IMPACT OF PLANT-BASED BIOPOLYMER ON SUSTAINABILITY

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May 3rd, 2022

NEW YORK
Society of Cosmetic
CHEMISTS

Global Challenge with Environmental Resources

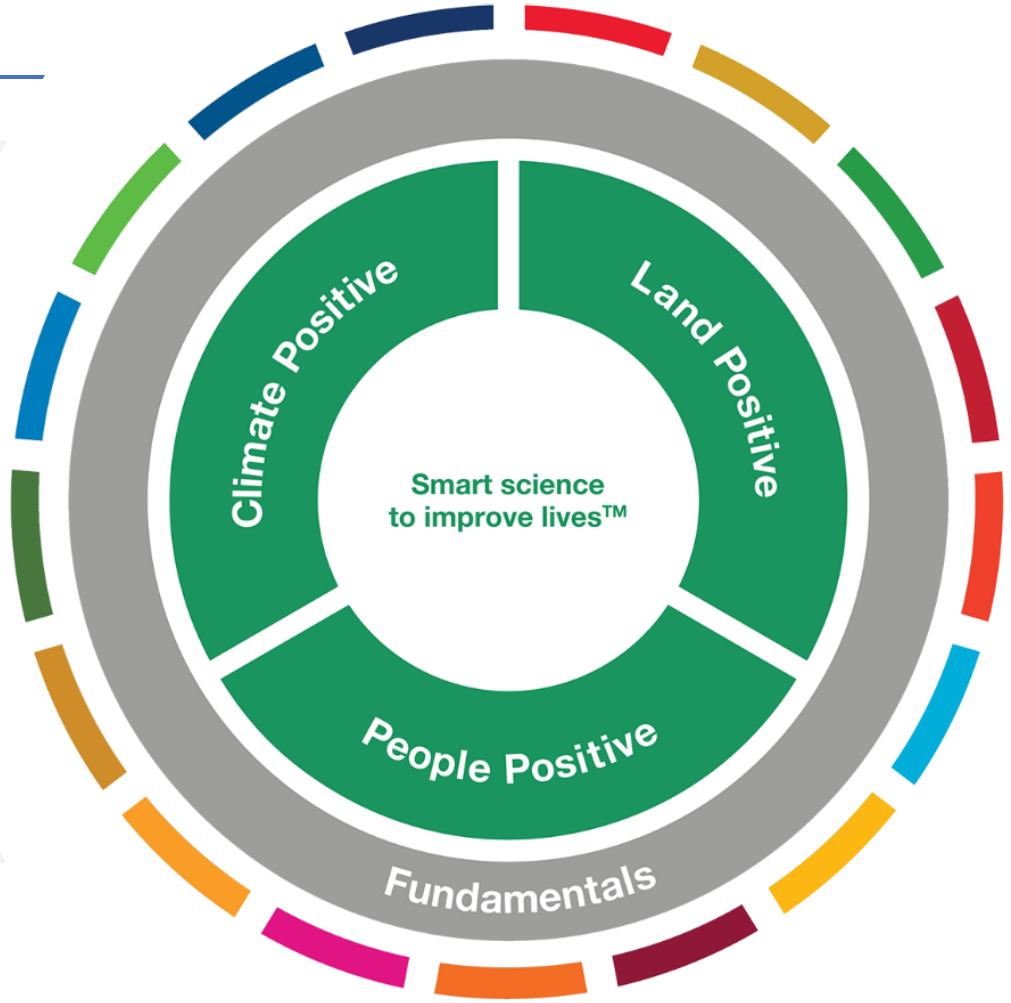
- Resource use per person will be **71% higher** in 2050[1]
- CO_2 emissions have **increased by about 90%** as since 1970[2]
- Nearly **5 billion people** will live in water-stressed regions by 2050[3]
- Expansion of cultivated land has led to **loss of natural vegetation**[4]

References:

1. Resources & consumption | Population Matters
2. IPCC (2014). *Climate Change 2014: Mitigation of Climate Change* EXITEXIT EPA WEBSITE.
3. Water Stress to Affect 52% of World's Population by 2050 (waterfootprint.org)
4. Y. Liu & Y. Chen (2006) Impact of population growth and land-use change on water resources and ecosystems of the arid Tarim River Basin in Western China, International Journal of Sustainable Development & World Ecology, 13:4, 295-305, DOI: 10.1080/13504500609469681

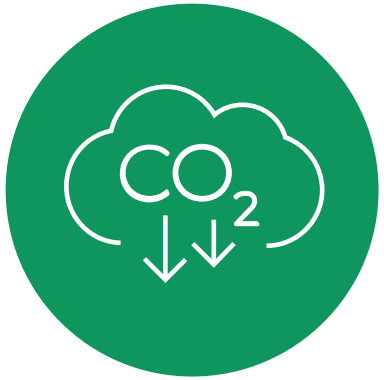
Croda's 2030 Commitment

We will be the most sustainable supplier of innovative ingredients, helping to provide solutions to some of the world's biggest challenges.



