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Biochemical changes associated with fast fermentation of squid processing by-products for low salt fish sauce

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Abstract

In order to enhance the economical values of squid processing by-products and reduce the environmental problems caused by the wastes from squid processing, the possibility of utilizing squid processing by-products for low salt fish sauce production was investigated. Low salt fish sauce was prepared experimentally from squid processing by-products, according to three different manufacturing techniques (A, B and C) with or without the autolysis process and the addition of flavourzyme, soybean koji. Fish sauce products with similar quality were obtained at 48 °C after 30 days fermentation. The content of total soluble nitrogen in three fish sauce A, B and C were 2.135 ± 0.038%, 1.958 ± 0.041% and 2.038 ± 0.043%, respectively. The content of formaldehyde nitrogen in three fish sauce A, B and C were 1.028 ± 0.038 g/100 ml, 1.000 ± 0.046 g/100 ml, 1.127 ± 0.043 g/100 ml, respectively. The salt content in three fish sauce A, B and C were 8.842 ± 0.138%, 9.058 ± 0.142%, 8.764 ± 0.129%, respectively. At the same time, changes in total soluble nitrogen, conversion of nitrogen, pH, formaldehyde nitrogen, total titration acid, total volatile base nitrogen, salt concentration, protease activity, total plate counts of fish sauce were observed during fermentation. The results suggested that total soluble nitrogen, conversion of nitrogen, formaldehyde nitrogen, total volatile base nitrogen and salt concentration increased throughout the fermentation period. However, pH, total titration acid, protease activity and total plate counts showed different changes in different fermentation stage. The result of amino acids analysis suggested that glutamic acid was the most prominent in three fish sauce samples. The results from quantitative descriptive analysis test showed that all fish sauce samples were tasted and no particularly strong or unpleasant flavor.

Keywords: Fish sauce; Squid by-products; Fermentation; Acceleration

1. Introduction

The exploitation of cephalopods has increased in recent years as a consequence of the declining stocks of commonly exploited fish species. The world demand for cephalopods increased at a rate of 15% per year between 1994 and 1996. The world total catches of cephalopods (squids, cuttlefishes and octopuses) were higher than 3.3 millions of tons between 1999 and 2001 (FAO, 2001). A large amount of squid by-products, which generally amount to 50% of the weight of the fish materials, was generated accompanying fishery processing. Despite international attempts to decrease squid wastes through various kinds of waste treatment systems, the quantity of wastes produced had been increasing annually (Nagai & Suzuki, 2000). These squid by-products could cause serious environmental problems if disposed improperly. Nowadays, the majority of squid by-products were dumped as wastes and caused serious environmental problems. Only a small part squid by-products was utilized for fishmeal and animal feed. And these recovered products are low in market values, making the recovery process uneconomical. It is necessity of converting these by-products into higher value products (Wang & Chang, 1997). In addition, some researcher reported that these squid by-products contained abundant natural protein and minerals that may be used for human

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consumption (Jeon & Kim, 1999; Kristinsson & Rasco, 2002). Therefore, the utilization of squid by-products for fish sauce production are both economical and environmental advantageous (Shi, Chen, Yu, Chang, & Wang, 2003).

Fish sauce fermentation is a common practice in Southeast Asia as a means of preserving and producing value-added products from underutilised fish species (Klomklao, Benjakul, Visessanguan, Kishimura, & Simpson, 2006). In Southeast Asia, fish sauce was not only popular as a condiment, but in some areas and certain social classes in the region, it was the main source of protein in the diet and had become a necessity in the household. Recently, Fish sauce has become more interesting for consumers in Europe, North America and other countries (Brillantes, 1999). Traditional fish sauce was produced by mixing whole fish with salt at a ratio of 1:1–3:1 and fermented for 6–12 months or longer (Tsai et al., 2006). High salt content in fish and shellfish sauces had limited its nutrient value because they could not be consumed in large quantities (Aryanta, Fleet, & Buckle, 1991). Therefore, low salt fish sauce is the urgent demand for society.

