Bulgarian Journal of Agricultural Science, 19 (No 4) 2013, 810-816
Agricultural Academy

FEEDING EARLY-WEANED LAMBS WITH PELLETED DRY DISTILLARS GRAIN WITH SOLUBLES (DDGS) PLUS WHOLE GRAIN, AND TWO METHODS OF SUPPLYNG MINERALS AND VITAMINS

N. TODOROV[1], M. SIMEONOV[2] and A. KIRILOV[2]
[1] *Trakia University, Faculty of Agriculture, BG - 6000 Stara Zagora, Bulgaria*
[2] *Institute of Forage Crops, BG – 5800 Pleven, Bulgaria*

Abstract

TODOROV, N., M. SIMEONOV AND A. KIRILOV, 2013. Feeding early-weaned lambs with pelleted dry distillers' grain with solubles (DDGS) plus whole grain, and two methods of supplying minerals and vitamins. *Bulg. J. Agric. Sci.,* 19: 810-816

The aim of the experiment is to examine possibilities to feed early-weaned lambs with pelleted DDGS, whole maize grain and alfalfa hay when minerals and vitamins supplement are given by two different methods. Lambs weaned at 19 days age are divided in two groups and for the period from 10 to 25 kg live weight (duration of the trial is 62-65 days) are fed on the same diet consisting of pelleted DDGS, whole maize and alfalfa hay *ad libitum*. Additionally lambs received restricted to 100 g soybean meal per head daily. For the first group minerals and vitamins are included in pelleted DDGS, while for the second group a mineral-vitamin mixture (MVM) is offered separately in a special trough *ad libitum*. The daily live weight gain is equal for two groups ($P>0.05$). There is a tendency for intake of more feeds and MVM when MVM is offered free consumption. Therefore, feed efficiency ratio is worse in the second group with free access to MVM. Separable inside body fat deposit ($P<0.05$) and slaughtering percentage are higher for lambs consuming *ad libitum* MVM ($P=0.10$). In conclusion, the two methods of feeding ensure practically equal results and their application merits attention because both tested systems of feeding are cheap and easy for applying under farm conditions.

Keywords: lambs, pelleted DDGS, whole maize, minerals-vitamins mixture, gain, carcass quality

Abbreviations: DDGS – dry distiller's grain with solubles, PDG-pelleted distillers grain with solubles, PDGA – pelleted distillers' grain with solubles plus additives, MVM – mineral-vitamin mixture

Introduction

There is evidence that DDGS is a good source of energy and protein for young lambs (Schauer et al., 2005; 2006; 2008; Huls et al., 2006; Arcibeque et al., 2008) and may replace part of soybean meal and part of maize in diets, without a negative effect on growth rate and carcass quality. Protein in DDGS has low rumen degradability (Todorov and Kozelov, 2011) which increases availability of amino acids in small intestine of ruminants. DDGS, however, is deficient of lysine, which is the first limiting amino acid (Todorov and Kozelov, 2011). Therefore, it is necessary to combine DDGS with soybean meal or some other rich in lysine feed.

When lambs weaned at 20 to 30 days of age are fed by whole grain plus pelleted protein concentrate, containing *ca.* 650 $g.kg^{-1}$ DDGS, 300 $g.kg^{-1}$ soybean meal and mineral + vitamin supplements in three of our experiments, they growth fast and feed conversion rate was acceptable (Ivanova et al., 2010; Krachunov et al., 2010 and Simeonov et al., 2010). The average daily live weight gain during the period of 10.6-12.6 to 27.0-27.7 kg live weight varies from 268 to 297 g in lambs of dairy sheep breed.

Additionally, it is established that lambs intake more pelleted protein concentrate and whole grain, and growth faster, compared to those fed starter feed in a loose form, produced by compound feed mills (Simeonov et al., 2010).

