EVALUATION OF COMBINATION TANNING AND NATURAL FINISHING ON SHEEP LEATHER WITH *Uncaria Gambir Roxb* EXTRACT

GRESY GRIYANITASARI¹, EMILIANA KASMUDJIASTUTI¹, RAGIL YULIATMO²,
MOHAMMAD ZAINAL ABIDIN^{3*}

¹Center for Leather, Rubber and Plastics, Ministry of Industry, Jl. Sokonandi No. 9, Yogyakarta, 55166, Indonesia

²Department of Leather Processing Technology, Polytechnic of Leather Technology, Yogyakarta, 55188, Indonesia

³Laboratory of Leather, Waste, and Animal By-products Technology, Department of Animal Product Technology, Faculty of Animal Science, University of Gadjah Mada, Bulaksumur, Yogyakarta, 55281, Indonesia; * corresponding author: m.zainal.abidin@ugm.ac.id

The discovery of natural local resources for tanning and coloring agents are growing dramatically to sustain a cleaner leather manufacturing technology. Gambir (*Uncaria gambir Roxb*) has been found potential as tannin and dyestuffs for leather and textile industry. Therefore, to explore these issues, a combination tanning and finishing system were evaluated to observe the efficiency of this extract on leather processing. A combination tanning system based on chrome or glutaraldehyde – gambir and followed by gambir as coloring agent with different concentrations (100 - 200 parts/L) have been applied. In this FTIR (Fourier-transform infrared spectroscopy) analysis of gambir extract showed the presence of phenolic hydroxyl group. Our results revealed that chrome - gambir and glutaraldehyde - gambir finished leather product with 150 parts/L of gambir extract showed excellent rub fastness, color fastness to perspiration and washing. Most of the result values obtained were generally at satisfactory levels which were between 3/4 and 5 fastness values. Visual evaluation reported that chrome-gambir finished leather product with 150 parts/L of gambir extract exhibited better uniformity of colour fastness.

Keywords: combination tanning, natural finishing, *Uncaria gambir Roxb*

INTRODUCTION

The leather tannery industry is one of the oldest industries in the world, in which need developing to meet requirements of the consumer. The various consumers and agencies expect the industry to limit the use of the hazardous materials. Tanning and leather finishing process is the critical step in leather manufacture. Mainly, chrome is used as tanning agents, in which have a negative impact for environment and health (Adiguzel-Zengin *et al.*, 2017; China *et al.*, 2020). While, finishing leather is the last step in whole process of leather manufacture on determination of the leather appearance (Ariram and Madhan, 2020, Sathish *et al.*, 2016). Thus, in the conventional leather making, tanning process produced chrome in form sodium dichromate, and leather finishing use chrome in azo dyes formed azo-chromophore (Dixit *et al.*, 2015).

Recently, eco-friendly tanning using plants and glutaraldehyde is the promising alternative for finishing leather process. Generally, this step consists of base coat and top coat, in which the base coat aims to give color effect in the leather. The colorant material can be categorized as a dyes and pigments (Covington and Wise, 2020).

Nowadays, the various consumers and agencies require the industry to limit the use of azo dyes in the manufacture of leather, and there is a rising awareness of the environment leads to the expanding demand of natural material and products (Tamil Selvi *et al.*, 2013). Plants are the main natural resource to replace pigment for leather coloring purposes. Each species of the plant has its natural colorant (Gong *et al.*, 2019).

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Tamil Selvi *et al.* (2013) reported that chrome-tanned leather was dyed and finished by a natural dye extract showed better coloring properties.

Gambir (*Uncaria gambir Roxb*) is one of the typical plants from West Sumatera, Indonesia that known as a vegetable tannin (Maier *et al.*, 2017) and is also usually used for textile dyes (Morakotjinda & Nitayaphat, 2016). However, the application of gambir extract for tanning agents and dyestuff of leather have not been explored yet. Thus, the objective of this study is to investigate the fixation of dyes to differently tanned-leather and to evaluate its employability in the process of natural dyeing. This approach will involve a measuring various colors and fastness that leather gains when applied with gambir through the use of different its concentration.

EXPERIMENTAL

Material and Instrument

Natural source of dyeing agent in this study were *Uncaria gambir Roxb* which procured from CV. Rasdi & Co., West Sumatera, Indonesia. Pickled sheepskins were obtained from local tanneries in Yogyakarta, Indonesia and all chemicals of experiment were commercial grades. FT-IR ATR measurement was carried out on a Perkin Elmer instrument (Spectrum one, wavelength range 500 – 4.500 cm⁻¹) to place the functional groups present in the gambir extract. Rub fastness test was determined according to (ISO, 2012), while colour fastness to perspiration and washing was determined according to (BSI, 1990).