Climate Positive by 2030

We will continue to reduce our carbon footprint and increase our use of bio-based raw materials



Reducing Emissions

By 2030, we will have achieved our SBTs, in line with limiting global warming to 1.5ºC

By 2050, we will be a net zero organisation

7.2 9.4 13.2

Sustainable Innovation

By 2030, over 75% of our organic raw materials by weight will be bio-based, absorbing carbon from the atmosphere as they grow

7.2 & 7.3 13.2

Carbon Cover

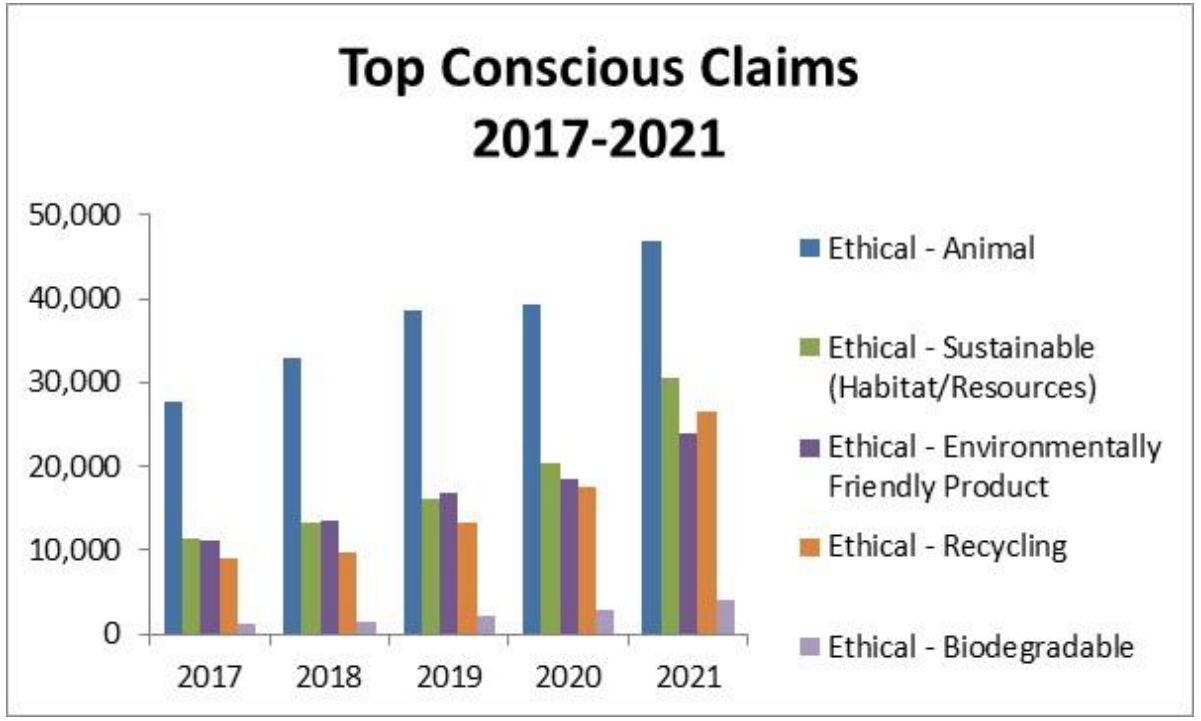
By 2030, use of our products will avoid four times the carbon emissions associated with our business, our 4:1 carbon cover

12.2

Smart science to improve lives™

CRODA

Conscious Claims in Personal Care



Products that claim **ethical treatment of animals** and **sustainability** currently drive product innovation in the industry*

***Reference:** Mintel Market Research

Development of Sustainable Plant-Based Biopolymer

SDG 3: Plant-derived biopolymer is **non-hazardous** and **vegan suitable**

SDG 6 & 12: **Minimized** water and energy consumption during manufacture

SDG 9: Demonstrated efficacy at **low usage levels** for formulated systems

SDG 12: Made with potato-derived protein that is a natural **by-product**

SDG 13 & 14: **Readily biodegradable** and expected to have **low aqua toxicity**

SDG 15: Plant-based biopolymer is **99% bio-based**

The newly developed plant-based biopolymer is **aligned with SDGs**

Carbon Savings of Sustainable Plant-Based Biopolymer

Wool derived keratin has a high carbon footprint due to intensive farming of sheep

Moving to plant-based biopolymer provides opportunity to lower the carbon footprint

24.9 kg CO_2e from 1 kg of wool[1]

<1.0 kg CO_2e from 1 kg of vegetable sources[2,3]