Recently, several mills producing ethanol from grain started to dry and pellet distiller's grain as well. This yields the idea for direct utilizing pelleted DDGS in combination with whole grain to feed early-weaned lambs from dairy breed. In

E-mail: ntodorov@tradel.net

this case, soybean meal, mineral and vitamin supplements have to be fed separately.

The soybean meal has good physical structure, without powder, excellent taste for lambs (Davies et al., 1974; Risa, 1996) and it is easy to give the necessary quantity to lambs separately, without including it in pelleted DDGS. For sheep and yearlings there is enough data on their ability to regulate consumption of salt and mineral mix containing salt, according to their need (Weir and Miller, Jr, 1953; Berger, 2006; Villalba et al., 2008). Offering minerals mixed with salt is considered an easy and efficient method of supplying necessary minerals for sheep (Church, 1980).

However, it is not clear if very young lambs, weaned at 19 days age will intake enough mixture of salt, minerals and vitamins to cover their requirements.

The aim of this experiment is to check the possibilities of feeding early-weaned lambs with pelleted DDGS, whole maize grain and small quantity of soybean meal when minerals and vitamins are included in the pelleted DDGS or offered free consumption.

Materials and Methods

Lambs and their raising. 22 lambs of Blackhead Pleven breed born in three days interval are used for this experiment. Starting from 5 days of age lambs have access to alfalfa hay, wheat bran, soybean meal, whole maize grain and clean water for drinking in the creep. Lambs are weaned on 19 days of age, weighed in two consecutive days, without withdrawal of feed and water, and divided into two groups equal by live weight at birth and weaning, sex and type of birth (seven female, four male, seven single and four twins in each group). Both groups were kept in confinement of 16 m^2 covered with straw surface. The experiment starts at 25 days of age, at about 10 kg live weight, and finishes when different lambs reach 25 kg live weight.

Feeding of lambs. The **first group** receives pellets consisting of DDGS from maize – 95.6%, limestone – 2.5%, common salt – 1.5% and vitamin-trace elements premix – 0.4% (PDGA). The premix contains in 1 kg: 4 500 000 IU vitamin A, 550 000 IU vitamin D, 30 000 IU vitamin E, 10 000 mg vitamin B_{12}, 1000 mg vitamin B_1 (thiamine), 100 mg biotin, 37 500 mg Fe, 40 00 mg Zn, 40 000 mg Mn, 2000 mg I, 500 mg Co, 100 mg Se, 2500 mg Mg, 50 mg etoxiquin, 150 mg butylhydrotuloene and 50 mg propilgalate. The premix does not contain Cu. Intentionally it was included higher then required common salt to stimulate drinking water as a measure against urinary calculi.

Additionally, the lambs receive whole maize grain, soybean meal and alfalfa hay. PDGA, maize and alfalfa hay are fed *ad libitum* with 5-10% reminder each day. The soybean meal is fed restrictedly at 100 g per animal daily. This leads to a decrease of proportion of soybean meal in the total diet, with an increasing intake of feeds according to the age of the lambs.

The second group is fed on similar diet, but pelleted DDGS does not contain mineral and vitamin supplements (PDG). Instead, the lambs receive *ad libitum* mineral-vitamin mixture (MVM) in a special trough. The MVM contains 57% limestone, 34% common salt and 9% of the same premix, which is included in PDGA. The PDG, whole maize, and alfalfa hay are fed *ad libitum,* and soybean meal restricted to 100 g/lamb/day, as in the first group. Therefore, the only difference between the two groups is methods of providing minerals and vitamins supplement.

The two types of pellets, without and with minerals and vitamins, have 4.2 mm diameter and 6-8 mm length. Pellets are not very hard, but have enough durability and do not crumble during transportation and manipulation. The composition of used feeds is given in Table 1.

The lambs have access to clean drinking water, which is replaced every day. In end of January and February 2012, when the experiment is carried out, ambient temperature was dropping to minus 20°C and in the barn, it comes down to minus 10°C. To overcome this problem several times per day water heated to 20-30°C is added into drinking trough. Despite that, in the morning the water was frozen.

