Suitability of Different Oils for Chamois Leather Manufacture

by

K.V. Sandhya,[A] N. Vedaraman,[A]* V. John Sundar,[B] R. Mohan,[C] K. C. Velappan[A] and C. Muralidharan[B]

[A]*Chemical Engineering Division,*

[B]*Tannery Division,*

[C]*SDDC Division, Central Leather Research Institute,*

Adyar, Chennai-600 020, India

Abstract

Chamois leather, conventionally made using fish oil finds wide industrial application. The major advantage with fish oils is that they contain significant amount of pentadienoic fatty acid in addition to higher iodine value. But the main problem with fish oil is its strong odor and high cost. The objective of the present work is to study the suitability of oils such as linseed oil, castor oil, sunflower oil, animal tallow for chamois leather manufacture in comparision with fish oil. The chamois leather, thus obtained was tested for properties such as sink test, water absorption and strength characteristics. Experimental results show that among different oils, linseed oil based chamois leather posseses higher water absorption and strength properties. It also has mild odour. This study shows that acceptable quality chamois leather can be made using linseed oil as tanning agent instead of fish oil.

Introduction

Chamois leather**,** a special type of highly porous leather that possesses exceptional absorption properties.[1,2] It has low density, excellent softness and high flexibility.[3] It is extensively used for cleaning polished surfaces. In addition, the leathers also find other uses such as resource for the production of gloves and orthopaedic application.[4,5] For making chamois leather, generally, skins with surface defects such as scratches, grain damages are preferred because during the process the grain is removed. In India, availability of goat skins is very high and skins with these defects are quite common, hence are preferred for this type of leather making.[6] The conventional method of chamois leather making is to carryout beam house operation and mild pre-tanning with formaldehyde.[7] Presently there is a restriction on the use of formaldehyde because of safety and health reasons, hence gluteraldehyde is used for tanning purpose. The traditional method of making chamois leather is to impregnate the aldehyde tanned skins/splits with fish oil and then hang them in the air to oxidize the oil for more than 9-14 days depending upon ambient conditions.[8] Fish oils such as menhaden oil and cod oil are used in leather industry for oil tanning.[9] Chamois tanning essentially is fixation of oil oxidation products to the protein fiber.[10] Excess oil is washed off using soap and alkali solution. Finally, these oil tanned leathers are dried and buffed using different grit emery papers. Studies are reported in literature, that chamois tanning using modified fish oil minimizes the odor and improve the water absorption characteristics, by esterification of fish oil.[11] Studies using rubber seed oil,[12] jatropha oil[13] for chamois leather tanning have also been reported. In the present study different oils such as linseed oil, castor oil, sunflower oil, animal tallow and fish oil, have been used for tanning.

Experimental

Materials

Wet salted goat skin purchased from local slaughter house, fish oil, linseed oil, castor oil, sunflower oil and animal tallow of commercial grade have been used for the study. The oils and fat were analyzed for various physical and chemical properties such as iodine value, acid value, sap value as per the standard methods. The chemical composition of the oils were analyzed using Gas Chromatography (GC) after converting them into fatty acid metyl ester.

Gas Chromatography (GC) analysis: The GC 1000 series system was used to identify the composition of all oils. The column used was SGE S/N. Nitrogen was used as carrier gas and the sample detection was made using FID detector. The following temperature programming was used during analysis: Start temperature 160°C-hold for 0 min. Heating rate 4°C/min till 210°C, finally hold for 6 min. The ester was dissolved in solvent and injected into the column at a split ratio of 1:11.

*Corresponding Author: Email: nvedaraman@yahoo.co.in, Tel: 0091-44-24916706,: 0091-44-24911589.

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Methodology Employed for Chamois Leather Processing and Testing

Raw Material

Wet salted goat skins of average weight 1 kilogram per skin were taken for processing. The skins were cut into two halves and processed as per conventional method up to aldehyde tanning.

Soaking: The goatskins were soaked in a paddle for 2 h. The skins were given a change of water and the paddle was run for another 30 mins after which they were piled for draining the water and weighed.

Unhairing by Painting

The skins were painted with the mixture of 2% sodium sulphide,10% lime and 25% water. The above paint was applied to the flesh side other skins and they were paired flesh to flesh and piled overnight after covering with wet gunny bags. They were unhaired on the next day.

