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The amino acid composition of Spirulina platensis as a feed supplement with the addition of milk whey to the nutrient medium Zarruka

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Experimentally was found that the addition of the nutrient medium Zarruka dairy whey affect the synthesis of amino acids in the cells of microalgae Spirulina platensis. Found a stimulating effect on the synthesis of amino acids by adding 1.0% (0.5 liters) of dairy whey volume of culture medium (first test nutrient medium) compared with control. With such a concentration of serum was obtained Spirulina platensis biomass with higher concentrations of lysine, threonine and glycine at 38.2 %, 23.9 and 3.1 %, respectively, compared with control. Also observed that increasing the concentration of milk whey to 4.0 % by volume of nutrient medium Zarruka negative effect on increased activity of the synthesis of amino acids in microalgae cells.

Spirulina platensis, biomass, nutrient medium, milk whey, amino acids

Today the most important tasks before producers of livestock and poultry products is to provide its high competitiveness and profitability by using inexpensive and effective feed and feed supplement [4].

It should be provide for obtaining the products of livestock and poultry intakes of sufficient nutrients and bioactive substances [5].All this is possible with the use of a balanced diet in feeding animals and birds. For this purpose different types of feed additives: premixes, protein-mineral, protein-vitamin-mineral, which include components of animal and plant origin that are high in protein, amino acids, mineral elements, vitamins, etc. [2, 5].

Today vital question of finding new species of valuable feed and feed supplement. Now widely cultivated microalgae, in particular, *Spirulina platensis*, a feed additive in animal feed [2, 3]. This is due to the chemical composition of

biomass – the presence of a high content of protein and essential amino acids [3, 4].

Depending on the culture conditions (light intensity, temperature, composition of the nutrient medium, pH) chemical composition of biomass blue-green microalgae *Spirulina platensis* may vary. On average, its biomass contains 17–18% dry matter to which 70.0% protein is digested at 85-95% and contains all the essential amino acids, carbohydrates 20% and 8% lipids, represented mainly fatty acids [4, 6]. Among the amino acids essential for livestock and poultry are: lysine, methionine, threonine, alanine, glycine, which contribute to a better absorption of phosphorus, calcium and iron, increasing the level of hemoglobin in the blood. Insufficient number of them resulting in blood disorders, decreased number of red blood cells, decreased level of hemoglobin and productivity [4].

The mineral nutrition for microalgae *Spirulina platensis* is an important indicator that determines the performance and direction of metabolism, as a medium for its existence is the solution of mineral salts in water. For its cultivation using standard nutrient medium Gromova, Tamiya or Zarruka containing optimal concentrations of essential minerals [6, 8]. Also, it is known that Spirulina platensis capable of heterotrophic type of nutrition and this can be used organic sources of supply of essential factors, like chicken manure, cattle manure, sewage (without dilution and dilution to 50.0%), waste fermentation production [2, 7, 8].

However, unexplored and promising way of cultivating *Spirulina platensis* by adding milk whey into the culture medium Zarruka [2]. Among the total wastewater milk business, 60% is whey, due to the lack of accessories for its collection or equipment for processing, and lack of understending by business leaders of value losses of raw materials for the urgency of the problem of protein deficiency. Milk whey containing 0.5–1.5 % protein which is characterized optimal set of amino acids, small dispersed milk fat (0.05–0.1%), lactose and mineral elements and vitamins that are necessary for life microalgae [1, 6].

Purpose of work - determine the effect of different concentrations of sour milk whey in nutrient medium consisting Zarruka on the amino acid composition

of biomass *Spirulina platensis*, as feed supplement to fodder for animals and poultry.

Materials and methods of research. For investigations were used pure cultures of cyanobacteria *Spirulina platensis* and milk whey obtained in dairy processors PJSC «Ukraine» of the town Bila Tserkva of the Kiev region in the production of low-fat cottage cheese. Milk whey had the following averages: titrated acidity – 61,5 ° T, pH – 4.06, Fat – 0.05%, mass fraction of protein – 0.67% and dry matter content is 5.58%. The cultivation of *Spirulina platensis* conducted in phytoreactors with a capacity of 50 liters each, by using standard nutrient medium Zarruka. The period of investigations was 30 days. The culture of microalgae around the clock ensure the light. For mixing nutrient medium whith cells of *Spirulina platensis* used compressors. Throughout the experimental period the temperature of the nutrient medium was at 24– 25 ° C. During the experiment to the composition of four research nutrient medium was added milk whey, control nutrient medium was without milk whey (Table. 1)

Table 1– The scheme of the experiment

The nutrient media	Quantity of added milk whey, liters	Quantity of added milk whey,% by volume
Control	–	–
I experimental	0,5	1,0
II experimental	1,0	2,0
III experimental	1,5	3,0
IV experimental	2,0	4,0

After the period of cultivation the culture of *Spirulina platensis* was separated of nutrient medium and dried. The concentration of amino acids in the dry matter biomass of *Spirulina platensis* was determined by capillary electrophoresis by I. Kotsyumbas.

