12 Lam XM, *et al.* Antioxidants for prevention of methionine oxidation in recombinant monoclonal antibody HER2. *J Pharm Sci* 1997; 86(11): 1250–1255.
13 Molina MD, Anchordoquy TJ. Formulation strategies to minimize oxidative damage in lyophilized lipid/DNA complexes during storage. *J Pharm Sci* 2008; 97(12): 5089–5105.
14 Ji JA. *et al.* Effect of EDTA and methionine on preventing loss of viscosity of cellulose-based topical gel. *AAPS PharmSciTech* 2009; 10(2): 678–683.
15 Vlugt-Wensink KD. *et al.* Effect of excipients on the encapsulation efficiency and release of human growth hormone from dextran microspheres. *Eur J Pharm Biopharm* 2007; 67(3): 589–596.
16 Brayfield A, ed. *Martindale: The Complete Drug Reference*, 38th edn. London, UK: Pharmaceutical Press, 2014: 1558.
17 Neuvonen PJ, *et al.* Methionine in paracetamol tablets, a tool to reduce paracetamol toxicity. *Int J Clin Pharmacol Ther Toxicol* 1985; 23(9): 497–500.

20 General References

Kamerzell TJ, *et al.* Protein–excipient interactions: mechanisms and biophysical characterization applied to protein formulation development. *Adv Drug Deliv Rev* 2011; 63(13): 1118–1159.
Maggio ET. Use of excipients to control aggregation in peptide and protein formulations. *J Excipients and Food Chem* 2010; 1(2): 40–49.

21 Authors

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22 Date of Revision

4 May 2017.

Methylcellulose

M

1 Nonproprietary Names

BP: Methylcellulose
JP: Methylcellulose
PhEur: Methylcellulose
USP–NF: Methylcellulose

2 Synonyms

Benecel; *BonuCel*; *Cellacol*; *Culminal MC*; E461; *Mapolose*; *Methocel*; methylcellulosum; *Metolose*; *Rutocel A 55 RT*; *Tylose*; *Viscol*.

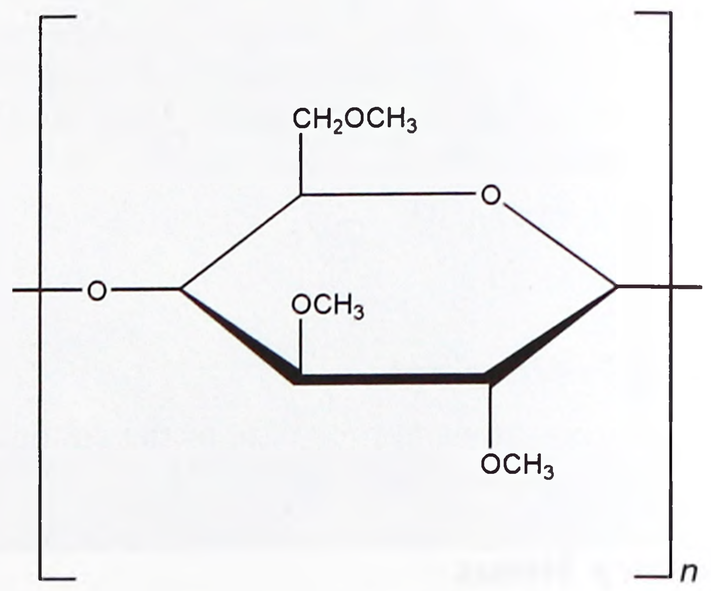
3 Chemical Name and CAS Registry Number

Cellulose methyl ether [9004-67-5]

4 Empirical Formula and Molecular Weight

Methylcellulose is a long-chain substituted cellulose in which approximately 27–32% of the hydroxyl groups are in the form of the methyl ether. The various grades of methylcellulose have degrees of polymerization in the range 50–1000, with molecular weights (number average) in the range 10 000–220 000 Da. The degree of substitution of methylcellulose is defined as the average number of methoxyl (CH_3O) groups attached to each of the anhydroglucose units along the chain. The degree of substitution also affects the physical properties of methylcellulose, such as its solubility.

5 Structural Formula



The structure shown is with complete substitution of the available hydroxyl units of methoxyl substitution. Note that methoxyl substitution can occur at any combination of the hydroxyl groups of the anhydroglucose ring of cellulose at positions 2, 3, and 6.

See Section 4.

6 Functional Category

Coating agent; emulsifying agent; modified-release agent; suspending agent; tablet and capsule binder; tablet and capsule disintegrant; viscosity-increasing agent.

7 Applications in Pharmaceutical Formulation or Technology

Methylcellulose is widely used in oral and topical pharmaceutical formulations; *see* Table I.

In tablet formulations, low- or medium-viscosity grades of methylcellulose are used as binding agents, the methylcellulose being added either as a dry powder or in solution.[1–3] High-viscosity grades of methylcellulose may also be incorporated in tablet formulations as a disintegrant.[4] Methylcellulose may be added to a tablet formulation to produce sustained-release preparations.[5]

Tablet cores may also be spray-coated with either aqueous or organic solutions of highly substituted low-viscosity grades of