THE NUTRITIONAL EFFECTS OF VEGETAL LECITHIN OVER THE MILK PRODUCTION, APPARENT DIGESTIBILITY AND SHEEP RUMINANT PARAMETERS

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Abstract

By introducing the vegetal lecithin within the fodder ration of the sheep during the lactation period it has been achieved an increased milk production, a production increase of 39.38% at Palas Merino sheep, of 24.44% at Palas prolific population of sheep and of 9.96% at Palas milk population. An increase of the main reproduction indexes and a health improvement at these animals were noticed. The vegetal lecithin contained within the residue from the soya and sun-flower oil production administrated within the sheep ration up to a contribution of 7% fat in the dry substance of ingesta has favourable and proportional effects with the lecithin dose over the apparent digestibility of DM, OM, CP, EE, NDF and NFE. The increase of fat proportion within the food over 7% from DM of the ration reduces the ruminant bacteria number. The fat from food has negative effects on the ruminant protozoa, tending to destroy the specific fauna. It is possible that the lecithin could be a potential source of Y_{ATP} in rumen. It is possible that the lecithin could protect the food proteins from the bacterial lyses of proteins enzymes and achieve the ruminant by-pass of the protein.

Key words: sheep, lecithin, milk production, apparent digestibility

INTRODUCTION

Feeding the sheep with ration containing vegetal lecithin from soy and sun flower as lipid supplement, by making use of the secondary product resulted from the manufacture of soy and sun flower sun oil, determines an increase of milk production, of reproduction main index and an improvement in the animals health condition.

The lecithin, a substance which is rich in phospholipids, plays a very important role within the body, it enters within the cellular membranes structure, has a specific role within the nervous system and the lipids' metabolism, favouring the fat emulsification and its efficient exposure to the digestive juices action.

LOUGH and his collaborators (1992) mentioned that the phospholipids contained by the soy lecithin influences the lipids emulsification, can remains un-degraded in rumen, influencing the fatty acids absorption within the small intestine. The lecithin determines the increase of polyunsaturated fatty acids level from the muscles and the adipose tissue.

SĂLĂGEANU and his collaborators (1990) by administrating lecithin to the youth Bubaline reproduction female noticed a 2.6% increase in weight in comparison with the control lots, a faster ripening of the sexual organs, demonstrated by the earlier appearance of the clinical oestrus.

GURIŢĂ and his collaborators (1998) by studying the implication of the vegetal lecithin within the milky secretion noticed an increase of 32% of the milk quantity and one of 9.4% of the fat percentage.

MATERIAL AND METHOD OF WORK

The researches were performed at ICDCOC Palas and USAMV Timişoara. The animals were individually watched by recording date with reference to the milk control production, based on the Romanian method of the control coefficient (***Nica-***

Dermengi). The method is based on the proportion between the daily milk production and the quantity of a single milking from the same day. During the nursing the sheep belonging to the experimental groups and to the control ones received the same fodder rations: for sheep a fodder ration of 1.68 DM, 1.62 MNU, 118 g PDIN, 147 g PDIE, calcium of 14.8 g and phosphorus 7 g, and a vegetal lecithin was added to this ration, residue (mucilage) from the soy oil manufacture, being well endured by the sheep (the mucilage does not modify the fodder or the drinking capacity of water).

The introduction of the lecithin within the fodder ration was performed within a mixture of concentrate or in drinking water (dilution of mucilage / fresh sediments with 10-12 litres of water and then this solution is poured over the water from the watering trough). The conservation of mucilage was done within sodium chloride, having the percentage of 3-5%, therefore avoiding the fermentation. The dehydrated sediments are diluted with water boiled at 80-85^{o}C temperature.

For the analysis of ruminant juice the ruminant fistula process was performed on the Ţurcana breed sheep which were accommodated within an individual cage. The animals were fed with hay and fodder mixed, to which a quantity of 100 g of vegetal lecithin was added. Postoperatively was settled a pre experimental period of accommodation to the ration structure and the hay and mixed fodder voluntary consumption was also settled. The following determinations were performed: apparent ration digestibility, inter-ruminant digestibility of barley straws cellulose in small bags; ruminant parameters before the fodder and 3 hours from the food provision. All the measurements were performed by usual techniques for the microbiology and animal nutrition laboratories.

