

Electronic supplementary information (ESI)

Ductile keratin films from deep eutectic solvent-fractionated feathers

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3.1 Deep eutectic solvent fractionation and film preparation

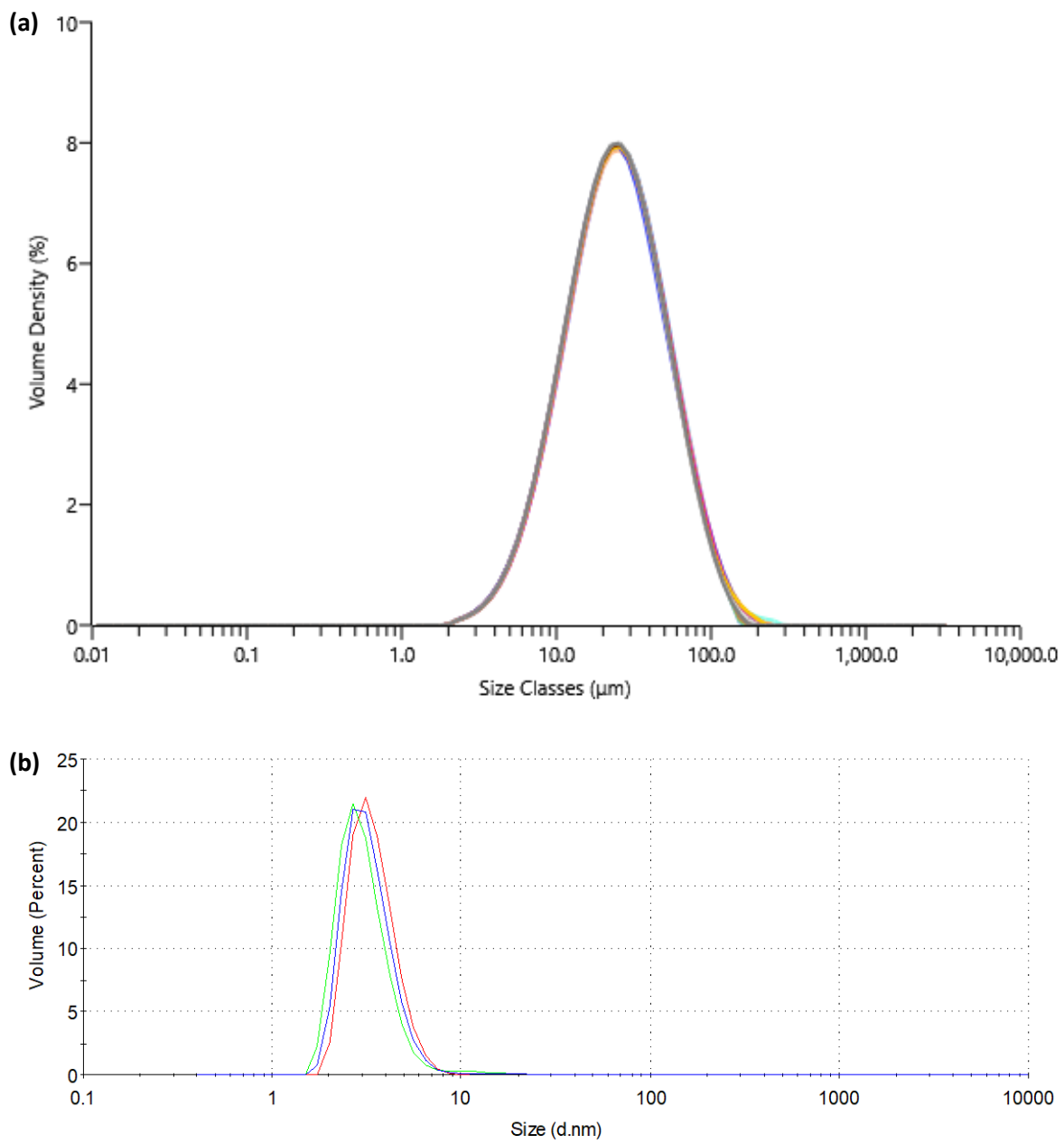


Fig. S1 Mean particle sizes of the (a) high and (b) low Mw keratin fractions.

