

The Vitreous Humor

C2

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C2.1 INTRODUCTION

The vitreous body, also termed the vitreous humor, vitreous, or vitreous, is a clear and transparent mass (gel or liquid or a mixture of both) that fills the posterior cavity of the eye in vertebrates, between the lens and the retina. The human vitreous body is a hydrogel with a very high water content which provides an adequate support for the retina, allows the diffusion of metabolic solutes, and allows the light to reach the retina. There are currently two differing concepts on the nature of vitreous body. A significant amount of evidence supports the view that the vitreous body is basically an extracellular matrix. Another model has been developed in which the vitreous body is considered as a specialized, but simple, connective tissue. The two concepts are not yet reconciled, therefore the structure and role of the vitreous body are usually regarded from both points of view. It is accepted that the vitreous body possesses a unique macromolecular organization, a double-network system consisting of a scaffold of randomly spaced rod-like collagen fibers filled and entangled with a network of very large coiled-up macromolecules of hyaluronic acid (hyaluronan). The latter is present in the form of its sodium salt (sodium hyaluronidate). The double-network model explains satisfactorily most of the properties of the vitreous body, as well as its remarkable stability, although it probably overestimates the importance of hyaluronan. The natural vitreous body displays true viscoelastic properties which enable it to resist sudden compression shocks, offering much the best protection for the retina against contusion trauma. It is believed that the hyaluronan network imparts the latter feature, while the collagen network is responsible for the plasticity and tensile strength of the vitreous body.

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As is the case with many other structural elements of the eye, there are presently much more data on animal vitreous body than on the human counterpart. Likely, the results reviewed here cover almost everything reported so far on the human vitreous. However, in many cases it is not possible to select a most reliable single value; dependable values representing a range are thus provided in several of the following tables.

Being a very loose tissue, albeit well structured in a very specific way, the vitreous body becomes homogeneous during processing for measurements and the resulting data for its physical properties merely illustrate the behavior of a fluid consisting mainly of water and containing minute amount of inorganic and organic components. The dimensional characteristics (Tables C3.1, C3.5 and C3.6), bulk chemical composition (Tables C3.2 and C3.3) and optical properties (Table C4.7) are seemingly not affected by the morphological heterogeneity of the vitreous. However, some investigators took into account the separate existence of gel and liquid fractions in the vitreous (Tables C3.4, and C3.6).

Over the past few decades the vitreous body was perceived as a typical viscoelastic material. However, its characterization by rheometry (as shown in Table C3.8) is still in its infancy.

C2.2 GENERAL PROPERTIES

Table C3.1 Physical properties of the human vitreous body

<i>Property</i>	<i>Value</i>	<i>Source</i>
Volume	3.9 ml	[1]
Weight	3.9 g	[1]
Water content	99.7%	[2]
	99%	[3]
pH	7.5	[4]
	7.4–7.52	[5]
	7–7.3	[6]
Osmolality	288–323 mOsm kg ⁻¹	[7]
Osmotic pressure (freezing point depression)	-0.554 to -0.518°C [4]	
Density	1.0053–1.0089 g cm ⁻³	[8]
Intrinsic viscosity	3–5 × 10 ³ cm ³ g ⁻¹	[9]
Dynamic viscosity	1.6 cP	[10]
Refractive index	1.3345	[11]
	1.3345–1.337	[1]