Доклади на Българската академия на науките
Comptes rendus de l'Académie bulgare des Sciences
Tome 62, No 3, 2009

AGRARIAN SCIENCES
Élevage du bétail

INFLUENCE OF BLUE ALGAE *SPIRULINA PLATENSIS* ON THE PRODUCTIVITY OF SOWS

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(Submitted by Academician Z. Chinkowski on January 27, 2009)

Abstract

The experiment was performed to investigate the effect of blue algae *Spirulina platensis* on sows' reproductive properties, milk composition, digestibility of diet nutritive substances and health status. The experiment with sows was started on the 82nd day of pregnancy and lasted till the weaning of the piglets (on the 28th day after birth). The pigs of the experimental group additionally to the common diet were given daily and individually granular preparation of blue algae *Spirulina platensis*, the daily diet of which was equal to 2 g of 75% humidity biomass of microalgae.

The results of the investigations revealed that the blue algae *Spirulina platensis* positively effected the reproductive properties of sows. The weight of a newborn piglet increased by 19.85% ($P < 0.05$), milk yield – by 11.23%, piglet weight on the 21st and 28th day of age by 17.12% ($P < 0.05$) and 16.56% ($P < 0.05$), respectively and liveability – by 10.1%. The amount of fat in the milk of sows increased by 0.33%, protein – by 0.39% ($P < 0.05$) and lactose – by 0.38% ($P < 0.05$). It was also defined that blue algae *Spirulina platensis* used in the experiments improved the digestibility of ration nutritive substances, made vitally important processes in the sows more intensive and positively effected haemopoiesis.

Key words: blue algae *Spirulina platensis*, sows reproduction, milk, digestibility, blood

Introduction. In Lithuania, as well as in other European countries, higher and higher requirements are held for animals' productive features and production quality. In order to compete successfully in the world market the production should be qualitative and safe for human consumption. Increasing demand for qualitative and safe animal production encourages farmers to use natural and safe zootechnical feed additives, which positively effect animal health, increase productivity and improve production quality [1–3].

The scientific paper is presented on the 1st Conference of the Balkan Network for Animal Reproduction Biotechnology within project 4-01-2008 under the European programme "Research Cooperation and Networking between Austria and South Eastern Europe" supported by the Austrian Science and Research Liaison Offices.

Scientists all over the world for a long time have been studying possibilities of using biomass of the oceans and fresh water in order to create new, safe food and forage supplements and additives. Recently nutritionists have become greatly interested in blue algae *Spirulina platensis.* This algae is spread in Texcoc lake in Mexica, Chade lake and some other lakes of Central Africa. According to the researches carried out it seems purposeful to use *Spirulina platensis* as a preventive measure in human and animal nutrition in order to enrich rations with useful nutritive substances and to improve metabolism. Due to the unique chemical composition, biologically valuable protein, favourable ratio of irreplaceable amino acids, unsaturated fatty acids, amount of pigments, vitamins and mineral substances as well as other biologically active substances which are necessary to ensure normal processes in an animal organism *Spirulina platensis* can be successfully used in the nutrition of farm animals [4-6].

Worldwide known research revealed that spirulina is distinguished by these unique characteristics: it is able to kill many viruses; compensates insufficiency of vitamins and mineral substances; decreases amount of fat in blood; acts as a preventive measure against atherosclerosis and coronary diseases; stimulates healing of wounds; facilitates recovery of cells; is distinguished by an enzymatic activity; strengthens resistance against radiation; normalizes metabolism; strengthens the immune system and resistance of the whole organism; is characterized by antiallergic and anticancer activity; helps to eliminate heavy metals, toxins, radio nuclides from the organism; increases milk production in certain animal species; is distinguished by high healing and preventive activity against many organism disturbances; helps to increase animals viability, activity and improves reproductive properties; it is characterized by probiotic activity [7-10].

In order to produce ecological and qualitative production in animal husbandry it is purposeful to use preparations of blue algae *Spirulina platensis.* Investigations about the effect of these biotechnological preparations in pigs' feeding are still insufficient. Consequently, studies of the preparation *Spirulina platensis* in sows feeding have remained important as for scientific and practical point of view.

Aim of the research. The experiment was performed to investigate the effect of blue algae *Spirulina platensis* on sows' reproductive properties, their milk composition, digestibility of diet nutritive substances and haematological parameters.

Material and methods. The experiment was carried out at JSC "Dainavos kiauliu veislynas" (Lithuania). Two groups of analogous sows (control and experimental) each containing 6 animals were formed. The pigs of Landrace breed were inseminated with the sperm of Diuroc and Pjetren boars. The experiment with sows started on the 82nd day of pregnancy and lasted till the weaning of the piglets (on the 28th day after birth).