Liming

The unhaired skins were limed with 10% lime, 0.5% soda ash and 300% water.The skins were handled in this bath twice for 15 min. a day for three days. On the fifth day (calculated from soaking), they were removed from the limed bath and washed in running water The skins were then machine fleshed and the fleshed weight was noted.

Deliming

The pelts were delimed with 1% ammonium chloride and 100% water in a drum for 45 minutes. The delimed skins were washed with a float of 200% water for 10 minutes.

Glutaraldehyde Tanning

The glutaraldehyde 2%, was diluted with 100% water and mixed with 0.25% soda ash and added to the drum in 3 feeds at 30 min interval. Finally, the drum was run for 2 h. The pH of the bath was adjusted to 8.5 by adding 10% soda ash solution. The skins were piled overnight. Next day, the skins were sammed and shaved to completely remove the grain. The shaved skins were weighed, washed in running water.

Oil Tanning

The following five experiments were conducted using different oils. The amount of oil taken was 20% (based on skin weight) in all the experiments.

Experiment 1 -Fish oil, Experiment 2 -linseed oil, Experiment 3 -castor oil Experiment 4 -sunflower oil and Experiment 5 -animal tallow.

Calcium carbonate (5%) was mixed with oil and the mixture was uniformly applied on both the sides of the skins before loading the skins into the drum. The balance of the oil was also added to the drum and run for 6 h. The skins were then hung up in an airy place for 11 days to promote oxidation. Oxidation was at room temperature (31 – 35°C).

Washing

The oxidized skins were first weighed and then wet back with 1000% water at 40^0 C for 40 mins in a drum. The skins were squeezed out and then treated with non-ionic wetting agent 0.5% and water 400%. The drum was run for 40 min. Then the skins were squeezed and washed twice with 1000% water at 45°C for 10 min. The skins were then treated with soda ash 2% and water 400% for 40 min. The process of treatment with wetting agent and soda ash was repeated thrice. The skins were then hung up for drying after through washing. When completely dried, the leathers were staked and trimmed. They were buffed with three different emery papers consecutively viz., 150, 240 and 400. After buffing, the leathers were dusted off and samples were taken for different tests.

Water Absorption

The sample was cut as per the standard procedure. The conditioned sample was weighed and soaked in 25 ml of distilled water in a dish for 30 min. The sample was removed with forceps, drained for 2 min. The sample was weighed and the solution in the dish was evaporated to dryness and the residue weight was taken.

Sink Test

A sample was cut from the official position of testing the leathers and was placed over water taken in a 2 litre beaker and the time required for it to sink to the bottom was noted.

Strength Analysis

The tensile and tear strength of all the four samples were carried out as per official methods [14].

Shrinkage test

The shrinkage temperature was measured using the shrinkage tester.

Organoleptic Properties of Leather

The leathers were subjected to organoleptic assessment for softness, fullness and general appearance by hand and visual examination by experts.

RESULTS AND DISCUSSION

Chemical and Physical Characterization of Oil

The oils were analyzed for iodine value, acid value and sap value. The results are shown in Table I. For fish oil the iodine value was 135 and for linseed oil it was 160. Among all the oils castor oil had the low iodine value. The sap value was between 174-188 for all the oils. Acid value was between 3-7 for all other oils except for fish oil.

Gas Chromatography Analysis

The gas chromatography analysis of fish oil is shown in Figure 1. Table II shows the retention time and peak area of all fatty acid

alkyl esters obtained for oils and fats used in the study. Fish oil contains high palmitic acid followed by eicosanpentaenoic acid. Linseed oil is rich in linolenic, oleic acid and linoleic acid. Castor oil has very high amount of mono hydroxyl mono unsaturated fatty acid. Sunflower oil has higher amount of di-unsaturated fatty acid. Animal tallow contains higher amount of saturated fatty acid compared to unsaturated fatty acid.

The water absorption for the oil tanned leathers is shown in Table III. Among different oils and fats, linseed oil tanned chamois leather has higher water absorption next only to fish oil tanned chamois leather. Castor oil, sunflower oil and animal tallow tanned chamois leather absorbed water only up to 200% of leather weight. However, chamois leathers made from linseed and fish oil absorbed about 300% of water on leather weight.

