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THE EFFECT OF THE UTILIZATION OF A HIGH FIBRE PELLETED FEED ON MILK YIELD AND COMPOSITION IN DAIRY SHEEP [1]

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SUMMARY

Twenty Sardinian lactating ewes were divided in four groups (A, B, C, D) and fed with four diets, obtained mixing a pelleted fibre integrator (PFI) and a normal pelleted concentrate (NPC) in different proportions (NPC/PFI: A = 27/73; B = 42/58; C = 58/42; D = 73/27). The intake was 123, 122, 114 and 135 g of DM per kg of metabolic weight. The ewes were able to choose between the two type of pellets. The chewing time per kg of DM decreased with the reduction of PFI content in the diet. The ewes were always able to maintain a regular ruminal activity. There were no significant differences in the milk yield, milk fat content, SCC and body weight variations, while the milk protein content was higher in the group B.

Key words: dairy sheep, milk production, fibrous feed.

RIASSUNTO

L'effetto dell'utilizzazione di un alimento pellettato ad elevato contenuto fibroso nella produzione quanti-qualitativa di latte in pecore da latte.

Venti pecore di razza Sarda in lattazione sono state suddivise in quattro gruppi (A,B,C,D) ed alimentate con altrettante razioni costituite da un pellettato ad alto contenuto in fibra e da un concentrato normale nelle seguenti proporzioni: A = 27/73; B = 42/58; C = 58/42; D = 73/27). L'ingestione di sostanza secca è stata di 123, 122, 114, e 135 g/kg di peso metabolico. Gli animali hanno mostrato capacità selettiva sugli alimenti somministrati. L'attività ruminale è stata regolare in tutti i gruppi; il tempo di masticazione per kg di s.s. è diminuito nei gruppi alimentati con le diete a minore concentrazione fibrosa. Non sono state evidenziate differenze significative nella produzione di latte, nel suo contenuto in lipidi ed in cellule somatiche, mentre il contenuto in proteine è stato più alto nel gruppo B.

Parole chiave: pecore da latte, produzione di latte, alimento fibroso.

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INTRODUCTION

One of the most important problems of dairy ewe feeding in the Mediterranean area is the shortage of pasture during the winter and the summer (4). In these periods feeding is based on the supply of hay and concentrates; the quality of hay, however, is usually poor and this leads to its low intake (2). To increase the milk production with low quality hay the shepherds usually increase the supply of concentrates (10); this technique, however, often causes digestive disorders (acidosis) due to the low fibre content of the diet (6,7).
To avoid this problem we have produced a pelleted feed with high NDF content and long fibre inside; this feed should be mixed with normal pelleted concentrates to increase the total chewing activity without affecting the intake of the other feeds. It has been thought as "long fibre integrator" to be used in different amounts, depending on the quantity and quality of the fibre content in the diet (8,9). An experimental trial, therefore, has been carried out on Sardinian dairy ewes to study the use of this pelleted fibre integrator feed at different levels of utilization and its effects on milk production, intake and feeding behaviour.

MATERIALS AND METHODS

Twenty multiparous ewes in the last two months of lactation (June and July) were divided in 4 groups (A, B, C, D), similar for milk production, of 5 ewes each one. The ewes were housed and kept in individual pens during both the preliminary (2 weeks) and the experimental period (6 weeks). They were fed only with pelleted fibre integrator (PFI) and normal pelleted concentrate (NPC).
The PFI was produced using: whole cottonseeds with lint (15%); wheat straw (45%); beet molasses (5%); dehydrated sugar beet pulp (24.5%); ligninesulfonate (0.5%); middlings (10%). The wheat straw was put in the pelletting machine as wafers of chopped straw; the straw and the cottonseeds with lints were included in the PFI to work as stimulators of the chewing activity of the ewes. The chemical composition of the PFI is reported in Table 1.
The NPC was a normal pelletted concentrate for dairy ewes, whose chemical composition is reported in Table 1.
Both feeds were produced in pellets of the same diameter (6 mm), to reduce the possibility of choice by sheep, and then mixed in different proportions to obtain four diets with different levels of NDF.
The following diets were used.
– Preliminary period, all groups: PFI = 50% NPC = 50%
– Experimental period:

- Group A	PFI = 73%	NPC = 27%
- Group B	PFI = 58%	NPC = 42%
- Group C	PFI = 42%	NPC = 58%
- Group D	PFI = 27%	NPC = 73%

Each diet was given *ad libitum* to the same group of ewes, following a monofactorial experiment with four different levels.
The individual milk yield, intake and body weight were measured every week during the trial. The percentage of PFI and NPC pellets in the orts was measured to estimate the diet actually eaten by the ewes. Individual milk samples were collected and then analyzed for the milk fat, protein and lactose content with the IRMA method (Milkoscan 605) and for the somatic cell count with the automatic instrument Fossomatic 306 (1).
At the end of the trial eating and ruminating time were measured on 3 ewes per group during 24 hours with continuous manual measurement.
The data were submitted to the analysis of the variance and the differences among groups were checked with the Turkey test, after doing logarithmic transformation of the data in the case of the somatic cell count.

