OPTIMIZATION OF SKINNING METHODS FOR AFRICAN CATFISH (CLARIAS GARIEPINUS) AND PROSPECTS FOR ITS USE IN THE LEATHER INDUSTRY

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Abstract. *This article presents the potential for using the skin of the African catfish (Clarias gariepinus), cultivated under intensive aquaculture conditions, as a competitive raw material for the leather industry. The functional significance of skinning methods and topographical zones is substantiated to ensure maximum yield by skin area. The obtained results indicate the possibility of using African catfish skin in the leather industry as part of an exotic product range, reducing waste, and increasing the economic and ecological efficiency of production.*

Keywords: *African catfish, Clarias gariepinus, fish skin, leather raw material, resource-saving technology, fishery waste, exotic leather, collagen structure, skin yield, leather industry.*

Within the context of economic modernization and increasing resource efficiency, implementing the "waste—raw material—added value" chain in agriculture and processing industries is of significant importance. In the

conditions of Uzbekistan, the African catfish (Clarias gariepinus) [1] is discussed as a fast-growing species in intensive aquaculture, and there exists the potential to transform the skin waste generated from its processing into a base of raw materials for the leather industry. Enumerating these possibilities, first and foremost, this species is widely spread in aquaculture and can ensure a stable volume of raw materials at fish processing enterprises. During filleting and processing, the skin remains as a by-product or waste. From this perspective, reprocessing skin waste into leather serves resource conservation, waste reduction, and increasing economic efficiency.

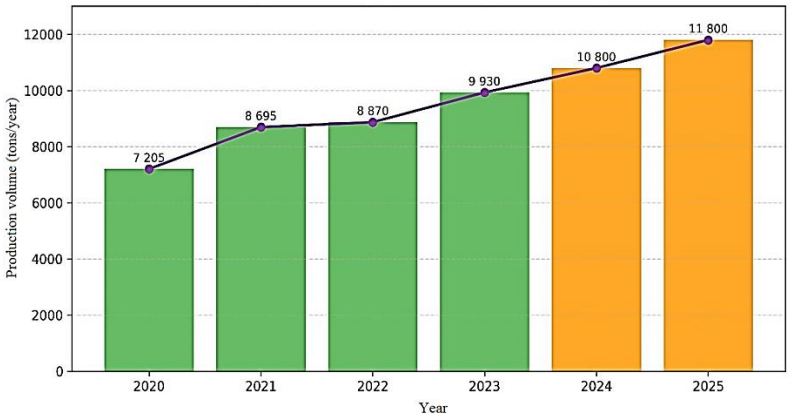


Figure 1. Production volume of African catfish (Clarias gariepinus) in Uzbekistan (2020-2025 period)

As presented in Figure 1, the production volume of African catfish from 2020 to 2025 demonstrates a consistent year-on-year growth trend. Specifically, the indicator, which was 7,205 tons in 2020, reached 8,695 tons in 2021, 8,870 tons in 2022, and 9,930 tons in 2023. Growth continued in subsequent years, rising to 10,800 tons in 2024 and reaching 11,800 tons in 2025. This dynamic is explained by the increasing demand among the population for protein-rich food products, the dietary benefits of fish products,

and the growth of consumption in the market. Furthermore, the African catfish's rapid growth rate, adaptability to various conditions, and high yield create economic incentives for increasing its production volume. Consequently, the expansion of catfish cultivation serves not only the food industry but also as an additional resource for the leather industry.

Secondly, the structure of African catfish (Clarias gariepinus) skin is considered a favorable object for leather production due to its important collagen structure. The dermis is the main part among the skin layers, and during the tanning process, the formation of additional bonds between collagen fibers shapes the mechanical properties of the finished product. Existing scientific sources note that in African catfish skin, the dermis separates into specific layers, and the collagen fibers form a dense layer [2]. Additionally, the fact that adipose tissue can sometimes be observed in specific areas of the skin is technologically important, necessitating the optimization of degreasing, pickling, and tanning processes.

Thirdly, fish collagen in general is distinguished by having a relatively low denaturation temperature [3]. Therefore, it is crucial to scientifically justify technological parameters for African catfish skin, including careful selection of temperature and pH regimes, controlling the duration of alkaline and acidic treatments, and preserving the collagen structure during the tanning stage. This serves as another basis for selecting this research object.

Fourthly, ecological factors are becoming increasingly important in the leather industry. Although chrome tanning processes are effective, issues related to waste, wastewater treatment, and, in some cases, risks associated with Cr(VI) necessitate reviewing technological solutions. Therefore, for processing African catfish skin, a comparative study of chrome and chrome-free tanning

methods, as well as developing mixed tanning options, holds significant importance for both practical application and scientific research.

Finished leather products obtained from African catfish skin are also considered effective from a market perspective, creating opportunities to obtain competitive materials as part of a new assortment, with the natural texture characteristic of fish skin [4], relative lightness, and as products for new design accessories and haberdashery.

