

Mushroom Beta Glucan as a Functional Ingredient in Extruded Products

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Abstract—In 21st century consumers are becoming more advanced and seeking combination of convenience and nutrition through their diets, owing to their hectic life schedules. The extruded products have drawn their attention as an ideal candidate fulfilling the criteria of convenient food having long shelf life, easy to prepare and have attractive appearance and texture. Although extruded products are superior from nutritional and handy viewpoint, but the extrusion process results in completely gelatinization of starch, which is further readily digestible and results in elevated glycemic loads and high calorific content. To control the glycemic response in extruded product, mushrooms as affluent source of dietary fiber (beta glucan) can be fortified in extruded products by replacing some portion of semolina. Other than a source of dietary fiber, intake of mushroom beta glucan also declines the tumor, inflammation, oxidation and microbial infections. This review aims at fortification of extruded products by incorporating mushrooms beta glucan, its potential health benefits and effect on nutritional and functional properties of these novel products.

1. INTRODUCTION

From the ancient to 21st century, mushrooms are gaining tremendous interest, just because of their potential health benefits and functional values. Besides the low fat and good vitamins and protein content, mushrooms are affluent source of various bioactive components such as polysaccharides, terpenoids, dietary fiber, phenols and peptides [1]. Beta glucan is a dietary fiber exists in the cell walls of certain mushrooms and has been well renowned for its potential health implications. The potential health advantages of mushroom beta glucan as antitumor, antioxidant, antidiabetic, and anti-inflammatory agent has been confirmed in various *in vivo* as well as *in vitro* studies [2]. Thus, this bioactive component has drawn the attention of food technologists and consumer demand urged the development of novel food products by incorporating this nutritional and functional ingredient. Regarding extruded products, high temperature and mechanical shear results in complete gelatinization of starch, which is easily breakdown by enzymes in gastrointestinal tract and results in elevated glucose responses [3]. Moreover extruded products have more calorific content [4]. So, snack industry is endeavored to ameliorate the nutritional and functional properties of these products. In the same way, the

reformulation of extruded is urged by the consumers by adding some sort of bioactive phytochemicals such as dietary fiber, which can help in diminution of calorific content and glycemic index of such kind of products. Dietary fiber extracted from diverse sources can be incorporated into these products with an attempt to reduce the glycemic effect as well as to maintain the nutritional profile [5]. Beta glucan as a dietary fiber from some varieties of mushrooms has drawn the tremendous interest nowadays just because of its positive effect on the foods in which it is incorporated.

A huge literature documented the fortification of different food products by using cereal beta glucan. However, the topic of food formulation produced by adding mushroom beta glucan has remained unexposed. So keeping in view about the significance of mushroom beta glucan, this review aims at the utilization of mushroom beta glucan in extruded food products, its potential health benefits and effect on functional and nutritional characteristics of the developed novel food products.

2. MUSHROOMS

Mushrooms being a part of diet have devoured by humans from time immemorial. In ancient civilizations, mushrooms have been renowned as hallucinogens [6], ingredient of gourmet cuisine [7], as well as a medicine [8]. Other than a culinary wonder mushrooms has also been valued to maintain the health and enhance longevity by humankind, across the globe [7]. Throughout the world more than 10,000 known species are recognized, but only 2000 are safe for humankind and approximately 300 are of medicinal in nature [9]. Mushrooms are defined as a macro fungus having distinguishing fruiting body, which can be either epigeous or hypogenous in nature and visible to naked eye and can be handpicked [10]. Mushrooms have high nutritional value as well as they are affluent source of various bioactive components such as essential amino acids (like lysine), dietary fiber, antioxidants, minerals, folates and various vitamins [1, 11-12]. Owing to their low calorific content [7] and good nutritional and functional value, they are considered as

nutraceuticals foods and alluring the food industries to reinforce its utilization in various novel food formulations.

