

Animal behaviour in the sub-tropics. II. Grazing behaviour of sheep

M. A. SHARAFELDIN and M. M. SHAFIE

Faculty of Agriculture - Cairo University, Cairo, Giza, U.A.R.

Summary

The behaviour of sheep en route to the pasture and while grazing was studied with the use of four breeds, *i.e.* Ossimi, Texel, Caucasian Merino and Fleisch Merino.

Compared to the foreign breeds, the Ossimi was the most efficient in covering distances without showing signs of fatigue.

All breeds showed a common diurnal trend as regards grazing activities, but each breed had its own characteristic behaviour as regards the time spent grazing in sun and shade, its response to exposure, and the time spent idling and lying.

All breeds tended to ruminate more while lying down in shade than when standing in the shade or sun. The time spent in rumination reached the maximum at mid-day. The Fleisch Merino ruminated longest, followed by the Texel, Caucasian Merino and Ossimi in this order.

1. Introduction

A careful study of animal behaviour is very important in animal husbandry. Such a study should provide a sound basis for new husbandry methods or the improvement of existent ones. Its value cannot be overestimated especially if different temperate-zone breeds of sheep are introduced in the sub-tropics.

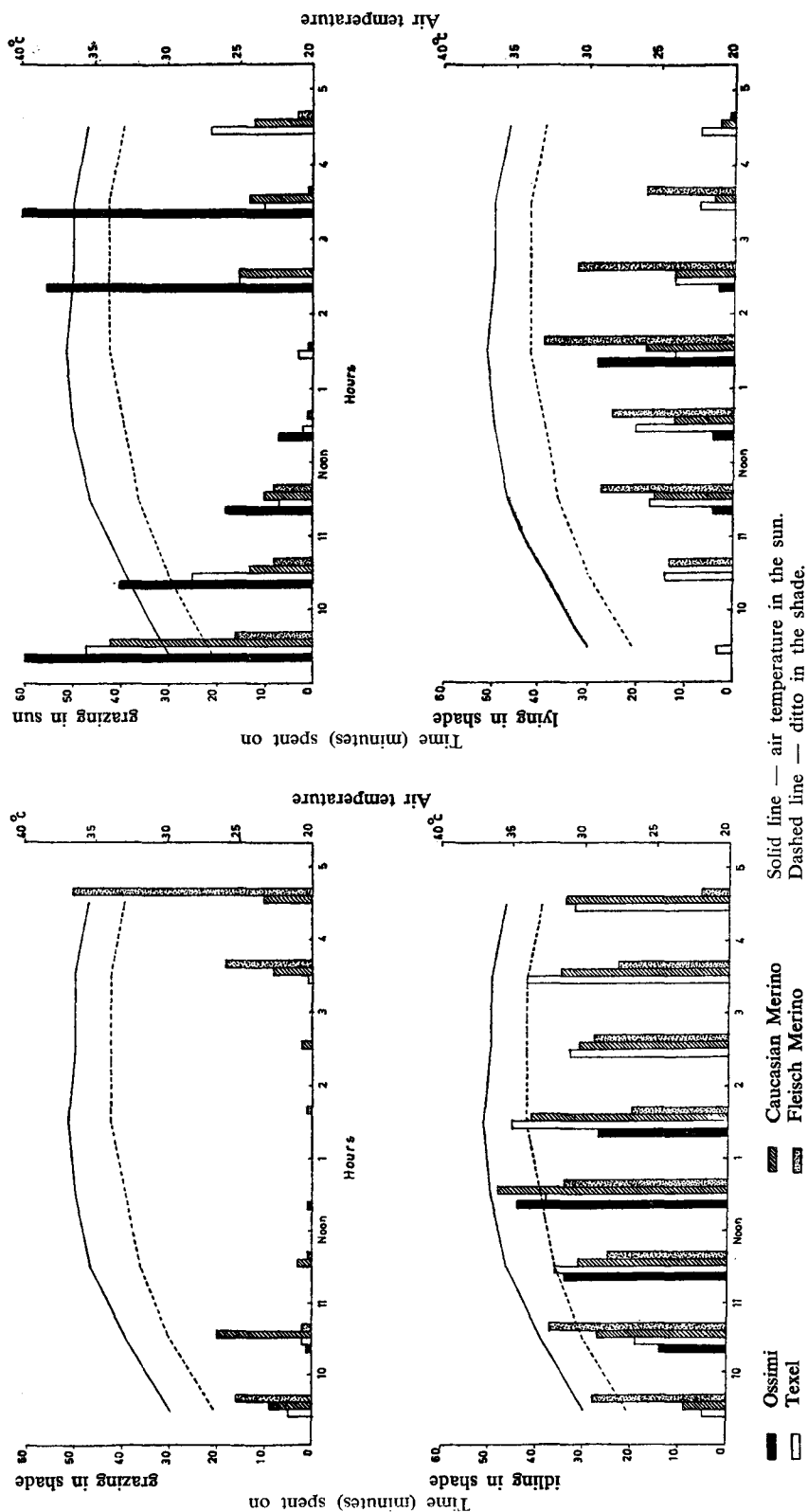
Although the science of animal behaviour is in its infancy, it has attracted the attention of many workers who have dealt with different aspects of the subject (ATKESON *et al.*, 1942; TRIBE, 1950a; GORDON and TRIBE, 1951; WEIR and TORRELL, 1959).

