Journal of the Society of Leather Technologists and Chemists, Vol. 93 p.158

CHAMOIS LEATHER TANNING USING RUBBER SEED OIL

ONO SUPARNO, IKA A. KARTIKA and MUSLICH

Department of Agroindustrial Technology, Faculty of Agricultural Engineering and Technology, Bogor Agricultural University (IPB), Darmaga Campus, P. O. Box 220, Bogor 16002, Indonesia

Abstract

Indonesia is one of the countries having the largest rubber plantations in the world. Besides producing latex, rubber plantations produce also about 1500kg/hectare of rubber seeds, which has not been utilised optimally. Rubber seed oil may be able to be used for chamois leather tanning.

Chamois leather is a popular leather article in the market, as it has unique uses, such as in high quality gasoline filtration and cleaning of optical equipment (spectacles, windows, vehicle, jewellery, silverware, *etc.*). In this research, the use of rubber seed oil for chamois tanning was investigated. The objectives of the research were to discover whether the rubber seed oil could be used as chamois leather tanning agent, and to identify chemical, physical as well as organoleptic properties of the rubber seed oil tanned leather. This study shows that the chemical, physical, and organoleptic properties of rubber seed oil tanned leather were similar to those of fish oil tanned leather. In terms of colour and odour, rubber seed oil tanned leather was better than fish oil tanned leather. The chemical properties of rubber seed tanned leather were a pH of 6.9-7.0 and ash content of 4.9%. Its physical properties were thickness of 0.4-1.0mm, tensile strength of 27.6N/mm^2, elongation at break of 104%, and water absorption of 380% (2 hours). The organoleptic properties of the leather, *i.e.* softness, colour, and odour, were good to excellent. All of those characteristics fulfill the quality requirements for chamois leather. Therefore, rubber seed oil might be suitable to use as a substitute for fish oil in oil tanning for chamois leather production.

Introduction

Indonesia is one of the biggest natural rubber producers in the world. Indonesia has about 3,338,162 hectares of rubber plantation. Besides producing latex, the plantation produces also rubber seed, about 1500 kilograms per hectare per season.

One of the uses of the rubber seed is for rubber seed oil. The oil is a drying oil; it changes into a thick viscous layer, and forms a membrane when it is oxidised or exposed to an open air. The type of oil can be used as a material for making soap, paint, and cosmetics.[1] Moreover, rubber seed oil has potential as a leather tanning agent for chamois leather.

Chamois leather is a well known product. It has specific uses, such as in high quality gasoline filtration, cleaning and drying optical equipment, spectacles, mirror, and vehicles, *etc.*

Nowadays, oil tanned leather is produced using fish oil as its main tannage. Tanning using fish oil faces an odour problem, caused by oxidized fish oil residues attached to the chamois leather. The odour cannot be removed completely from the leather. Reducing the use of fish oil in the chamois tanning would help to reduce the odour.

Rubber seed oil is a vegetable oil which is expected to substitute for fish oil in tanning. The oil will not produce odour and might be able to cross-link with protein in the skin or hide to produce leather.[3-4] The objectives of the research were to discover whether the rubber seed oil could be used as chamois leather tanning agent, and to identify the chemical, physical as well as organoleptic properties of the rubber seed oil tanned leather.

Materials and methods

Materials and equipment

Materials used in the research were pickled sheep skin, rubber seed oil, fish oil (as a control), sodium chloride, Relugan GT (50% glutaraldehyde, BASF), sodium formate, sodium carbonate, and Eusapon S (Wetting/degreasing agent, BASF). The equipment used included an hydraulic press, tanning drum, stacking, paddle, shaving machine, toggle dryer, buffing machine, pH meter, shaker, grinder, burner, tensile strength meter, Kubelka glass apparatus, and Fourier Transform Infra Red Spectrophotometer (FT-IR).

Method

Oil Extraction

The seeds were sun dried for 3 days, 5 hours each day, and then were dried in an oven at 70°C for 1 hour. Oil was extracted by using a hydraulic press at 65°C. The yield of oil was approx. 10% for whole seeds or 20% for endosperm only.

