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The removal of fishy odor from tilapia skin using for gelatin extraction

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Introduction

Gelatin is a protein obtained from partial denaturation or hydrolysis of collagen. Due to its unique functional and technological properties, gelatin has been widely used in food, pharmaceutical, cosmetic and photographic applications [1]. Generally, gelatin is obtained from mammals, especially pig and cow skins and bones. However, porcine gelatin cannot be used in Kosher and Halal foods; whereas bovine counterpart is not consumed by Hindu because of religious constraints [2]. Particularly fish processing waste, skin, scale or bone, have gained attention for gelatin production due to their availability and the need to increase their value [3]. Because of fishy odor, fish skin is not material using for commercial gelatin production. The objective of this research was removed fishy odor from tilapia skin using for gelatin extraction.

Materials and methods

Materials
Nile tilapia (*Oreochromis niloticus*) skins were obtained from Grobest Marine Co.,LTD., Bangkok, Thailand. The skin was cut into small pieces (1.0 × 1.0 cm^2), placed in polyethylene bag and stored at -20°C until use.

Gelatin extraction
Tilapia skin was treated by 3 chemicals before extraction of gelatin by using hot water at 55°C for 3 h.
I. Skin was pretreated with 0.2% NaOH, 0.2% H_2SO_4 and 1% citric acid according to Grossman et al. [4].
II. Skin was pretreated with 1.5% NaCl according to Tiwtha and Usawakesmanee [5].
III. Skin was pretreated with 1.5% NaCl, 0.2% NaOH, 0.2% H_2SO_4 and 1% citric acid.

Yield of extracted gelatin
Yield of extracted gelatin was calculated from the formula.
Yield (%) = (dried weight of gelatin/wet weight of skin) × 100

Determination of gel strength
Gel strength was determined using a Texture analyzer (TA.XT Plus, Stable Micro Systems Ltd., Surrey, England). Dried gelatin (6.67%, w/v) was dissolved in distilled water at 65°C for 15 min until completely dissolved. The gelatin solution was added in glass measuring bottles and then kept at 4°C for 12 h. The maximum force (gram) was recorded when the penetration distance reached 4 mm.

Gas chromatography - mass spectrometry (GC-MS) analysis
Gelatin was dissolved (6.67%, w/v) with distilled water at 65°C for 15 min until completely dissolved. The gelatin solution was added in 5 ml cap vials (Head space screw tap 20 ml clear vials). The GC-MS analysis was performed using an Agilent Technologies 7890B and Agilent Technologies 5977A, Stable Micro Systems Ltd., Surrey, England [6].

Sensory evaluation
Gelatin gel was prepared as above (6.67%, w/v) Sensory evaluation for fishy odor intensity of gelatin gel was carried out according to Sae-leaw and Benjakul [7] using 36 trained panelists with the ages of 23-30. The panelists were asked to open the sealable cup and sniff the head space above the samples in order to determine the intensity of fishy odor, using a nine point hedonic scale from 9 (none) to 1 (extremely strong fishy odor).

Statistical analysis
Statistical tests were done using the SPSS computer program (SPSS Statistical Software Inc., version 20, Chicago, IL, USA). One-way analysis of variance was done. Differences between pairs of means were

assessed on the basis of confidence intervals using the Turkey test. The level of significance selected wasp <0.05.

Results and discussion

Yield of extracted gelatin

The percentages of gelatin yields of each treatment were no different as shown in table 1. The extracted yields were 18.79±0.23% to 21.03±0.55% was in the same range of previous experiments [8] all chemicals did not effect to extracted gelatin yield. The effects of alkaline/acid pretreatments on tilapia skin to were remove some alkaline/acid soluble proteins, lipids and other undesired components, disrupt some cross links of collagen molecules, and result in skin swelling, which made it more efficient to extract gelatin [8].

Determination of gel strength

Gel strength is one of the most important functional properties of gelatin. Gel strength is a function of complex interactions determined by amino acid composition and the ratio of α-chain and the amount of β-component. The gel strength of commercial gelatins ranges from 100 to 300 [9]. The gel strength of TrtI, TrtII, TrtIII and control (commercial) was shown in Table 1. This significant difference ($p<0.05$) among these gelatins in gel strength could be due to intrinsic characteristics, such as molecular weight distribution and amino acid composition as well as the type of extraction treatments. According to the amino acid composition, high gel strength of extracted gelatin may be due to the possible high content of proline and hydroxyproline which could result in massy organized triple helical structures. Proline and and hydroxyproline are thought to be responsible for the stability of the triple helix of collagen structure through hydrogen bonding between free water molecules and hydroxyl group of the hydroxyproline in gelatin [10].

GC-MS analysis

Fishy odor intensity of extracted gelatin was analysis by the GC-MS as shown in Table 1. Gelatin from defatted skin had lower fishy odor, compared with those extracted from skin without defatting. Fishy odor of gelatin also decreased when acid was incorporated during gelatin extraction. The formation of secondary lipid oxidation products is the main contributor to undesirable offensive fishy odor in fish skin. The fishy odor development in skin, which contained high level of poly unsaturated fatty acids, was mediated by lipid autoxidation and lipoxygenase induced oxidation. The result suggested that the use of defatted skin in combination with acid incorporation during gelatin extraction was a promising means to minimize the formation of fishy odor in the gelatin.

Volatile base in Table 1 is volume of volatile other compound is remaining and cannot be removed (Area normalized (%)). The volume of volatile is high. It will make a lot of smell, but if volume of volatile is low. It will make the smell less. In the treatment TrtII, volatile of alcohols decrease and other compound will decrease as well such as methoxy phenyl oxime. The effect is reduced to 10 times compare to control and TrtIII the substance will be reduced to 29 times compare to control.

Sensory evaluation

Sensory evaluation of extracted gelatin was related to the result of GC-MS. It made TrtIII was accepted by panelists was similar to a commercial gelatin.

Table 1. Yield (%), gel strength (g) and fishy odor of gelatin from tilapia skin

Treatment	Yield (%)†	Gel strength (g)†	Volatile base†	Sensory
Commercial	-	964.50±7.92^{b}	-	A
TrtI	21.03±0.55^{a}	856.07±5.30^{c}	326^{a}	R
TrtII	18.79±0.23^{b}	541.87±6.74^{d}	321^{a}	R
TrtIII	20.37±0.64^{ab}	1811.73±8.80^{a}	36^{b}	A

Values are expressed as mean±SD (n=3).
† Different letters within the same row indicate significant differences ($p<0.05$).
Accept (A), Reject (R)

Conclusions

Gelatin extraction from tilapia skin using 1.5% NaCl, 0.2% NaOH, 0.2% sulfuric acid and 1% citric acid as TrtIII effectively prevented lipid oxidation, the development of volatile compounds and fishy odor in the extracted gelatin and improve gel strength of gelatin.

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