RESULTS AND DISCUSSIONS

During the nursing the sheep belonging to the experimental groups and to the witness ones received the same fodder rations, to which a vegetal lecithin was added, residue (mucilage) from the soy oil manufacture. The vegetal lecithin was provided in the morning in the drinking water. It was noticed that the vegetal lecithin does not modify the drinking capacity of the water and is well tolerated by the sheep and goats. The milk production of sheep and goats was determined by the bimonthly control, following Nica-Dermengi method (table no. 1 and 2).

Table no. 1
Total average milk production, average merchandise milk production and the nursing period of the sheep treated with lecithin and of the sheep belonging to the control groups

Breed or population of sheep / group	n	Total average milk production (litres)		Average production of milked milk (litres)		% from C
		$\bar{X} \pm s_{\bar{X}}$	V%	$\bar{X} \pm s_{\bar{X}}$	V%	
Palas Merino- Experimental lot	58	117.51±3.1	20.16	48.66±1.8	28.95	39.88
Palas Merino- Control lot	38	84.21±3.4	24.96	38.05±1.1	16.32	
Palas prolific population-Experimental lot	46	137.2±4.6	22.74	56.2±2.6	31.37	24.44
Palas prolific population- Control lot	25	110.25±2.1	9.75	42.75±1.6	19.06	
Palas milk population- Experimental lot	25	217.3±7.8	17.94	81.6±2.8	17.15	9.96
Palas milk population- Control lot	70	197.6±10.3	43.61	72.8±3.9	44.82	

Merino breed sheep from the experimental group had a total milk production of 117.5±3.1 litres and an average production of milked milk of 48.66±1.8 litres; the sheep belonging to the control lot had a total milk production of 84.21±3.4 litres and an average production of milked milk of 38.05±1.1 litres; Palas prolific population belonging to the experimental lot had a total milk production of 137.2±4.6 litres and an average production of milked milk of 56.2±2.6 litres; the control lot obtained a total production of milk amounting to 110.25±2.1 litres and an average production of milked milk of 42.75±1.6 litres; Palas milk population sheep belonging to the experimental lot obtained a total milk production of 217.3±7.8 litres and

an average production of milked milk amounting to 81.6±2.8 litres; the control lot obtained a total production of 197.6±10.3 litres, having an average milked milk production amounting to 72.8±3.9 litres.

Food's apparent digestibility

The average values of the apparent digestibility usage coefficients (DUC) of the nutritive substances (NS) within the food are presented in the table no. 2. By comparing the values DUC which is apparent from the control lot (C), from the lot having an amount of 100 g supplement of lecithin (L_{100}) and respectively of 200 g lecithin (L_{200}), it was noticed that the sheep digestibility of dry matter (DM) increases as against the lecithin dose.

Table no. 2
DUC of NS from the supplemental food with lecithin for the sheep

Lot	DM	SM	OM	CP	EE	NDF*	NFE
M	72.94	69,98	73.27	58.86	52.03	78.09	69.30
L_{100}	76.32± 3.68	65,76± 7,01	77.46± 3.35	62.63± 10.06	86.17± 1.63	82.98± 3.93	71.03± 0.32
L_{200}	79.16± 9.02	73,91± 11,92	79.72± 8.74	67.71± 15.13	91.63± 3.47	84.76± 5.78	69.54± 16.16

*neutral-detergent fiber

It was noticed the sheep apparent digestibility of mineral salts (DUCDM), apparent digestibility of organic substances (DUCOM), apparent digestibility of crude protein (DUCCP) and apparent digestibility of gross fat (DUCCF) at control lots (C), at the group with the supplement of 100 g lecithin (L_{100}) and respectively 200 g lecithin (L_{200}), the values being presented in table no. 3.