Oil Analyses

Colour, density, iodine value, acid value, free fatty acid content, peroxide value, and saponification value of rubber seed oil and fish oil were measured. The colour of the oils was measured by using a DR 2000 spectrophotometer at wavelength of 455nm. A pycnometer was used to measure the density of the oils. Iodine value was analysed using Wijs method.[5] Acid value was measured using the AOAC method.[6]

TABLE I
Procedure of tanning using rubber seed oil

Process	Chemical	Amount (%)	Duration	Remarks
pH adjustment	Water	200		Drum at 8rpm
	NaCl	10	10min.	Measure pH at 3 and °Be at 8
	Formic acid			
Pretanning	Relugan GT	1.5	4 x 15min., then 1 hour	Dilute with water 3 times Drum at 12rpm
Fixation	Sodium formate	1	4 x 10min.	Dilute 20 times
	Sodium carbonate	1		Measure pH at 8
Drain				
Ageing			Overnight	Cover with plastic
Shaving				Shave both sides
Washing	Water	1,000	3 x 15min.	
Drain				
Oil tanning	Water	200	10min.	Drum at 8rpm
	Sodium carbonate	0.5		
	Rubber seed oil	30		Leave ovenight
	Fish oil (control)			Drum for 1 hour Hang at room temperature for 3 days
Washing	Sodium carbonate	3		Stake
	Eusapon S	0.2		Repeat 3 times
	Water	300		
Drain				
Toggling and drying			24 hours	
Buffing				Buff both sides

The process was carried out at room temperature of about 20-35°C

Free fatty acid content was determined by converting acid value to free fatty acid content.[7] Peroxide values of the oils were measured using an AOAC method.[6] Saponification value was also measured using an AOAC method.[6]

Tanning

The tanning process consisted of pH adjusting, pretanning, oil tanning, milling, oxidation, washing, staking, drying, toggling, and buffing. The procedure of the tanning is shown in Table I.

Leather Analyses

Chemical properties (pH and ash content), were measured using SLC 13.[8] Physical properties, (tensile strength, elongation at break, water absorption) were analysed using SLF 6.[5] Organoleptic properties, such as softness, colour and odour, were tested by two chamois leather experts.

Results and discussion

Oil Characteristics

The Iodine value of rubber seed oil was 146 indicating a good degree of unsaturation of the oil, which is one of the requirements for an oil tannage. The value was similar to the iodine value of fish oil (148). Other characteristics, such as acid value, free fatty acid content, saponification value, peroxide value and density were similar with those of fish oil. Comparison of the rubber seed oil and fish oil's physico-chemical characteristics are given in Table II.

TABLE II
Physico-chemical properties of rubber seed oil and fish oil

No.	Physico-chemical properties	Rubber seed oil	Fish oil
1	Colour (Unit PtCo)	4076	6106
2	Density (g/cm³)	0.92	0.92
3	Iodine value	146	148
4	Acid value	2.08	0.19
5	Free fatty avid content (%)	1.0	0.095
6	Peroxide value	31.33	13.97
7	Saponification value	185	168

TABLE III
Functional groups of rubber seed oil and fish oil

Functional group	Wavenumber (cm^{-1})	
	Rubber seed oil	Fish oil
COOH	2912.82	2910.20
COOR	1163.80	1152.00
–CH=CH–	722.73	720.89
OH	3471.97	3472.33
C–H	2855.41	2854.27