The remaining feed is collected and weighed every morning, and the MVM every week. The experiment continues until each lamb reaches 25 kg live weight.

Live weight is controlled in the beginning of the experiment and each week during the trial. At the end of the experiment, live weight is measured after deprivation for 24 h of feed and 12 h of water. **Slaughtering analysis** of three female lambs per group is carried out by following description of Zhahariev and Pinkas (1979) and (S)EUROP system described by Marinova et al. (2002) and Raicheva and Marinova (2002).

The chemical composition of feeds and *Musculus Longissimus dorsi* is done accordingly to AOAC (2007). The price of the feeds is as they were purchased. Statistical significances of the differences between the two groups are calculated by t-test (Statistica, 2006).

Result and Discussion

The two tested methods to provide minerals and vitamins to early-weaned lambs do not affect significantly the growth rate. There is a tendency second group of lambs, receiving *ad libitum* MVM, to grow faster (Figure 1) and to reach 25 kg live weight in a shorter time (Table 2).

The daily live weight gain in this experiment (240-245 g) is lower, compared to our previous trial with the lambs from the same breed (297 g), raised under similar conditions (Simeonov et al. 2010). The reasons may include less soybean meal given to the lambs in this experiment, compared to experiment of Simeonov et al. (2010). Moreover, that replacement of sunflower meal for soybean meal decreases the rate of gain of early-weaned lambs (Krachunov et al., 2010). Another reason may be unusual low ambient temperature (during the January-February period of 2012) in the first half of the experiment (minus 20°C outside and minus 10°C inside the barn for lambs). These low temperatures coincide with early weaning at 19 days of age and approximately 10 kg live weight and hamper develop-

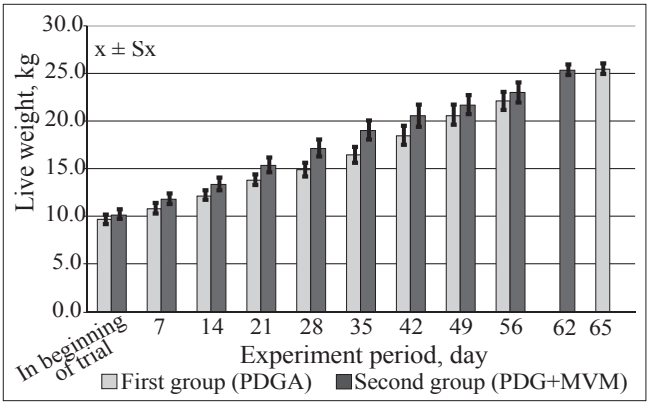

Fig. 1. Increase of live weight during experimental period

Table 1
Composition and feeding value of feedstuffs

Items	Feeds				
	PDGA*	PDG**	Soybean meal	Maize	Alfalfa hay
Nutrients, *g.kg^{-1} as feed basis*:					
Dry mater	893	891	890	872	861
Crude protein	243.8	254.3	440.7	80.3	134.7
Ether extract	85.3	89.0	16.4	30.9	15.8
Crude fiber	77.7	81.1	42.7	28.3	260.9
Nitrogen free extractives	413.0	427.1	327.3	720.0	367.1
Ash	73.2	39.5	62.8	12.5	82.4
Nutritive value:					
Feed units for growth (FUG) / kg #	1.10	1.15	1.22	1.54	0.64
Protein digestible in intestine (PDI), *g.kg^{-1}* #	158.0	174.6	228.6	84.5	71.0
Balance of protein into rumen (BPR) *g.kg^{-1}* #	31.6	32.9	151.0	-32.4	21.0
Calcium, *g.kg^{-1}*	11.70	1.51	3.03	0.35	18.17
Phosphorus, *g.kg^{-1}*	6.61	8.55	6.85	2.35	2.50

