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Utilisation of whey by finishing beef cattle in alpine cheese production regions

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Abstract. In alpine cheese-production areas, whey represents an important source of available energy which is nevertheless little used, in addition to being perceived as an environmental problem. Consumption of whey by beef cattle might represent a profitable solution to this problem. Three groups – grass (G), grass+cereals (B) and grass+whey (W) – of 16 animals each with an average live weight of 478 ± 55 kg were put out to summer pasture in the Jura (1200 m altitude). Two kg of rolled barley granules with added molasses (B) and the energy equivalent of warm full-fat whey (W) were distributed daily. After 95 days, group B had consumed less grass on average ($p<0.01$), as assessed by a differential in grass height, than groups G and W. A substitution effect appears to exist with the barley but not with the whey, despite an average daily intake of 25.5 litres per animal. Average daily weight gain was 911 g, with the differences of +12% for B and +9% for W not being significant. Carcass quality (conformation and level of fattening) was not affected by the treatments. Although it is possible to utilise warm whey derived from alpine cheesemaking in beef-cattle production, this additional energy intake did not translate into higher performance under the conditions of our experiment.

Keywords. Beef cattle – Whey – Alpine pastures – Feed intake – Growth performance – Carcass quality.

Valorisation du petit-lait par des bovins à viande dans les zones de fabrication de fromage d'alpage

Résumé. *Le lactosérum ou petit-lait représente dans les zones de production de fromages d'alpage une source d'énergie disponible importante, peu valorisée et problématique pour l'environnement. Son ingestion par des bovins à viande pourrait représenter une opportunité intéressante. Trois groupes, herbe (G) - herbe+ céréales (B) - herbe+petit-lait (W), de 16 animaux d'un poids vif moyen de 478 ± 55 kg, ont été estivés dans le Jura (1200 m a.s.l.). Deux kg de granulés d'orge mélassée (O) et un équivalent énergétique de petit-lait non écrémé chaud (W) ont été distribués quotidiennement. Après 95 jours, le groupe B a consommé en moyenne moins d'herbe ($p<0.01$), estimé par un différentiel d'hauteur d'herbe, que les groupes G et W. Un effet de substitution semble présent avec de l'orge mais pas avec le petit-lait malgré une consommation moyenne de 25,5 l par jour. Le gain moyen quotidien s'est élevé à 911 g, les écarts de +12% pour B et +9% pour W n'étant pas significatifs. La qualité de la carcasse, la conformation et l'état d'engraissement, n'ont pas été affectés par les traitements. La valorisation par des bovins à viande du petit-lait d'alpage chaud est possible, mais cet apport supplémentaire d'énergie ne s'est pas traduit, dans nos conditions expérimentales, par des performances supérieures.*

Mots-clés. *Bovins à l'engrais – Petit-lait – Alpages – Ingestion – Croissance – Qualité de carcasse.*

I – Introduction

Mountain agriculture is faced with a substantial decrease in both the number of farms and livestock numbers, the encroachment of forest on farmland, the need to research viable economic alternatives, and society's growing demands for the upkeep of the landscape, the preservation of biodiversity and the provision of local quality products. In such a context, the PASTO project (Chassot A. and Deslandes K.A., 2009; Miéville *et al*., 2009) has shown that it is possible to reconcile alpine meat production with caring for the landscape, provided that a minimum feeding intensity can be

guaranteed. In alpine-cheese production areas, whey represents an important source of available energy which is not only little used, but is also considered to be a problem for the environment. Currently, it is either fed to pigs, purified by passage through a bed of compost (Fiaux J.-J., 2004), or spread on pastures. Whilst use by pigs remains problematic owing to the mismatch of their intake capacity and the quantities produced at the start of the season, use of the purification system incurs a high cost, producing heat, CO_2 and ammonia. The feeding of whey to beef cattle could represent a worthwhile alternative. To our knowledge, no study combining the production of alpine cheese with the production of beef within a mixed production system has ever been carried out. On the occasion of a first study of the LACTOBEEF project, the effects of different grazing supplements on feed intake, animal performance and carcass quality were compared.

