RESEARCH ON THE INFLUENCE OF EWE DIET ON MILK COMPOSITION AND GROWTH PERFORMANCE OF SUCKLING LAMB

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Abstract

This study evaluated the effects of ewe dietary composition-alfalfa silage vs. hay-based rations-on milk composition and suckling lamb growth from birth to weaning. Thirty-six lactating ewes were assigned to two experimental groups: group 1- alfalfa silage-based diet and group 2- hay-based diet. During the suckling period, the body weight of the lambs was recorded weekly, and the milk was analyzed for total solids, fat, protein and solids-not-fat. The study reveals that group 1 produced milk with higher fat and protein content, while group 2 yielded slightly higher SNF values. Lambs in group 2 exhibited significantly greater total weight gains ($p < 0.01$, $p < 0.001$) during mid-lactation and entire suckling period, as well as average daily gains (ADG) during mid-lactation ($p < 0.01$, $p < 0.001$), although ADG over the total period did not differ significantly between group (247.02 g/day to group 1 vs. 263.02 to group 2). Group 1 showed no advantage in lamb growth despite higher milk fat and protein content. Correlation analysis revealed strong positive relationships between milk SNF and lamb weight during the weeks 3–8. The results indicate that, although alfalfa silage improves certain aspects of milk composition, hay-based diets may better support lamb growth, highlighting a nutritional balance between benefits under the conditions studied.

Key words: *alfalfa silage, body weight, average daily gain, Tsigai breed*

INTRODUCTION

Optimizing lamb growth and ewe productivity is a cornerstone in ovine management, with nutrition playing a central role. Research has consistently demonstrated that the nutritional status of the ewe-both during late gestation and lactation-critically determines neonatal lamb viability and long-term growth performance. Notably, a deficiency in energy intake during the last four weeks of gestation has been shown to reduce colostrum quality and milk production, consequently impairing average daily gain post-birth [1].

Dietary composition plays a crucial role in determining lamb growth performance and ewe milk composition. Alfalfa silage is a valuable nutrient source, rich in protein and fiber, commonly used in ruminant nutrition due to its high quality and good digestibility [2]. Studies have shown that including alfalfa silage in the diet of ewes prior to lambing can positively influence growth rate of lambs [3]. According to [4], incorporating alfalfa semi-silage into the diet of sheep has a beneficial

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impact on lamb growth. Considering these benefits, evaluating the effects of alfalfa silage on productive parameters in sheep is important for optimizing nutritional strategies and maximizing both productive yield and quality.

This study aimed to investigate the influence of dietary composition-specifically the use of alfalfa silage versus hay-based rations-on the chemical composition of ewe milk and the growth performance of suckling lambs. Additionally, correlations between milk components and lamb body weights throughout the suckling period were analyzed to better understand how maternal nutrition affects early development.

MATERIAL AND METHOD

The present study was conducted between January and April 2025 at the Reghin Experimental Base of Research and Development Institute for Sheep and Goat Breeding Palas Constanta, Romania.

The study involved a total of 36 lactating ewes of Tsigai breed – rusty variety, with similar body condition scores, ages, and gestation status, which were assigned to two dietary treatment groups: Lot 1 was and Lot 2, each consisting of 18 ewes with their lambs (single born).

During the gestation period and the first week after lambing, all animals received the same basal diet, formulated to ensure maintenance and fetal growth requirements (2,5 kg alfalfa silage, 0,5 kg barley and 0,5 g straw/head/day). This uniform feeding period continued until the first control of milk production. After this initial phase, the groups were fed different diets formulated to meet the nutritional requirements of lactating sheep (calculated composition was derived from tabular values based on ingredient composition of the experimental diet – [5]) (Tables 1). Lot 1 was fed a ration in which alfalfa silage accounted for 54% of the ration structure, while Lot 2 was fed a ration in which hay made up 75% of the ration structure

Lambs' body weights were recorded at birth and after that weekly until weaning (corresponding to the control - C8 time point) using a digital scale with ±0.1 kg precision. These measurements allowed the calculation of average daily gains (ADG) and monitoring growth trends.

Starting with de 4rd life week until weaning, the lambs received pelleted concentrate feed with 16% crude protein, the lambs were creep fed *ad libitum*.

