

PROTEIN SUPPLEMENT PRODUCTION BY FERMENTATION FROM WASTE VEGETABLE RAW MATERIALS

Proteins are an integral part of any living cell and consist of amino acids, some of which are not synthesized in animals and therefore are an important component in their diets. Protein is a building material for the organism and allows to provide its normal functioning, growth and development. Traditional sources of protein are foods of plant (soybeans and other legumes, nuts, se-men) and animal (eggs, fish, meat) origin.

All countries of the world are interested in finding alternative ways to produce protein products. Such solutions are: protein of microbial origin (bacteria, yeast-like and mycelial fungi), protein from microalgae and insects.

Microbial protein production is a process in which the number of micro-organism cells grows by fermentation of the producer cells on a suitable (most often carbohydrate) substrate under creation of the necessary cultivation conditions (primarily aeration, suitable temperature and pH). As a result of this process, the amount of biomass increases, which contains 40-50% of protein, which is close to the proteins of animal origin. As a result of a series of fermentation and subsequent technological operations aimed at dehydration and increasing the digestibility of protein, a product is obtained that can be used as a biologically active additive in animal feed, since it consists of proteins, lipids and carbohydrates [1].

As a raw material for microbial protein production, it is more rational to use plant resources, since they are widespread in the world and renewable. As a result of processing of plant raw materials for food production, plant wastes are formed, which are most often directed for use as fodder for farm animals and birds. If such use is not possible, the plant waste is sent for composting. This is a biochemical process in which solid organic waste, at a certain humidity, in the presence of oxygen and a mixed culture of microorganisms, transforms into a stable product containing humic and fulvic acids, which can be used as a fertilizer and soil improver.

These two methods of utilization of plant waste are the most common and convenient in modern conditions, but they are not optimal. More promising is the use of plant waste as a substrate (carbon and energy source) in the fermentation process.

Beet pulp is produced as a result of sugar beet processing, so it is significantly depleted in water-soluble sugars, it includes cellulose (22-24 % of dry matter, hemicellulose (30 %), pectin (15-25 %), fat (1.4 %), protein (10.3 %), ash (3.7 %) and lignin (5.9 %) [2].

Apples have in their composition, in terms of dry matter: carbohydrates (71-80%), fiber (13-17%), fats (1-3%), proteins (2-3%). When processing apples to produce apple juice, most of the water-soluble carbohydrates become part of the main product, in the composition of apple cake remain mainly fiber, part of fats and proteins and only a small part of sugars.

Polysaccharides of plant origin are different in their composition and structure, mainly represented by hemi-cellulose, cellulose and lignin. Some microorganisms have a complex of hydrolytic enzymes, and they are able to hydrolyze and utilize a part of polysaccharides that are relatively easy to hydrolyze. In the composition of beet and apple pulp about 30 and 48 % of free sugars and easily-hydrolyzable polysaccharides from the absolute dry matter respectively. Preliminary stage of raw material treatment before the main fermentation process allows to increase the amount of reducing substances and the content of easily hydrolyzable polysaccharides, thus increasing the efficiency of microorganisms growth process.

There are different groups of pretreatment methods: physical, chemical, physicochemical and biological. Physical methods include: mechanical extrusion (materials are subjected to heating by stirring with a screw, thus destroying amorphous and crystalline cellulose matrix), mechanical grinding, microwave irradiation, ultrasound treatment, pulsed field treatment. Chemical methods include: treatment with acidic or alkaline solutions, organic solvents, ionic liquids, ozonolysis. Physico-chemical methods include: steam explosion, wet oxidation, treatment with hot water at high pressure, treatment with magnesium or calcium sulfites, ammonia solution, oxidizers. Biological methods of pretreatment are based on the use of enzymes in enzyme preparations or microorganism cultures. A promising strategy is the use of combined approaches with the use of two or more methods of pretreatment of plant raw materials.

REFERENCES

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