Gambir Extraction

Gambir was used as a natural tanning and dyeing agent in the finishing process. After procured the gambir, sample was then ground using grinder machine Retsch Gmbh 5657 HAAN type SK1 and filtered manually using a sieve. Five hundred grams of ground gambir was extracted with 1500 mL of water in the Memmert water bath for 5 hours and stirred occasionally. Subsequent extract of dye solution was filtered and concentrated under vacuum filtration.

Leather Tanning Procedure

Six samples of sheepskin were treated with two different tanning combination: glutaraldehyde-gambir and chrome-gambir. Then, the finishing leathers were applied with a various level of gambir extract as natural dyes.

Table 1. Sample identification

Sample identification	Tanning agent	Quantity of gambir for finishing (parts/L)
GG100	glutaraldehyde – gambir	100
GG150	glutaraldehyde – gambir	150
GG200	glutaraldehyde – gambir	200
CG100	chrome – gambir	100
CG150	chrome – gambir	150
CG200	chrome – gambir	200

Table 2. Formulation of the tanning process

Process	Product	%	Duration (min)
Repickle	Salt	8	10
	Water	100	
	Sodatan SB	2	30
Pretanning	Sodatan TSN	2	30
	Tannit LSW	0,5	30
	Chrome/glutaraldehyde	6	60
Tanning	Baking Soda (NaHCO ₃)	0,5 - 2	3 x 15
	Gambir extract	25	6 x (30 Ø 15)
Drained, aged, and shaved			
Retanning	Acrylic Syntan	6	60
	40 °C water	70	
	Synthetic fatliquor	16	
Fatliquoring	40 °C water	40	120
	Synthetic fatliquor	16	
Fixating	Formic acid (HCOOH)	1,5	2 x 30
Antifungal	Antifungal agent	0,05	30
Masking	Catalix GS	1	15

Leather Finishing Procedure

The finishing procedure of two steps: basecoat and topcoat. For the base coat, the gambir extract was varied at 100, 150, and 250 parts/L (Table 2).

Table 3. Basecoat formulation

Materials	Quantity (g/L)		
	100	150	200
Medium soft acrylic (RA 193)	150	150	150
Soft acrylic (RA 1)	100	100	100
Soft Uretane (Resin Uretane)	50	50	50
Wax filler	35	35	35
Penetrator	15	15	15
Gambir (Dyes)	100	150	200
Water	550	500	450

To protect the base coat and improve the properties of leather, the leather was treated using lacquer water, water, and KS water for the top coat. The formulation of topcoat was presented at Table 4.

Table 4. Topcoat formulation

Materials	Quantity (g/L)
Lacquer water	500
Water	350
KS water	150

RESULTS AND DISCUSSION

FT-IR

Figure 1. FTIR Spectra of gambir extract

The FTIR Spectra of gambir extract can be seen in Fig. 1. In the spectra, the broad band that falls in the range of 3700 – 3200 cm⁻¹ is attributed to the fundamental stretching vibration of –OH groups. The peak at 1631 cm⁻¹ is associated with the aromatic C=O stretching. Further, the peak at 1288 cm⁻¹ corresponds to the phenol C-O, while at 1053 cm⁻¹ is stretching vibration of C-O-C. In general, FTIR spectra for gambir extract indicated that gambir extract containing an anthocyanin, in which the core component of natural dyeing.

Rub Fastness

Wet and dry colour fastnesses of leathers analyzed on the grain sides to rubbing are comparatively shown in Table 5. The higher quantity of gambir extract showed the low value of wet rub fastness of glutaraldehyde-gambir finished leather. Whereas, chrome-gambir tanned leather finished at 200 parts/L gambir extract also obtained lower wet rub fastness value than at 150 parts/L. Various quantity of gambir extract resulted in excellent rub fastness with no variation (4/5 at dry basis) on glutaraldehyde-gambir finished leather. Meanwhile, 100 parts/L of gambir extract has the highest dry rub fastness for chrome-gambir finished leather.

