selected a diet comprising 80.6% bush and 19.4% grass, compared to the 65.2% grass and 30.8% bush of Dorpers. Despite the difference in preference of the available plants (grass or bush), Dorpers selected a diet with 11.2% crude protein (CP) and the Boer goats 13.4% CP. Aucamp (1980) also reported on the body mass changes of lactating Dorper ewes and their lambs, but not on the feed intake of the animals.

Several studies were conducted at the Agricultural Research Institute, Glen in the Free State on the nutrition of Dorpers and Merinos grazing Cymbopogon-Themeda veld (veld type 50; Acocks, 1988). Various stock licks or supplementary feeding are provided to livestock on veld in South Africa (De Waal, 1990), varying from simple mineral licks, i.e., mostly salt (NaCl) and phosphorus (P), to compound supplements including nitrogen (both NPN and/or protein) and energy. Often the levels of daily supplementation are fairly high. Many nitrogen (N) containing supplements are claimed to have so-called rumen stimulating effects, i.e., they are intended to stimulate rumen microbial activity and thus increase digestibility, feed intake and performance of grazing animals.

Against this background, De Waal et al. (1980) studied the effect of supplementary feeding on the composition and digestibility of the diet selected by Dorper and Merino wethers. The sporadic and inconsistent consumption of supplements by sheep is often suggested as cause for the poor response by sheep to supplementary feeding. Therefore, the two supplements (i.e., a P supplement and protein supplement)
were provided as a lick, with ad lib. daily access, or as a constant daily dose via rumen fistulae (RF). It was concluded that neither the protein (fish meal) nor the P supplement, provided as a lick or administered daily via RF, influenced grazing behaviour on veld as reflected in CP content and organic matter digestibility (OMD) of samples collected by OF wethers. Equally important, there was no breed difference regarding selective grazing behaviour, as reflected in the CP content and OMD of samples collected by Dorper and Merino wethers. This is in agreement with other results (Langlands, 1969; Engels et al., 1974; Du Toit and Blom, 1995) and refutes the common belief that the two most populous sheep breeds in South Africa, select different diets when having access to the same pasture. Furthermore, a seasonal trend in CP content and OMD was evident, which closely corresponded with the seasonal trend in rainfall and is in agreement with other studies (De Waal, 1990). Typical CP and OMD values for Glen (De Waal, 1979; De Waal, 1990), are shown in Fig. 2.

The diet selection by OF Dorper wethers on *Tarchonanthus* veld (veld type 16b1; Acocks, 1988) at the Koopmansfontein Research Station on the Ghaap Plateau in the Northern Cape, was also studied (de Waal and van Zyl, 1986; unpublished data). Although slightly different from that for Glen (Fig. 2), the results at Koopmansfontein also showed a typical seasonal trend for CP content and OMD (Fig. 3), reaching highs during the active growing season in summer and lows during the dormant winter. On the Ghaap Plateau sheep browse the bush component (*inter alia* such as *Tarchonanthus camphoratus*, *Grewia flava* and *Acacia* spp) extensively during certain times of the year, thus accounting for the higher CP values during winter and very low OMD of the selected herbage, especially during July 1986 (Fig. 3).

In the trial at Glen, the CP content of the OF collected samples varied between 7.9 and 14.8% and the OMD ranged from 54.0 to 65.9% (De Waal et al., 1980). These values are much higher than those usually cited for South African veld and is a discrepancy originating from the differences in techniques used for sampling of the pastures for analysis. It was concluded by Engels and Malan (1978) that chemical analysis based on samples collected manually, can by no means serve as an indication of the nutritive value of mixed veld. Ruminants have the ability to select plants and parts of plants in satisfying their quest for quality food. Nevertheless, many individuals erroneously persist in quoting absurdly low values from analysis of manually collected veld samples, especially with a view to justify the need for supplementation.

