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(Research Article)

On the Horsley's test for morphine

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Abstract

In the Horsley test for morphine, to a hot solution of morphine acetate silver nitrate solution is added. Metallic silver is separated and the filtrate is coloured blood-red by nitric acid. In this communication the reactivity of both reagent and substrate was checked and commented. The first reaction is nucleophilic attack of nitrate anion to the carbonyl group of the ester, forming acetyl nitrate and a phenoxide ion. The electrodotic property of the last ion originates a secondary carbanion at C-2. This unstable intermediate cedes an electron to an Ag+ forming metallic silver and a free radical in the morphine molecule which is stabilised by coupling with another similar species, forming 2,2'-bimorphine.

Keywords: Carbanion; Electrodotic effect; Electron coupling; Morphine acetate; Silver nitrate

1 Introduction

Morphine is a well-known prescription drug for pain killing. However, it is also available as street drug for recreational use. This can direct to overdose and many deceases. This situation evolved enough creating a serious problem, and an overdose-reversal medication was needed. It was found that naloxone help prevent opioid-related overdose deaths. The molecular structure is similar to that of morphine, the methyl group on the nitrogen is replaced with an allyl group (CH_2-CH=CH_2). Figure 1. When a person overdoses and stop breathing, naloxone can reverse the effect by eliminating opiates from the user's brain receptors and then fixing to the receptors to block the opiates, [1, 2].

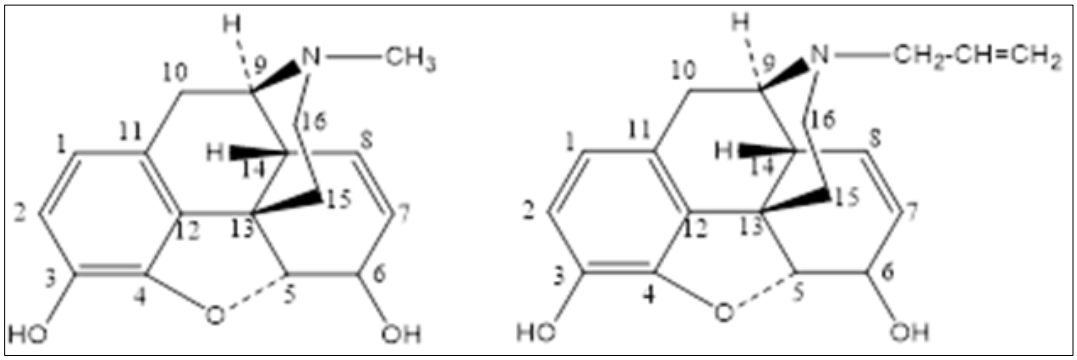

Figure 1 Morphine and naloxone structures

In this communication the reaction route of the test for morphine due to Professor Horsley is provided. This study is a follow up of other similar ones [3, 7).

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2 Antecedents

The test under study is due to Professor John Horsley of Cheltenham, England. He published his test in a German analytical journal [8], and it was recorded in a book on chemical tests, [9]. The assay is as follows: if a few drops of silver nitrate solution are added to a hot solution of morphine acetate, metallic silver is separated and the filtrate is coloured blood-red by nitric acid.

Colour reactions are rapid an do not require expensive apparatus. They are not specific since other substances can do positive result also, but they are very useful when you have a target molecule in mind. Besides, you can do other test in order to confirm the positive result.

3 Discussion

The phenolic group in morphine gives blue colour with ferric chloride. Morphine is easily oxidized and this property is responsible of the many colour reactions used for its identification, [10]. Thus, the first step in Horsley's test for morphine must be the hydrolysis of the substrate, morphine acetate. This can be done by the nitrate anion of the reagent, silver nitrate. Attack of this anion to the carbonyl group of the ester forms acetyl nitrate and a phenoxide at C-3 in the morphine molecule. The several resonance structures for nitrate anion are shown in reference [11], using a coordination or dative bond. This of course can be changed to a dipole structure, which has been chosen. The trans-acetylation is favoured by the heating.

