

Potential to use extracts from *Lawsonia inermis* (Marathondhi) leaves and *Emblica officinalis* (Nelli) fruits as tannin agents in leather manufacturing

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Introduction

In Sri Lanka mainly mimosa bark powder and chesnut powder are used to produce vegetable tanned leather. However, these tannin agents can produce limited number of colors and are imported to Sri Lanka with high import cost. As a result, final vegetable tanned leather products become high in price. Thus, it is necessary to find out locally available, low cost tannin agents to produce vegetable tanned leathers. *Emblica officinalis* (Nelli) fruits and *Lawsonia inermis* (Marathondhi) leaves are two such locally available tannin agents with considerably high tannin content (nelli fruits-18-35 % (Pushpakumara and Heenkenda, 2012) and Marathondhi leaves- 11.12% (Musa, 2012). Therefore, the objective of the present study was to assess the quality of leather prepared using locally available tanning agents, Marathondhi leaves and Nelli fruit extracts.

Methodology

3.6 kg of marathondhi leaves and 1.2 kg of nelli fruits were first crushed and ground separately. Then it was mixed with 3 L of water and was filtered into separate containers. Same tannin concentration (5 backometer value) was maintained in all containers. Further, a mimosa solution with same concentration was prepared as the control.

Then, the buffalo hides were, soaked, dehaired and delimed and partial pickling was also done prior to the tanning according to the leather manufacturing procedure of Ceylon Leather Products PLC. Then, nine hide pieces with 6 x 7 inch was selected from same area of these buffalo hides. Weight and thicknesses of each piece was measured and recorded. After that, solutions were added into separate containers and three pieces of hide were dipped in each container.

After hides were dipped, concentration of each solution was increased by 5 backo every four days up to four weeks. Tannin penetration was also measured until it obtains 3 mm. After finishing process, physical parameters, mean penetration rate (mm/day), thickness, mean yield of the leather (%) and mean tensile strength was measured in all treatments and was compared with control. Completely Randomized Design (CRD) was used to allocate treatments and data

analysis was done using Minitab 15 software. Analysis of Variance (ANOVA) was used for comparison of data at (significance level of 95%) and. Dunnet's procedure was used for mean separation. Sensory evaluation was conducted to select the best tannin agent based on the appearance, hardness, fullness and overall acceptability of finished leather using 10 trained panelists and results of the sensory evaluation after analysis by Friedman test.

Result and Discussion

During tanning of hides Nelli tannin media was seen as light cream color whereas control (Mimosa) and Marathondi media were darker in color. Though, Nelli and Mimosa media had pleasant smell, Marathondi had an unpleasant smell. Nelli was more acidic (pH 3.2) and pH values of Mimosa and Marathondi were pH- 4.6 and pH 4.3, respectively. After the tannin process, loose grain was observed on the Nelli treated hides. Mean penetration rate, yield, thickness reduction and tensile strength were measured as physical parameters (Table 01).

Table 01: Mean values of physical parameters of leather treated with tannin agents, Mimosa, Nelli and Marathondi

Treatments	Mean values			
	Penetration rates (mmday ⁻²)	Yield of the leather (%)	Thickness reduction (mm)	Tensile strength of the leather (Nmm ⁻²)
Mimosa (Control)	0.29±0.02 ^a	51.27±3.84 ^a	0.17±0.06 ^a	270.00±6.00 ^a
Nelli (Treatment 1)	0.20±0.00 ^b	44.15±4.35 ^a	3.43±0.25 ^b	517.33±54.86 ^b
Marathondi (Treatment 2)	0.13±0.00 ^b	43.45±3.82 ^a	1.23±0.15 ^b	262.33±7.37 ^a

^{a,b} means with same letter are not significantly different

According to Dunnet's mean separation procedure, highest mean penetration rate was recorded in Mimosa compared to other two treatments ($P < 0.05$). The studies indicated that tannins first approach the surface of collagen fibers by hydrophobic bonding, and then combine with collagen fibers by multi-hydrogen bonding (Zhongbing, 2003). However, the other components of plant extracts, including polyphenolic compounds with small molecular weight, are not able to form multi-hydrogen bonding with collagen fibers due to the fact that they have no enough phenolic hydroxys or are lack of structure of ortho-phenolic hydroxys (Zhongbing, 2003). Therefore, they have relatively weaker adsorption capacity on collagen fibers. Thus, molecular weights of tannin agents are important for tannin penetration into the hides. Nelli and Mimosa have tannins with higher molecular weight compare to Marathondi. Molecular weight of tannin agents in Mimosa and Nelli are 1250 and 782.52, respectively (Pushpakumara and Heenkenda, 2012). However, molecular weight of tannin agents in Marathondi (gallic acid) is 170.17 (Musa and Gasmelseed, 2012). Therefore, these can be reasons for low penetration rates of tannin in to hides.

Yield of the vegetable tanned leathers is important since it determines the price of the leather. However, there is no any significant difference ($P>0.05$) between mean yields of the leather. Thickness of the hide needs to be lowered after drying. Lowest mean thickness reduction was observed in Mimosa ($P<0.05$).

Highest mean tensile strength was observed in Nelli followed by Mimosa and Marathondi. According to these results, mean tensile strength of Nelli is significantly different ($P<0.05$) from other two treatments. Nelli contains hydrolysable tannins whereas Mimosa and Marathondi mainly contain condensed tannins (Pushpakumara and Henkenda, 2012). Since, hydrolysable tannin agents give more strength to leather compare to condense tannin type of tannin agent present in Nelli can be the main reason for the results obtained.

When measuring qualitative parameters best appearance was recorded in Nelli treated leather whereas fullness, hardness and overall best leather were reported in mimosa treated leather (Figure 01).

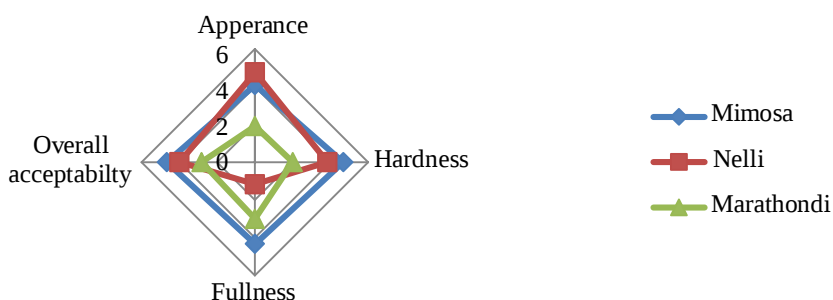


Figure 01: Sensory evaluation for all qualitative parameters

Conclusions

Mimosa is the best tannin agent to produce sole leather compare to other two treatments, Nelli and Marathondi.

References

Pushpakumara, D.K.N.G. and Heenkenda, H.M.S. (2012). Nelli [online] Available at: <http://outputs.worldagroforestry.org/> [Accessed 2 April 2014].

Musa, A.E. and Gasmelseed, G.A. (2012). Characterization of Lawsonia inermis (Henna) as Vegetable Tanning Material. Journal of forest products & industries, [online] 1(2), 35-40. Available at:<[http:// researchpub.org](http://researchpub.org) > [Accessed 2 April 2014].

Zhongbing, L.I.A.O., Xuepin, L.U. and Bi, S.H.I., (2003). Selective adsorption of tannins onto hide collagen fibres. Science in china, [e-journal] 4, 6(5). Available through <[http:// chem.scichina.com](http://chem.scichina.com)> [Accessed 2 April 2014].