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MUSHROOM BETA GLUCANS FOR DEVELOPMENT OF FUNCTIONAL FOOD PRODUCTS

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Abstract: *Beta-glucans are structural polysaccharides of fungal cell-wall. Nowadays they are gaining interest due to their multiple functional and bioactive properties. Fortification of ordinary foodstuff with beta-glucans will lead to increase the fiber content of food products and at the same time will enhance their health properties. Beta-glucans can influence activity of immune cells and modulate metabolic dysregulations associated with the metabolic syndrome. In our resurch it was shown, that beta-glucans can help to weight –control, decrease of cholesterol and glucose levels in blood serum, and support the growth of beneficial Lactobacilli and Bifidobacteria, which are antagonists to pathogenic bacteria in the digestive system.*

Development of functional food products containing beta-glucans can be important and prospective in prevention or treatment of disorders associated with immune system disorders, obesity or metabolic syndrome.

Keywords: *beta-glucan, functional food, obesity, metabolic syndrome.*

INTRODUCTION

Mushrooms contain a large variety of biologically active compounds that are still not enough studied (Mizuno, T., Sakai, T., & Chihara, G. 1995; Chang, S.T., & Buswell, J.A.1996; Shamtsyan M. 2016). From prehistoric period mushrooms have been used not only as food, but also for healing purposes. Recently, they start to attract growing interest of scientists and at present some of them are already used as dietary supplements or for fortification of food with functional compounds. Besides well studied immune modulating and anti-tumor properties, mushrooms possess other important effects including antioxidant, anti-hypertensive, anesthetic, cholesterol-lowering, liver protection, anti-obesity, anti-inflammatory, anti-diabetic, antiviral, anti-microbial, antifungal and some others. Mushrooms also can be a source of various surfactants and enzymes, which can be used in food and cosmetic industry.

EXPOSITION

Historically, mushrooms were collected in the forests wild for eating and to fight deseases. In the second half of 20th century technologies for mushroom cultivation were strongly developed, and at the beginning of 21st century the overall value of the world's mushroom production was estimated to be over $ 45 billion (Chang, S.T. 2006).

Very promising technique of mushroom production is submerged cultivation of mycelia. This is a more fast and efficient way to attain mushroom biomass. Generally, mycelia possess almost same nutritional and bioactive properties as the fruit bodies. Native liquid of cultivation of basidiomycetes also could be a source of of various important bioactive compounds.

Beta-glucans are structural polysachharides of cell wall of basidiomycetes. Mushroom beta-glucans have a branched 1-3, 1-6 strucchure, and depending from species can vary in molecular weight and associated functional groups. Thus beta-glucans from different mushrooms vary also in their activities.

The aim of our research was to study various biological activities of beta-glucans obtained from fruit bodies and submerged mycelia of different mushrooms.

Investigation of immune-modulating activity of mushroom beta-glucans

Immune-modulation activity of water-soluable beta-glucans obtained from various mushroom fruit bodies and submerged mycellia was evaluated on different imuune-competent cells. It was shown, that beta-glucans significantly activated generation of active forms of oxygen by the neutrophils of human peripheral blood (figure 1).

