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Wet-white shavings as a potential source for leather retanning bioagents

T. Freitas[1]*, I. Marujo[1], D. Ribeiro[1], A. Crispim[1], P. Neto[1], J. Gaião[2], J. Oliveira[3]
[1]CIETI/ISEP – Centre of Innovation on Engineering and Industrial Technology/IPP-ISEP, School of Engineering, Porto, Portugal, tiasf@isep.ipp.pt
[2]CTIC – Technological Centre for Leather Industry, Alcanena, Portugal
[3]Prodyalca, Alcanena, Portugal

Introduction:

The tanning industry generates a high quantity of solid wastes, so there is a need to create ways to value these wastes with the aim to reduce environmental impact. A lot of research work has been done recently and some authors have shown the potential for obtaining protein hydrolysates from solid wastes and its application [1-9]

The present work had as main objective the wet-white shavings valorization by production of hydrolyzed protein and biopolymers for leather retanning.

Methods:

Wet-white shavings were firstly crushed and then characterized for moisture content, solids content, mineral and organic matter content, and Kjeldahl nitrogen content.

Crushed wet-white shavings were treated by thermal and alkaline hydrolysis regarding the influence of several factors such as the amount of alkaline agent, temperature and contact time, using sodium hydroxide (NaOH) as alkaline agent. Three groups of trials were carried out to evaluate the effect of the alkaline agent (table 1), contact time (table 2) and temperature (table 3).

Table 1 Alkaline agent effect on the wet-white hydrolysis.

Trial	Wet-white mass (g)	Ratio mass/water	% NaOH	Time (minutes)	Temperature (ºC)
1	9.98	1:4	4	180	80
2	10.04	1:4	6	180	80
3	10.16	1:4	8	180	80
4	10.02	1:4	10	180	80
5	10.11	1:4	12	180	80

Table 2 Time effect on the wet-white hydrolysis.

Trial	Wet-white mass (g)	Ratio mass/water	% NaOH	Time (minutes)	Temperature (ºC)
6	10.56	1:4	8	60	80
7	10.04	1:4	8	120	80
8	10.18	1:4	8	180	80
9	10.06	1:4	8	240	80
10	10.06	1:4	8	300	80
11	10.24	1:4	8	360	80

Table 3 Temperature effect on the wet-white hydrolysis.

Trial	Wet-white mass (g)	Ratio mass/water	% NaOH	Time (minutes)	Temperature (ºC)
12	10.22	1:4	8	120	60
13	10.25	1:4	8	120	70
14	10.06	1:4	8	120	80

The hydrolysate obtained was used, after pH adjustment to 5.5, to prepare biopolymers by the addition of glutaraldehyde. The biopolymers were designated as PWW1, PWW2, PWW3, PWW4, and PWW5 with a quantity of glutaraldehyde of 0%, 5%, 10%, 15%, and 20% (w/w) respectively, based on the total mass of biopolymer. Then, the biopolymers were used in a standard retanning process replacing 50% of the acrylic resin, 50% of the synthetic tannin, and 20% of the mimosa vegetable extract, by 8% of the biopolymer. The standard process was also done without biopolymer to have a reference for leather quality comparison.

Results:

The results obtained by thermal and alkaline hydrolysis to evaluate the influence of the amount of alkaline agent, temperature and contact time are shown in Figure 1, Figure 2, and Figure 3.

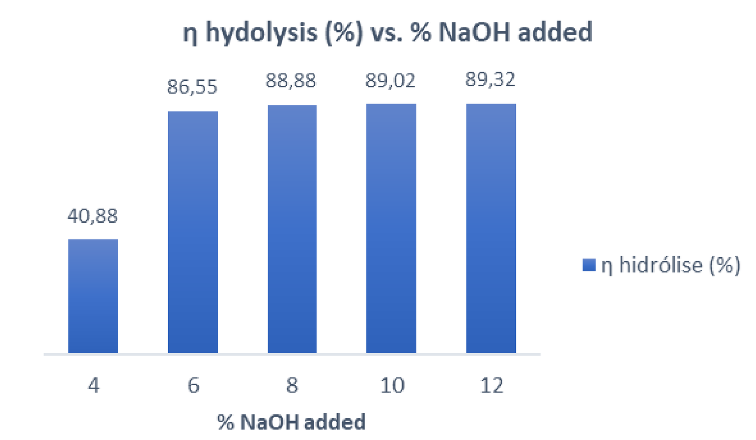

Figure 1. Hydrolysis yield as a function of NaOH quantity.

