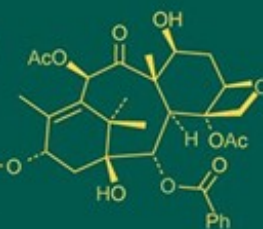
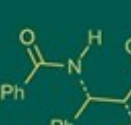


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
Indexing: Embase
IJABR 2026; 10(9): 959-963
www.biochemjournal.com
Received: 14-07-2026
Accepted: 14-08-2026
Published: 30-09-2026

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Assessment of Talang queenfish (*Scomberoides commersonnianus*) skin as a potential raw material for fish leather production

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DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i9l.10238>

ABSTRACT

The increasing amount of fish processing waste has made it necessary to valorise this waste into high-value materials. Fish skin is highly valued because its dermal matrix is rich in structural proteins, especially collagen, which can be used as a raw material for leather manufacturing. The present study was carried out to evaluate the morphometric properties, biochemical composition and collagen content of Talang queenfish (*Scomberoides commersonnianus*) skin for the suitability as raw material for fish leather production. The fish skin had a mean length of 61.90 ± 3.60 cm and a width of 20.05 ± 2.28 cm, showing a relatively large skin surface area for value addition. The skin contained 62.33 ± 1.96 % moisture, 26.99 ± 1.38 % crude protein, 4.48 ± 0.49 % crude fat, 6.54 ± 0.34 % ash and 31.59 ± 0.91 % collagen. Protein was the major constituent of the skin after moisture. The skin has the potential to be converted into value-added leather due to its high collagen content, appreciable protein concentration and relatively large skin dimensions.

Keywords: Talang queenfish, Fish skin, Collagen, Biochemical composition, Chrome-free leather

1. Introduction

The rapid development of fisheries and seafood-processing activities has increased the availability of processing waste, creating both an environmental challenge and an opportunity for resource recovery. Processing operations generate several by-products, including skin, scales, bones, heads, viscera and trimming materials. Rather than throwing these materials solely as waste, increasing attention is being directed towards their conversion into products containing higher economic and functional value. These approaches are in line with the principles of circular bioeconomy, where biological resources are kept in productive systems for as long as possible (Caruso *et al.*, 2020; Gaikwad *et al.*, 2024) [1, 2].

Among fish-processing by-products, skin is of particular interest because it contains a dense extracellular matrix dominated by collagen. Collagen is the principal structural protein of connective tissues and provides strength and mechanical integrity to biological tissues. Fish skins have consequently attracted considerable attention as sources of collagen for food, pharmaceutical, cosmetic, biomedical and biomaterial applications (Jafari *et al.*, 2020; Rajabimashhadi *et al.*, 2023) [3, 4]. Fish-derived collagen is also considered an important alternative source to mammalian collagen because it can be recovered from materials that would otherwise have limited utilization. The biochemical characteristics of fish skin vary considerably among species. Moisture, protein, lipid and mineral fractions can influence the behaviour of skin during preservation, pre-treatment, collagen recovery and tanning. Protein concentration is particularly important because the dermal structure is predominantly proteinaceous, whereas excessive lipid can interfere with chemical penetration during leather processing and may necessitate more intensive degreasing. Mineral matter, represented by ash, can also influence processing characteristics. These negative factors create a need to characterize the raw skin before deciding its suitability for leather manufacture (Muyonga *et al.*, 2004; Kittiphattanabawon *et al.*, 2005) [5, 6]. The potential of fish skin for leather production has been demonstrated for several marine and freshwater species. Fish skin has a characteristic grain pattern present on its surface which gives an exotic appearance to the final leather. Also, the collagen fibre arrangement can produce distinctive material properties after tanning. Nile perch, tilapia, cobia, basa and leatherjacket fish skin have already found useful in collagen recovery and leather production (Muyonga *et al.*, 2004; Muralidharan *et al.*, 2013; Sasidharan *et al.*, 2020; Souza *et al.*, 2017) [5, 7, 8, 9]. Kotian *et al.* (2025) [10] and Krishnamurthy *et al.* (2026) [11] used chrome-free tanning method to produce fish leather and reduce the environmental concerns associated with conventional chromium-based tanning processes.