Table 1 - Chemical composition (% on DM) of feeds and diets supplied.

FEEDS			**DM**	**CP**	**EE**	**NDF**	**ADF**	**ADL**	**ASH**
Pelleted fiber integrator (PFI)			92.21	12.51	3.19	44.32	30.53	8.03	8.63
Normal pelleted concentrate (NPC)			92.04	16.85	3.00	24.84	10.95	3.56	9.08
Diets supplied	PFI (%)	NPC (%)							
Group A	73	27		13.68	3.14	39.06	25.24	6.82	8.75
Group B	58	42		14.33	3.11	36.14	22.31	6.15	8.82
Group C	42	58		15.03	3.08	33.02	19.17	5.44	8.89
Group D	27	73		15.68	3.05	30.10	16.24	4.77	8.96

RESULTS AND DISCUSSION

The **chemical composition** of the feeds and of the diets supplied is reported in table 1. The different proportion of PFI and NPC in the four diets resulted in a range of NDF from 39.06% to 30.1%. The long fibre of the diet came only from the PFI, which therefore was the main chewing activity stimulator.
The mean **intake** of feed (Table 2) was high in all groups and there were no statistical differences among groups, probably as result of the high variability within each group. In the second week of trial the group C had very low intake, due to the anomalous behaviour of some animals of this group. The intake data of the first week of the experimental period were not collected.

Table 2 - Intake of feed.

Periods	Group A Mean	Group A SD	Group B Mean	Group B SD	Group C Mean	Group C SD	Group D Mean	Group D SD
			As fed intake (g/day * head)					
2	2780a	319	2410a	810	1400b	757	2400a	423
3	2280	760	2500	567	1998	407	2274	292
4	2750	429	2540	640	2290	773	2110	383
5	2230	552	2310	241	2590	451	2420	448
6	2410	700	2610	826	2530	368	2920	266
Mean	2490	260	2474	117	2162	485	2425	303
			Dry matter intake (g/day * kg of bw ^ 0.75)					
2	138	19	125	40	85	53	134	18
3	113	40	131	27	102	15	127	14
4	137	25	133	28	119	33	118	18
5	111	27	122	11	133	21	135	21
6	117	31	98	59	129	22	159	17
Mean	123	23	122	15	114	11	135	8
Initial	48.50	4.81	44.86	3.16	46.05	5.28	40.45	3.53
Final	50.14	3.97	46.10	5.54	47.64	6.46	43.56	4.18
Variation	1.64	4.89	1.24	4.97	1.59	4.72	3.11	1.23

Different suffix letters show significant differences at 0.05
SD = standard deviation

The animals were able to make a choice between the two feeds supplied (Table 3 and Figures 1 and 2). In the groups A and B, which had the highest percentage of PFI in the diet, the choice of the ewes was directed to increase the intake of NPC, while in the other two groups (C and D) the choice was directed to increase the intake of PFI. This kind of behaviour was clearer in the intermediate groups (B and C), where the choice done by the ewes resulted in the fact that both groups ate very similar diets. It seems that the ewes have chosen the feeds to have 34-35% of NDF in their diet (Table 3 and Figure 2). The ability of sheep to satisfy their requirements by selecting their diet has been already showed by Forbes (3).

The **total chewing time** (Table 4) was similar in the groups A, B and D and lower in the group C. The **chewing activities per kg of dry matter** (Table 4) decreased from the group A (highest content of PFI) to the group D (lowest content of PFI). In any case this parameter was high enough to maintain normal ruminal fermentation in all groups. The manual survey of the chewing time, however, may have influenced the behaviour of the animals, above all during the night.

The **milk yield** (Table 5) was high in all groups; there were no statistical differences among the groups, due to the high variability; this variability may be an effect of the variability in the feeding behaviour and in the intake. The milk yield, in any case, decreased regularly during the trial in the groups B and D, while the groups A and C showed an irregular pattern in the 1st (group A) and in the 2nd (group C) week of trial.

