Functional Food Materials Production from Food Process Waste and Its Physiological Activity Evaluation

論文要約

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Content：

This study reutilized food process waste to functional food materials and evaluated physiological activities of functional food materials.

The following is the first part of this study. In recent years, cancer becomes one of the most serious diseases that damage human health. *Undaria pinnatifida* is an important economic brown algae mainly in Asian countries and Japanese traditional food. The worldwide annual production of *Undaria pinnatifida* exceeds millions of tons, amount of which comes from China. Around 79,000 tons of cultured kombu is discarded in Japan during thinning out and food processes. *Undaria pinnatifida* contains a large amount of fucoxanthin and would be regarded as an excellent source of fucoxanthin. It is known that fucoxanthin has anti-cancer activity on some human cancer cells such as human colon cancers, leukemia cells, prostate cancer cells, breast cancer cells. However there are few studies about antioxidant activity of fucoxanthin and inhibitory effect and apoptosis of fucoxanthin on human cancer cells (HT1080, MDA-MB-231, U-2 OS and T24 cells). Therefore, we reutilized the waste brown algae to extract fucoxanthin and evaluated its physiological activity, which included antioxidant activities, immunomodulatory activity and anticancer activity.

The following is the second part of this study. As a food processing waste, a large amount of soybean curd residue arises from food industries, especially the preparation of tofu. It can be utilized as a fermentation medium for fungus culture. *Cordyceps militaris* is an entomegenous fungus that has broadly been used as a crude drug. Meanwhile, the functional ingredients found in *Cordyceps militaris* include

polysaccharide, cordycepin, cordycepic acid, which had various physiological activities. Therefore, re-utilizing the soybean curd residue to produce *Cordyceps militaris* is an efficient and commercial method to dispose the soybean curd residue waste materials. In this study, soybean curd residue was utilized to ferment *Cordyceps militaris*, and the optimal fermentation condition was investigated. We also evaluated the physiological activities of cordycepin and polysaccharides from fermented soybean curd residue by *Cordyceps militaris*, which included antioxidant activities, immunomodulatory activities and anticancer activities.

Conclusion and discussion:

On the one hand, fucoxanthin from *Undaria pinnatifida* had strong anti-oxidant activity on hydroxyl radical scavenging activity (EC_{50} = 7.03 μM) and ferrous metal ions chelating activity (EC_{50} = 30.22 μM). Fucoxanthin can activate proliferation of RAW 264.7 and protect it from DOX-induced and LPS-stimultaed cell damage. Fucoxanthin could inhibit proliferation of HT1080, MDA-MB-231, U-2 OS and T24 cells. We also indicated low dose of fucoxanthin-induced proliferation inhibition of T24 cells was associated with growth arrest at G0/G1 phase through up-regulation of p21 followed by down-regulation of CDK 2, CDK 4, Cyclin D1 and Cyclin E. However high dose of fucoxanthin-induced apoptosis was contributed to down-regulate Hsp70/ mortalin, which also released p53 from cytoplasm to nuclear translocation followed by up-regulation of cleaved caspase-3.

On the other hand, polysaccharides from fermented soybean curd residue showed potent antioxidant activity on five kind of antioxidant assays. After cytotoxicity assay,

cordycepin significantly activated proliferation of RAW 264.7 from 100% to 110.76%, and protected it from DOX-induced and LPS-stimulated cell damage, and cell viabilities were recovered from 100% to 176.51% and from 100% to 270.13%, respectively. Polysaccharides also significantly activated proliferation of RAW 264.7 from 100% to 153.41%, and protected it from DOX-induced and LPS-stimulated cell damage, and cell viabilities were recovered from 100% to 241.61%, and from 100% to 152.36%, respectively. Meanwhile, cordycepin and polysaccharides inhibited the proliferation of HT1080, Hela, A549, U-2 OS and MDA-MB-231 cells. The inhibitory effect of cordycepin on U-2 OS cells was the strongest, which cell viability decreased from 100% to 69.59%.

Therefore, this study can reutilize the food process waste (brown algae and soybean curd residue) to produce anti-oxidant and anti-cancer health food supplement or cancer therapy candidate drug, at the same time we can solve the disposition of food process materials to avoid the environment pollution.