The results of investigations. It was found that decrease the concentration of amino acids in Spirulina platensis biomass depends on increasing the number added milk whey into the culture medium Zarruka (Table 2).

Table 2 – The concentration of amino acids in dry matter biomass of *Spirulina platensis*, M ± m, n = 4

The amino acid	The concentration of amino acids in biomass of *Spirulina platensis*, %
	The culture medium

	Control	I experimental	II experimental	III experimental	IV experimental
lysine	1,02 ± 0,004	1,41 ± 0,024***	0,91 ± 0,008***	0,81 ± 0,074	0,47 ± 0,025***
methionine	0,82 ± 0,076	0,65 ± 0,092	0,48 ± 0,004*	0,4 ± 0,031*	0,3 ± 0,017**
threonine	1,71 ± 0,021	2,12 ± 0,012***	1,47 ± 0,094	1,27 ± 0,072**	0,77 ± 0,083**
alanine	3,68 ± 0,047	3,21 ± 0,148	2,52 ± 0,128**	1,96 ± 0,059***	1,45 ± 0,094***
glycine	1,6 ± 0,004	1,65 ± 0,011*	1,32 ± 0,087*	1,08 ± 0,122*	0,81 ± 0,093**

Note: * $p \leq 0,05$; ** $p \leq 0,01$; *** $p \leq 0,001$

Adding 1.0 % (0.5 liters) milk whey to the nutrient medium Zarruka stimulates cells of microalgae to synthesize their own amino acids. The concentration of lysine, threonine and glycine in biomass from I experimental culture medium, was higher compared with the control at 38.2 %, 23.9 and 3.1 %, respectively, and the concentration of methionine and alanine was lower by 41.4 % and 12.8 %, respectively. By adding 2.0 % (1.0 liters) milk whey was obtained biomass *Spirulina platensis* with a lower concentration of methionine and alanine at 41.4 % and 32.0 % and lysine, threonine and glycine at 11.0 % 14.0 and 18.0 %, respectively, compared with the conrol. A further increase concentration milk whey in nutrient medium Zarruka was accompanied by decreased activity synthesis of amino acid. So, the concentration of amino acids in biomass *Spirulina platensis* obtained from III experimental medium by adding 3.0% (1.5 liters) of milk whey were: methionine decreased by 51.2 %, 46.7 % – alanine, threonine – 25.7 %, lysine and glycine, respectively, by 20.6 % and 32.5 %. By adding 4.0% (2.0 liters) milk whey to the nutrient medium (IV experimental) concentration of alanine and methionine decreased by 60.6 % and 63.4 %, and threonine, lysine, glycine by 54.9 %, 53.9 and 49.3 % compared with biomass obtained from control nutrient medium.

It is known that *Spirulina platensis* is capable of three types of nutrition (autotrophic, heterotrophic and miksotrofnoho) [3, 8]. So by the addition of milk whey adapts to the optimal – autotrophic and using amino acids of milk whey

slows the synthesis of amino acids own. Detected regularity indicates that with increasing concentration of milk whey in the nutrient medium Zarruka decreases content of amino acids in the biomass of microalgae Spirulina platensis.

Conclusions and prospects for further research.

The results of the studies found that the synthesis of amino acids in the cells of microalgae Spirulina platensis affect serum concentration of sour milk in the nutrient medium Zarruka. Increased activity synthesis occurs adding 1.0% (0.5 liters) of milk whey to the nutrient medium. With such a concentration of milk whey was obtained *Spirulina platensis* biomass with higher concentrations of lysine, threonine and glycine at 38.2 %, 23.9 and 3.1 %, respectively, compared with control. By increasing the concentration to 4.0% decreased synthesis of amino acids.

Therefore, prospective of investigations is the use of biomass *Spirulina platensis* as a feed supplement obtained by using milk whey in the nutrient medium Zarruka in feeding quail.

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