IS SCREENING OF GENUINE LEATHER POSSIBLE?

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Abstract. The value chain of leather is complex and originates from the animal husbandry system to meat processing, pre tanning, tanning, post tanning and product manufacturing processing. The imbibed properties of the material gained from the environmental conditions under which the animal grew to the range of human skills and processing chemicals determines how best the leather products meet the customer desires. The customer desire for feel and handle is ultimately traced back to the origin of the animal itself. Leather thus is a unique product whose properties such as visco-elasticity, breathability etc. remained unmatched by synthetics. Industrialization activities, reduced farming, the vegan culture all have contributed to reduced availability of hides and skins for meeting the quantity of leather required for various end products. This in essence contributed to the growth of a new market for synthetics, wherein the manmade fabrics tried to reproduce all the features of leather, synthetically. Commercially, these products came to be known through various names such as leatherette, faux leather, vegan leather, PU leather, pleather etc. Advancement in material science led to a range of products and manufacturing methods has today ensured that conventional identification techniques such as rough edges, imperfect surfaces, wrinkle test, water absorption, burnability, uneven stitch holes, structure retention, smell, grain pattern can no longer be used to distinguish between leather and similar artificial products. Advancement in technology for the manufacture of various types of leather like materials has made it difficult to identify genuine leather from other leather like materials. With leather like materials meeting most of the conventional methods of identifying genuine leather there is today a need for a new methodology for identifying genuine leather. This paper addresses to a study of a statistically relevant number of samples of leather and non-leather materials through a range of iterative instrumental techniques leading to the establishment of a protocol for identification of genuine leather. The methodology starts with the FTIR-ATR based (non-destructive) identification of signature bands of collagen – the amide I, II and III. After the first level screening, iterative analysis of samples that have the amide bands matching with that of collagen would be screened through techniques such as hydroxyproline estimation, thermogravimetric analysis, fibre structure assessment etc. The paper would report the results, the positives and negatives associated with the first level screening for genuine leather using FTIR.

1 Introduction

In recent years, synthetic leather has seen major improvements as they become more comparable to genuine leathers. Synthetic leather is dyed and treated to make it look and feel like a real leather. These synthetic leathers are less expensive and do not require a tedious process for the manufacturing, since genuine leather has to go through many processes before reaching the final product. It's not easy to differentiate between a genuine leather product and a synthetic leather product. Nowadays the genuine leather is slowly occupied by the synthetic leather as upholstery, clothing and fabric. So the identification of leather genuinity becomes essential.

Leather is made from raw hide by tanning process. The tanning process makes the leather durable and flexible. Tanning process keeps the protein fibre (collagen) intact. The making of leather from raw skin is considered to be time and money consuming process.

Synthetic leather, which is a polymer (Poly Urethane or Poly Vinyl Carbonate) based product. The feel and look of synthetic leather resemble to that of original leather. These synthetic leather are marketed in various names like leatherette, faux leather, vegan leather, PU leather and pleather.

The leather whose protein fibre is kept intact is differentiated by the marker collagen. Collagen is found in our various types of connective tissues such as cartilage, tendons, bones, and ligaments. There are about 30 types of collagen present in the body of a mammal. Every collagen type consists

of three polypeptide chains, each one composed of at least one Gly–X–Y sequence structured in left-handed α-like helices and where the X and Y positions are often proline and hydroxyproline, respectively. In the skin of mammals the type I collagen is present in abundance. Both destructive and non-destructive methods to identify the leather genuinety is scanty. Determination of nitrogen content in leather is a destructive method. In recent trends, the sophisticated instruments like Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), and Fourier Transform Infrared spectroscopy (FT-IR) are used in identification leather matrix and some salient feature of leather which is said to be a non-destructive method.

This study focuses on the non-destructive techniques for confirming the genuinity of the leather with some of its markers like collagen, using some latest available sophisticated instruments like FT-IR-ATR, FT-IR-imaging, and FT-Raman. To pick the signature characters of the marker collagen, and to compare these signals with the synthetic.