Milk samples were collected weekly from the ewes of both groups to analyze milk composition parameters: total solid (TS) (%), fat content (%), protein content (%), solids-not-fat (SNF, %). Milk composition analyses were performed using the Ekomilk M**,** calibrated specifically for sheep milk.

Total solid (TS) were calculated using formula:

TS(%) = SNF (%) + Fat (%);

Table 1. The structure of fodder used to feed ewes in the suckling period

Specification	Lot 1	Lot 2
Hil hay (%)	-	75.08
Alfalfa silage (%)	54.00	0.00
Straw (%)	32.40	0.00
Barley (%)	12.96	24.02
Calcium (%)	0.32	0.45
Salt (%)	0.32	0.45
DM intake/day (kg)	2.74	2.94
DP g/day	190.00	220.00
NEM MJ/day	12.30	15.21

Statistical analysis was conducted to evaluate differences between groups and to explore relationships between dietary factors, milk composition, and lamb growth. Descriptive statistics, Pearson correlation analysis, and significance testing (t-test) were performed using JASP software (version 0.10.2.0).

RESULTS AND DISCUSSIONS

Milk composition during the suckling period

Milk composition parameters measured by Ekomilk M are shown in Table 2. Total solid content in milk showed no consistent significant difference ($p > 0.05$) between the two groups throughout the suckling period. However, milk fat percentage was significantly higher ($p < 0.05$) in L1 at several control points, particularly at C8 and in the C1 - weaning period, indicating a possible positive influence of the alfalfa silage diet on milk fat content.

Protein content showed fluctuations but was generally higher in Lot 1, with significant differences noted at some points ($p < 0.05$). Solids-not-fat (SNF) values varied between groups, with L2 exhibiting higher SNF at some points, though differences were mostly not statistically significant ($p > 0.05$).

Lamb body weight evolution from birth to weaning

The growth performance of lambs from both groups during the period from birth to weaning is summarized in Table 3. At birth, there was no significant difference in body weight between L1 and L2 lambs (4.27 ± 0.11 kg *vs*. 4.41 ± 0.12 kg, $p > 0.05$).

However, starting from the first control point (C1), lambs in L2 (with sheep fed with meadow hay-based ration) consistently showed significantly higher body weights compared to those in L1 (where sheep fed with alfalfa silage-based ration), with differences maintained throughout the study period ($p < 0.001$ for most control points). By weaning, the average weight in L2 was 20.58 ± 0.53 kg compared to 18.59 ± 0.48 kg in L1 ($p < 0.01$).

Table 2. Evolution of milk composition parameters (mean ± SE)

Control	Lot	TS (%)	Fat (%)	Protein (%)	SNF (%)
C1	1	19.02 ± 0.47	8.32 ± 0.53	5.50 ± 0.09^{c}	10.79 ± 0.11
	2	22.61 ± 5.31	6.89 ± 0.47	5.08 ± 0.14^{C}	15.73 ± 5.37
C2	1	16.97 ± 0.24	6.71 ± 0.25	5.08 ± 0.08	10.26 ± 0.08
	2	17.33 ± 0.16	7.09 ± 0.23	5.03 ± 0.11	10.24 ± 0.13
C3	1	15.43 ± 0.34	4.61 ± 0.32	5.50 ± 0.11	10.82 ± 0.13^{d}
	2	15.36 ± 0.21	4.16 ± 0.24	5.77 ± 0.10	11.20 ± 0.12^{D}
C4	1	15.97 ± 0.26	5.62 ± 0.27	4.29 ± 0.18	10.35 ± 0.10
	2	15.40 ± 0.84	5.16 ± 0.41	4.27 ± 0.17	10.23 ± 0.62
C5	1	14.97 ± 0.35	4.24 ± 0.31	5.27 ± 0.16	10.73 ± 0.14
	2	15.76 ± 0.75	4.58 ± 0.65	5.76 ± 0.13	11.18 ± 0.14
C6	1	15.21 ± 0.29	4.51 ± 0.25	5.37 ± 0.08	10.71 ± 0.09
	2	14.48 ± 0.41	3.85 ± 0.22	5.27 ± 0.22	10.62 ± 0.27
C7	1	15.53 ± 0.32	4.49 ± 0.29	5.62 ± 0.07	11.04 ± 0.10
	2	15.40 ± 0.33	4.19 ± 0.19	5.78 ± 0.18	11.21 ± 0.20
C8	1	14.97 ± 0.37^{a}	4.20 ± 0.21^{b}	5.40 ± 0.20^{c}	10.77 ± 0.24^{d}
	2	13.30 ± 0.56^{A}	3.46 ± 0.27^{B}	4.62 ± 0.30^{C}	9.83 ± 0.36^{D}
C9	1	16.26 ± 0.38	5.38 ± 0.36	5.52 ± 0.09	10.88 ± 0.10
	2	15.96 ± 0.25	4.93 ± 0.20	5.64 ± 0.08	11.03 ± 0.10
C1-weaning period	1	16.04 ± 0.15	5.33 ± 0.15^{b}	5.28 ± 0.05	10.70 ± 0.05
	2	16.17 ± 0.63	4.92 ± 0.15^{B}	5.24 ± 0.07	11.25 ± 0.60

