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APPLICATION OF FATLIQUOR PREPARED FROM SUDANESE CASTOR OIL IN LEATHER FATLIQUORING PROCESS

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ABSTRACT

Fatliquors are added to the leather during fatliquoring process to separate leather fibers from each other and to impart softness, flexibility and hand feeling. Fatliquors are mainly emulsifying mixtures, prepared by introduction of phosphate, sulphonate, and sulphiteqroups etc. into the structure of oils and fats or by addition of surfactants to the composition of fatliquoringagent.Sulphation is one of the common methods used to prepare fatliquor emulsion where sulphuric acid is used. In the present study, castor oil extracted from Sudanese castor beans in the previous work was used to prepare fatliqour by sulphation process. The physicochemical properties of the prepared fatliquor were tested. The fatliquor was applied to the bovine leathers in the fatliqouring process and the strength properties of the resultant crust leather were assessed through variousphysical and chemical tests.The results obtained revealed that Sudanese castor oil can effectively be used to prepare fatliquor to be used to lubricate leather in fatliquoring process.

KEYWORDS: Fatliquor, Sulphation, Sudanese castor oil.

I. INTRODUCTION

The castor plant (Ricinuscommunis L.), belonging to the family Euphorbiaceae, and grows mostly in tropical and subtropical areas between latitudes 40˚ South and 52˚ North. It grows naturally over a wide range of geographical regions and may be cultivated under a variety of physical and climatic regions. (1).

Castor oil is a nonedible oil crop, pale amber viscous liquid and non-drying oil with mild or no odor or taste. Its propertied differ depending on the geographical location in which the plant is grown and the agricultural modifications which have been made during growth. (2)

Like any other vegetable oils it contains triglycerides, which chemically is a glycerol molecule with each of its three hydroxyl group esterified with a long clown fatty acid. Its major fatty acid is the unsaturated, hydroxylated 12-hydroxy, 9-octadecenoic acid, known familiarly as Ricinoleic acid. The fatty acid composition of a typical castor oil contains about 87% - 90 % of ricinoleic acid. (3)

It is reported that castor beans contains about 30-35% and can be extracted either by mechanical pressing or solvent extraction or combination of the two. Mechanical pressing only recovers about 45% of oil from the beans and the remainder in the cake can be recovered by solvent extraction using heptane, hexane or petroleum ethers .Actual yield depends on particular seed variety, geographical origin/climatic conditions, and on the oil extraction methods used(4).

Castor oil and its derivatives find outlet in industries and pharmaceuticals because of the ricinoleic acid, which predominates to about 89%, and is unusual because of the fact that it has a hydroxyl functional group on the twelfth carbon. The functional group causes ricinoleic acid to be unusually polar, and also allows chemical derivation that is not practical with most other seed oils. These characteristics, together with the oil's biodegradable and ecofriendly nature and its being a renewable resource, explain its limitless potentials(5)

Thus, the oil can be used in the production of vanishes, lacquers, protective coatings, lubricants, soaps, cosmetics, paints, inks, and it is a primary raw material for the production of nylon and other synthetic resins and fibers and a basic ingredient in racing motor oil for high-performance automobile motorcycle engines (6)

As we know, physical-mechanical properties and sensory properties are two important parameters for evaluating the application performance of leather and leather products. Softness is especially one of the most important physical properties to be taken into consideration when assessing the quality of light leathers (7).

In order to produce soft leather, after tanning the leather is processed through a fatliquoring step, which is designed to introduce oils and fats into the leather matrix preventing the adhesion of fibers. Fatliquoring is one of the critical steps for garment and upholstery leather manufacturing, which makes the leather soft and has a pleasant feel. The physical characteristics of the leather, as well as comfort properties of the leather, depend on fatliquoring(8).

Oil in water emulsions known as fatliquors are used to lubricate tanned leather fibres to get softness and also to improve the strength properties. An emulsion is a fine dispersion of one liquid in another liquid. Sulphation is one of the common methods followed to prepare fatliquor emulsion where sulphuric acid is used. In the conventional process, emulsifying agent is also added to increase the stability of oil in water emulsions. The emulsifying agents generally used are chemicals or metal soaps (9).

Fatliquor may be anionic, cationic or non-ionic. Anionic fatliquors are commonly employed for fat binding with chrome-tanned leather, which is cationically charged. Anionic fatliquors are commonly prepared by sulphation, sulphonation or bi-sulphitation of oils/fats(9).

