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Fish glue from tilapia scale and skin and its physical and chemical characters

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Abstract
Fish glue is impure gelatin (collagen) prepared from fish heads, bones and skins. Fish glue is known for value added product from fish processing by-products as the adhesive agent. A fine looking, attractive and very good quality glue was prepared from wastes sample of tilapia fish. Firstly tilapia was assessed to know their body proportions (muscle, head, frame, skin, scale, intestine and fin). Assessments were made on the proximate composition, specific gravity, pH value, flammability and sensory quality (colour) of the glue obtained. Protein contents were higher in both scales and skins. Collagen mainly constituted proteins in both scales and skins which transformed into glue after heating. The crude protein content in glue ranged from 51.14±2.15% to 65.67±1.07% with higher value in tilapia skin and lower in tilapia scale glue. Lipid contents were drastically reduced in two glues. Ash and moisture contents had similar pattern. The pH of glue ranged between 3. 26 to 3.42. Very good looking and attractive coloured glues were prepared from tilapia wastes samples.

Keywords: Fish, glue, tilapia, wastes

1. Introduction
Fishery is the occupation or industry of catching fish or tapping other marine or freshwater resources. One of the major sectors of Bangladesh agriculture is represented by the fisheries sector [4]. About one-third of the world catch of fish is not used for direct human consumption but for the production of fishery by-products [7]. Tilapia production in Bangladesh is increasing day by day. Tilapia production in the fiscal year of 2013-14 was 298062 MT [4]. It is now possible to make glue from tilapia skin and scale as a by-product. Fish glue and gelatin are synonymous, but some differences exist between them [11].
Fish glue is a natural product which is obtained by cooking fish skin, followed by evaporation [8]. Collagen is the main component of fish glue. It is a highly viscous liquid at room temperature. Collagen is the main component of fish glue. Collagen itself is not soluble in water, but it can be broken down in heat in the presence of water and other chemicals to produce a water soluble product, where the end product is glue [5]. Fish glue is usually more expensive than animal glue, since fish glue is liquid and it is easy to use [3].
Tropical fish such as tilapia was a superior material for gelatin processing than other fishes [6].
The conversion of collagen to glue involves the breaking of hydrogen bonds which stabilize the triple-coil helix transforming it into the random coil configuration of glue. The hydrolyzed products depend upon the crosslinks which remain between the peptide chains and reactive amino carboxyl-terminal groups that have been formed [2, 12]. The effect of heating on the fish component is the occurrence of physical and chemical changes such as the denaturation of protein, causing the colour changes and the shrinkage of the molecule of amino acids as the collagen [9, 14].
The major objective of this research was to understand the volume of the wastes parts of Tilapia body and to assess the suitability of different wastes parts (scale, skin etc.) for the manufacture of fish glue in Bangladesh condition.

2. Materials and Methods
2.1 Glue processing
Fresh whole fishes were purchased from local markets in Mymensingh, Bangladesh and preserved at -20 ºC until use.

Fishes were thawed at room temperature. After thawing, assessment of body parts was done. After scaling skin was collected by filleting process. Fresh fish skins were washed in running water for 1-2 hours to remove odour. Then it was chopped and immersed in 0.2% NaOH (two volumes of raw materials) for one hour to open the fibre bundle and remove the connecting materials. It was then neutralized with dilute HCL (0.1N) for one hour and again washed with running water. Scales were simply washed in running water. Both scales and skins were kept at -20 ℃ until use.

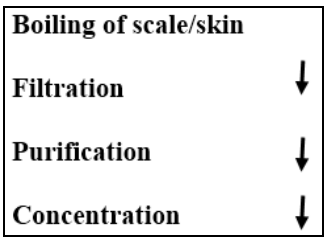

Fig 1: Scheme for the preparation of fish glue

Glue was prepared from both scales and skins by following procedure. 2% alum was added to make clear glue solution.

2.2 Physical and chemical characterization

Moisture, ash, protein and lipid were analyzed by AOAC (1990) method. pH of the glue was measured by pH meter and specific gravity was determined by dividing its density by that of water at room temperature. Flammability was measured using safe matches. Colour of glue prepared from tilapia fish scale and skin was determined by organoleptic scales based on eye estimation using a scale from 1~5 with 1 being light and 5 being dark and keeping brown in the middle as standard preferred colour.