Note: C1-C9: Weekly milk controls; TS (%): total solid; SNF (%): solids-non-fat; $^{a, b, c, d, A, B, C, D}$: indicate statistically significant differences ($p < 0.05$);

Total gain (TG) from birth to weaning

Lambs in the hay-fed group (L2) achieved better growth performance across almost all control points (Table 4), especially during the early and mid-suckling periods.

While ewes in L1 (alfalfa silage) produced milk with a higher fat and protein content (as seen in previous data), this did not translate into improved growth for the lambs. The slightly improved final interval (C7–weaning) in L1 was insufficient to close the overall growth gap between the groups.

Table 3. Evolution of lamb body weight from birth to weaning (kg) (mean ± SE)

Specification	Lot 1	Lot 2	T - Test	Significance
BW	4.27 ± 0.11	4.41 ± 0.12	-0.872	ns, p > 0.05
WC1	6.20 ± 0.14	7.38 ± 0.21	-4.613	***, p < 0.001
WC2	8.63 ± 0.25	9.78 ± 0.25	-3.328	***, p < 0.001
WC3	10.48 ± 0.29	11.86 ± 0.31	-3.254	***, p < 0.001
WC4	12.20 ± 0.32	13.94 ± 0.36	-3.639	***, p < 0.001
WC5	13.72 ± 0.37	15.88 ± 0.37	-4.104	***, p < 0.001
WC6	15.46 ± 0.40	17.52 ± 0.44	-3.489	***, p < 0.001
WC7	17.22 ± 0.43	19.37 ± 0.48	-3.301	***, p < 0.001
WC8 (WW)	18.59 ± 0.48	20.58 ± 0.53	-2.794	**, p < 0.01
Days from birth to C1	7.00 ± 0.38	10.50 ± 0.20	-8.145	***, p < 0.001
Days from birth to weaning	58.00 ± 0.38	61.50 ± 0.20	-8.145	***, p < 0.001

Note: WC1-WC8 - weight of lambs at control 1 to 8; BW – birth weight; WW-weaning weight;

Table 4. Evolution of total gain of lambs during the birth–weaning period (kg) (mean ± SE)

Specification	Lot 1	Lot 2	T - Test	Significance
TG C1–birth	1.93 ± 0.11	2.98 ± 0.16	-5.421	***, p < 0.001
TG C2–C1	2.43 ± 0.15	2.41 ± 0.11	0.144	ns, p > 0.05
TG C3–C2	1.85 ± 0.07	2.07 ± 0.11	-1.753	ns, p > 0.05
TG C4–C3	1.72 ± 0.06	2.09 ± 0.10	-3.097	**, p < 0.01
TG C5–C4	1.52 ± 0.09	1.93 ± 0.07	-3.651	***, p < 0.001
TG C6–C5	1.74 ± 0.07	1.64 ± 0.12	0.713	ns, p > 0.05
TG C7–C6	1.77 ± 0.09	1.85 ± 0.12	-0.55	ns, p > 0.05
TG weaning (C8)–C7	1.37 ± 0.12	1.22 ± 0.09	0.994	ns, p > 0.05
TG C1–weaning	12.39 ± 0.42	13.21 ± 0.37	-1.462	ns, p > 0.05
TG birth–weaning	14.32 ± 0.46	16.17 ± 0.44	-2.9	**, p < 0.01

Note: TG – total gain; C1-birth to C8-C7 – control period

Average daily gain (ADG) from birth to weaning

The average daily gain (ADG) data is presented in Table 5. There were no significant differences between groups during the early postnatal periods (C1 to C3). However, from C3 to C5, lambs in L2 showed significantly higher ADG values compared to L1 ($p < 0.01$ and $p < 0.001$, respectively). During other intervals, the differences were not significant ($p > 0.05$).