This sink test results of various oils and tallow tanned leathers are shown in Table IV. The test results show that fish oil absorb water faster than all other oils and fats. Among various oils and fats, linseed oil based chamois leather had sink property similar to fish oil tanned leathers.

Fish oil contains higher amount of eicosanpentenoic acid followed by docosahexanoic acid which is a penta and hexa unsaturated fatty acids. In case of linseed oil it contains significantly large amount of linolenic acid and linoleic acid which are di and tri unsaturated fatty acids nearly to 68% of the total fatty acids.Sunflower oil has 61% linolenic acid which is a di unsaturated fatty acid and animal tallow has nearly 48% of tri and di unsaturated fatty acids. Higher amount of di and tri unsaturated fatty acids amounting to more than two third of the total fatty acids and higher iodine value is probably the reason for linseed oil to act as a better tanning agent similar to fishoil whereas the other oils contains lesser amount of unsaturated fatty acids.

TABLE I
Chemical and physical characterization of oil.

Experiment	Iodine value	Acid value	Sap value
Fish oil	135	15	180
Linseed oil	160	7	188
Castor oil	80	4	176
Sunflower oil	120	6	188
Animal tallow	160	3	174

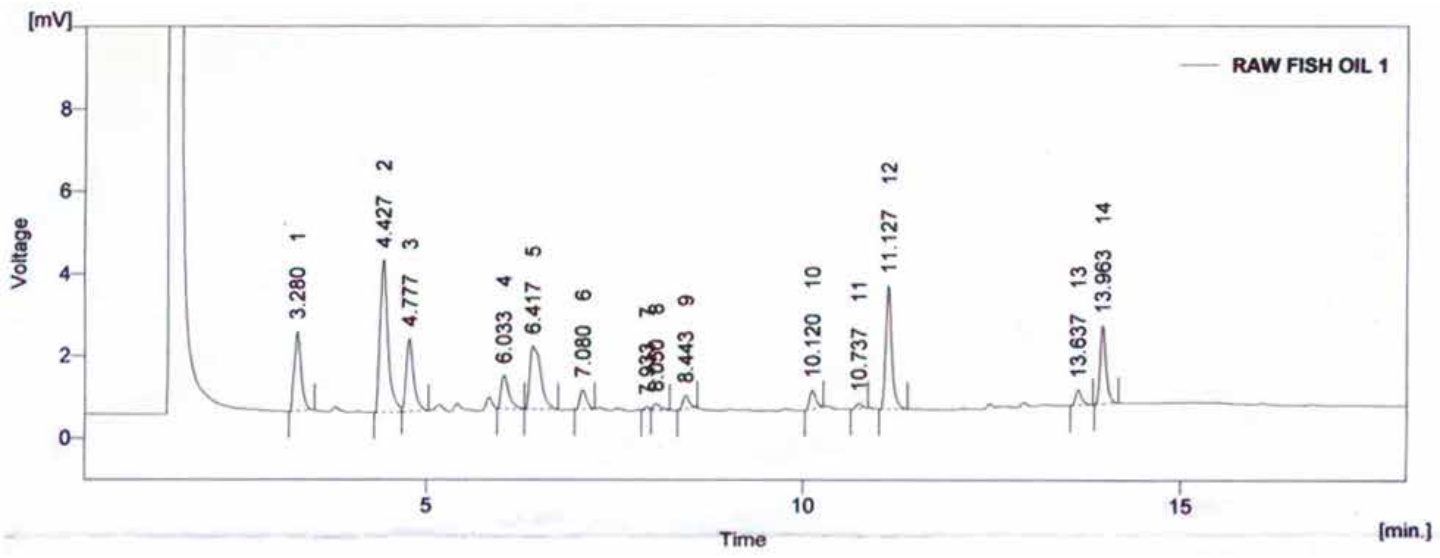

Figure 1. Gas chromatograph of fish oil.

TABLE II
GC analysis data.