~17 tonnes CO_2e to produce 1 tonne of animal-derived keratin

~8 tonnes CO_2e to produce 1 tonne of plant-derived biopolymer

Save ~9 tonnes (or ~20,000 lbs.) CO_2e

References:

1. Greenhouse gas emissions profile for 1 kg of wool produced in the Yass Region, New South Wales: A Life Cycle Assessment approach (fao.org)
2. Nette, A.; Wolf, P.; Schlüter, O.; Meyer-Aurich, A. A Comparison of Carbon Footprint and Production Cost of Different Pasta Products Based on Whole Egg and Pea Flour. *Foods* **2016**, *5*, 17. https://doi.org/10.3390/foods5010017
3. Carbon-footprints-of-table-potatoes-and-chips-July-2011.pdf (blonkconsultants.nl)

Carbon Savings of Plant-Based Biopolymer

For each tonne of plant-based biopolymer used, carbon savings is equivalent to:

(annual savings of ~20,000 lbs. of CO_2 emissions)

20 more households recycling waste

~1,000 lbs. of annual CO_2 savings from recycling paper, metal, plastic and glass[1]

2 more households using 100% green electricity

~10,000 lbs. of annual CO_2 emissions from using non-green electricity[1]

2 more electric powered vehicles on the road

~10,000 lbs. of annual CO_2 emissions from personal vehicle[1]

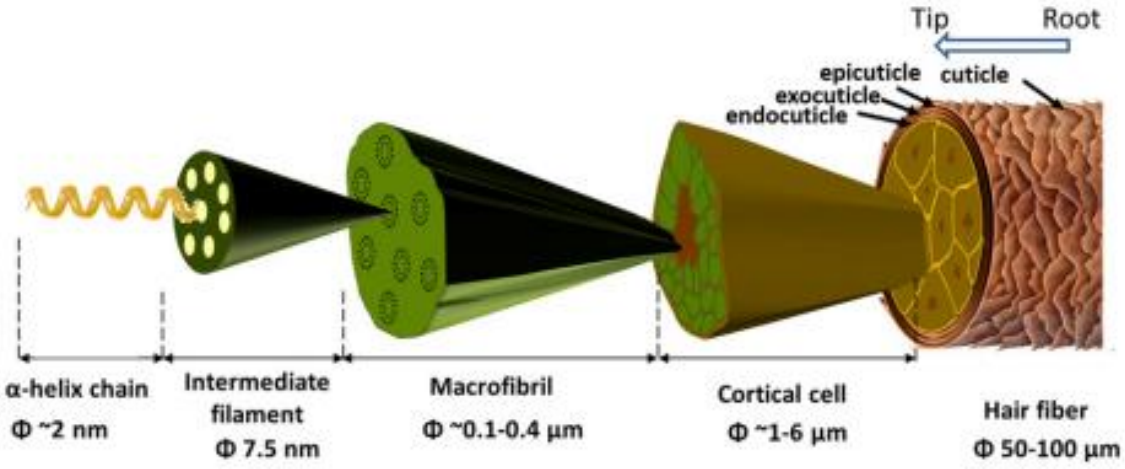
Using plant-based biopolymer instead of animal-derived keratin offers opportunity of significant carbon footprint reduction during use in products

Reference:

1. Carbon Footprint Calculator | Climate Change | US EPA

Vegan Suitable Alternative to Keratin

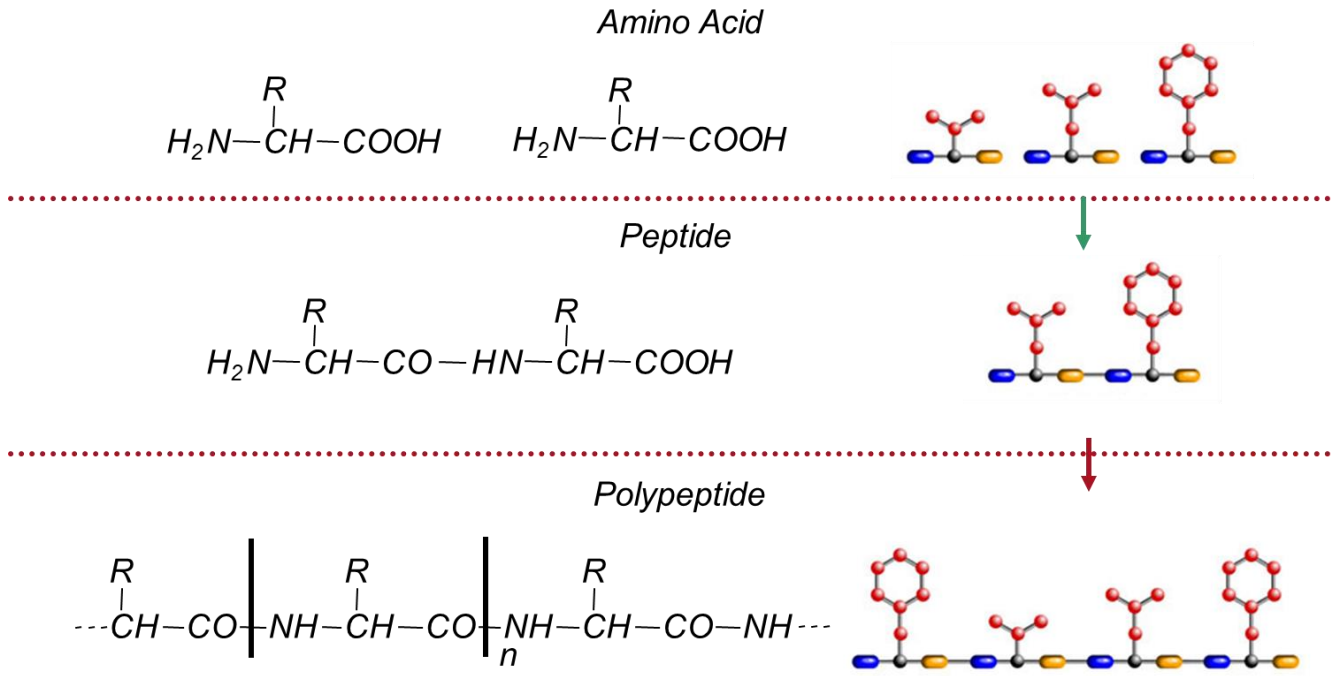
- Consumers are embracing vegan values, driven by the "conscious beauty" trend
- Consumers recognize keratin as main component of hair
- Considered as a biopolymer, the mechanical response of keratin has been extensively studied
- As keratin is derived from animal sources, there is a need for a vegan suitable alternative which matches performance of animal-derived keratin

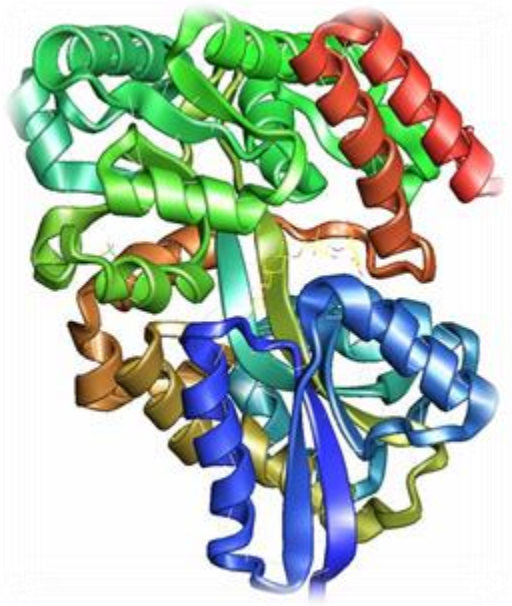


Y. Yu et al. *Structure and mechanical behavior of human hair* Materials Science and Engineering C 73 (2017)

Protein Structure – Made up of Amino Acids

- Primary Structure:
  - **Amino Acids** Linked by Peptide Bonds to Form Polypeptide Chains

