# Formation of hair keratin fibres

Blumenberg, M., Jupe, S.

European Bioinformatics Institute, New York University Langone Medical Center, Ontario Institute for Cancer Research, Oregon Health and Science University.



02/06/2024

# Introduction

Reactome is open-source, open access, manually curated and peer-reviewed pathway database. Pathway annotations are authored by expert biologists, in collaboration with Reactome editorial staff and cross-referenced to many bioinformatics databases. A system of evidence tracking ensures that all assertions are backed up by the primary literature. Reactome is used by clinicians, geneticists, genomics researchers, and molecular biologists to interpret the results of high-throughput experimental studies, by bioinformaticians seeking to develop novel algorithms for mining knowledge from genomic studies, and by systems biologists building predictive models of normal and disease variant pathways.

The development of Reactome is supported by grants from the US National Institutes of Health (P41 HG003751), University of Toronto (CFREF Medicine by Design), European Union (EU STRP, EMI-CD), and the European Molecular Biology Laboratory (EBI Industry program).

## Literature references

Fabregat, A., Sidiropoulos, K., Viteri, G., Forner, O., Marin-Garcia, P., Arnau, V. et al. (2017). Reactome pathway analysis: a high-performance in-memory approach. *BMC bioinformatics, 18*, 142. ↗

Sidiropoulos, K., Viteri, G., Sevilla, C., Jupe, S., Webber, M., Orlic-Milacic, M. et al. (2017). Reactome enhanced pathway visualization. *Bioinformatics, 33*, 3461-3467. ↗

Fabregat, A., Jupe, S., Matthews, L., Sidiropoulos, K., Gillespie, M., Garapati, P. et al. (2018). The Reactome Pathway Knowledgebase. *Nucleic Acids Res, 46*, D649-D655. ↗

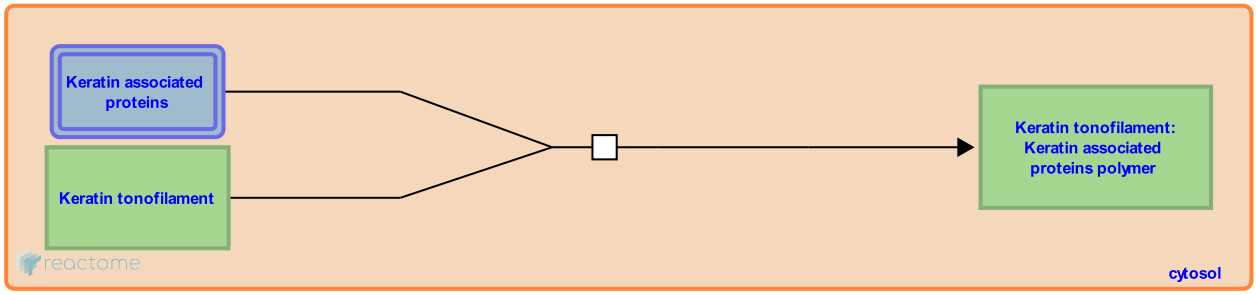
Fabregat, A., Korninger, F., Viteri, G., Sidiropoulos, K., Marin-Garcia, P., Ping, P. et al. (2018). Reactome graph database: Efficient access to complex pathway data. *PLoS computational biology, 14*, e1005968. ↗

## Formation of hair keratin fibres ↗

**Stable identifier:** R-HSA-6809663

**Type:** transition

**Compartments:** cytosol




Hair consists of three major structural components: the cuticle, the cortex and the central medulla. Approximately 90% of cortical cells contain longitudinally arrayed keratin filaments. These filaments have a surrounding matrix that contains keratin-associated proteins (KAPs) that are involved in the formation of cornified, resilient hair shafts (Shimomura & Ito 2005, Lee et al. 2006, Harland et al., 2010, Gong et al. 2016). KAPs forming extensive disulfide cross-links with keratin filaments (Marshall et al. 1991).

The proliferative cells that give rise to hair fibres are located in the bulb at the base of the hair follicle. As they leave the germinative compartment, trichocytic differentiation begins and in matrix, cuticular, and cortical cells, the genes for keratins and KAPs (KRTAPs) are expressed. In the lower and middle cortex, keratin filaments are embedded in a matrix that consists of KAPs. Based on amino acid composition, three classes of KAPs have been described, the high sulfur KAPs (<30 mol % cysteine content), the ultrahigh sulfur KAPs (>30 mol % cysteine content), and the high tyrosine/glycine KAPs (Rogers et al. 2001). KAPs can be divided into subfamilies based on amino acid composition and phylogenetic relationships (Wu et al. 2008). Humans have approximately 100 KAP genes (Wu et al. 2008). Compared to the conserved structure and modality of keratins within mammals, KAP genes differ significantly between species and are likely to explain the variety of characteristics seen in hard keratin appendages such as feathers, claws, scales and hair (Wu et al. 2008, Khan et al. 2014). KAPs are crucial for the assembly of keratin intermediate filaments into arrays and likely to affect attributes of hair such as strength, rigidity and chemical inertness (Parry & Steinert 1999, Koster et al. 2015).

## Literature references


Shimomura, Y., Ito, M. (2005). Human hair keratin-associated proteins. *J. Investig. Dermatol. Symp. Proc., 10*, 230-3. ↗

Marshall, RC., Orwin, DF., Gillespie, JM. (1991). Structure and biochemistry of mammalian hard keratin. *Electron Microsc. Rev., 4*, 47-83. ↗

Johnson, WE., Antunes, A., Khan, I., O'Brien, SJ., Vasconcelos, V., Maldonado, E. (2014). Mammalian keratin associated proteins (KRTAPs) subgenomes: disentangling hair diversity and adaptation to terrestrial and aquatic environments. *BMC Genomics, 15*, 779. ↗


## Editions

| | | |
|---|---|---|
| 2016-03-10 | Authored | Jupe, S. |
| 2016-08-09 | Edited | Jupe, S. |
| 2016-08-12 | Reviewed | Blumenberg, M. |