* PDGA- pelleted distillers grain with additives, ** PDG-pelleted distillers gain, # Date are according Todorov et al. (2007), corrected for moisture content, FUG (= to 6 MJ net energy growth) for crude fiber, PDI and BPR for crude protein content

Table 2
Growth of lambs during experiment #

Item	1 group, PDGA	2 group, PDG+MVM
Age of lambs, days:		
- in beginning of trial	24.5 ± 0.312	24.7 ± 0.333
- in end of trial	89.9 ± 2.125	86.5 ± 2.761
Duration of trial, days	65.4 ± 2.150	61.8 ± 2.779
Live weight, kg:		
- at birth	4.75 ± 0.209	4.63 ± 0.276
- in beginning of trial	9.75 ± 0.513	10.23 ± 0.499
- in end of trial *	25.48 ± 0.567	25.37 ± 0.548
Gain during the trial, kg	15.73 ± 0.730	15.14 ± 0.428
Average daily gain, kg	0.240 ± 0.015	0.245 ± 0.015

There are not significant differences between two groups (P>0.05);
* Weighed after 12 h deprivation of water and 24 h of feed

ment during the starting period of the small lambs. Even the feed intake is depressed, although in adult sheep low temperature leads to increase of forage intake (Kennedy et al., 1986)

Changes in the consumption of concentrate and roughage during the experiment are shown in Figures 2 and 3. The average intake of feeds (respectively dry matter, energy, and protein) during the experiment is higher in the second group of lambs, receiving PDG plus free consumption of MVM (Table 3). The MVM consumption is shown in Figure 4.

Table 3
Daily intake of feeds, energy and nutrients, and expenses per kilogram live weight and carcass weight

Item	I group, PDGA	II group, PDG+MVM
Feed intake, kg/lamb/day:		
Alfalfa hay	0.151	0.163
Pelleted distillers grain with additives (PDGA)	0.248	-
Pelleted distillers grain (PDG)	-	0.366
Soybean meal	0.100	0.100
Maize	0.305	0.428
Mineral-vitamin-mixture	-	0.028
Total feeds and additives	0.804	1.085
Total dry matter	0.706	0.928
Intake of minerals	0.036	0.063
Intake of drinking water	2.364	3.465
Water, kg/kg dry matter in feeds	3.348	3.734
Energy and nutrient intake/lamb/day:		
Feed units for growth (FUG)	0.961	1.306
Crude protein (CP), g	132.0	170.9
Crude protein, % of dry matter	18.7	18.4
Protein digestible in intestine (PDI),g	87.0	118.7
Balance of the protein in the rumen (BPR), g	14.5	15.0
Crude fiber (CF), g	62.4	77.3
Calcium (Ca), g	5,04	8.84
Phosphorus (P), g	3.02	4.62
Expenditure per 1 kg live gain of lambs:		
Feed dry matter, kg	2.94	3.79
Concentrate feeds, kg	2.72	3.76
Feed units for growth (FUG)	4.00	5.33
Crude protein (CP), g	550	697
Protein digestible in intestine (PDI), g	363	484