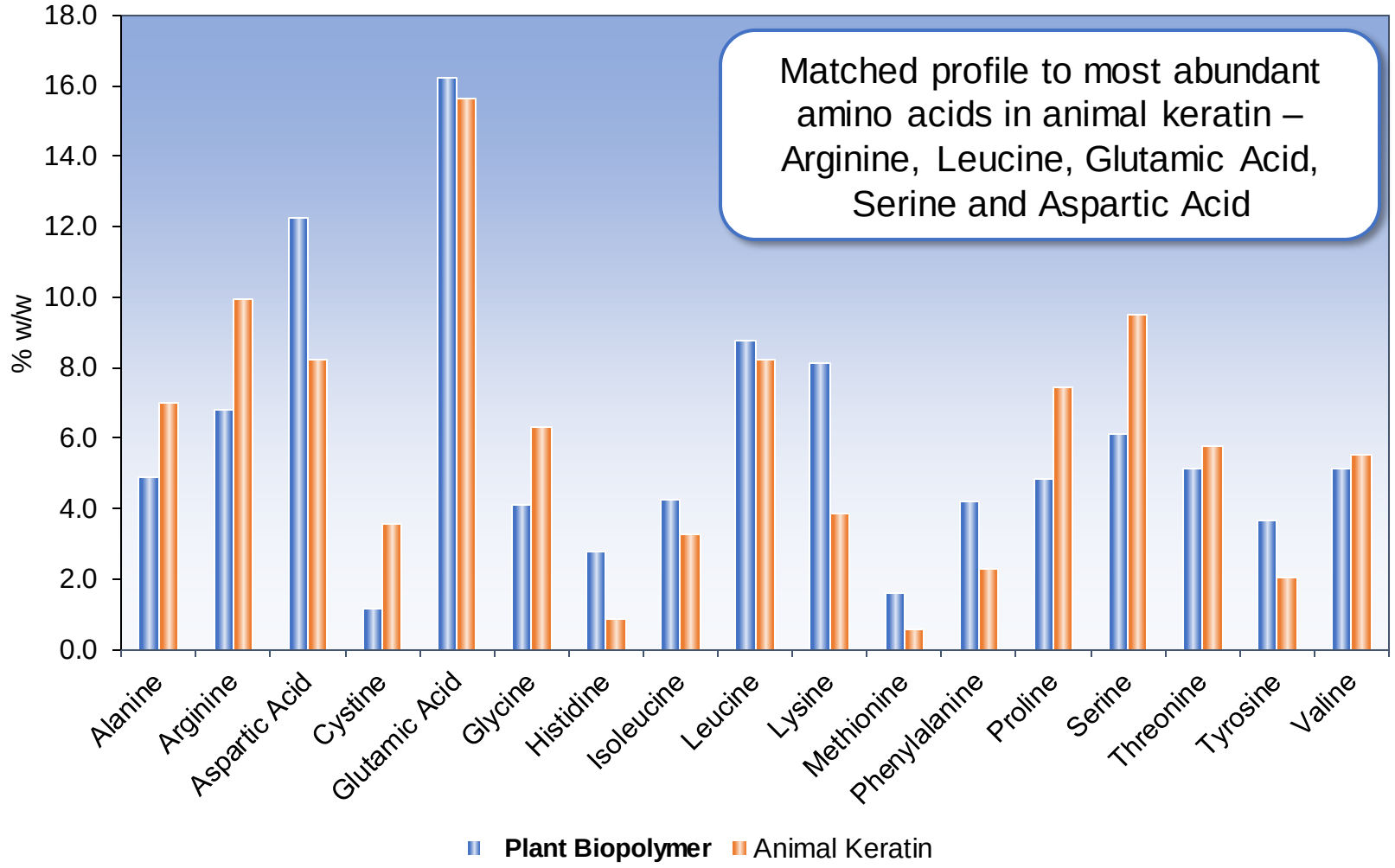




Reference:

Biochemistry, 5th edition. Jeremy M Berg, John L Tymoczko, and Lubert Stryer. New York: W H Freeman; 2002. ISBN-10: 0-7167-3051-0

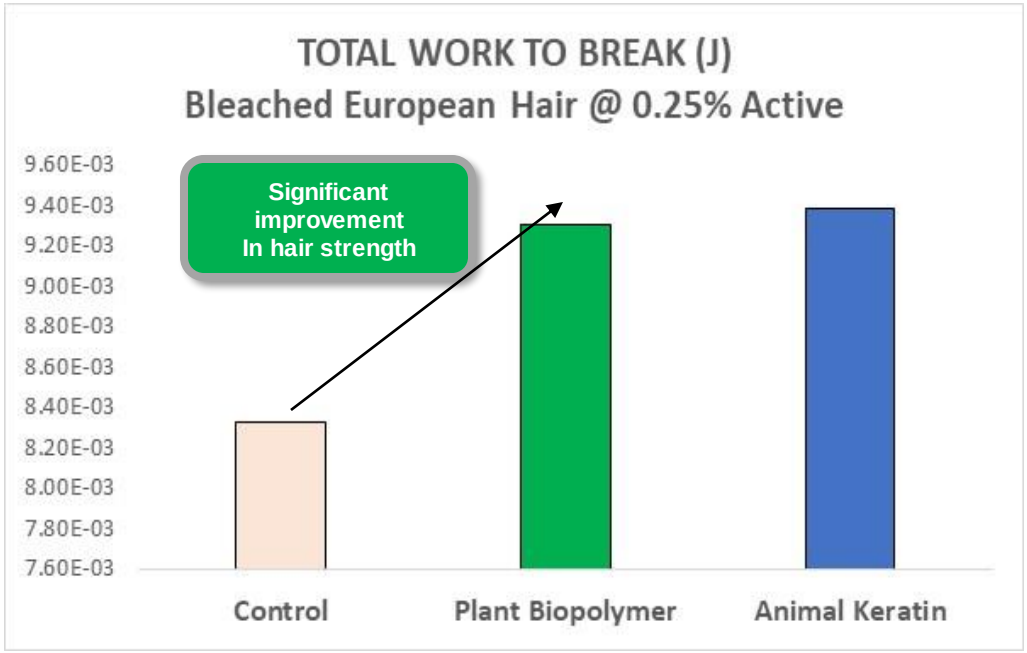
Optimized Amino Acid Profile of Plant-Based Biopolymer

