Influence of compound feed amount on silage intake and weight gain in steers

M. Nicolae, C. Popescu, A. Călin, C. Dragomir, Smaranda Pop
Institute of Biology and Animal Nutrition, 8113 Baloteşti

Abstract

The experiment used 48 Romanian Spotted fattening steers assigned to 4 groups of 12 animals each, with an initial average weight of about 300 kg. The experimental design stipulated different amounts of compound feeds and different bulk forages (free access) given to the animals of the four groups as follows: group 1 – 30 CF, corn silage; group 2 – 30% CF, barley silage; group 3 – 60% CF, corn silage; group 4 – 60% CF, barley silage. After 155 experimental days the increase of dietary CF level from 30 to 60% depressed the amount of ingested bulk feed by 25% for the corn silage (from 5.32 kg DM/day/animal in group 1 to 3.96 kg in group 3) and by 22% for the barley silage (from 4.88 kg in group 2 to 3.82 kg in group 4), the total DM intake being, however, higher in the groups with higher CF levels. The average weight gains, g/animal/day, increased with the CF level, by 17% in the corn silage (1229.7 in group 3 compared to 1055.5 in group 1) and by 12% for the barley silage (1148.4 in group 4 compared to 1021 in group 2).

Keywords: *steers, diet optimization, compound feed, silage intake, weight gain*

Introduction

Bulk forage replacement by compound feeds is important in optimizing the diets for ruminant animals, particularly as concerns the level of CF and the total DM intake (Laird *et al.*,1981; Gordon, 1984; Faverdin *et al.*,1992).

These two aspects bear a clear influence on the weight gain of fattening steers.

When the amount of CF increases the overall DM intake increases while bulk feeds intake decreases (Jarrige, 1988).

The increase of overall DM intake by feeding CF next to bulk feeds (provided on a free access basis) is possible by the partial replacement of bulk feeds by CF under the conditions in which the ingestion capacity remains the same.

Among the factors influencing the level of replacement the most important are bulk feed satiety and the increase of dietary compound feeds (Berge and Dulphy, 1985; Thomas, 1987). These are the reasons we selected for this experiment two bulk forages

(corn silage and barley silage) and two levels of compound feeds, monitoring the influence on silage (and diet) intake and on fattening steers weight gain.
Aspects concerning diet ingestibility were also presented in a previous paper (Nicolae *et al.*,1997).

Material and method

The experiment used 48 Romanian Spotted fattening steers assigned to 4 groups of 12 animals each, with an initial average weight of about 300 kg. The experiment lasted 155 days. The experimental design stipulated different amounts of compound feeds and different bulk forages (free access) given to the animals of the four groups as follows: group 1 – 30 CF, corn silage; group 2 – 30% CF, barley silage; group 3 – 60% CF, corn silage; group 4 – 60% CF, barley silage.
The monitored experimental parameters were:

- nutritive value of the feeds;
- feed intake;
- replacement rate;
- weight gain;
- feeding efficiency

Results and discussion

Nutritive value of the dietary ingredients
Table 1 shows the nutritive value of the bulk forages and of the compound feeds, determined by their chemical composition (Burlacu 1991, 1996).

Table 1 *Feed nutritive value (by kg DM)*

	DM (g)	FU_{meat}	IDPN (g)	IDPE (g)	Ca (g)	P (g)
Corn silage	280	0.9	50	66	3.5	2.5
Barley silage	350	0.72	52	61	4.0	3.0
Corn	860	1.53	80	122	0.3	3.5
Sunflower meal	880	0.85	240	126	3.1	10.3
Dicalcium phosphate	910	-	-	-	240	180
Feed grade limestone	920	-	-	-	390	-

Noteworthy are the dry matter level of the two silages, 28% in the corn silage and 35% in the barley silage, and the fact that related to dry matter, the determined nutritive values are in agreement with the standard values mentioned by the literature.

Feed intake

Table 2 shows the structure of the four compound feeds used in the diets for groups 1 to 4. The structure shows the anticipated difference between animal requirement and the supply of nutrients of the two silages (available on a free access basis).

In groups 3 and 4, with a higher CF level, the proportion of protein feed (sunflower meal) decreased to 16.6% and 16.7% respectively, compared to groups 1 and 2 where sunflower meal represented 27.8% and 24.7% respectively. The lower leve of protein feed in groups 3 and 4 was balanced by the higher level of energy feed (corn).