II – Materials and methods

The 95 day-long trial took place on a summering farm situated at 1200 m altitude in the Swiss Jura. Forty-eight animals aged 17.5 months and weighing 478 ± 55 kg, belonging to four genetic groups (Angus, Limousin, Angus x Limousin, Limousin x Red Holstein) and two sexes (castrated males and females) were used in the study. The cattle were randomly assigned to 3 experimental treatments (2 animals per genetic group and per sex in each treatment). One group had access to grazed grass only (group G), whilst the two other groups received an individually distributed daily isoenergetic supplement to grazing either in the form of 2 kg of rolled barley granules with added molasses (group B) or in the form of full-fat whey (6.68% DM) delivered once a day warm to the manger (group W).

Grazing was organised as a rotating system and comprised four paddocks for each group. The available area and stocking density were the same (5.6 ha and 1.8 LU/ha, respectively) for the three groups. All three groups were always moved simultaneously to different paddocks. In the event of differences in grass height when the herds were moved, a herd not currently involved in the trial ('shuttle' animals) was brought in to consume the excess grass, thereby ensuring comparable regrowth conditions (quality and quantity of grass) in the paddocks of all three groups. The height of the sward was measured with a herbometer before and after each use of a paddock. In a first approach, prior to observations made by means of wax-markers (alkanes), forage intake was estimated for each group on the basis of the differences in grass height measured at the beginning and at the end of each grazing period.

The animals were accustomed to the whey over a five-week pre-experimental period in the lowlands (650 m altitude). Whey intake was measured per group, except during three 5-day periods when the animals were brought into the stable daily for individual *ad libitum* bucket feeding. The animals were weighed at the beginning and end of the experiment as well as at the end of each rotation period, the last day before changing paddocks, *i.e.* about once a month. Conformation and level of fattening were evaluated in the live animal at the beginning and end of the experiment by professional experts. Carcasses were classified in the abattoir according to these same parameters.

III – Results and discussion

1. Grass intake

During the experimental period, the quantity of grass consumed by the animals of group B (5.5 kg DM/d) was lower (p<0.05) than that consumed by the animals of groups G (7.8 kg DM/d) and W (7.3 kg DM/d). The substitution effect caused by the intake of barley was not observed for whey (group W), despite the substantial quantities of this food consumed by the animals. Differences

between the rotations also became evident, with the animals consuming significantly less grass in summer (July) than in late spring (June).

Over the entire season, the animals consumed between 6.6 and 9.0 kg of dry matter (DM) of grass per day on average. With respect to the reference values given in the Swiss feeding recommendations for cattle (Agroscope, 2013), viz. 8.9 kg DM, these values seem fairly realistic, especially bearing in mind the supplements for variants B and W.

2. Whey intake

The constraints of the experimental design (allocation criteria breed, sex) prevented the selection exclusively of animals which consumed whey. Despite the long adaptation period, only 13 animals of 16 consumed the whey distributed on pasture, which was limited to a maximum of 320 litres per day. So the average maximum amount consumed by each of the 13 animals was 24.6 litres per day (Fig. 1). The three peaks in intake which can be seen in this figure correspond to the *ad libitum* bucket-distribution periods in the stable with measurement of individual intake. After these *ad libitum* periods, negative peaks appear. These generally correspond to the day of entry in the new field, where the animals had access to plenty of young grass, and therefore neglected the whey to an extent. Over the entire experimental period (pasture restricted and stable *ad libitum*), average intake came to 25.5.litres per animal and per day, i.e. 1.7 kg DM, corresponding to 19% of the total DM intake. According to Schingoethe (1975), this share can reach 30%.

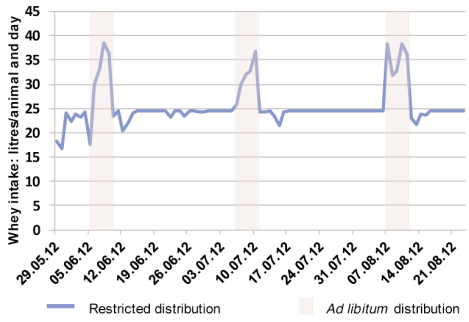

Fig. 1. Average whey intake per animal and day throughout the entire experiment.

