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Effects of Nutritional Systems on Early Weaned Lambs

Research Article

M.S. Simeonov[1*] and D.L. Harmon[2]

[1] Research Agricultural Institute, Stara Zagora, Bulgaria
[2] Department of Animal and Food Science, University of Kentucky, Lexington, USA

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*Correspondence E-mail: msimeonov78@abv.bg

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ABSTRACT

The aim of this study was monitor the effect of inducement baits and to test four nutrition systems after early weaning lambs of Blackhead Pleven sheep breed. The experiment was conducted with 80 early weaned lambs. The study shown that during partial deprivation of milk (from 14 days of age), lambs intake more feed when an inducement is placed baits. In both groups, on the last day before weaning, the lambs intake over 100 g of concentrated feed, which proved sufficient and allowed the animals to be weaned at 19 days of age. Growth of animals after weaning is higher at fed on pelleted protein concentrate and barley grain ($P<0.01$). This is indicative of the fact that age and body weight do not influence the growth of early weaned lambs, but the kind of forages used. Studies shown that the early weaning of lambs at an average body weight of 8.80 and an age of 19.4 days kg allowed an additional 41.8 kg of milk per sheep to reach 15 -16 kg body weight of lambs.

KEY WORDS baits, body weight, lambs, nutrition, pelleted protein concentrate, starter mixture.

INTRODUCTION

The early weaning of lambs in the dairy sheep industry represents a significant energy reserve, increasing the economic efficiency of the farm by subsequently increasing the length of the lactation (Stoykova *et al.* 2009). The increased sheep lactation period increases the amount of milk obtained. This is particularly critical in that almost 25% of milk in small ruminants is obtained during the first 30 days of lactation (Ricordeau and Denamur, 1962; Folman *et al.* 1966). According to previous studies, 75% of sheep milk is obtained during the first 56 days of lactation, which can be significantly enhanced through the early weaning of lambs (Simeonov, 2013). Numerous practices are common throughout the world. In Northern Europe, lambs of the East Frisian breed are weaned from 1-3 days after birth (Flamant and Ricordeau, 1969). In the USA, early weaning is performed at 5-10 days of age (Hinds, 1972). In Israel, lambs of the Avasi breed are provided milk until 30-60 days of age, after which they are weaned (Folman *et al.* 1966), and in Egypt, lambs are provided milk until 60-90 days of age (Abbas *et al.* 2010). The question is what is the optimum time to early weaning lambs? Typically, body weight and dry feed consumption are the major deciding factors for when to wean, however, weaning age varies widely (from 24 h after birth to 60 days of age). All are described as "early weaning". In order to reduce the cost of feeding lambs with a milk replacer, an alternative is sought in which the lambs weaned at an early age go directly to dry feed. According to Brown (1964), growth disorders of lambs that were weaned at 3 weeks of age and with an average body weight of 7-9 kg were not reported. Large (1965) suggests 3 weeks as the age at which lambs can switch to dry feed, provided they are pre-conditioned to consume it. Heaney *et al.* (1984) also reported that lambs can be weaned successfully at 3 weeks of age, although a

decrease in body weight is detected during the first week, which according to Frederiksen *et al.* (1980) is associated with reduced consumption of dry feed. These results suggest that the earlier lambs learn to consume dry feed: the smaller will be the stress of weaning (Neres *et al.* 2001).

According to Poe *et al.* (1969) the habituation of small lambs to receive dry food at an early age accelerates the morphological and functional development of the rumen. This creates the conditions for the emergence of a microbial population allowing carbohydrate fermentation and early weaning with reduced stress (Ørskov, 1982).

Previous studies suggested that one way to stimulate early intake of dry feed by lambs is to offer palatable and highly digestible forages in a creep.

The use of suitable inducements, such as shiny objects (large new bolts and a CD) and milk replacer, attracts lamb attention as early as 4 days of age, hastening consumption (Simeonov *et al.* 2013). These authors suggested that the taste and odor of the milk replacer kept the lambs in the creep consuming more dry feed for longer periods. The objective of the present study was to monitor the effect of inducement baits prior to weaning and to test four nutrition systems for growing early weaned lambs of the Blackhead Pleven Sheep breed.

