Influence of alpine grazing time on feeding behavior, milk yield and milking characteristics on Aosta Red-Pied cows

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Influence of alpine grazing time on feeding behavior, milk yield and milking characteristics on Aosta Red-Pied cows

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Abstract. Alpine areas are characterised by extensive animal production systems and by the need to valorise alpine grasslands to produce high-quality dairy products through locally adapted breeds. The aim of this study was to evaluate the influence of the management system on milk production, milking characteristics and feeding behaviour of Aosta Red-Pied cows in an alpine environment. Eight multiparous cows per herd from two different herds were monitored in two alpine grazing management systems. The first herd was managed with a restricted grazing time (R), where the cows had free access to the pastures twice a day for up to 4 hours each. The second herd was managed with full-time open air grazing (O), where dairy cattle remained outside during the entire summer period. Measurements were made twice a month, during winter feeding, transition (from hay to fresh grass) and summer grazing. They included determination of feeding behaviour, milk yield, milking characteristics, and milk coagulation properties of individual cows. Although milk yield and coagulation properties did not differ between the two management systems, ingestion time was shorter and rumination-time/ingestion-time ratio was higher in R- than in O-cows ($p<0.01$) during summer. Peak milk flow rate, average milking time and average milk flow rate were higher for R- than O-cows ($p<0.05$) even under winter conditions, indicating that differences found in these parameters were independent from time allocated for grazing. These results show that Aosta Red-Pied cows can adapt their feeding behaviour to the time allocated for grazing without compromising either milk production or milk coagulation properties. Milking characteristics were not directly affected by the alpine farming system.

Keywords. Alpine farming system – Aosta Red-pied cows – Milking characteristics – Feeding behaviour.

Influence du temps de pâturage en alpage sur le comportement alimentaire, la production et les caractéristiques du lait des vaches Pied Rouge Valdôtaines

Résumé. *Les régions alpines sont caractérisées par des productions animales extensives et par la nécessité des éleveurs d'exploiter les prairies alpines pour produire des produits laitiers de très haute qualité à l'aide de races locales adaptées à l'environnement. Le but de cette étude est d'évaluer l'influence de la conduite du système d'alpage sur la production laitière, la qualité du lait et le comportement alimentaire des vaches de race Pied Rouge Valdôtaine dans un milieu alpin. Huit vaches multipares de deux élevages différents ont été suivies au sein de deux systèmes de gestion d'alpage. Dans le premier, appelé restreint (R), les vaches pâturaient 2 fois par jour pour un total de 4 heures. Dans l'autre système (O), les vaches avaient libre accès à l'herbe sans restriction. Les échantillonnages ont été effectués 2 fois par période: pendant la période hivernale, pendant la transition alimentaire (passage du foin à l'herbe) et pendant 3 périodes d'alpage. Ces mesures comprenaient la détermination du comportement alimentaire, la production et les caractéristiques du lait ainsi que l'aptitude à la coagulation du lait de chaque vache. Si la production de lait ne montrait pas de différence entre les deux systèmes de gestion, le temps d'ingestion était par contre plus court et le rapport temps d'ingestion/temps de rumination plus grand pour les vaches du groupe R par rapport à celles du groupe O ($p<0,01$) dans la période de l'alpage. Le débit maximal de lait, le temps moyen de traite et le débit moyen étaient plus élevés pour les vaches du groupe R ($p <0,05$), aussi bien dans des conditions hivernales que d'alpage ce qui signifie que cela n'était pas le résultat du système de gestion des pâtures. Ces résultats montrent que les vaches Pied Rouge Valdôtaines peuvent adapter leur comportement alimentaire*

au temps alloué au pâturage sans compromettre la production de lait et son aptitude à la coagulation. Les caractéristiques de traite ne sont pas directement concernées par les systèmes de gestion de l'alpage.

Mots-clés. *Système de gestion des alpages – Vaches Pied Rouge Valdôtaines – Caractéristiques de traite – Comportement alimentaire.*

I – Introduction

In alpine areas, farmers use high altitude pastures to feed animals in the summer season to produce high-quality dairy products through locally adapted breeds. Traditionally, in the Aosta Valley, a region located in the North-West of Italy, farmers use alpine barns during summer to house animals half of the day. However, nowadays the costs of renovating buildings are too high and farmers need alternative systems, like a 24 h/d outdoor system, never applied in this region before, with lower costs for maintaining the exploitation of alpine pastures with dairy cows. The interest to investigate the effect of the alpine pasture management systems, the traditional and the alternative 24 h/d outdoor system, is also based on the need to understand the interactions between the alpine pasture and farms (Nietter *et al*., 2014). The aim of this study was to evaluate the influence of the management system on milk production and milking characteristics as well as feeding behaviour of indigenous Aosta Red-Pied cows in an alpine environment.

