Utilization of Marine Wastes for Developing Next Generation Leather Colorant

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Abstract

The growing demand on sustainable and eco-friendly practices in the leather industry has driven interest in marine-based resources as an alternative sources for natural colorants. Synthetic colors are commonly used, but these can be substituted with eco-friendly colorants extracted from natural sources, which reduces ecological footprint of conventional processes.

This work investigates the potential of marine wastes, squid ink pigment (melanin) as a viable, non-toxic alternatives for leather dyeing. Squid ink, a by-product of seafood processing, offers a rich, stable source of coloring agent. The extracted colors were used in the leather dyeing process. This approach not only valorizes marine processing wastes but also contributes to greener leather manufacturing practices, aligning with circular economy principles.

Introduction

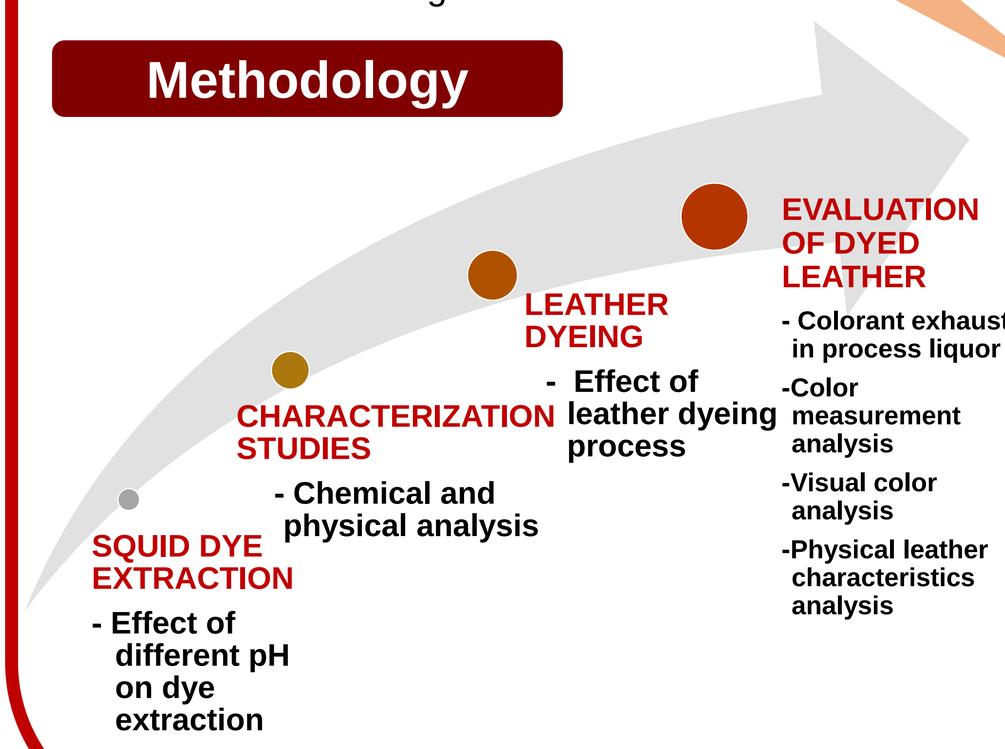
Marine-to-Manufacturer

- Dyeing of leather is an important process in manufacturing of leather products.
- Synthetic colorants are commonly used, but these can be substituted with eco-friendly colorants extracted from bio-resources such as plants, animals and microbial cultures.
- The highly growing demand for natural colorants in sustainable fashion and leather industries.

Purpose

- Marine waste (squid ink) has been used as a raw material to extract colorant and utilized them in leather processing. Squid inks are rich sources of melanin pigment, that are usually discard as waste after cleaning squids for food industry. These wastes can be used as a biocolorant for leather manufacturing.

