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# Electrochemical study of hepta–oligonucleotides

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## Abstract

The study deals with the description and characterization of two hepta–oligonucleotides (DNA and RNA) forming special structures. We studied their electrochemical behaviour by means of cyclic voltammetry (CV) and elimination voltammetry with linear scan (EVLS) in combination with adsorptive stripping (AdS) technique. Differences in electrochemical behaviour of hepta–deoxyribonucleotide and its RNA analog were discussed with regard to their different structures in solutions and their melting points.

**Keywords:** DNA, RNA, Cyclic voltammetric, electrochemical behaviour

## Introduction

Hairpin formation provides a potential structural basis for the constancy of the three–nucleotide regions of several grave diseases. d(GCGAAGC) regions has been found in viral nucleci acid sequences, and in several important prokaryotic and eukaryotic genes (Arai et al. 1981; Cowing et al. 1985; Elias and Lehman 1988; Hirao et al. 1994). This study utilizes electrochemical methods for the study of DNA and RNA heptamers – d(GCGAAGC) and r(GCGAAGC) in aqueous buffered solutions. At mercury electrodes, the hairpin d(GCGAAGC) provides voltammetric reduction overlapped signals of adenine and cytosine and oxidation signals of guanine (Trnkova et al. 2004). The aim of the study was to investigate both types of signals using cyclic voltammetry (CV) and elimination voltammetry with linear scan (EVLS) influenced by various experimental parameters.

## Materials and Methods

Synthetic heptanucleotides d(GCGAAGC) and r(GCGAAGC) were synthesized by IDT (Integrated DNA Technology, USA). Buffer components were purchased from Sigma–Aldrich Chemical (purity of ACS). Cyclic voltammetric measurements were carried out with AUTOLAB PGS20 Analyzer (Ecochemie, Netherlands) connected to the VA–stand 663 (Metrohm, Switzerland). The standard cell consisted of three electrodes. Hanging Mercury Drop Electrodes (HMDE) with an area of 0.4 $mm^2$ were employed as working electrodes. An Ag/AgCl/3M KCl electrode served as the reference electrode. Platinum wire electrode was used as the auxiliary electrode.

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## Results and Discussion

Both heptamers d(GCGAAGC) a r(GCGAAGC) provide reduction signals of A and C and oxidation signal of G of its reduction product forming at very negative potentials, close to the hydrogen evolution at mercury electrode. These signals were studied by CV and EVLS and the effect of pH, concentration of ODNs, temperature, scan rate, time and potential of accumulation were determined.

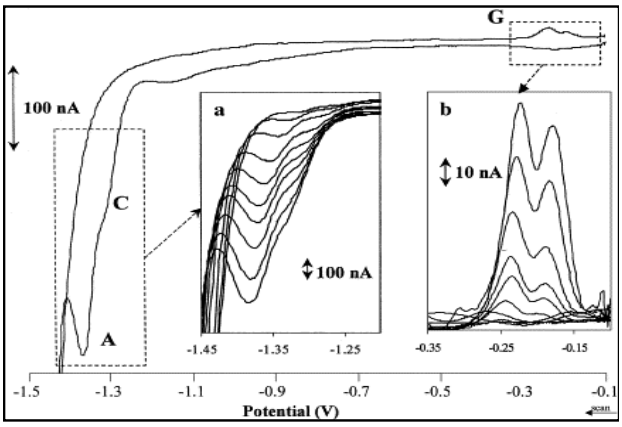


Figure 1: Cyclic voltammograms of d(GCGAAGC) (100nM) at different scan rates (pH 5.35)

Within all pH values, d(GCGAAGC) provides two guanine signals, whereas r(GCGAAGC) only one. Poorly distinguished signals of A and C were resolved by EVLS (Fig 1 & 2).

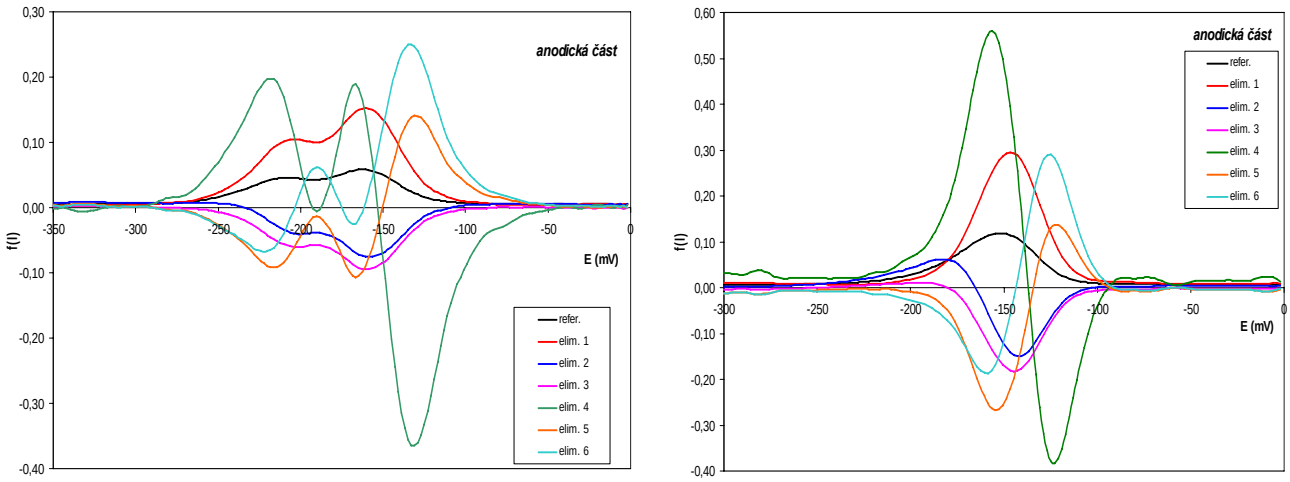


Figure 2: Elimination voltammograms of d(GCGAAGC) and r(GCGAAGC), 1μM; pH 5,3; scan rates 200, 400, 800 mV/s; accumulation at –0.1 V for 60 s

## Conclusion

In this study, RNA heptamer was studied to compare it with its DNA analog (Trnkova et al. 2004). It was found that these mini–hairpins differ in their electrochemical behaviour. Replacement of deoxyribose with ribose leads to conformational changes which can be easily detected by electrochemistry.

## Acknowledgement

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