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BIOCHEMICAL COMPOSITION AND NUTRITIONAL VALUE OF THE LEMNA MINOR PLANT

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Abstract. *This article investigates the biochemical composition, nutritional value, and potential applications of* Lemna minor *in livestock and aquaculture. The research results demonstrate that this plant contains a high amount of protein, essential amino acids, vitamins, and mineral substances. In addition, the presence of bioactive compounds, including flavonoids and phenolic substances, further enhances its biological significance. The obtained results substantiate the possibility of using* Lemna minor *as an affordable, efficient, and environmentally friendly feed resource.*

Keywords. *Lemna minor, biochemical composition, protein, amino acids, feed, biomass, aquatic plants.*

Introduction. At present, ensuring food security on a global scale, particularly the development of protein-rich and economically efficient feed resources, is one of the most pressing challenges. The rapid growth of the world’s population, increasing demand for livestock and aquaculture products, and the limitations of traditional feed resources necessitate the search for new, alternative, and efficient biological resources. In this regard, aquatic plants, especially *Lemna minor* (duckweed), are gaining significant scientific and practical importance.

Lemna minor belongs to the Lemnaceae family and is a small-sized, free-floating aquatic plant characterized by its rapid growth capacity. Its main feature is its ability to reproduce quickly through vegetative propagation. Under optimal conditions, its biomass can double within 2-3 days. This makes it a highly efficient biological resource.

Recent scientific studies have shown that *Lemna minor* possesses a highly rich biochemical composition. In particular, it contains a high level of protein (30–45%), essential amino acids (lysine, methionine, threonine), vitamins (A, B-complex, and C),

as well as mineral substances. This makes it a promising raw material not only for livestock and aquaculture but also for applications in the food industry.

In addition, *Lemna minor* contains bioactive compounds such as phenolic compounds, flavonoids, and antioxidant components, which further enhance its biological and physiological value. These substances play an important role in regulating oxidative processes in the body and strengthening the immune system.

From an ecological perspective, Lemna minor is also of significant importance. It actively absorbs nitrogen and phosphorus compounds from aquatic environments, thereby reducing water pollution. For this reason, it is widely used in bioremediation processes. This provides a dual benefit in its application—both biomass production and environmental purification. However, despite existing studies, the biochemical composition and nutritional value of Lemna minor have not yet been comprehensively investigated, particularly under varying environmental conditions. In addition, the variation in the content of key compounds, their nutritional significance, and their practical applications require in-depth scientific analysis, making this a relevant research problem.

Therefore, the main objective of this study is to conduct an in-depth investigation of the biochemical composition of *Lemna minor*, to evaluate its nutritional value, and to scientifically substantiate its effective application in livestock and aquaculture.

Materials and Methods. This study was conducted under laboratory and semi-natural conditions. Healthy, disease-free, and morphologically uniform samples of the aquatic plant *Lemna minor* were used as the research object. Prior to the experiment, the plant samples were acclimatized to laboratory conditions and brought to a stable state in relation to external environmental factors.

Sample Preparation. The *Lemna minor* samples collected for the study were initially washed several times with clean water to remove impurities and microorganisms. After that, excess moisture from the plant samples was removed using filter paper, and the samples were prepared for biochemical analysis. A portion of the samples was analyzed in fresh form (fresh biomass), while another portion was dried at a temperature of 60–70°C until a constant weight was achieved, and subsequently ground into powder form. This approach allowed for a more accurate determination of the main components present in the plant.

Experimental Conditions. The experimental studies were conducted under controlled conditions based on the following parameters:

- temperature: 22–28°C;
- light regime: 10–12 hours/day;
- light intensity: 4000–7000 lx;
- medium pH: 6.5–7.5;

- nutrient solution: containing nitrogen (N), phosphorus (P), potassium (K), and micronutrients.

A modified Hoagland solution was used as the standard nutrient medium in the experiments, ensuring normal growth and development of the plant.

The experiments were organized according to the following variants:

1. Control variant – plants grown under optimal conditions;
2. Nutrient variant – growth under different concentrations of nutrient solutions;
3. Light variant – growth under varying light intensities.

Each experimental variant was conducted in triplicate, which increased the reliability of the results and allowed for statistically valid conclusions.

Biochemical Analysis Methods. The main biochemical composition of *Lemna minor* was determined using the following methods:

Protein content – determined by the Kjeldahl method and calculated based on total nitrogen content;

Fat content – determined using Soxhlet extraction;

Carbohydrate content – determined by the colorimetric method;

Phenolic compounds and flavonoids – evaluated using spectrophotometric analysis;

Chlorophyll content – determined by spectrophotometric analysis;

Mineral content – determined using standard chemical analysis methods.

Amino Acid Analysis. The essential amino acids present in *Lemna minor* (lysine, methionine, threonine, and valine) were identified using specialized laboratory methods, and their quantitative composition was evaluated. These indicators play a crucial role in determining the nutritional value of the plant.

Statistical Analysis. The obtained results were processed using mathematical and statistical methods, and mean values, standard deviation (SD), and significance level ($p < 0.05$) were determined. The results were analyzed in graphical and tabular forms, and their scientific validity was verified.

Conclusion.

1. Lemna minor is an important biological resource for ensuring modern food security due to its high content of protein and bioactive compounds.
2. Its rich composition of essential amino acids and vitamins enables its use as a highly efficient and alternative feed source in livestock and aquaculture.
3. Its rapid growth rate and ability to produce large amounts of biomass in a short time make Lemna minor a promising object for intensive biotechnological production.

4. The plant's ability to purify aquatic environments by absorbing nitrogen and phosphorus enhances its significance as a dual-purpose solution for addressing environmental challenges.

5. The development of environmentally friendly, economically efficient, and high-quality feed products based on Lemna minor represents a relevant and перспектив scientific and practical direction.

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