



(RESEARCH ARTICLE)



The mechanism of the oxidation of narceine by means of selenous acid -sulphuric acid

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Abstract

The chemistry of selenous acid was misunderstood for many years, being explained by electron back donation. In this communication we disclose the reaction mechanism of the interaction of narceine with selenous acid in sulphuric acid. Narceine is a complex molecule that displays a carboxylic acid, a tertiary amine, a ketone, three methoxy groups and a benzodioxole; so, it was necessary select the principal reaction site. Although a methoxy group can be demethylated with the employed reagent since codeine gives the same violet colour obtained with morphine. The chemical department of the methylenedioxy ring in the presence of methoxy groups needed revision. It was found that the five-member ring is cleaved preferentially. Thus, a sustained reaction mechanism could be advanced. The reactive species is protonated selenous acid, which reacts with an oxygen of the cyclic group, water being eliminated. The oxonium ion is neutralized by ring opening in a concerted mechanism involving water reaction at the methylene. An organometallic intermediate is obtained, a selenite, and a hemiacetal. Finally, protonation of the selenium-oxygen double bond produces an acidolysis via a synchronous mechanism involving five electron shifts. This way selenium (II) hydroxide, an ortho-quinone and formaldehyde are obtained.

Keywords: Acidolysis; Concerted mechanism; Hemiacetal; Methylenedioxy group; Organic selenite; o-Quinone

1. Introduction

Morphine and codeine are best known opium alkaloids, but papaverine, laudanoside, narcotine, and narceine are four other alkaloids found in opium. Narceine is a stilbene, that is, contains a 1,2-diphenylethylene moiety. It is a bitter crystalline narcotic amphoteric alkaloid acting as a mild relaxant on smooth muscle. Narceine forms good crystals, the form being that of long rhombic prisms or fine bushy united needles, [1-4].

In this communication we disclose the interaction of narceine with selenous acid in sulphuric acid and give the series of reactions to the final product, as well as, the electron flow. Narceine structure is in Formula 1.

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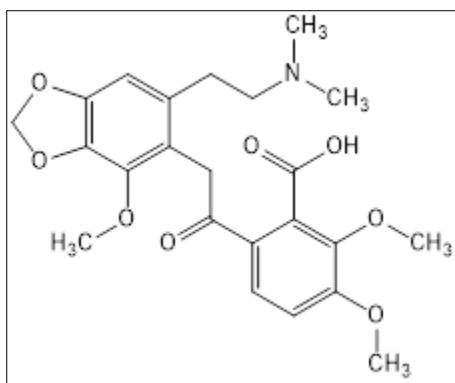


Figure 1 Structure of narceine

This paper is a follow up of our studies on reaction mechanism, [5-9].

2. Study Method and Process

This is a Theoretical Organic Chemistry Study. It is based on the chemical department of reagent and substrate. All is in accordance with the reaction medium, the nature of the oxidizer employed and catalyst present. The several steps that lead to the final product are entirely commented and the reaction mechanism is given too.

3. Antecedents

Narceine has a weak morphine-like action. It may be administered in a pill as a mild hypnotic and to allay cough. Ethyl narceine is a narcotic, analgesic, and antitussive. The use of selenous acid/sulphuric acid as reagent in Mecke colour test for narceine: greenish-yellow then violet, has been registered in two books on analytical chemistry, [10, 11].

The chemistry of selenous acid has not always been understood since it was explained by electron back donation. This error has been omitted in a congruent mechanism [12], in accordance with electrodotic properties, [13]. For information on the Riley oxidation see references [14, 15]. The preferred reaction site in narceine will be treated in the next section.

4. Discussion

Narceine has a complex structure, it displays a carboxylic acid, a tertiary amine, a ketone, three methoxy groups, and a methylenedioxy group, that is, a benzodioxole. Levine observed the colour reactions of phenols and phenolic ethers with selenous acid/sulphuric acid reagent, [16]. Since morphine and codeine give violet colour in this test, it indicates demethylation in the codeine molecule. So, narceine presents three possible sites for de-etherification. But what about the methylenedioxy group? The chemical department of this group was revised. Two examples were found in which this group reacts first in the presence of methoxyls: with boron trichloride [17] and with lead tetraacetate, [18]. Acetoxylation takes place via free radicals [19], and can occur also at benzylic position like in acenaphthene, [20].

Thus, the five-member cycle was the elected site for reaction with selenous acid in sulphuric acid medium. Protonation of selenous acid favours union with one oxygen atom in the dioxole. Figure 2, a. Reaction with water at the methylene breaks the ring and a selenite results, b, c. Protonation of the double bond $\text{Se}=\text{O}$ gives rise to a synchronous concerted mechanism involving five electron shifts, d. This way stationary, unstable ions are eliminated in favour of incipient, transient ions, rejecting formal intermediates. The final products are selenium (II) hydroxide, an ortho-quinone, and formaldehyde, e, f.