Talang queenfish, *Scomberoides commersonnianus* Lacepède, 1801, belongs to the family Carangidae and is distributed throughout the Indo-West Pacific region. It is a marine species associated with coastal waters and

is known by several common names, including Talang queenfish. The relatively large body dimensions of the species make its skin potentially attractive for value-added applications. Despite the recognized potential of fish skin as a collagen-rich raw material, species-specific information is necessary to determine the suitability of individual fish-processing by-products for leather manufacture. Information on the biochemical composition and collagen content of *S. commersonnianus* skin is particularly useful for assessing its raw-material characteristics before undertaking tanning trials. Therefore, the present study was undertaken to determine the morphometric characteristics, moisture, crude protein, crude fat, ash and collagen contents of Talang queenfish skin and to evaluate its potential as a raw material for leather production.

2. Materials and Methods

2.1. Collection and preparation of sample

Fresh Talang queenfish (*Scomberoides commersonnianus*) skin were collected from the fish landing centres and markets around Mangaluru, Karnataka, India, and transported under chilled conditions to the Department of Fish Processing Technology, College of Fisheries, Mangaluru, for laboratory analysis.

The skin was carefully separated from the underlying muscle tissue. Adhering flesh, blood and other extraneous material were removed manually, followed by thorough washing with chilled distilled water. The cleaned skin samples were packed in suitable polyethylene bags and maintained under frozen conditions until further analysis. Prior to biochemical and collagen analyses, the required quantity of skin was thawed and homogenized.

2.2. Morphometric analysis

Morphometric measurements were recorded before skin processing. Total length and maximum skin width were measured in centimetres. The measurements were used to characterize the physical size of the raw material and to provide an indication of the available skin surface for subsequent leather applications.

2.2. Biochemical composition

The proximate composition of the fish skin was determined in accordance with the procedures prescribed by AOAC (2019) [12]. For moisture estimation, the homogenized skin samples were subjected to hot air oven drying at 100 °C and maintained until a constant mass was obtained. Kjeldahl method was used to determine the protein and the nitrogen content was multiplied by 6.25 to obtain the protein value. Lipid content was determined by Soxhlet extraction using petroleum ether as the extraction medium. Ash was quantified by heating the previously dried samples in a muffle furnace at 550 °C until complete incineration and attainment of a constant weight of mineral residue.

2.3. Collagen extraction and estimation

Acid-soluble collagen (ASC) was obtained from the fish skin following the procedures described by Muyonga *et al.* (2004) [5] and Sasidharan *et al.* (2020) [8], with suitable modifications. Initially, the frozen skin was allowed to thaw under refrigerated conditions and subsequently subjected to alkaline treatment using 0.1 M NaOH at a skin-to-solution ratio of 1:8 (w/v). The treatment was continued for 6 h with the NaOH solution being renewed after every 3 h to facilitate the removal of non-collagenous proteins. Following alkaline treatment, the skin was repeatedly rinsed with chilled distilled water until the sample attained a neutral pH.

The alkali-treated skin was then subjected to defatting using 10 % butyl alcohol at a sample-to-solvent ratio of 1:10 (w/v) for 24 h at 4 °C. Solution was refreshed after every 12 hr. After defatting, the samples were thoroughly washed to remove residual solvent. Acid extraction of collagen was subsequently carried out using 0.5 M acetic acid at a skin-to-acid ratio of 1:10 (w/v). The mixture was continuously stirred and maintained at 4 °C for 12 h to facilitate solubilization of the collagen fraction.

After extraction, the resulting mixture was centrifuged at 10,000 × g for 30 min. Leftover residues were resolubilized in 0.5 M acetic acid for 12 hrs. Collagen was recovered from the clarified extract by salting-out with sodium chloride. Finally, the it was freeze-dried at -57 °C for 6-8 hrs and packed in HDPE bags until further analysis as per the Jafari *et al.* (2020) [3] and John Kumar *et al.* (2025) [13].