2. Materials and methods

The experiment was so designed as to be an exact replica of the common grazing practice in the Tahreer province, a newly reclaimed desert area in Egypt. The experiment was performed during five consecutive days of August, 1961, when weather conditions were practically the same (the average hourly air temperatures are shown in the FIGURE). Four groups of 30 ewes in their early pregnancy and of about the

Received for publication 27th May, 1964.

FIGURE. Breed differences in the average time (minutes) spent on different items of behaviour during successive hours at pasture



same age, represented four breeds of sheep: - Ossimi (indigenous), Texel, Caucasian Merino and Fleisch Merino, imported from Holland, Russia and Germany respectively. Each of the four breeds was placed under observation on separate days, and they were afterwards all brought together on the 5th and last day of the experiment.

At 8 a.m., the flock of 30 heads of the same breed were let out of the shed and taken to graze on a pasture 5 km away. Observations on the behaviour of the ewes were made during each kilometre of the journey. The first km was half-shaded, partly asphalted and partly sand, the second was half-shaded and asphalted, the third was exposed and asphalted, and the fourth and fifth exposed and partly asphalted, partly sand. The same shepherd was employed for the five days of the experiment so as to establish a maximum uniformity of conditions for the different breeds during their journey to the pasture.

When at pasture, the flock was left to graze on groundnuts, weeds and maize for 8 hours, water being available all the time. The area of the pasture was 5 feddans (about 5 acres), surrounded by three lines of wind-breaks which provided enough shade.

The increase in body temperature, skin temperature and respiration rate of the animals, resulting from the route exercise and grazing activities, were computed as the differences between the initial values of these items and the corresponding values after grazing. These values were correlated with the time spent grazing under conditions of exposure and with the total grazing time so as to establish the relationship between the heat-tolerance responses of these breeds and their grazing behaviour.

3. Results and discussion

3.1. Route behaviour

Route behaviour is defined as the behaviour of animals en route to the pasture and back. Compared to the other breeds, the Ossimi covered the distance (5 km) in the shortest time, whereas the other three breeds did not differ much in this respect (TABLE 1). Generally speaking, all breeds were able to cover paved distances in a relatively shorter time than sandy ones. The Ossimi ewes showed no signs of fatigue until they reached the pasture, and their respiration rate did not start to accelerate until they had to walk for 10 km.

