

Keratin extraction



The 3 Rs and the Products of the Future

Introduction

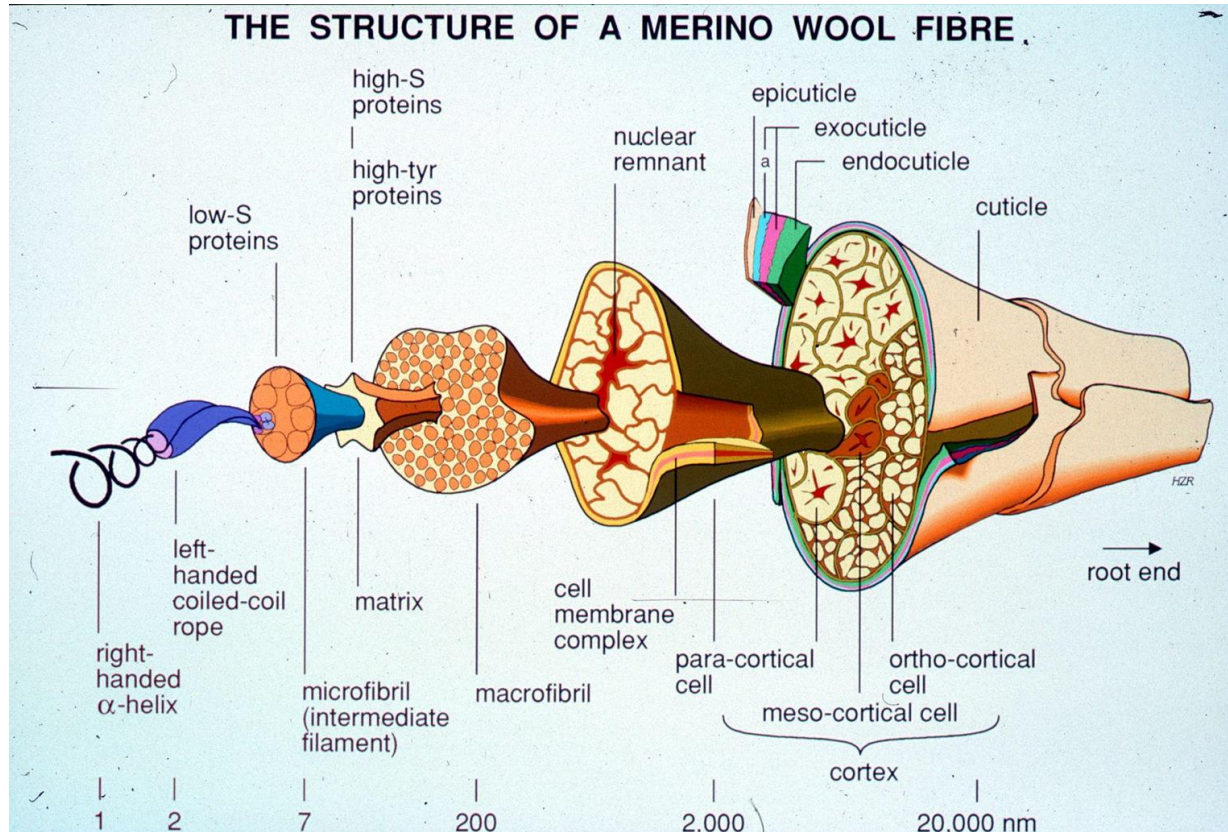


What is keratin?

