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Comparative study of the Dyson Perrins, Kippenberger and Wagner colour tests

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Abstract

There are three colour tests that employ iodine-potassium iodide solution. However, the obtained results differ. Dyson Perrins employed a hot alcoholic solution of berberine as substrate and obtained green crystals. Kippenberger used a strong alkaline solution of morphine, adding small quantities of iodine-potassium iodide solution. A green colour was observed, whereas Wagner obtained reddish-brown precipitates with alkaloids. After a comparative study, it can be concluded that the different results observed are due to different quantities of potassium iodide in relation to the iodine employed, notwithstanding the general composition is the same. Other factors intervening are the reaction temperature and the solvent, water or alcohol.

Keywords: Dyson Perrins test; Kippenberger test; Lugol's iodine; Triiodide; Wagner test

1 Introduction

There are three related colour tests: the Dyson Perrins test for berberine, the Kippenberger test for morphine, and the Wagner test for alkaloids, since the three tests employ iodine in potassium iodide solution. However, in the first test green crystals are obtained, in the second one a green colour is observed, and in the third a brown precipitate is thrown.

In this communication the chemistry and reaction mechanism of these reactions are commented. It is a follow up of our studies on reaction mechanism, [1-5]

2 Antecedents

James Dyson Perrins (1823-1887) worked at the city of Worcester, England. He published some researches on the organic base berberine, [6]. The work that will be commented was published in the Journal of the Chemical Society (London), [7], and was downloaded from Research Solutions, [8].

Professor Karl Kippenberger (1868-1937) studied chemistry at the Hesse state, with several universities, and pharmacy in Erlangen, Middle Franconia, Bavaria, [9]. Kippenberger's reaction with morphine: a strong alkaline solution of morphine with small portions of iodine-potassium iodide solution gives green colour, [10]. Papers on the estimation of alkaloids, [11, 12].

Professor Rudolph Wagner worked in Würzburg, north Bavaria (Franconia region). Wagner's test is a standard qualitative test used to detect the presence of alkaloids in plant extracts or solutions. Wagner's reagent for alkaloids is a solution with 12.7g of iodine and 20g of potassium iodide in 1 L of water. This reagent gives with alkaloids a brown precipitate, [13]. A recent variant is: 1g of iodine and 3g of potassium iodide are dissolved in 50 mL of distilled water. A

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few crystals of alkaloid are dissolved in few mL of ethanol in the test tube, and 2 drops of diluted HCl and 2 drops of Wagner's reagent are added. Brown precipitate will occur. [14].

The solution iodine-iodide was first prepared by the French physician Jean Guillaume Auguste Lugol in 1829. Lugol's iodine is made up of two parts of potassium iodide to one part elemental iodine in water. The standard concentration contains 100 mg/ml potassium iodide and 50 mg/ml iodine, [15, 16].

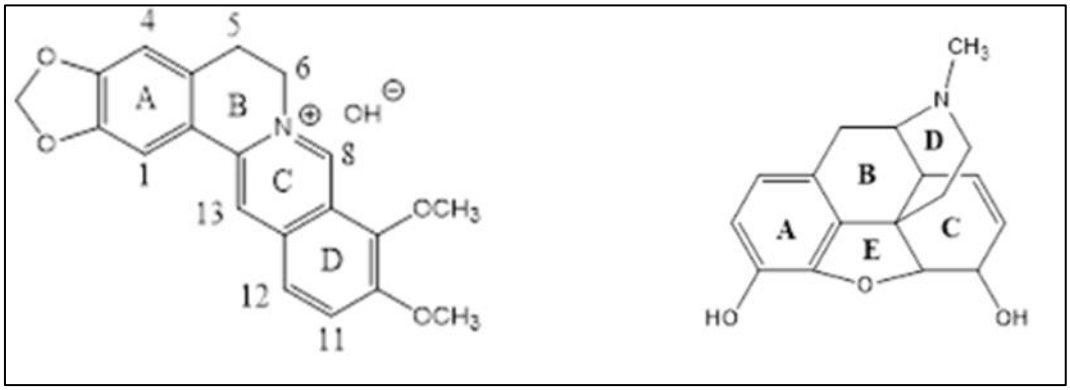

Figure 1 Structures of berberine and morphine

3 Discussion

The iodine-iodide solution is an iodophor and the resulting molecule is potassium tri-iodide, or better, teriodide. The I_3^- ion is linear, with a single bond between each iodine atom, and there are 3 lone pairs around each of the iodines, with the central atom having a formal negative charge, (Lewis electron dot structure), [17].

