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Feeding strategy of Lacaune dairy sheep: dairy ewes fed in groups according to their milk yield

P. Hassoun[1], A. Hardy[2], A. Tesnière[1], J. Legarto[3] and C. De Boissieu[3]

[1]UMR Selmet, Inra Phase, 2 place Pierre Viala, 34060 Montpellier Cedex 01, France
[2]Lycée Agricole La Cazotte, Route de Bournac, 12400 Saint-Affrique, France
[3]Institut de l'Elevage, BP 42118, Campus INRA, Chemin de Borde Rouge, 31321 Castanet-Tolosan, France

Résumé. En France, les brebis laitières Lacaune du rayon de Roquefort sont alimentées en groupes avec grande variabilité de niveau de production de lait (MY). Un essai a été conduit en début de stade de lactation (50 j) pendant 100 jours avec trois lots de 54 brebis adultes sur la base de leur MY(l/j) : haut (H, 3,2), moyen (M, 2,7) ou bas (L, 2,2). Chaque lot était divisé en 2 groupes alimentés soit avec le même niveau de concentrés (CH, CM et CL) soit avec un apport ajusté à la MYdu groupe (EH, EM et EL). Toutes les brebis recevaient un mélange de fourrages distribué à volonté. Les quantités ingérées de fourrages n'ont pas été différentes (P>0,05) entre les groupes H et M (2,3 ± 0,17 kg MS), mais celles de CL(2,0 ± 0,17 kg MS) étaient inférieures (P<0,05) à EL(2,2 ± 0,17 kg DM). La variation de poids de EH (59,2 g/j) était supérieure (P<0,01) à celle de CH (33,9 g/j), et non significative (P>0,05) pour les autres groupes de même que pour l'état corporel. Aucun effet n'a été observé (P>0,05) sur la MY, la composition du lait ou les cellules somatiques. Seule la concentration en urée du lait de ELétait inférieure (P<0,001) à celle de CL. Aucun effet n'a été observé sur les paramètres biochimiques sanguins entre les lots E et C. Dans nos conditions, l'ajustement des apports de concentrés n'a ni économisé du concentré ni modifié la production de lait et sa qualité.

Mots-clés. Brebis laitière – Alimentation en lots – Production laitière – Composition du lait – Ingestion.

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Abstract. *In France, Lacaune dairy sheep in the Roquefort area are fed in groups with a wide range of milk yields (MY). In order to adapt concentrate levels to MY, a100-dayexperimentwas conducted during the early milking period (50 days in milk) with three batches of 54multiparous ewes constituted according to their MY (L/d): high (H: 3.2), medium (M: 2.7) and low (L: 2.2). Each batch was separated into two groups of 27 ewes, a control group (C) and an experimental group (E), fed either with the same level of concentrate(CH, CM and CL) or with concentratesadjusted to theMY (EH, EM and EL), respectively.All ewes were fed a forage mixturead libitum.The average daily individual forage dry matter intake was not different (P>0.05) between groups EH, CH, EM and CM(2.3 ± 0.17 kg DM),but that of CL(2.0 ± 0.17 kg DM) was lower (P<0.05) than EL (2.2 ± 0.17 kg DM).Body weight gain was higher (P<0.01) for EH (59.2 g/d) than for CH (33.9 g/d), but not for the other groups (P>0.05). Body condition score was not affected (P>0.05) by concentrate level in any of the groups.There was no effect (P>0.05) on MY and milk composition. However,the urea level in the milkwas lower (P<0.001) for ELthan CL.There was no effect on metabolism parameters between batches E and C. In our conditions, adjusting concentrates to the MYneither saved concentrate nor changed total milk yield.*

Keywords. *Dairy sheep – Feeding strategy – Milk yield – Milk composition – Intake.*

I – Introduction

In France, in the Roquefort area during thewinter period, confined dairy sheep are fedin batches with the same ration. This ration is determined at the beginning of the milking period on the basis of the milk yield (MY), fat (FC) and protein (PC) contents expected for the average ewe in the batch. Energy and nitrogen intakes are calculated according to INRA recommendations (Hassoun and