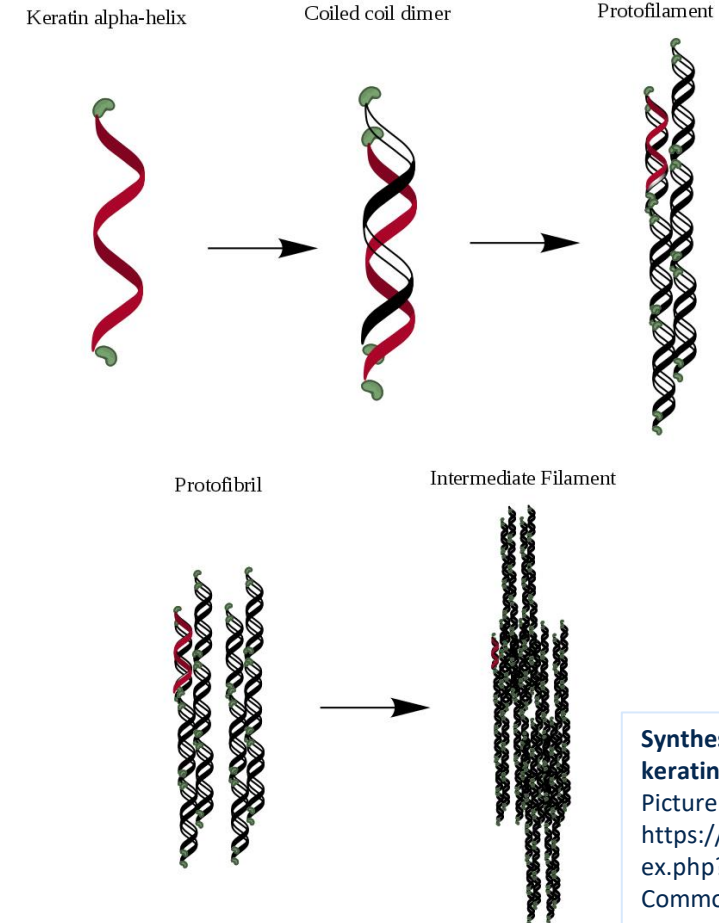
- ▶ Keratins are the most abundant group of insoluble and filament-forming proteins produced in epithelial cells of mammals, birds, reptiles, and humans. As structural components of wool, nails, horn, feathers, and hair, they exploit mechanical support and protective functions against the environment. (Reichl, 2009; Wang et al., 2016)
- ▶ Reichl, S. (2009). Biomaterials films based on human hair keratin as substrates for cell culture and tissue engineering. Biomaterials 30, 6854–6866. doi: 10.1016/j.biomaterials.2009.08.051 | [CrossRef Full Text](#) | [Google Scholar](#)
- ▶ Wang, S., Taraballi, F., Tan, L. P., and Ng, K. W. (2012). Human keratin hydrogels support fibroblast attachment and proliferation in vitro. Cell Tissue Res. 347, 795–802. doi: 10.1007/s00441-011-1295-2 | [PubMed Abstract](#) | [CrossRef Full Text](#) | [Google Scholar](#)



Keratin



Schematic diagram of wool fibre structure. Picture: Textile and Fibre Technology, CC BY 3.0, www.scienceimage.csiro.au/image/2490/, via CSIRO



Synthesis of Alpha-keratin with red keratin to follow throughout diagram.
Picture: Mlpattton, CC BY-SA 4.0, <https://commons.wikimedia.org/w/index.php?curid=56888235>, via Wikimedia Commons



Keratin



Why is Keratin extracted from wool?

- Keratin is extracted largely from wool. This way the wool is recycled and not wasted.

Can wool be recycled infinitely?

- The answer is no, because the regeneration cycle of a fibre is not infinite. Every time a fibre is regenerated, its length shortens. For this reason, each material has a well-defined regeneration cycle. For instance, wool and cashmere can be recycled up to 4 times.

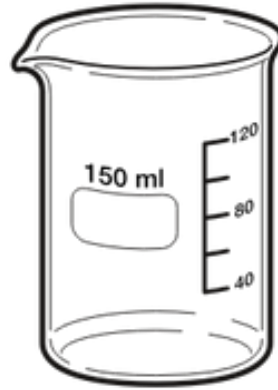


Upcycling wool: <https://youtu.be/5UJLCJkH3dk>



Tools

► Beaker 150 ml



► Glass rod

► Test tubes

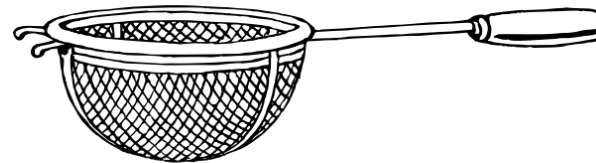
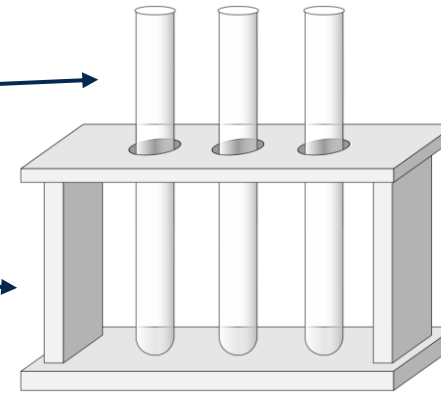
► Rack

► Strainer

► Pipettes

► Safety goggles

► Petri dish



Materials



Extraction

- ▶ NaOH (1 M)
- ▶ Raw wool

Flocculation

- ▶ Lemon Juice
- ▶ Ethanol ($\text{CH}_3\text{CH}_2\text{OH}$)
- ▶ Acetone (Dimethylketone, $\text{CH}_3\text{-CO-CH}_3$)
- ▶ White wine vinegar



Method for keratin extraction

- ▶ Wear protective gloves, a lab coat, and goggles.
- ▶ Put the wool fibres in a beaker.
- ▶ Cover them with the sodium hydroxide solution and mix the mixture with the glass rod.
- ▶ Let it stand for at least 30 minutes.
- ▶ Extract a part of the fibres from the extraction solution and observe their appearance.