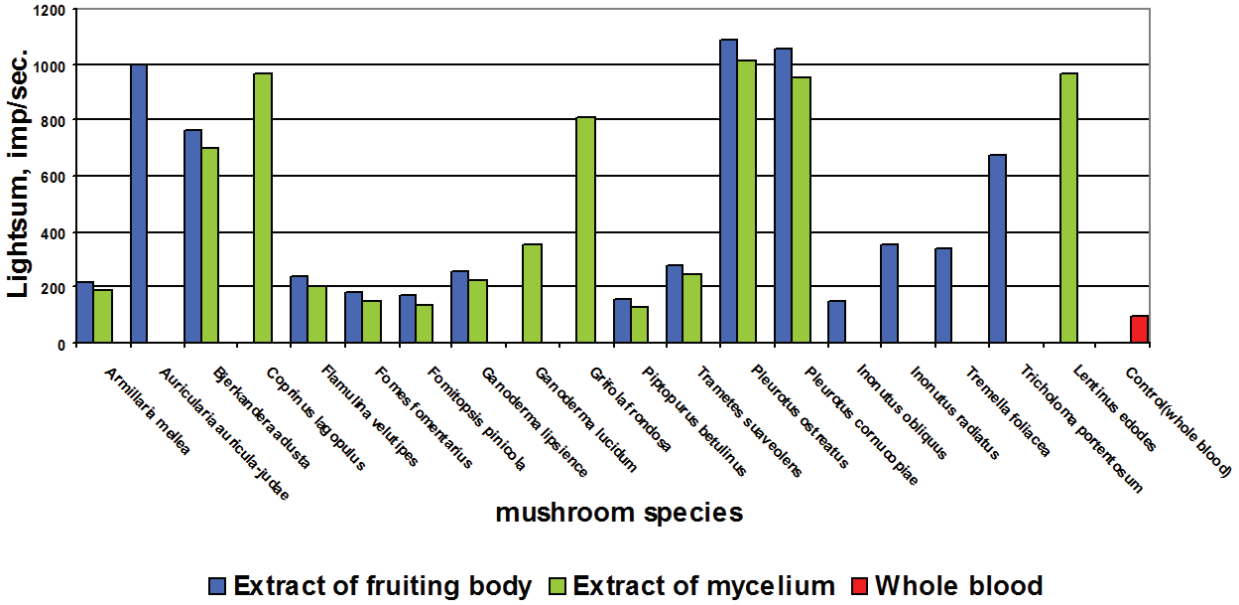

Fig. 1. The influence of mushroom extracts on production of reactive oxygen species by human blood neutrophils

Aqueous extracts of mushroom mycelia were stimulating blasttransformation of spleen lymphocytes (figure 2) and, although to a lesser extent, activated spontaneous proliferation of thymus cells (figure 3).

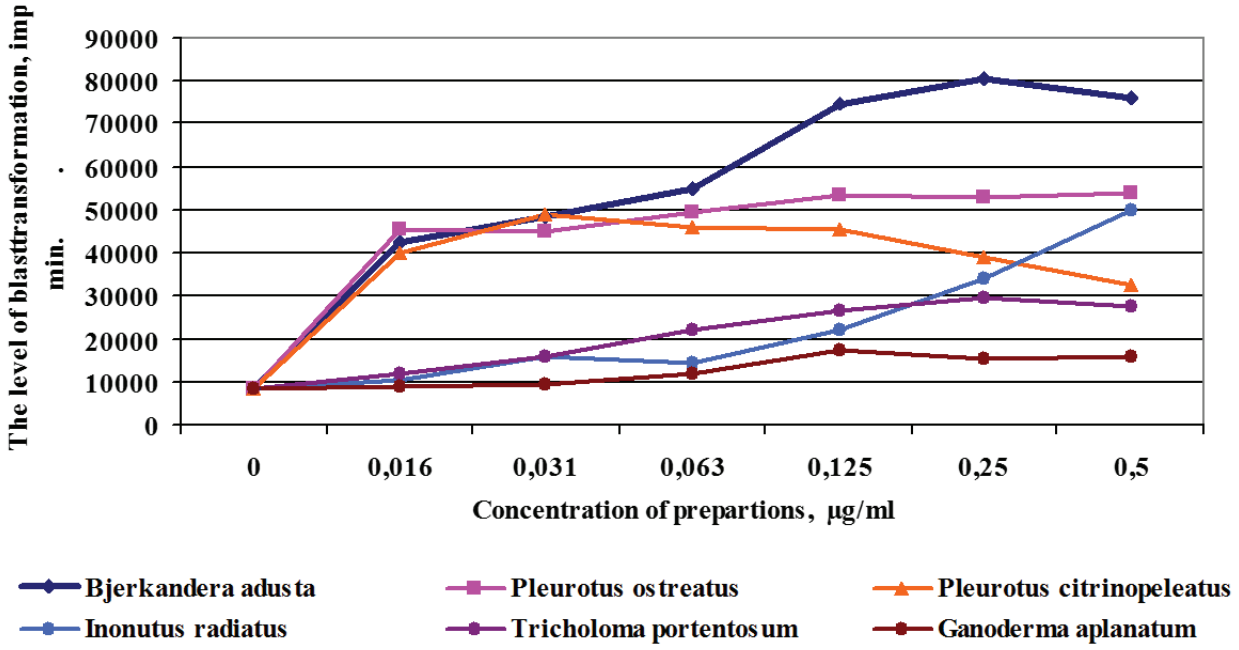

Fig. 2. The influence of aqueous extracts of mushroom mycelia on the blasttransformation reaction of spleen lymphocytes