Depending upon the source of the oils/fats used, the fatliquor can be classified as vegetable, synthetic and semi synthetic. Generally, castor oil is used as a source for vegetable based fatliquors. The synthetic fatliquors are usually obtained by sulphochlorination of C10 - C20 fractions obtained through the Fischer-Tropsch method of paraffin synthesis or from the petroleum industry. Semi-synthetic fatliquors are prepared from both the vegetable and synthetic sources (9).

Any fat or oil can be used as raw material for making a fatliquoringagent, the commonly available oils are those of cod oil, castor oil, neatsfoot oil, rapeseed oil, palm oil and sperm oil. All these oils have similar chemical structure of triglycerides. Castor oil is suitable as a basic raw material for the preparation of fatliquor due to hydroxyl functionality on ricinoleic acid (10).

Fatliquor affects the physical properties of the leather and makes it more flexible and softer (11).

The main characteristics of fatliquored leathers are feel, softness and a certain degree of water repellency. Physical properties such as tear resistance, break, and tensile strength as well as comfort properties of leathers depend on fatliquoring (12).

The objectives of the present work were to investigate the possibility of producing quality fatliqouring agent from abundant locally grown castor plant. Also, to assess the physical properties of the leathers produced after the application of the prepared fatliqour.

Materials and methods

Castor oil was obtained from castor beans by means of solvent extraction. The chemical used for preparation of fatliquor such as Sulphuric acid, sodium chloride and sodium hydroxide were analytical grade. The chemical used in retanning process were commercial grade. Full grain chrome tanned goat skins were obtained from a local tannery.

Preparation of fatliquor from castor oil

A concentrated sulphuric acid (98%) was added drop wise to 500 gm of castor oil with a constant stirring at 18-20°C. Thesulphation process was carried out slowly for about 3hrs. A saturated sodium chloride solution was added to the resultant products and mixed with them.The mixture was then kept in a separating funnel overnight to separate the layers. The upper layer was neutralized to pH 5.0 by adding 30% sodium hydroxide solution to produce the fatliquor.

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Analysis of fatliquor

The sulphated castor oil was subjected to physical and chemical tests. The tests were carried out in Central Laboratory for Technical Services and calibration (CLTSC), by using NIST traceable reference equipment and materials in accordance with ISO/IEC 17025:2005 requirements and the test methods referenced below meets ISO/IEC 17025:2005 and accreditation bodies. Thetests were carried out at 20°C and 60% relative humidity.
The uncertainties values are calculated according to the standard uncertainty by coverage factor (k = 2) at 95% confidence level according to ISO 17025:2005 and accreditation body requirements as describing in the work instruction CLTSC/Work 1./5.4.1. The tests results were presented in Table 3.1

II. RETANNINGAND FATLIQUORING PROCESS

Full grain chrome tanned bovine leathers of fairly similar size and free from physical defectsleatherswere wet back, retanned, fatliquored and converted into crust leather using the recipe presented in**Table 2.1**. The prepared sulphated castor oil was used for experimental leathers and an imported fatliquor was used for control leathers.The process was carried out using an experimental stainless steel drum.

Table 2.1 Formulation of the retanning processes for experimental and control leathers

Process/products	% *	Time (min)	pH	Remarks
Wetting back				
water Ps/A (wetting agent) Formic acid	200 0.3 0.3	30		
Drain				
Re-chroming				
Water chrome	200 2			
Leave O/N, run 10′ morning, drain, wash				
Neutralization				
Water KNB(Syntan) Sod-formate Sod- bicarbonate	150 1 2 1	30 60	 5	
Drain, wash				
Retanning				
Water Mimosa DD7(syntan) MTS (syntan) Coraline 6 kw PN3	200 3 3 3 1.5 1.5 1.5	 40 10 30		
Fatliquoring				
MR Filler Fatliqour Formic acid	2 3 6 1.5	30 45 40		
Drain, wash, pile O/N, toggle dry, trim and stake *Percentages are based on wet blue weight.				

III. PHYSICAL AND CHEMICAL TESTS OF THE CRUST LEATHERS

Physical and Chemical tests for the crust leathers were carried out by the Quality Control and Assurance Laboratory of the National Leather Technology Center (NLTC).