The observed colours in these assays are due to halochromism, [21, 22].

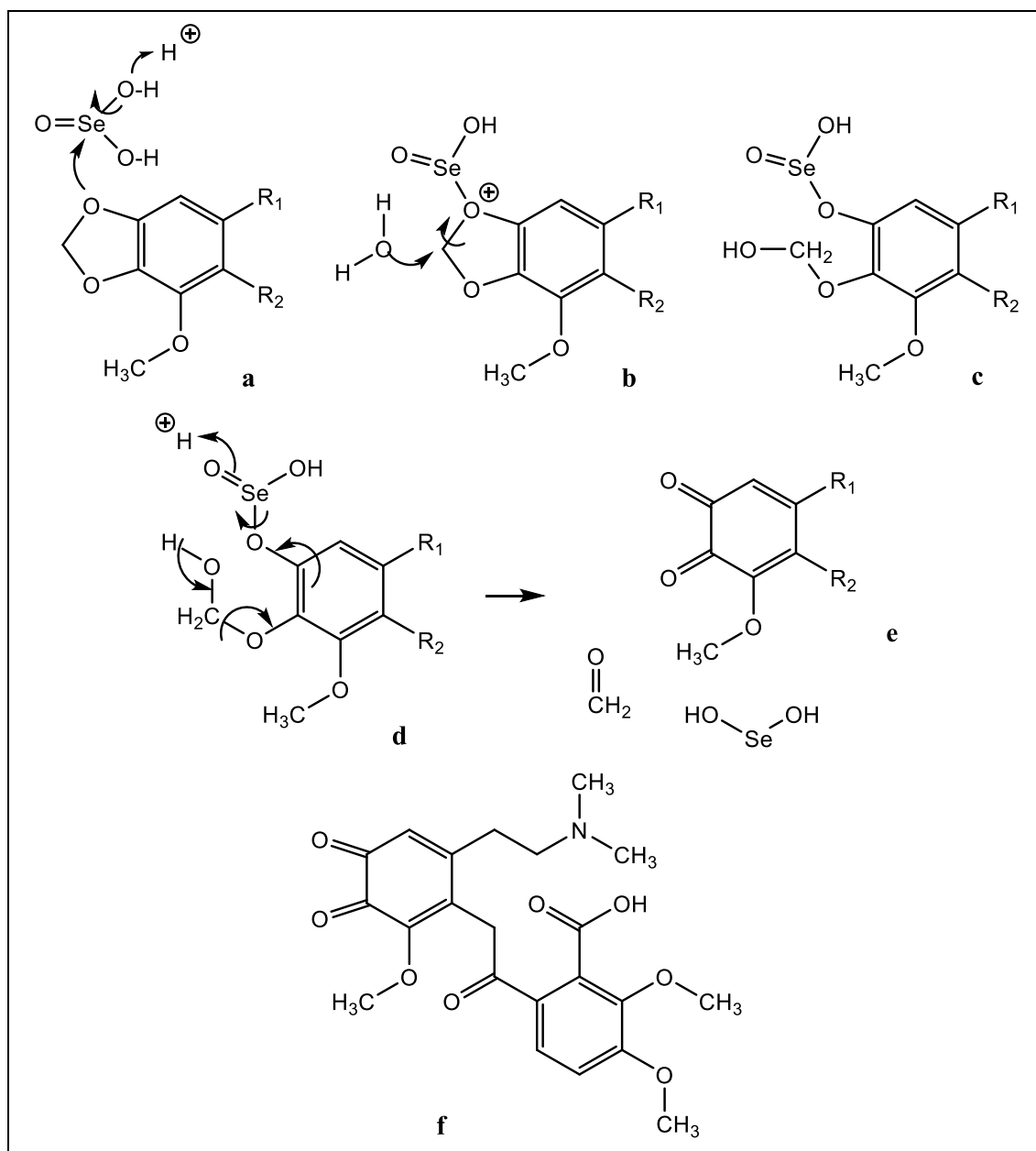


Figure 2 Oxidation of narceine by means of $\text{Se}=\text{O}(\text{OH})_2/\text{H}_2\text{SO}_4$

5. Conclusion

The chemistry of selenous acid has been updated and the chemical department of benzodioxole has been revised in order to sustain an adequate mechanism for the interaction of narceine with selenous acid in acidic medium. Protonation of the reagent favour reaction with the five-member ring. Reaction with water at the methylene group gives rise to an organometallic intermediate, a selenite, and a hemiacetal. Finally, protonation of the $\text{Se}=\text{O}$ double bond promotes an acidolysis reaction via a concerted mechanism involving five electron-shifts. This way the following compounds are formed, selenium (II) hydroxide, an ortho-quinone, and formaldehyde.

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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