II – Materials and methods

This study was carried out in the Aosta Valley, a small alpine region located in the North-West of Italy. Winter and transition conditions were investigated in two farms in Aosta (45°44′14″N 7°19′14″E) at 600 m a.s.l. Summer grazing was studied in parallel in two locations, Rhêmes Notre Dame Valley (45°34′11.17″N 7°07′05.16″E), from 1500 to 2500 m a.s.l. for the restricted grazing time and in Vertosan Valley (45°42′31.32″N 7°08′25.8″E) for the 24 h/d outdoor system, at similar altitude. Two herds of Aosta Red-Pied cows were selected after their different alpine grazing management systems. In each herd eight multiparous cows were monitored. In winter both groups received the same diet based on hay and up to 4 kg/d of concentrate. In the transition period cows had access to fresh grass and hay for 1 month with an unchanged amount of concentrate. From the beginning of June till the end of September cows remained on high altitude pastures and received 1 kg/d of concentrate. The first herd was managed with a restricted grazing time (R), where the cows had free access to the pasture twice a day for up to 4 h each. For the rest of the day, animals were sheltered in the barn where they were milked twice a day. The second herd was kept in a full time *open air* grazing management system (O), where dairy cattle remained outside during the entire summer period for 24 h/d and were milked in a mobile milking parlour. This experiment was a continuation of the study of Berard *et al.* (2014) which, however, focused on primiparous cows. Both sites had similar grassland quality during the entire summer period (average grass chemical composition of the three summer periods for O-pastures and R-pastures, respectively: crude protein 138 *vs*. 127, crude fiber 216 *vs*. 232, crude lipid 28.3 *vs*. 28.0, NDF 459 *vs*. 464, ADL 60.3 *vs*. 60.8 and ADF 331 *vs*. 351 g/kg dry matter).

Measurements were made twice per sampling period: during winter feeding in the barn (Barn; Period A), during feeding transition period from hay to fresh grass (Trans; Period B) and, in order to investigate three summer pasture altitudes, three times during the summer grazing period (Alp; Period C, 1400 m a.s.l.; D, 1700 m a.s.l.; E, above 2000 m a.s.l.). The O-condition started with summer grazing. Sampling included feeding behaviour, milk yield, milking characteristics, (like milk peak flow rate, average milking time, average milk flow rate, traits that could be affected by the different milking procedures) and milk coagulation properties as determined for individual cows. The

feeding behaviour was measured with chewing sensors (MSR Electronics, Henggart, Switzerland) for 24 h twice per sampling period. Moreover, milk samples were collected and milking characteristics recorded with a Lactocorder (WMB AG, Balgach, Switzerland) twice per sampling period, during morning and evening milking. The milk samples from the evening and from the morning were mixed and divided into subsamples. A part of this milk (10 ml in two replicates) was used to measure milk coagulation with a Lactodynamograph (Foss Electric Danemark). Data were analysed using the MIXED procedure of SAS (version 9.1 Inst. Inc., Cary, NC). The statistical model included the experimental condition (R- or O-system) period (from A to E) and their interaction as fixed factors. Period was considered as repeated factor, with animals nested within treatment as subject. Differences with probability levels of $p<0.05$ were considered significant.

III – Results and discussion

Although milk yield systems (average milk yield during the five monitored periods, R-group 6.33 kg/milking, O-group 6.28 kg/milking) and coagulation properties (data not shown), did not differ between the two alpine management; ingestion time was shorter in the R-group than in the O-group ($p<0.01$) (Table 1).

Table 1. Effect of alpine grazing time (R-group *vs.* O-group) on feeding behaviour and milking characteristics

	R-group[1]					O-group[2]					
	Barn[3]	Trans[4]		Alp[5]		Barn[3]	Trans[4]		Alp[5]		SEM
Time/Period	A	B	C	D	E	A	B	C	D	E	
Ingestion time, min	242	269	219[a]	270[a]	292	194	315	347[b]	362[b]	366	± 21.5
Rumination/ ingestion time ratio	1.55	1.64[b]	1.42[b]	1.25[b]	1.13	1.89	1.19[a]	0.92[a]	0.83[a]	1.09	± 0.10
Milk peak flow rate, kg/min	3.57[b]	3.62[b]	3.3	3.25[b]	3.3[b]	1.8[a]	1.71[a]	2.04	1.72[a]	1.31[a]	± 0.22
Average milking time, min	3.08[a]	3.16[a]	3.22[a]	2.81[a]	2.47[a]	7.5[b]	6.84[b]	6.05[b]	5.55[b]	5.55[b]	± 0.36
Average milk flow rate, kg/min	2.37[b]	2.42[b]	2.02	1.95[b]	1.95[b]	1.16[a]	1.11[a]	1.3	1.07[a]	0.85[a]	± 0.15

[a-b] Within a row, least squares means without a common superscript differ in R- *vs*. O-group for the same sampling Time ($P < 0.01$).

[1] R-group: Cows managed with a restricted grazing time on pasture

[2] O-group: Cows managed with an open air grazing time on pasture

[3] Winter feeding period in the barn with hey

[4] Transition feeding period from hay to fresh grass

[5] Summer grazing periods

Conversely the rumination-time/ingestion-time ratio was higher in R-group than in the O-group ($p<0.01$). In both groups statistical differences were registered in the first and second period on the summer pasture, while in the last period of summer grazing (period E) the statistical evidence disappeared for both parameters, probably due to an adaptation to alpine conditions. Because forage quality was obviously high enough to fulfil the cows' requirements for milk production, the difference in the rumination/ingestion time ratio suggests that R-cows ate very fast, and when they were sheltered at the barn they spent more time ruminating. On the other hand, O-cows had more time to eat and thus the ratio of rumination/ingestion time was lower. Milk ejection and consequently

milking characteristics (like average milking time, peak and average milk flow rate) could be affected by stress factors, induced by different milking procedures. In our experiment, cows were milked outdoor in a mobile milking parlour in O-condition and, like in winter, in the barn in R-condition. But also milking routine may have had an effect. Peak milk flow rate, average milking time and average milk flow rate were higher for R- than O-cows ($p<0.05$) even under winter conditions (Table 1), which means that this was not the result of grazing time allocation. No significant difference was found between the systems in terms of coagulation properties (data not shown in table).

IV – Conclusions

These results show that, if Aosta Red-Pied cows are fed with alpine forages of sufficient quality, they can adapt their feeding behaviour to the time allocated for grazing without compromising either milk production or milk coagulation properties. Milking characteristics were not directly affected by the type of farming management system.

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