It is known that in recent years, the fishery sector in our country has been developing at an accelerated pace. This is explained primarily by the increase in demand and consumption of fish products among the population, as well as the expansion in the number of fish farms and production capacities. In the "ELYORBEK" farm operating in the city of Namangan, African catfish cultivation has also been initiated [5].

This species is one of the most common fish for cultivation in artificial pond conditions and is assessed as an economically efficient, i.e., highly profitable, object for the fishery sector. Based on this, three water reservoirs, each measuring 12 meters in length and 3.5 meters in width, have been established at the "ELYORBEK" farm for cultivating African catfish. These reservoirs have the capacity to cultivate up to 10,000 catfish fingerlings in total [5].

To effectively utilize fish skins as leather raw materials, one of the primary objectives was to preserve the skin raw material to the maximum extent, i.e., to ensure its maximum yield by surface area. For this reason, attention was focused on preventing the cutting of essential parts of the skin and preserving its total area as much as possible during the fish skinning process.

From a practical standpoint, to achieve this objective, the incision was performed in two main directions:

Incision along the belly – i.e., an incision is made from the lower (belly) side of the fish, and the skin is removed intact with the dorsal part. This method also helps preserve the maximum skin surface area, especially retaining the valuable lateral parts of the skin in certain species.

Bilateral (symmetrical) incision – Given that a large portion of the raw fish in production conditions is used for fillets, the fish is divided into two symmetrical parts by a bilateral incision. Removing the skin from the fillet is easier and more convenient than from a whole fish, making this process more productive.

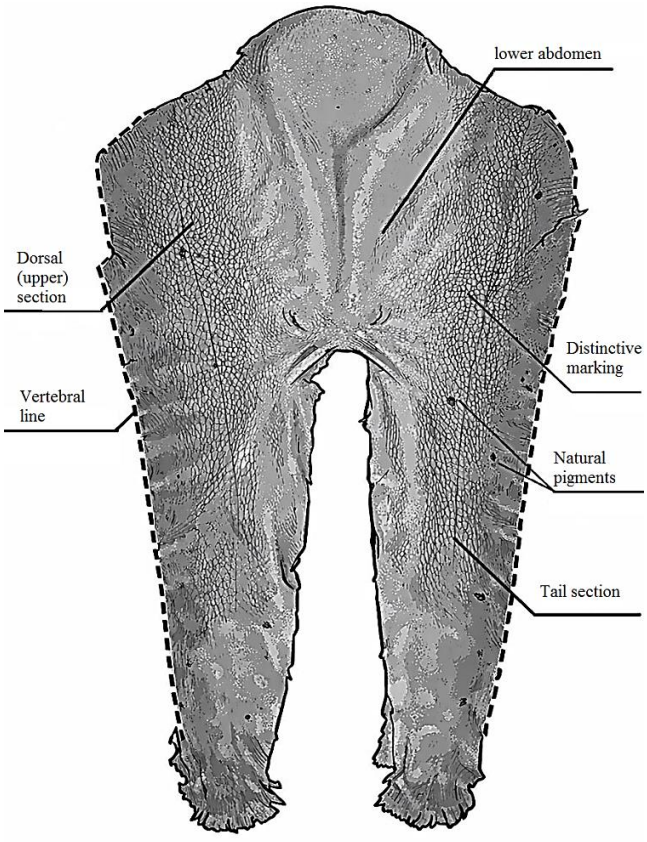


Figure 2. Contour and functional zones aimed at maximizing area yield during African catfish skinning

For utilizing fish skins as leather raw materials, with the aim of ensuring maximum yield of the skin raw material, the incision in the research work was performed from the back side, i.e., along the vertebral and abdominal lines. The topographic parts of the skins obtained as a result of skinning fish using this method are shown in Figure 2.

The main working parts of the skin are identified:

- Dorsal (upper) part – This is a zone with relatively stable fiber density and texture, which enhances leather quality and is considered convenient for placing product details.
- Abdominal (lower) part – Has higher elasticity and can be effectively used for small details.
- Vertebral line – This is an axial zone where fiber direction changes, and it is recommended to consider the risk of deformation when placing details.
- Unique pattern and natural pigments – These are decorative characteristics specific to fish leather, enhancing its value as "exotic leather."
- Tail part – Although a small zone, it can be used in waste-free production for small elements (as decorative additions in straps, trims).

This schematic shows the shape of the skinned African catfish hide and is based on ensuring maximum yield of the skin area and efficient utilization of the raw material. The objectives during skinning include preserving the contour as intact as possible, avoiding cuts and holes, and also increasing the usable surface area for the finished leather product.

Thus, the contour and zones in the figure serve to maintain a high degree of area yield during skinning, maximize the utilization of the skin in subsequent technological processes (processing, cutting), and reduce waste. This method

of skinning is recommended for the African catfish under investigation. By making an incision along the fish's vertebral line, the skin is separated into two sides. This method preserves a relatively wider skin area and results in less damage to the hide.

The proposed method, i.e., choosing the incision line along the vertebral or abdominal line, allows for increasing the area of raw material necessary for leather production, reducing waste in subsequent technological processing, and ensuring higher economic efficiency of the finished leather product.

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