THE INFLUENCE OF *SPIRULINA PLATENSIS* AND CONCENTRATES ON LAMBS' GROWTH

A. SHIMKIENE, Z. BARTKEVICHIUTE, J. CHERNAUSKIENE,
A. SHIMKUS, A. CHERNAUSKAS, A. OSTAPCHUK*, M. NEVITOV*
Lithuanian Veterinary Academy, Kaunas, Lithuania
*Penza State Agricultural Academy, Penza, Russia

Low production costs and high quality of mutton are able to ensure high profitability of sheep farms and competitiveness on the market. Most commonly sheep are fed only the forage of low nutritional value grown of the farm. Therefore it is very important to organize suitable feeding of lambs taking into consideration the fact that they grow and develop very fast and meat production is distinguished by high nutritional value. Hence, intensive growth of lambs is considered to be most effective from an economical point of view (**Wand,** 2003; **Zapasnikiene,** 2004). The meat of such lambs is especially marketable due to good nutritional and gustatory properties. However, such a way of growth is not very popular in Lithuania. Generally, lambs are fed roughage ration up to satiety and little amount of concentrates, so the supply of energy and nutritive substances is insufficient. The consequences of such feeding are low weight gain, high food expenditure and long fattening (**Cernauskiene, Bartkeviciute,** 2003). Besides, the meat of older lambs is fatter and the carcass output lower (**Patrick et al.,** 1997; **Zapasnikiene,** 2001; **Meelis, Kart,** 2003). Applying the technologies of intensive growth, the daily weight gain of lambs can reach 250-350 g, in specialized breeds for meat production - up 400-450 g and the required weight of 40-45 kg before slaughtering is reached at the age of 4 months (**Head,** 2000).

The rapid growth of the lambs during the first weeks of life is mainly determined by the milk productivity of the sheep. During the first ten days of life the main food for the lambs is sheep milk (**Vuchkov and Dimov,** 2006). Milk synthesis of the sheep starts to decrease at the end of the first month of lactation. Due to this, in order to maintain intensive growth of the lambs supplementary feeding is especially important (**Flamant and Morand-Fehr,** 1982; **Raycheva et al.,** 2007). It has been defined that supplementary feeding with concentrates caused by 100-150 g higher daily weight gain of suckling lambs if to compare to those grown without concentrates (**Karim et. al.,** 2001).

Recently such preparations as probiotics, prebiotics, phytobiotics and other probiotic preparations, regulating the microbial processes related to the digestibility of nutritive substances and having preventive effect against intestinal infections, have been widely used in sheep farming (**Klaenhammer,** 2000). The blue algae *Spirulina platensis* may be attributed to the phytobiotic preparations. The research carried out in the world evidently demonstrated that spirulina is distinguished by the following unique properties: destroys many viruses; is able to compensate insufficiency of vitamins and mineral substances; decreases the amount of fat in blood; is distinguished by enzymatic activity; normalizes processes of metabolism, enhances the immune system and resistance of the organism; has antiallergic and anticancer activity; removes from the organism heavy metals, toxins, radio nuclides; increases milk productivity in particular species; is distinguished by rather high treating-preventive activity against many disturbances of the organism; increases the viability and activity of the animal; has probiotic activity (**Мазо и др.**, 2004; **Берестов,** 2005; **Егорова и др.,** 2006).

Spirulina contains a high amount of minerals and trace elements important for the organism: iron, calcium, sodium, potassium, copper, magnesium, zinc, phosphorus, selenium, carotene, nucleic acid, enzymes and other active substances (**Алтунин и др.,** 2000; **Чернова и др.,** 2001; **Гмошинский и др.,** 2006; **Qiao and Shang,** 2000; **Simsek et al.,** 2007).

The research data about the application of the blue algae *Spirulina platensis* in sheep farming is still quite limited. The aim of our research was to define the effect of the blue algae *Spirulina platensis* on the reproductive properties of ewes and growth rate of the lambs. Furthermore, we also defined the effect of supplementary feeding with concentrates on the growth rate of suckling lambs.

OBJECT AND METHODS OF THE INVESTIGATION

The experiment was carried out on a farm with Lithuanian Black Face and Romanov crossbred sheep. The experimental ewes were grown under the same feeding and keeping conditions. Two analogous groups of the ewes were formed (control and experimental one), each containing 5 sheep. Conventional ration for the experimental ewes individually and daily was mixed with pelleted preparation of blue algae *Spirulina platensis* containing 2 g blue algae biomass with 75 percent humidity preserved with molasses. Feeding of this preparation to the ewes of this group was started from the 120th day of pregnancy and lasted up to 30 days of lambs' age. Later the lambs of the experimental ewes (kept in special pens) from the 30th to the 60th day of age were fed to satiety a mixture of oat flour and soybean meal. This mixture contained 80% of oat flour and 20% of soybean meal. From the 60th to the 90th day of age the ration was changed with one containing 85% of oat flour and 15% of soybean meal. The protein concentration in the dry matter of this mixture during the first month was 21.1%, and during the second one 19.4%. The lambs of the control group were not additionally given concentrates. The forage intake in each group of lambs and ewes was calculated according to the data of control feeding carried out weekly.

