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Okara Usage in Food Industry and Medical Application

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Abstract

This mini review paper presented the applications of okara in two major fields namely food industry and medical fields. From the perspective of food industry, okara was introduced in food industry such as cookies, gluten free flour for baking purposes, extruded snack food with their optimal conditions. Okara modified with endopeptidase (Alcalase) and exopeptidase (Flavourzyme) improved the protein hydrolysis conditions. Endopeptidase with ultrasound pretreatment further improved the protein hydrolysates. Okara also improved the microbial activities to enhance nutritional quality and antioxidant activities to develop healthy animal feeds. From the perspective of medical application, okara became a potential agrowaste which applied as natural immobilizer due to prebiotics and probiotics fibers within okara. Prebiotics fiber helped in soymilk fermentation, glucosidic isoflavone bioconversion, cell resistance to simulated gastric and intestinal stresses as well as to enhance the human gut (faecal output) while probiotics fiber increased the protection against gastrointestinal juices. Okara also developed as dietary supplement that helped to prevent diabetes, obesity and hyperlipidemia.

Keywords: Okara; Applications; Food; Medical

Introduction

Soymilk and tofu consumption have been greatly increasing as it is claimed that both soymilk and tofu are good in improving cardiovascular health. In processing the soymilk or tofu, the by-products namely okara was produced either in equal amount or more than the products produced. The continuous production of soymilk and tofu lead to serious disposal problem due to high moisture content within okara as well as short shelf life which limited the applications of okara in large scale operations. Therefore, okara was undergo intensive research to be applied in two major fields namely food industry and medical applications.

From the perspective of food industry, around 47-50% of okara provided optimal condition to produce okara based cookies preparation [1]. The incorporation of okara reduced the water absorption towards the cookies. However, the beany flavour affected the aroma and taste of the cookies. Another research showed that okara was blended with broken rice by undergoing single-screw extrusion to form extruded snack food [2]. The optimum conditions to achieve this snack food were the reduction of moisture content must be around 14-22% and the ratio of broken rice towards okara should be either 70-30 or 90-10. The barrel temperature must be maintained at 120-160 °C and the screw speed at 50-90rpm. The introduction of okara into the broken rice enhanced bulk density while reducing the sectional expansion index and specific length of the snack food. Another type of food products was gluten free flour which were produced by drying the okara incorporated okara with other ingredients for baking purposes [3]. This flour was suitable to be used by individuals who suffered from celiac disease. Besides, the flour produced can be used to improve the fiber and protein contents of food to replace wheat or soy flour in the production of biscuits, cookies, pancakes and muffins. Thus, this improved the value of okara. Okara modified with both endopeptidase (Alcalase) and exopeptidase (Flavourzyme) was proven to improve antioxidant activity of protein hydrolysates to obtain value-added peptides in Applications of Okara 2 a processing food products [4].

The same group of researchers further investigated and proven that okara could be well optimized using Alcalase endopeptidase through ultrasound pretreament which increased the protein hydrolysis conditions [5]. The optimum conditions obtained were enzymatic hydrolysis at 55°C, 8.8% of enzyme substrate ratio and pH 9.0. Besides food productions for human being, okara could be utilized in producing animal feed supplements [6]. The yeast fermented soybean curd residue (okara) reduced the fiber contents that was able to improve the microbial activities that enhanced the nutritional quality and antioxidant activities by lowering the fortification level in developing healthy animal feed supplements. Through this method, the cost of producing the healthy animal feed could be significantly reduced.

Another perspective of improving the value of okara by applying in medical field. Okara was well functioned as prebiotic and probiotic fibers that improved the health conditions of human beings. Research of Xia, Wang, Liu, Li and Zhou (2016) presented that the food-grade byproduct named okara which was rich in prebiotics was functioned as natural immobilizer on few conditions namely soymilk fermentation, glucosidic isoflavone bioconversion, and cell resistance to simulated gastric and intestinal stresses [7].

