Paper B59

Combination tanning based on Tara and THPS: A new chrome free tanning system

B. Madhan, R. Aravindhan, T. Senthil Raja and J. Raghava Rao
Central Leather Research Institute, Council of Scientific & Industrial Research, Adyar, Chennai-600020

One of the important criteria in determining the sustainability of an industrial activity is the eco-acceptability of the processing methods. Eco-friendliness of the processing methods employed in industrial production has gained paramount importance. In this regard, chrome tanning process has raised serious ecological concerns in leather sector. Hence, to overcome the problems associated with chrome tanning, tanners throughout the world are looking for alternative tanning systems. In the present study, chrome free combination tanning system based on Tetrakis Hydroxymethyl Phosphonium Sulphate (THPS) and Tara has been developed. Combination tanning trials employing Tara followed by THPS (Tara-THPS) and THPS followed by Tara (THPS-Tara) has been carried out. THPS-Tara combination trials were observed to result in leathers with better organoleptic properties. Shrinkage temperature of these leathers were around 88°C. Making of upper leathers was feasible using THPS-Tara combination. The developed combination tanning system is commercially viable for the manufacture of both upper and garment leathers. This combination tanning is expected to be an effective eco-friendly alternative to chrome tanning.

1.0 INTRODUCTION

Leather is a by-product of meat industry; the main sources of raw material for the leather industry worldwide are cow, buffalo, sheep and goat, which are reared specially for the production of meat and dairy products. Typically, the value of the cattle hides, sheep and goat skin contributes to only 5–15 % of the market value of the animal (Flora et al., 1990). The leather industry utilizes hides and skins, which would otherwise create enormous waste disposal problems with the attendant health hazards, if not processed. The most primitive tanning agents were leaves, barks and fruits containing tannins capable of converting putrisible raw hides and skins into imputrisible leather. After some thousands of years, human gained experience in making different types of leathers and they discovered that alum salts could tan hide/skin. Then it was only in the middle of 19th century salts of chrome were found to be suitable for tanning. From then on chromium salts dominated the tanning industry. Chrome tanned leathers were found to be ideal for footwear and garments.

In the present environment, conscientious world is driving researchers to explore eco-friendly products and processes (Nickolauss 1995). The leather industry, similar to most other potential polluting industries is continuing to implement environment friendly procedures in proportion to the regulatory legislation. Use of chromium in leather industry is being questioned owing to reports emerging on the toxicity and disposal problems associated with it. Hence, it is obvious that worldwide research is being focused on chrome free tanning systems. The comprehensive concern on the negative impact of the leather industries on the environment has forced tanners to pay attention to the processes that would reduce the problems related to pollution. Alternatives to chromium are being sought actively owing to the stringent regulations on disposal of chromium containing wastewater and solid wastes. In order to avoid chromium completely in leather processing, other tanning agents ought to be investigated. Many alternatives have been explored but without much success as no individual tanning agent has been able to match the properties of chromium. In this regard, the concept of chrome free combination tannages emerges as suitable option as a solution to be eco-friendly. Any alternative tanning system should not only satisfy environmental criteria but also should be able to

match the properties of conventional tanned leathers. Less chrome approach based on chrome-zinc and chrome-zinc –silica tanning agent has been attempted to reduce discharge of chrome (Madhan et al 2002, Fathima et al 2002). Zirconium oxychloride, aluminium zinc combination tanning agent are some of the inorganic alternative tannages to chrome (Madhan et al 2001b, Sundararajan et al 2003). Vegetable-oxazolidine, Vegetable-acrylic and newer vegetable tannin combinations were reported for organic alternative tannings systems for chromium (Das Gupta et al , Madhan et al 2001a, Madhan et al 2007, Musa et al 2008) . In this paper we are reporting combination tanning system based on Tara and THPS.

2.0 MATERIALS AND METHODS

2.1 MATERIALS

Pickled goat skins were chosen as raw material. All the chemicals used for the experiments were of commercial grade.

2.2 TANNING EXPERIMENTS USING TARA AND THPS

Combination tanning based on of Tara and Tetrakis hydroxymethly phosphonium sulphate (THPS) were carried out from conventionally processed pickled skins from goat. Two different tanning methods were adopted viz. tanning first with THPS followed by Tara and tanning first with Tara and followed by THPS.

2.2.1 Tanning Trails Using THPS Followed By Tara (Trial A)

The experimental trail using THPS-Tara combination was carried out as per flow cart shown in Figure 1. THPS (1.5%) and Tara (10%) was used for tanning. Post tanning for upper leather is carried out as mentioned in Table 1.

2.2.2 Tanning Trails Using Tara Followed By THPS (Trial B)

The experimental trail using Tara-THPS combination was carried out as per flow cart shown in Figure 1. Tara (10%) and THPS (1.5%) was used for tanning. Post tanning for upper leather is carried out as mentioned in Table 1.

2.3 Organoleptic Properties of Leathers

Experimental crust leathers were assessed for softness, fullness, grain flatness, grain smoothness, grain tightness (break) and general appearance by hand and visual examination. The leathers were rated on a scale of 0-10 points for each functional property by experienced tanners, where higher points indicate better property.