The three foreign breeds showed different signs of fatigue at different kilometres of

TABLE 1. Breed differences in route behaviour; in brackets the number of animals showing signs of fatigue

Breed	Time (minutes) needed for covering the successive kilometres of the route				
	1st	2nd	3rd	4th	5th
Ossimi (Os.)	12 (—)	12 (—)	15 (—)	15 (—)	15 (—)
Texel (T.)	17 (—)	15 (5)	16 (8)	15 (10)	20 (14)
Caucasian Merino (C.M.)	15 (—)	15 (—)	15 (14)	20 (15)	18 (15)
Fleisch Merino (FL.M.)	16 (—)	16 (—)	14 (13)	15.5 (15)	20 (15)

the route. These signs started at the second and third kilometre as an increase in the respiration rate of some ewes of the Texel and the two Merino breeds. By the end of the third kilometre the number of ewes with accelerated respiration rate increased, and at the fourth kilometre they started panting and many were protruding their tongues. At the fifth and last kilometre, half the ewes of each breed were panting and showed obvious signs of stress (TABLE 1).

The mucous membranes of the Texel ewes in particular seemed to be very sensitive to dust as they started coughing and excreting large amounts of mucus from the nostrils after walking for a short time in the sandy tracks.

Owing to their different skeletal and conformational structures, breeds differ in their gaits and consequently in their ability to cover distances. The Ossimi has the least compact body; it is moulded externally so as to make for ease of movement, and it has the highest ratio of extremities to body weight. As a result of this body conformation the Ossimi breed has a wider and lighter step and can cover twice the distance of the foreign breeds without showing serious signs of fatigue; this shows that the Ossimi breed is more functionally adapted than the other breeds to the sparse grazing conditions.

When all breeds walked to the pasture together the Ossimi took the lead and the foreign breeds showed the same signs of fatigue as they did when they walked separately.

3.2. Grazing behaviour

As soon as the Ossimi ewes arrived at the pasture they first spread out widely, covering an area of about 2.5 acres, and then crowded together and grazed in a flock. This behaviour denotes that over the generations this breed has acquired the least refinement in grazing habits, which did not differ greatly from those of wild types of sheep which before grazing instinctly spread out in their search for good pasture so as to protect themselves against various predators. Another interesting feature of this breed is that they are indifferent as to what they graze on, sometimes cropping straw and dry weeds while better plants were within their reach. It was also noticed that compared to the foreign breeds they were not heavy grazers, but this point should be examined in further detail.

The Texel ewes grazed over some 1.5 acres. They started grazing very intensively but afterwards selectively preferring the more succulent and leafy maize to ground-nuts and weeds.

On arrival at the pasture the Caucasian Merino ewes spread and grazed intensively on about one acre of the exposed pasture, and it was noticed that when they were not grazing they spent more time on idling than on lying and resting, and when lying they chose the shaded, damp parts of the pasture near the canals. On the other hand, the Fleisch Merino ewes entered the pasture in a row covering an area of about $\frac{1}{2}$ acre, spent 10–20 minutes grazing heavily under conditions of exposure, and then grazed or rested in the shade, after which the same pattern was repeated either individually or as a group.

As regards grazing behaviour there was a common diurnal trend among all breeds; they all started grazing very actively at the beginning of the day, but towards noon their grazing activities diminished and they tended to idle or lie in shade for nearly two hours (12 noon to 2 p.m.). In the afternoon they again started grazing for periods which differed according to the breed (TABLE 2). These observations agree with TRIBE (1955) as regards the sequence of grazing, resting and rumination. This trend of

TABLE 2. Breed differences in the average time (minutes) spent on different items of behaviour during successive hours at pasture

