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Determination of Uric Acid by Voltammetric Method (DPASV) Comparing with Spectrophotometric Methods

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Abstract: The study includes determination of uric acid in urine by DPASV technique and comparing the results with those obtained by the routine spectrophotometric technique, the estimation of the products from using direct method to detect uric acid in patients with renal, renal failure comparing with normal these disease cause obvious decrease in uric acid concentration in patients urine.Determination of uric acid by chemical method using voltammetric technique (DPASV), it showed an obvious reduction current peak at potential (-0.592V)vs Ag/AgCl(3M KCl) as reference electrode .DPASV technique gave better result comparing with spectrophotometric method in Economy ,Accuracy ,Effort, time and the speed.

Keywords: Uric acid, DPASV, Voltammetric

Introduction

Uric acid is a chemical produced when our body breaks down foods that contain organic compounds called purines. Most uric acid is dissolved in the blood, filtered through the kidneys, and expelled in the urine. Sometimes the body produces too much uric acid or doesn't filter out enough of it. Hyperuricemia is the name of the disorder that occurs when you have too much uric acid in your body.

Uric acid is the final product of the metabolism of purines in the human body (End product of purines metabolism) where he poses with diuresis. Figure 1 shows the structural formula of uric acid.

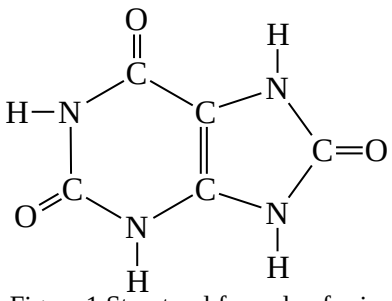

Figure 1.Structural formula of uric acid

The Voltammetric properties of uric acid were studied by DPASV after the initial and final fixation and optimum conditions were determined for the compound. Uric acid is a compound that can be analyzed using the voltometric techniques. It contains an electroactive functional group that gives a clear reduction wave by DPASV (as figure 2).

- Selection and peer-review under responsibility of the Organizing Committee of the Conference

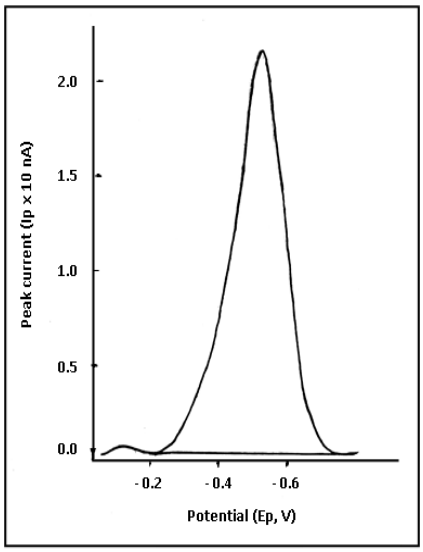

Figure 2. DPASV of uric acid

Method

Method of measurement using DPASV technique with sample:

1. 5 ml of pH solution (pH = 7.0) was taken in the measuring cell (clean and dry).
2. Transfer the nitrogen gas for 10 minutes after which the measurement is done for the reference (Blank).
3. Add 0.02 mL of the sample , nitrogen gas (5) minutes and then measure.

Results and Discussion

Optimization of the conditions

The optimum conditions for the study of DPASV The optimum conditions were determined for the study of uric acid voltammogram which gave the highest value of the propagation current (Ip) and the best form of the Uric acid reduction wave, by adding 5 milliliters of phosphate buffer with pH 7.0 by adding 0.1) Of the uric acid and then the nitrogen gas emitters. The output current (Ip) is then read at a voltage of -0.592 volts against the reference electrode (Ag / AgCl) with a concentration of (3M) KCl. Figure (3-14) shows the reduction wave of uric acid. The optimal conditions were determined under the following factors:

Effect of Deposition Time

Voltamogram was measured with different pulse deposition rates of the uric acid at varying levels of precipitation on the surface of the HMDE. The table (1) shows the values of the propagation current (Ip) obtained by changing Sedimentation time.

Table 1. The effect of Deposition time on Voltamogram shows the differential pulse anodic pulse of uric acid

Deposition time (sec.)	0	5	10	15	20	25
Ip (nA)	9.340	11.66	9.970	9.370	8.430	7.920

It is noticed from Table (1) that, following the results obtained, the sedimentation time (5) seconds gave the best and highest value of the propagation current. Therefore, this value was selected and adopted in subsequent measurements.