Table no. 3
Percentage presentation of DUCDM, DUCOM, DUCCP and DUCCF to sheep as against the lecithin dose

Specification	DUCDM	DUCOM	DUCCP	DUCCF
DUC C%	100	100	100	100
DUC L_{100}	104.63	104.80	106.40	106.40
DUC L_{200}	108.33	108.80	115.03	115.03

The apparent digestibility of mineral salts (DUCDM) decreases to L_{100}, but to L_{200} increases to 5.61%. The apparent digestibility of organic substances (DUCOM) increases proportional to the lecithin, 104.80% to the group having the supplement of 100 g lecithin (L_{100}), but mostly to L_{200} (108.80%). The apparent digestibility of gross protein within the food is also influenced by the lecithin dose, DUCCP increases with 6.40% to L_{100} and with 15.03% to L_{200}. The apparent digestibility of gross fat within the food is also influenced by the lecithin dose, increases with 18.34% to L_{100} and decreases to 15.13% to L_{200}.

By determining the sheep digestive usage of fat within the food it was noticed that by increasing the dose of lecithin from 100 g to 200 g daily the fat digestibility increase takes place (table no.4).

Generally, the supplement of fat within the ruminants' food over 8% from DM of the ration reduces the cellulose digestibility from the rumen. The fat levels ensured within the experiment did not overpass this limit; moreover the lecithin being more water soluble, did not affect the digestibility of cellular walls' digestibility (NDF). It was noticed that by the increase of DUCNDF to sheep the cellulose-lyses is favoured as against the lecithin dose.

Table no. 4
The digestive usage of fat within the sheep food as against the lecithin dose, the fat quantities voluntarily ingested and the percentage presentation DUCNDF

Specification	DUCCF	g/day	g/100 g DM	DUCNDF%
DUC C%	100	1.230	1.19	100
DUC L_{100}	165.61	3.82 ±0.06	3.80	106.26
DUC L_{200}	176.11	6.29 ±0.04	6.82	108.54

The ruminant parameters were determined. The rumen does not have enzymatic secretion glands but 50-80% from the enzymatic processes from the entire digestive tube takes place in this segment under the action of ruminal symbionts enzymes. This dependence and performance, especially within the cellular walls' and nitrogen digestion are mainly due to ruminant bacteria, which, by the bacteria species' structure and weight, selectively lead the ruminant fermentation. The role of protozoan in the rumen, although is known especially post- ruminant for the protein quality, within the rumen it is uncertain; the process against the rumen's fauna had contradictory effects over the productive performance of the ruminants. Generally, it is admitted the fact that the ruminant fermentation can be nutritionally lead, the weight of a nutrient within the food, favouring the reproduction of certain species of ruminant bacteria; the exponential increase of the streptococci to the soluble glucides supplementation and the decrease of the cellulose to fat supplementation are well known but the lecithin effects were not yet studied.

The comparison of sheep NTG values and the lecithin supplementation having as reference the witness ration are presented in the table no. 5. It was noticed a depression of NTG, as a matter of fact the reducing to half of the bacteria number after a 7 days accommodation with 100g lecithin.

The increase of lecithin dose to 200g daily determined the increase with 22.22% of NTG. Comparing these NTG values three hours from the fodder providing it is noticed an exponential increase (367.81) to the supplementation of 100g lecithin. The fact that to sheep at the value of L_{200} a reduction to half takes place (45.98%) of NTG suggests that at a dose of 100 g, the lecithin has a stimulative effect over the bacteria and at a dose of 200 g it has an inhibitive one. These results can be modified by the differences in structure of the rations but also by the species. As against the lecithin dose to sheep, it was noticed a decrease of the protozoan number to 54.96% at L_{100} and to 13.74% at L_{200}, before the fodder providing, model which is also maintained after 3 hours from the fodder providing. This fact proves that, as concerns the sheep, the depressive effect, as a matter of fact an effect due to the process of altering the fauna of the rumen proportional with the lecithin dose, with the destruction of Diplodinium type and stimulation of Dasitricha type.

