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PHYSIOLOGICAL AND BIOCHEMICAL ACTIVE SUBSTANCES OF CHLORELLA SUSPENSION

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Abstract: Based on the literature the article provides information on the physiological and biochemical properties of chlorella suspension, as well as biologically active substances in it.

Keywords: chlorella, suspension, strain, biomass, ecology, protein, carbohydrate, lipid, vitamin, macro and microelement, antibiotic, chlorellin.

Introduction. Nowadays, our country pays great attention to the development of cattle breeding, poultry, fisheries and other livestock. It was noted that it is necessary and important to use more natural biological agents, especially in the livestock production, with the least use of chemicals. This will ensure food security and the production of environmentally friendly and high-quality food products.

The use of natural biologically active substances in animal breeding in order to perform and achieve such tasks is giving good results. In particular, chlorella suspension from chlorella algae is one of them.

Chlorella is a generic name for single-celled green algae belonging to the *Chlorellaceae* family, *Chlorococcales* order, *Chlorellaceae* class, *Chlorophyta* division.

Place of residence - freshwater basins (except for halophilic species), where these single-celled microscopic algae are a typical

planktonic organism. Chlorella is spherical, in some cases elliptical in shape, and has a smooth shell consisting of three layers that protect the cell contents from external adverse factors.

The chlorella cells diameter does not exceed 18 μm . The cell contains a single nucleus with 0.3–0.5 μm diameter. The middle chlorella shell consists of cellulose, while the outer part consists of a polymer carotenoid - sporopollenin, which is able to absorb toxic elements and remove them from the animals' body. Chlorella is propagated by division. The life cycle lasts about a day, but the most active strains are able to divide several times and, under optimal conditions at the required level, the primary cell can produce up to 64 generation cells per day.

Many chlorella strains can be used for breeding under production conditions. However, the most promising strain is chlorella *vulgaris* IBCE C-19 [3]. This is an

autotrophic strain with distinct planktonic properties, i.e., algae cells are virtually absent from the walls of cultivation vessels during cultivation. The young cells of chlorella *vulgaris* IBCE C-19 strain have a weak ellipsoidal shape, their diameters from 1.5 to 2.0 μm , while adults are spherical, up to 6–9 μm in diameter.

Cell division begins 10 hours after irradiation. The number of autospores is 2-8, in some cases 16. The morphological features of this strain do not differ significantly from other similar species of *Chlorella vulgaris*. The chloroplast is broadly uncoated, green in color.

In a quiet state, cell subsidence begins within 6–15 days. Another positive feature of this strain is its ability to grow even in "poor" nutrient media, i.e. in environments with low total mineralization (0.5 g salts per 1 liter).

Chlorella is an active producer of a balanced amino acid composition of proteins, carbohydrates, lipids and vitamins, which has the ability to easily regulate the relative values of these compounds when growing conditions change [4-5].

When grown in a normal mineral environment, dry chlorella biomass consists of:

- protein (40-55%)
- carbohydrates (35%)
- lipids (5-10%).

Protein

Chlorella protein is superior in quality to all known fodder and food products: it contains all amino acids, including those that are not exchangeable or irreplaceable - **valine, isoleucine, leucine, lysine, methionine, threonine, tryptophan and phenylalanine**. Because *chlorella* protein contains all the essential amino acids, its nutritional value is 2 times higher than soybeans protein. If we

compare the nutritional biomass value in general, 1 kg biomass is equal to 4 - 5 kg soybeans. *Chlorella* protein is equivalent to dry milk or meat protein. The amount of amino acids in *chlorella* cells is given in Table 1.

Table 1

Amino acids in chlorella (g/kg dry matter)			
Glutamic acid	31.84	Isoleucine	11.30
Asparagine acid	25.66	Pyrrolidine carboxylic acid	9.78
Leucine	21.68	Lyzine	8.78
Alanin	20.13	Tyrosine	8.25
Valine	17.58	Arginine	8.17
Glycine	17.02	Cystine	7.53
Threonine	13.66	Tryptophan	5.11
Phenylalanine	12.06	Methionine	4.82
Serine	11.60		

The combination of substances containing nucleic and amino acids, peptides (e.g., glutathione), vitamins, and sugar is known as the growth factor of *chlorella*.

Carbohydrates

The dry *chlorella* biomass contains an average 10-20% carbohydrates. The main part of them is starch. Carbohydrates include cellulose, xylan, glucofructose, and amorphous substances: hemicelluloses and pectin.

Lipids

Chlorella lipids are characterized by high content of unsaturated fatty acids (arachidonic, linoleic, linolenic,

palmitoleic). The relative fatty acid composition of chlorella is similar to most vegetable oils. Chlorella lipids also contain polyunsaturated fatty acids - octothetradecatetraenes and hexadecatetraenes.

Vitamins

In terms of vitamin content, chlorella is superior to all plant foods and agricultural crops. Chlorella suspension also contains many vitamins, including vitamin B12 (see Table 2).

Table 2

Amount of vitamins in 1 g of dry matter (mkg)	
1. β carotene (provitamin A)	1000-1600
2. Ergosterol (provitamin D)	1000
3. Thiamine (vitamin B1)	2-18
4. Riboflavin (vitamin B2)	21-28
5. Nicotinic acid (vitamin B3)	110-180
6. Choline (vitamin B4)	3000
7. Pantothenic acid (vitamin B5)	12-17
8. Pyridoxine (vitamin B6)	9
9. Folic acid (vitamin B9)	485
10. Cyanocobalamin (vitamin B12)	0,025-0,1
11. Ascorbic acid (vitamin C)	1300-5000
12. Tocopherol (vitamin E)	10-350
13. Biotin (vitamin H)	0,1
14. Vitamin K.	6
15. Leucovorin	22

In terms of vitamins amount contained in chlorella, it is superior to yeast, which is a rich source of substances necessary for this life. Chlorella cells contain 1.5 times more inositol, 2 times more biotin, 1.3 times more pantothenic acid and 2.9 times more para-aminobenzoic acid than yeast. Vitamin B12

(cyanocobalamin) is not present in either yeast or plants, but chlorella produces it.

According to some data, in addition to β -carotene, which contains 7-10 times more chlorella than dried dog-rose or apricot, these algae, unlike plants [6], also contain vitamin A in pure form: up to 100 mg of dry matter per 100 g. Fresh chlorella contains the same amount of vitamin C as in lemon juice.

Macro and microelements

The mineral part of chlorella contains 4.79% calcium, 2.51% phosphorus, 4.7% iron, 0.47% manganese, 0.009% cobalt and 0.048% copper, which is 6-10 times higher than the minerals in crops such as alfalfa and clover. It also contains magnesium, potassium, sulfur, zinc and others. Chlorella cells are also rich in iodine.

Natural compounds with antibiotic properties

Chlorella synthesizes the natural substance "*chlorellin*" which successfully destroys pathogenic microflora. Chlorellin at 1:500000 and 1:1.000.000 concentrations are also effective against streptococci, staphylococci, intestinal rods and, to a lesser extent, the causative agent of tuberculosis.

In summary, the chlorella suspension application in various animal breeding sectors creates an economic basis for increasing productivity and achieving high efficiency.

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