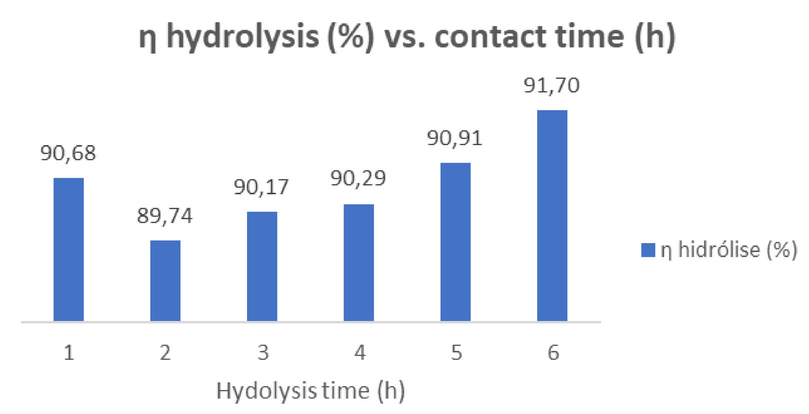

Figure 2. Hydrolysis yield as a function of contact time.

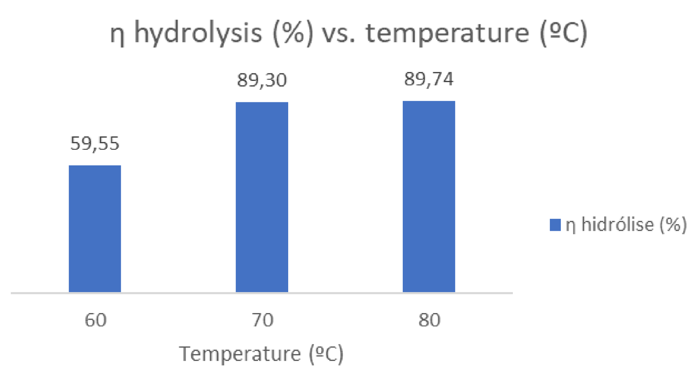

Figure 3. Hydrolysis yield as a function of temperature.

Optimal amount of sodium hydroxide (NaOH): 8%
Ideal hydrolysis time: 2 hours
Ideal hydrolysis temperature: 70ºC
Ratio water/wet-white shavings: 4

With these conditions, a larger trial was done and obtaining a hydrolysis yield of 96%. The hydrolysate was characterized and the results are shown in Table 4. The hydrolysate obtained was used to prepare biopolymers that were used in a modified standard retanning process to be compared against the standard process. The physical-mechanical resistances obtained are presented in Table 5.

Table 4. Hydrolysate characterization

Parameter	Results
Moisture (% w/w)	84,63 ± 0,21
Total solids (% w/w)	15,37 ± 0,21
Organic matter (% dry basis)	82,99 ± 1,07
Mineral matter (% dry basis)	17,01 ± 1,07
Kjeldahl nitrogen (g/L)	21

Table 5. Physical-mechanical resistances

Leather from the process	Grain cracking		Tear Strenght
	Distension	Load	Load
	mm	N	N
Standard	6.8	180	94
PWW1	8.0	240	94
PWW2	6.8	160	106
PWW3	7.2	180	85
PWW4	7.6	190	97
PWW5	6.7	210	90
Minimum values required for footwear	7.0	200	50

These results show that, in all the cases, the leather pieces have a good tear strength performance, and, in some cases, the grain cracking resistance is practically in the limit of acceptance and needs to be improved. Comparing with the standard process the grain cracking has the same problem which implies the need to review the structure of the process and adjust it.

Concerning the organoleptic properties, the color is very uniform and slightly more intense than the standard, the grain break and the touch are very similar comparing with the standard.

Conclusions:

The results obtained in this work allow us to say that wet-white shavings can be valued to obtain sustainable retanning agents, environmentally friendly, whose application can reduce the carbon footprint of the retanning process.

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