Table 2 *Compound feed formulations (%)*

	Group 1	Group 2	Group 3	Group 4
	30% CF, corn silage	30% CF, barley silage	60% CF, corn silage	60% CF, barley silage
Corn	67.8	72.3	79.6	80.0
Sunflower meal	27.8	24.7	16.6	16.7
Feed grade limestone	2.0	2.0	1.8	1.8
Dicalcium phosphate	1.4	-	1.0	0.5
Vitamin-mineral premix T2	1.0	1.0	1.0	1.0
TOTAL	100	100	100	100

Table 3 shows the average and overall feed intake, as well as the proportion of compound feeds in the diet.

Under the conditions of similar intakes of compound feeds (administered with limit), the amount of ingested silage (free access) decreased with the increase of dietary concentrate level, from 5.32 kg DM/day in group 1, to 3.96 kg DM/day in group 3 (corn silage) and from 4.88 kg DM/day in group 2 to 3.82 kg DM/day in group 4 (barley silage).

Table 3 *Average feed intake (kg DM/animal/day)*

	Group 1	Group 2	Group 3	Group 4
Corn silage	5.32	-	3.96	-
Barley silage	-	4.88	-	3.82
Compound feed	2.47	2.44	4.51	4.49
TOTAL	7.79	7.32	8.47	8.31
% compound feed	31.7	33.3	53.2	54.0

Overall diet, however, despite the depression of silage intake, the amount of ingested DM increased in the groups that received higher proportions of compound feeds, from 7.79 kg DM/day in group 1 to 8.47 kg DM/day in group 3 and from 7.32 kg DM/day in group 2 to

8.31 kg DM/day in group 4, which supports the data from literature (Dulphy, 1978; Dulphy *et al.*,1987).
Barley silage intake was lower than corn silage intake, particularly for a low proportion of dietary compound feeds (4.88 kg DM barley silage in group 2 compared to 5.32 kg DM corn silage in group 1).

Replacement rate
Based on the data from Table 3 we could calculate the replacement rates (coefficients) between CF and silage, using the established formula:

$$Sg = \frac{\text{less ingested kg DM of silage}}{\text{extra ingested kg DM of CF}}$$

The replacement rate of the corn silage by CF, when the dietary proportion of CF increased from 31.7% (group 1) to 53.2% (group 3) was 66% [(5.32 – 3.96) / (4.51 – 2.47)].
The replacement rate of the barley silage by CF, when the dietary proportion of CF increased from 33.3% (group 2) to 54.0% (group 4) was 52% [(4.88 – 3.82) / (4.49 – 2.44)].

Dietary energy and protein supply
Table 4 shows the dietary energy and protein supply, which is in agreement with the amount of ingested feeds and with their nutritive value.

Table 4 *Daily dietary energy and protein supply*

	Group 1	Group 2	Group 3	Group 4
FU_{meat}	8.02	6.85	9.83	9.02
IDPN (g)	589	577	702	701
IDPE (g)	656	602	813	785

Under the conditions of higher corn silage intake, irrespective of CF level, the supply of energy and protein was higher in groups 1 and 3 compared to groups 2 and 4. Thus, group 1 consumed 8.02 FU_{meat}/day compared to 6.85 FU_{meat}/day in group 2, while group 3 consumed 9.83 FU_{meat}/day compared to 9.02 FU_{meat}/day in group 4.
However, no significant differences between groups were observed for similar dietary CF levels concerning IDPN value. Differences were observed in IDPE, similarly with the energy.

Weight gain
Table 5 shows the initial and final weight of the animals in groups 1 to 4.
For an average body weight of 420 kg, group 1 gained 1055 g/day, while group 2, for an average body weight of 380 kg, gained 1021 g/day (3.3% more for group 1 compared to group 2).

Table 5 *Body weight and weight gain*

	Group 1	Group 2	Group 3	Group 4
Initial weight (kg)	336.6±23	303.1±36	305.9±18	305.5±31
Final weight (kg)	496.9±27	447.6±76	490.7±47	480.1±38
Gain (g/day)	1055.5±67	1021±78	1229.7±103	1148.4±97

For an average body weight of 400 kg, group 3 gained 1230 g/day, while group 4, for an average body weight of 390 kg, gained 1148 g/day (7.1% more for group 3 compared to group 4).
Comparing the groups which received the same type of silage, according to the experimental design, it resulted that weight increased with the amount of dietary compound feed. Group 3 gained 17% more than group 1 (corn silage), while group 4 gained 12% more than group 2 (barley silage).

