

Detection of Dopamine in the Presence of Interferents Using Redox Cycling

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The neurotransmitter dopamine (DA) is involved in neurological disorders such as Parkinson's disease. To be able to detect its concentration in the extracellular fluid of the brain is of great importance. Traditional techniques such as microdialysis and fast scan cyclic voltammetry have been used for in vivo analysis of neurotransmitters in brain for a long time but still have limitations in spatial and temporal resolution. The electrochemical method of redox cycling is being explored for use in this field because of its ability of recycling electrochemically reversible species. This method provides signal amplification and the ability of discriminating between electrochemically reversible and irreversible species. Its advantage in low background current also leads to possible application of detecting not only transients of DA that are evoked by behavior or controlled stimuli, but also basal levels DA in the brain.

The redox cycling behavior of DA in the presence of up to 100-fold excess concentration of ascorbic acid (AA) has been studied before^{1,2}, however, there are also other interfering species in the brain that oxidize near the same potential as DA. Electrochemical detection of DA in the presence of interferents including AA, uric acid (UA), L-3, 4-dihydroxyphenylalanine (L-dopa), homovanillic acid (HVA), 3-methoxytyramine (3-MT) and 5-hydroxyindoleacetic acid (5-HIAA), under redox cycling conditions is carried out on microfabricated gold microelectrode arrays (MEAs). The detection limit and sensitivity will be reported.

MEAs consisting of 18 microband electrodes with 4 μm widths and separated by 4 μm gaps were used for the redox cycling studies. An alternating interdigitated configuration was used in which one set of electrodes served as the generator and another set as the collector. In the redox cycling of DA, DA is oxidized to its o-quinone form (DAQ) at the generator electrode. DAQ then diffuses to the neighboring collector electrodes (poised at -0.01 V vs Ag/AgCl saturated KCl) and reduces. However, all the other interferents investigated are electrochemically irreversible species, so that they can only be oxidized at the generator but cannot be reduced back to their original form. Thus, DA can be selectively detected at the collector electrode.

In addition, to minimize electrode fouling and further enhance selectivity of DA detection over other reversible interferents, modifying the electrodes with polymers, such as conducting polymers will also be discussed.

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REFERENCES

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