2 Material and methods

FTIR a non-destructive technique considered to a major tool for differentiating the leather from synthetic leather. The collagen marked peaks of amide I, II and III at 1600 cm-1 (C=O), 1525 cm-1(CH2), 1400, 1300, 1200 cm-1 (C-N and N-H) respectively. The synthetic leathers which are considered to be the polymer based product the collagen (protein fibre) and its significant IR absorption are expected to be absent. Collagen was considered to be a marker for the identification of the leather. The FTIR Analysis was performed using JASCO 4700 series(Japan) IR Spectrophotometer using the ATR mode. The crystal used is ZnSe. ZnSe has a Refractive Index of 2.4; long wavelength cut off of 525, Depth of penetration in microns@1000cm-1 of 2.0 and the working pH range of 5-9. Pure Reference Type I Collagen was obtained from Sigma-Aldrich. Hide powder was purchased from BLC international. Finished leather was collected from various species and different tanneries was collected and analyzed. Synthetic leather was collected from Hong Kong fare. Several polymer-based materials(synthetic leathers)like PU, PVC, etc., were analyzed.

3 Results and Discussion

FTIR spectrum of collagen (Fig.1) the signatory amide peaks and its wavenumber (cm^{-1}) was noted down. The C=O stretch at 1627 cm^{-1}(amide I) and the CH2 bending at 1547 cm^{-1} (amide II)and the cluster of peaks at 1451,1336,1234 cm^{-1} (amide III) were also found in the collagen reference materials. Leather (Fig.5-a)and hide powder (purest form of leather) IR spectrum(fig.2 &3) was compared with the reference IR spectrum of Type I collagen. It was found that the signatory peak of amide I, II, III was found in both the leather and hide powder. The IR spectrum of the leather had a wavenumber shift of 2$cm^{-1}$to 5cm^{-1} because of the interference of the chemical that was used for finishing. The hide had a good match to that of collagen standard.

Synthetic leather(Fig.5-b) which was similar in look to that of leather was taken for the IR analysis. Its spectrum (Fig.4) failed to show any of the signatory amide peaks. This gives a clear intimation of differentiating synthetic leather from a original leather.

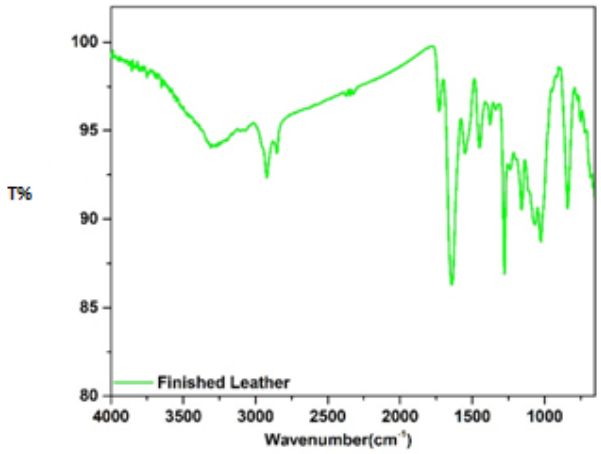

Fig. 1. IR spectrum of Type I collagen.

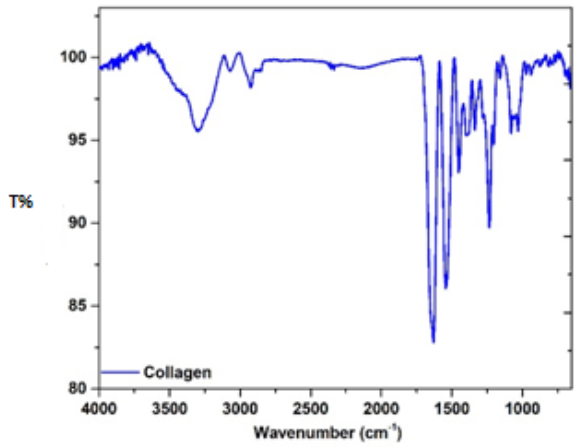

Fig. 2. IR spectrum of Finished leather.

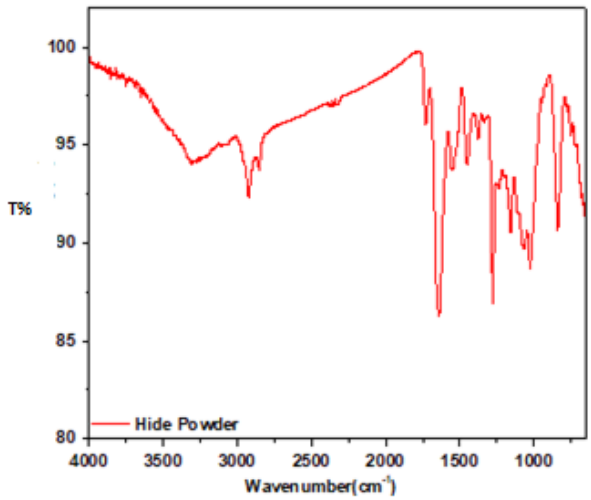

Fig. 3. IR spectrum of Hide powder.