MATERIALS AND METHODS

The experiment was conducted in 2015 at the experimental farm of the Institute of Forage Crops, Pleven, Bulgaria using 80 early weaned lambs of the of Blackhead Pleven Sheep breed. The animals were born within a 3-day period. In the begining of the experiment, lambs with their mothers were divided randomly into two groups. From the age of 5 days on, the lambs had *ad libitum* access to feed and water in a creep (Alcock, 2006) and offered a common nutritional program (*ad libitum*) consisting of a pelleted protein concentrate (PPC), cracked maize, a starter mix, alfalfa hay, and water (Tables 1 and 2). One group also received an inducement, a lamb milk replacer (200 g/d for the entire group) hand sprinkled onto the feed without mixing, to serve as a stimulator of dry feed intake whereas the second group received none. The milk replacer was sprinkled only in the morning as the feed was offered.

The lambs were weaned according to the method of Simeonov (2013). Briefly the animals were separated from their mothers over 5 days with an increasing interval of time each day on the first day the lambs were separated from the mothers for 8 h, on the second day for 9 h, on the third day for 10 h, on the fourth day 11 h and on the fifth day for 12 h, after which the lambs were weaned. The lambs were weaned at an average age of 19.4 days and average body weight of 8.80 kg.

After weaning, the lambs were divided into four groups (20 animals per group) balanced by age, weight, sex and type of birth. Animals from each group were divided into 10 subgroups and reared 2 lambs per pen. Each pen was 1.5 m long by 3 m wide. The first group was control with lambs receiving ad libitum commercial starter mix and alfalfa hay. The second group lambs received *ad libitum* PPC, alfalfa hay and cracked maize. The third group received *ad libitum* PPC, alfalfa hay and cracked barley. The fourth group lambs received *ad libitum* PPC, alfalfa hay and cracked wheat (Table 2).

The PPC pellets, forage and grains were offered separately allowing the lambs to be selective. The refusal weights were determined daily and new feed offered. The lambs always had *ad libitum* access to water.

The body weights were determined in the morning without depriving lambs of food and water. During the periods when lambs were separated from their dams, the weight of the animals were determined every day until the twelfth day after weaning, after which they were determined every second day (the day of weaning was the exception), after which weight was recorded at the end of the experimental period.

At the end of the experiment, the lambs' body weight was determined after 12 hours of water deprivation and 24 hours of food deprivation.

The chemical content of feeds (Table 1) was determined by standard methods AOAC (2007).

Milk from ewes was reported daily beginning when the lambs were separated from the mothers (before being weaned completely) up to 16 kg body weight of the lambs. The milking of the sheep was machine in a milking hall (2×24). The milking of the sheep was 2 times a day (at 7:00 a.m. and at 6:30 p.m.).

During the preweaning phase treatments could only be applied to the entire pen of lambs, thus only mean intake data shown for this phase of the experiment. For the growth phase the experiment was analyzed as a completely random design using pen as the experimental unit (5 pens 2 lambs each). When treatment effects were significant ($P<0.05$ and $P<0.01$) means were separated using LSD (Statistica, 2006).

RESULTS AND DISCUSSION

The study showed that during partial deprivation of milk (from 14 days of age), lambs consumed more feed when an inducement was provided, particularly early in the restriction period (Figure 1). In both groups, on the last day before weaning, the lambs consumed over 100 g of concentrated feed, which proved sufficient and allowed the animals to be weaned at 19 days of age.

Table 1 Nutrition scheme for lambs after weaning

Fodder	Starter mixture[1] (n=10)	PPC[2] + Maize (n=10)	PPC + barley (n=10)	PPC + wheat (n=10)
Alfalfa hay	×	×	×	×
Starter mixture for lambs (not granulated)	×			
Pelleted protein concentrate		×	×	×
Maize		×		
Barley			×	
Wheat				×

[1] Starter mixture for lambs (not granulated).
PPC: pelleted protein concentrate.