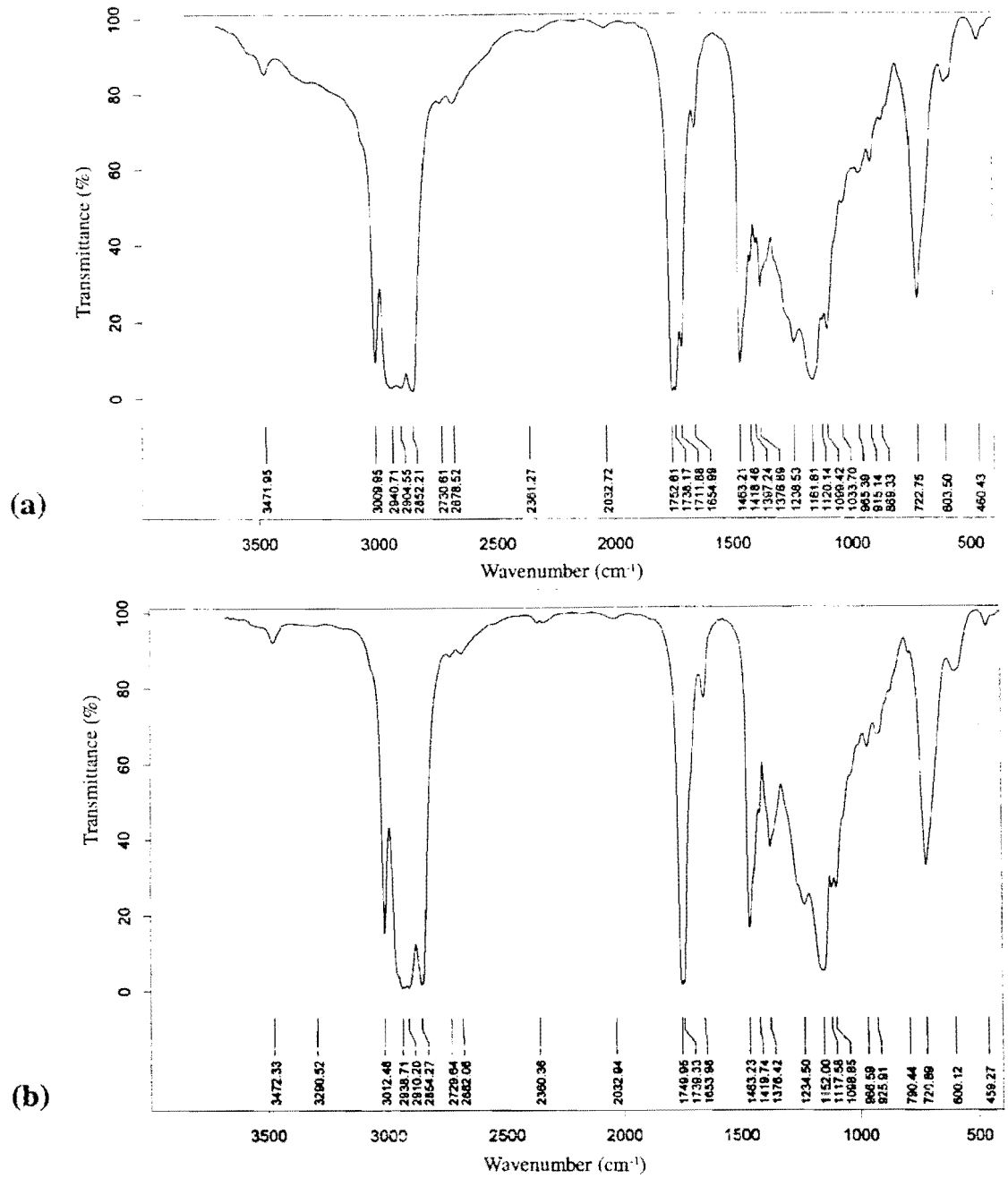

Figure 1. FT-IR spectra of rubber seed oil (**a**) and fish oil (**b**).

The colour of rubber seed oil was lighter than that of fish oil, as shown in Table II, a positive advantage of the rubber seed oil. The low colour intensity oil might produce leather with bright colour close to white, where required in the specification for chamois leather, SNI 06-1752-1990 (see Appendix).

The FT-IR spectrum of the rubber seed oil (Fig. 1) demonstrates that rubber seed oil has the same functional groups as fish oil as shown in Table III. It shows also that drying of rubber seed at 70°C for an hour did not alter the functional groups of rubber seed oil.

Tanning Process

The success of oil tanning could be identified from appearance of the treated skin after tanning by the oil. The skin gave a pale colour when it was stretched or pulled, which showed that the oil tanning worked well on the leather. The leathers were repeatedly wetted and dried, this had no discernable effect on the leathers. The tanning using rubber seed oil and fish oil shows the same effect. Therefore, both tannages were successful. It was also supported by other characteristics, such as shrinkage temperature (Ts), for the rubber seed oil tanned leather 73 +/- 2°C and 71 +/- 2°C for the fish oil tanned leather.

Chamois Leather Characteristics

Chemical Properties

pH value of rubber seed tanned leather was almost the same with that of fish oil tanned leather, as demonstrated in Table IV. The pH values of the both leathers met fulfill requirement, *i.e.* maximum pH8. The ash contents of both leathers also met the quality requirement for chamois leather.