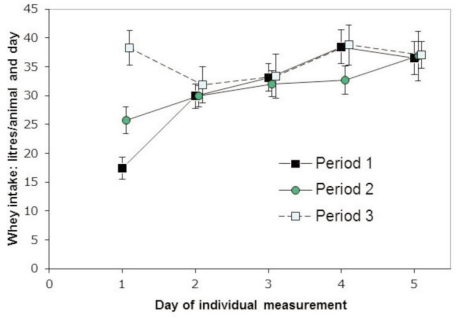

Fig. 2. Average whey intake per animal and day during the 3 *ad libitum* individual distribution periods.

The results of the individual-intake measurements (Fig. 2) indicate that there are few differences between the three periods. Only the first day of each period shows major differences, with an increase of over 20 litres between the first and third period. This may be due to an adaptation of the animals to bucket feeding in the stable. The average intake reached from the second day of each period lies between 30 and 35 litres per animal and day. The maximum intake per day reached 58.4 litres. According to Thivend (1978), ruminants are capable of consuming between 12 and 15 litres of fresh whey per 100 kg live weight.

3. Growth performance and carcass quality

With respect to control group G, the supplemented groups B and W achieved a daily growth of +12% and +9% respectively (Table 1) (n.s.).The effect of both breed and sex on the average daily gain (ADG) was significant, but will not be discussed here. In a trial with stabled beef cattle, the

distribution of 40 litres of whey per day as a supplement to hay and beets contributed to a 16% increase in the ADG (Lehmann *et al*., 1993). Carcass quality (conformation and level of fattening) was not influenced by the treatments. The higher yield at slaughter for group W (P<0.05) can be explained by less filling of the digestive tract.

Table 1. Effect of the different treatments on growth performance and carcass quality

Trait		Treatment			P value		
		G	B	W	Group	Breed	Sex
No. of animals		16	16	13			
Live weight initial	kg	480 ± 52	475 ± 56	478 ± 60	0.949	**0.010**	**<0.001**
Live weight final	kg	560 ± 59	564 ± 62	565 ± 69	0.968	0.179	**<0.001**
Duration	d	94 ± 7	94 ± 7	93 ± 7	0.964	0.990	0.570
ADG	g/d	852 ± 163	957 ± 196	928 ± 290	0.271	**0.001**	**0.039**
Hot carcass weight	kg	307 ± 37	313 ± 37	324 ± 46	0.593	**0.024**	**<0.001**
Carcass yield	%	54.7 ± 2.5	55.5 ± 2.4	57.4 ± 2.6	**0.020**	**<0.001**	0.160
Conformation:							
Diff.score initial-final		0.70 ± 0.45	0.88 ± 0.44	0.75 ± 0.34	0.212	**0.024**	0.217
Score at slaughter[1]		4.22 ± 0.66	4.31 ± 0.83	4.42 ± 0.70	0.662	**<0.001**	1.000
Level of fattening:							
Diff.score initial-final		0.59 ± 0.59	0.89 ± 0.52	0.75 ± 0.65	0.231	**0.001**	0.074
Score at slaughter[2]		3.06 ± 0.68	3.19 ± 0.75	3.08 ± 0.86	0.641	**<0.001**	**0.019**

[1]Conformation: 1 (fleshless) to 5 (very good conformation); [2]Level of fattening: 1 (lean) to 5 (excessively fat); ADG=average daily gain

IV – Conclusions

Appreciable amounts of fresh warm whey may be consumed once daily by beef cattle without this causing any health problems. Animal performance indicators such as growth and carcass quality are not adversely affected by this practice.

The experiment will be pursued under the same conditions, but with an *ad libitum* distribution during the entire experimental period as well as under practical conditions for the techno-economic aspects, particularly in order to study joint use of fattening cattle with dairy cows on alpine pastures where cheese is produced. Finally, the possibility of setting up a quality-label beef production system will be validated.

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