Potentials of Invasive *Pterygoplichtys Disjunctivus* (Janitor Fish) Rind as Fish Skin Leather

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ABSTRACT

Janitor fish (Pterygoplichtys disjunctivus) is one of the most destructive invasive fish species in the Philippines. Without having a natural predator to reduce its population, the number of janitor species had rapidly increased throughout the years. Laguna de Bay had been documented to be one of the bodies of water in the Philippines that had an abnormal number of janitor fishes. Since Janitor fish had been identified as an invasive species that had no recorded natural predators and had no use in fishery and agriculture, the researchers aim to produce fish skin leather made from janitor fish rind by removing and harvesting the skin then curing the produced fish leather in order to limit the population of these invasive fishes and to make an alternative product that would possibly help in aquaculture and economy in the Philippines. The Janitor Fish rind was acquired by removing the skin of the fish and separating the scales and meat from it. It was then marinated for a day in a solution containing 100 ml vegetable oil, dishwashing liquid, and one egg yolk. The skin was then hanged in direct sunlight overnight. It was then softened with the use of hands and a rolling pin, then was hanged for another three days in a cool shaded area. The Janitor fish leather was tested using the feasibility test provided by South African Leather Research Institute (SALRI). The leather registered a stretch index of 30% which passed the ≥ 20% and ≤ 40% LSI (Leather Stretch Index) of SALRI and it was also tested to be waterproof. The Flex Resistance was also measure using Bally Flex Method. Recommendations for the study includes careful removal of the scales from the skin since the scales of Pterygoplichtys disjunctivus is hard and rugged and would easily damage the skin if not carefully removed. It is also recommended to extract skin from adult Janitor fish as it does contain more abundant amount of removable skin throughout its body.

Keywords: *Janitor fish rind, fish skin leather, leather stretch index, bally flex method, water spotting (water staining)*

INTRODUCTION

Janitor fish (Pterygoplichtys disjunctivus) is a South American aquarium fish that was introduced in the Philippines as a potential fish to help clean the algae and debris in tropical fish enthusiasts' aquariums and in local rivers and lakes (Banos, 2006). As early as 1998, the unabated proliferation of Janitor fishes in the Philippines was considered a pest outbreak already but is still unresolved until now (Delos Reyes, 2010).

Janitor fish is one of the most destructive invasive fish species in the Philippines. Without having a natural predator to reduce its population, the number of janitor species had rapidly increased throughout the years. The invasive janitor fish (Pterygoplichtys disjunctivus) species had soon spread in different freshwater bodies in the Philippines such as Laguna de Bay, Taal Lake, Angat River, and Marikina River. This species of janitor fish is said to be causing the degradation of Laguna de Bay, the largest lake in the Philippines and the second largest inland freshwater lake in Southeast Asia. It is also considered as a "thrash fish" or a species of fish that does not have any use to agriculture and economy and is also considered as a hindrance to the natural diversity in oceans and lake since it is not considered to be a source of food for humans and other animals.

Janitor fish had also been found that it contributes to the destruction and pollution of the local waters that it considers as its habitat as it destroys the riverbanks and tributary when it burrows and builds its nesting grounds (Fernandez, 2016). This species had been documented to also destroy the habitat of

the local fishes and eat its eggs and fingerlings. Laguna de Bay had been documented to be one of the bodies of water in the Philippines that had an abnormal number of janitor fishes.

Ethical considerations pertaining to the use of Janitor fish (Pterygoplichtys disjunctivus) states that the use of animals and plants, particularly invasive and parasitic organisms, is permissible when it is necessary to do so in order to preserve the biodiversity found within the ecosystem. Since Janitor fish (Pterygoplichtys disjunctivus) had been identified as an invasive species that had no recorded natural predators and had no use in fishery and agriculture, the researchers aim to produce fish skin leather made from janitor fish rind by removing and harvesting the skin then curing the produced fish leather in order to limit the population of these invasive fishes and to make an alternative product that would possibly help in aquaculture and economy in the Philippines.

The focus of this study was making feasible leather out of Pterygoplichtys disjunctivus rind. The researchers only intended to make homemade natural leather that does not involve the use of harsh chemicals and other leather making processes. The study is only limited to testing the Leather Stretch Index (LSI), Flex Resistance, and Water Fastness & Perspiration Testing since these are the most applicable tests that can be used in determining is a dried animal hide can be made into feasible leather.