TABLE IV
Chemical properties of rubber seed oil and fish oil tanned leathers

Chemical properties	Rubber seed oil tanned leather	Fish oil tanned leather
pH	6.9-7.0	7.1-7.3
Ash content (%)	4.8	3.0

Physical Properties

Rubber seed oil tanned leather had similar thickness to fish oil tanned leather and similar fullness. They both met the quality standard. Tensile strength and elongation at break of rubber seed oil was higher than that of fish oil tanned leather, which indicated their stabilities.

The water absorption test showed that skin tanned with rubber seed oil gave properties close to those of fish oil tanned leather. The physical properties of both leathers are shown in Table V.

TABLE V
Physical properties of rubber seed oil and fish oil tanned leathers

Physical properties	Rubber seed oil tanned leather	Fish oil tanned leather
Thickness (mm)	0.4-1.0	0.4-0.1
Tensile strength (N/mm^2)	27.6	23.1
Elongation at break (%)	104	91
Water absorption (%)		
2 hours	388	395
24 hours	424	437

Organoleptic Properties

The softness of rubber seed oil tanned leather was similar to fish oil tanned leather, as shown in Table VI, the softness of both was good. The colour of rubber seed oil tanned leather was brighter then that of fish oil tanned leather, a consequence of the brighter of colour rubber seed and of its lower protein content compared to fish oil; oxidised protein can produce a higher intensity of colour. Rubber seed oil tanned leather has better odour than fish oil tanned leather. Organoleptic properties of both leathers are shown in Table VI.

TABLE VI
Organoleptic properties of rubber seed oil and fish oil tanned leathers

Organoleptic properties	Rubber seed oil tanned leather	Fish oil tanned leather
Softness	7-8	7-8
Colour	8-9	6-7
Odour	7-8	5-6

On a10 point scale, 0 = poor, 10 = excellent.
The result was average results from two experts.

Conclusions

Physical properties of rubber seed oil tanned leather were: thickness of 0.4-1.0 mm, tensile strength of 27.6N/mm^2, elongation at break of 104%, water absorption of 380% (2 hours). Chemical properties of the leather were pH of 6.9-7.0 and ash content of 4.8%. Its organoleptic properties of softness, colour, and odour were rated as good to very good. All of the parameters fulfilled the quality standard required. Physico-chemical and organoleptic properties of rubber seed oil tanned leather were similar with those of fish oil tanned leather. The colour and odour of rubber seed oil tanned leather were better compared with those of fish oil tanned leather. We suggest that rubber seed oil could be used as tanning agent and has the ability to be used to substitute fish oil in oil tanning to produce chamois leather.

Acknowledgement

The author acknowledges the Directorate of Higher Education, Indonesian Ministry of National Education for its financial support and Bogor Agricultural University for its facility for conducting this research.

References

1. Anon. 1984. Rubber seed oil. *Rubber News*, 1984, **6** (5), 12.
2. Krishnan, S. H., Sundar, V. J., Rangasamy, T. *et al.*, Studies on chamois leather tanning using plant oil. *J. Soc. Leather Technol. Chem.*, 2005, **89**, 260-262.
3. Suparno, O., Phenolic reactions for leather tanning and dyeing, Ph.D. thesis, University of Leicester, UK, (2005).
4. Suparno, O., Potency of Rubber Seed Utilisation in Indonesia. Unpublished paper. 2006.
5. AOCS. 1951. Official and Tentative Methods of The American Oil Chemist Society 2nd ed. AOCS, Chicago.
6. AOAC. 1995. Official Methods of Analysis. AOAC, Washington DC.
7. Sudarmadji, S., Haryono, B., and Suhardi. Analysis Procedures for Food and Agricultural Materials. Liberty, Yogyakarta. (1989).
8. SLTC. Official Methods of Analysis. Society of Leather Technologists and Chemists, Northampton. (1996).

Appendix

SNI 06-1752-1990 is a quality standard for chamois leather in Indonesia, published by Badan Standardisasi Nasional (National Standardization Agency of Indonesia). The standard states that chamois leather must meet quality requirements for chemical, physical and organoleptic properties.

Chemical requirements:
pH: max 8; ash content: max 5%.
Physical requirements:
thickness: 0.3-1.2 mm; elongation at break: min 50%; tensile strength: min 7.5N/mm^2; water absorption: 2 hours: min 100%; 24 hours: min 200%.
Organoleptic requirements:
handle: soft; colour: light yellow to white.