Table 3 - Composition of the diets actually eaten by the ewes (% on dry matter basis).

Periods	GROUP A				GROUP B				GROUP C				GROUP D			
	PFI	*NPC*	*NDF*	*CP*	*PFI*	*NPC*	*NDF*	*CP*	*PFI*	*NPC*	*NDF*	*CP*	*PFI*	*NPC*	*NDF*	*CP*
2 Mean	73.1	26.9	39.1	13.7	56.7	43.3	35.9	14.4	53.4	46.6	35.3	14.5	29.2	70.8	30.5	15.6
3 Mean	68.6	31.4	38.2	13.9	54.3	47.5	35.4	14.5	39.0	61.0	32.4	15.2	30.5	69.5	30.8	15.5
4 Mean	66.6	33.4	37.8	14.0	43.6	56.4	33.3	15.0	57.2	42.8	36.0	14.4	38.5	61.5	32.4	15.2
5 Mean	61.9	38.1	36.9	14.2	49.2	50.8	34.4	14.7	43.6	56.4	33.3	15.0	34.2	65.8	30.8	15.5
6 Mean	64.4	35.6	37.4	14.1	51.9	49.9	34.9	14.6	54.2	45.8	35.4	14.5	29.4	70.6	28.2	16.1
2-6 Mean	66.9	33.1	37.9	14.0	51.1	48.9	34.8	14.6	49.5	50.5	34.4	14.7	29.2	70.8	30.6	15.6
SD	4.3	4.3	0.4	0.1	2.3	2.3	0.4	0.1	3.5	3.5	0.7	0.2	3.4	3.4	0.7	0.2

SD = standard deviation.

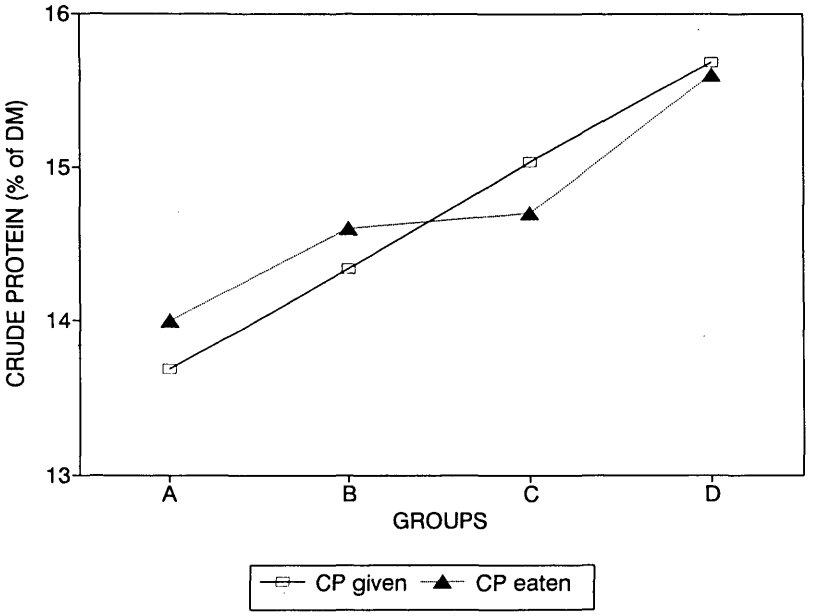

Fig. 1 - Crude protein given and eaten.

