PR proteins

PARAMETER	UNIT	VALUE	REFERENCES
GENERAL			
Common name	-	proteins	
Acronym	-	PR	
CAS number	-	9010-10-0, 70084-87-6	
EC number	-	232-720-8	
HISTORY			
Date	-	1923	
Details	-	soy-based adhesives developed	
SYNTHESIS			
Method of production	-	soybean processing: first the oil and husk are removed, the remaining flakes are subjected to protein extraction; pH control permits isolation of required range of protein molecules; next step involves chemical modification, which imparts required properties; grades obtained in this technology include: unhydrolyzed grades, hydrolyzed grades, carboxylated soy protein, and proteinates	
Mass average molecular weight, M_w	dalton, g/mol, amu	50,000-300,000; 30,000-1,000,000 (molecular weight of raw soy protein); 19,000-25,200 (casein); 10,000-15,000 (albumins); 150,000-450,000 (globulins)	
Hydrodynamic radius	nm	3.12-3.26 (ovalbumin, main protein in egg white)	Hulse, W L; Forbes, R T, Int. J. Pharmaceutics, 411, 64-68, 2011.
Radius of gyration	nm	3.7-12.8	Vorup-Jensen, T; Boesen, T, adv. Drug Delivery Rev., in press, 2011.
STRUCTURE			
Cell dimensions	nm	2.2-4.5x3.0-4.4x3.0-5.7	Schwenke, K D, Studies in Interface Science, Vol. 7, pp 1-50, Elsevier, 1998.
Chain conformation	-	α-helix (most), β-sheet, unordered	Sinha, S; Li, Y; Williams, T D; Topp, E M, Biophys. J., 95, 12, 5951-61, 2008.
COMMERCIAL POLYMERS			
Some manufacturers	-	DuPont; Pentapharm	
Trade names	-	Pro-Cote; Elhbin	
PHYSICAL PROPERTIES			
Density at 20°C	g cm^{-3}	1.36	
Bulk density at 20°C	g cm^{-3}	0.28-0.6	
Color	-	off-white to light brown	
Odor		odorless	
Denaturation temperature	°C	118-124 (lentil protein)	Joshi, M; Adhikari, B; Aldred, P; Panozzo, J F; Kasapis, S, Food Chem., in press, 2011.
Glass transition temperature	°C	181 (wheat glutenin); 192 (collagen); 217 (gelatin); 252 (elastin)	Matveev, Y I; Grinberg, V Y; Sochava, I V; Tolstoguzov, V B, Food Hydrocolloids, 11, 2, 125-33, 1997.
MECHANICAL & RHEOLOGICAL PROPERTIES			
Tensile strength	MPa	40-50 (soy protein); 99 (soy protein drawn, 2.5 draw ratio); 12.7 (zein); 5-6 (zein processed by casting)	Kurose, T; Urman, K; Otaigbe, J U; Lochhead, R Y; Thames, S F, Antec, 1489-93, 2006.

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PARAMETER	UNIT	VALUE	REFERENCES
Elongation	%	4.6 (soy protein); 61-122 (zein)	
Young's modulus	MPa	104-1,200	
CHEMICAL RESISTANCE			
Acid dilute/concentrated	-	poor	
Alcohols	-	good/poor	
Alkalis	-	poor	
Aliphatic hydrocarbons	-	good	
Aromatic hydrocarbons	-	good	
Esters	-	good	
WEATHER STABILITY			
Absorption	nm	280 – tyrosine and tryptophan, 260 – phenylalanine	Davies, M J; Truscott, R J W, Comprehensive Series in Photosciences, Vol. 3, pp 251-275, Elsevier, 2001.
Spectral sensitivity	nm	250-300 (disulfide bond)	Davies, M J; Truscott, R J W, Comprehensive Series in Photosciences, Vol. 3, pp 251-275, Elsevier, 2001.
Emission wavelengths	nm	280 – phenylalanine, 300 – tyrosine, 350 – tryptophan	Davies, M J; Truscott, R J W, Comprehensive Series in Photosciences, Vol. 3, pp 251-275, Elsevier, 2001.
BIODEGRADATION			
Typical biodegradants	-	composting according to ASTM D5338 (fast biodegradation of PR/PVOH film)	Su, J-F; Yuan, X-Y; Hung, Z; Xia, W-L, Polym. Deg. Stab., 95, 1226-37, 2010.
TOXICITY			
Carcinogenic effect	-	not listed by ACGIH, NIOSH, NTP	
Mutagenic effect	-	none	
Teratogenic effect	-	none	
Reproductive toxicity	-	none	
ENVIRONMENTAL IMPACT			
Aquatic toxicity, *Daphnia magna*, LC_{50}, 48 h	mg l^{-1}	>1,000	
Aquatic toxicity, *Rainbow trout*, LC_{50}, 48 h	mg l^{-1}	>1,000	
PROCESSING			
Typical processing methods	-	casting, compounding, compression molding, extrusion, injection molding, mixing, solution processing	
Processing temperature	°C	70-105 (extrusion); 130 (molding); 135-165 (compression)	
Additives used in final products	-	Plasticizers: ethylene glycol, glycerin, propylene glycol, sorbitol, triacetin, triethylene glycol; Antistatics: cationic polysoap, N-acyl derivative of a protein hydrolysate; Release: calcium salt, magnesium stearate, stearic acid	
Applications	-	adhesives, animal pharmaceuticals, ceiling tiles, fibers, horticultural pots, leather finishing, mushroom fertilizer, paper and paperboard coatings	

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PARAMETER	UNIT	VALUE	REFERENCES
BLENDS			
Suitable polymers	-	poly(hydroxy ester ether), PLA, PVOH	
ANALYSIS			
FTIR (wavenumber-assignment)	cm^{-1}/-	hydrogen bonding – 2900-3100; NH – 1636-1680, 1533-1559; C-C – 750, 900, 920; C-O – 1110, more in ref.	Su, J-F; Yuan, X-Y; Hung, Z; Xia, W-L, Polym. Deg. Stab., 95, 1226-37, 2010.
Raman (wavenumber-assignment)	cm^{-1}/-	C=C – 1634, 1546; C-H – 1168	Chen, L; Han, X; Yang, J; Zhou, J; Song, W; Zhao, B; Xu, W; Ozaki, Y, J. Colloid Interface Sci., 360, 482-87, 2011.
x-ray diffraction peaks	degree	10, 24 (lentil protein); 22 (soy protein)	Joshi, M; Adhikari, B; Aldred, P; Panozzo, J F; Kasapis, S, Food Chem., in press, 2011; Su, J-F; Yuan, X-Y; Hung, Z; Xia, W-L, Polym. Deg. Stab., 95, 1226-37, 2010.