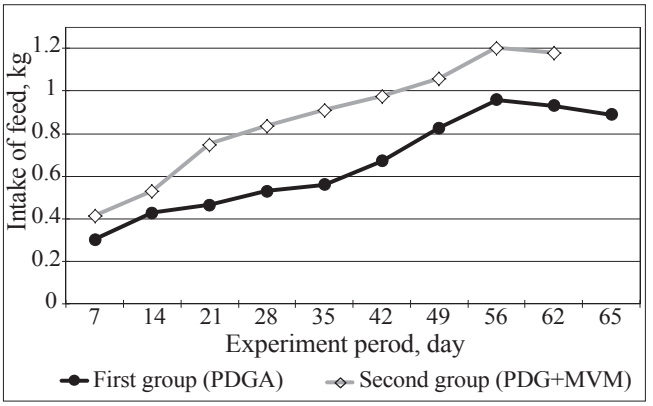

Fig. 2. Intake of concentrate during experimental period

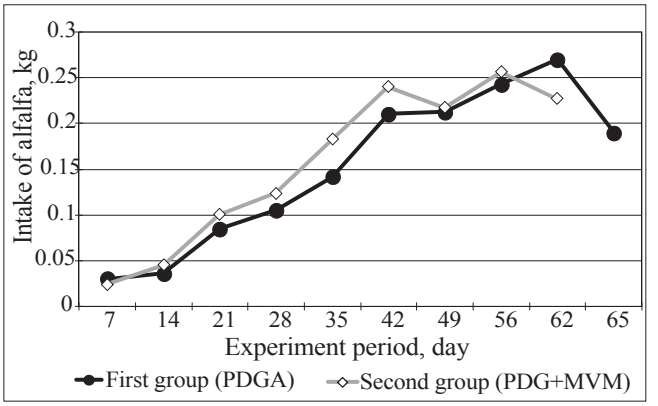

Fig. 3. Intake of alfalfa hay during experimental period

The reason for a higher consumption of maize grain, PDG and MVM is not clear. As a result of higher intake of energy in the second group, deposition of separable inside fat around large intestine, kidney and other organs is higher in the second group receiving PDG and MVM (P <0.05) and slaughtering percentage is higher, compared to the first group (Table 4). Differences in slaughtering percentage are of low significance (P=0.10). Additionally, lambs of the second group, receiving PDG and MVM have a slightly thicker fat cover of the carcass, although carcasses of the two groups of lambs belong to the same class of fatness, according to (S) EUROP system.

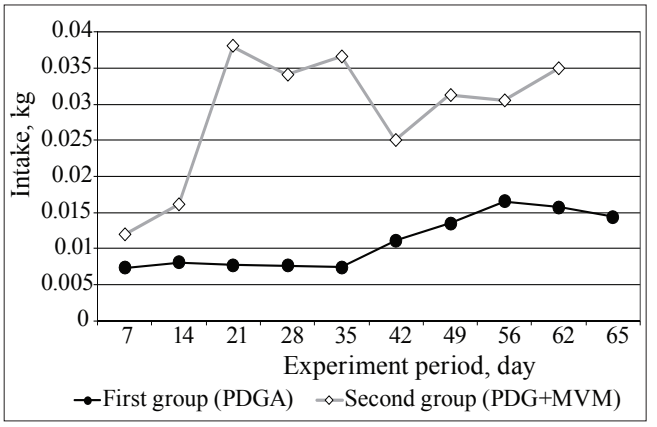

Fig. 4. Consumption of minerals and vitamin-trace element premix by PDGA and as MVM provided *ad libitum*

It seems that the intake of more energy from lambs of the second group is used mostly for deposition of more fat, without a significant impact on the daily live weight gain.

There was not found significant differences in weight of inside organs (heart, lung, liver, spleen, small intestine, large intestine, diaphragm and kidneys) which was measured. Only weight of stomach tissue is significantly heavier in second group than in first (Table 6).There are not differences in length of the small intestine and volume of the rumen.

There is a tendency for consumed water, relative to dry matter to be higher in the second group, compared to first one (Table 3). This is probably related to the higher salt and minerals intake out of the total diet for lambs receiving PDG plus MVM. When the MVM is offered for free consumption lambs intake more minerals and vitamins mixture (average 28 g per day), compared to the case in which those supplements are included into PDGA (average 10.9 g per day). Therefore under free access lamb intake 2.5 times more MVM, compared to the same components included into PDGA.