Overall, the total ADG from birth to weaning tended to be higher in L2, although without statistical significance. The average daily gain (ADG) showed similar values between the two groups throughout the period weaning - C1 (when the ewes began receiving different diets), indicating that both dietary treatments supported comparable growth rates in the lambs.

According to the data in Table 5, the average daily gain (ADG) shows a downward trend in L1, reaching a minimum of 216 g/day at control point C5, after which it began to increase again. In contrast, in L2, the ADG followed an upward trend until control point C4, where it reached a maximum of 298 g/day, after which it started to decline.

The similar ADG values recorded during the C1–lambing and C2–C1 periods are exclusively due to the quality and quantity of milk production in the ewes, especially considering that the differentiated feeding of the ewes was implemented only after the first qualitative control of the milk and the lambs' body weight.

Table 5. Average daily gain (g) of lambs from birth to weaning (mean ± SE)

Specification	Lot 1	Lot 2	T - Test	Significance
C1-birth	278.47 ± 9.68	281.59 ± 12.32	-0.199	ns, p > 0.05
C2-C1	270.18 ± 16.49	267.28 ± 11.63	0.144	ns, p > 0.05
C3-C2	263.73 ± 9.99	296.03 ± 15.49	-1.753	ns, p > 0.05
C4-C3	246.03 ± 8.45	298.41 ± 14.65	-3.097	**, p < 0.01
C5-C4	216.67 ± 13.33	276.19 ± 9.38	-3.651	***, p < 0.001
C6-C5	248.41 ± 10.14	234.13 ± 17.29	0.713	ns, p > 0.05
C7-C6	252.38 ± 12.70	264.29 ± 17.53	-0.55	ns, p > 0.05
C8-C7	195.24 ± 17.21	173.81 ± 12.98	0.994	ns, p > 0.05
Weaning-C1	242.92 ± 8.28	258.93 ± 7.17	-1.489	ns, p > 0.05
Birth-weaning	247.02 ± 7.95	263.02 ± 7.23	-1.462	ns, p > 0.05

Note: C1–C8: weekly wight controls

The results of our study indicate that although the milk produced by ewes fed with alfalfa silage (Lot 1) had a higher fat and protein content, this did not translate into significantly greater growth in lambs compared to the hay-fed group (Lot 2), which produced better values for solids-not-fat (SNF) in the milk.

Lambs fed with alfalfa silage (L1) recorded a mean ADG of 247.02 g/day, while the hay group (L2) had a slightly higher ADG of 263.02 g/day. The difference was not statistically significant ($p > 0.05$).

These values are higher than those reported by [4] for alfalfa semi-silage in 2023, where the ADG was 224.44 g/day, as well as those from the non-silage group, which had an ADG of only 183.49 g/day.

These results confirm findings from previous studies highlighting the beneficial effects of alfalfa silage on milk composition [3].

The observed variability in lamb growth parameters and milk composition reflects the complex relationships between diet composition, offspring development, and milk nutrient content, emphasizing the need to tailor feeding strategies according to specific production goals.

It is important to note that the alfalfa silage ration (L1) was lower in digestible protein (PDI: 190 g/day) and net energy (12.3 MJ/day) compared to the hay-based ration in L2 (220 g PDI/day and 15.21 MJ/day).

These nutrient differences between ration can explain the slight difference in weight gain observed in the lambs from L1 compared to those from L2.

Therefore, the results reflect not only the differences in forage type (silage *vs*. hay) but also the total nutritional adequacy of the diet in terms of protein and energy available for milk production and lamb development.