3. BETA GLUCAN

Beta glucan is a polysaccharide composed of glucose monomers joined to each other by either β (1, 3), (1, 4) or (1, 6) glycosidic bonds. The beta glucan exists in the bran and endospermic cell portion of cereals and in cell walls of microorganisms and also in some mushroom varieties. Chemically beta glucan from mushrooms have β -(1, 3) and β -(1, 6) glycosidic linkage in the backbone which shows the anticancer and immune stimulating characteristics [13]. The various beta glucan such as Schizophyllan, Grifolan, Pleuran, Lenitan and Krestin from the *Schizophyllum commune*, *Grifola frondosa*, *Lentinula edodes*, *Trametes versicolor* mushroom varieties, all are components of the cell wall of the mushrooms. The molecular weight of lentinan beta glucan from *Lentinula edodes* varies from 400-1000kDa and Schizophyllan has only 450 KDa [1].

Mushrooms beta glucan exhibits a wide spectrum of biological activities such as immune modulating, antitumor [14], antiviral [15] and antioxidant, hepato-protective effects [16]. The various factors influencing the concentration and efficiency of the beta glucan in the mushroom are age and type of mushroom, developmental stage, fruiting and or storage conditions and cooking techniques [17, 1].

4. UTILIZATION OF BETA GLUCAN IN EXTRUDED PRODUCTS

Currently, research is emphasizing on the functional ingredients, which helps to provide nutrients as well as have health benefits, is of utmost interest. Mushroom beta glucan, as nutraceuticals food, is gaining terrific attention in the research area owing to its functional properties (in foods) and biological properties which relies crucially on its structural conformation and molecular weight. Food technologists are trying to develop mushroom beta glucan fortified functional food products such as bread, cookies, soups and dairy food products to use its potential health benefits as well as its capacity to enhance viscosity and gel forming capacity in aqueous systems. It has been forecasted that, in terms of revenue, mushroom beta glucan market is the fastest growing segment having a CAGR of 7.7% from 2017 to 2025, just because of potential health benefits of the mushroom, cultivated for production of different beta glucan products. It is well know that snack products are energy dense and lacking in dietary fiber, beta glucan as an affluent source of dietary fiber, which can fulfill dietary fiber requirements of the modern consumer, can be incorporated in the snack extruded products. Moreover, incorporation of the beta glucan in snacks helps to manipulate the starch digestibility, leads to controlled release of glucose. Eventually mushroom beta glucan reduces the glycemic response of the samples *in vitro* studies and energy content of snack products [18]. Heo *et al.* [19] used

beta glucan rich fractions from the *Lentinula edodes* mushroom to fortify the extruded rice noodles with dietary fiber and to enhance its quality characteristics. Although, rice suspension with beta glucan rich fractions showed reduction in values of water hydration and pasting properties, but beta glucan modified the thermo-mechanical characteristics of rice flour in the dough, which subsequently resulted rice noodles with increased firmness and extensibility. Hence, amelioration of these textural characteristics can be positively linked with declined swelling power and cooking loss in the gluten free extruded rice noodles.

In another investigation Other than increasing the dietary fiber content, incorporation of mushroom beta glucan in the pasta products also leads to enhanced dough stability and reduced quality deterioration. This fortification enhanced the consumer acceptability of the pasta products [20].

Inclusion of barley and mushroom beta glucan in extruded product results in more product expansion as compare to control and subsequently decline in product hardness. Moreover, this fortification helped in manipulation of starch digestibility profile and reduction in potential glycemic response during digestion [5].

5. CONCLUSION

Beta glucan from mushrooms is a novel bioactive component and has well renowned health implications and functionalities in food formulations. Although the biological effects of beta glucan from mushroom source has been documented plentifully in literature, but its exploitation in food products has not been well explored yet, especially in extruded products. The reason may be the research gap and lack of highly developed procedures and technologies in the extraction, purification and processing of this functional component and lack of knowledge about its health and bio-functional related implication on the novel product, in which it is incorporated. Hence there is a need of valorization of knowledge and research about the mushroom beta glucan and its fortified products, to make it acceptable and value added product having low cost and bioactive phytochemicals source.

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