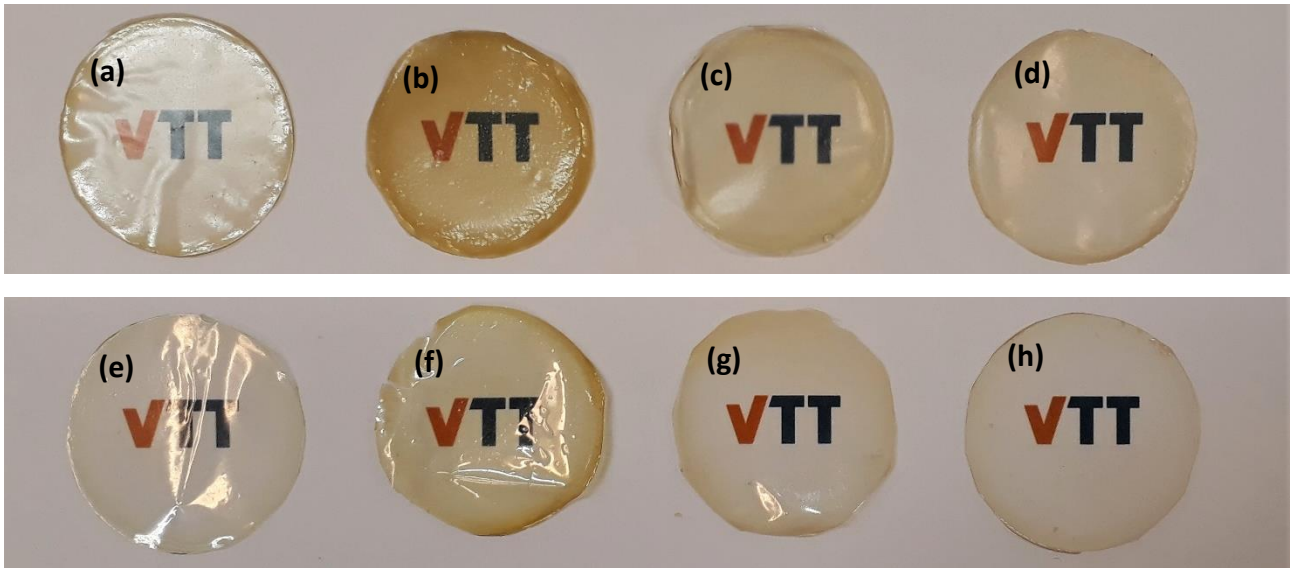


Fig. S2 Glycerol plasticised keratin films made of (a) high and (e) low Mw keratin fractions and which are cross-linked with glutaraldehyde at (b,f) pH 9 and (c,g) 12 as well as with (d,h) 1,4-Butanediol diglycidyl ether at pH 9.5.

