

SOME STUDIES ON SULPHUR-CONTAINING COMPOUNDS OF
PHYSIOLOGICAL INTEREST

Thesis

Presented by:

ABLA ABDEL-MONEIM HAMMOUDA
B.Sc. (Home Economics, 1962)

تم الموضوع في كتابه الدكتور محمد عبدالرسول

For

The Master Degree of Science

To

Women's College
Ain-Shams University

1974



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A.M.

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PUBLISHED WORK

- 1- A Photoelectric Colorimetric Method for the Determination of Some Sulpha Drugs in Urine and Pharmaceutics; Al-Azhar Medical Journal; In Press.

- 2- Antibacterial Agents: A New Titrimetric Method for the Microdetermination of Sodium-1,2-Naphthoquinone-4-Sulphonate; Al-Azhar Medical J., accepted for Publication.

BIBLIOGRAPHY

PART I

INORGANIC SULPHUR COMPOUNDS

- 1- A New titrimetric method is described for the iodometric determination of sodium thiosulphate with standard N-bromosuccinimide solution. The mechanism of the reaction is discussed. The proposed method is simple, rapid and highly sensitive to determine amounts as low as 25 ug of sodium thiosulphate. The experimental error does not exceed $\pm 2\%$. Application of the proposed method to determine sodium thiosulphate in pharmaceutical preparations and in biological fluids such as urine and gastric juice is reported.

- 2- A New titrimetric method is described for the micro-determination of sodium sulphite or metabisulphite by the use of standard N-bromosuccinimide solution. The mechanism of the reaction is discussed. The experimental error of the proposed method does not exceed $\pm 2\%$. The proposed method is simple, rapid and highly sensitive to determine amounts as low as 50 ug of sodium sulphite or metabisulphite.

The proposed method surpasses the previous iodine method in accuracy. Application of the proposed method for the microdetermination of sulphite or metabisulphite in certain foodstuffs and therapeutic solutions is shown.

PART II

ORGANIC SULPHUR COMPOUNDS

- 3- A titrimetric method for the determination of cysteine by the use of standard N-bromosuccinimide and methyl red as an indicator is discussed. The proposed method is sensitive to determine amounts as low as 50 μg of cysteine. The experimental error does not exceed $\pm 2\%$. Comparative analysis of cysteine by the proposed method and the previously accepted iodine method is reported.
- 4- Application of the colour reaction given by either sulphadiazine, sulphaguanidine or sulphacetamide sodium, with sodium-1,2-naphthoquinone-4-sulphonate is shown to be suitable for the quantitative determination of any of these sulpha drugs. Recovery

experimental error or error of $\pm 1\%$ in urine, $\pm 10\%$ in tablets and $\pm 2.5\%$ in eye drops. The method is sensitive to determine amounts as low as 100 ug of each sulpha drug either in urine, tablets or eye drops, respectively.

- 5- A new method for the microdetermination of sodium-1,2-naphthoquinone-4-sulphonate is described involving the use of either standard L-ascorbic acid solution or standard stannous chloride solution. The mechanism of the reaction is discussed. The proposed method is simple, rapid and sensitive to determine amounts as low as 100 ug of sodium-1,2-naphthoquinone-4-sulphonate. The experimental error does not exceed $\pm 2\%$. Comparative analysis of sodium-1,2-naphthoquinone-4-sulphonate by the proposed method and the previous thio-sulphate method is reported.

PART III
CYSTEINIMETRY

- 6- A new titrimetric method for the iodometric determination of potassium iodate involving the use of standard cysteine hydrochloride solution is described. The mechanism of the reaction is discussed. The proposed method is simple, rapid and sufficiently accurate to determine amounts as low as 10 ug of potassium iodate. The experimental error does not exceed $\pm 2\%$. Comparative analysis of potassium iodate by the proposed method and the reversed potassium iodate method previously known for the standardisation of sodium thiosulphate is shown. The method is suitable to determine potassium iodate in therapeutic solid mixtures and solutions.

INTRODUCTION

Sulphur is a non-metal, which enters in the formation of a notable number of compounds, some of which may be inorganic and others may be organic compounds, which are of biological importance or medical interest or technical value. Examples of these compounds which are studied in this work are listed below.