At present, although some works have been done on traditional fish sauce process (Dissaraphong, Benjakul, & Visessanguan, 2006; Shih, Chen, & Yu, 2003), there has few report on fast fermentation technology for low salt fish sauce, especially utilized squid by-products as materials. To accelerate the fermentation of fish sauce, soybean koji was used as inocula. The reason of koji used as inocula is that it was nonpathogenic and frequently used in food processing. In addition, it could add to the aroma, nutrition, and color of the fermentation product (Shih et al., 2003). The objective of the study is aimed at investigating fast fermentation technology for low salt fish sauce, in which squid byproducts were used as materials. The changes on biochemical and microbial were compared in different fish sauce fermentation technology process. It was hoped to obtain a fast fermentation technology for low salt fish sauce with better flavor and nutrition value.

2. Materials and methods

2.1. Raw materials

Squid (*Symplectoteuthis oualaniensis*) processing by-products used was obtained from China Aquatic Zhoushan Marine Fisheries Corporation, Zhoushan, China. Soy bean koji (*Aspergilus oryzae*) used was obtained from Qingdao Brewing Limited Corporation, Qingdao, China. Flovourzyme used was obtained from Novozyme Corporation (Danmark). Fig. 1 was a flow chart of fermented fish sauce process from squid by-products.

2.2. Fish sauce samples preparation

The squid (*S. oualaniensis*) processing byproducts was composed of heads, viscera, skin and fins. The by-products was thawed by tap water, cut into pieces and chopped into pastes. Fish sauce mush was prepared by fermenting the mixture of squid by-products pastes, soy sauce koji (20%, koji/pastes, w/w), distilled water (80%,water/pastes,w/w), salt (8%, salt/mixture, w/w) and with or without flovourzyme (0.2%, enzyme/pastes, w/w). The mixture was placed in conical flask (1000 ml) and the conical flask were covered tightly with triple-layer gauze clothe to maintain a semiaerobic condition. The mixture was fermented at 48 °C for 30 days and exhibited characteristic, favorable taste of fish sauce. Then the fish sauce mush was sterilization at 115 °C in autoclaves sterilizer for 10 min. The fish sauce mush cooled was centrifuged at 5000 r/min for 15 min. The lipid was removed with a spoon in the supernatant. The defatted fish sauce obtained was filtered with a filter paper (No. 5) and subjected to chemical analysis. During fermentation, the liquid formed was taken for analysis on days 1, 5, 10, 15, 20, 25 and 30.

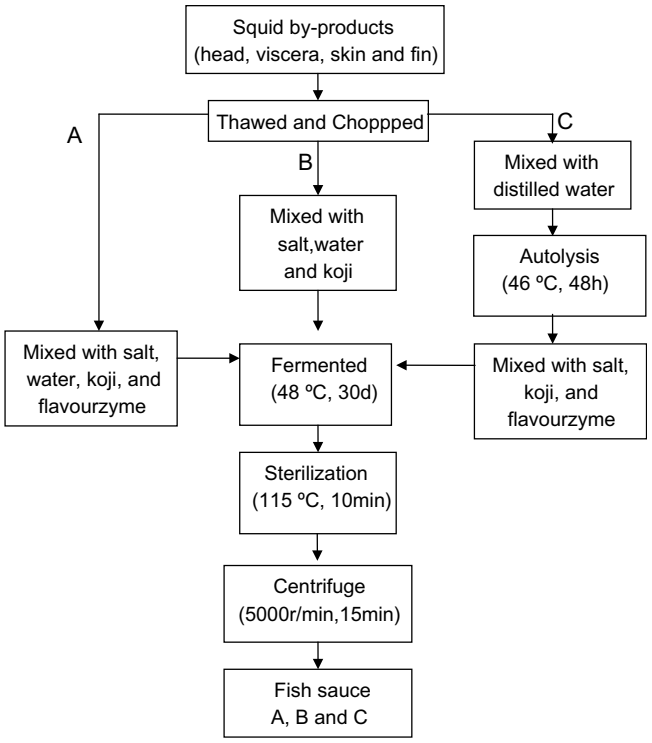

Fig. 1. Flow chart of fermented fish sauce from squid by-products.

2.3. Collection of liquid

At the designated time, the liquid used for protease activity detection was only centrifuged and filtrated.

2.4. Chemical analysis

2.4.1. Determination of pH, formaldehyde nitrogen and total titratable acid

The pH of liquid was determined directly using a digital pH meter (HM-5 S; TOA Electric Industrial Co. Ltd., Tokyo, Japan). Formaldehyde nitrogen was determined by the titration (Beddows, Ismail, & Steinkraus, 1979).