Bocquier, 2010) on the requirements of each average ewe, increased by 15% for energy and 25 to 30% for nitrogen. This strategy makes it possible to cover approximately 80% of the energy needs and 90% of the nitrogen needs of the ewes. However, it tends to overfeed a high proportion of the ewes whose needs are much lower than the average ewe and to underfeed the most productive ones. In this context, the interest in constituting more homogeneous milk yield batches makes it possible to provide a more adapted diet to ewes with different yield levels(Bocquier*et al*., 1995).In addition, the formation of batches strongly reduces the heterogeneity of the intra-batch yield level, with a decrease of 24% for two batches and of 30% for three batches (Bocquier *et al*., 1997). Within the framework of the CASDAR AUTELO project dealing with food self-sufficiency, among other things, we once again studied the effect of batch feeding.

II – Material and methods

The experiment was carried out over 14 weeks in a sheepfold during the winter period (2015-2016) at the farm of the Lycée Agricole de La Cazotte (St. Affrique, France). Two batches(**C**, control; **E**, experimental) of 81 multiparous ewesin second lactation or more were formed on the basis of their milk yield (**MY**) at the first control, fat (**FC**) and protein (**PC**) contents, body weight (BW), body condition score (**BCS**) of the litter size and lactation number. Each batch was subdivided into three groups according to the MY, and balanced two-by-twoon the basis of the preceding criteria: two “low” groups (**CL** and **EL**, MY=2.2 L/d), two“medium” (**CM** and **EM**, MY=2.7 L/d) and two “high” (**CH** and **EH**, MY=3.2 L/d).GroupsL, MandHhof batchCwere fed with the same ration calculated on the basis of the BW,theMYand the average FCandPCof the batch with the aim of covering 115% and 125% of the needs in energy (**UFL**) and in nitrogen (**PDI**) according to the system recommended by INRA (Hassoun and Bocquier, 2010). GroupsL, MandHof batch E were fed with the same aim, but taking the average values (BW, MY, FC, PC) of each group. The forage ration common to the two batches was constituted on the basis of the dry matter (DM) of a mixture ofcorn silage (32%), silage (24%) andwrapping (11%)of Italian ryegrass and of alfalfa hay (33%). This mixture was distributed every morning *ad libitum* with a minimum refusal rate of 15%. The type and quantity of concentrates distributed to each group are presented in Table 1.

Table 1. Quantities (kg DM/d/ewe) of concentrate distributed daily to each group during the two periods

	Period 1				Period 2			
	C (L, M, H)	E L	E M	E H	C (L, M, H)	E L	E M	E H
Barley	0.19	0.14	0.19	0.39	0.15	0.00	0.15	0.30
Fortolis énergie®*	0.69	0.53	0.69	0.74	0.45	0.36	0.45	0.53
Dehydratedalfalfa	0.49	0.35	0.49	0.64	0.37	0.27	0.37	0.64
Total	1.37	1.02	1.37	1.77	0.98	0.62	0.98	1.47

* proteincommercial concentrate.

After 35 d (Period 1, **P1**), the quantities of concentrate were decreased and maintained until the end of the experiment to be adjusted to the observed MY (Period 2, **P2**).TheMY, FC, PC and thesomatic cell count (SSC) were measured at the beginning of the experiment and then every two weeks. The urea level in the milk could only be measured as of the 3rd milk control. The BWand theBCSwere measured every month. The dry matter intake (DMI) of the mixture for each group was measured every week for 3 to 4 days. A sample of each forage was taken every two weeks to determine the DM content and kept for analysis. A blood sample was also taken at the beginning of the experiment and then at the same time as the milk controls in order to determine plasma concentrations of glucose (GLU), insulin (INS), nonesterified fatty acids (NEFA) and beta-hydroxybutyrate (BHB) according to the methods described by Gonzalez-Garcia *et al*. (2015).

All of the data were compared intra-group (CHvs. EH; CMvs. EM; and CLvs. EL), and then inter-batch (Cvs. E). Forage dry matter intake was analyzed with the Mann-Whitneynonparametric U test by comparing intake per period and using average weekly measurements. The average daily gain (ADG) between the last weighing and the first at the beginning of the experiment and the variation of the BCS for the same period were analyzed with the Mann-Whitney nonparametric U test. Biochemical blood parameters (GLU, BHB, NEFA and INS) were analyzed with a one-way ANOVA (group) with repeated measurements (time). The MY, FC andPC contents, urea concentration and total fatty matter (TFM),protein (TP) and urea (TU) were analyzed with a one-way ANOVA (batch) each week. Statistical tests were conducted using STATISTICA software, v10,for Windows (Statsoft 2010, www.statsoft.fr).