The intake of NaCL included in the MVM is 9.52 g per day. According to Todorov and Dardjonov (1997), salt requirements for lambs with an average live weight of 20 kg and 250 g daily live weight gain (which corresponds approximately to the average live weight and daily gain in the ex-

Table 4
Data from slaughtering of lambs (average data of 3 lambs)

Item	I group, PDGA	II group, PDG+MVM
Live weight before slaughtering, kg *	26.627 [a]	26.723 [a]
Carcass weight, kg	12.683 [a]	13.115 [a]
Carcass yield, g/kg-[1]	476.3 [a]	490.8 [a]
Inside separable fat, kg	0.465 [a]	0.625 [b]
Carcass evaluation by (S)EUROP-system	Category C Quality 1	Category C Quality 1
Fatness	3.0 [a]	3.0 [a]
Collar of meat	Light red	Light red

*- After 12 h deprivation of water and 24 h of feed
[a, b]- Differences between two group without common later are significant (P<0.05)

Table 5
Chemical composition of Musculus longissimus dorsi*

Components	I group, PDGA	II group, PDG+MVM
Water, %	72.997 ± 0.390	73.067 ± 0.766
Dry matter, %	27.003 ± 0.392	26.933 ± 0.763
Crude protein, %	22.100 ± 0.661	21.793 ± 0.929
Ether extract, %	3.743 ± 0.302	4.050 ± 0.237
Ash, %	1.106 ± 0.020	1.090 ± 0.015

* Differences between two group are not significant (P>0.05).

periment) is 1.5 g daily. The same requirements are given by NRC (2007).

It seem that lambs intake more than their minimal need of salt, when they have free access to the MVM in loose form and clean drinking water with the appropriate temperature.

Smith et al. (1953) find that ruminant animal's intake more salt when offered free consumption in loose form, than when they have access to blocks of salt. The authors report an increased intake of mineral mixture when sheep have easy access to fresh and clean drinking water. The sheep have a defined appetite for salt and consume the completely mineral mixture containing salt, in spite of bad palatability of other components of the mixture, such as dicalcium phosphate, manganese oxide and limestone. Deficit of other essential minerals is not possible to be satisfied by free access if they are not mixed with salt (Burghardi et al., 1982).

When the intake of mineral mixture is too high it is advised that mineral mixture is put away from drinking water (Wahlberg and Greiner, 2008). Another measure is decreasing the palatable ingredients in the mixture.

In our experiments intake of enough limestone by lambs is important to ensure the required ratio of calcium to phosphorus, and to avoid occurrence of urinary calculi, especially in male lambs. In spite of bad palatability of limestone, the lambs in this experiment consume even more than the needed quantity of limestone by MVM. Intake of MVM, however, is not proportional neither to intake of dry matter, age, live weight, nor to daily gain of lambs.

Data of this experiment shows that lambs consume more common salt than they need when it is provided in loose form. It is evident that the requirement of salt is not the only regulator of intake. It seems that intake of salt mixture and water, when they are close to one another, is some type of play for young lambs. The lambs of first group despite receiving enough common salt in the PDGA also consume 3.74 g/day by licking available stone pieces of common salt.

Table 6
Weight of internal organs

Internal organs	I group, PDGA		II group, PDG+MVM	
	kg	g.kg^{1}*	kg	g.kg^{1}
Heart, kg	0.173 ± 0.018	13.6	0.177 ± 0.036	13.2
Lung, kg	0.585 ± 0.043	46.2	0.558 ± 0.029	41.9
Liver, kg	0.700 ± 0.051	55.1	0.655 ± 0.026	49.2
Spleen, kg	0.063 ± 0.070	5.0	0.063 ± 0.004	4.8
Small intestine, kg	1.008 ± 0.032	79.6	0.930 ± 0.052	69.8
Length of small intestine, cm	3036.7 ± 135.933	-	3001.0 ± 43.524	-
Large intestine, kg	0.443 ± 0.031	34.9	0.478 ± 0.030	35.9
Stomachs, kg	0.810 ± 0.016 ^{a}	63.9 ^{a}	0.888 ± 0.016 ^{b}	66.7 ^{a}
Volume of rumen, L	8.417 ± 0.217	-	8.337 ± 0.912	-
Diaphragm, kg	0.088 ± 0.007	7.0	0.110 ± 0.010	8.2
Kidney, kg	0.148 ± 0.002	11.7	0.143 ± 0.010	10.8