Effect of Conditioning Time

A study was conducted on the effect of the time of conditioning conditions after the deposition time was fixed at (5) seconds, as shown in Table (2), which shows the measurement time and different times between 0-20 seconds.

Table 2.The effect of Conditioning Time on voltammogram illustrates the DPASV of uric acid

Conditioning time (sec.)	0	5	10	15	20
Ip (nA)	8.750	9.070	9.340	8.420	7.610

The results obtained in Table 2 indicate that the Conditioning Time is 10 seconds

Effect of Equilibration Time

A study was conducted on the effect of equilibrium time, as shown in Table 3

Table 3. The equilibrium time on voltammogram shows the DPASV of the uric acid

Equilibration time (sec.)	0	5	10	15	20	25
Ip (nA)	7.710	7.860	7.920	8.140	8.780	7.800

It is noted from Table (3) that the values of the propagation current (Ip) increase to 20 seconds and then begin to decrease with the increase of the equilibrium time. Therefore, the b equilibrium time (20) was chosen because it gave the highest value of the propagation current (Ip).

Effect of Scan Rate

voltammogram uric acid was recorded after the previous conditions were established. A study was conducted on the effect of the Scan Rate, as shown in Table (4).

Table 4. The effect of the Scan Rate on voltammogram illustrates the DPASV of uric acid

Scan rate (mV/sec.)	1	2	3	4	5	6
Ip (nA)	12.840	13.370	17.150	17.230	17.650	15.450

Effect of Conditioning Potential

After stabilizing the previous influencing factors, the diffusion current (Ip) was measured by changing the Conditioning Potential as shown in Table (5).

Table (5): The effect of Conditioning Potential on voltammogram illustrates the DPASV of uric acid

Effect of Pulse Height

voltammogram was recorded in uric acid after the optimal conditions for the influencing factors were determined to determine the effect of pulse height in the propagation current (Ip). Table (6) shows the obtained results.

Table 6. The effect of Pulse Height on voltammogram illustrates the DPASV of uric acid

Pulse height(Mv)	0.020	0.022	0.024	0.026	0.028	0.030	0.032	0.034	0.036	0.038	0.040
Ip (nA)	7.980	8.640	9.210	9.710	9.800	11.440	11.460	12.520	12.820	14.570	13.300

Effect of Height of Uric Acid without Addition of Urine

The effect of increasing the concentration of uric acid was studied after the optimal conditions were achieved by taking (5) milliliters of the pH solution (pH 7.0) and the measurements by adding successive quantities of solution (10-3) molar uric acid and concentrations ranging from (29,126* 10-6 - 1.990*10-6) molar as shown in figure (3).The correlation coefficient value (R) is 0.99512. These results indicate that the reduction process was regular and the figure.2 show this

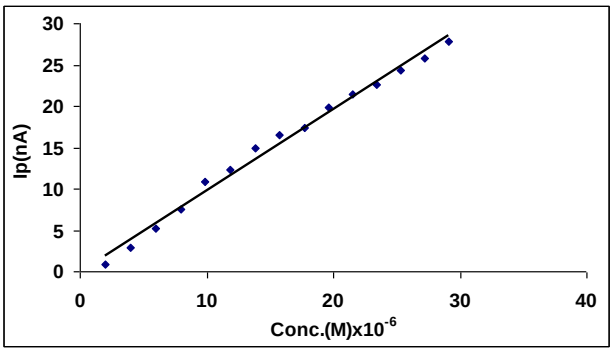

Fig.3. The relationship between the concentration of uric acid and the current values of the addition

Effect of increased uric acid in the presence of urine

voltammogram was measured with the DPASV excretion of uric acid with concentrations ranging from (13.67188*10-6 - 1.976285*10-6) molar, and measurements were made at optimal conditions previously determined for measurement.I n the relationship between the concentration and the current values of the addition, a straight line of 338636.8 was obtained and the correlation coefficient (R) was 0.997. This indicates that the reduction process was regular. Figure (4)show the relationship between the concentration of uric acid and the current values of the addition.