3.2.1 Film morphology

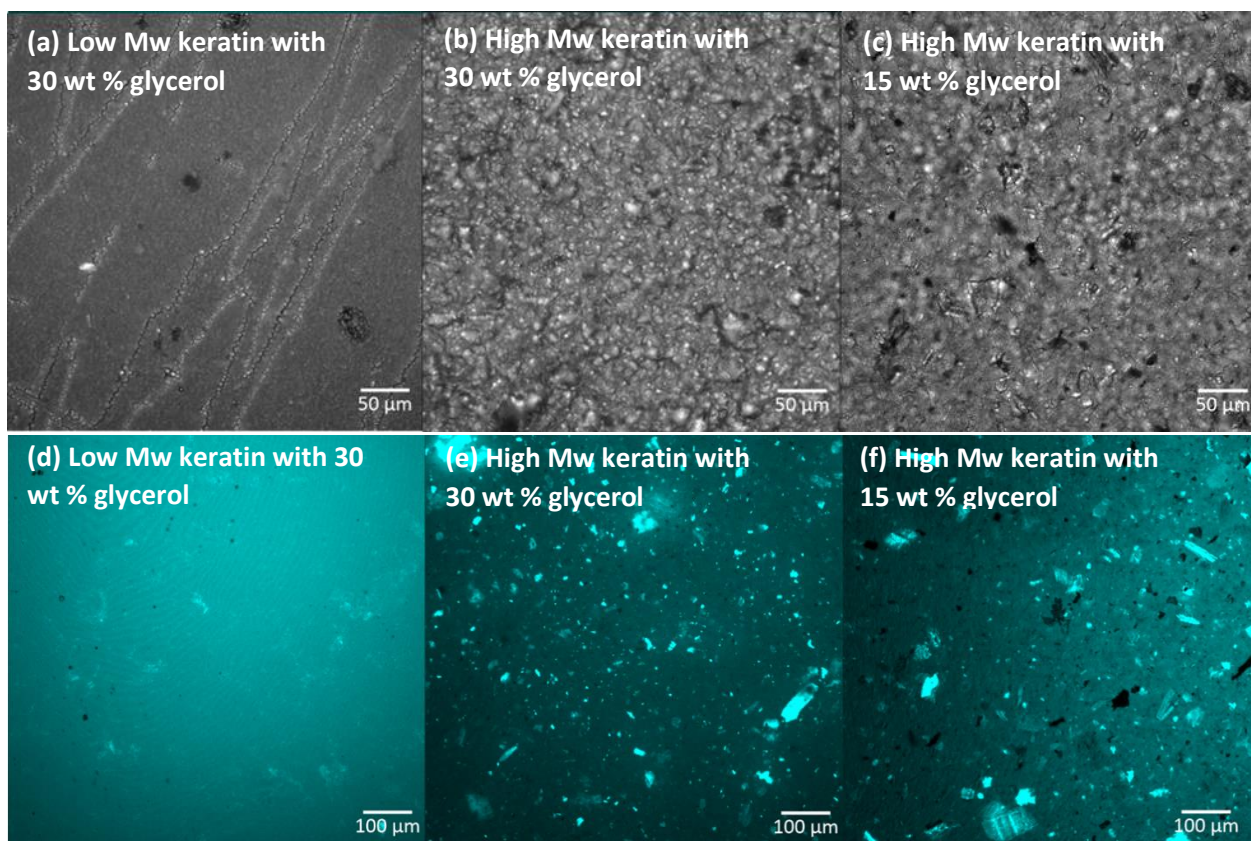


Fig. S3 Optical microscopy images of the glycerol plasticised keratin films from the surface (a-c) and permeable imaging (d-f). The films are made of the low and high Mw keratin fractions and plasticised with glycerol.

3.2.2 Molecular structure

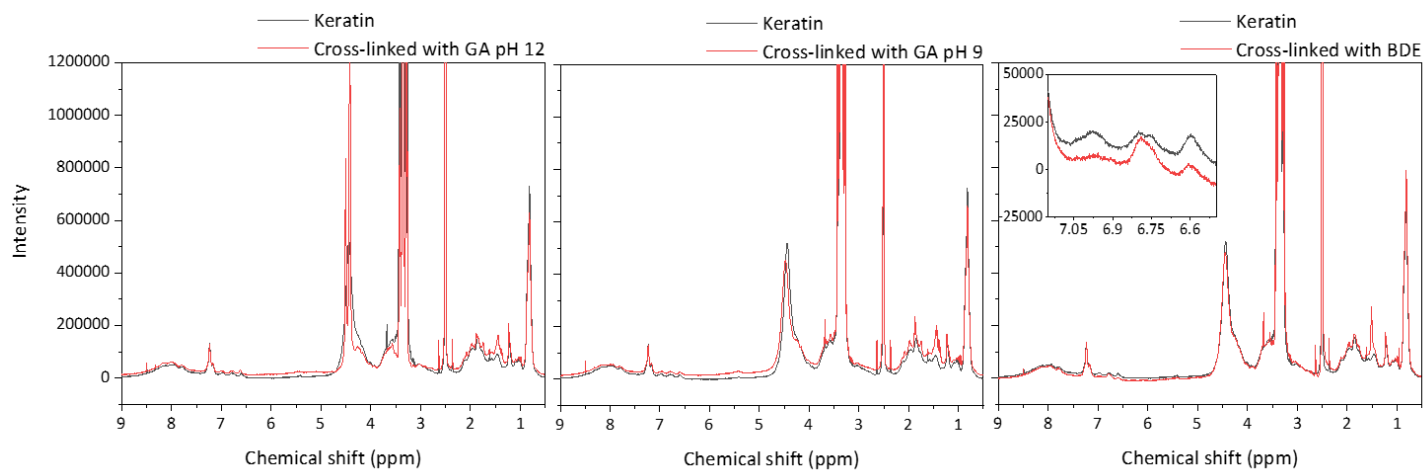


Fig. S4 ¹H-NMR spectra of the low Mw keratin fraction, the films made of this fraction and plasticised with 30 wt% glycerol concentration and cross-linked with glutaraldehyde (GA) at pH 12 and 9 as well as with 1,4-butanediol diglycidyl ether (BDE) at pH 9.5.