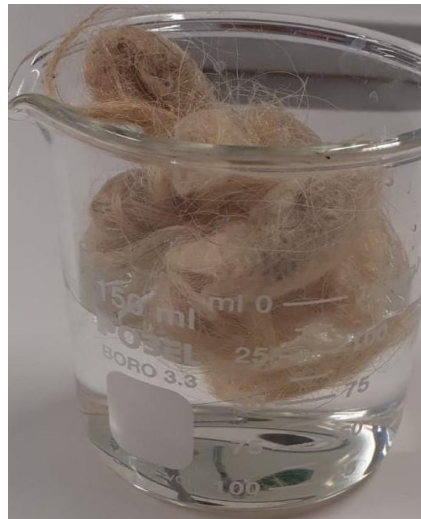


Method for keratin extraction

Wool before the
experiment



Wool in a beaker
with sodium
hydroxide
(NaOH)



Mix the mixture
well with the
glass rod



Results of keratin extraction

Appearance of the wool before extraction:	White colour, soft, crimps or not
Appearance of the wool after the extraction period:	The wool takes on a dark colour and a gelatinous appearance.
Appearance of the extraction solution at the end experience:	The clear and colourless solution at the beginning becomes dark and cloudy.

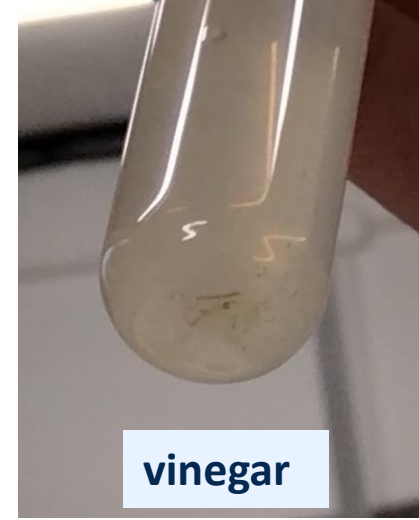
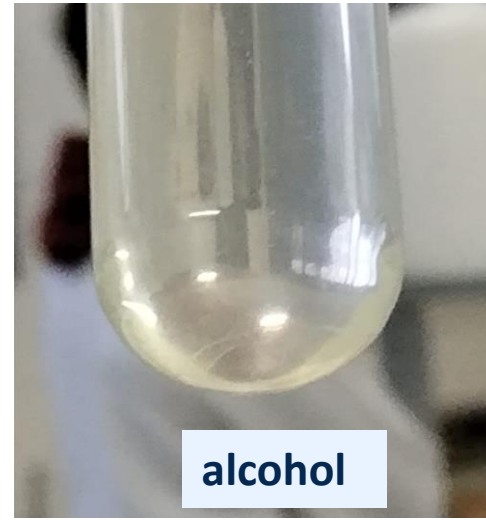


Method for keratin flocculation

- ▶ Wear protective gloves and goggles.
- ▶ Strain the lemon juice.
- ▶ Take five tubes, mark them and add about 10 mL of different solutions in each one: ethanol, acetone, citric acid, vinegar, lemon juice.
- ▶ Add about 1-2 mL of the extraction solution drop by drop to each tube and complete the table below with your observations.
- ▶ Pour the contents of each tube into a petri dish and let it evaporate until it is completely dry.
- ▶ Observe against a dark background and report your results in a table.



Method for keratin flocculation



Results of keratin flocculation

Acetone	Vinegar	Alcohol	Lemon juice
<ul style="list-style-type: none">the solution becomes cloudythe protein settles on the bottom of the tube	<ul style="list-style-type: none">The solution becomes cloudythe protein settles on the bottom of the tube	<ul style="list-style-type: none">the solution becomes cloudythe filaments initially remain in suspension and then settle on the bottom	<ul style="list-style-type: none">the lemon juice does not allow the vision of flocculationyou can observe stratifications