Successive hours at pasture	Minutes spent on														
	grazing in the sun					grazing in the shade					idling in the shade				
	Os.	T.	C.M.	F.L.M.		Os.	T.	C.M.	F.L.M.		Os.	T.	C.M.	F.L.M.	
1st	60	47	42	16		—	5	9	28		—	3	—	—	
2nd	40	25	13	8		1	2	20	2		14	19	27	37	13
3rd	18	7	10	7		—	—	3	1		34	36	31	25	27
4th	7	2	—	1		1	—	—	—		44	38	48	34	25
5th	—	3	1	—		—	—	—	1		32	45	41	20	39
6th	55	15	15	—		—	—	2	—		—	33	31	28	32
7th	60	10	13	1		—	1	8	18		—	42	35	23	18
8th	—	21	12	3		—	—	10	50		60 ²	32	34	6	1
Average	240	130	106	36		2	8	52	88		124 + 60	250	256	201	155
P. day	± 3.5 ± 6.8 ± 5.6 ± 3.8					± 0.8 ± 1.8 ± 4.5 ± 4.2					± 5.7 ± 6.4 ± 12.2 ± 11.0				
S.E.															

1 Minutes spent on lying in the sun.

2 Idling in the sun.

For explanation of abbreviations see TABLE 1.

behaviour was governed by two factors, *i.e.* the state of repletion of the animal and the climatic conditions. On arrival at the pasture, they were impelled by hunger and climatic conditions were still favourable, so that all breeds grazed to appetite, after which the environmental temperature reached the maximum (FIGURE) and the animals were inclined to rest and ruminate. This agrees with SEATH and MILLER's (1947) conclusion that extremes of temperature may alter behaviour. However, rumination evacuates food from the rumen, so that the animals started grazing again despite the high environmental temperature during the second half of the day.

Within this general trend each breed exhibited a certain characteristic behaviour as regards the time spent on grazing in the sun and shade, its response to exposure to the sun and the time spent on idling and lying. The Ossimi ewes spent more time grazing in the sun than any other breed (TABLES 2, 3), and even when they were no longer grazing during their last hour at pasture they crowded very close together and remained exposed to the sun without exhibiting the least signs of fatigue, as demonstrated by the fact that they had the lowest respiration rate, skin and body temperatures (SHAFIE and SHARAFELDIN, 1962). Moreover, the Ossimi ewes were the only ones that idled and lay in the sun, showing that this indigenous breed is comparatively the most heat tolerant.

TABLE 3. Average time (minutes) and % of average time spent on different items of behaviour at pasture

Behaviour	Minutes and % of average time per day spent at pasture							
	Ossimi		Texel		C. Merino		Fl. Merino	
	min.	%	min.	%	min.	%	min.	%
Grazing (gt)	242	51	138	29	158	33	124	26
Idling	184	38	250	52	256	53	201	42
Lying	54	11	92	19	66	14	155	32
Ruminating ¹ (rt)	24	5	51	11	29	6	74	15
rt/gt		0.10		0.38		0.18		0.58

¹ The animals were ruminating while either idling or lying.

As regards time spent grazing in the sun, the Texel ewes came next to the Ossimi. The Texel ewes did not respond rapidly to the increase in ambient temperature and exposure to sun as instead of seeking shelter they continued to graze in the sun, their respiration rate, skin temperature and body temperature showing a marked increase (SHAFIE and SHARAFELDIN, 1962). This feature indicates that the breed is less sensitive to direct solar radiation and tries to dissipate excess heat through the respiratory tract. However, this method of eliminating excess heat is bound to interfere with the metabolism as it upsets the acid-base balance (BIANCA, 1955).

The grazing behaviour of the Caucasian Merino ewes was intermediate between that of the two other foreign breeds as regards the time they spent grazing either in the sun or shade. These ewes also spent the longest time idling in the shade and the shortest lying down. The most striking feature of this breed is that it idled for a comparatively long period and ruminated for a shorter period than the other foreign breeds (TABLES 2, 3), which might be taken as a sign of discomfort; however, this point requires further proof.