2.4. Statistical analyses

All biochemical and collagen analyses were conducted in triplicate. The results were expressed as mean ± standard deviation (SD), $n = 3$. The obtained values were tabulated and interpreted to describe the biochemical characteristics and collagen content of Talang queenfish skin.

3. Result and Discussion

3.1 Morphometric measurement

The morphometric characteristics of Talang queenfish used in the present study are presented in Table 1. The fish skin had a mean length of 61.90 ± 3.60 cm and a width of 20.05 ± 2.28 cm, indicating a relatively large body size (Fig. 1). These measurements give practical significance for fish leather production because, larger skin surface area provide large usable leather area. The observed morphometric characteristics showed a favourable dimension for Talang queenfish skin as a raw material for leather production.

Values are expressed as mean ± standard deviation ($n = 3$).

3.2 Biochemical composition and collagen content

The biochemical composition and collagen concentration of Talang queenfish skin are summarized in Table 2. The skin had 62.33 ± 1.96 % of moisture, 26.99 ± 1.38 % of crude protein, 4.48 ± 0.49 % of crude fat and 6.54 ± 0.34 % of % ash.

Table 1. Morphometric parameters of Talang queenfish Skin

Parameter	Value
Length (cm)	61.90 ± 3.60
Body width (cm)	20.05 ± 2.28

The results indicated that water and structural protein were the major components of Talang queenfish skin and that it also contained quantifiable amounts of lipid and mineral matter. Fish skins from different species may show considerable variation in proximate composition due to differences in species, age, habitat, season, nutritional condition, skin structure and analytical methodology (Muyonga *et al.*, 2004; Kittiphattanabawon *et al.*, 2005; Jafari *et al.*, 2020) [5, 6, 3].

Table 2. Biochemical Composition and Collagen Content of *Scomberoides commersonnianus* Skin

Sr.No.	Parameter	Content (%)
1	Moisture	62.33 ± 1.96
2	Crude protein	26.99 ± 1.38
3	Crude fat	4.48 ± 0.49
4	Ash	6.54 ± 0.34
5	Collagen	31.59 ± 0.91

Values are expressed as mean ± standard deviation ($n = 3$).

3.2.1 Moisture content

The moisture content of Talang queenfish (*Scomberoides commersonnianus*) skin was 62.33 ± 1.96%, representing the major component of the fresh skin. This value was lower than the 68 % reported for Nile perch skin by Muyonga *et al.* (2004) [5], but similar to the 62.73% reported for tilapia skin by Li *et al.* (2018) [14] and slightly lower than the 67.55% reported for barramundi skin. Differences in moisture content among species are due to variations in tissue composition,

physiological condition, habitat and relative amounts of protein, lipid and mineral constituents.

The moisture content found is of concern for the handling and processing of the skin, particularly as fresh moisture-laden skins are susceptible to microbial degradation during storage. Hence, the integrity of the skin matrix needs to be maintained by either rapid treatment or appropriate storage prior to tanning. Further, moisture removal in subsequent pretreatment and drying should be well controlled to achieve uniform processing and avoid adverse changes in the structural properties of the skin.



Figure 1. Talang queenfish (*Scomberoides commersonnianus*) Skin

The Talang queenfish is notably protein rich where the dermal tissue mostly contains structural proteins with collagen being the dominant fraction. The collagen content was 31.59 ± 0.91 % which can be considered as the value of crude protein in the present study and indicates the well-developed proteinaceous matrix in the skin. Fish skins have also been studied for collagen recovery and leather production, and found to possess similar protein-rich properties (Muralidharan *et al.*, 2013; Jafari *et al.*, 2020) [7, 3]. The results indicated that the skin of Talang queenfish has high potential to be used as value added biomaterials especially as fish leather with proper pretreatment and tanning optimisation.