Review of Literature

Pterygoplichthys disjunctivus belongs to Family Loricariidae (Order Siluriformes), the largest catfish family with 80 genera and 680 known species. They have large dorsal fins with 9 or more dorsal fin rays, adipose fin, and an enlarged stomach connected to the dorsal abdominal wall by a connective tissue sheet (Hubilla, Kis, & Primavera, 2007). As early as 1998, the unabated proliferation of Janitor fishes in the Philippines was considered a pest outbreak already but is still unresolved until now (Delos Reyes, Mendoza, & Padrid, 2010). Moreover, displacement of native species and alteration of the normal ecosystem function are likely due to the characteristics of janitor fish, it is a low trophic level consumer (detrivore), a habitat modifier, and a low-oxygen tolerant fish that enable janitor fish to dominate its new environment and cause alteration to the existing community structure in the area (Chavez & Carandang VI, 2014).

The invasive janitor fish (Pterygoplichtys disjunctivus) species had soon spread in different freshwater bodies in the Philippines such as Laguna de Bay, Taal Lake, Angat River, and Marikina River. This species of janitor fish is said to be causing the degradation of Laguna de Bay, the largest lake in the Philippines and the second largest inland freshwater lake in Southeast Asia. The janitor fish now consists of 75 percent of the daily fish catch of small fishermen. It means that this fish is fast becoming the dominant fish species in the lake (Guerrero, 2014). Pterygoplichtys disjunctivus build burrows in the banks of the rivers and lakes it inhabits. This behavior accounts for the reproductive capacity of the fish and its success as an invasive species in the Philippines. Moreover, their burrowing behavior allows them to survive during drought and contributes to soil erosion and water turbidity. This event alters the river environment and reduction of available potable water to human settlements in the area (Almadin & Jumawan, 2016). Similarly, the burrowing habit of janitor fishes had also eroded the banks of Marikina River, a tributary of Laguna de Bay (Fernandez, 2016).

Moreover, Pterygoplichtys disjunctivus invasion has also caused environmental and socioeconomic impacts in the Agusan Marsh. Their burrowing behavior may contribute to water turbidity and soil erosion. High water turbidity slows down photosynthesis because it changes the amount of light that can pass down through the water column. This may disrupt food webs and the energy flow in the marsh ecosystem. Meanwhile, local fishermen have reported that their gill nets were damaged while removing the janitor fish, thus destroying their livelihood. Another problem is that Pterygoplichtys disjunctivus now comprises the bulk of their catch. They end up catching more janitor fish instead of their target species such as tilapia, common carp, and giant gourami (Hubilla et al., 2007).

Janitor Fish Invasion on Laguna Lake

Laguna de Bay covers almost one half of the 190,000 hectares total area of all existing lakes in the Philippines (Laguna Lake Development Authority, 2011). The lake is naturally eutrophic and highly productive. Increasing enrichment in terms of plant nutrients such as nitrogen and phosphorus has been caused by human activities in the basin. The lake is surrounded by low-lying alluvial plains which are often inundated during heavy rainfall. Janitor fish had soon been observed to boom in population after the typhoon Ondoy in 2009 that caused massive flood and destroyed hundreds of fish pens located at Laguna de Bay.

A study conducted by Soriano, et al. (2010) stated the population model of these janitor fish (Pterygoplichtys disjunctivus) species and suggested possible solutions in controlling its alarming population growth rate. Since janitor fishes eat algae and other waste products found on rivers and lakes, it contained a high amount of E. coli which can be harmful to humans if ingested (Chavez & Carandang VI, 2014) and can also be harmful to fishes if these janitor fishes are turned into fish feeds as a potential solution to its population control. To help control the population of the janitor fish in Laguna de Bay, fishermen are paid for the fish they catch by the government which is known as the "Bounty System" (Guerrero, 2014). It has been recommended to utilize the janitor fish as fertilizer, fish leather, and home/office decoration (Hubilla et al., 2007). Another potential solution stated was turning the fish's skin into leather since janitor fish's skin tends to be hard and flexible This species of janitor fish is said to be causing the degradation of Laguna de Bay, the largest lake in the Philippines and the second largest inland freshwater lake in Southeast Asia (Gregory, 2001).

According to a study conducted by Vallejo & Soriano (2011), control of the population of Pterygoplichtys disjunctivus will be effective if a large proportion of juvenile and adult populations are caught. The survival rate of juveniles is 99.18% while reproductive adults have a survival rate of 98.8% which means that almost all juveniles end up as reproductive adults without the presence of predators. Most individuals in the wild can live for 7 years and are likely to be reproductive until the end of their lifespan. The study also suggests that females might be starting to mature sexually are smaller sizes and is a sign of extreme directed selection which is typically observed in domesticated animals.