The Fleisch Merino ewes grazed for the shortest time in the sun and for the longest time in the shade (TABLES 1, 2). The behaviour pattern of these ewes merits discus-

sion, as they grazed intensively in the sun for about 10—20 minutes until they were no longer able to tolerate the effect of direct solar radiation and sought releaf grazing or resting in the shade, after which the same pattern was repeated several times. This interesting behaviour would indicate that the skin of this breed is sensitive enough to warn the animal to the effect of direct solar radiation; it may be due to lack of pigment, and consequently does not permit any further signs of fatigue to appear (SHAFIE and SHARAFELDIN, 1962).

The correlations shown in TABLE 4 agree with the previous discussion on the response of the Fleisch Merino and Texel to exposure. The significant positive correlation between the increase in skin temperature and time spent grazing in the sun confirms the sensitivity of the Fleisch Merino skin to exposure. The negative correlation between the increase in respiration rate of the Texel and the total grazing time denotes that the acceleration in the respiration rate was the main reason why this breed changed from grazing to idling.

When all breeds were driven to pasture together their individual grazing behaviour and habits did greatly differ from when they were grazing separately.

TABLE 4. Correlation between grazing time and the heat-tolerance reactions of different sheep breeds

Breed	Correlation of grazing time in sun with increase in			Correlation of total time of grazing with increase in		
	body temp.	skin temp.	respiration rate	body temp.	skin temp.	respiration rate
Texel	0.107	0.215	—0.352 *	0.112	0.209	—0.361 **
Fleisch Merino	0.079	0.361 **	0.198	0.099	0.150	0.052
Caucasian Merino	0.108	0.228	0.240	0.344	0.056	0.135
Ossimi	0.002	0.008	—0.052	—	—	—

* Non-significant.

** Significant at the 5 % level.

3.3. Rumination

All breeds tended to ruminate more when lying down in the shade than when standing in the shade or sun (TABLE 5). The general trend of all breeds was that they spent some time idling or resting before they shifted from grazing to rumination, which agrees with TRIBE's (1955) conclusions.

TABLE 5. Breed differences in the average time spent on rumination

Successive hours at pasture	Ruminating in minutes per hour											
	lying in the shade				standing in the shade				standing in the sun			
	Os.	T.	C.M.	F.L.M.	Os.	T.	C.M.	F.L.M.	Os.	T.	C.M.	F.L.M.
1st	—	—	—	—	—	—	—	—	—	—	—	—
2nd	—	2.0	—	0.7	—	—	—	—	—	—	—	—
3rd	3.3	5.3	7.0	10.7	—	1.3	—	3.3	—	—	—	—
4th	5.0	11.0	12.0	4.3	—	0.3	—	0.7	0.7	—	—	—
5th	3.3	7.7	5.7	17.0	—	—	—	2.0	—	—	—	—
6th	1.0	7.3	4.3	17.3	—	—	—	3.3	—	—	—	—
7th	0.7	4.3	0.3	7.3	—	2.7	—	4.7	1.3	—	—	—
8th	—	4.3	—	1.7	—	4.7	—	0.7	9.0	—	—	—
Total	13.3	41.9	29.3	59.0	—	9.0	—	14.7	11.0	—	—	—

Rumination followed a diurnal trend; during the first grazing hour no breed ruminated, the Texel and Fleisch Merino only started ruminating for a comparatively short time during the second hour, and all breeds were ruminating during the third hour. The time spent on rumination increased with successive hours, starting from the third hour and reaching the maximum at the 4th and 5th hours (12.30—2.30 p.m.) when most of the animals were resting, and afterwards decreased. This trend could be explained on the assumption that rumination is a function of repletion and comfort.