A- INORGANIC SULPHUR COMPOUNDS

1- SODIUM THIOSULPHATE

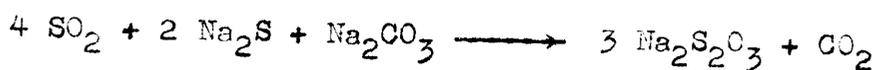
Sodium thiosulphate is available in the form of colourless, odourless crystals or white granules and effloresces in warm dry air. It is extremely soluble in cold water (one gram dissolves in 0.5 ml of distilled water, but insoluble in alcohol. It slowly decomposes in an aqueous solution at ordinary temperature, but more rapidly when heated. The aqueous solution is practically neutral. It dissolves the halide and many other salts of silver (The Merck Index, 1960, The Dispensatory of U.S.A., 1960).

Sodium thiosulphate can be prepared in the laboratory by heating a solution of sodium sulphite with free sulphur.



This reaction is formally analogous with the oxidation of sodium sulphite by atmospheric oxygen; hence the name thiosulphate (Perkes, 1961).

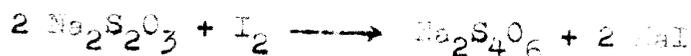
At the present time, the largest production of sodium thiosulphate is by passing sulphur dioxide through "by-product sulphite liquor", which contains sodium sulphide and sodium carbonate and is obtained by extracting a heated mixture of crude sodium sulphate and coal with water; the reaction is as follows:



Another commercial process consists in passing sulphur dioxide through a solution of soda ash, thereby producing sodium bisulphite; this is converted to the neutral sulphite by adding more soda ash and then heated with powdered sulphur to produce sodium thiosulphate; which is crystallised from the concentrated solution (The Dispensatory of U.S.A., 1960).

Thiosulphates, e.g. sodium thiosulphate, are characterised by certain reactions (Alexerev, 1967) :

1. A solution of sodium thiosulphate discharges the colour of iodine solution.



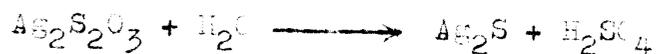
The reaction of iodine with thiosulphate is very important in quantitative analysis.

2. Acids liberate free $\text{H}_2\text{S}_2\text{O}_3$ from solutions of thio-sulphates; the free acid decomposes into H_2O , SO_2 and sulphur:



The sulphur formed in the reaction makes the solution turbid. The turbidity appears more rapidly at higher concentrations and temperatures.

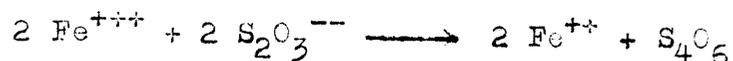
3. Silver nitrate, added in excess, gives a white precipitate of $\text{Ag}_2\text{S}_2\text{O}_3$, which rapidly turns yellow, then brown, and finally black owing to conversion into silver sulphide:



This is one of the most characteristic reactions of the thiosulphate ion. It must be taken into consideration that the $\text{Ag}_2\text{S}_2\text{O}_3$ precipitate dissolves in excess thio-sulphate to form complex ions. Therefore the precipitate can form only if Ag^+ ions are present in excess.

4. When barium chloride solution is added to thio-sulphate solution a white precipitate of BaS_2O_3 is formed. As barium thiosulphate readily forms supersaturated solutions, the walls of the test tube should be rubbed with a glass rod.

5. When ferric chloride solution is added to thio-sulphate solution, a deep violet colour appears, which quickly disappears. It is probably due to the formation of ferric thiosulphate (or a corresponding complex). The colour fades due to the reduction of ferric iron to ferrous:



Sodium thiosulphate is important industrially and therapeutically. It is also of great importance in analytical chemistry.

Because of its solvent action on silver halides, sodium thiosulphate is used in photography to dissolve unchanged silver iodide or bromide from the film or plate after action of light, thus fixing the image already formed. It is also largely used as an "antichlor" in

paper manufacture, to free the paper pulp from the excess of chlorine used in the bleaching process.

Sodium thiosulphate is also used for extraction of silver from ores; as mordant in dyeing and printing textiles; reducer in chrome dyeing; manufacture of leather; bleaching bone, straw, ivory and also as a reagent in analytical chemistry (The Merck Index, 1960).

Medically, sodium thiosulphate is used in 10 per cent concentration as a prophylactic agent against ringworm infection in swimming pools and common shower-bath rooms. Since thiosulphate is itself not parasiticidal, it would seem that its beneficial effect results from some chemical reaction of the ion in contact with skin (The Dispensatory of U.S.A., 1960).

In 1920, intravenous injection of sodium thiosulphate was recommended for the treatment of arsenical dermatitis due to use of arsphenamine. In 1928, it was suggested not only as an antidote for arsenical poisoning, but also in poisoning by various metals, especially mercury and lead (The Dispensatory of U.S.A., 1960).