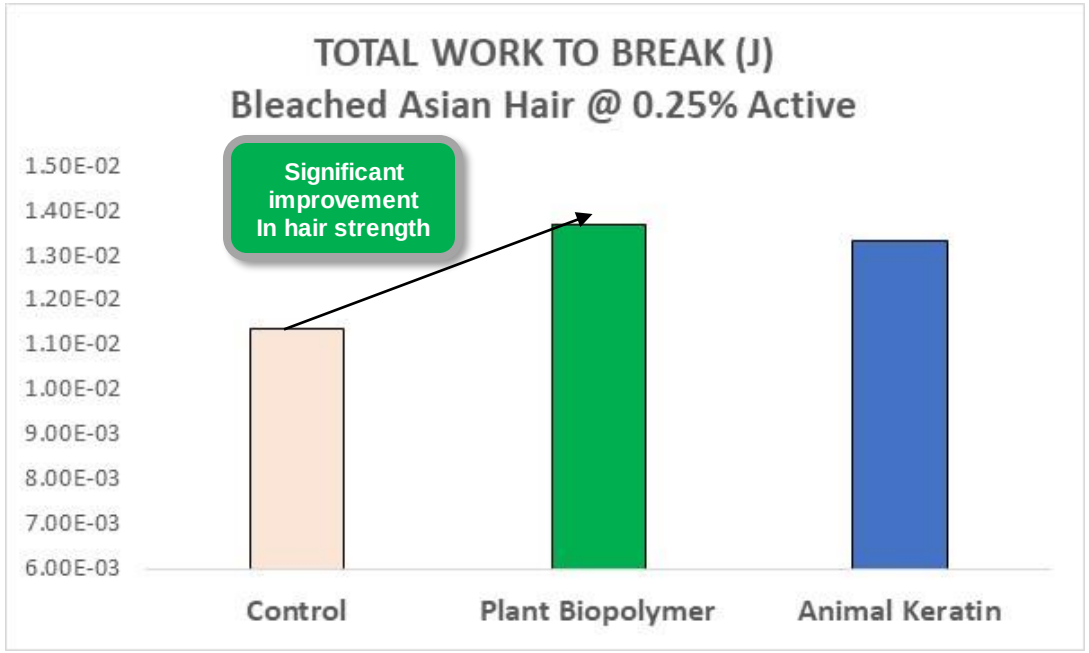


Performance of Sustainable Plant-Based Biopolymer

- **Comparable** amino acid profile to animal-derived keratin
- **Substantive** to the hair after treatment
- Tested on **multiple hair types** at **low usage level** in formulation
- Provides **strengthening** benefits for damaged and fragile hair
- Consumer perceivable benefits (**salon tested**)