* g.kg^{1} carcass; $^{a, b}$ – Data marked with different letters differ significantly

Table 7
Cost of feeds per a lamb per day

Feeds/Item	Price/ton, Euro	I group, PDGA	II group, PDG
Alfalfa hay	100	0.015	0.016
PDGA	186	0.046	0
PDG	175	0	0.064
Soybean meal	400	0.040	0.040
Maize	162	0.050	0.070
Mineral-vitamin-mixture	414	0	0.012
Total for one lamb		0.151	0.202
For 1 kg live weight gain		0.629	0.824
For 1 kg carcass weight		1.191	1,540

Observations in this experiment show that it is necessary that the MVM is kept dry. It is desirable to change it every week. By frequently (for example, each week) supplying lambs with MVM it will be possible to control whether the intake is enough or too much.

It is better to exclude copper from MVM because the difference between the requirement and toxic dose is too small (approximately 2.5 times).

The cost of the feedstuffs for one lamb, for 1 kg live weight gain, and for 1 kg carcass is a little higher for second group, compare to first one receiving PDGA (Table 7)

In spite of consumption of more MVM when offered *ad libitum*, experimented method of cheap feeding of early-weaned lambs directly with feedstuffs as they are produced, without transporting them to compound feed mills and preparing complete starter feed may be considered as successful. Intakes of some more limestone and common salt in not harmful niter have significant effect on price of the diet. Only vitamin-trace element premix is expensive, but it is possible to decrease it percentage into MVM, taking in account real intake of MVM by the lambs.

In conclusion, early-weaned lambs can be fed *ad libitum* with whole grains, PDG, alfalfa hay and MVM plus 100 g of soybean meal daily/animal with good success and acceptable daily gain.

References

AOAC, 2007. Official Methods of Analyses of AOAC International (18 edition, revision 2). *Association of Official Analytical Chemist International, Gaithersburg, MD, USA*.

Archibeque, S. L., H. C. Freetly and C. L. Ferrell, 2008. Feeding distillers grains supplements to improve amino acid nutriture of lambs consuming moderate-quality forages. *J. Anim Sci.,* **86**: 691-701.

Berger, L. L., 2006. Salt and Trace Minerals for Livestock, Poultry and Other Animals. *Published by the Salt Institute, Alexandria, Virginia, USA*

Burghardi, S. R., R. D. Goodrich, J. C. Meiske, M. L. Thonney, D. H. Theuninck, T. S. Kahlon, D. E. Pamp and K. Kraiem, 1982. Free choice consumption of minerals by lambs fed calcium-adequate or calcium-deficient diets. *J. Anim. Sci*., **54**: 410-418.

Church, D. C., 1980. Digestive Physiology and Nutrition of Ruminants. Vol. 3. Practical Nutrition (2 ed.). *Publ. O&B Books Inc. Corvallis, Oregon, USA*, p. 186.

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

Kennedy, P. M., R. J. Christopherson and L. P. Milligan, 1986. Didestive responses to cold. In: L. P. Milligan, W. L. Grovum and A. Dobson (Eds), Control of Digestion and Metabolism in Ruminants (Proc. 6th Intern. Symp. Ruminant Physiology, Banff, Canada), pp. 285–306.

Huls, T. J., A. J. Bartosh, J. A. Daniel, R. D. Zelinsky, J. Held and A. E. Wertz-Lutz, 2006. Efficacy of dried distiller's grains with solubles as a replacement for soybean meal and a portion of the corn in a finishing lamb diet. *Sheep & Goat Research Journal,* **21**: 31-34.

Ivanova, I., N. Dimova, M. Michailova, and N. Todorov, 2010. Feeding of lambs by starter feed or maize grain plus protein concentrate with DDGS from wheat. *Zhivotnovadni nauki,* **47** (2): 50-59 (BG).