Table 2 Component and chemical composition of feed used

Ingredient (%)	Starter mixtur[1]	PPC	Maize	Barley	Wheat	Alfalfa hay
Maize	26.2	-	-	-	-	-
Barley	22.5	-	-	-	-	-
Sunflower meal	17	32.5	-	-	-	-
Soybean meal	12	25.5	-	-	-	-
Rapeseed meal	-	29.5	-	-	-	-
Alfalfa hay	5	-	-	-	-	-
Molasses	5	5	-	-	-	-
Calcium carbonate	0.5	2.5	-	-	-	-
Vitamins and minerals	0.5	2.5	-	-	-	-
Sodium chloride	0.5	1.5	-	-	-	-
Sodium bicarbonate	-	1.5	-	-	-	-
Nutrient analyses (g/kg)						
Dry matter	883	887	893	897	890	901
Feed units for growth (FUG)[2]	1.24	0.97	1.54	1.34	1.44	0.64
Crude protein	182	328.6	74.7	112.4	124.8	175.6
Digestible protein in the intestine	111	145.8	96	98	97	73
Balance of the protein in the rumen	27	128	-35	-30	-29	45.1
Crude fats	21.2	17.3	34.2	20.4	18.3	21.6
Calcium	8	15.5	0.42	0.55	0.51	15.1
Phosphorus	5.1	8.1	2.7	3.7	4.1	3.1
Vitamin A, IU/kg	10	45	-	-	-	-
Vitamin D, IU/kg	2000	9000	-	-	-	-
Vitamin E, mg/kg	60	270	-	-	-	-

[1] Starter mixture for lambs (not granulated).
[2] FUG= 6 MJ NE.
PPC: pelleted protein concentrate.

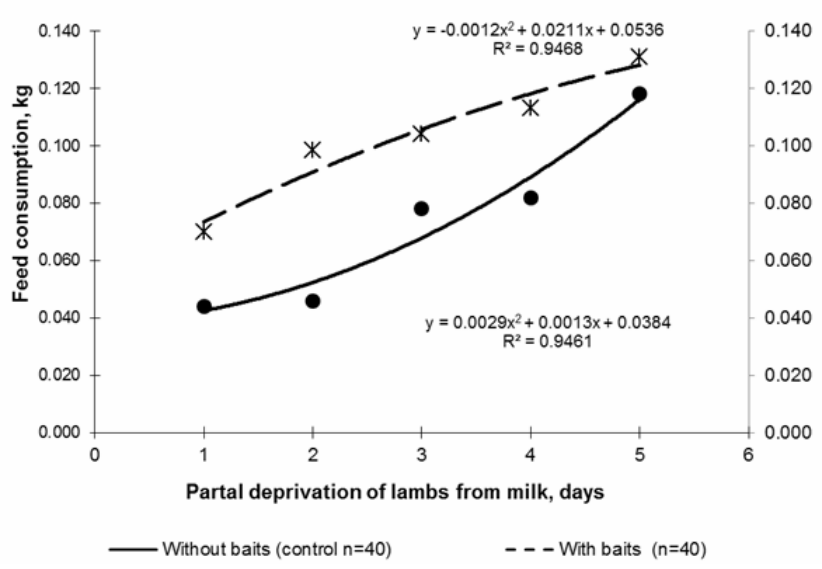

Figure 1 Comparison of dry feed consumption for lambs during the period of partial deprivation of milk

Growth of animals after weaning was highest for lambs fed PPC + barley while lambs feed PPC + maize or wheat were similar and were better than those fed the starter control (Table 3, P<0.01).

It was found that the lambs receiving the cracked grains consumed minimal amounts of roughage (124 to 158 g/day) despite the constant presence (Table 4), while lambs receiving the starter mixture consumed the most roughage (P<0.05).

Despite consuming the least amount of roughage, lambs consuming barley ate the largest amount of grain (P<0.05) whereas lambs consuming wheat ate the least amount of PPC. Despite these apparent differences in selection preference, lambs consumed similar amounts of DM with maize and barley providing the greatest intakes of CP (P<0.05) followed by wheat (Table 4).