Strengthening Performance on Damaged Hair

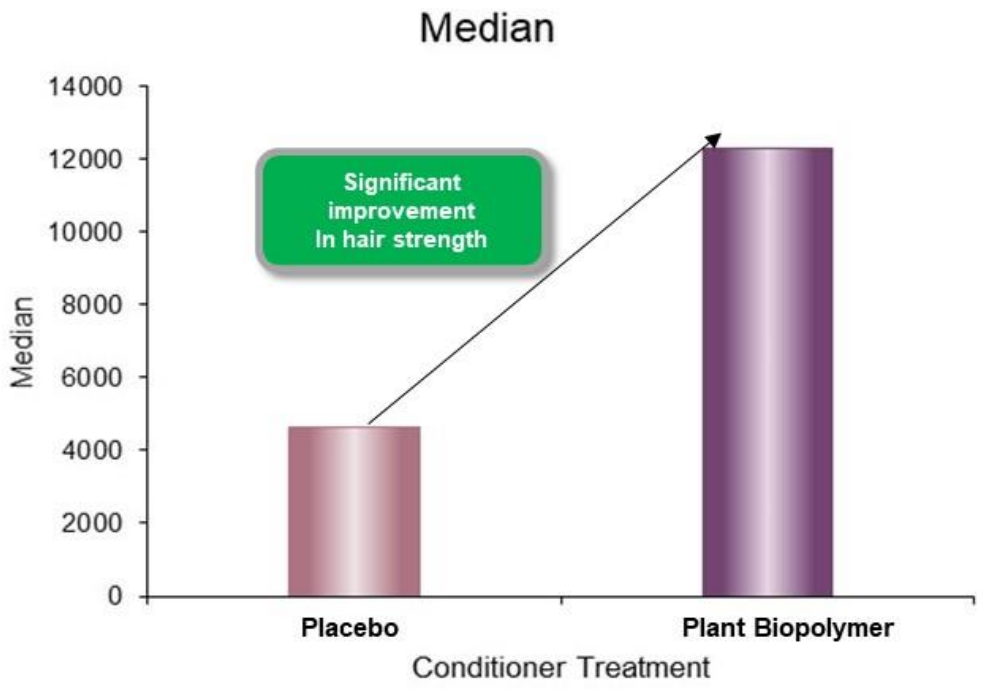


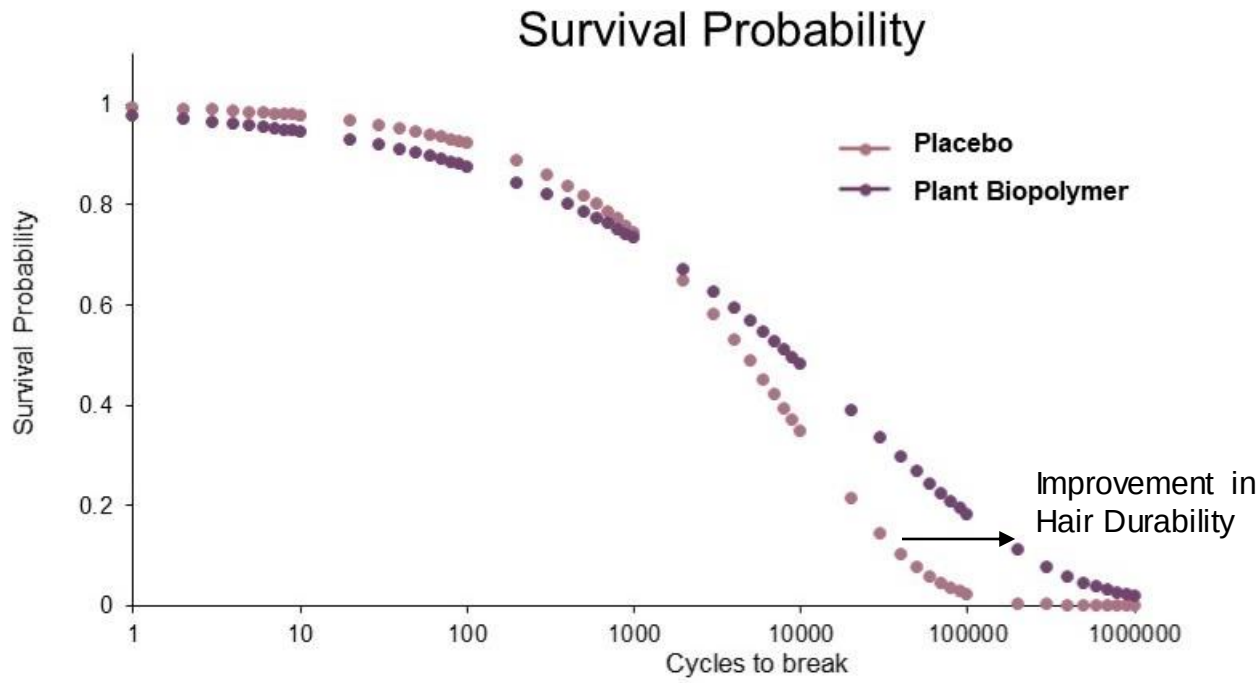


The strength of bleached European and Asian hair has **significantly improved** after treatment with **plant-based biopolymer**

Performance of **plant-based biopolymer** is comparable to **animal-derived keratin**

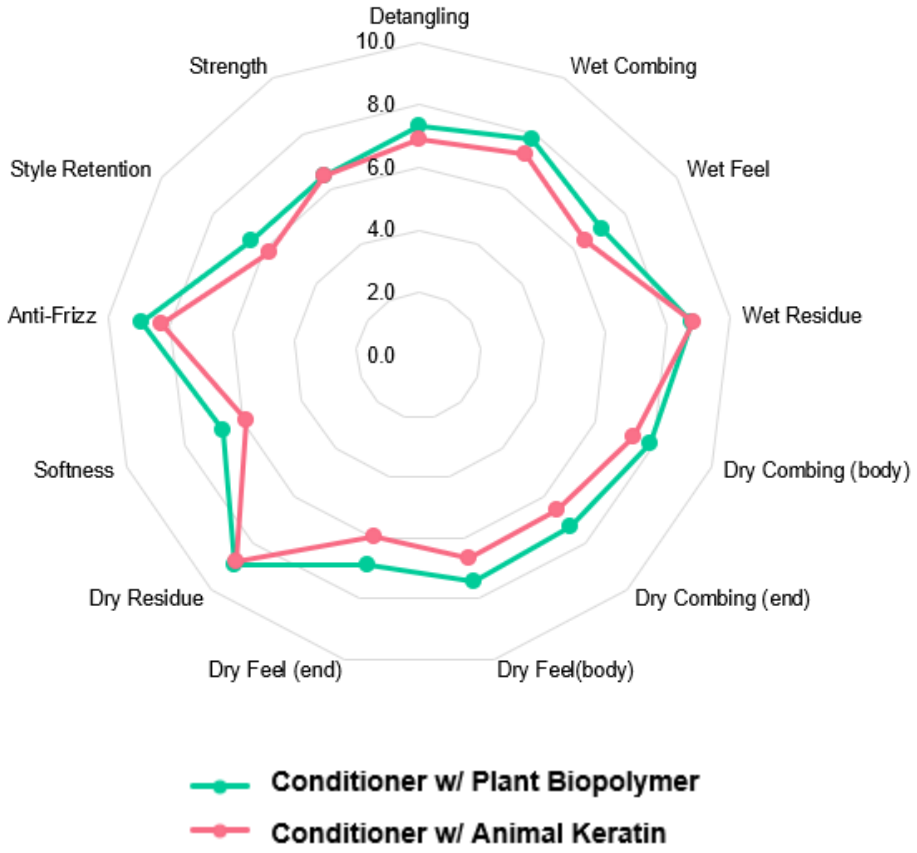
Strengthening Performance on Textured Hair