It was expected that the supplements, especially the protein supplement being a so-called rumen stimulating supplement, may have affected events in the rumen. Therefore, rumen fluid was sampled monthly from RF wethers at Glen (De Waal et al., 1980). Rumen NH₃ concentrations followed a seasonal trend,
in which CP content of the diet played a prominent role. However, the increases in CP content and rumen NH₃ concentration did not occur simultaneously. Rumen NH₃ concentration usually increased the month after a major rise in CP content and was attributed to the sampling procedures applied (De Waal et al., 1980). Protein supplementation also tended to produce higher rumen NH₃ concentrations. Nevertheless, the rumen NH₃ concentrations suggested that a N containing supplement on veld will not necessarily have a stimulating effect on the activity of the microbial population. Rumen NH₃ concentrations were almost consistently in excess of the lower limit (3 mg NH₃–N per 100 ml rumen fluid) suggested for optimal microbial synthesis (Satter and Roffler, 1975; Barry and Johnstone, 1976). The similarity in rumen NH₃ concentration of the Dorper and Merino wethers, concurred with the similarity in CP content in their diets.

In the trial at Glen described above, De Waal et al. (1981) also studied the effects of protein (fish meal) and P supplementation on the voluntary feed intake and body mass changes of young Dorper and Merino wethers. Feed intake was estimated on a monthly basis. Faecal excretion was collected by means of faeces collection bags from which digestible organic matter intake (DOMI) was estimated (De Waal et al., 1981). Although some of the differences in DOMI between treatments within breeds were significant ($P \leq 0.05$), the differences were not consistent. However, Merino wethers consumed significantly ($P \leq 0.05$) more DOM than Dorpers (47.4 g vs 43.1 g DOM per $W_{75}^{0.75}$). This is in agreement with the results of Engels et al. (1974) and is especially important with regard to stocking rate, because in practice adult Dorpers are generally larger animals than Merinos. Some of these principles are contained in the guidelines provided by Meissner et al. (1983) regarding substitution rates for different classes of livestock.

It is important to emphasise another critical difference between grazing and penned ruminants. Engels (1972) estimated the maintenance energy requirement of grazing sheep to be 33.5 g DOM per $W_{75}^{0.75}$ per day, which is in agreement with that reported by Young and Corbett (1968). Thus, the maintenance energy requirement of grazing sheep is about 50% higher than the corresponding requirement proposed for sheep confined to pens. A substantial part of this difference in requirements is accounted for by the energy expended during walking while grazing and the effects of exposure to inclement weather. In the trial by De Waal et al. (1981), the DOMI of the Dorper and Merino wethers were mostly equal to or in excess of the maintenance requirement of grazing sheep and as such reflected in their growth during the year. As was to be expected, the Dorpers maintained a higher growth rate than the Merinos, partly because some of the DOMI of the Merinos was partitioned towards wool production.

Fig. 3. Crude protein (CP) content and organic matter digestibility (OMD) of samples collected by oesophageally fistulated (OF) wethers on veld at Koopmansfontein.
The CP and DOM of veld usually decline with the onset of winter in the central Free State (Fig. 2), but sheep are still able to select herbage with a fairly high quality. However, animal performance is often affected by an insufficient intake of digestible nutrients (De Waal and Biel, 1989a). The amount of herbage ingested by grazing ruminants depends on the availability of herbage acceptable to the animals, the physical and chemical composition of the herbage, and the nutritional requirements as well as the capacity of the animal to ingest herbage (Minson, 1982). The nutritive value of veld can, therefore, be improved only by altering these factors to the advantage of grazing animals.

De Waal and Biel (1989b) studied the effects of energy and CP supplementation on feed intake of lactating ewes on veld at Glen during autumn and spring lambing seasons. Different levels of energy (maize meal) and/or CP (commercially available high protein concentrate) were provided daily via RF to the ewes. In view of the results obtained earlier with wethers (De Waal et al., 1981), it was not surprising that herbage intake of lactating Dorper and Merino ewes was not increased in response to CP during the winter. However, herbage intake decreased in winter when energy was supplemented, suggesting some degree of herbage substitution on veld, an effect which is well documented (De Waal and Biel, 1989b), while supplementation of energy plus CP increased herbage intake slightly. Feed intake of lactating ewes is at a maximum four to six weeks post partum (Hadjipieris and Holmes, 1966; Peart, 1967, 1968). Therefore, it was assumed that a response in feed intake to supplementation would be greatest during this period. De Waal (1986) has calculated from published data that lactating ewes at pasture require at least 55 g DOM/W0.75 kg day−1. During winter the herbage intake by the lactating ewes was less than the estimated minimum daily requirement (De Waal and Biel, 1989b). Total DOMI (i.e., herbage plus supplements) of the Merino ewes in some treatments was, however, owing to substantial contributions made by the supplements, higher than the estimated minimum requirement, while the total DOMI of the Dorper ewes was always less. The highest level of supplementation contributed about 18 and 30% of the total DOMI and CPI, respectively, of the Merino and Dorper ewes, but despite this, all the ewes lost body mass during lactation in winter (De Waal and Biel, 1989a,b).