3.2.3 Crude fat content

Talang queenfish (*Scomberoides commersonnianus*) skin had 4.48 ± 0.49 % crude fat, indicating moderate amount of lipids stored in the skin. The value was higher than 2.00 ± 0.33 % as reported for Bullseye (*Priacanthus hamrur*) skin by Chavan *et al.* (2026) [15] and 2.27 ± 1.09 % as reported for tilapia skin by Li *et al.* (2018) [14], but lower than 5.56 % as reported for Cobia (*Rachycentron canadum*) skin by Kotian *et al.* (2025) [10]. Such interspecific, age, tissue differences and lipid deposition may account for the differences in skin lipid content between species. For example, higher levels of lipid in the skin of adult versus young Nile perch were reported by Muyonga *et al.* (2004) [5] suggesting an age effect on lipid accumulation. From the perspective of leather processing, the observed level of lipids is important because residual fats can prevent the uniform penetration of the tanning chemicals into the collagen fibre network. Proper degreasing should be incorporated in the pretreatment of Talang queenfish skin to assist in the subsequent tanning and to improve the uniformity of the finished leather.

3.2.4 Ash content

The ash content of Talang queenfish (*Scomberoides commersonnianus*) skin was 6.54 ± 0.34 % which was higher than that reported for some fish skins. Chavan *et al.* (2026) [15] found ash content in the

3.2.2 Crude protein content

The crude protein of Talang queenfish (*Scomberoides commersonnianus*) skin was 26.99 ± 1.38 % indicating that the skin was protein-rich and could be an important resource for processing. This was higher than 21.6 % reported for Nile perch skin by Muyonga *et al.* (2004) [5] but lower than the values reported for barramundi (28.92 %) and tilapia (33.45 %) indicating that there is a significant interspecific variation in the skin protein composition. Chavan *et al.* (2026) [15] reported the Bullseye skin to contain significant levels of protein, which further supports the use of fish skins as protein-rich by-products. These differences can be attributed to species, age, nutritional status, habitat and variation in the relative proportions of connective and non-connective tissues.

skin of Bullseye (*Priacanthus hamrur*) of 3.41 ± 0.29 % and Kotian *et al.* (2025) [10] found 2.59 % in the skin of Cobia (*Rachycentron canadum*). The higher ash content of Talang queenfish may be due to species difference in mineral composition, tissue characteristics and mineral-rich residual structures. This variation is of significance in leather processing as high levels of inorganic matter can interfere with the efficiency of pre tanning and the subsequent reaction of tanning agents with the collagen matrix. Therefore, good pretreatment and cleaning of Talang queenfish skin is likely important to get consistent tanning and quality of leather.

3.3. Collagen content

The collagen content is an important parameter in assessing the suitability of fish skin for leather production. The collagen content of Talang queenfish skin was 31.59 ± 0.91 % and it could be used as raw material for leather production (Fig. 2). The fish skin is mainly constituted by type I collagen that makes a framework of structural fibers that contribute to the strength and stability of the dermal tissue (Bae *et al.*, 2008; Jafari *et al.*, 2020) [16, 3]. The type of this collagen can also vary with species and environmental factors (Silva *et al.*, 2014) [17]. Some of the fish species such as Nile perch, tilapia and catfish also showed similar collagen rich properties (Muyonga *et al.*, 2004; Kittiphattanabawon *et al.*, 2005) [5, 6].

The relatively high collagen content observed in this study is promising for future trials for leather development, but the final quality of the leather depends also on the conditions of pretreatment, degreasing, tanning, cross-linking, drying and finishing (Fadda *et al.*, 2024; Covington *et al.*, 2019; Costa *et al.*, 2022) [18, 19, 20]. Recent research has also reported the potential of developing fish leather with chrome-free tanning processes, supporting the potential for sustainable use of fish processing by-products (Souza *et al.*, 2017; Sasidharan *et al.*, 2020; Kotian *et al.*, 2025; Krishnamurthy *et al.*, 2026) [9, 8, 10, 11]. So, the collagen content in the skin of the Talang queenfish is a promising

starting point for further research and optimization for the production of chrome-free fish leather.