Components	Retention. Time [min]	Area [%]				
		Fish oil	Linseed oil	Castor oil	Sunflower oil	Animal tallow
Lauric acid	3.010					0.211
Myristic acid	3.280	11.638				5.021
Palmitic acid	4.427	22.289	6.512		5.024	30.534
Palmitoleic acid	4.777	10.595				
Stearic acid	6.033	4.871	3.531	2.413	2.015	21.521
Oleic acid	6.417	9.210	23.047	7.422	29.023	
Elaeostearic acid	7.010			87.007		
Linolenic acid	7.050	2.799	48.022		61.016	3.012
Linoleic acid	7.080	--	20.515			45.028
Arachidic acid	8.050	0.931	0.520		2.014	
Gadoleic acid	8.443	2.012				
Docosenoic acid	10.737	0.735				
Eicosanpenteanoic acid	11.127	18.022				
Decosahexanoic acid	13.963	9.233				

The tensile and tear strength analysis results are shown in Table V. Test results show that leather tanned with fish oil has better strength compared to other oils and fats taken for this study. Among different vegetable oils and tallow tanned leathers, linseed oil tanned leather has better strength.

The shrinkage test results are shown in Table VI. The main aim of the component of the study was to understand whether the new tannage had any effect on the stabilization of collagen matrix. All the sample show shrinkage temperature between 67-83ºC. Again linseed oil tanned chamois leather has higher shrinkage temperature compared other oils and fats taken for this study.

The leathers were subjected to organoleptic assessment for softness, fullness and general appearance by hand and visual examination by experts and were rated based on a scale of 1 – 10 grade points for each functional property. The higher grade points indicate better property for the subsequent end usage of leather which are shown in Table VII. Fish oil tanned leathers had marginally better organoleptic properties compared to linseed oil. Among different vegetable oils and fats except linseed oil, other vegetable oils and fat have poor organoleptic properties compared to fish oil. The smell of the skins tanned using different vegetable oils are relatively pleasent compared to fish oil and tallow tanned leathers. As linseed oil is available in large quantities and it is cheaper in price, it can be used as a substitute to fish oil for making chamois leather. In addition, the chamois leather produced using linseed oil is better in colour and pleasent smell compared to fish oil tanned chamois leather.

TABLE III
Water absorption of leathers.

Experiment	% (W / W)
Fish oil	320 ± 5
Linseed oil	303± 5
Castor oil	195± 5
Sunflower oil	197± 5
Animal tallow	190± 5

TABLE IV
Sink test of leathers.

Experiment	Sink Time (Sec)
Fish oil	120 ± 5
Linseed oil	130± 5
Castor oil	155± 5
Sunflower oil	167± 5
Animal tallow	158± 5

TABLE V
Physical testing method.

Experiment	Tongue tear strength (Kg/cm)	Stitch Tear strength (Kg/cm)
Fish oil	66.7± 0.5	199.8± 0.5
Linseed oil	55.0± 0.5	154± 0.5
Castor oil	41.0± 0.5	115.3± 0.5
Sunflower oil	39.0± 0.5	109.3± 0.5
Animal tallow	40.0± 0.5	120.2± 0.5

TABLE VI
Shrinkage temperature of leathers.

Experiment	Shrinkage Temperature (°C)
Fish oil	83±1
Linseed oil	79±1
Castor oil	70±1
Sunflower oil	67±1
Animal tallow	72±1

TABLE VII
Organoleptic properties of leather.

Experiment	Softness	Fullness	Smell	General appearance
Fish oil	7	7	2	8
Linseed oil	6	7	8	7
Castor oil	4	5	8	6
Sunflower oil	3	4	8	5
Animal tallow	4	5	3	6

Scale 1 – Poor, 10 – Excellent

CONCLUSIONS

Chamois leathers are produced in large quantities, mainly using fish oil. In this study different oils such as linseed oil, castor oil, sunflower oil, and animal tallow were used for tanning goat skin. The chamois leather, thus obtained was tested for sink test, water absorption and strength properties. It was found that linseed oil tanned chamois leather possesses comparable properties similar to fish oil tanned chamois leathers. Other oils and tallow tanned leathers lack important chamois leather characteristics such as sink test, water absorption and strength properties. This study shows that a acepatable quality chamois leather can be produced using linseed oil as the tanning agent.

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