Nutrients derived from ingested feed and body tissue mobilization by lactating ewes are utilized for milk synthesis. De Waal and Biel (1989b) used published data to calculate that, during weeks 4 and 5 of lactation, a loss of 100 g per day by ewes can potentially yield 440 g milk. Furthermore, again from published data, it was calculated that a feed intake of 250, 500 and 750 g DOM is required to sustain daily milk yields of 500, 1000 and 1500 g, respectively (De Waal and Biel, 1989b). This is in agreement with estimates by Coop and Drew (1963) and Hadjipieris and Holmes (1966), showing that lactating ewes require about 0.5 g DOM/g milk produced. The extent and rate of body tissue mobilization during lactation have a sparing effect on the feed intake required for milk synthesis per se and, conversely, the level of feed intake has an effect on the rate and extent of body tissue mobilization (Cowan et al., 1980). The rate of body mass loss by the ewes in 1981 and 1982 varied, respectively, between 50–100 and 115–160 g per day for the Merino ewes and between 100–200 and 175–270 g per day for the Dorper ewes (De Waal and Biel, 1989a,b). In view of the inadequate nutrient intake by the lactating ewes in winter, the excessive and continuous losses in body mass during lactation was not surprising and combined supplementation of energy and CP at fairly high levels, could only reduce the rate of body mass loss by 50% (De Waal and Biel, 1989a).

A totally different situation prevailed in spring/summer (1984 and 1984) and herbage intake of lactating Dorper ewes was substantially higher than in winter (De Waal and Biel, 1989b). The Dorper ewes in the control treatment, i.e., receiving no CP or energy supplementation, consumed more herbage than their estimated minimum daily requirements. Furthermore, herbage intake of lactating Dorper ewes was not increased by supplementary CP, but decreased substantially by supplementary energy. Again suggesting herbage substitution on veld, but more so than in winter. The higher DOMI of the ewes in spring/summer was positively reflected in an overall higher level of animal performance (De Waal and Biel, 1989a). In 1983, the Dorper ewes lost body mass until about the sixth week of lactation, whereafter they started regaining body mass, while in 1984 the Dorper ewes started regaining mass after the third week of...
lactation (De Waal, 1986). This was attributed to the greater availability of herbage with a higher quality, which generally improved conditions for a higher digestible nutrient intake by the ewes and their lambs. This in turn increased the milk yields by the ewes and thus the growth rates by their lambs (De Waal and Biel, 1989a).

When feed intake was estimated during early lactation in the two winter periods, the Dorper ewes were, respectively, 22% (45 vs. 55 kg) and 28% (40.5 vs. 51.9 kg) heavier than the Merino ewes (De Waal and Biel, 1989b). Thus, despite the similar amounts of herbage ingested by the two breeds during winter, the lactating Merino ewes had a higher herbage intake per metabolic size (DOMI/W_{0.75}^{kg} per day). This difference in feed intake per metabolic size between breeds corroborates other reports (Engels et al., 1974; De Waal et al., 1981). Feed intake of the Dorper and Merino ewes during early lactation (four weeks post partum) in winter was ca. 10 g per W_{0.75}^{kg} per day higher than in late lactation (nine weeks post partum), suggesting a declining trend in feed intake with advancement of lactation (De Waal and Biel, 1989b).