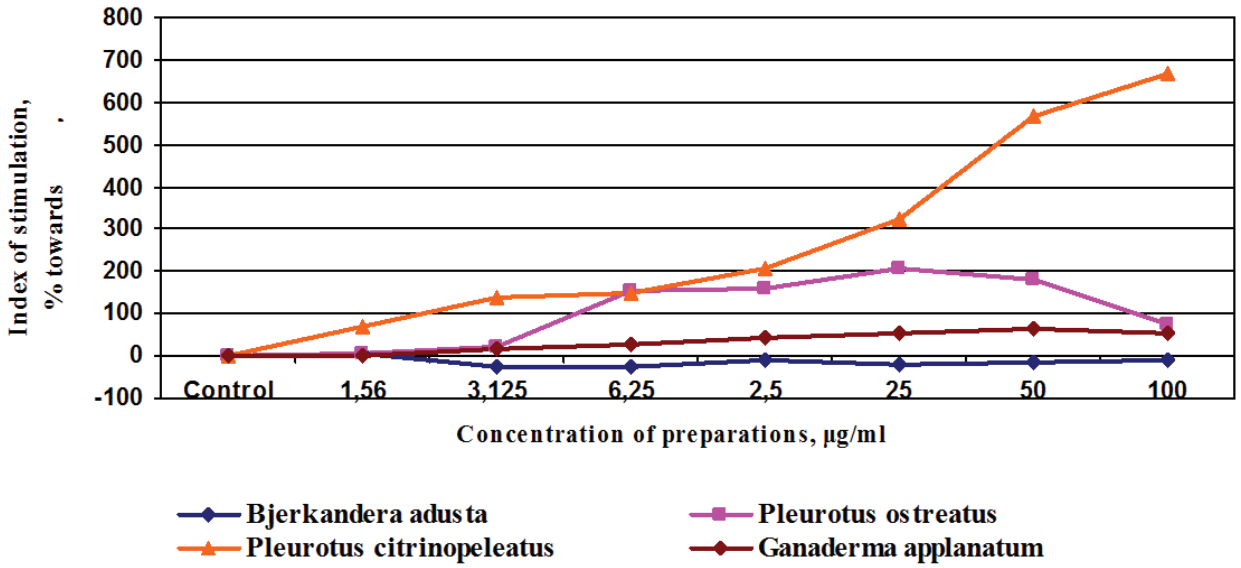

Fig. 3 The Influence of Preparations of Submerged Mycelium on The Spontain Proliferation of Thymus cells

Beta-glucans also were stimulating production of pro-inflamatory cytokines Interleukin-1-β and Interleukin-8, but practically did not affect the production of interleukin-2 (table 1).

Table 1. The Influence of Beta-glucans from different mushrooms on the spontain proliferation of thymus cells

Preparation concentration, mg/ml	MYCELIA EXTRACTS						FRUIT BODY EXTRACTS			
	B. adusta		P. ostreatus		P. cornucopiae		I. radiatus		*T. PORTENTOSUM*	
	Level of cytokines production, ng/ml									
	IL1-β	IL-8	IL 1-β	IL-8	IL 1-β	IL-8	IL 1-β	IL-8	IL 1-β	IL-8
5.0	2155	6753	2216	3178	1420	4773	2455	>10000	1882	7874
0.5	1438	3911	1879	2950	1844	6797	1820	>10000	2231	>10000
0.05	916	2773	1287	2877	1514	3987	968	9006	1748	3736
0.005	709	2230	1015	2383	1021	2440	813	4196	1275	2250
0.0005	671	2170	815	2161	872	2180	710	2877	898	2160

Level of spontaneous production cytokines: IL 1- β: 670 ng/ ml, IL-8: 2169 ng/ ml
Level of production induced by LPS: IL 1- β: 1653 ng/ ml, IL-8: 6668 ng/ ml
Performed *in-vivo* experiments also demonstrated pronounced immune-modulating activity of mushroom beta-glucans.