The early weaning of lambs at an average body weight of 8.80 kg and an age of 19.4 days kg allowed an additional 41.8 kg of milk per sheep during the period when the lambs grew to reach 15 -16 kg body weight.

The results suggested that during the period of training for intake of dry forages, lambs had a higher consumption of feed more quickly when an inducement such as a small amount of milk replacer (Figure 1) was provided. Similary, Simeonov *et al.* (2013) found that using a milk replacer increased attempts to consume concentrated feed by 2.9 times/lamb, with an average duration of 1.3 min/lamb.

In this study, lambs from both groups had free access to feed, indicating that they were placed under similar growing conditions. Even at a young age, lambs quickly learn to visit feed, especially when the area is well-lit, warm, airless, easily accessible, and with attractive and appetizing forages for young animals (NRC, 2007). With its pleasant odor, sweet taste and white color, the milk replacer attracts the lambs to the creeps. The pleasant odor of the milk replacer, which is also transmitted to the feed, along with its good taste and amino acid composition, is the reason why it is used as an additive in granulated pelleted protein concentrates (Bimczok *et al.* 2005). Considering the early age at which the lambs received dry forages and had permanent access to the mothers, the average consumption for the 14-day period (the last day before partial deprivation of milk), averaged 40 g per lamb in the non-inducement lambing group and 70 g per lambs with an inducement which may be considered satisfactory. Minimum feed intake does not affect growth but favors the development of compartments in the proventriculus and ruminal papillae (Ward Abou, 2008), which is important for digestive processes (Göncü *et al.* 2010). During the 53 days after weaning the lambs intake of the starter mixture was lower than the other three groups (Table 3). This difference in intake resulted in slower growth of starter-fed lambs which was associated with lower energy and specific nutrient consumption compared to lambs fed PPC and the cracked grains (Table 4).

Table 3 Growth of the lambs during experimental periods

Indicators	Starter mixture	PPC + maize	PPC + barley	PPC + wheat	SEM
Age, days					
-at weaning	19.2[a]	20.2[a]	18.5[a]	19.6[a]	0.37
Body weight, kg					
-at weaning	8.5[a]	8.6[a]	8.9[a]	9.2[a]	0.16
-ending	20.1[a]	23.1[b]	24.8[c]	23.9[b]	1.02
-daily growth	0.219[a]	0.274[b]	0.301[c]	0.277[b]	0.02

PPC: pelleted protein concentrate.
The means within the same row with at least one common letter, do not have significant difference (P>0.01).
SEM: standard error of the means.

Table 4 Intake of feed during experimental periods

Indicators	Starter mixture	PPC + maize	PPC + barley	PPC + wheat	SEM
Intake (kg/day)					
Alfalfa hay	0.226[c]	0.158[b]	0.124[a]	0.133[a]	0.033
Starter mixture	0.712	-	-	-	-
PPC	-	0.395[b]	0.391[b]	0.365[a]	0.009
Cracked grains	-	0.442[a]	0.464[b]	0.443[a]	0.007
Total	0.938[a]	0.955[a]	0.979[a]	0.941[a]	0.009
Total dry matter	0.832[a]	0.846[a]	0.864[a]	0.832[a]	0.008
Energy and protein intake (animal/day)					
Feed units for growth (FUG)[2]	1.005[a]	1.162[d]	1.012[b]	1.086[c]	0.037
Crude protein (CP), g	167.8[a]	201.4[c]	205.8[c]	197.1[b]	8.60
CP % of DM	20.2	22.9	23.8	23.7	-

[1] FUG= 6 MJ NE
PPC: pelleted protein concentrate.
The means within the same row with at least one common letter, do not have significant difference (P>0.01).
SEM: standard error of the means.

The lambs fed the starter mixture consumed more alfalfa hay compared to the lambs that received the grains and PPC (P<0.05, Table 4). According to Simeonov *et al.* (2010) the reason is that grain maintains the normal function of the rumen, including rumination. When the grain is whole the fermentation rate in the rumen is slower (Koenig *et al.* 2003), which increases the rumination time (Cazes *et al.* 1990) and this can reduce the need for roughage (Castrillo *et al.* 1989; Landa *et al.* 2001; Askar *et al.* 2006). In the starter mixture, the grains are ground (Table 1) whereas fiber in the whole grains remain intact, thus increasing the fermentation processes in the rumen which increases rumination time (Ørskov *et al.* 1974).