The Fleisch Merino ruminated longer than any other breed, being successively followed by the Texel, Caucasian Merino and Ossimi. The different breeds also followed the same order when the rt/gt -ratio (HANCOCK, 1950) was applied (TABLE 3). This phenomenon might be attributed to the fact that early-maturing breeds have a comparatively smaller digestive-system/body-weight ratio than late-maturing ones (HAMMOND, 1932). Hence the earlier-maturing Fleisch Merino and Texel breeds would require less time to reach a state in which they were sufficiently replete to ruminate, especially when we consider that these two breeds were heavy grazers.

4. General Discussion

There were many reasons why different breeds of sheep differ in their grazing behaviour. They differ genetically in their anatomical characteristics and body conformation as regards the narrowness or shortness of the lower jaw, the ratio of the alimentary canal to the rest of the body, and the ratio of the extremities to the body. Moreover, different breeds differ in hardiness, viz. in functional adaptivity to the botanical composition and climate of the pasture. The initial grazing behaviour of a breed might also vary according to the extent of domestication.

Under the grazing conditions prevailing in the newly reclaimed desert areas of Egypt, it is advisable to avoid sandy tracks, especially in the case of such breeds as the Texel which have sensitive mucous membranes. For foreign breeds of sheep, the pastures should not be farther than three kilometres from the sheds so as to ensure a better performance, whereas indigenous breeds such as the Ossimi could travel 10 kilometres.

According to the animal-pasture complex theory advanced by TRIBE (1955) the lower the rt/gt -value, the more efficient is the sward for animal production. This theory could be extended and used for comparing the efficiency of different animals on one and the same sward. The Ossimi breed had the lowest rt/gt -value and the Fleisch Merino the highest, the other two breeds occupying an intermediate position, thus showing that the type of pasture these animals grazed was optimal for the Ossimi and less favourable to the Fleisch Merino. This indicates that the Ossimi is much more adapted to poor pastures than the Fleisch Merino, Texel and Caucasian Merino and that these foreign breeds of sheep require high-quality swards in order to thrive and produce efficiently.

ACKNOWLEDGEMENTS

The authors are greatly indebted to Prof. Dr. M. T. RAGAB, Professor of Animal Breeding and Councillor of Animal Production of the Tahreer Province, for providing facilities, suggestions and constructive criticism. Thanks are also due to Mr. M. MANDOUR who contributed much in the field work.

REFERENCES

- ATKESON, F. W., A. O. SHAW and H. W. CAVE
BIANCA, W. 1942 Grazing habits of dairy cattle. *J. Dairy Sci.* 25, 779—784.
- 1955 The effect of thermal stress on the acid-base balance of the Ayrshire Calf. *J. Agric. Sci.* 45, 428—430.
- GORDON, J. G., and D. E. TRIBE 1951 The self-selection of diet by pregnant ewes. *J. Agric. Sci.* 41, 187—190.
- HAMMOND, J. 1932 Growth and development of mutton qualities in sheep. Edinburgh.
- HANCOCK, J. 1950 Grazing habits of dairy cows in New Zealand. *Emp. J. Exp. Agric.* 18, 249—263.
- SEATH, D. M., and G. D. MILLER 1947 Effect of hay feeding in summer on milk production and grazing performance of dairy cow. *J. Dairy Sci.* 30, 921—926.
- SHAFIE, M. M., and M. A. SHARAFELDIN 1962 Animal behaviour in the sub-tropics. I. Heat tolerance in relation to grazing behaviour in sheep. *Neth. J. agric. Sci.* 13, 1—5.
- TRIBE, D. E. 1950 Influence of pregnancy and social facilitation on the behaviour of grazing sheep. *Nature, Lond.* 166, 74.
- 1955 The behaviour of grazing animals. In: Progress in the physiology of farm animals. J. Hammond (ed.). Butterworths, London. Vol. 2, p. 585.
- WEIR, W. C., and D. T. TORRELL 1959 Selective grazing by sheep as shown by a comparison of the chemical composition of range and pasture forage obtained by hand clipping and that collected by oesophageal-fistulated sheep. *J. Anim. Sci.* 18, 641—649.