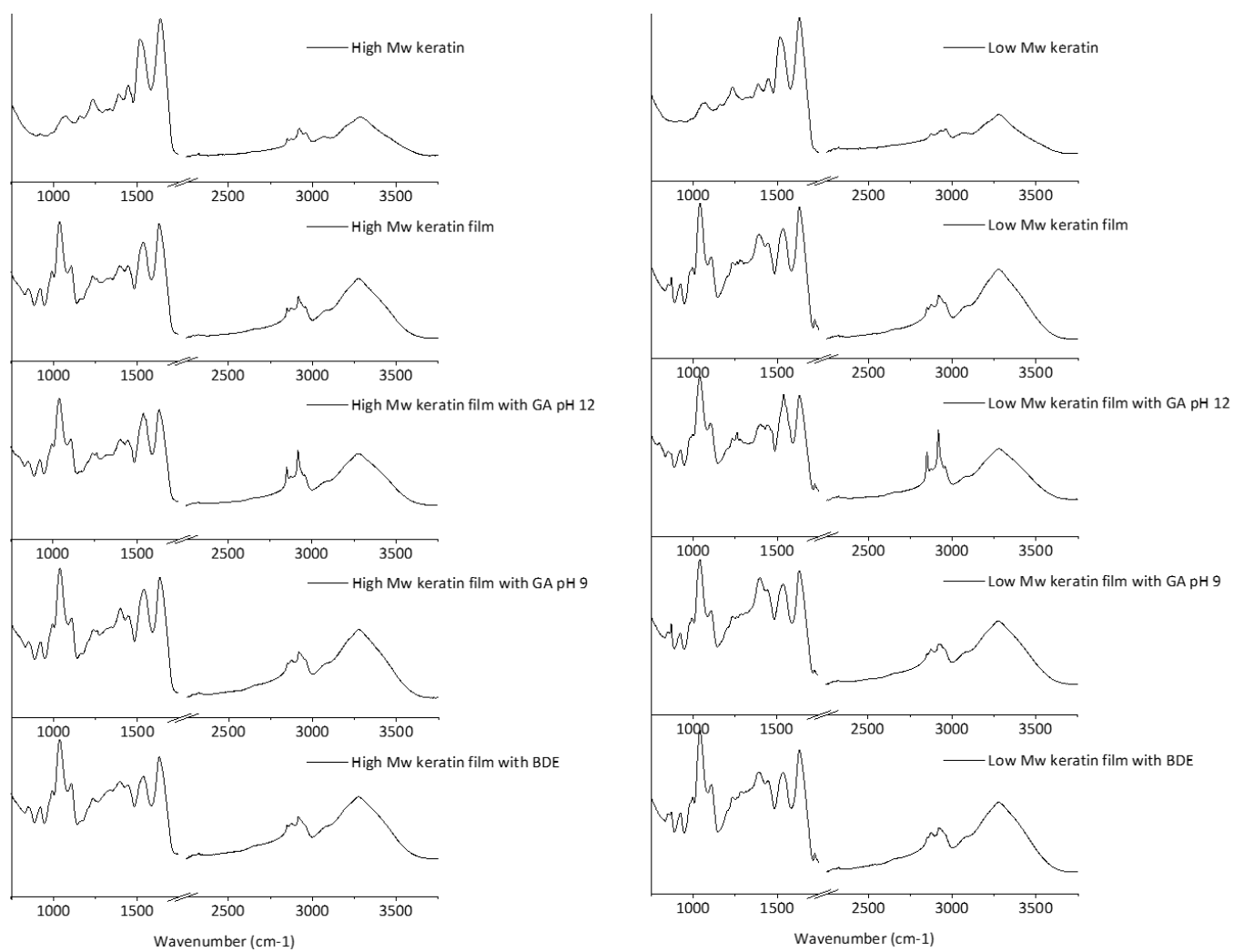
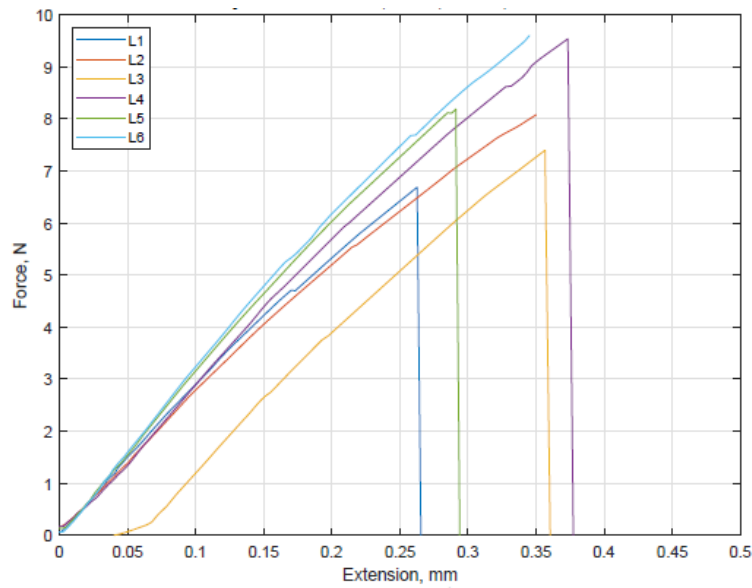