Table no. 5
Sheep ruminant parameters

Specification		Control ration	
		Before the fodder providing	3 hours from the fodder
NTG		4.5×10^7	8.7×10^7
Protozoan	Total (nr/mm^3)	614062	446875
	Entodinium (%)	99.06	96,31
	Diplodinium (%)	0.47	2,76
	Dasitricha (%)	0.47	0,92
pH		6.9	6.5
Ammoniac (mg/100 ml ruminant fluid)		20.40	21.76

Specification		Ration + 100g lecithin sediments	
		Before the fodder providing	3hours from the fodder
NTG		2.1×10^7	3.2×10^8
Protozoan	Total (nr/mm^3)	337500	212500
	Entodinium (%)	98.78	96,05
	Diplodinium (%)	0	0
	Dasitricha (%)	1.21	3,94
pH		7	6.5
Ammoniac (mg/100ml fluid ruminant)		9.45	10.13

Specification		Ration + 200g lecithin sediments	
		Before the fodder providing	3hours from the fodder
NTG		5.5×10^7	4×10^7
Protozoan	Total (nr/mm^3)	84375	90625
	Entodinium (%)	97	91,17
	Diplodinium (%)	0	0
	Dasitricha (%)	3	8,83
pH		7	6.5
Ammoniac (mg/100ml ruminant fluid)		5.51	10.27

CONCLUSIONS

- The sheep which received in their ratio a supplement of vegetal lecithin had a greater total average milk production (Merino with 39.38%, Palas prolific population with 24.44%, Palas milk population 9.96%) and a greater average production of milked milk (Merino with 27.8%, Palas prolific population with 31.49%, Palas milk population with 11.1%), in comparison with these productions from the control lot sheep.
- The supplementation of small ruminants' food with lecithin up to 7% fat within the dry substance has effects which are favourable and proportional with the lecithin dose over the apparent digestibility of DM, OM, CP, EE, NDF and NFE.
- The increase of fat proportion in the food of over 7% from the DM of the ration reduces the number of ruminant bacteria.
- The fat from the food has negative effects over the ruminant protozoan, leading to the process of altering the fauna.
- It is possible that the lecithin should protect the alimentary proteins from the bacteria proteolitic enzymes and achieve the ruminant by-pass of the protein.

REFERENCES

Journal articles

[1] Guriță, E.; Sălăgeanu, Gh.; Liuba, Ghelțu; Oana, Nica; Rodica, Matei, 1998- Implication of the vegetal lecithin in the Taurine cows' milky secretion, Scientific Works, volume 16, S.C. Agris Publishing House- Agricultural Magazines Editorial Office, p.301-309.

[4] Jenkins, T.C, Fotouhi, N., 1998- Effects of lecithin and corn oil on site of digestion, ruminant fermentation and microbial protein synthesis in sheep, Journal of Animal. Sci., 68:460-466.

[5] Jenkins, T.C., 2003- Nutrient digestion, ruminant fermentation and plasma lipids in steers fed combinations of hydrogenated fat and lecithin, J. Dairy Sci.,73: 2934-2939

[6] Lough, D.S.; Solomon, M.B.; Rumsey, T.S.; Elsasser, T.H.; Slyter, L.L.; Kahl, S.; Lynch, G.P., 1992- Effects of dietary canola seed soy lecithin in high-forage diets on cholesterol content and fat acid composition of carcass tissues of growing ram lambs. J. Anim. Sci. 70: 1153-1156.

[7] Salagean, Gh.; Podar, C.; Sut Gherman Mariana, 1990- The usage of lecithin as bio stimulator of growth to animal youth, Annals of Research Institute for Bovine Corbeanca.

[8] Sălăgeanu, Gh.; Bota, A.; Liuba, Ghelțu; Oana, Nica; Nicoleta, Lemne; Mariana, Tataomir, 1998- The process of supplementing the ration of lecithin for Bubaline-Taurine reproduction youth, Scientific Works, volume 16, S.C. Agris Publishing House- Agricultural Magazines Editorial Office, p. 311-315.

[9] Shain D. H.; Sindt M.H.; Grant, R. J.; Klopfenstein T.J.; Stok R.A., 1993- Effect of Soybean Hull: Soy Lecithin: soapstok mixture on ruminant digestion and performance of growing beef calves and lactating dairy cattle. J. Anim. Sci. 71:1266-1275.

Books

[2] Jarige, R., 1990- Alimentation des bovins, ovins et caprins. INRA, Paris.

[3] Jenkins, T. C., -1996- Consultant's Corner: Lecithin lexicon leson –West Central; Ralston, Iowa.