Immobilized *Lactobacillus plantarum* cells provided higher specific growth rate with rapid decreasing in pH that protected the okara from spoilage. In addition, okara could be acted as potential immobilization carrier to improve cell survivability in gastric and intestinal conditions. Another group of researchers proven that treated okara *via in vitro* process was an alternative prebiotic from agrofood industrial waste which increased the soluble dietary fibre content to enhance the human gut [8]. The optimum conditions to produce a potential prebiotic effect of okara were 48 hours, pH-controlled and anaerobic batch cultures introduced with human faecal slurries. Moreover, the introduction of okara onto fermented soy products through *in vitro* method could be an important method that enhanced the probiotic protection against gastrointestinal juices as it did not affect the viability of *Lactobacillus acidophilus* La-5 and *Bifidobacterium animalis* Bb-12 within the product [9].

Okara was also prepared as dietary supplement which might prevent diabetes, obesity and hyperlipidemia [10]. This was clearly proven the research of [10] that the plasma levels of triglycerides as well as total cholesterol in Syrian hamsters were significantly decreased 20% by feeding okara supplemented diets that helped in faecal output [11]. The aim of this study is to review the applications of okara in food industry and medical fields. Through this review, the application of okara should be widen with optimal conditions.

Discussion

The by-product from soymilk and tofu processed produced soy residues namely okara. Okara contained high amount of fiber with low fat amount. These conditions led to the high utilization of okara in food industry as well as the medical field. However, okara contained high moisture and usually in wet conditions. This prevented okara from further utilized in wider scope. The optimum conditions obtained from previous research on okara in solid state food products was 47-50%. Besides, moisture content of okara should be greatly reduced until 14-22%. Based on the optimal conditions, okara was able to incorporate into other substances with the ratio to other substance of 1:1. This helped to reduce the disposal problem and increased the value of low-cost okara. Okara should undergo drying to obtain minimum amount of moisture. Many drying processes were available such as jet spouted bed of sorbent particles method [12], air jet impingement drying [13], convective drying [14], flash drying [15] and others. Therefore, with the aid of drying methods, solid okara or okara powder could be achieved with minimum moisture content. However, the nutritional quality of okara should be improved through drying processes. Thus, drying temperature should be around 55℃ to enhance enzymatic hydrolysis with the pH of okara maintained at 9.0. With the introduction of immobilized *Lactobacillus plantarum* cells, okara could maintained the pH to prevent the spoilage of okara. Besides the immobilized *Lactobacillus plantarum* cells, yeast fermented okara could be applied to expand the microbial activities that boosted the nutritional quality and antioxidant activities.

With the optimal conditions achieved, okara is suggested to be applied as biofertilizers for agricultural plantation such as mushrooms as it contains high concentrations of organic nitrogen and phosphorus. However, the insolubility of okara as well as the high molecular weight of proteins and carbohydrates can prevent the application of okara. The introduction of either endopeptidase Applications of Okara 3 (Alcalase) or exopeptidase (Flavourzyme) improves antioxidant activity of protein hydrolysates within okara and thus, okara can be developed as biofertilizer in agricultural plantation and at the same time, the soil of plantation can be significantly improved.

Conclusion

Okara can be applied in two major fields namely food industry and medical fields. Both applications bring benefit to human beings and animals. In food industry, okara undergo various processes to achieve optimal conditions that improved the nutritional quality of the food. Besides, animal feed could be produced at low-cost as well as healthy to the animals been feed. In medical field, endopeptidase and exopeptidase increased the protein hydrolysates that improved the health conditions within human bodies. Okara was suggested to be applied not only as food, animal feeds, supplemented diets, it could be applied as biofertilizer for agricultural plantation especially mushroom which was agronomically, environmentally and sustainability for the ecosystem.

Conflict of Interest

The authors have no conflicts of interests to declare.

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