Milk samples from ewes were taken on the 7th and 20th day after yeaning. The milk samples were analyzed at the accredited SI "Pieno tyrimai" by certified methods of analysis.

The amount of milk fat, protein and lactose was defined by a special method (LST ISO 9622), using special equipment for measuring mid-infrared spectrum LactoScopeFTIR (FT1.0. 2001; Delta Instruments, Holland). The milk production of the ewes was calculated according to the lambs' weight gain from the birth to the 20th day of lactation.

Blood samples were taken on the 30th and 90th day of lambs' age. Morphological investigation of blood samples was carried out at the Department of Noninfectious Diseases of the Lithuanian Veterinary Academy by special equipment "Picoscell" (Hungary). Total protein was investigated by a reflectometric method. Calcium in the blood serum was analyzed by a photocolorimetric method using a Screen Master Plus analyzer (2002; Hospitex Diagnostics S.A., Italy).

The data of the investigations were evaluated statistically by the "R" statistic package (http://www.r-project.org). Arithmetic means and standard square deviations of the traits were calculated. The statistical significance of the arithmetic means differences (p) was also evaluated, the difference was considered to be statistically significant when $P<0.05$.

RESULTS OF THE EXPERIMENTS

The growth rate of lambs is considered to be an inherited feature of the breed, however, successful growth and viability of the lambs greatly depends on the feeding and keeping conditions. During the first weeks of life the lambs' growth mainly depends on sheep milk production.

The reproductive indicators of the ewes (table 1) revealed that *Spirulina platensis* influenced their productivity.

The data for the ewes yeaned (table 1) indicate that the weight of a newborn lamb in the case of *Spirulina platensis* preparations feeding was by 0.12 kg or 4.07 percents higher ($P>0.05$) if to compare to the control group. Respectively, the lamb weight on the 20th day of life was by 0.54 kg or 7.8% higher ($P>0.05$), and on the 30th - by 0.76 kg or 8.6%

Table 1. **Reproductive indicators of the ewes and lambs growth rate**

Indicators	Groups	
	Control	Experimental
	(n = 5)	(n = 5)
Prolificacy of the ewes, units	1.80 ± 0.224	1.60 ± 0.274
Weight of a newborn lamb, kg	2.95 ± 0.253	3.07 ± 0.281
Weight of a 20-day-old lamb, kg	6.89 ± 0.124	7.43± 0.199
Weight of a 30-day-old lamb, kg	8.85 ± 0.326	9.61 ± 0.209
Daily weight gain up to the 30th day of age, g	197 ± 51	218 ± 63

higher (P>0.05) than in the control group of the ewes. The daily weight gain of the lambs given the Spirulina platensis preparation up to the 30th day of life was by 21 g or 10.7% higher (P>0.05) than in the control group.

The data for ewes' milk chemical composition presented in table 2 demonstrate that 7 and 20 days after yeaning the preparation of blue algae *Spirulina platensis* positively affected the indicators of milk composition. On the 7th day after yeaning the milk fat in the experimental group of ewes was by 0.13% higher, protein - by 0.19% higher, and the amount of lactose - by 0.23% higher than in the milk of the control group of ewes (P>0.05). Twenty days after yeaning the milk fat determined in the milk of the experimental group was by 0.58% higher (P>0.05), protein was by 0.77% higher (P<0.05), and lactose was by 0.47% (P>0.05) higher than in the milk of the control group of ewes. The relative milk production of the ewe significantly increased by 3.8 kg or 10.7% (P<0.05). It could be stated on the basis of the data obtained that the preparations of blue algae *Spirulina platensis* stimulated the mammary glands secretion and the synthesized milk was of a higher nutritional value, consequently these facts affected the growth rate of lambs.

Starting from the 30th day of lambs' age, the experiment was aimed to define the effect of supplementary feeding with concentrates on the growth rate of sucking lambs.

On average the lambs from 30 to 60 days of age consumed 148 g of the mixture of oat flour and soybean meal daily, in which soybean meal was 20%. This caused by 51 g or 28% higher daily weight gain (P>0.05). Starting from the 60th day of age up to weaning (90th day of age), the lambs of the experimental group consumed 245 g of the mixture of oat flour and soybean meal daily on average and the daily weight gain was by 55 g or 31.9% (P>0.05) higher than in the control group of lambs. During the period of 60 days, i.e. from the 30th to the 90th day of age, the lambs from the experimental group gained by 3.36 kg or 32.6% (P<0.05) higher weight than the lambs of the control group.

