Mechanical properties of gelatin films

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Hard gelatin capsules are essentially thin gelatin films containing approximately 16% moisture. The properties of such films are altered by moisture which will in turn affect handling and behaviour on storage. Bradbury & Martin (1952) demonstrated the effect of moisture on load extension curves of thin gelatin films. A more detailed study has been undertaken of the effects of moisture on acid and alkaline processed ossein gelatin films.

Films were prepared by spreading 30% aqueous gelatin solutions on to siliconed glass chromatography plates. The films were cooled and maintained at room temperature for 24 h. Dumb-bell shaped pieces were cut from the films using a template; the central portion was 10 mm wide and 50 mm long. The non-equilibrium moisture content was varied by placing the samples in dessicators, containing saturated salt solutions, for three days or by drying over phosphorus pentoxide. The effect of ageing under constant humidity was also investigated. The protein concentration of the films was determined using a microbiuret technique, (Itzhaki & Gill, 1964).

Measurements of Young's modulus and tensile strength were carried out at room temperature using an Instron bench model tensile tester. The thickness of each sample was measured with a micrometer prior to testing. Stress-strain tests were carried out at low stress loadings from which Young's moduli were calculated.

Initial experiments indicated that the results varied with rate of application of strain which was therefore maintained at 5 mm min^{-1} in all subsequent tests.

50:50 gelatine films containing less than 40% moisture exhibited higher moduli than the corresponding alkaline film, but was less than the observed value for an acid gelatin film. Above 40% moisture the moduli decreased in the order 50:50 mixture, alkaline, acid. For all samples, the Young's modulus increased from approximately 2×10^9 Nm^{-2} at 78% moisture content to a maximum of approximately 5×10^9 Nm^{-2} between 15 and 10% moisture content after which it gradually decreased to approximately 3×10^9 Nm^{-2} at 2%. A similar trend was observed in the low stress Young's moduli although these were of lower magnitude ($5–20 \times 10^8$ Nm^{-2}).

The percentage decrease in stress after 200s at constant strain increased rapidly from 2 to 90% for moisture contents between 20 and 10% respectively. The magnitude and rate of relaxation was in the order alkaline, 50:50, acid.

Films equilibrated at constant humidity exhibited a lower magnitude and rate of relaxation. Orientation effects were also observed since stress increased with time after the application of a constant and rapidly applied strain. The Young's modulus was lower than in the non-equilibrated samples.

For equilibrated samples the Young's modulus and tensile strength were constant over a 5 day ageing period. Similarly, the percentage increase in stress, when maximum orientation was observed, remained constant over the same ageing period.

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The determination of disulfiram in blood, and of exhaled carbon disulphide using cathode ray polarography

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Disulfiram (DS), on heating with 50% w/w sulphuric acid is quantitatively converted into carbon disulphide (CS_2), which when reacted with diethylamine and cupric copper can be determined polarographically as copper diethyldithiocarbamate. This compound is also used to determine DS by reacting it directly with cupric copper (Porter & Williams, 1972).