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Properties and utilization of shark skin

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Abstract
Sharks come in Elasmobranch order of fishes, and different from the order Teleostei, or bony fishes in certain important aspects. Sharks possess various components in their body which can be useful in processing, out of which shark skin is taken as an important part of its various properties and its usefulness in various industries. Their skins possess physically and chemically resistant denticles, or tooth-like projections, rather than conventional scales. Shark skin also has an unusual lamellar structure of collagen fibers onto which muscle tissue (i.e. the meat) is directly attached. Shark skin is considered a useful component for the manufacture of various leather products as well as consumption.

Keywords: Properties, utilization, shark skin

Introduction
Sharks belong to the Elasmobranch order of fishes, which differ in certain important aspects from the order Teleostei, or bony fishes. One of the major characteristics of this group is that their method of osmoregulation is dependent upon maintaining high tissue levels of urea and this has important consequences in the processing of the meat. Some specific characteristics of shark skin create number of problems to the potential processors of shark, like their skins possess physically and chemically resistant denticles, or tooth-like projections, rather than conventional scales and this creates difficulties in tanning them into leather and shark skin has an unusual lamellar structure of collagen fibres onto which muscle tissue (i.e. the meat) is directly attached.

Sharks have a variety of uses other than for food and leather, and a feature of the shark is that all the parts of shark can be utilised. The fins, skin, meat, liver and teeth all have high commercial value but there are some difficulties in producing high quality skins and meat simultaneously under commercial conditions. If gutting is done immediately the quality of the meat will be improved but, inevitably, when the skin is flayed it will produce two 'sides' rather than a whole skin. In practice, whether or not the shark should be gutted and how long it takes until processing or flaying can commence, will depend upon the actual conditions pertaining - for example, whether there are processing facilities on board the boat, whether the fishermen themselves have sufficient expertise to flay the shark, whether it is intended to market both the meat and other products, such as skins and fins, etc. Shark meat also deteriorates rapidly and must be chilled or frozen soon after capture to preserve the quality, (although it has been suggested that chilling or freezing has a detrimental effect on the commercial value of the skin).

Shark skin structure has been comprehensively reviewed by several scientists [1, 9, 12, 13]. In last few decades, epidermis of shark skin had been proven status of biomimetic among two science popularizes and in research circles for the notion that the specialized skin surface structure could remove drag and enhance the efficiency of locomotion. Shark epidermis along with undulated ridges and identically have been modelled by manufactured body suit, that infuse surface roughness and purportedly amplify swimming performance in human. The movement and locomotion are efficiently affected by special surface of shark skin.

The shark skin is unique in many ways. It is characterised through its grey colour and the contrast between its slippery appearance and its rough tactile texture. The shark's skin has dermal denticles and it give the rough texture that has earned it its primary human function as sandpaper. These are small structures that resemble hard, grooved teeth but are actually placoid scales. They have a central pulp cavity, dentine and an outer layer of enamel. These potent and defend the skin of the shark against injury.

They also aid in streamlining the fish while it glides by the water as they alleviate turbulence. This is done by directing the water through the grooves and thereby decreasing the friction of the water against which the body travels. These teeth are which makes the shark feel rough and that shark skin use as sandpaper. The skin is so rough, in fact, that softer animals brushing against it can be badly injured. These denticles' spines point towards the tail, so the rough effect is best felt by moving one's hand over the body from the tail to the head, and surrounded to the body of shark as helix like because of their arrangement in a mosaic pattern and that acts as a supportive corset. As the sharks have no skeletal bones, the muscles used for swimming are attached directly to the inside of this corset. This saves energy, allowing them to swim faster and further without tiring. Shark skin is generally grey in colour, with the top of the body being darker than the underneath. This means that the shark's body camouflages with the dark depths of the ocean when viewed from above as well as the lighter surface of the water when viewed from below.

Sharks living on the bottom of the ocean and feeding off small crustaceans are usually browner in colour, aiding them to blend in with the sand in which they hunt. This sophisticated method of camouflage, able these stealthy hunters to approach prey without being detected until it is too late, which is a necessary skill for their survival. The skin of the shark has to be very thick in order to assist it to retain heat and to support the muscles that are attached to its inner layers. The biggest living shark, The Whale Shark which have boasts skin of about 10 centimetres in thickness. [4]. Sharks, like all animals, have been designed to suit their habits and habitats exactly. Their skin is no exception. It displays ingenuity in design and function and ensures that these creatures are well suited to their aquatic homes and hunting lifestyle.

Properties

Most of the research on shark skin collagen used to production of leather. The structure ,thermal resistance, composition and swelling capacity of shark skin collagen and also give the method for removing the scale from the shark such as sandbar shark, spiny dofish, blue shark and shortfin mako [14]. The cartilage and shark skin has high level of collagen specially in blue shark. Type two collagen rich in cartilage of blue shark that used as a food. A antic type of collagen is transferred in the transparent fibrous tissue between cartilage and skin of the shark fins [11]. Blue shark skin has good properties including acid soluble collagen and low destroyed temperature [6].

