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Effect of Caffeic acid on the Tumor Cells U937 Evaluated by an Electrochemical Voltammetric Method

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Abstract: Electrochemical voltammetric method can be used to monitor cell health state during its growth. Here we studied the effect of caffeic acid on leukemia cells U937 by the voltammetric behavior of the cells. The result showed that this drug had a negative influence on cell health, which suggests that caffeic acid may be used in inhibition of tumor cells.

Keywords: Voltammetric behavior, U937 cells, caffeic acid.

Caffeic acid is one of the major polyphenol compounds found in numerous plant species, which can be accumulated to 2% in human daily diet[1]. It is widely recognized to be antioxidant, which can scavenge reactive species of oxygen and nitrogen[2]. Its anti-mutagenecity has also been evaluated by *Salmonella typhimurium* system[3]. However, there is no report of this chemical's direct effect on tumor cells. Recently, as a kind of non-morphological observation method, electrochemical method has been developed for following cell health states[4] and evaluating effect of drugs and chemical compounds[5]. The voltammetric technology is also used to describe biological behavior of living cells and even used to evaluate the effect of anti-tumor drugs[6-7]. In this paper, we investigate the inhibition effect of caffeic acid on the growth of tumor cells U937 by electrochemical method. The result obtained by electrochemical method is in accordance with that observed by traditional methods.

Figure 1 showed the typical cyclic voltammogram of the cells U937 with the scan rate of 50 $mV.s^{-1}$ *vs* SCE. For the first scan, the half-height potential of the cells appeared at 0.64 volt *vs* SCE with a relative error of less than 3%. No corresponding reduction peak waves were observed in the reverse scans, a clear irreversible character of the cell electrode process. Most of the cells died of the voltammetric stimulation after the first scan, result in a very low height potential in the second scan. This Faradaic response, in fact, is a general phenomenon in living cells and is recognized to have positive relation with cell viability[6-7]. The robust voltammetric response of living cells, in addition to monitoring cell health in cell growth, can also be used to quantify the effect of drugs. **Figure 2** showed the Faradaic response of the cells U937 at different culture times with and without caffeic acid. The cells were cultured in RPMI-1640 media supplemented

with 10% FCS and incubated at 37℃ in a humidified atmosphere of 5% CO_2 /95% air. Before scan, 1×10^5 cells were harvested and washed twice with PBS. Curve (a) showed the time course of the cell culture without caffeic acid and curve (b) showed the effect of caffeic acid (800μg/ml) on the cells at the same culture condition as in curve (a). With the treatment of caffeic acid, the peak current of U937 began to drop at 2 h and there was only a little increase during the following time. It showed that caffeic acid had an effect on the Faradaic response of the cells. The effect was not the result between caffeic acid and the electrode because the drug has been endocytosized into the cells partially and the remainder in the cell solution was washed out before experiment. The decreasing of the Faradaic response should come from intrinsic response of the cells. Caffeic acid has a toxic effect on tumor cell U937 and JAR when the dose of the drug was above 50 μg/ml, which was also revealed in our results by Giemsa staining, MTT staining and H^3-TdR labeling system (data not shown). However caffeic acid had no significant effect on tumor cell 7721 treated by 400μg/ml, which suggested that it might be useful in inhibition of tumor cells selectively. The accordance with traditional methods reflected that the electrochemical method could be used to evaluate the effect of caffeic acid on tumor cells.

Of course, there are much other work needed to be carried out in the future in order to get further information of caffeic acid and other plant polyphenolic compounds.

Figure 1 The cyclic voltammogram of the cells U937. The scan rate was 50 mV/s.

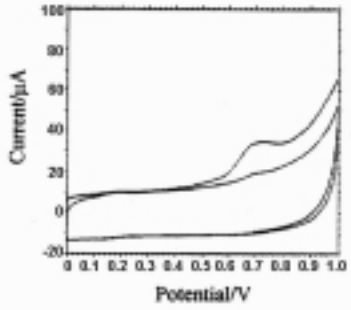
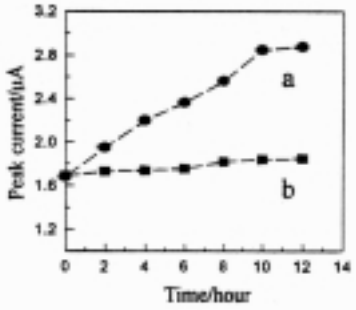


Figure 2 Effect of caffeic acid during cell culture course. (a) control group; (b) experiment group. The scan rate was 50 mV/s.



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