Electrochemical behaviours of Aclonifen on GC electrode in non-aqueous media: Investigation of Aclonifen determination

A. Demir Mülazımoğlu[1], N. Durmuş[1], S. Sağır[1] and İ. E. Mülazımoğlu[1]
[1]Necmettin Erbakan University, Ahmet Keleşoğlu Education Faculty, Department of Chemistry, Konya, Turkey
Keywords: Aclonifen, Cyclic Voltammetry, Surface Modification, Surface Characterization
Presenting author email: admulazimoglu@konya.edu.tr

Herbicides are used globally to eliminate weeds. Even after one application, they can be absorbed by the plant or deposited on the soil surface. These processes are strongly dependent on the type of herbicide, crop, soil, application method, and climatic conditions. Thus, nowadays, there is a growing emphasis on the development of analytical methods for determination of herbicides due to their toxicity (Liu et al. 2012; Wang et al. 2010)

Aclonifen, also a carotenoid synthesis inhibitör, is used frequently for the protection of soybeans, corn, sunflowers, tomatoes and various other crops against weeds (Kilinc et al., 2009; Vischetti et al. 2002; Trevisan et al. 1999). Aclonifen (2-chloro-6-nitro-3-phenoxyaniline), pertain to the diphenyl ether herbicide (DPhEH) group, this group includes many potent herbicides with a photodependent capability to inhibit protoporphyrinogen oxidase (Choi et al. 1999; Grasset et al. 2011).

Electrode modification is an important part of the electrochemical studies and has been frequently used. After the optimum conditions are set the modification can be performed by the electrochemical oxidation (amine and alcohol oxidation, *etc*.) or electrochemical reduction (diazonium reduction, *etc.*). Electrochemical modified electrodes have a broad range of applications in modern electrochemistry (Mülazımoglu et al. 2011).

In this study, aclonifen was modified on the glassy carbon (GC) electrode surface by electrochemical oxidation in non-aqueous media. Electrochemical behaviours of aclonifen were investigated by cyclic voltammetry (CV) and square wave voltammetry (SWV). The modification of aclonifen on the GC electrode surface was performed between +0.5 V and +2.5 V potential range at 0.1 V s^{-1} scan rate with 10 cycles (Fig. 1A). The nitro group on the surface after modification and characterization operations was reduced to amine group in the 100 mM HCl media. After this process, which was made +0.2 V to -1.4 V potential range at 0.1 V s^{-1} scan rate and 10 cycles (Fig. 1B), the electro-inactive surface was made electro-active. The presence of aclonifen at the GC electrode surface was characterized by CV and electrochemical impedance spectroscopy (EIS). The potential range was used from +0.8 V to +1.7 V in SWV experiments for determination of aclonifen (Fig. 1C).

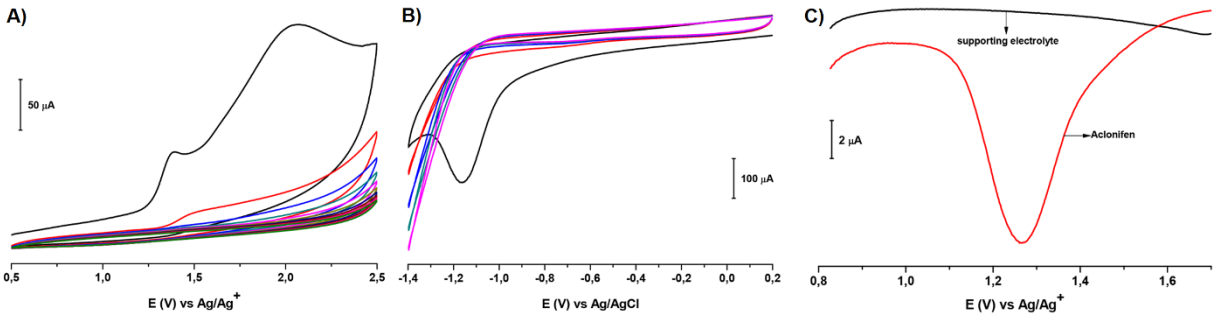

Figure 1. A) Cyclic voltammogram of 1 mM aclonifen in CH_3CN containing 100 mM NBu_4BF_4 vs. Ag/Ag^+/(10 mM $AgNO_3$). Potential scan rate is 100 mV s^{-1}. B) Cyclic voltammogram of reduction of nitro group to amine group on aclonifen modified GC electrode surface in 100 mM HCl solution media. C) Square wave voltammograms of Aclonifen (1 mM) and supporting electrolyte onto the modified GC electrode surface. Square wave voltammetric parameters were as follows: initial potential, +0.8 V end potential, +1.7 V; pulse amplitude, 50 mV; step potential, 1.5 mV; and frequency, 100 Hz.

References

Choi, J.S., Lee, H.J., Hwang, I.T., Pyon, J.Y., Cho, K.Y.: Differential susceptibilities of wheat and barley to diphenyl ether herbicide oxyfluorfen. Pesticide Biochemistry and Physiology, 65, 62-72 (1999)

Grasset, R., Reynaud, S., Kilinç, O.: The herbicide aclonifen: The complex theoretical bases of sunflower tolerance. Pesticide Biochemistry and Physiology, 100, 193-198 (2011)

Kilinc, O., Reynaud, S., Perez, L., Tissut, M., Ravanel, P.: Physiological and biochemical modes of action of the diphenylether aclonifen. Pesticide Biochemistry and Physiology, 93, 65-71 (2009)

Liu, H.J., Cai, W., Huang, R., Xia, H., Wen, Y.: Enantioselective toxicity of metolachlor to *scenedesmus obliquus* in the presence of cyclodextrins. Chirality, 24, 181-187 (2012)

Mülazimoglu, I.E., Mülazimoglu, A.D., Yilmaz, E.: Determination of Quantitative Phenol in Tap Water Samples as Electrochemical using 3,3'-Diaminobenzidine Modified Glassy Carbon Sensor Electrode. Desalination, 268, 227-232 (2011)
Trevisan, M., Capri, E., Cella, A., Errera, G., Sicbaldi, F.: Field, laboratory and modelling studies to evaluate Aclonifen soil fate. Toxicoloical Environmental Chemistry, 70, 29-47 (1999)
Vischetti, C., Marucchini, C., Leita, L., Cantone, P., Danuso, F., Giovanardi, R.: Behaviour of two sunflower herbicides (metobromuron, aclonifen) in soil. European Journal of Agronomy, 16, 231-238 (2002)
Wang, J., Leung, D., Chow, W.: Applications of LC/ESI-MS/MS and UHPLC QqTOF MS for the Determination of 148 Pesticides in Berries. Journal of Agricultural Food Chemistry, 58, 5904-5925 (2010)