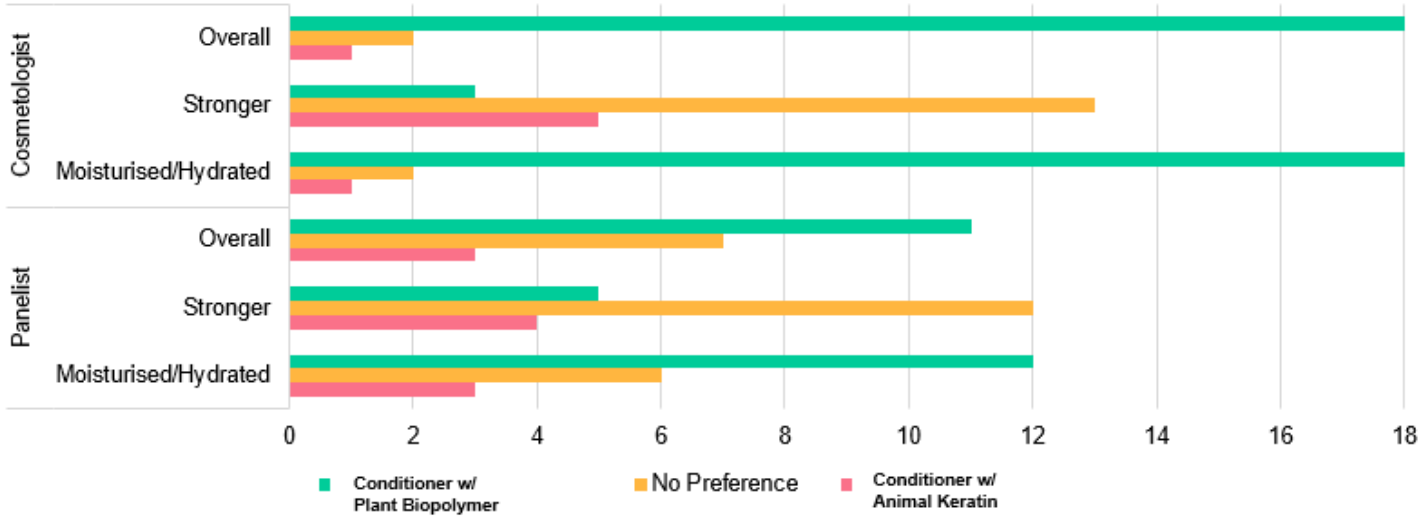




The strength and resiliency of Type VII textured hair has **significantly improved** after treatment with **plant-based biopolymer**

Consumer Perceivable Benefits





Plant-Based Biopolymer exhibited similar performance as animal-derived keratin in conditioner formulation

Both cosmetologists and panelists preferred conditioner with plant-based biopolymer

Summary

- A plant-based biopolymer was developed as an **alternative to animal-derived keratin**
- The new plant-based biopolymer **aligns with SDGS** and is **vegan suitable**
- The **optimized amino acid profile** of plant-based biopolymer is **comparable to that of animal-derived keratin**
- The plant-based biopolymer provides **hair strengthening benefits,** and demonstrates **consumer perceivable benefits** via salon test
- Use of plant-based biopolymer **reduces carbon footprint**, contributing to our commitment to be **Climate Positive by 2030**

Acknowledgements

- Kelcie Lesko
- Panayiota Kalimanis
- Arayna Singh
- Lumbidzani Moyo
- Lizzie Ryder
- Kumpal Mehta
- Yingxia He
- Farahdia Edouard

THANK YOU FOR YOUR ATTENTION

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