

# Development of garment leather from Yellowfin tuna (*Thunnus albacares*) skin

E.M.B.S. Eakanayake and S.C. Jayamanne

Faculty of Animal Science and Export Agriculture, Uva Wellassa University of Sri Lanka

and

W. Wickramasinghe

Ceylon Leather Product PLC, No 115/1, Kelaniganga Mill Road, Mattakkuliya, Sri Lanka

## Introduction

Leather is defined as hide or skin with its original fibrous structure more or less intact, tanned to prevent putrefaction (Covington, 2009). Due to tanning, skins that have been processed to prevent putrefaction retain its characteristics such as flexibility and toughness. Hides and skins from cattle, buffalo, sheep, pig, goat, horse, crocodile, snake and fish are used for leather production. When considering the fish leather, fish skins are used for production of leather after tanning and re-tanning processes. Texture of fish leather depends on pocket size of the scales. Presently, carp, pacific salmon, bass, sturgeon, shark, tuna, catfish, salmon, tilapia and several other fish species are taken for leather production. Garment leather is tanned with chrome and treated with softeners. The quality of the garment leather should be thin enough to use on garments and it should feel softer and smoother than any other types of leather. These types of leathers are made from the top-grain of a hide. Good stitch tensile strength and light weight are some other characters of garment leathers. Cow hide and skins from deer, pig and lamb are commonly used for garment leather manufacturing. But there is a potential to develop garment leather from fish skin similar to other garment leathers. The present study was carried out to add value to waste generated during the Yellowfin tuna (*Thunnus albacares*) fish processing and promote a fish leather production in Sri Lanka through developing garment type leather using discarded skins. At present, hides and skins from cattle, buffalo, sheep and goat are used for leather production. In addition, fish species including carp, pacific salmon, shark, tuna, catfish and tilapia are taken for leather production in the world. The objectives of this study were to find out the best fat liquor percentage to obtain maximum softness of chrome-tanned Yellowfin tuna fish leather and to find out the best tanning method for garment leather production from Yellowfin tuna skin.

## Methodology

The current study was carried out at the tannery of Ceylon Leather Product PLC (CLP), Mattakkuliya. Tuna skins were collected from the processing factory of Jay Sea Food (Pvt) Ltd in Ja-Ela. Two experiments were carried out to find out best fat liquor concentration and best tanning method. In experiment 1, yellowfin tuna skins were treated with 33% basic chromium sulphate and five different concentrations (12%, 14%, 16%, 18% and 20%) of fat liquors (on weight of pelt). In experiment 2, yellowfin tuna skins were treated with four different tanning methods (Full chrome tanning, full vegetable tanning and two types of semi chrome tanning methods - vegetable tanned skins directly tanned with chrome and vegetable tanned skins tanned with chrome after stripping with  $\text{NaHCO}_3$ ). Before initiating the experiments pre-trial was conducted to find out the optimum conditions for liming. Six pieces of raw skins were immersed in solutions of 0.25%, 0.5% and 1%  $\text{Na}_2\text{S}$ , 6%  $\text{Ca(OH)}_2$  and 200% water (on weight of skins). One day after, skins were taken out and scales and flesh were removed. Then, skins were kept for another 5 days in a new 6%  $\text{Ca(OH)}_2$  solution. Weight

and the physical conditions (scale pockets, colour and plumpness) of the skin were observed daily. After identifying the optimum conditions for liming 40 skins were subjected to 8 production process steps (liming, de-liming, pickling, tanning, basifying, fat-liquoring, fixing, drying and dyeing). Experiment 1 was done in fat-liquoring step and experiment 2 was done in tanning step. Then, the dried leathers were dyed and waxed. Finally softness, feel, tensile strength, tear strength and stitch tear strength were measured in developed leathers. Physical evaluation was done to check softness and feel by ten expertise. Tensile strength, tear strength and stitch tear strength were done using universal testing machine. This experiment was designed according to Complete Randomized Design (CRD). The collected data were analyzed using Friedman test and one-way ANOVA in MINITAB 16 and SPSS 22 statistical analyzing software to find out the significant difference between treatments. Mean separation was done using pairwise comparison.

Chemicals percentages were weighted according to the weight of skins, used in experiment 1 and 2.

## Results and Discussion

According to pre-trial, 0.5% Na<sub>2</sub>S solution was identified for descaling with 6% Ca(OH)<sub>2</sub> and 200% H<sub>2</sub>O. For liming it was identified that immersing for 4 days is the best method in 6% Ca(OH)<sub>2</sub> and 200% H<sub>2</sub>O solution.