The haematological analyses revealed (table 4) that the morphological and biochemical parameters of all the investigated lamb blood fluctuated within the limits of the physiological norm. On the basis of

Table 2. **Milk chemical composition and productivity of the ewes (n =5)**

Indicators	Fat, %	Protein, %	Lactose, %	Milk production, kg
		7th day of lactation		
Control group	7.85 ± 0.11	4.81 ± 0.14	4.39 ± 0.21	–
Experimental group	7.98 ± 0.14	5.00 ± 0.09	4.62 ± 0.18	–
		20th day of lactation		
Control group	7.28 ± 0.16	5.31 ± 0.11	3.85 ± 0.33	36.00 ± 1.08
Experimental group	7.86 ± 0.28	6.08 ± 0.16*	4.32 ±0.22	43.40 ± 1.68*

*P <0.05

Table 3. **Growth rate of sucking lambs**

Indicators	Control group (n=9)	Experimental group (n=8)
Weight of a 30-day-old lamb, kg	8.85 ± 0.326	9.61 ± 0.209
Weight of a 60-day-old lamb, kg	14.28 ± 0.287	16.57 ± 0.341*
Daily weight gain from the 30th day to the 60th day of age, g	181 ± 24	232 ±42
Weight of a 90-day-old lamb, kg	19.14 ± 0.533	23.26 ± 0.477*
Daily weight gain from the 60th day to the 90th day of age, g	172 ± 28	227 ± 36
Lambs' weight gain during the period of 60 days, kg	10.29 ± 0.568	13.65 ± 0.489*

*P <0.05

Table 4. **Data of lambs blood analyses**

Groups	Erythrocytes	Leucocytes	Haemoglobin	Hematocrit	Total protein	Calcium
	10^{12}/l	10^{9}/l	g/l	%	g/l	mmol/l
30 day lambs						
Control group	10.14 ± 0.92	9.88 ± 0.43	92.60 ± 1.92	31.41±2.93	72.35 ± 3.44	2.39 ± 1.65
Experimental group	10.74 ± 0.60	9.80 ± 0.45	99.30 ± 1.99*	32.27±3.01	73.52 ± 3.42	2.38 ± 1.64
90 day lambs						
Control group	9.32 ± 0.38	7.90 ± 0.32	91.39 ± 1.68	31.67±2.87	73.48 ± 3.28	2.60 ± 1.56
Experimental group	9.64 ± 0.32	7.86 ± 0.39	91.86 ± 1.76	31.87±2.98	75.39 ± 3.29	2.79 ± 1.59

*P <0.05

the experimental results it was defined that the *Spirulina platensis* supplement in the ration of ewes positively affected the general morphological appearance of blood during the first month after birth. In the blood of the experimental group of lambs a higher number of erythrocytes by 0.6 x 1012/l or 5.9 percents was found and by 6.7 g/l or 7.2 percents (P<0.05) higher amount of haemoglobin than in the control group of the lambs. The preparation had no effect on the other haematological indicators.

The main functions of erythrocytes are related to haemoglobin. As the main function of haemoglobin is to transform oxygen from the lungs to the tissues and carbon dioxide - from the tissues to the lungs and this process helps maintain a constant blood pH, it could be suggested that the vital processes were more intensive in the organisms of the lambs whose mother ewes were given the *Spirulina platensis* phytobiotic preparation.

CONCLUSIONS

When the daily ration for the ewes was supplemented with the preparation containing preserved 2 g blue algae *Spirulina platensis* biomass of 75 percents humidity, the reproductive properties of the ewes improved. The newborn lambs had by 4.07 percent higher weight and grew more intensively, the daily weight gain increased up to 10.7 percents. The ewes synthesized milk with 10.7 percent higher nutritional value.

Spirulina platensis preparations in the ration of the ewes stimulated some vitally important processes in the lambs during the first weeks of life.

When the sucking lambs were additionally given oat flour and soybean meal mixture, up to 32.6 percents higher daily weight gain could be reached and at the age of 3 months the lambs weighed by 4.12 kg or 21.52 percents more than the lambs of the control group.

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Lithuanian Veterinary Academy, Kaunas, Lithuania
**Penza State Agricultural Academy, Penza, Russia*

SUMMARY

The experiment was carried out on a farm with Lithuanian Black Face and Romanov crossbred sheep. Two analogous groups of the ewes were formed (control and experimental one), each containing 5 sheep. The conventional ration for the experimental ewes individually and daily was mixed with pelleted preparation of the blue algae *Spirulina platensis* containing 2 g blue algae biomass of 75 percent humidity preserved with molasses. Feeding of this preparation to the ewes of this group started from the 120th day of pregnancy and lasted up to 30 days of lambs' age. Later the lambs of the experimental ewes (kept in special pens) were fed to satiety a mixture of oat flour and soybean meal from the 30th to the 60th day of age. The lambs of the control group were not additionally given concentrates.

The experiment revealed that when the daily ration of the ewes was supplemented with *Spirulina platensis* biomass the reproductive properties of the ewes improved. The newborn lambs had by 4.07 percent higher weight and grew more intensively, the daily weight gain increased up to 10.7 percents. *Spirulina platensis* preparations in the ration for the ewes stimulated some vitally important processes in the lambs during their first weeks of life. When sucking lambs were additionally given oat flour and soybean meal mixture, up to 32.6 percent higher daily weight gain could be reached and at the age of 3 months the lambs weighed by 4.12 kg or 21.52 percents more than the lambs of the control group.

Key words: *sheep, sucking lambs, Spirulina platensis, concentrates, weight.*