3. Results and Discussions

3.1 Assessment of body parts

Body parts were assessed to know the proportion specially to know waste percentage. After scaling, skin of tilapia was collected in the Fish Processing Laboratory, Department of Fisheries Technology by filleting of fish.

Table 1: Body proportion of tilapia

Species	Body weight (g)*1	Scale (%)*1	Fin (%)*1	Intestine (%)*1	Skin (%)*1	Head (%)*1	Frame (%)*1	Muscle (%)*1
Tilapia	400±0	4.42±0.04	1.75±0.01	7.65±0.44	3.50±0.01	19.70±0.05	8.68±0.30	54.30±0.15

*1Mean± SD of three replicates

From Table 1 it is understood that, tilapia *(Oreochromis niloticus*) contained 4.42±0.04% scale, 1.75±0.01% fin, 7.65±0.44% intestine, 3.50±0.01% skin, 19.70±0.05% head, 54.30±0.15% muscle and 8.68±0.30% frame.

3.1 Analysis of Proximate Composition

Analysis of proximate composition was done to know their composition specially to know protein content because protein is the main component of glue. The data for proximate composition is given in Table 2.

Table 2: Proximate composition of tilapia skin and scale

Fish Wastes	Moisture (%)*1	Ash (%)*1	Protein (%)*1	Lipid (%)*1
Tilapia Scale	56.34±0.64	19.72±0.74	21.84±1.30	0.82±0.10
Tilapia Skin	70.73±0.33	3.80±0.41	22.31±1.15	1.60±0.51

*1Mean± SD of three replicates

Moisture, ash, protein and lipid of tilapia scale were found to be 56.34±0.64%, 19.72±0.74%, 21.84±1.30% and 0.82±0.10%, respectively. The moisture, ash, protein and lipid of tilapia skin contained 70.73±0.33%, 3.80±0.41%, 22.31±1.15% and 1.60±0.51%, respectively. Muyonga et al. (2004) analyzed proximate composition of tilapia skin and found moisture 72.6±2.49%, ash 4.24±0.35%, protein 21.30±2.53% and fat 3.85±0.22%. Akter *et al*. (2016) also analyzed proximate composition of tilapia skin and found moisture 71.73±0.31%, ash 3.88±0.44%, protein 21.31±1.17% and fat 1.55±0.49%.

Collagen mainly constituted proteins in both scales and skins which transformed into glue after heating. Ash contents were significantly higher in scales compared to skins, while lipid contents were very low.

3.2 Quality of glue

The data for quality test are given in the Table 3.

Table 3: Quality of glue

Quality	Tilapia skin	Tilapia scale
Moisture (%)*1	30.35±1.35	43.86±1.02
Ash (%)*1	2.10±0.34	2.82±0.41
Protein (%)*1	65.67±1.07	51.14±2.15
Lipid (%)*1	0.57±0.05	0.55±0.03
Colour	Brown (1.7±0.15)	Light Brown (2.8±0.01)
pH	3.26	3.42
Flammability	Non-flammable	Non-flammable
Specific gravity	1.24 (26^0C)	1.10 (26^0C)

*1Mean± SD of three replicates

The crude protein content ranged from 51.14±2.15% to 65.67±1.07%, with higher value in tilapia skin and lower in tilapia scale. Protein content was found 81.16±2.15% in tilapia skin gelatin [6]. Lipid contents were drastically reduced in glue proving its purity and good quality Ash contents have almost similar pattern in two types of glue. Moisture content was higher in tilapia scale glue and lower in tilapia skin glue. Standard and preferred brown colour was found in tilapia skin

glue. pH of fish glue has important role in its stability during storage, the lower the pH value, the longer the storage life of the products. In the present study, tilapia skin glue had lower pH value. Both types of tilapia glues were non-flammable. Comparing the yield, it was found from table 4 that skin produces more glue than scale.

Table 4: Yield of fish glue

Raw material	Wt. of raw material (g)	Glue (g)
Tilapia scale	350	40
Tilapia skin	500	90

4. Conclusion

Very good looking, attractive coloured and appealing flavoured fish glue was prepared from tilapia skin and scale especially from skin. In near future, there is possibility of growing tilapia processing industry in Bangladesh. So tilapia wastes could be easily collected for making glue. It will raise an alternative way to enhance the value added of the fish for the new product and will able to reduce cost of the eliminated garbage that usually create problem of pollution to human and environment.

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