In experiment 1 (from the five different concentrations of fat liquors), there was a significant effect on treatment method on tensile strength, tear strength and stitch tear strength ( $P < 0.05$ ). Maximum tensile strength and tear strength values were observed in 16% fat-liquored leather with average values of  $23.46 \pm 6.06$  N/mm and  $401.59 \pm 77.75$  N/mm, respectively meanwhile 18% fat-liquored leather showed the highest stitch tear strength ( $187.91 \pm 5.39$  N/mm). There was a significant treatment effect on softness of leather ( $P < 0.05$ ) and on feel of leather ( $P < 0.05$ ). According to the ranking values, treatment 4 (18% fat liquor) showed the best response for softness (Ranking value = 46.5) and feel (Ranking value = 47.0) compared with the other treatments.

While adding fat-liquors, it improves the tensile strength of leathers (Tex Biosciences, 2008). But increasing the fat liquor concentration further leads to decreasing of the ability to make fine emulsion as well as reduction of the ability of fat liquor penetration in to collagen fiber. Hence, softness is reduced when increasing the fat liquor concentration therefore, the hardness of leather is increased (Gutterres and Melo dos Santos, 2009). It may be the reason for reduction of tensile strength.

Increasing and again decreasing of the values of tear strength and stitch tear strength may be due to the decreasing of the ability to make fine emulsion. Hence, ability of fat liquor penetration in to collagen fibers was decreased. The reason for increasing softness might be fat liquor which acts as a lubricant in between collagen fibers (Gutterres and Melo dos Santos, 2009). Reason for increasing and again decreasing the softness maybe due to the decreasing of the ability to make fine emulsion. Therefore, the ability of fat liquor penetration in to collagen fibers is decreased. Hence, it can be suggested to use 18% fat liquor concentration to produce garment type leather from yellowfin tuna skin.

From the four tanning methods studied in experiment 2, there was no significant effect of treatment on tensile strength ( $P > 0.05$ ). But full chrome tanned leather showed the highest value for tensile strength ( $22.56 \pm 0.86$  N/mm). When considering the tear strength there was no significant effect of treatment ( $P > 0.05$ ). Highest value of tear strength showed the full chrome tanned leather ( $373.75 \pm 23.20$  N/mm). But there was a significant effect of treatment on stitch tear strength ( $P < 0.05$ ). Highest value of stitch tear strength showed the full chrome tanned leather ( $187.91 \pm 5.39$  N/mm). There was a significant treatment effect on softness of leather and on feel of leather ( $P < 0.05$ ). In addition, the highest ranking value for softness (30.0) was observed in full-chrome tanned leather. Hence, it can

be suggested to use full chrome tanning with 18% fat-liquor concentration to produce garment type leather from yellowfin tuna skin.

There was no effect from fat liquor concentration and surface treatment on tensile strength, tear strength, stitch tear strength, softness and feel due to equal fat liquor concentration (18%) and surface treatment (wax). Reason for no significant effect of treatment on tensile strength and tear strength might be due to the reason that tensile strength and tear strength are only dependent on the fiber structure of the skin. Fish skin has a cross fiber structure (Hebrank and Hebrank, 1986). Reason for high value for stitch tear strength might be due to the high amount of covalent bonds between chromium sulphate and collagen fibers in full chrome tanned leather. Vegetable tanned leather hardness was higher than the chrome tanned leather. Hence, softness is higher in full chromed tanned leather than the vegetable tanned leather. When considering the tanning agents chromium sulphate makes covalent bonds with collagen fibers and mimosa acts as a filling agent between collagen fibers.

## **Conclusion**

According to the results obtained in this study, the best fat-liquor concentration was 18% to prepare soft garment leather from yellowfin tuna skin. The most effective tanning method was the full chrome tanning compared to full vegetable tanning and semi tanning methods. Using this combination a marketable garment leather from yellowfin tuna skin can be produced. This could be used to produce commercially valuable products such as ready-made garments.

## **References**

- Covington, A.D., 2009. Tanning Chemistry: The Science of Leather. The Royal Society of Chemistry, Cambridge.
- Gutterres, M. and Melo dos santos, L. 2009. Study of Fatliquoring Parameters Using Experimental Design. *Journal of the Society of Leather Technologists and Chemists*, 93(5):171-175.
- Hebrank, M.R. and Hebrank, J.H. 1986. The Mechanics of Fish Skin: Lack of an "External Tendon" Role in Two Teleosts. *Biological Bulletin*, 171: 236 - 247.
- Tex Biosciences, 2008. Product Information. Tex Biosciences Publishing, Chennai.