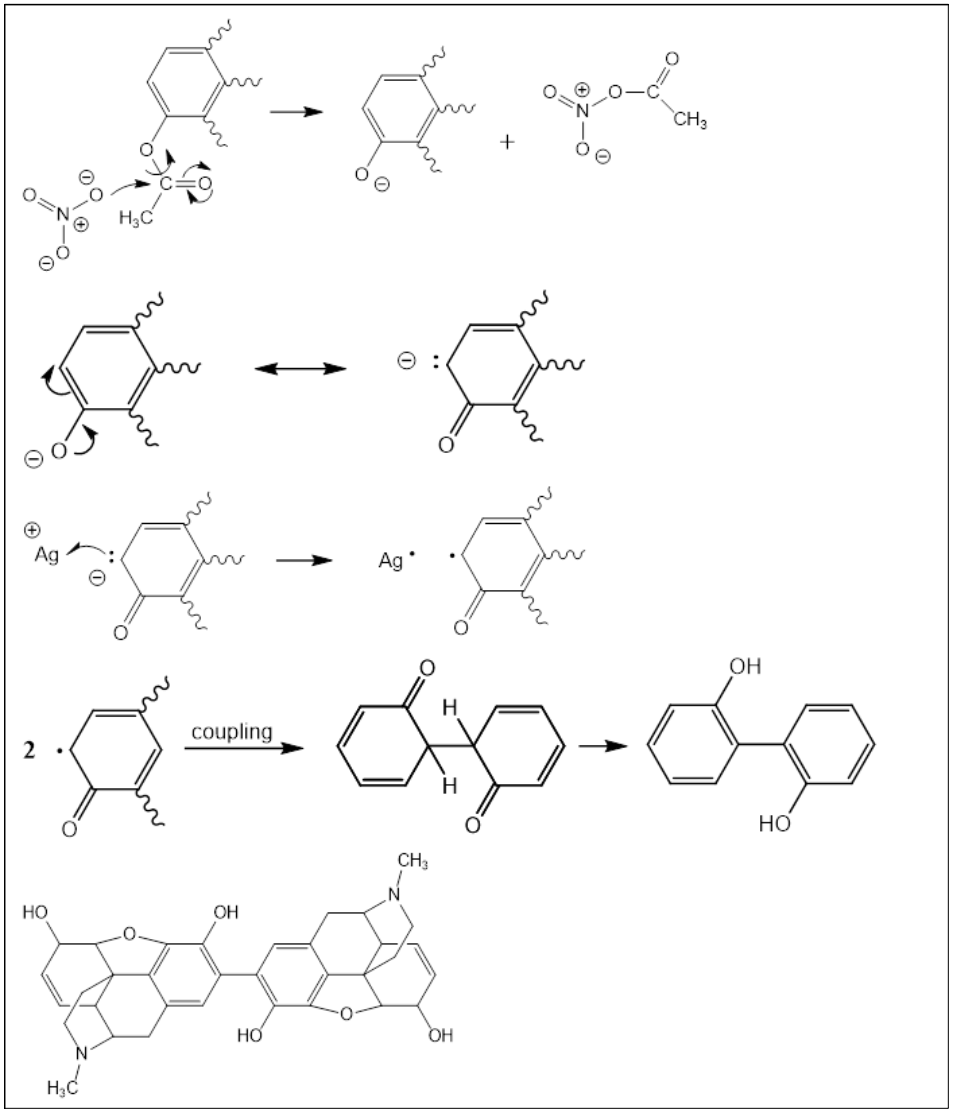

Figure 2 Reaction route from morphine acetate to 2,2'-bimorphine

The phenoxide anion is in resonance with a carbanion at C-2 whose instability makes it very reactive, donating an electron to the Ag**+** cation, forming metallic silver and a free radical at C-2 which stabilises by coupling with a similar species.

This way 2,2'-bimorphine is formed by a redox reaction derived from the electrodotic effect [12, 13] of the phenolate. The silver cation is reduced and the organic molecule is oxidized to a neutral radical.

2,2'-bimorphine can be formed by oxidation of morphine with potassium permanganate, Beckurt's test [14, 15]. There is an interesting article on this compound, which has been named also as oxydimorphine, pseudomorphine, and dehydromorphine, [16]. The reaction route of this alternate oxidation has been provided, [17].

The red colour observed in Horsley test for morphine after addition of nitric acid is due to halochromism [18. 19].

4 Conclusion

The reaction route of Horsley's test for morphine has been established. It is a redox process that is initiated by a trans-acetylation, followed by resonance of a phenoxide to carbanion. This anion reacts with Ag**+** giving elemental silver and a free radical at C-2 in the morphine molecule. Coupling between two radicals afford 2,2'bimorphine.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

There is no conflict of interest to declare.

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