An interesting question is posed regarding the voluntary daily herbage intake by lactating ewes from veld in winter. Herbage was abundantly available during the trials in winter (De Waal, 1986), yet the lactating ewes seemed incapable of increasing their daily herbage intake beyond a certain limit. When acceptable herbage is scarcely distributed, sheep can extend their grazing time in order to increase intake, but only to a limited extent (Allden and Whittaker, 1970). Despite claims that so-called ‘rumen stimulating’ supplements increase both feed intake and digestibility of low quality roughage, the lactating ewes failed to consume more herbage in response to CP supplementation and is in agreement with the results of De Waal et al. (1981). Apparently, rumen activity as influenced by the herbage ingested in these studies, was not suboptimal and could therefore not have been influenced by supplementary CP. Alternatively, the selective grazing behaviour of sheep, being a time-consuming process, simply prohibited any positive response.

Although it was not possible to measure the effect of supplementation on in vivo digestibility in these studies with grazing ruminants, any nutritional advantage of CP supplementation should have been reflected in positive responses in animal performance, which was not the case (De Waal et al., 1981; De Waal and Biel, 1989a). Results concerning the DM disappearance rate in the rumen, as determined with the fibre bag technique, are particularly relevant. De Waal (1995) showed that CP supplementation tended to increase the rate at which herbage was fermented in sacco in the rumen of the lactating ewes during winter by 22% (26.0% vs. 31.8% of DM disappeared/24 h), compared to 3.9% in summer (49.0% vs. 50.9% of DM disappeared/24 h). Part of the slower rate of DM disappearance in winter could have been a result of suboptimal rumen NH3 concentrations. The relative resistance to microbial breakdown, resulting from senescent herbage during winter, seems to have been the primary factor limiting the rate of fermentation. The small positive response in animal performance to supplementary CP and energy in winter (De Waal and Biel, 1989a), may therefore be ascribed mainly to the direct effects of an increase in nutrients available for absorption in the lower alimentary tract and to a lesser effect of rumen stimulation per se (De Waal, 1986).

De Waal and Biel (1989c) also studied the effects of supplementation on rumen pH and NH3. They reported considerable diurnal and seasonal variation in rumen pH between and within the winter and summer lactation periods and ascribed it to seasonal differences in grazing pattern, herbage intake, ruminal activity of grazing sheep and type of supplementation (i.e., energy or CP or energy plus CP). With regard to the effect of energy supplementation on rumen pH, the results suggested that much of the maize starch was apparently digested postruminally. Furthermore, prevailing ruminal pH of Dorper ewes was always lower than for Merino ewes. De Waal (1986) also reported that grazing lactating Dorper and Merino ewes exhibited lower rumen NH3 levels than non-lactating ewes and suggested that the higher protein requirement posed for lactation could be responsible for this. In spite of a higher feed intake by lactating ewes, drainage of N from the body pool for milk synthesis would have left less N available for recycling to the rumen, thereby accounting for the lower rumen NH3 levels (De Waal and Biel, 1989c). Nevertheless, the large differences in rumen NH3 levels of the ewes in response to supplementary CP, compared to the small differences in animal performance (De Waal and Biel, 1989a), suggest that rumen NH3 levels had in fact not
been the primary limiting factor in either rumen activity, feed intake or animal production. Therefore, according to De Waal and Biel (1989a,b,c), the concept of supplements stimulating the rumen, especially in grazing sheep on grassveld of the central Free State, is questionable.

6. Animal production levels

The Glen Dorper flock was founded in 1982 at the Glen Agricultural Research Institute (de Waal and Combrinck, 1998; unpublished data). The Dorpers are grazing veld and have access only to a salt (NaCl) lick all year round. After being exposed to teaser rams for 14 days, the ewes are mated annually for a period of 34 days during April/May (autumn) to lamb during October/November (spring/early summer). The data base of the Glen Dorper flock consists of 3 958 lamb records. The average birth mass (i.e., within 24 h of birth), 35-day adjusted body mass, 100-day adjusted weaning mass of single and twin ram and ewe lambs, ewe fecundity and post partum body mass of ewes over a period of 16 years, are given in Figs. 4–8.