Conversely, given the ability to choose, lambs consumed approximately equal amounts of PPC and grain (Table 4). The ratio of carbohydrate and protein intakes provided intakes close to recommended levels. This confirms the view of Kyriazakis and Oldham (1993) that lambs consuming from two available feeds with different protein contents, consumed quantities that satisfied their protein needs.

The type and mode of nutrition of the protein feed is apparently important, because in the experiments of Rodríguez *et al.* (2007), when lambs were able to choose barley, soybean meal and vitamin-micronutrient premix, lambs consumed significantly more protein than necessary and had a higher yield than lambs fed a complete feed. The high palatability of soybean meal and its preference over the other forages is apparently the reason why it is adopted in a larger amounts than is necessary, to meet the protein needs (Davies *et al.* 1974).

CONCLUSION

During partial deprivation of milk (from 14 days of age), lambs consumed more feed when an inducement was provided. The lambs consumed over 100 g of concentrated feed and this was sufficient for animals to be weaned at 19 days of age. The lambs receiving the cracked grains consumed minimal amounts of roughage despite their constant presence. The lambs receiving the starter mixture consumed the most roughage (P<0.05).

REFERENCES

Abbas S.F., Abd Allah M., Allam F.M. and Abon-Ella A.A. (2010). Growth performance of Rahmani and Chios lambs weaned at different ages. *Australian J. Basic Appl. Sci*. **4(7),** 1583-1589.

Alcock D. (2006). Creep feeding lambs. *Primefacts*. **224,** 1-4.

AOAC. (2007). Official Methods of Analysis. 18th Ed. Association of Official Analytical Chemists, Arlington, Washington, DC., USA.

Askar A.R., Guada J.A., González J.M., de Vega A. and Castillo C. (2006). Diet selection by growing lambs offered whole barley and a protein supplement, free choice: Effects on performance and digestion. *Livest. Sci*. **101,** 81-93.

Bimczok D., Röhl F.W. and Ganter M. (2005). Evaluation of lambs performance and cost in motherless rearing of German Grey Heath sheep under field conditions using automatic feeding systems. *Small Rumin. Res*. **60,** 255-265.

Brown T.H. (1964). The early weaning of lambs. *J. Agric. Sci*. **63,** 191-204.

Castrillo C., Guada J.A. and Gasa J. (1989). Effect of barley processing and straw supplementation on diet utilization by fattening lambs. *Investig. Agrar. Prod. Sanid. Anim*. **4,** 111-119.

Cazes J.P., Vallade C. and Van Quackebeke E. (1990). Effect of concentrate on quality of subcutaneous tissue of lamb carcasses. *World Rev. Anim. Prod*. **25,** 55-62.

Davies D.A.R., Lerman P.M. and Crosse M.M. (1974). Food preferences after weaning of artificially reared lambs. *J. Agric. Sci*. **82,** 469-471.

Flamant J.C. and Ricordeau G. (1969). Adjustments between the ovary breeds Prealpes du Sud and Frisonne (East African Milk). I: The Oriental Fries Press Elavage in purebred. Use in crossings. *Ann. Zootec*. **18(2),** 107-130.

Folman Y., Volcani R. and Eyal E. (1966). Mother-offspring relationships in Awassi. I: The effect of different suckling redimes and time of weaning on the lactation curve and milk yield in dairy flocks. *J. Agric. Sci*. **67,** 359-368.

Frederiksen K.R., Jordan R.M. and Terrill C.E. (1980). Rearing Lambs on Milk Replacers. Farmers Bull. 2270. Science and Education Administration, U.S. Department of Agriculture, Washington, DC., USA.

Göncü S., Boğa M., Kilic U., Görgü M. and Doran F. (2010). Effects of feeding regime without roughage and performances and rumen development of calves during pre-weaning period. *J. Agric. Sci*. **16,** 123-128.

