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# Detanning and valorization of chrome-tanned leather waste

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## CONTEXT

*Estimation by CTC*

Estimated volume of bovine chrome-tanned waste generated by tanneries :

**≈0,8*** kg of chrome-tanned waste / kg of manufactured leathers

**The quantities vary considerably depending on the initial and final leather's thicknesses*

*Waste treatment pathways*

- Landfill disposal for non-hazardous waste
- Incineration with energy recovery
- Agricultural valorization of protein **and** chromium

## MAIN OBJECTIVES

1. Optimization of a universal alkaline hydrolysis method to upcycle chrome-tanned leather waste.
2. Study of agricultural valorization pathways for collagen-derived proteins.
3. Determination of the cost price of the established method, along with a mass and energy balance.

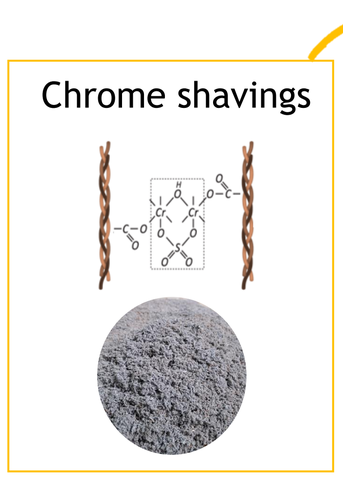
## METHOD - ALKALINE HYDROLYSIS

### Why an alkaline hydrolysis ?

1. Under unfavorable conditions, there is a risk of forming toxic hexavalent chromium (Cr(VI)).
2. It's an environmentally friendly way to recover collagen-based protein hydrolysates from the shavings.
3. The need for safe and sustainable waste management strategies.

### Principle of alkaline hydrolysis

During the hydrolysis process, hydroxide ions ($OH^-$) replace carboxylate ligands bound to trivalent chromium (Cr(III)), breaking the Cr-collagen complex and precipitating chromium as $Cr(OH)_3$.




## RESULTS AND DISCUSSION

**Table 1** Average chemical composition of hydrolysate (± standard deviation (SD)) from calf shavings

| Parameters | Value ± SD |
|---|---|
| Dry matter [%] | 30.7 ± 1.4 |
| Total organic carbon (TOC)* [%] | 34.8 ± 0.2 |
| Nitrogen* [%] | 12.7 ± 0.3 |
| Phosphorus* [%] | 2.6 ± 0.4 |
| Potassium* [%] | 8.1 ± 1.1 |
| **Chromium* [ppm]** | **21.6 ± 6.8** |

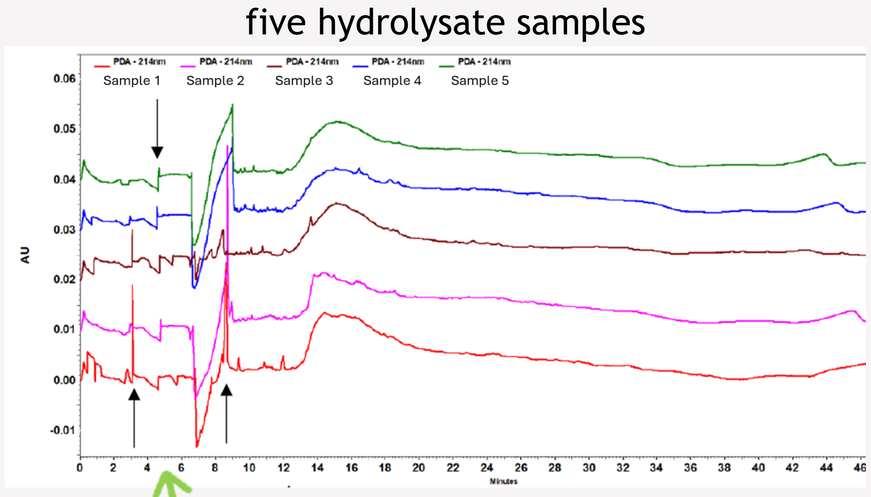
***related to the dry matter of the sample**

Yield of *dry matter > 70%*

Corresponding to approximately *75% crude protein.*

This *low residual chromium* level is favorable from both environmental and safety standpoints and enhances the potential use of the hydrolysate.

**Figure 1** Capillary gel electrophoresis performed on five hydrolysate samples




Collagen in the hydrolysates was *fully denatured* through alkaline hydrolysis. The process results in substantial breakdown of α-chains into *low-molecular-weight proteins* and *peptides* (< 10 kDa).

## CONCLUSION

The results of the alkaline hydrolysis experiments show promising potential for the efficient recovery of protein-rich material from chrome-containing leather waste, with minimal contamination by chromium. The obtained hydrolysate's features are suitable for its use in agriculture as a fertilizer with biostimulant effects. This supports the notion that such a treatment process could serve as an environmentally sound and economically valuable method for shavings.

**Under progress...**

1. Demonstrate proof of concept for a *standardized*, *repeatable*, and *reproducible* method for processing all types of chrome shavings, contributing to a circular economy.
2. Perform an *economic*, *mass*, and *energy balance* for the approved method.
3. Future studies may extend this approach to *other solid wastes* from the leather industry.