INFLUENCE OF CONCENTRATE SUPPLEMENTATION STRATEGY ON GRAZING DAIRY COWS' PERFORMANCE

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ABSTRACT

The aim of this experiment was to compare the effect of 3 concentrate supplementation strategies on the performance of grazing dairy cows, relative to concentrate-free (C0) control supplementation. The 3 treatments consisted of 2 single doses of 2 and 4 kg gross (C2 and C4) for each cow and 3-kg supplementation on average, depending on the animals' potential (R3). The FCM yield reached 22.5 kg per cow with C0. Concentrate supplementation (2.75 kg DM intake, on average) increased milk yield (+2.8 kg) and protein level (+0.7 g/kg) and reduced milk fat content (-1.1 g/kg). The C4 treatment had little effect on performance, compared to C2. There were no significant differences between the 2 supplementation strategies (C2+C4 vs R3). The mean effectiveness of concentrate (0.85 kg milk / kg concentrate) did not vary according to the animals' baseline production level. This high effectiveness is to be related to the small amounts of concentrate intakes, to the high baseline production levels and probably to a moderate level of concentrate-grass substitution.

KEYWORDS

Dairy cows, grazing, supplementation, animal performance

INTRODUCTION

Supplementation of individual grazing dairy cows is often distributed according to milk yield (INRA, 1988). Simplified supplementation strategies are possible, the extreme being single dose concentrate. That technique has mainly been described in winter diets (Johnson, 1977 ; Rijpkema et al., 1990) and, paradoxically, has been little explored for grazing. However, grass intake can cover up to 70% of the additional requirements linked to milk yield increase (Peyraud et al., 1995). Under these conditions, the optimal supplementation remains to be determined, so as to improve concentrate effectiveness without penalizing the highest producing cows.

The aims of the experiment conducted in 1995 were : 1) to describe the milk yield response to increasing concentrate supplementation as part of a single dose strategy; 2) to compare that simplified strategy to supplementation adjusted to the animals' potential and 3) to analyze the possible interactions between supplementation and the baseline milk production of dairy cows.

MATERIALS AND METHODS

Four supplementation strategies were compared according to a continuous testing design in 4 groups of 16 dairy cows over the 8 weeks' experiment. The 4 treatments were : no concentrate (C0), 2 kg (C2) or 4 kg (C4) of concentrate administered as constant single doses to all cows and 1 supplementation (R3) computed as 1 kg concentrate for each 3 kg milk above 20 kg milk yield. The supplementation threshold was reduced to 17 kg for primiparous cows. The mean amount of concentrate given to the R3 group was 3.3 kg gross, with extremes ranging from 1.3 to 5.0 kg. The cows were given mineral vitamin supplementation (0.44 DM intake) to the amount of 9, 28 and 12 g P/Ca/Mg per day.

The Holstein dairy cows were assigned to the treatments according to their lactation number (12 primiparous cows), their lactation stage (176±46 days), milk yield (30.2±6.4 kg), milk fat content (38.2±4.7 g/kg) and protein content (30.2±2.3 g/kg) and live weight (609±44 kg). In pasture, the animals were in a single herd under strip grazing management.

The experiment was conducted at the INRA Méjusseaume farm (Rennes) on limon soil (pH 6.0; OM 2%) sensitive to water deficit. Climatic conditions are of the oceanic type, with an annual rainfall of 700 mm and mean temperature of 11.2 °C. Seeded perennial rye grass (PRG) meadows were fertilized with 50 to 60 kg N/ha/cycle (250 kg/year).

Individual milk yield was measured daily at the two milkings. Milk fat and protein contents were determined for each cow during 6 consecutive milkings each week. Animals were weighed weekly. The amounts of concentrate given and refused were measured individually every day. On grazed meadows, biomass and grass height before and after grazing were measured weekly with an automatic rising plate meter. The chemical composition of the grass (OM, CP, CF, Pepsin-cellulase digestibility, Aufrère and Demarquilly, 1989) was determined in each weekly sample of grass dried in an oven.

The effect of supplementation strategy was analyzed from the mean individual performance over the 8 weeks' experiment. Besides the effect of treatments, the covariance analysis model chosen (SAS, 1989) integrated the reference yields before the trial as a covariate, and treatment x covariate interaction. That interaction was discarded when it was non-significant (P>0.10).

RESULTS AND DISCUSSION

Upon entering the plots, grass height was 16.3 cm (±3.9) with a 2.76±0.68 tDM/ha biomass. The grass chemical composition was characterized by a CP content of 141 g, a CF content of 234 g per kg DM and a 78% OM digestibility. The computed energy value (INRA, 1989) was 1615 kCk EN/ kg DM on average. With a daily grazing area of 64 m-/cow, the available biomass was 17.1 kg DM/cow/day (±3.2). The grass height upon leaving the plots varied little (6.8±1.0 cm) over the 8 experimental weeks.

During the experiment, the mean milk yield was 25.3 kg milk with 37.5 g/kg fat content and 29.9 g/kg protein content. The supplementation strategy (C2+C4 vs R3) did not affect all the production parameters studied (Table 1). This is consistent with results observed in winter diets or in pasture (Andries et al, 1989). Also, no treatment x covariate interaction was found (P>0.10). So, contrary to Hoden et al's results (1991), the response to concentrate supplementation was not dependent on the animals' baseline production level. Under similar grazing conditions, Peyraud et al (1995) observed an increase in grass intake by 265 g OM/kg milk, corresponding to a net energy supplementation of around 500 kCal. The amount and quality of grass available probably enabled the dairy cows to increase their intake level according to their production potential and the amounts of concentrate given.