Investigation of immune-modulating activity of mushroom beta-glucans

Based on obtained results we studied anti-tumor activity of mushroom beta-glucans. We studied the influence of oral administration of beta-glucan containing mushroom extracts on the development of two malignant tumors: Melanoma B16 and Ehrlikh's ascit carcinoma. Obtained results demonstrate that daily oral uptake of beta-glucan containing extract from oyster mushroom (Pleurotus ostreatus) significant increases the survival rate of mice with melanoma B16 (figure 4). In case of Ehrlik's Ascit carcinoma the highest effect eas detected when extract from Coriolus unicolor was daily oraly administered to animals.

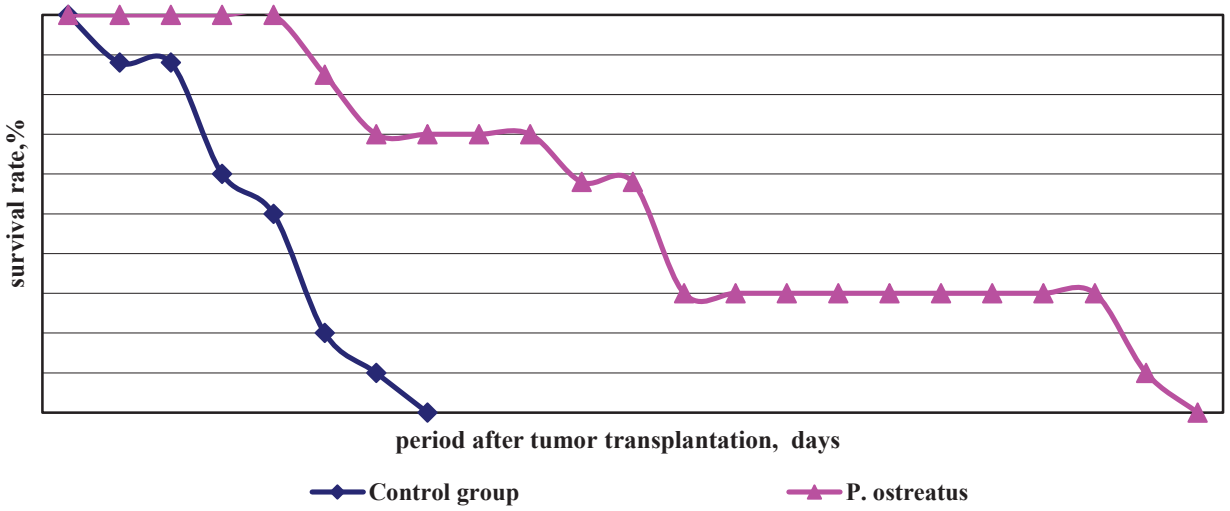

Fig. 4. Survival rate of mice with melanoma B16

Investigation of other effects

In our studies oral administration of water soluble beta-glucans was significantly decreasing the level of cholesterol in blood serum and the coefficient of atherogenity. The level of triglicerides also was also decreased. Thus beta-glucans posess valuable hypocholesterolic and hypolipidenmic action.

In the experiments with streptozotocin-induced diabetic rats, daily addition to the diet of beta-glucans after 4 weeks of administration results in normalization of blood glucose level, thus possessing pronounced anti-diabetic action.

Based on obtained beneficial effects beta-glucans were used to develop functional dairy and bakery products. Their addition to milk, yogurts and bread increased their organoleptical characteristics and also gave them important functional properties. Beta-glucans preserve their properties at 130◦C and don't decreased reological properties of the dough. Obtained bread has more brounish color, than the one, produced without addition of beta-glucans.

Yogurts fortified with beta glucans were more viscouse, without syneresis. Beta-glucans stimulated glycolytic activity of lactic acid bacteria, thus increasing their growth rate and the rate of accumulation of lactic acid.

CONCLUSION

Mushroom beta-glucans have various beneficial effects on human health. Fortification of daily used food products with beta-glucans allows to develop new functional products with immune-modulating, anti-diabetic, hypocholesterolic and hypolipidemic effects.

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