All experimental pigs were grown under the same standard feeding and keeping conditions. The pigs of the experimental group additionally to the common

diet daily and individually were given granular preparation of blue algae *Spirulina platensis*, the daily diet of which was equal to 2 g of 75% humidity biomass of microalgae. Blue algae were grown under artificial conditions (in a bioreactor) in Lithuania.

To study the effect of *Spirulina platensis* preparation on the reproduction of sows and the results of suckling piglets growth the following parameters were evaluated: prolificacy (units), weight of a newborn piglet (kg), weight of the newborn piglets nest (kg), weight of the nest on the 21st day of the age (kg), weight of the piglet on the 21st day of the age (kg), weight of the nest at weaning (kg), weight of the piglet at weaning (kg), piglets daily weight gain (g), percent of piglets liveability. On the basis of weight data was calculated daily weight gain of the piglets.

Milk samples for the investigations were taken from the sows 4 h and 14 days after the farrow. Analysis of milk samples was carried out at the accredited laboratory of milk investigations SI "Pieno tyrimai" according to certified methods of the investigations. Milk fat, protein and lactose were measured by the method of infrared radiation middle zone rays absorbtion (LST ISO 9622), using an equipment LactoScope FTIR (FT1.0. 2001; Delta Instruments, Holland). Conditional milk production of sows was evaluated according to the nest weight on the 21st day after the farrow.

Digestibility of diets nutritive substances was studied at the end of the experiment and blood samples were taken from sows for haematological analysis.

Digestibility of nutritive substances for each pig was defined using TiO_2 as indicator, according to its concentration in forage and faeces. On the basis of forage and faeces chemical analysis data was calculated the coefficient of digestibility. The following parameters were measured in forage and faeces: total amount of nitrogen, protein and nonprotein nitrogen – according to the Kjeldal method; dry matter – by drying samples at 100–105 °C temperature; crude fat – according to the Sokslet method; crude fibre – according to the Kurshner method [11].

The blood was collected from ear vein (*vena auricularis*) of sows. Morphological parameters of blood were studied by a haematological device SWELAB-AC920 EO+ (2004; Boule Medical AB, Sweden), biochemical parameters – by a semiautomatic biochemical analyser Screen Master Plus (2002; Hospitex Diagnostics S.A., Italy).

The results of investigations were evaluated statistically by the statistic package "R 1.7.1." (`http://www.r-project.org`) and WinExcel programme. The reliability of arithmetic means difference (P) was defined according to the Student t-test. The results are considered to be statistically significant when $P < 0.05$ [12].

Results and discussion. The results of sows' reproduction are presented in Table 1. According to the results of the farrow the prolificacy of the experimental sows was by 1.83 piglet lower than in the control group, but weight of nest and weight of a newborn piglet were respectively by 0.25 kg or 1.53% and 0.27 kg or 19.85% ($P < 0.05$) higher.

Weight of the piglets nest in the experimental group of sows as well as milk yield on the 21st day of the experiment was by 5.86 kg or 11.23% higher than in the control group of sows. An average piglet weight on the 21st day after the farrow respectively was by 0.89 kg or 17.12% ($P < 0.05$) higher, daily weight gain of piglets – by 29 g or 15.85% and piglets survival by 10.1% higher than in the sows of the control group.

At weaning, i.e. on the 28th day after farrow the nest weight of the experimental group of sows was by 6.94 kg or 10.74%, weight of piglet by 1.07 kg or 16.56% ($P < 0.05$), daily weight gain by 29 g or 15.93%, liveability of piglets by 10.1% higher than in the control group of sows.

Chemical composition analysis of sows' milk 4 h and 14 days after the farrow demonstrated (Table 2) that supplement of blue algae *Spirulina platensis* positively effected milk composition. 4 hours after the farrow the amount of fat in milk of the experimental sows was by 0.33%, protein – by 0.39% ($P < 0.05$) and lactose – by 0.38% ($P < 0.05$) higher than in the control group of sows. The similar tendency was observed after 14 days after farrow and 4 h after the farrow. In the milk of the sows from the experimental group the amount of fat was by 0.32%, protein – by 0.14% and lactose – by 0.13% higher than in the control group of sows.

According to the results of the experiments it can be concluded that under the effect of blue algae *Spirulina platensis* sows synthesized more milk with higher nutritional value, consequently, higher concentration of nutritive substances in milk stimulated piglets' growth and increased their liveability.