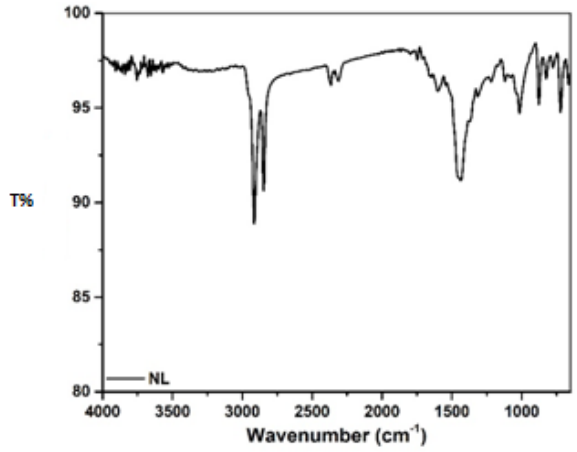

Fig. 4. IR Spectrum of Synthetic leather.

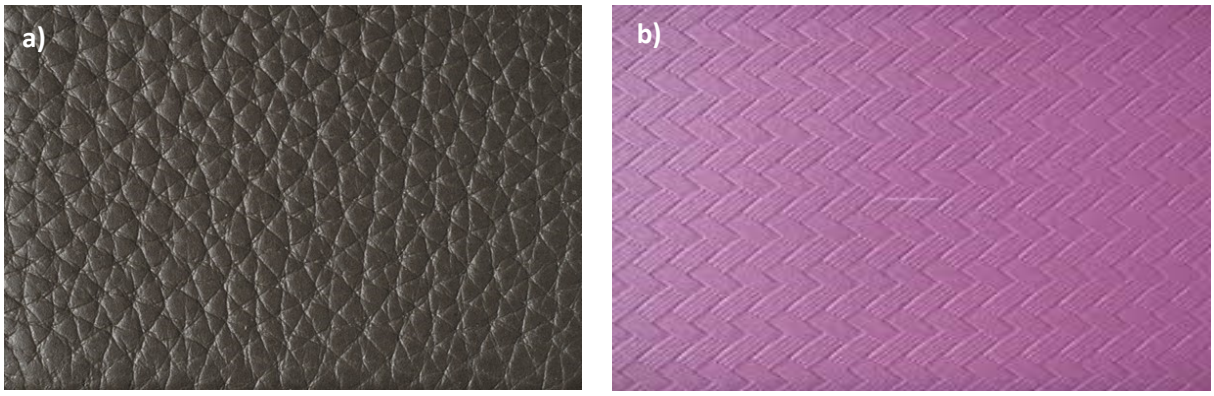

Fig. 5. a) Genuine leather b) Synthetic Leather.

4 Conclusion

FTIR-ATR helped in screening 30% of leather from that of leather like material by utilizing the characteristic features of collagen. Further studies are required to distinguish materials carrying collagen products (composites based on hydrolysates) from genuine leather.

Reference

1. *Alejandro Heredia, Maria Colin-Garcia, Miguel A. Peña-Rico4, Luis F. L. Aguirre Beltrán, José Grácio, Flavio F. Contreras-Torres, Andrés Rodríguez-Galván, Lauro Bucio4, Vladimir A. Basiuk1 "Thermal, infrared spectroscopy and molecular modeling characterization of bone: An insight in the apatite-collagen type I interaction" Advances in Biological Chemistry, 2013, 3, 215-223*
2. *R. Cantero, J. R. Riba, T. Canals, L. L. Izquierdo and H. Iturriaga "Characterization of leather finishing by ir spectroscopy and canonical variate analysis" Journal of the Society of Leather Technologists and Chemists,. 93 p.12.*
3. *Stamatis C. Boyatzis1, Marina Kehagia1, Katerina Malea "Evaluation of Effectivenes of Tanned Leather Cleaning with SEM-EDX and FTIR Spectroscopy" Analytical Bioanalytical Chemistry*
4. Elshahat H.A.Nashy Osama Osman[b] Abdel AzizMahmoud[b] MedhatIbrahim "Molecular spectroscopic study for suggested mechanism of chrome tanned leather" Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy *88, 2012, 171-176.*