The rate of 4/5 on dry basis implies that leather has good to very good fastness, while the rate of 5 showed very good fastness on the finished leather (Çolak and

Ortafidan, 2016; Berhanu & Ratnapandian, 2017). It was observed that the higher parts of gambir in the finishing process did not increase the wet and dry rubbing fastness. The addition of 200 parts/L gambir extract on base coating resulted in lower wet and dry basis rub fastness. However, the drying rubbing fastness of the leather proved to have the same or higher values compared to wet rubbing fastness. Leather rub fastness could be affected by a combination of pigment, resin, and binder used for base coat (Sundar *et al.*, 2006).

Table 5. Dry and wet rub fastness test results

Rub fastness	Glutaraldehyde – Gambir			Chrome – Gambir		
	GG 100	GG 150	GG 200	CG 100	CG 150	CG 200
Wet	4	4	3/4	3/4	4	3/4
Dry	4/5	4/5	4/5	5	4/5	4/5

Colour Fastness to Perspiration

The leather colour fastness to perspiration in all combinations were separately analyzed on the grain sides and are shown comparatively in Table 6. The staining to each type of fiber (acetate, cotton, polyamide, polyester, acrylic, and wool) and the colour change in the experimental piece were assessed. This method was analyzed using a Grey scale and rated from 1-5, where the value close to 5 means that leather has excellent fastness properties (Prakash, et al., 2016). In Table 6. presented the values of colour fastness of different tanned and finished leather with varied gambir extract in terms of acetate, cotton, polyamide, polyester, acrylic, and wool.

Table 6. Colour fastness to perspiration test result

Colour fastness to perspiration	Glutaraldehyde – Gambir			Chrome – Gambir		
	GG 100	GG 150	GG 200	CG 100	CG 150	CG 200
Acetat	4	4/5	3/4	3/4	5	3/4
Cotton	3	3/4	3	3/4	4	3
Polyamide	3/4	4/5	3/4	4	4/5	4
Polyester	3/4	4	3	3/4	4/5	3/4
Acrylic	4	4	3	3/4	5	3/4
Wool	3	4	3	3/4	4	3/4

Thus, examination of Table 6 revealed that the fastness of chrome-gambir tanned leather are slightly better compared to glutaraldehyde-gambir finished leather. It also showed that the concentration of gambir (150 part/L) exhibited better colour fastness. Overall, the result of colour fastness to perspiration samples were quite good value (not less than 3), especially at concentration of Gambir 150 parts/L.

Colour Fastness to Washing

This colour fastness to washing test could determine the colour resistance of leather samples to washing under domestic conditions. The staining materials were similar with colour fastness to perspiration. Before washing and drying, samples were agitated in a neutral of synthetic solution. The result of colour fastness to washing test samples are shown in Table 7. Compared with each material samples, chrome-gambir tanned leather at 150 parts/L produced slightly higher value of colour fastness to wool. However, all of

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finished leather with glutaraldehyde-gambir and chrome-gambir showed excellent colour fastness to washing value.

Table 7. Colour fastness to washing test result

Wash fastness	GG 100	GG 150	GG 200	CG 100	CG 150	CG 200
Acetat	5	5	5	5	5	5
Cotton	4/5	4/5	4/5	4/5	4/5	4/5
Polyamide	5	5	5	5	5	5
Polyester	5	5	5	5	5	5
Acrylic	5	5	5	5	5	5
Wool	4/5	4/5	4/5	4/5	5	4/5

Visual Assessment

The visual assessment of finished leather showed different unique colour as Figure 2. The higher proportion of gambir extract on base coating resulted the darker colour of chrome-gambir finished leather. The use of 200 parts/L of gambir extract showed a better colour uniformity for both glutaraldehyde-gambir and chrome-gambir finished leather, while finished leather at low concentration of gambir was less consistency. At the similar quantity of gambir extract, the chrome-gambir finished leather produced a slightly darker colour than glutaraldehyde-gambir tanned leather.

Figure 2. Photograph samples of finished leather

On the other hand, at 100 parts/L of gambir extract generated less uniform colour. Because of the concentration of gambir is dilute, the penetration of dye to leather could not as good as concentrated dyes (200 g/L). The concentrated dye provided the finished leather was darker.

CONCLUSIONS

One hundred fifty parts/L of gambir extract at base coating (finishing stage) were conclude as optimum concentration for the finished leather, resulted the value of the rub fastness, colour fastness to perspiration, and colour fastness to washing are excellent. Here, *Uncaria Gambir Roxb* (Gambir) provides an alternative of natural dyeing for finishing leather and support for eco-benign leather finishing process. However, further exploring about natural local resources for tanning and dyeing agents in Indonesia is on progress.

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