The formation of the teriodide anion takes place via attack of iodide ion to the iodine molecule, and the mentioned electronic structure result. This is an equilibrium reaction, and elimination of an iodide ion from the I_3^- ion can afford free iodine.

Let us see the Dyson Perrins paper. When he adds iodine to a solution of any berberine salt, either in water or dissolved by heating in alcohol, red-brown prisms are obtained. This compound is not a substitution product since silver nitrate removes the iodine. From this chemical deportment we can conclude that the red-brown compound is berberine iodide. The formation of iodide ion from elemental iodine can be explained since berberine is the hydroxide of a positive tetrasubstituted nitrogen atom. Thus, the hydroxy ion attacks the iodine molecule, liberating an iodide ion.

The interesting compound is that obtained when dilute solution of iodine in potassium iodide is added to solution of any salt of berberine in hot alcohol, brilliant green crystals are obtained, which increase in quantity as the solution cools. The compound can be obtained from iodine tincture containing hydriodic acid. From both results can be deduced that this compound is the teriodide of berberine.

The Kippenberger experiment with a strong alkaline morphine solution gave green colour using small quantities of iodine-potassium iodide solution. This result is in accordance with Dyson Perrins results.

However, the Wagner's test for alkaloids doesn't give similar results, but only reddish-brown, or brown, precipitate. This can be due to lack of potassium iodide, remaining free iodine that gives the alkaloid iodide. See the compositions of the reagent in the previous section.

4 Conclusion

A comparative study of the colour tests that employ iodine-potassium iodide solution has been made. That is, the Dyson Perrins test for berberine; the Kippenberger test for morphine; and the Wagner test for alkaloids. It can be concluded that the different results observed employing these tests are due to different quantities of potassium iodide in relation with the iodine employed, although the general composition is the same. Other factors intervening are the reaction temperature and the solvent, water or alcohol.

Compliance with ethical standards

Disclosure of conflict of interest

There is no conflict of interest to declare.

References

[1] Sánchez-Viesca F. and Gómez R. (2022) The mechanism of the morphine-apomorphine rearrangement. Am. J. Chem. 12(4), 73-75.

[2] Sánchez-Viesca F. and Luz Clarita. (2026). Theoretical study on apomorphine formation. Magna Scientia Adv. Res. and Rev. 16(02), 242-245.

[3] Sánchez-Viesca F. Gómez R. and Luz Clarita. (2026) An insight into the mechanism of the murexide reaction. World J. Chem. and Pharm. Sci. 08(01), 001-004.

[4] Sánchez-Viesca F. Gómez R. and Luz Clarita. (2026). Mechanism of the interaction of uric acid with bromine in acetic acid. Magna Scientia Adv. Res. and Rev. 16(01), 093-096.

[5] Sánchez-Viesca F. Gómez R. and Luz Clarita. (2026). On the mechanism of the test for thiophene via alloxan from uric acid. Int. J of Scholarly Res. in Chem. and. Pharm. 06(01), 001-004.

[6] Monthly Notices of the Royal Astronomical Society, (1889) "J. Dyson Perrins". 49(4), 163-164.

[7] Dyson Perrins J. (1862). On berberine. J. Chem. Soc. (London), 15, 339-356.

[8] Dyson Perrins J. (1862). On berberine. Research Solutions, https://zenodo.org/records/1572934

[9] 'Karl Kippenberger'. Retrieved form. https://de.zxc.wiki/karl_Kippenberger

[10] Merck E. (1903). Merck's List of tests. Springer, Darmstadt, 77.

[11] Kippenberger K. (1899). On the estimation of alkaloids by iodine solution. Zeit. anal. Chem. 38(4), 230-236.

[12] Kippenberger K. (1900). Contribution to the analytical chemistry of alkaloids. Zeit. anal. Chem. 39(4), 201-229.

[13] Merck E. (1903). Merck´s List of tests. Springer, Darmstadt, 152.

[14] Wagner´s test. Pharmacognosy. https://wwww.uomus.edu.iq/img/lectures21/MUCLecture_2024_3515205.pdf

[15] Lugol´s iodine. https://en.wikipedia.org/wiki/Lugol%27s_iodine

[16] Look out for Lugol´s. https://ncbi.nlm.nih.gov/articles/PMC4495864/#.~text=Lugol´s

[17] The Lewis structure for triiodide anion. https://lavalle.chem.ucla.edu/forum/viewtopic.php?t=38336