Leather Making Using Fish Skin

Leather making using fish skin was started in the early '90s by testing if salmon and tuna rind would be a good alternative to cow leather. There are many qualities that make the salmon leather ideal in performance and aesthetics. It is stronger and more flexible than its cow leather counterpart yet is softer and comparable in texture as snakeskin leather. What makes salmon leather stronger and more durable is that it has natural cross-fiber structure unlike the fibers in cow leather, which only run in one direction (Barton, Chandler, 2008). Fish leather had later used widely as a source of exotic leather because the developed leather exhibited better mechanical properties and finds application in making high grip articles, therapeutic footwear, and other niche products. The tanning and dyeing processes used for fish is also far less aggressive to the skin and environment than that used for mammal leathers, which require strong chemical products that release gases such as hydrogen sulfide (an explosive, corrosive, and flammable gas) to strip the hairs from the hide. Since fish have no hair, this step is unnecessary. The scales may be removed, but this is never through chemical processing. Fish skins are gaining interest among tanners as an additional source of raw material for making leathers due to their attractive and unique grain structure possessing high market value (Alia, Ramanathan, Fathima, Uma, & Rao, 2017). Furthermore, production of fish skin leather is based on taking waste and turning it into a useful product due to its similarity in strength to tough cow hide. It can be used to create handbags, belts, small accessories, furniture, interior decoration, and shoes (Duraisamy, Shamena, & Berekete, 2016).

Fish leather is stronger than other leather types if the same thicknesses are compared. This is because the fiber structure of fish skin runs crosswise, rather than parallel as in, for example, cowhide. The tensile strength of fish leather reaches up to 90 Newtons (Slade, 2000).

Janitor fish's skin is known to have a rubber-like skin which is very suitable in making good quality leather material. In Marikina, Philippines, the use of catfish and suckerfish skin as leather is

already being practiced as cheaper substitutes to cow leather in making shoes and sandals (Samar, 2012). Economic research conducted by Delos Reyes, Medoza, & Padrid (2010) in which survey method was used in order to know the market potential of leather products from janitor fish showed that most tanning companies that use cow leather would consider using janitor fish in making leather products.

The South African Leather Research Institute (2016) provided a research that tests dried animal skin and determining if they have potentials in being made into natural leather. The parameters used in this study is using Leather Stretch Index (LSI) by measuring if the dried animal skin would overstretch or would not stretch at all. The assigned LSI value was≥ 20% and ≤40% LSI which states that the dried skin should not be elastic and should also not be hard which resists to stretching. The Flex Resistance was also measure using Bally Flex Method which determines if the dried skin resists repetitive wear and tear. The tested dried animal skins were flexed, stretched, and bended up to 200 times. If the skin is not damaged in the process of Bally Flex Method, it is then considered to be a good natural leather material. Water Spotting (Water Staining), Water Fastness & Perspiration Testing was done to determine if the dried animal hides exhibit water resistance as it is important in leather making and prevent the fast aging and deterioration of the leather.

Objectives of the Study

The general objective of this study is to create a limiting factor to the population of the invasive Janitor Fish (Pterygoplichtys disjunctivus) by creating fish skin leather made from its rind. Specifically, this study aims to measure the Leather Stretch Index (LSI), The Flex Resistance using Bally Flex Method, and Water Fastness & Perspiration Testing on the Janitor fish leather in order to prove its potentials.

METHODOLOGY

The researchers used quantitative approach to this study. The data gathered were collected by measuring the made janitor fish leather. Different parameters provided by The South African Leather Research Institute (SALRI) was used to determine the feasibility of the made janitor fish leather. The Janitor Fish (Pterygoplichtys disjunctivus) needed for this research were collected in Laguna lake, Calamba, Laguna. The experiment was conducted in the NatSci Laboratory of Lyceum of the Philippines University – Laguna. The drying and treatment process of the janitor fish rind was done in Calamba, Laguna. The species of janitor fish that would be used in this study is the Pterygoplichtys disjunctivus which is the primary invasive fish species found on Laguna lake. The skin of the fish would be removed, and the remaining flesh and scales attached to the skin would be scrapped.

The skin was soaked for 24 hours in emulsified oils made from the mixture of one egg yolk, 100ml vegetable oil, salt, and dish washing liquid to make it softer and be able to withstand elements and other leather treatments. The skin was washed by clean water in order to remove moisture and oil residue and was stretched equally on all sides to make it longer and wider. The treated skin was soaked again in egg yolk with salt and vegetable oil then was hung - dried in direct sunlight for 24 hours. The dried janitor fish skin was then softened by stretching by hand and using a rolling pin. It was then hanged in a shady place not on direct sunlight for about 1-3 days. The dried fish leather was then sandpapered to remove excess fibers and leather balm was applied to moisturize the fish leather.

