

A NOTE ON THE APPLICATION OF THE FLASK COMBUSTION TECHNIQUE TO SULPHUR-CONTAINING SUBSTANCES

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It has been shown that the flask combustion method is applicable to the assay of a number of sulphur-containing materials of pharmaceutical and horticultural interest and that results agree with those obtained by established methods.

THE flask combustion method, which has been used for iodine-containing substances (Johnson and Vickers, 1959), has now been applied to pharmaceutical materials containing sulphur. Two methods have been investigated, one, that of Schöniger (1956), who used an alkalimetric titration and the other that of Wagner (1957) who applied the barium perchlorate titration procedure of Fritz and Yamamura (1955). The first of these methods is suitable only for samples which, on combustion, do not yield acidic or basic products other than sulphuric acid.

The alkalimetric determination has been applied to dibenzyl disulphide of micro-analytical reagent grade and to many pharmaceutical and

TABLE I
SULPHUR COMPOUNDS DETERMINED BY DIRECT TITRATION WITH ALKALI
AFTER COMBUSTION

(Results expressed as per cent S unless otherwise stated)

Substance	Results by Fleck and Ward (1934) method	Results by flask method
Dibenzyl disulphide	26.03 (Theory)	25.9 (Mean of 10 determinations range 25.8 to 26.1.)
Sublimed Sulphur B.P.		99.7 (Mean of 6 determinations range 99.4 to 100.0.)
Precipitated Sulphur B.P.		99.5 (Mean of 4 determinations range 99.3 to 99.6.)
Sulphur Ointment B.P.*	10.3	10.3; 10.3; 10.2
Sulphur dust black-horticultural (containing charcoal)	90.7	91.3; 91.2; 91.2
Sulphur dust green-horticultural (containing charcoal and dye-stuffs)	79.5	79.4; 79.6; 79.6
Tablets of sulphur and yeast (3 grains)	2.94 grains/tab.	2.99; 2.97; 2.98 grains/tab.
Tablets of guaiacum and sulphur (3 grains)	2.78 grains/tab.	2.97; 2.96; 2.98; 2.98 grains/ tab.
Compound Tablets of Liquorice (containing Senna, Liquorice and a trace of Saccharin)	2.31 grains/tab.	2.36, 2.38, 2.37; 2.30 grains/tab.
Dimercaprol†	99.9 per cent $C_8H_8OS_2$ 100.3 " " " (by B.P. Method)	100.1 per cent $C_8H_8OS_2$ 100.3 " " " 100.2 " " "

* Ointments should be weighed onto grease-proof paper.

† Liquids should be absorbed on ashless filter paper floc contained in a small methylcellulose capsule.

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horticultural preparations. Of the various methods for titration of sulphate which have been examined, that of Fritz and Yamamura (1955) was considered to be the most satisfactory. This has been successfully applied to dibenzyl disulphide and to many formulations.

METHODS

The recommended methods are as follows.

(i) Alkalimetric titration procedure. Burn a suitable quantity of the sample as described by Johnson and Vickers (1959) absorbing the combustion products in 15 ml. of distilled water containing an excess of hydrogen peroxide (about 1 ml. of solution of hydrogen peroxide B.P.) by

TABLE II
SULPHUR COMPOUNDS DETERMINED BY TITRATION WITH BARIUM PERCHLORATE
AFTER COMBUSTION
(Results expressed as per cent S unless otherwise stated)

Substance	Results by Fleck and Ward (1934) method	Results by flask method
Dibenzyl disulphide	26.03 (Theory)	25.9 (Mean of 10 determinations range 25.6 to 26.0.)
Lozenges of Sulphur B.P.C. 1954	0.310 g./lozenge 0.318 g./lozenge	0.310; 0.310; 0.311; 0.310 g./lozenge
Proprietary tablets also containing guaiacum, mag. carbonate and potassium bicarbonate	1.86 grains/tab.	1.85; 1.85; 1.86 grains/tab.
Sulphur dust, horticultural, containing magnesium stearate	98.4	99.2; 98.7; 99.3
Ointment of Salicylic Acid and Sulphur B.P.C.*	3.11 2.98	3.15; 3.08; 3.08; 3.17
Proprietary ointment also containing charcoal and creosote*	2.40 2.39	2.36; 2.34; 2.47; 2.35
Proprietary ointment containing also resorcinol and hexachlorophene*	Fleck and Ward method inapplicable. Label declaration 8 per cent	7.92; 7.88; 7.82; 7.98
Sulphanilamide, B.P.C.	99.7 per cent $C_6H_8N_2O_2S$ (by B.P.C. method)	100.4; 100.9; 100.5 per cent $C_6H_8N_2O_2S$
Sulphacetamide, B.P.C.	99.7 per cent $C_8H_{10}N_2O_2S$ (by B.P.C. method)	101.6; 101.2; 101.8 per cent $C_8H_{10}N_2O_2S$
Saccharin, B.P.	99.7 per cent $C_7H_5NO_2S$ (by B.P. method)	100.7; 100.7; 101.0 per cent $C_7H_5NO_2S$

shaking for about 5 min. Wash the stopper and platinum gauze with water, boil the solution and washings for about 10 min. to destroy excess peroxide. Cool and titrate with standard sodium hydroxide solution (0.05 N or 0.02 N according to the material being assayed) using screened methyl red as indicator.

(ii) Barium perchlorate titration procedure. Burn a quantity of the sample containing about 8 mg. of sulphur by the method of Johnson and Vickers (1959), absorbing the combustion products in 15 ml. of distilled water containing an excess of hydrogen peroxide (about 1 ml. of solution of hydrogen peroxide B.P.) by shaking for about 5 min. Wash the stopper and platinum gauze with 60 ml. of industrial methylated spirit,

add 2 drops of a 0.2 per cent solution of Thoron in water and 2 drops of a 0.0125 per cent solution of methylene blue in water and titrate with 0.02 M or 0.01 M barium perchlorate solution until the yellow colour changes to pale pink. During the titration, which should be carried out in a good natural light, the solution should be stirred vigorously by means of a magnetic stirrer.

RESULTS

Results from a selection of the substances to which the alkalimetric determination has been applied are given in Table I, and some results using the method of Fritz and Yamamura (1955) are listed in Table II. Although sulphur determinations are not used to assay sulphonamides, the method was applied to those listed in Table II. It will be noted that high results were obtained in every case and it was thought that this might be due to the presence of nitrate as suggested by Fritz and Yamamura. This suggestion was confirmed both by titrating sulphuric acid in the presence of varying quantities of nitrate and by burning mixtures of dibenzyl disulphide and urea. Soep and Demoen (1960) have also noted this effect and are investigating a different titration method for the determination of sulphur in sulphonamides.

CONCLUSIONS

The methods described may be applied to a wide range of pharmaceutical preparations and are in routine use for the determination of sulphur in complex ointments. They are not satisfactory for the determination of sulphur in organic compounds containing a high proportion of nitrogen.

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