Mechanical properties of gelatin films

J. A. J. ROBINSON, I. W. KELLAWAY AND C. MARRIOTT
Pharmaceutics Research Unit, The University, Nottingham NG7 2RD, U.K.

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

M. W. BROWN*, G. S. PORTER* AND A. E. WILLIAMS†
**School of Pharmacy, Liverpool Polytechnic, Liverpool L3 3AF, U.K. and †Biochemistry Laboratory, Chester City Hospital.*

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).

A Davis differential cathode ray polarograph was used as a single cell instrument in the direct mode with a start potential of −0·35V. Determinations were made at 25° using the mercury pool anode, and all solutions to be analysed were flushed (5 min) with nitrogen previously passed through support electrolyte.

Method: (a) Whole blood (1·0 cm^3) from DS treated patients was heated (boiling water bath) with 50% sulphuric acid (10 cm^3) in suitable apparatus. Liberated CS_2 was swept with a stream of nitrogen into 5·0 cm^3 of diethylamine (2%) in ethanol (95%). After 15 min 0·3% copper nitrate solution (0·1 cm^3) and 0·6 M hydrochloric acid (2·0 cm^3) were added to the diethylamine solution which was then polarographed.

(b) CS_2 in expired air (10–15 litres) was passed via a respirometer through diethylamine solution (5·0 cm^3) and polarographed after treatment with cupric copper and hydrochloric acid as above.

Calibration: (i) DS (1·0 μg–30·0 μg) was included in the diethylamine solution and the determination completed after adding cupric copper and hydrochloric acid.

(ii) citrated whole human blood (1·0 cm^3) loaded with DS (1·0 μg–30·0 μg) was treated as in Method (a).

Equivalence:

$$Et_2NC(=S)-S-S-C(=S)NEt_2 \equiv 2\,Et_2NC(=S)S^-$$

disulfiram ≡ 2 diethyldithiocarbamate

$2CS_2$ carbon disulphide

Results: Calibration (peak height v weight DS) was linear, 1·0 μg DS = 170 graticule units at maximum sensitivity. Recoveries from blood were 85% to 105% (1·0 μg level) and 95% to 105% (30·0 μg level). Typical results for patients given a single 200 mg dose of DS were as follows:

Time (h) after dose	DS concentration (μg cm^{-3})	CS_2 concentration (mg m^{-3})
6·0	1·4	0·6
12·0	4·5	2·3
18·0	3·0	4·2
24·0	2·3	4·7

The method is in current use for decomposition studies, cell/plasma DS ratio determination and evaluation of new intramuscular DS preparations.

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Sensitivity of R^+ strains of *Proteus mirabilis* to sodium desoxycholate

STUART R. HESSLEWOOD

Department of Pharmacy, University of Aston, Birmingham B4 7ET, U.K.

The ability of *Proteus mirabilis* to swarm on solid media is notorious. During a study of R-factor mediated antibiotic resistance in this organism, it was found that introduction of R-factor TEM (conferring resistance to ampicillin and streptomycin) into *P. morabilis* F67 abolished swarming on solidified Davis-Mingioli (DM) medium. On the other hand, R-factor 1818 (conferring resistance to ampicillin, streptomycin, sulphonamide and tetracycline) enhanced the swarming ability of the organism on this medium. Since swarming is associated with the formation of elongated cells as a result of the inhibition of cell division (Jones & Park 1967), the R-factors may be affecting the surface layers of the cell. Accordingly, exponential cultures in DM medium were challenged with the anionic detergent sodium desoxycholate. *P. mirabilis* F67 (1818) was slightly more sensitive than the parent