Leather Quality Tests

The tests that were done to know if a dried animal hide is executable to be made into natural animal leather were provided by The South African Leather Research Institute (SALRI). The following tests are as follows:

A. Leather Stretch Index (LSI) were used in order to measure the sturdiness and elastic capability of the made leather. A measuring tape or ruler is used to measure the stretch capability of the made janitor fish leather. The universal parameter set by SALRI is

equivalent to the range of values from ≥ 20% and ≤ 40% LSI and the leather to be tested should be within the percentage set by SALRI.

B. Flex resistance of the leather by using the Bally Flex Method is determined by the repetitive flexing, stretching, and tumbling of the made Janitor fish leather. The test was done to evaluate the strength and durability to prevent premature wear and tear of the leather. 200 repetitions of flexing, stretching, and tumbling was done and every 50 repetitions, the researcher inspects the fish leather using observation method to know if it exhibits damage and tear.

C. Water Spotting (Water Staining), Water Fastness & Perspiration Testing was done in order to determine if the acquired janitor fish skin leather exhibits waterproof capabilities as it is important in making quality animal leather. A medicine dropper was used to drop water onto the leather. After 10 minutes, the researcher determined if the underside of the leather is wet or humid to test if the water passed through the upper dermis of the fish skin.

RESULTS AND DISCUSSIONS

The LSI of the made janitor fish leather was tested in reference to the method used by The South African Leather Research Institute (2016) in order to test the sturdiness and elasticity of the homemade fish leather. 3 trials or repetitions were done on separate corners of the leather. A ruler was used in order to know the length and rate of stretch in co ordinance to the methods done by The South African Leather Research Institute. The data showed that the leather exhibited a total LSI of 30% which is within the parameter provided by The South African Leather Research Institute. Janitor fish's skin is known to have a rubber-like skin which is very suitable in making good quality leather material (Reyes, Medoza, & Padrid,2010).

Table 1. The computed Leather Stretch Index (LSI) of the fish leather in 3 trials

Trials	Stretch Index (cm)	Measured LSI (%)
1	3	30
2	2.5	25
3	3.5	35

The Table 2 shows the flex resistance of the leather by using the Bally Flex Method wherein the animal leather is flexed, stretched, and tumbled for a repetition of 200 times in order to know its strength and durability. The data gathered showed that the leather did not exhibit any wear and tear after 200 repetitions hence it passed the Flex Resistance test according to The South African Leather Research Institute (2016). Fish leather is stronger than other leather types if the same thicknesses are compared. This is because the fiber structure of fish skin runs crosswise, rather than parallel as in, for example, cowhide. The tensile strength of fish leather reaches up to 90 Newtons (Slade, 2000).

Table 2. The flex resistance of the Janitor fish leather using the Bally Flex method

Repetitions	Condition
50	No Tear
100	No Tear
150	No Tear
200	No Tear

The leather was then tested for its water resistance using Water Spotting (Water Staining), Water Fastness & Perspiration Testing provided in the research made by The South African Leather Research Institute (2016). A medicine dropper was used to drop water into the leather surface. Data showed that

water did not enter the skin of the fish since the underside of the skin was observed to not exhibit wetness and humidity. Since fish skin does not contain sweat glands hence, they have lesser pores than that of mammals, its skin is naturally waterproof and is a good leather material (Slade, 2000).

Table 3. The water fastness & perspiration testing on the janitor fish skin leather

Trials	Wetness under the skin
1	Not Present
2	Not Present
3	Not Present

CONCLUSION

The fish skin leather made from janitor fish rind was created as an attempt to reduce the population of the invasive janitor fish (Pterygoplichtys disjunctivus) species in Laguna lake. The leather exhibited great results during the testing of its Leather Stretch Index (LSI) and Flexibility Resistance using the Bally Flex Method. The made leather was also proven to be waterproof thus the data gathered while testing the janitor fish leather is within the accepted parameters provided by the South African Leather Research Institute making the acquired janitor fish rind feasible in leather making and can also induce solution to the overwhelming population of these janitor fish species in Laguna lake since it is also considered as pests.

Recommendations

The researchers recommend being careful in removing the scales and the use of proper snipping tools in order to remove the scales of the janitor fish from its skin since it has hard and sturdy scales that is mainly used as its protection against harsh environments hence it named as “armored catfish”. It is also recommended to skin an adult size janitor fish (7 inches above) in order to get more skin since janitor fishes have less removable skin found on their body.

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