Utilization of shark skin

Skin leather is used in the production of such fancy items as wallets, chappals, ladies handbags etc. In many countries skin of the shark is used for consumption but mostly it is used for manufacturing of leather. Production of extravagant and daily used items such as cowboy boots, shoes, handbags, knife holders, watch straps, lighter cases mostly made of shark leather. In past practices for polishing articles made up of wood were primarily employed from shark skin. Skin on which denticles are attached were rarely used to produce leather. Many shark species are used for production of leather including some of red listed species. Global demand for sharks and rays derived products, results in unregulated and exploitative fishing practice [5]. The most preferable sharks for leather production are hammer head, tiger, porbeagle, lemon, dusky, nurse, sandbar and shortfin mako. It was also used for polishing in arts, as a rough surface for matches, sword-hilts and for amour.

Skin as food

Shark skin is preferred as food in several countries including the Japan, Maldives, Taiwan and the Solomon Islands [16]. Processing involves washing, drying, removing the denticles, bleaching and drying [3]. In Taiwan, people prefer shark skin as a food from dusky, thresher, whale sharks and giant guitarfish (*Rhynchobatus djiddensis*). The famous gelatinous food nikigori in Japan process from shark skin [7]. Shark lips or Fish lips marketed in Malaysia and Singapore after processing. In the Solomon Islands salted or smoked shark skin sun dried, boiled and the denticles are removed. The final product is then made into soup with coconut milk [10].

Shark skin leather

The shark skin along with undulated dents which is called as shagreen, was used as sand paper in wooden industries since couple of decades. Shark skin has also been used to cover sword hilts (providing a slip-free grip) and as a striking surface for matches [8]. Now a days, the shark skin mostly used for leather production. The procedure for the tanning of shark skin is same as other animals [15]. Leather of shark generally used to make a variety of products like furniture, bookbinding, shoes and handbags. Earlier tanneries were in several countries and shark leather products were marketed in major markets in the USA, Germany, France and Japan. But, due to environmental restrictions on the tanning industry and problems with a steady supply of raw skin, today, the most tanned leather is produced only in Mexico [8]. For making good quality skins, sharks must be carefully skinned immediately after capture. Shark skin carcasses used for frozen and meat on ice are usually damaged to the point and useless for making leather. The skin of Shark is very thick and tough, so, it is very difficult to remove properly. But, experienced shark skinners can remove shark's hide efficiently. Some luxury products like leather from skin of stingray skin has been used in luxury leather products in the USA [2] while expensive Boroso leather has been prepared from small Moroccan shark [8].

Shark skin use in footwear

Shark leather was most popular use for water resistance footwear. Shark skins are plenty large enough at 30" long and up to 20" wide to accommodate the panel sizes needed for footwears. Shark skin is suppler than stingray skins, so it's easy to create comfortable footwear that is also high-fashion. Extremely luxurious boot can be formed by combining the shark hide with some eel leather.

Shark skin use in belts

Because of the length of a shark hide, it is very easy to create a flexible high-fashion belt. In fact, a single full-sized Grade III or IV shark skin could easily produce enough leather to make two or three belts. The leftover scraps from the belt cuts could be used to fill in patches on other exotic leather projects, or to make wristbands, tongues for shoes, and decorative tassels.

Shark skin use in wallets

As a flexible, durable and water-resistant leather, shark skin can make for a top-class wallet. Shark skin is large

enough for billfolds, passport cases or even envelope wallets. Shark leather wallets are very durable.

Processing of shark skin

(1) Curing of skin

The shark skin should be free from defects like scars, butcher cuts, wrinkles or excessive variation in thickness. It should carefully removed from shark, either on board the vessel or immediately after landing, scraped off adhering meat and cured the skin with salt by spreading it over the flesh side. Alternately, skin can be preserved by drying for processing later.

(2) Washing and soaking

If the skin is dried / salted, it is first washed & soaked in water. This step restores the original state of texture & consistency to the skin.

(3) Liming

It is then limed in a saturated solution of calcium hydroxide containing some sodium sulfide. Liming softens the epidermis facilitating its easy removal. The skin is subjected to several fresh liming operations followed by washing in warm water.

(4) Bating

The washed skin is next subjected to bating, a process of hydrolyzing the elastin fibres in the skin using proteolytic enzyme, particularly trypsin. After beating, the skin is tanned using one of the established process, vegetable or chrome tannage. When vegetable tannage is employed, shagreen should be removed before tanning. Shark hides are tanned in much the same way as the skins of land animals.

(5) Drying

Drying may be done in a tunnel dryer.

(6) Finishing operations

After tanning, the leather should not dried rapidly to avoid stiffness. The fibres are lubricated with fat-liquor to give leather pliability and softness. Various types of oils and greases are used for fat-liquoring. The colour and shade of the finished leather is produced by a combination of dyeing and finishing operations.

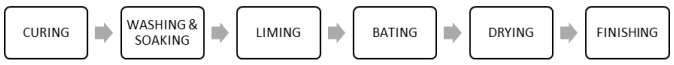

Fig 1: Flow diagramme of shark skin processing

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