Feeding efficiency
Table 6 shows the efficiency of feeding expressed in dry matter, energy and protein per 1 kg weight gain.

Table 6 *Feeding efficiency (per 1 kg weight gain)*

	Group 1	Group 2	Group 3	Group 4
DM	7.38	7.17	6.88	7.24
FU_{meat}	7.60	6.71	7.99	7.86
IDPN	558	565	570	610
IDPE	622	590	661	683

The higher level of dietary compound feed depressed feeding efficiency, irrespective the type of silage. Thus, for 1 kg gain, group 3 spent 7.99 FU_{meat} and 570 g IDPN compared to 7.60 FU_{meat} and 558 IDPN in group 1 (+5% for energy and +2% for IDPN). This situation is even more obvious in the groups fed on barley silage: for 1 kg gain, group 4 spent 7.86 FU_{meat} and 610 g IDPN compared to 6.71 FU_{meat} and 565 IDPN in group 2 (+17% for FU_{meat} and +8% for IDPN).

Conclusions

Increasing the level of dietary compound feed to 60% for fattening steers depressed the amount of ingested bulk feeds, by 25% for corn silage and by 22% for barley silage, while the overall ingested dry matter increased in the groups on higher CF level.
The weight gain increased with the level of dietary CF by 17% for the corn silage and by 12% for the barley silage.

Feeding efficiency is inversely proportional to the gain, which was dressed by the higher levels of dietary CF irrespective of the type of silage.

References

Berge P., Dulphy J. P. 1985 – Etude des interactions entre fourrage et aliment concentre chez le mouton. 1. Facteurs de variations du taux de substitution. Ann. Zootech., 34, 313 – 334.

Bertilsson J., Burstedt E. 1983 – Effects of conservation method and stage of maturity upon the feeding value of forages to dairy cows. Swedish. J. Agric., Rev., 13, 189 – 200.

Burlacu Gh. 1983 – Metode şi tehnici pentru măsurarea valorii nutritive a nutreţurilor, Ed. Ceres, Bucureşti

Burlacu Gh., Cavache A., Burlacu R. 1996 – Indicatorii noului sistem de apreciere a valorii nutritive a nutreţurilor, calculul normelor de hrană şi optimizarea raţiilor pentru animalele de fermă – vol.1 şi 2

Dulphy J. P. 1978 – Quantites ingerees et phenomenes de substitution. INRA Publ. (Ed.), 87 – 98.

Dulphy J. P., Faverdin P., Micol D., Bocquier F. 1987 – Revision du systeme des Unites d'Encombrement. Bull. Tech. CRZV Theix, INRA, 70, 35 – 48.

Faverdin P., Dulphy J. P., Coulon J. B., Verite R., Garel J. P., Rouel J., Marquis B., 1992 – Les phenomenes de substitution fourrages – concentres chez la vache laitiere. INRA Prod. Anim. 5 (2), 127 – 135.

Gordon F. J. 1984 – The effect of level of concentrate supplementation given with grass silage during the winter on the total lactation performance of dairy cows. J. Agric. Sci., Comb., 102, 163 – 179.

Jarrige R. 1988 – Capacite d'ingestion. In: Alimentation des bovins, ovins et caprins. INRA, Paris, 21 – 24.

Laird R., Leaver J. D., Maisey F. R., Castle M. E. 1981 – The effects of concentrate supplements on the performances of dairy cows offered grass silage ad libitum. Anim. Prod., 33, 199 – 209.

Nicolae M., Coman G., Popescu C. 1997 – Efectul rasei şi a structurii raţiilor în îngrăşarea tineretului taurin. Lucr. ştiinţ. IBNA – Baloteşti, vol XVIII, 157 – 167.

Montgomery M. J., Culvahouse E. W., Henderson H. A. 1971 – Effect of concentrate supplementation on the voluntary intake of high and low quality forages. J. Dairy Sci., 54, 772.

Thomas C. 1987 – Factors affecting substitution rates in dairy cows on silage based rations. Rec. Adv. in Anim. Nutr., 205 – 218.