Chitosan Molecular Weight Using Mark-Houwink Equation

Introduction

Commercial chitosan products are produced with different molecular weight (MW) typically ranging from 100 to 800 kDa. Chitosans' MW, degree of deacetylation (DDA), high polydispersity index (PDI), and distribution of acetyl groups are important intrinsic factors of chitosan, which can affect its physicochemical properties, rheology, bioactivity, and interaction with co-materials and tissue. Therefore determining and tuning chitosans' MW can be critical in meetings a system's target(s) in its application.

There are several methods to determine the Mw of chitosan. But this is a Quick Guide to determine MW of chitosan using the Mark-Houwink equation, where viscosity is known.
Molecular weight (MW) of chitosan is the mass of one mole of a substance and influences the physiochemical and rheology of the native chitosan and the materials produced with said chitosan. It can affect many properties of the material including but not limited to conformation [1], solubility, viscosity [2] and cytotoxicity [3]). In the case of chitosan-based hydrogels for example, MW impacts on the form and strength of the hydrogel[1] and release rates of drug delivery systems [4].
With all this, it's important that MW is calculated and known to effectively and efficiently construct ones chitosan-based system. Therefore calculating the MW via a formula can be helpful.
A commonly used calculation is the Mark-Houwink equation, also known as Mark-Houwink-Sakurada (MHS) equation, where viscosity may be known.

Chitosan Molecular Weight Calculation

The intrinsic viscosity describes a polymer's ability to form viscous solutions in water and is directly proportional to the average molecular weight of the polymer. The intrinsic viscosity is a characteristic of the polymer under specified solvent and temperature conditions. It is independent of concentration.

The intrinsic viscosity (η) is directly related to the molecular weight of a polymer through the Mark-Houwink-Sakurada (MHS) equation:

$$[\eta] = KM^{a}$$

where: η = *Intrinsic viscosity*
K = a constant in chitosan solvent system,
M = viscosity derived average molecular weight, and
a = an empirical constant identifying the chitosan polymer.
If K , *a* , and η values for a chitosan solution is known, the intrinsic viscosity and molecular weight can be calculated using the above equation.
By measuring the intrinsic viscosity, the viscosity average molecular weight can be determined if *K* and *a* are known: $\log [\eta] = \log K + a(\log M)$, where *M* is the molecular weight. If the intrinsic viscosity is not known, it can be determined by measuring the relative viscosity in an Ubbelohde capillary viscometer. The measurements should be performed in a solvent containing 0.1*M* NaCl (a non-gelling, monovalent salt) at a constant temperature of 20°C, and at a sufficiently low chitosan concentration.

References:

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