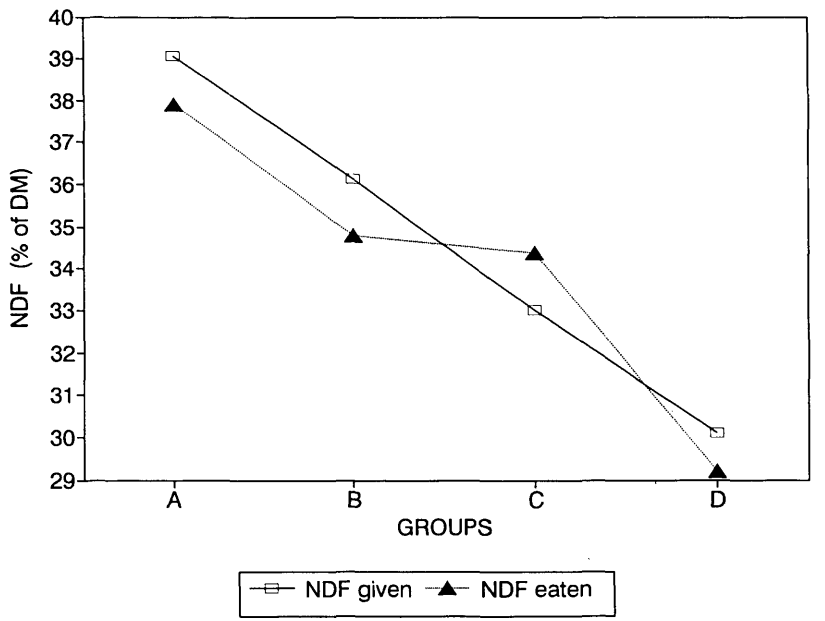

Fig. 2 - NDF given and eaten.

Table 4 - Chewing activity of the ewes.

	Group A		Group B		Group C		Group D	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Chewing time min/day								
- eating	110	19	91	9	87	72	96	35
- rumination	155	48	174	72	99	57	167	56
- total	265	67	265	63	186	17	263	67
Intake (kg/d of DM)	1.749	0.470	1.959	0.200	1.661	0.499	2.371	0.298
Chewing activities (min/kg of DM)	152	18	137	40	115	29	114	45

Table 5 - Milk yield and composition.

	Group A		Group B		Group C		Group D	
Periods	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
				Milk yield (g/d)				
Pre-experimental	1311	141	1336	201	1327	161	1332	190
1	957	148	1234	278	1112	208	1206	144
2	1095	194	927	343	590	265	1087	389
3	1005	225	914	314	926	256	964	255
4	976	193	774	267	874	188	989	170
5	856	299	712	180	932	243	852	242
6	721	261	619	413	774	186	974	253
Mean	935	130	863	217	868	175	1012	121
				Milk fat (%)				
1	5.88	0.85	6.02	0.23	5.72	0.40	6.01	0.50
2	7.40	1.24	8.66	1.29	9.08	2.05	7.35	1.46
3	8.12	1.76	8.57	0.87	7.19	0.84	7.05	1.26
4	8.39	2.14	8.28	0.50	6.74	0.63	7.63	0.86
5	7.81	2.70	8.16	0.99	7.06	1.10	7.48	0.48
6	8.24	2.35	8.11	1.81	8.21	2.21	7.78	0.77
Mean	7.64	0.95	7.97	1.00	7.33	1.19	7.22	0.66
				Milk protein (%)				
1	5.90a	0.21	6.23b	0.38	5.91a	0.33	5.95a	0.33
2	5.89	0.48	6.50	0.69	6.48	0.79	6.22	0.74
3	5.99	0.74	6.69	0.84	5.90	0.41	6.23	0.54
4	5.65	0.58	6.43	0.40	5.80	0.31	5.94	0.45
5	5.52a	0.53	6.48b	0.51	5.66a	0.22	6.20ab	0.46
6	6.01	0.68	6.72	1.08	6.10	0.84	5.83	0.43
Mean	5.83a	0.20	6.51b	0.18	5.98a	0.29	6.06ab	0.18
				SCC (n/ml) in thousands				
1	2616	3264	855	736	282	154	836	1389
2	743	730	1672	2899	375	163	514	445
3	1078	1348	282	210	187	43	1254	2109
4	2069	2186	2021	2671	183	25	2908	3871
5	918	1127	352	151	172	21	2747	5244
6	793	1158	412	279	180	34	539	515
Mean	1370	798	932	760	230	84	1466	1111

Different suffix letters show significant difference at 0.05
SD = standard deviation.

The **milk fat content** (Table 5) was high enough (and sometimes very high) in all groups. This indicates that even the group fed with the highest content of NPC had an adequate ruminal activity.
The **milk protein content** (Table 5) was statistically higher in the group B than in the other groups, both as average and in the 1st and 5th week of trial; this, however, is probably the effect of pre-existing differences, since the group C ate a very similar diet to that eaten by the group B.
The **somatic cell count** (Table 5) of the milk did not show any significant difference, even if the values of the group C were much lower than those of the other groups.
The **body weight variations** (Table 2) were always positive but not statistically different among groups.

CONCLUSIONS

The pelleted fibre integrator (PFI) was able to maintain normal ruminal fermentation in all the doses used. This feed can allow, therefore, the correct feeding of lactating ewes even when there is shortage of long fibre in the diet. The effects of the PFI on feeding behaviour and on milk production, however, require more investigations to understand which level of PFI and NDF is able to maximize milk production.

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