Large variation in animal production variables between successive years is apparent, showing that animal production is intricately linked to rainfall and its effects on the quality and quantity of veld, thus corroborating conclusions by De Waal (1990, 1994). In this regard De Waal (1990) stated that body mass changes of grazing sheep and cattle generally follow seasonal trends in CP and DOM content of the veld during specific years, but differ between years. Excessive losses of body condition during lactation have been recorded during autumn/winter in Merino (Engels and Malan, 1979; De Waal and Biel, 1989a), S.A. Mutton Merino (Engels and Malan, 1979) and Dorper ewes at Glen (De Waal and Biel, 1989a) and Dorper ewes at Koopmansfontein (de Waal et al., 1987; unpublished data). In contrast to this, De Waal and Biel (1989a) showed that less mature, lactating Dorper ewes and their lambs at Glen performed considerably better when grazing veld during the active growing season (spring and summer), because of the improved quality and availability of acceptable herbage. Clearly, animal production systems on veld should be planned according to the ability of the veld to satisfy the specific nutrient requirements for reproduction.

As discussed earlier, milk synthesis is sustained by utilizing nutrients derived from ingested feed and body tissue mobilization by lactating ewes. The variation in post partum body mass (Fig. 8) of the Dorper ewes at Glen suggests considerable variation in body reserves at the onset of lactation and, as was to be expected, the birth mass (Fig. 4) of their lambs also showed considerable variation between years. The body mass of a lamb at 35 days of age is a good indication of the milk yield of its dam, i.e., before its own solid feed intake becomes substantial. Thus, the compounded effect of variation between years as reflected in the post partum body mass of the ewes

![Fig. 4. The average birth mass of single and twin Dorper ram and ewe lambs over a period of 16 years at Glen.](image-url)
as well as the herbage available during lactation, is reflected in the 35-day body mass of the Dorper lambs (Fig. 5). By the time the lambs were weaned (Fig. 6), their body mass reflected to a greater extent their own ability to ingest sufficient nutrients from the veld, but residual effects of the milk yield of their dams are also present. Nevertheless, the overriding effect of variation in rainfall on availability and quality of herbage on offer, is quite obvious in terms of lamb growth (Figs. 4–6).

The choice of the mating season for the Dorper flock is based on the optimum period for nutrient supply for lactating ewes and their lambs from the veld at Glen (Fig. 1). Lambs are weaned annually during January, leaving another three months post weaning during the peak of summer and veld production (Fig. 1) before the ewes are mated during April/May. In spite of this, fecundity of the ewes (Fig. 7) also differed between years, varying between 112 and 145% with a mean of 128%. The effects of multiple births on lamb body mass variables, as well as the effect of sex, are shown in Figs. 4–6.

Many Dorper producers practice some form of accelerated lamb production by increasing the frequency of mating. In a study at Koopmansfontein, Coetzer et al. (1995) reported no increase in efficiency of Dorper weaner lamb production through an increase of frequency of mating over a period of eight

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![Fig. 5](image5.png)

Fig. 5. The average 35-day adjusted body mass of single and twin Dorper ram and ewe lambs over a period of 16 years at Glen.

![Fig. 6](image6.png)

Fig. 6. The average 100-day adjusted weaning mass of single and twin Dorper ram and ewe lambs over a period of 16 years at Glen.
years, when ewes were mated every eight months, namely either in October, June or February. In their study, the most efficient weaner lamb production system (kg live body mass/ha) was when the ewes were mated annually in June/July, coinciding with the seasonal peak sexual activity in Dorper ewes. Coetzer et al. (1995) stressed that the availability and quality of the veld during the period of high demand for nutrients for lactation of the ewes and growth of the lambs, namely from November to February, also played an important role in this regard.

Experience with the Dorper flock at Glen and the trial at Koopmansfontein (Coetzer et al., 1995) corroborates the statement by Nel (1993) that the Dorper is an easy-care breed. Furthermore, this robust breed, with a moderately high fertility and fecundity and very good mothering abilities under free ranging conditions, has shown to produce quite well at different locations from veld. Indeed, during the past five decades, the Dorper has become a true South African success story.

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