2.4 Reflectance and Colour measurements

The principle involves measuring the amount of light reflected from the surface of opaque specimen at wavelengths throughout the visible spectrum as a fraction of that reflected by a white standard identically illuminated. It is known as the reflectance factor. The white standard used should be an absolute one i.e., it should be a perfect reflecting diffuser whose reflectance at every wavelength is 100%. The experimental crust leathers made in this study were subjected to reflectance measurements using a Mitton Roy Colour Mate HDS instrument. Colour measurement parameters viz., L, a, b, h and C were also recorded for crust leathers. ‘L’ represents lightness factor, ‘a’ represents red and green axis and ‘b’ represents yellow and blue axis; ‘h’ represents hue; ‘c’ represents chromaticity.

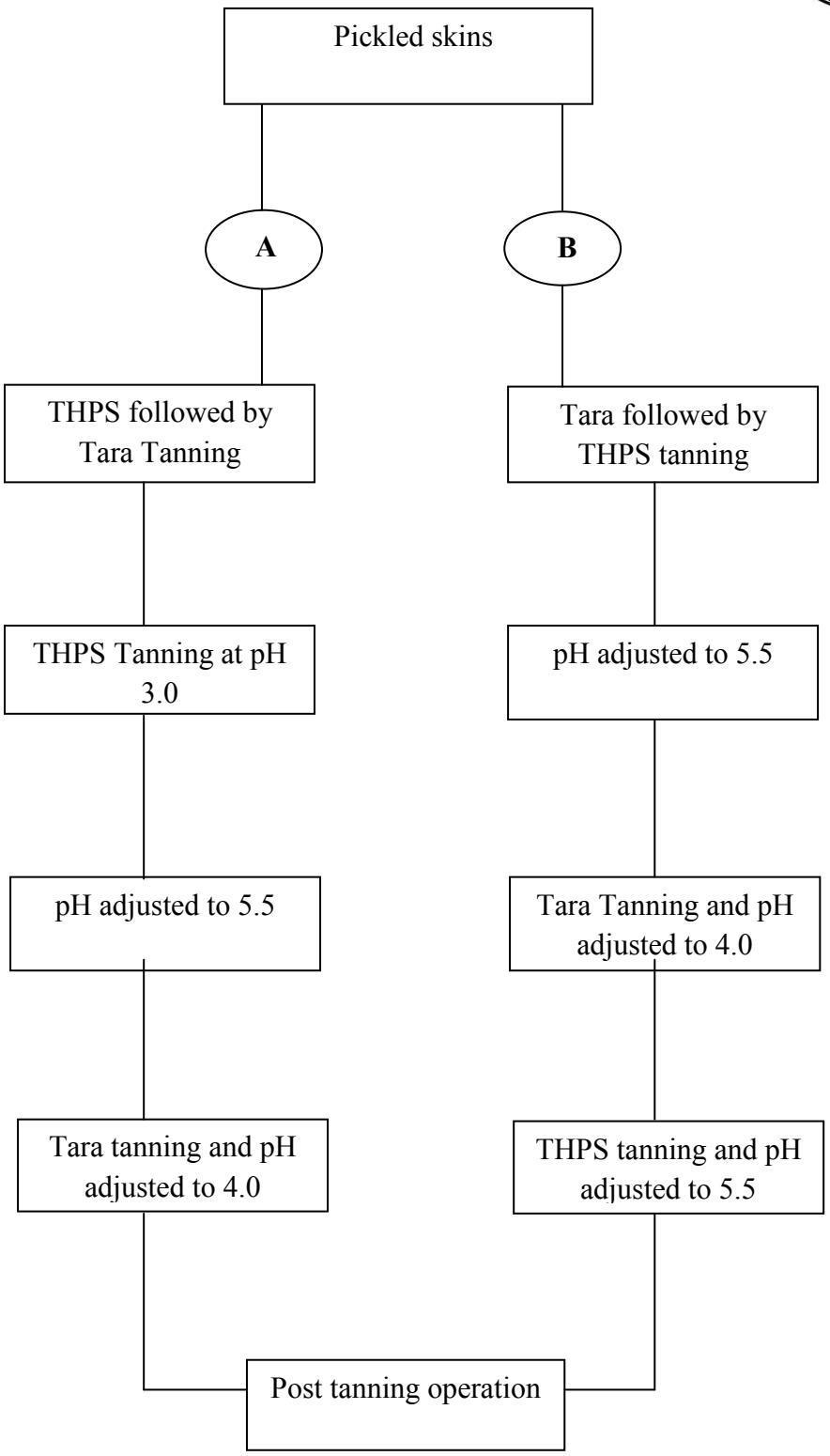

Figure 1 : Flow chart representing experimental trails of Tara and THPS tanning system

Table 1: Post tanning recipe for Upper leather manufacture

Raw material: Leathers from Trial A and B Samming and shaved to a thickness of 1.0 -1.1 mm