III – Results and discussion

For the entire experiment, three ewes (1CH, 1EM and 1EL) were removed because of severe mastitis, and no other health problems were observed for the other animals.

1. Dry matter intake

During the first period (P1), the forage DMIswere not different (P>0.05) for groups EHandCH(2.44 vs. 2.43 kg DM/d/ewe) and EM and CM (2.33 vs. 2.42 kg DM/d/ewe), whereas they tended (P=0.066) to be greater forEL (2.27 kg DM/d/ewe) compared toCL (2.05 kg DM/d/ewe). During P2, the same results were observed for EH and CH (2.10vs. 2.26 kg DM/d/ewe) and EM and CM (2.27 vs. 2.25 kg DM/d/ewe). On the other hand, EL consumed more forage (P<0.01) thanCL (2.19 vs. 1.95 kg DM/d/ewe). No difference (P>0.05) was observed between theHandMgroups of the two batches, nor between EHandEL, whereas theDMIof concentrates was clearly greater in P1 (+ 0.75) and P2 (+ 0.85) forEH. Even if the differences between ELandCLfor the two periods can be explained by the substitution phenomenon since CL consumed more concentrate (+ 0.35 kg DM/d/ewe),it was not observed in the other cases despite greater differences in concentrate intake. These results are in contradiction with those observed by Bocquier *et al*. (1997) that did not reveal the effect of MY level at similar stages of lactation (61 d). Nevertheless, the MY sat the beginning of the experiment were lower (2.02 L/d/ewe) and less than that of theLgroups in our experiment (2.2 L/d/ewe),and the ewes were not separated into batches like here. By comparing the results of the regrouped E and C batches, we obtain results identical to the total intake of those obtained with the intake capacity (IC) equation of Bocquier *et al*. (1997).When the concentrate quantities decreased between P1 and P2 (-0.3 to – 0.4 kg DM/d/ewe), forage intake increased for all of the batches in the week that followed from 0.24 to0.38 kg DM/d/ewe, representing a marginal substitution rate of 0.81 to0.98,comparable to the one previously observed (Bocquier *et al*., 1997).

For the totality of both periods (98 d), the total forage concentrate intake for batches C and E was identical, with1.13 and 1.17 kg DM/d/ewe of concentrates and 2.22 and 2.26 kg DM/d/ewe of forage, respectively, as had been previously reported (Bocquier *et al*., 1995) when constituting only two batches for the same period and lactation time.

2. Milk yield,milk composition, weight and body condition score

The adjustment of the rations at the level of the MY, had no effect on the number of somatic cells in the milk. The intra-group MY did not differ throughout the experiment (P>0.05) (Fig. 1), whereas the MY of the EL group tended to be lower that that of the CL group. After the formation of batches, the MY slightly decreased (0 to 0.19 l/ewe) for all of the groups during Period 1. In contrast, after the decrease in concentrate intake (P2) and despite a week of transition, the drop in MY was greater, with 1.3 L/d/ewe (H groups), 1 L/d/ewe (M groups) and 0.7 to 0.9 L/d/ewe (L groups) in 56 days. Likewise,

the FC and PC were not different (P>0.05) for the H (76 and 59 g/L)and M (76 and 59 g/L) groups, but greater for the EL group compared to CL (81 vs. 78 and 62 vs. 59 g/L) as a result of a lower MY. Urea levels in the milk (UR) at each milk control were not significant (P>0.05) for groups H and M. For the seven controls, they were, on average, 0.50 ± 0.051 and 0.51 ± 0.063 g/L and 0.47 ± 0.061 and 0.49 ± 0.064 g/L, respectively. However, they were always lower (P<0.05) for the EL group with an average of 0.43 ± 0.058 g/L and 0.50 ± 0.061 g/L for CL. These results were confirmed for the quantities of fatty matter, proteins and urea that are not different (P>0.05) intra-group (H, M and L), except for the quantities of urea that are lower (P<0.05) for EL, with average values of 0.71 ± 0.125 g/d compared to 0.91 ± 0.176 g/d for CL. When we estimate the cumulative milk yield for the totality of both periods (98 d) for both batches, it is identical (P>0.05), with 205 and 202 L/ewe for batches C and E, respectively. The FC and the PC were also identical for the entire experiment. These results are consistent with those reported by Bocquier *et al*., (1995) when the animals were separated into two milk yield batches (low and high) over the same period and lactation time.