Thickness, tensile strength, tear strength, distention at grain crack and flexibilitytests of both experimental and control crust leathers were performed according to the standard methods (IUP). The readings averagesfor each test were presented in **Table 3.2**

Moisture, oil & fats and total ash contents of both experimental and control crust leathers were determined according to the official methods of analysis of (SLTC 1996). The readings averagesfor each test were shown in **Table 3.3.**

IV. ANALYSIS OF SULPHATED CASTOR OIL

Table 3.1presents the physicochemical properties obtained for the sulphated castor oil.

Table3.1 Physicochemical properties of sulphated castor oil

No.	Test	Test method No.	Result
1	Acid value (mgKOH/100gm)	AOAC	0.82
2	Free fatty acid (%)	AOAC	0.414
3	Specific Gravity (g/cm3)	AOAC2000	0.95714
4	Viscosity@40°C (cps)	Cock and van(1966)	2.43
5	Saponification (Mg/g)	BS	143.5

It is observed that the acid value of crude castor oil which was indicated in the previous work as 1.466mgKOH/100gm () decreased after sulphation to be 0.82 mgKOH/100gm however, both of them fall within the standard range of quality castor oil.

The free fatty acid of the sulphated castor oil was determined to be 0.414%. This value falls within the range of 0.00 -3.00% for free fatty acid of oil.

From the table the specific gravity value was found to be 0.95714 approximately the same as the valuereported by(11) for sulphated castoroil and agree with the ASTM standards properties of quality castor oil reported by (13) .

The viscosity of the sulphated castor oil was determined at 40°C and it was found to be 2.43 cps. The value of viscosity obtained is significantly higher than that of ASTM standard. This may be attributed to the presence of some impurities and components.

The value obtained for the saponification value of the prepared castor oil was found to be 143.5mg/mg. this value is less than the value of 176 mg/mg reported by(11),for sulphated castor oil. Andit is also less than the value reported by the author(14) for the raw castor oil and it is non confirmative with ASTM standards. Saponification value is inversely proportional to the molecular weight of the fatty acid present in oil.

V. STRENGTH PROPERTIES

The values for physical tests for experimental and control leathers were presented in Table 3.2 Values for tensile strength, elongation and tear strength are the average values of fourdeterminations; two are parallel and two are perpendicular to the backbone. Values for load at grain crack are the average of three separate determinations.

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Table 3.2: Physical Testing Results for Experimental and Control Crust Leathers

Test	Average Readings	
	Experimental	Control
Thickness (mm)	2.1	2.0
Tensile strength (kg/cm2)	334.8	330.5
Elongation at break %	59	52
Single hole tear strength (kg/cm)	137	138
Tongue tear strength (kg/cm)	40.5	49
Double hole tear strength (kg/cm)	178.5	280
Distention at grain crack (mm)	13.3	12.0
Flexibility	Pass	Fail

From the table it was observed that the strength properties of experimental leatherwere comparable to the strength properties of the control leathers. The results obtained were found within the limits of standard specification. The results shows that the prepared fatliqoure has good lubrication properties and possesses good penetration power and emulsion stability.

The high value of tensile strength indicates the high strength of collagen fibers. The elongation at break indicating the softness, flexibility, strength and toughness of leather. The experimental leathers pass the flexibility test while the control leather fail. This shows the good lubrication and penetration properties of the prepared fatliquor.

VI. CHEMICAL ANALYSIS

The values for chemical analysis of experiments and control crust leathers were presented in **Table 3.3**

Table 3.3Chemical Analysis Results for Experimental and Control Crust Leathers

Test	Readings Average	
	Experimental	Control
Moisture content %	5.97	6.9
Fat and Oil %	8.50	10.9
Ash content %	7.11	8.7

The chemical characteristics of the experimental and control leathers were found to be quite normal. The moisture, fat and ash content, in leather seems to have acceptable value for both the experimental and control leathers.

VII. CONCLUSION AND RECOMMENDATION

The physical and chemical characteristics of leathers produced the prepared fatliquor are comparable to that of leathers produced using the imoported fatliquor.so that the locally produced fatliquor from Sudanese castor oil would be a substitute to imported fatliquor.It is recommended to pay attention to castor plant cultivation for its tremendous uses of castor oil in industrial applications.

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