PROCESS	CHEMICAL	%	DURATION	REMARKS
Neutralisation	Water	150		
	Sodium formate	1		
	Sodium bicarbonate	0.75	3 x 20+30	pH - 5.0 -5.2 D/O wash
Retanning, dyeing & fatliquoring	Water	150		
	Relugan RE	2		
	(Basyntan FB6)	3	40	Check exhaustion
	Vinkol PB	0.5		
	Dermapel Black CLI	2	40	Check penetration
	Lipoderm liquor SA	6		
	Lipoderm liquor SAF	6		
	Basyntan DI	3	40	Check exhaustion
Fixing	Formic acid	2	3 x10 + 30	D/W, pile O/N

Setting, hook to dry, staking, trimming and buffing

3.0 Results and Discussion

Shrinkage temperature of THPS-Tara was observed to be 88° C which is slightly better than Tara-THPS which resulted in leathers with shrinkage temperature of 87° C. Leathers tanned using Tara-THPS and THPS-Tara tanning methods have been evaluated by 3 experienced tanners and the results are provided in Table 2. The grain smoothness and tightness is better in THPS-Tara tanned leathers. The leathers tanned with THPS-Tara found to have better handling properties than Tara-THPS tanned leathers.

Table 2 Hand evaluation* of upper leathers processed using two tanning methods

Samples	Fullness	Roundness	Smoothness	softness	Tightness
Tara-THPS	6±1	6±1	7±1	6±1	6±1
THPS-Tara	8±1	7±1	9±0.5	7±1	8±1
*Hand evaluation was done after final crusting					

Leathers from THPS-Tara combination tanning system were observed to be better than Tara-THPS combination. The lightness factor L, a, b, hue, chromaticity values of crust leathers tanned using the THPS-Tara combination tanning system was determined and the values are shown in Table 3 and Figure 2.

Table 3: L*, a*, b*, hue* and chromaticity* of the leathers tanned using THPS-Tara tanning system

Leather	L	A	B	Hue	Chromaticity
THPS-Tara	24.36	-0.10	4.04	90.45	4.037
* L, a, b, hue and chromaticity values are evaluated after final crusting					

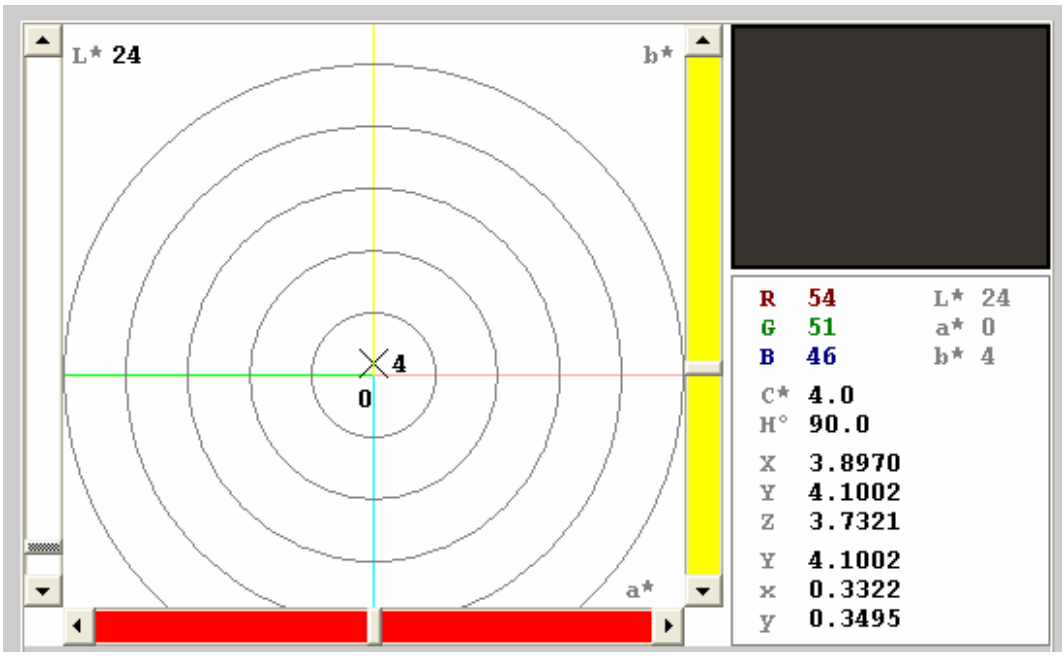

Fig 2: Colour measurement diagram of Upper leathers from THPS-Tara Tanning

From the above table it could be observed that the lightness factor is around 24 for upper leathers manufactured, which indicates the richness in colour could be obtained by using only 2% dye.

4.0 CONCLUSION

The combination tanning system using Tara and THPS results in leathers with good organoleptic properties. The hydrothermal stability of the leathers obtained is found to be around 88° C. The developed tanning system can be employed with ease and would result in quality leathers. Hence, the developed combination tanning system is commercially viable for the manufacture of upper and garment leathers.

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