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Aimakov O.A.*

Sh. Ualikhanov Kokshetau University, Kokshetau, Republic of Kazakhstan

* Corresponding author (aimakov[at]rambler.ru)

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BIOLOGICAL VALUE OF EXTRACTIVES OF BROWN ALGAE

Research article

Abstract

The article tells about algae as a unique source of valuable nutrition and technological products. Among the algae, there are highly productive species, the biomass productivity by several times surpasses record figures, reached when growing land plants. In addition, brown algae extracts contain a number of valuable biologically active compounds. Brown algae also contain algic acid, which is not digested by a human body, but performs an important function of body clearance of sodium, radioactive strontium and cadmium and potassium accumulation. Summarizing all known data in literature about edible usage of microphytes, the conclusion comes out that food products from brown algae concede to food products produced from land plants taking into account content and quality protein and carbohydrates composition. Nevertheless, they possess valuable properties which are lacked by plant food primary products of land origin.

Keywords: algae, chemical compounds, extract, brown algae.

Аймаков О.А.*

Кокшетауский Университет имени Ш. Уалиханова, Кокшетау, Республика Казахстан

* Корреспондирующий автор (aimakov[at]rambler.ru)

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БИОЛОГИЧЕСКАЯ ЦЕННОСТЬ ЭКСТРАКТИВНЫХ ВЕЩЕСТВ БУРЫХ ВОДОРОСЛЕЙ

Научная статья

Аннотация

В статье рассказывается о водорослях как об уникальном источнике ценных пищевых и технологических продуктов. Среди водорослей есть виды с высокой продуктивностью, производительность биомассы которых в несколько раз превосходит рекордные показатели, достигнутые при выращивании наземных растений. Кроме того, экстракты бурых водорослей содержат ряд ценных биологически активных компонентов. Бурые водоросли также содержат альгиновую кислоту, которая не усваивается человеческим телом, но выполняет важную функцию очищения организма от натрия, радиоактивного стронция, кадмия и накопления калия. Обобщая все известные в литературе сведения о пищевом использовании микроскопических растений, можно сделать вывод, что продукты из бурых водорослей по содержанию и качественному составу белков и углеводов уступают продуктам, произведенным из наземных растений. Тем не менее, они обладают ценными свойствами, которых лишены основные продукты растительной пищи наземного происхождения.

Ключевые слова: водоросли, химические соединения, экстракт, бурые водоросли.

1. Introduction

Algae are a unique source of valuable nutrition and technological products, above all polysaccharides.

Among algae there exist highly productive types. Their biomass productivity by several times surpasses record figures, reached when growing land plants. Seaweeds (algae) have been used as food products on a much larger scale in the Eastern countries (particularly in Japan, China). Moreover, not limiting themselves by exploiting natural resources, people organized the cultivation of algae for food on sea plantations [9, P. 47].

Also, one can't but take into account the usage of algae as raw material for obtaining various chemical compounds. They in fact are ecologically pure natural substances.

In present time it became clear that the utmost value is represented by organic components of algae biomass.

It is known that brown algae (*Fucus evanescens*) contain polysaccharides, which in turn contain main components such as algic acids [3, P. 85].

Extracts of brown sea algae contain some valuable biologically active substances such as a set of amino acids (tyrosine, phenylalanine), polyunsaturated fatty acids, oligosaccharides, polyphenol compounds.

Extractives that have multi aspect biomedical properties show viability of their usage as a functional ingredient for creating products of medical and preventive effect, and subsequently, possibly, as a basis for creating biologically active food supplement [10, P. 148].

The primary metabolites of algae include, as well as proteins, nucleic acids, carbohydrates and lipids. In addition, biosynthesis of a large number of various organic compounds classified as secondary metabolites is carried out in algae. For algae, it is typical that the predominant component of the biomass is most often carbohydrates. These substances perform two main functions: they serve as an energy reserve and play the role of supporting structures, participating in the construction of cell walls and forming an intercellular substance. It should be noted that brown algae contain alginic acids. The predominance of carbohydrates in the general case does not exclude the possibility that certain types of algae can accumulate mainly lipids, be very rich in protein, etc. The huge variety of algae just makes it possible to find among them convenient sources of many useful compounds.

Many algae can serve as a source of lipids. Algae lipids are usually enriched in polyunsaturated essential acids, which are of great importance in the human diet.

Algae are a unique source of the most valuable food and technological products, primarily polysaccharides.

