THE EFFECT OF CHLORELLA ON THE GROWTH OF CATTLE

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Biodiesel from microalgae is a new promising industry for sustainable energy source because of their high photosynthetic efficiency and ability to grow in extreme environmental conditions [1]. The ability of algae to survive under different environmental conditions, to a large extent is due to changing pattern of cellular lipids as well as by modifying lipid pathways [2]. Researchers are focused in developing new and cheap technologies to produce biodiesel from micro algae not only due to high lipid productivity but also lack of competition with food, water and land [3]. By adopting integrative approach, a simple solution can be designed for large scale production of microalgal biodiesel.

Algae has shown huge growth potential under nutrient deficient conditions, which makes it the role model for studying its molecular pathways for enhancing desired lipids. Recently conducted experimentation reveals that various physiochemical stress conditions can induce varying expression patterns for lipids [4]. Literature shows improvement in microalgae biomass and lipid production by modifying various nutrient conditions such as nitrogen [5, 6], carbon source2 [7]; salinity and iron content of the medium also affect algae growth [8]. Extensive work is done on production of biodiesel from algae but the fuel is still costlier than normal diesel with the price of US$ 1.25/lb and US $0.43/lb, respectively, which obstructs large-scale applications of algae biofuel [9]. Media composition requires the expensive operation cost and therefore limits its availability at larger scale. There is a need to use cost effective media for growth of algae for bioenergy application.

The present study focused on the cultivation of Chlorella pyrenoidosa using an alternative low cost nitrogen source that is a waste and which can be advantageous for commercial production of biodiesel. Cattle urine is a rich source of nitrogen and other microelements; total N ranging from 6.8 to 21.6 g l−1 , of which an average of 69% is present in the form of urea [8]. Among the organic nitrogen sources, urea is found the best nitrogen source for culturing Chlorella sp. [10, 11]. We have chosen Chlorella pyrenoidosa for our study, as the species has potential to grow under variety of environmental conditions with high lipid accumulation [12, 13]. A comparative analysis is done for growth and biochemical composition of the Chlorella sp. under cow urine (CU) medium and normal Fogg`s medium for its biofuel application.

Chlorella is a representative of green algae - microscopic aquatic plants. The use of a suspension of chlorella in the feed ration of farm animals makes it possible to obtain additional weight gain up to 40% and to bring the safety of the livestock up to 99%. This is achieved due to the fact that chlorella is a unique biological natural product. No other aquatic or terrestrial plant has as many beneficial properties as chlorella.

Due to the beneficial properties of chlorella, its use in various fields of human activity is very wide:

- in agriculture for feeding plants, birds and animals, in beekeeping and fisheries;
- in the food industry;
- in medicine, cosmetology and perfumery;
- for wastewater treatment and rehabilitation of water bodies;
- for the production of oxygen;
- for the production of biofuel. It is known that thanks to chlorella it is possible to achieve:
- increase in average daily weight gain during fattening of cattle and pigs by 30-40%, increase in milk yield of cows up to 25%;
- a sharp, up to 4-5 times, reduction in the mortality of young animals by strengthening the natural immunity of animals;
- significant extension of the terms of economic use of animals;
- increasing the fertility of the parent flock, reducing unproductive inseminations and the timing of the service period, saving on veterinary drugs;

• increasing the digestibility of feed, which allows to save their consumption up to 22% [1].

The production of a chlorella suspension is based on photosynthesis of microalgae, which is carried out in a container using artificial lighting and a solution of carbon dioxide [2]. Photobioreactor is a device for creating favorable conditions for the cultivation of chlorella [3]. This device, depending on the design, is capable of operating in automatic or semi-automatic (with the presence of an operator) mode. Allows to grow large volumes of this algae on an industrial scale. Incandescent lamps, including quartz halogen lamps with reflectors, mirror lamps, fluorescent lamps, are traditionally used as a light source in closed installations, but at present, LEDs are widely used in the lighting market, which have a number of advantages over traditional light sources.

The purpose of the research work is to create an energy efficient, automated photobioreactor of a new generation with LED light sources of the optimal radiation spectrum to reduce the time of growing chlorella in artificial conditions.

Due to the current foreign policy and economic situation in Russia, the increase in the level of development of the domestic agro-industrial complex is beyond doubt. Automation of the photobioreactor is a key task of the proposed project. The photobioreactor will be available to every farmer, regardless of his skill and education, because there is no need for operator supervision.

The main distinctive features of the developed photobioreactor, in contrast to competitive installations: the use of semiconductor light sources as irradiators; automation of the cultivation process; use of the most efficient, from the side of radiation distribution, form of the reservoir for cultivation.

It is planned to create a facility that will provide algae with all the necessary conditions for their life and reproduction. Therefore, the following tasks were set:

1. Determine the required optical characteristics of the photobioreactor reservoir;
2. Select the components that can provide them;
3. Choose a reflective coating with an optimal reflectance;
4. Develop a plan for the automation of the system;
5. Create a prototype installation.

All the above studies will become the starting point for assembling a sample, in which the speed of obtaining and the quality of the finished product must reach a new level, while saving energy costs and the work of maintenance personnel.

The photobioreactor can be widely used in large agro-industrial and agricultural enterprises, and given the small size of the developed installation and the expected ease of use, also in private agriculture and small farms.

The proportion of saturated, monounsaturated and polyunsaturated fatty acids are better in CU grown cells, which meets the requirements of the European Standard EN 14214 for biodiesel production. In our study cow urine; a rich source of nitrogen is used to cultivate algae and the effect is found to be very positive in respect to both biomass and lipid accumulation.

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