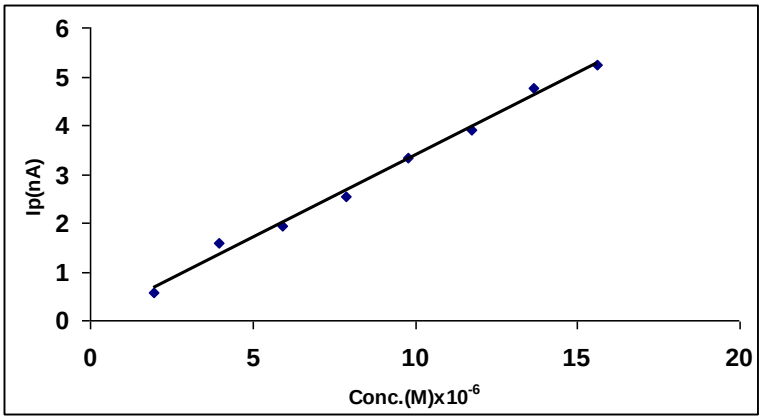

Figure 4 . the relationship between the concentration of uric acid and the current values of the addition Results and Discussion

Clinical Application of Uric Acid by DPASV

The amount of uric acid (mg / 24hr) was estimated in the administration of healthy and sick people using the (DPASV), to measure uric acid in urine samples A reduction of uric acid was observed in the urine sample as shown in (Fig. 5)

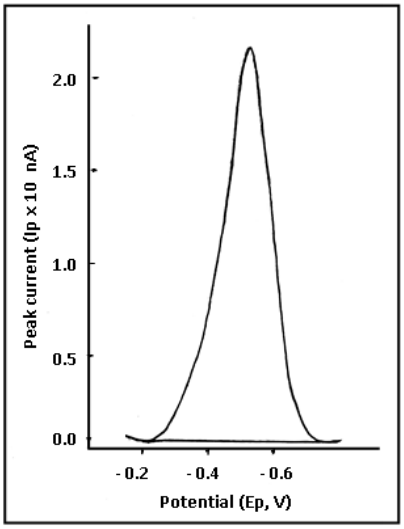

Fig .5. DPASV voltammogram of Uric acid in urine sample

Relationship between DPASV Method and Spectrophotometric Method

(DPASV) and the colorimetric method used to measure uric acid (mg / 24hr) in generation. A total of 24 samples were obtained from 8 samples of healthy individuals and 16 patients with renal diseases and renal failure and hypertension.

The uric acid was measured according to the color method, which is one of the methods routinely used in the pathological analyzes to estimate uric acid, which is based on an enzymatic reaction that produces a light pink color in the natural state and a deeper pink color in the cases of the disease. 510) nanometer.

Figure (6) shows the comparison between the proposed method of spectrometry (DPASV) and the color method of measuring the concentration of uric acid in the administration of people with kidney disease, kidney failure, hypertension and healthy people.

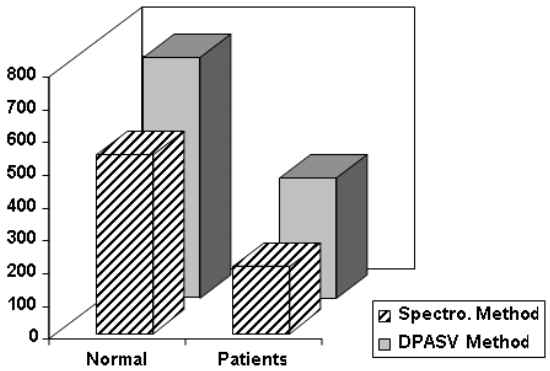

Figure 6. Shows the comparison between the suggested method of voltmeter (DPASV) and the color method for the concentration of uric acid in both natural and pathological condition

In order to prove the accuracy of the comparison between the suggested method and the color method to estimate the concentration of uric acid, the following correction equation is used:

DPASV method = [(202.0606) + (0.982511× colorimetric method)]

Conclusion

The use of DPASV is one of the most recently proposed methods for estimating uric acid in mg / 24hr in healthy individuals with renal disease and renal failure and hypertension. Comparison of the results obtained from this

method with the chromatic method routinely used in pathological analyzes. It was found through the results obtained between the two methods that the proposed polarographic method gave results consistent with the results obtained in the color method with the distinction of the first method of the following: Economic ,Characteristics of solutions ,Interferences, and Sensitive

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