Heaney D.P., Shrestha J.N.B. and Peters H.F. (1984). Postweaning performance of artificially reared lambs weaned at 21 *vs*. 28 days of age under two post-weaning housing regimes. *Canadian J. Anim. Sci*. **64,** 667-674.

Hinds F.C. (1972). Feeding for Growth from Early Weaning to Market. Intensive Management Symposium, Sheep Industry Development Program, Denver, Colorado.

Koenig K.M., Beauchemin K.A. and Rode L.M. (2003). Effect of grain processing and silage on microbial protein synthesis and nutrient digestibility in beef cattle fed barley-based diets. *J. Anim. Sci*. **81,** 1057-1067.

Kyriazakis I. and Oldham J.D. (1993). Diet selection in sheep: The ability of growing lambs to select a diet that meets their crude protein (nitrogen×6.25) requirements. *British J. Nutr*. **69,** 617-629.

Landa R., Mantecon A.R., Frutos P., Rodriguez A.B. and Giraldez F.J. (2001). Effect of type of cereal (barley *vs*. maize) on ingestion, weight gain and carcass characteristics of lambs fed on feed and straw or only on feed. *ITEA Prod. Anim*. **97(3),** 204-216.

Large R. (1965). The effect of concentration of milk substitute on the performance of artificially reared lambs. *Anim. Prod*. **7,** 325-332.

Neres M.A., Garcia C.A., Moneiro A.L.G., Costa C., Silveira A.C. and Rosa G.J.M. (2001). Alpha hair and physical form of the

ratio, no pattern of cords in creep feeding. *Rev. Bras. Zootec*. **30(3),** 941-947.

NRC. (2007). Nutrient Requirements of Sheep. National Academy Press, Washington, DC, USA.

Ørskov E.R. (1982). Protein Nutrition in Ruminants. Academic Press, London, United Kingdom.

Ørskov E.R., Fraser C. and McHattie I. (1974). Cereal processing and food utilization by sheep. 2. A note on the effect of feeding unprocessed barley, maize, oats and wheat on food utilization by early-weaned lambs. *Anim. Prod*. **18,** 85-88.

Poe S., Glimp H., Deweese W. and Mitchell G. (1969). Effect of pro-weaning diet the growth and development of early-weaned lambs. *J. Anim. Sci*. **28,** 401-405.

Ricordeau G. and Denamur R. (1962). Production laitière des bredis prélpes du Sud pendant les phases d'allaitement, de sevrage et de traite. *Ann. Zootec*. **11,** 5-38.

Rodríguez A.B., Bodas R., Fernández B., López-Campos O., Mantecón A. and Giráldez F.J. (2007). Feed intake and performance of growing lambs raised on concentrate-based diets under cafeteria feeding systems. *Anim. J*. **1,** 459-466.

Simeonov M. (2013). Effect of diferent methods of early weaning of lambs of dairy breeds and systems for feeding them. Ph D. Thesis. Institute of Forage Crops, Pleven, Bulgaria.

Simeonov M., Todorov N., Krachunov I. and Ribarsci S. (2010). Study of starts for early weaned lambs of dairy breeds. *Bulgarian J. Anim. Sci*. **47(1),** 84-95.

Simeonov M., Todorov N., Kirilov A. and Stoicheva I. (2013). Using baits for inurement lambs to dry feed at an early age. *Bulgarian J. Anim. Sci*. **50(1),** 40-48.

Statistica. (2006). Statistica for Windows, StatSoft Inc., Tulsa, Oklahoma, USA.

Stoykova M., Kirilov A., Krachunov I. and Todorov N. (2009). Economic assessment of different variants for feeding of lambs weaned on the 30st days after birth. "Early weaning" economic effect. *J. Mount. Agric. Balkans*. **12,** 349-360.

Ward Abou G.A. (2008). Effect of Pre-Weaning Diet on Lamb's Rumen Development. *American-Eurasian J. Agric. Environ. Sci*. **3(4),** 561-567.