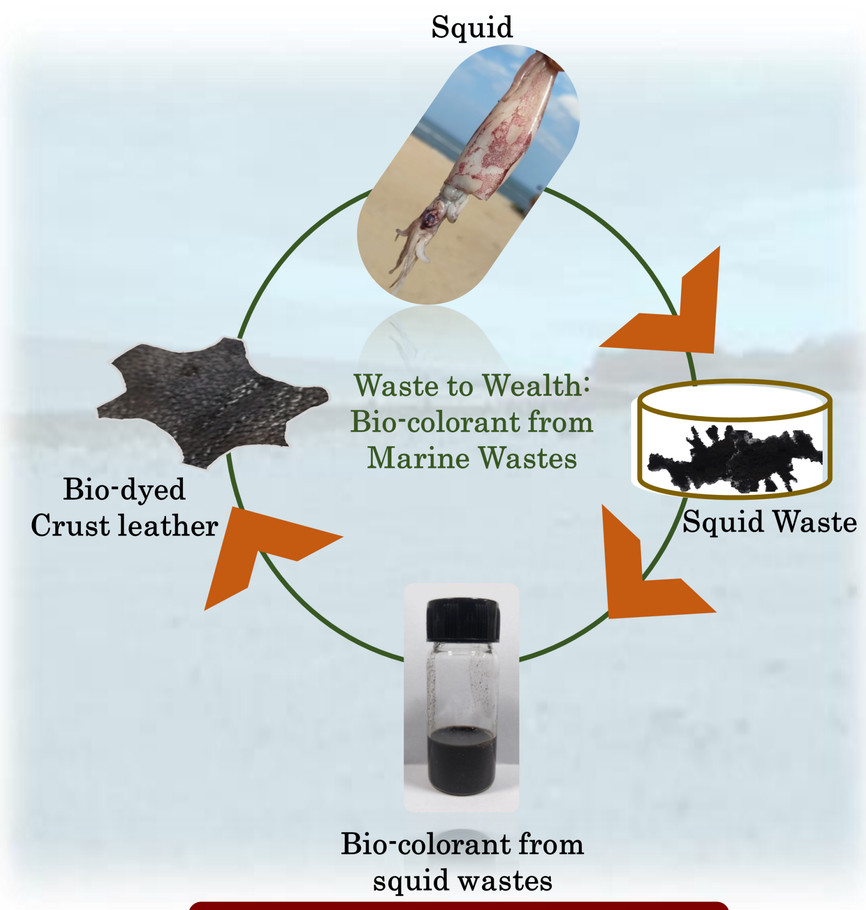
Methodology



Results

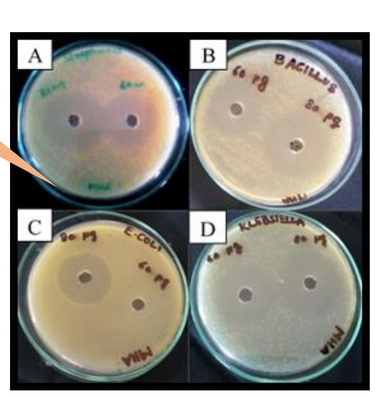
Process Recipe using Colorant (Squid waste)

Process	Chemicals	%	Duration	Remarks
Material: Goat skin				
Wetback	Water	100		
	Wetting Agent	0.5	60 min	D/W/D
Neutralization	Water	100	30 min	
	Sodium formate	1		
	Sodium bicarbonate	1.5	30 min	pH 4.8±0.2
Retanning	Relugan RE	4	20 min	
	GS powder	5		
	Phenolic syntan	5		
	Melamine syntan	4		
	Biopolymer	4	60 min	
Dyeing	Extracted Colorant	10		
	Surfactant	0.5	45 min	Check for penetration
Fatliquoring	Synthetic fatliquor	1		
	Semi synthetic fatliquor	2	60 mins	
Fixation	Formic acid	3	30 min	Check exhaustion D/W/D
Leathers piled overnight, hooked to dry, staked, trimmed				

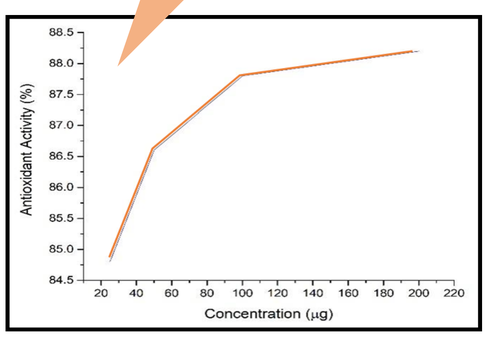


Characterization

Antibacterial activity



Anti-oxidant Analysis



Bio-dyed leather

Salient features

- Extracted colorant exhibited slightly acidic pH (6.54 ± 0.02), and also stable across a wide pH range (3-12) without color change.
- High antioxidant activity (84.8-88.2%) due to phenolic and alkaloid compounds, enhancing shelf life.
- Effective inhibition zones against both Gram-positive (*Streptococcus, Bacillus*) and Gram-negative (*E. coli, Klebsiella*) bacteria, proving antimicrobial potential.
- Dye exhaustion ~ 85 ± 2% and produced uniform shade on goat crust leather with the Lab* value (ΔE = 29.60).
- Light-fastness (grey scale rating 4/5) and also exhibited good rub fastness (dry/wet).
- Average particle size~179 nm (DLS), indicating efficient penetration and uniform dyeing of leather substrate.

Fastness Properties of Squid Colorant Treated Leather

Test			Control	Treated Sample
To-and-fro rubbing (leather)	Dry	512	5	5
	Wet	256	4/5	4/5
To-and-fro rubbing (felt)	Dry	512	5	5
	Wet	256	5	4/5

Discussion

- Marine environment offer promising sources for natural colorants. Goat skin leather dyed with squid (*Logio duvauceli*) colorant exhibits a uniform coloration with vibrant, intense shades, which concluded based on the standard parameters.
- Findings of this study suggest marine-sourced natural colorants could serve as an alternative for leather dyeing.
- In future, this could pave the way forward research into marine-based natural dyes and fine renewable chemicals.

References

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