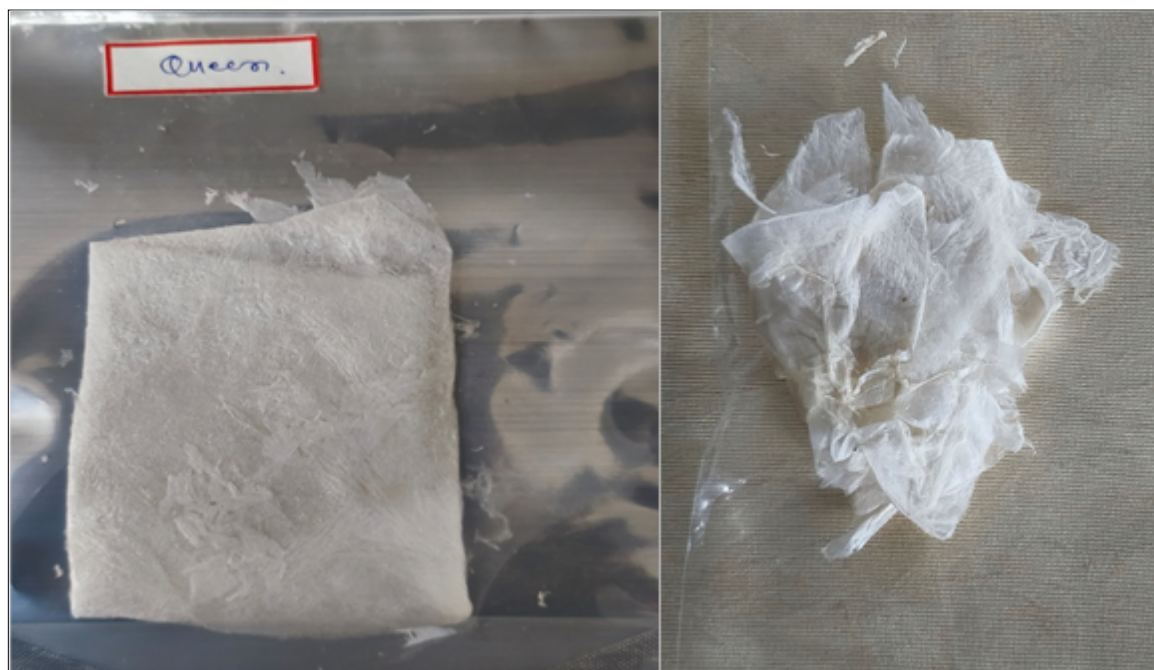


Figure 2. Collagen extracted from Talang queenfish (*Scomberoides commersonnianus*) Skin

4. Conclusion

The present study showed good biochemical properties of the skins of Talang queenfish (*Scomberoides commersonnianus*), particularly its good collagen levels, suggesting its potential for fish leather production. The results suggest that this underutilized fish processing by-product could be a promising raw material for the manufacture of value-added leather. Its use can contribute to the reduction of processing waste and to the sustainable use of fisheries resources. Further investigations on optimization of tanning and mechanical, physical and storage properties of the developed leather are needed to establish its suitability for commercial applications.

5. Acknowledgement

The authors gratefully acknowledge the support and encouragement extended by the Head, Department of Fish Processing Technology and the Dean, College of Fisheries Mangalore, Karnataka Veterinary, Animal and Fisheries Sciences University (KVAFSU), Bidar, India. The authors also sincerely thank the Director of Instructions (PGS), KVAFSU, Bidar, India, for providing the necessary institutional support and financial assistance throughout the study period.

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How to cite this article: Chavan SD, Bojayaiaik M, Rekhyanaik S, Ganachari J, Prapti. Assessment of Talang queenfish (*Scomberoides commersonnianus*) skin as a potential raw material for fish leather production. *International Journal of Advanced Biochemistry Research.* 2026;10(9):959-963. doi: <https://www.doi.org/10.33545/26174693.2026.v10.i9l.10238>