Most important polysaccharides are algic acid and alginates. In medical practice algic acid is used to stop internal hemorrhage including ulcer deceases hemorrhage. In connection with this we undertake experimental research in the field of polysaccharides. The synthesis methodology of amine salt of algic acid was elaborated. During the experiment algae extracts were derived as they contain algic acid. Obtained algic acid is an initial chemical monomer and on its basis it is possible to obtain various modified derivatives [11, P. 73].

Brown algae are a unique plant material capable to form a large biomass in a short time period and synthesize most various biologically active compounds of a wide range of spectrum activity of medical and preventive value in the first place. As research work shows, some of these substances are exclusively part of brown algae such as mannitol, algic acids, fucoidan and considerable amount of iodine. There is not only a lot of iodine in algae but also micro- and macroelements, vitamins, which are important for metabolic process and help to digest iodine. Besides, iodine in algae is in the most suitable form of salt types to be digested by a human organism [1, P. 93].

It is known that many modified polysaccharide conjugates have found practical application in medicine. Conjugates of polysaccharides with drug substances may have a greater solubility or duration of action compared to the drugs themselves and can be used as combination drugs. In this regard, we continued experimental studies in the field of chemistry and biochemistry of polysaccharides based on seaweeds. During the experiment, extraction and chromatography methods were used to determine the composition of the algae. With the help of extraction and chromatography methods, they were separated into fractions of protein substances, amino acids, carbohydrate components and others. Initially, we isolated the amount of extractive substances of algae. The resulting algae extracts were added to the tests. In the production of bread, the use of extractives helped prevent the finished product from becoming stale. Next, we developed a procedure for the synthesis of the amine salt of alginic acid. During the experiment, extracts from algae were isolated. The extracts contain alginic acid.

We also developed methods for the preparative synthesis of the amine salt of alginic acid based on the vinyl ester of monoethanolamine.

In conclusion, in the course of the experiment, not only the production of alginic acid was developed, but also the ways of synthesis of chemically modified alginate derivatives.

2. Methods

Content of protein substances in brown algae is 5–15%, nitrogen-free substances – 38–68% and mineral substances – 17–39% of dry weight [2, P. 445].

Brown algae in dietary intake are a powerful source of mineral substances, which in general (75–85%) are represented by water-soluble salts of potassium and sodium (chlorides, sulphates). There is an excessive amount of potassium, magnesium, sulphur and especially chlorine in brown algae [5, P. 24]. Algae, brown particularly, contain a large amount of iodine salts (0,1–0,8% of dry weight). Considerable amount of iodine can be the reason of iodine surfeit when eating raw algae.

High iodine content predetermines the value of algae food for prevention and medical treatment of goiter. Algae are also of big interest as a source of vitamin C in nutritive diet (300–470 mg per 1 kg of raw substance). In literature there is data about presence of vitamins D, E, F, G in algae [8, P. 423].

A larger part of polysaccharides of brown algae is not accessible for human digestive ferments. Nutrition value of brown algae is mainly determined by a high amount of extractive nitrogenous matters and first of all free aminoacids [13, P. 62].

Technique of seed sprouting in an absorbent paper roll was used for evaluation of extract biological action on soya sprouts growth [15, P. 125]. Dry seeds were laid out on absorbent paper strips of 12–42 cm size, preliminarily soaked in tested solution of targeted concentration. Then they were folded in rolls, put into glasses filled with tested solution (140 ml) and incubated in thermostat at 26–27 °C for 3 days. After incubation length of main root and stem of sprouts were measured. For control served sprouts grown from seeds sprouted in distilled water. Every trial had 25 seeds. Two independent series of experiments were carried out with three iterations for each concentration of tested extract.

3. Results

Chemical composition of *Fucus evanescens* brown algae extract.

Table 1 – Chemical composition of brown algae extracts

Chemical composition	<i>Fucus evanescens</i>
Dry substances, % of dry weight of algae)	28,0 ± 1,66
Dry substances of extract, g/100 ml	1,97 ± 0,13
% from dry substances of extract	
Mineral substances	35 ± 2,55
Protein	8,1 ± 0,11
Polyphenol compounds	10,1 ± 1,45
Free amino acids	0,98
Neutral sugars (in terms of glucose)	4,0 ± 0,34
Iodine	0,04

Brown algae contain algal acid, which is not digested by a human body, but performs an important function of body clearance of sodium, radioactive strontium and cadmium and potassium accumulation. Pharmacological action is in improving of intestinal motility and stimulating hair growth [8, P. 422]. Summarizing all known data in literature about edible usage of microphytes, the conclusion comes out that food products from brown algae concede to food products produced from land plants taking into account content and quality protein and carbohydrates composition. Nevertheless, they possess valuable properties which are lacked by plant food primary products of land origin.

Conflict of Interest

None declared.

Конфликт интересов

Не указан.

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