

## **Development of Fish Glue using Skin of Yellow fin tuna (*Thunnus albacares*) and Mahi-mahi (*Coryphaenidae hippurus*) and Characterization of Glue Properties**

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### **Introduction**

Fish glue is made out of fish skin and is a special type of glue which differs from other animal glue due to their specific glue properties. It remains as a liquid in room temperature and has a higher open time, and very sticky (Shepherd, 2009). Fish glue is usually made from head bones, skin and fins of the cold water marine fish. Characteristics of the final glue product depends on the raw material selected (Norland,, 1990). Recognition of the limited biological resources and increasing environmental pollution has emphasized the value-addition using under-utilized fish and the by-products from the fish industry (Geurard *et al.* 2002). Dorsal skin of Yellow fin tuna (*Thunnus albacares*) is removed during tuna processing and can be used as a source of fish collagen.

The main objective of this study was to find out the best quality fish glue using fish skin of the yellow fin tuna and Mahi-mahi (*Coryphaenidae hippurus*), and to identify the best and cheapest processing method for extraction of fish glue from yellow fin tuna and Mahi-mahi fish skin.

### **Methodology**

The moisture content (Oven drying procedure), ash content, crude protein and fat content (using ether extraction) of tuna fish skin and Mahi mahi fish skin and glue were analyzed according to the AOAC standard methods.

Gelatin was prepared by acid extraction method. Cleaned tuna skin and Mahi mahi skin were treated at different solutions with known concentrations. The tuna and Mahi mahi skin were first washed in water separately at 23 °C and incubated twice in different concentrations of NaOH solution (0.1%, 0.2%, 0.4% w/v) for a period of different soaking times (for tuna, 18 hours and 24 hours and for Mahi mahi 1 hour, 3 hours). Then the skins were washed thoroughly with tap water and two successive acid incubations were performed using dilute HCl acid (0.1%, 0.2%, 0.4%v/v). Incubated time for tuna was 12 hours, 24 hours and for Mahi mahi 1 hour and 3 hours. The acid solution was drained and the sample was washed with running tap water for 1 hour and weighted the final skin sample. A gelatin extraction was performed by gentle stirring in open pan at 55-60 °C (8 hours for tuna and 6 hours for Mahi mahi). Solubilized gelatine was separated from residual skin fragments by filtering through a muslin cloth. The gelatine solution was boiled at 90 °C for 5-6 hours in an open pan to evaporate water to concentrate the glue sample. Finally a preservative (wintergreen oil) was added and bottled glue samples were kept in the refrigerator at chilled temperature -12 °C.

## Results and Discussion

Moisture content of the Yellow fin tuna and Mahi-mahi were 39.1% and 33.8% respectively. According to Cho *et al.* (2005) the dorsal skin of Yellow fin tuna has 56.1% moisture, 6.8% crude fat, 1.0% of crude ash and 33.6% of crude protein. The Mahi-mahi skin contained 46.73% of crude protein, 5.83%, of crude fat and 6.7% crude ash.

The acid and alkaline concentration of the solution used for pretreatment has great influence on the extraction of collagen from fish skin. This study showed that at the 0.4% acid and alkaline concentrations, considerable swelling and loss of collagen was experienced during 24 hours of soaking time compared to 18 hours.

Since Yellow fin tuna skin has considerable thickness than Mahi mahi skin, with the same alkaline and acid concentration significant changes in swelling of Mahi mahi skin was observed. Therefore, the soaking time for Mahi mahi skin was limited to 1- 3 hrs.

The mild alkaline treatment liberates all of the volatile bases which are the causative agents of the characteristic fish gelatin odour. In this study no fish odour in extracted glue was experienced due to the mild alkaline treatment followed by acid treatment.

The higher yield of gelatin and glue were recorded at 0.2% acid and alkaline solution for 24 hours soaking time and next at 0.2% acid and alkaline for 18 hours soaking time. For Mahi mahi 60% yield was experienced at 0.1% acid and alkaline concentration for one hour soaking time.

The chemical composition of gelatin extracted from yellow fin tuna and Mahi-mahi is with the standard fish glue is given in Table 1.

Table 1. The chemical and physical composition of yellow fin tuna and Mahi-mahi fish glue

Quality factors	Tuna Fish Glue	Mahi-mahi Glue	Fish Standard fish glue (Kremer)
Moisture content (%)	76.32%	78.50%	55%
Solid content (%)	23.68%	21.5%	45%
Ash (%)	0.81%	2.1%	Less than 0.1%
pH	5.06 -5.30	4.17- 4.40	4-6
Bonding power (after 30 minutes)	0.5 kg- 2.5 kg	0.1 kg -0.8 kg	-
Open time (hours)	1-3	4-5	1.5- 2
Time to tack (minutes)	1-3	4- 5	1
Melting point	20-22 °C	21-22 °C	5-10 °C
Color	Dark brown	Yellowish green	Light caramel

The concentration of the NaOH and HCl had a significant effect on extraction yield and open time. Other responses such as time to tack, melting temperature, colour were not significant. The best tuna glue sample was obtained at the concentration of 0.2% NaOH, with a soaking time of 24 hours, extraction temperature 55 °C and extraction time 8 hours (P<0.05). The best Mahi mahi fish glue sample was obtained at the concentration of 0.2%

NaOH, with a soaking time of 3 hours, extraction temperature 60 °C and extraction time 6 hours ( $P < 0.05$ ).

### **Conclusion**

Yellow fin tuna and Mahi-mahi skin can be used as good sources for gelatin extraction and glue preparation using acid extraction method.

### **References**

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