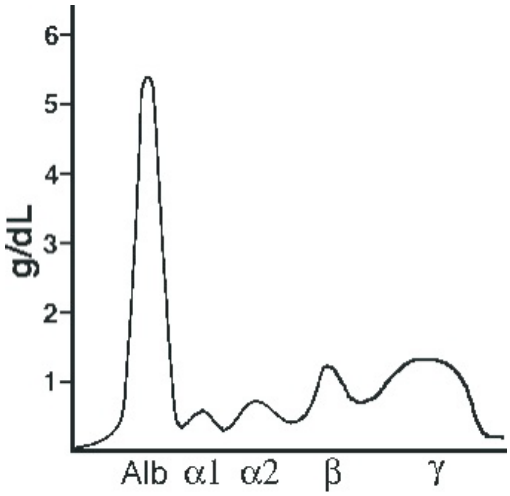
Protein Electrophoresis

Protein electrophoresis is a specialised test used to separate globulins from serum (or urine) when a dysproteinemia (usually hyperglobulinaemia) is present. With routine biochemistry tests serum total protein, albumin and the calculated globulins are estimated. The serum globulins can be elevated when there is dehydration, chronic inflammation (due to infectious or non-infectious conditions) and immunoglobulin-producing B cell lymphoid disorders, such as extramedullary plasma cell tumours, multiple myeloma, and lymphoma. When serum globulins are increased and this is not found to be due to dehydration, electrophoresis can be utilised to investigate its cause.

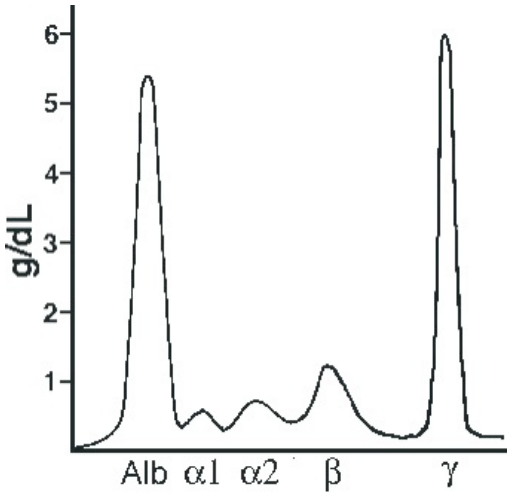
The principal of the test involves separating serum proteins based on their molecular weight and charge using a gel matrix. An electrical current is applied to the matrix and the proteins migrate through at various speeds. The proteins will separate within the matrix according to their size and electric charge. Albumin is a small molecule with higher electric charge than the globulins, therefore under electrophoretic conditions, it will migrate the quickest and farthest It is also the most abundant of the serum proteins. Therefore, on the electrophoretic trace from a normal patient (see below), it will be the first peak on the graph and the peak with the greatest amplitude.



Under electrophoretic conditions, the globulins are separated into the following fractions: alpha1-; alpha2-; beta1-; beta2-; and gamma-globulins. Below is a list of the common proteins present within these fractions in most domestic species.

Alpha1-: α-1 acid glycoprotein, a-1 lipoprotein, α-1 antitrypsin, α-1 antichymotrypsin
Alpha2-: α-2 macroglobulin, haptoglobin, ceruloplasmin, Protein C, (HDL), antithrombin, α-2 lipoprotein (VLDL)
Beta1-: transferrin, hemopexin
Beta2-: fibrinogen, IgM, IgA, CRP, complement 3a (C3a), b-2 lipoprotein (LDL)
Gamma-: IgG (and sometimes IgA and IgM in this fraction)

Increases in the alpha- and beta1-globulins (i.e. globulins produced by the liver) are most often associated with acute inflammatory disease. Increases in some of the beta2- and all gamma-globulins (i.e. globulins produced by lymphocytes and plasma cells) are most often seen with chronic inflammation/ antigenic stimulating and Ig-producing B cell neoplasms. Two patterns may be observed on the electrophoretic trace with increases in beta- and gamma globulins. The first is a “broad-based peak” indicating the presence of a polyclonal gammopathy typically associated with chronic inflammatory disease and liver disease. The second is a “narrow-based peak” indicating the presence of a monoclonal gammopathy and consistent with B or plasma cell neoplasia (see below).



It is important to note however that in. some cases there may be an overlap in the two classifications, for example a monoclonal peak may be mask by a polyclonal peak.

The method can also be applied to urine for screening of Bence-Jones proteins in patients with suspected multiple myeloma.