Supplementation (C0 vs C2+C4+R3; 0 vs 2.75 kg DM) induced a significant increase in milk yield (+2.8 kg, P<0.001), fat (+80 g), milk protein (+100 g) and protein content (+0.7 g/kg, P<0.01) and reduced the butter fat level (-1.1 g/kg, P<0.06). The mean live weight and daily weight gain tended to be lower in the absence of concentrate supplementation. The concentrate effectiveness expressed as kg of fat-corrected milk (FCM) per kg DM of concentrate intake was high (0.85 on average for C2, C4 and R3). Wilkins et al (1994) and Rook et al (1995) have recently described equally high responses to concentrate supplementation.

Increasing concentrate supplementation (C2 vs C4) induced a curvilinear performance response. The overall effectiveness of the concentrate was significantly lower between 0 and 4 kg than between 0 and 2 kg (0.70 and 1.15, respectively) and the milk protein content no longer varied between treatments C2 and C4. These results were accompanied by a linear increase in live weight parallelling the increase in concentrate supplementation.

In animals with high energy requirements, grass alone, even given ad libitum in the spring, can cover requirements for 22.5 kg FCM yield (C0). Response to concentrate supplementation is then all the higher as supplementation is lower. Furthermore, our results confirmed that the effectiveness of concentrate also depends on the distribution of energy intake between milk yield and live weight gain.

As in winter management, using a single dose concentrate is possible in grazing without affecting the mean animal performance of the herd. However, that strategy requires grazing conditions favouring maximum grass intake by dairy cows.

REFERENCES

Andries J.I., D.L. de Brabander, C.V. Boucque and F.X. Buysse. 1989. Simplification de la distribution des aliments concentré aux vaches laitières pendant la période de pâturage. XVI International Grassland Congress. AFPF (ed), Nice, France. pp. 1129-1130.

Aufrère J. and C. Demarquilly. 1989. Predicting organic matter digestibility of forage by 2 pepsin-cellulase methods. XVI International Grassland Congress. AFPF (ed), Nice, France. pp. 877-878.

Hoden A., J.L. Peyraud, A. Muller, L. Delaby and P. Faverdin. 1991. Simplified rotational grazing management of dairy cows: effects of rates of stocking and concentrate. Journal of agricultural Science, Cambridge. **116**: 417-428.

INRA. 1989. Ruminant Nutrition. Recommended allowances and feed tables. R. Jarrige (Ed). John Libbey & INRA, London & Paris. pp. 193-212.

Johnson C.L. 1977. The effect of the plane and pattern of concentrate feeding on milk yield and composition in dairy cows. Journal of agricultural Science, Cambridge. **88**: 79-94.

Peyraud J.L., R. Delagarde and L. Delaby. 1995. Influence des conditions d'exploitation du pâturage et des caractéristiques animales sur les quantités ingérées par les vaches laitières: analyse et prédiction. Rencontre autour des Recherches sur les Ruminants. **2**: 37-44.

Rijpkema Y.S., L. Van Reeuwijk and P.W. Goedhart. 1990. Effects of pattern of concentrate feeding on milk production of dairy cows offered silage ad libitum. Netherlands Journal of Agricultural Science. **38**: 461-474.

Rook A.J., C.A. Huckle and R.J. Wilkins. 1994. The effects of sward height and concentrate supplementation on the performance of spring calving dairy cows grazing perennial ryegrass-white clover swards. Animal Production. **58**:167-172.

SAS/STAT User's Guide, Version 6, Fourth Edition, Volume 2, Cary, NC: Sas Institute Inc., 1989. 846 pp.

Wilkins R.J., M.J. Gibb, C.A. Huckle and A.J. Clements. 1994. Effect of supplementation on production by spring-calving dairy cows grazing swards of differing clover content. Grass and Forage Science. **49**: 465-475.

Table 1
Concentrate intake and animal performance (Adjusted means over 8 experimental weeks)

Treatment	C0	C2	C4	R3	Syx	Pr<	Constrasts (**)		
Concentrate* (g DM)	0	1775	3565	2930			1	2	3
Milk yield (kg)	23.2	25.5	26.4	26.1	1.57	0.001	0.001	NS	0.108
FCM (kg)	22.5	24.5	25.0	25.0	1.36	0.001	0.001	NS	NS
Milk fat content (g/kg)	38.3	37.6	36.6	37.5	1.94	0.100	0.059	NS	0.130
Protein content (g/kg)	29.4	30.0	30.0	30.3	0.92	0.063	0.013	NS	NS
Milk fat (g)	881	953	961	969	58.5	0.001	0.001	NS	NS
Milk protein (g)	677	759	786	787	46.0	0.001	0.001	NS	0.096
Live weight (kg)	596	601	606	603	14.5	NS	0.097	NS	NS
LW variation (kg/d)	0.48	0.56	0.70	0.69	0.30	0.126	0.06	NS	NS

(*) Composition (in gross %) : Wheat 16.0 ; Maize 15.5 ; Barley 14.0 ; Dried sugar beet pulp 16.0 ; Citrus pulp 16.0; Soybean meal 18.0 ; Molasses 2.5 ; Fat 1.0 ; NaCl 1.0.
Chemical composition (g/kg DM) : OM 938 ; CP 182 ; CF 81 ; NE 1840 kCal (INRA 1989)
(**) Orthogonal contrasts : (1) = C0 vs C2+C4+R3 ; (2) = C2+C4 vs R3 ; (3) = C2 vs C4.