Alfalfa silage-based diets should be carefully balanced with additional sources of PDI and energy to compensate these deficiencies, ensuring both high milk quality and improved lamb growth

Correlation analysis

The Pearson correlation analysis (Table 6) revealed a strong and statistically significant positive association between solids-not-fat (SNF) and total solids (TS), with a correlation coefficient of $r = 0.95$ ($p < 0.001$). This indicates that higher SNF values are consistently associated with higher total solids in milk, reflecting a close biochemical relationship between these two milk components.

A weak but significant positive correlation was also observed between milk fat content and TS ($r = 0.34$, $p < 0.001$), suggesting that increased fat content contributes moderately to total solids in milk.

Regarding milk protein, no significant correlations were found with lamb weights or other milk components ($p > 0.05$), except for a weak but statistically significant association with SNF ($r = 0.14$, $p < 0.05$). This indicates that protein content has a limited influence on the other traits analyzed.

As for lamb body weight, strong and highly significant correlations were observed between weights recorded at different control points (C1–C6), with r values exceeding 0.85 ($p < 0.001$). This reflects consistency in growth over time.

Birth weight showed moderate correlations with subsequent weights, the highest being with weight at C1 ($r = 0.61$, $p < 0.001$), and its influence gradually decreased over time.

An interesting finding was the weak but significant correlation between milk fat content and lamb weight at C7 ($r = 0.26$, $p < 0.001$), suggesting a potential late-stage influence of milk fat on lamb growth.

Additionally, weaning weight (C8) showed strong correlations with weights recorded at earlier stages, especially from C3 to C6 (r ranging from 0.83 to 0.96; $p < 0.001$).

This suggests that mid- to late-lactation body weights are reliable predictors of weaning weight.

There is a positive correlation between lamb birth weight and weaning weight. Studies by [6] and [7,8] showed that for every 1 kg increase in birth weight, weaning weight increased by 3.35 kg, 3.16 kg, and 3.17 kg, respectively.

Table 6. Correlation coefficients of milk components and lambs weight (n = 36)

Item	TS	F	P	SNF	BW	WC1	WC2	WC3	WC4	WC5	WC6	WC7	WC8
TS	1.00												
F	0.34***	1.00											
P	0.15	0.04	1.00										
SNF	0.95***	0.02	0.14*	1.00									
BW	0.02	-0.01	0.02	0.02	1.00								
WC1	0.09	0.03	-0.04	0.08	0.61***	1.00							
WC2	0.06	0.04	-0.11	0.05	0.52***	0.89***	1.00						
WC3	0.04	-0.01	-0.12*	0.04	0.48***	0.85***	0.97***	1.00					
WC4	0.05	0.00	-0.11*	0.05	0.51***	0.87***	0.97***	0.98***	1.00				
WC5	0.02	-0.02	-0.12*	0.03	0.51***	0.86***	0.95***	0.96***	0.98***	1.00			
WC6	0.03	-0.01	-0.10	0.04	0.56***	0.83***	0.93***	0.92***	0.96***	0.98***	1.00		
WC7	0.08	0.26***	0.02	-0.02	-0.10	0.15	0.18	0.12	0.07	0.03	0.05	1.00	
WC8	0.03	0.01	-0.08	0.03	0.55***	0.78***	0.85***	0.83***	0.90***	0.92***	0.96***	-0.02	1.00

Note: ***p < 0.001; **p < 0.01; *p < 0.05; TS - total solid; F – fat; P – protein; SNF – Solids Not Fat; WC1–WC8 – weight of lambs at control 1 to 8

CONCLUSIONS

The research results suggest that without appropriate supplementation to correct protein and energy imbalances, such diets may underperform compared to more modest but nutritionally balanced rations based on hay. This highlights the need to evaluate forages not just by their individual nutritive value but by how well they integrate into the overall dietary formulation.

Further research should investigate the impact of supplementing alfalfa silage-based diets with energy- and protein-rich concentrates to determine the optimal nutritional balance that maximizes both milk quality and lamb growth. Such studies could help define specific thresholds for digestible protein (PDI) and net energy (NE) required in silage-based rations to match or exceed the performance of hay-based systems.

It would be valuable to extend the evaluation period beyond weaning to assess the long-term effects of early lactation milk composition on post-weaning growth, feed efficiency, and carcass quality. Understanding whether early-life nutritional differences translate into lasting performance advantages would offer practical insight for optimizing ewe and lamb feeding strategies.

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