Krachunov, I., N. Todorov and M. Simeonov, 2010. Comparison of different protein sources for early-weaned lambs of dairy bred. *Zhivotnovadni nauki,* **47** (Suppl. 1): 95-101(BG).

Marinova, P., E. Raicheva, and D. Lazarov, 2002. Manual for Evaluation of Live Animals and Carcasses of Sheep, Cattle, and Pigs According to (S)UROP System. *Institute of Animal Sciences, Kostinbrod,* (BG).

NRC, 2007. Nutrient Requirements of Small Ruminants (sheep, goats, cervides, and new world camelids). *The National Academies Press, Washington, D .C. USA*

Raicheva, E., and P. Marinova, 2002. Manual for Evaluation of Live Animals and Carcasses of Sheep, According to (S)UROP System. *Institute of Animal Sciences, Kostinbrod*, (BG).

Risa, D., 1996. Weaning lambs at 30 days of age. *Proceedings of the Great Lakes Dairy Sheep Symposium*, pp. 6–8.

Schauer, C. S., L. P. Anderson, D. M. Stecher, D. Pearson, and D. Drolc, 2005. Influence of dried distillers grains on feedlot performance and carcass characteristics of finishing lambs. *Western Dakota Sheep & Beef Day*, **46**: 31-33.

Schauer, C. S., M. M. Stamm, T. D. Maddock and P. B. Berg, 2008. Feeding of DDGS in lambs rations**.** Feeding dried distillers grains with solubles as 60 percent of lamb finishing rations in acceptable performance and carcass quality. *Sheep & Goat Research Journal,* **23**: 16-19.

Schauer, C. S., P. B. Berg, M. Stamm, D. M. Stecher, D. Pearson and D. Drolc, 2006. Influence of dried distillers grains of feedlot performance and carcass characteristics of finishing lambs. *Western Dakota Sheep & Beef Day*, **47**: 34-37.

Simeonov, M., N. Todorov, I. Krachunov and S. Ribarski, 2010. Examination of srarter feed for early weaned lambs of dairy breed, *Zhivotnovadni nauki*, **47** (Suppl. 1): 84-95 (BG).

Smith, S. E., F. W. Lengemann, and J. T. Reid, 1953. Block vs. loose salt consumption by dairy cattle. *J. Dairy Sci*., **36**: 762-765.

Statistica, 2006. Statistica for Windows. *StatSoft Inc., Tulsa, OK, USA*.

Todorov, N., I. Krachunov, D. Djuvinov, and A. Alexandrov, 2007. Handbook of Animal Feeding. *Publ. Matcom, Sofia*, (bg).

Todorov, N., and T. Dardjonov, 1997. Nutrient Requirements and Feeding Value of Feedstaffs for Sheep and Goats**.** *Publ. house Pensoft, Sofia*, (BG).

Todorov, N. and L. Kozelov, 2011. Use of DDGS in ruminants feeding**.** *Zhivotnovadni nauki,* **48** (6): 49-74 (BG).

Villalba, J. J., F. D. Provenza, and J. O. Hall, 2008. Learned appetites for calcium, phosphorus, and sodium in sheep. *J. Anim. Sci.,* **86**: 738-747.

Wahlberg, M. L. and S. P. Greiner, 2008. Mineral and vitamins for sheep. *Sheep Breeding (Virginia Tech. Cooperative Extension)*, pp. 1-4.

Weir, W. C. and R. F. Miller, Jr, 1953. The use of salt as a regulator of protein supplement intake by breeding ewes. *J. Anim. Sci*., **12**: 219-225.

Zhahariev, Z. and A. Pinkas, 1979. Methods of Slaughter Analysis and Carcass Evaluation in Cattle, *NAPK, Sofia*, (BG).

Received June, 22, 2012; accepted for printing February, 2, 2013.