Fig. S5 ATR-FTIR spectra of the high and low Mw keratin fractions, the films made of these fractions and plasticised with 30 wt% glycerol concentration and cross-linked with glutar aldehyde (GA) at pH 12 and 9 as well as with 1,4-butanediol diglycidyl ether (BDE) at pH 9.5.

3.2.3 Mechanical properties

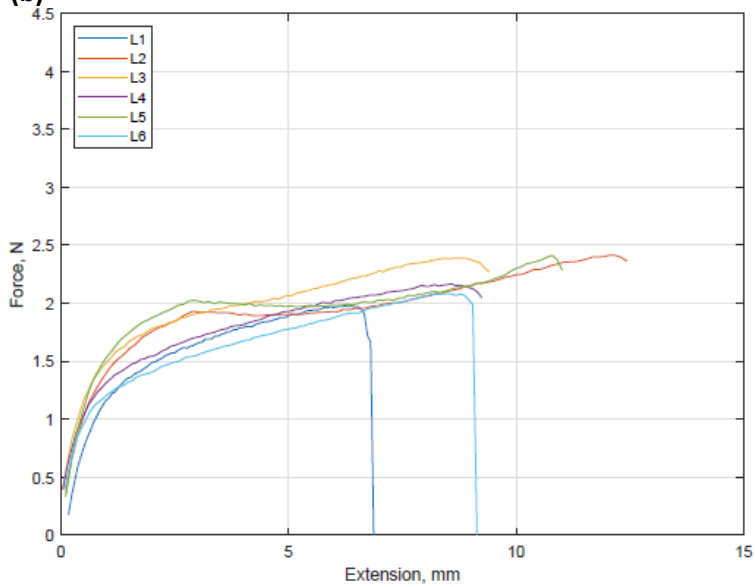
(a)



	Thickness (mm)	Young's Modulus (MPa)	Tensile Strength (MPa)	Load at Maximum Load (N)	Extension at Maximum Load (mm)	Load at Break (N)	Extension at Break (mm)	Stress at Break (MPa)	Strain at Break	Stiffness (N/m)	Work to Break (Nm)
Ave	65,8	649	8,39	8,28	0,33	8,28	0,33	8,39	0,0166	32008	1,45
STD	4,7	29	0,95	1,06	0,04	1,06	0,04	0,95	0,0020	2183	0,34

Treg Speed 2 mm/min, strip width 15 mm, gauge 20 mm, load cell 100 N

(b)



	Thickness (mm)	Young's Modulus (MPa)	Tensile Strength (MPa)	Load at Maximum Load (N)	Extension at Maximum Load (mm)	Load at Break (N)	Extension at Break (mm)	Stress at Break (MPa)	Strain at Break	Stiffness (N/m)	Work to Break (Nm)
Ave	52,7	98	2,85	2,25	9,14	1,99	9,74	2,53	0,4874	3798	18,11
STD	3,9	25	0,21	0,17	1,90	0,21	1,80	0,28	0,0898	744	4,39

Treg Speed 2 mm/min, strip width 15 mm, gauge 20 mm, load cell 100 N

Fig. S6 Example of stress-strain curves of the keratin films prepared from the high Mw keratin fraction and plasticised with (a) 15 wt% and (b) 30 wt% glycerol concentrations.