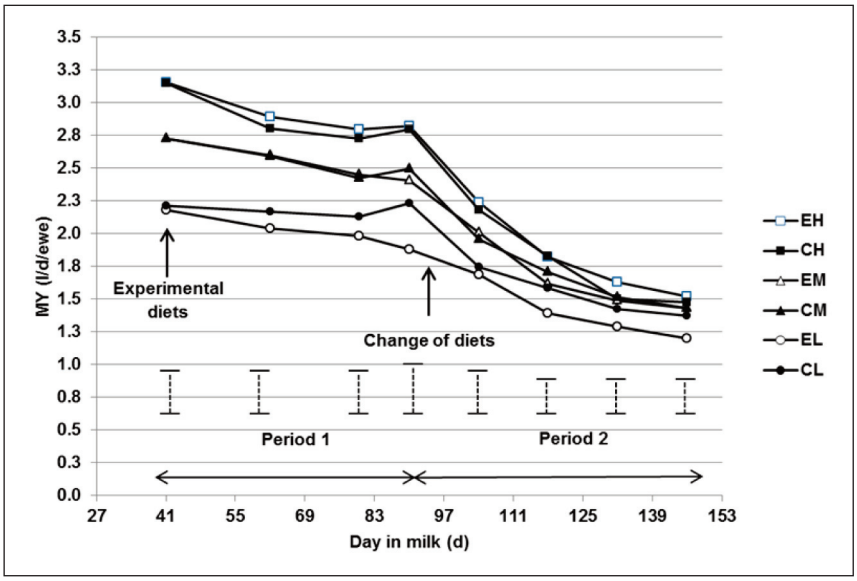

Fig. 1. Milk yield (MY) evolution and standard error (vertical dotted lines) during the two periods.

The ADG was higher (P<0.01) in group EH (59.2 g/d) than in group CH (33.9 g/d), and no difference was observed for groups M and L although the ADG of CL (50.7 g/d) tended to be higher (P=0.11) than that of EL (37.1 g/d). No difference (P>0.05) was observed in the variations of BCS.

3. Biochemical blood parameters

NEFAand GLU levels are not different (P>0.05) between groups or between batches. NEFAlevels are low and comparable to those observed by Gonzalez-Garcia *et al*., (2015) on Lacaune dairy ewes at similar lactation stages when there is no longer any mobilization of body reserves. Consequently, when ewes are fed according to their production level, intake is sufficient to cover their needs in MY, FC and PC. For the EH group, BHB levels were greater (P<0.01) or tended to be than those of the CHgroup as a result of a higher intake of concentrates during the two periods. This can also be seen in the plasma insulin levels that are often higher (P<0.01) for EH compared to TH. In these groups, overfeeding (EH) most likely leads to the accretion of fat in the fatty tissue that is not reflected in the BCS because the method is probably not precise enough.

IV – Conclusions

In the conditions of this experiment with high-quality forage, the adjustment of concentrate intake to the average level of milk yield did not lead to significant changes at the batch level in terms of forage or concentrate intake, milk yield or its composition. Intake adjustment led to a higher weight gain for group EH and a lower one for group EL without affecting the animals' fat cover, whereas the biochemical parameters (insulin, BHB) suggest an accretion of fats in the fatty tissue.As long as the ewes are raised and fed in heterogeneous milk production batches, the equations currently used (Hassoun and Bocquier, 2010) are applicable. On the other hand, if the ewes are to be fed in more homogeneous batches, additional studies should be carried out to better determine substitution phenomena according to MY level and forage quality. An experiment is currently in progress to determine these effects on more homogeneous groups of ewes in terms of milk yield.

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