Table 1

Parameters of sows reproduction ($n = 6$)

Parameters	Control group	Experimental group
Farrow day		
Weight of the piglets nest, kg	16.32 ± 1.02	16.57 ± 0.96
Prolificacy, (units)	12.00 ± 1.22	10.17 ± 0.96
Weight of newborn piglet, kg	1.36 ± 0.07	1.63 ± 0.09*
21st day after farrow		
Weight of the piglets nest, kg	52.0 ± 3.11	57.86 ± 3.16
Weight of piglet, kg	5.20 ± 0.25	6.09 ± 0.31*
Piglets daily weight gain, g	183.0 ± 20.19	212.0 ± 18.72
Number of the piglets in the nest, units	10.00 ± 0.58	9.50 ± 0.49
Piglets liveability, %	83.30 ± 5.98	93.40 ± 5.58
28th day after farrow		
Weight of the piglets nest, kg	64.60 ± 3.21	71.54 ± 2.97
Weight of piglet, kg	6.46 ± 0.23	7.53 ± 0.36*
Piglets daily weight gain, g	182.0 ± 14.61	211.0 ± 15.91
Number of the piglets in the nest, units	10.0 ± 0.58	9.50 ± 0.49
Piglets liveability, %	83.30 ± 5.98	93.40 ± 5.58

*$P < 0.05$

Table 2

Chemical composition of milk in sows ($n = 6$)

Parameters	Control group	Experimental group
4 hours after farrow		
Fat, %	6.94 ± 0.26	7.27 ± 0.18
Protein, %	12.62 ± 0.09	13.01 ± 0.15*
Lactose, %	3.05 ± 0.10	3.43 ± 0.08*
14 days after farrow		
Fat, %	8.94 ± 0.44	9.26 ± 0.56
Protein, %	5.24 ± 0.15	5.38 ± 0.08
Lactose, %	4.32 ± 0.06	4.45 ± 0.07

*$P < 0.05$

Evaluation of digestibility of diet nutritive substances revealed (Table 3), that *Spirulina platensis* preparation improved digestibility of diets nutritive substances in the experimental group of sows. Digestibility of dry matter in the experimental group of sows was by 1.12%, protein - by 3.63%, fat - by 1.72% and fibre – by 1.33% higher than in the control group of sows.

Morphological and biochemical investigations of blood (Table 4) revealed, that blue algae *Spirulina platensis* positively effected the haematological parameters of blood in sows. Haemoglobin concentration in blood of the experimental group of sows was by 7.2 g/l, or 5.33% ($P < 0.05$), erythrocytes – by 0.9×10^{12}/l or 14.52%, leucocytes - by 0.2×10^{9}/l or 2.4%, total protein – by 0.2% higher than in the blood of the control group. *Spirulina platensis* preparation had no effect on the calcium and phosphorus concentration in blood.

From the results of the investigations it becomes evident that the haematological parameters of blood in both groups of sows are considerably high and characterize good health condition of sows [13]. On the basis of the results obtained it can be stated that vitally important processes tended to be more intensive in the organism of the experimental sows than in the organism of the control group of sows and blue algae *Spirulina platensis* preparations in the diet effected haemopoiesis.

Conclusions. In the case when daily diet of sows was supplemented with the preparation in which is preserved 2 g of 75% humidity biomass of blue algae *Spirulina platensis* reproductive properties of sows was improved. The weight of a newborn piglet increased by 19.85% ($P < 0.05$), milk yield - by 11.23%, weight

Table 3

Digestibility of diet nutritive substances in sows ($n = 6$)

Parameters	Control group	Experimental group
Dry matter, %	75.41 ± 2.87	76.53 ± 3.83
Protein, %	79.13 ± 2.12	82.76 ± 3.26
Fat, %	46.90 ± 1.86	48.62 ± 2.45
Fiber, %	37.65 ± 0.98	38.98 ± 1.26

Table 4

Blood haematological parameters of sows ($n = 6$)

Parameters	Control	Experimental
Erythrocytes, 10^{12}/l	6.2 ± 0.41	7.1 ± 0.39
Leucocytes, 10^9/l	8.2 ± 0.53	8.4 ± 0.34
Haemoglobin, g/l	115.4 ± 2.13	122.6 ± 2.35*
Total prot., %	6.7 ± 0.26	6.9 ± 0.43
Calcium, mg/%	10.5 ± 0.18	10.6 ± 0.56
Phosphorus, mg/%	5.2 ± 0.39	5.2 ± 0.44

*$P < 0.05$

of a piglet on the 21st and 28th day of the age by 17.12% ($P < 0.05$) and 16.56% ($P < 0.05$), respectively, piglets liveability – by 10.1%.

Digestibility of diet organic matter improved under the effect of blue algae preparation, sows synthesized more milk of higher nutritional value.

Spirulina platensis made vitally important processes in the sows more intensive and positively effected haemopoiesis.

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