

THE INVESTIGATION OF PALLADIUM CHLORIDE REACTION WITH URINE OF DIABETICS BY A POLAROGRAPHIC METHOD

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The investigation of palladium chloride reaction with the urine of diabetics was done under the standard condition, by a polarographic method.

The results obtained were statistically elaborated and it was found that 65.10% Pd(II) ions reacted to the urine. Comparing these results with the results obtained from the reaction of palladium chloride to the urine of normal persons, in which case 60.05% of Pd(II) ions has reacted, we believe that the keto-compounds in the urine of diabetic persons are the cause of the reduction of Pd(II) ions.

Key words: Palladium chloride; urine; polarographic method

INTRODUCTION

Palladium chloride has a broad application in analytical chemistry for qualitative and quantitative experiments. As a qualitative reagent it is used in thin-layer chromatography (TLC) for the identification of organophosphate pesticides [1], while as a quantitative one it is used for the formation of colored complexes and their spectrophotometric determination [2].

In our work we wanted to check the possible application of palladium chloride as a quantitative reagent for biological samples. It has already been

shown [3] that hemolizate binds a certain quantity of Pd(II) ions and that the ions are bound to histidine.

On the other hand, Stojanova and al. [4] have found that palladium chloride reacts with urine and therefore it can be used a quantitative reagent for the assessment of biological changes in urine.

The aim of this experiment was to find out whether the keto-compounds present in the urine of diabetics bound some Pd(II) ions and if this was the case to estimate the quantity of Pd(II) ions bound.

EXPERIMENTAL

Reagents and solutions

Solutions of PdCl₂:

0.1 M – mix in a beaker 0.8880 g of PdCl₂ p.a. with some distilled water, add 10 drops of concentrated HCl (d=1.19 g/cm³) and heat gently until dissolved. Cool, transfer the liquid to a volumetric flask and dilute to 100.0 cm³ with water.

0.005 M – dilute 5.00 cm³ of the 0.1 M solution to 100.0 cm³ with water.

Supporting electrolyte solution:

a) Dilute 80.0 cm³ of NH₄OH 25% with water to 1000.0 cm³.

b) Dissolve 53.3 g NH₄Cl p.a. in water and dilute to 1000.0 cm³.

Prepare the supporting electrolyte solution by mixing equal volumes of solution a) and b).

Apparatus and methods

All experiments were performed on a polarographic RADIOMETER – POLARITER PO4.

A polarographic cell [5] with a calomel electrode and a dropping mercury electrode, was used. The sensitivity of the instrument was $6 \cdot 10^{-2} \mu\text{A}$ per scale division, and current – voltage curves were recorded from –0.4 V to –1.0 V. All experiments were done at a temperature of 298 ± 0.1 K.

Methods:

Place 2.0 cm³ urine with a positive test on keton bodies into a 10.0 cm³ volumetric flask, add 5.00 cm³ of 0.005 M solution of PdCl₂ and fill up to the mark with distilled water (solution A).

Into a second 10.0 cm³ volumetric flask, pipet 5.0 cm³ of supporting electrolyte solution (S.E.S.), add 1.00 cm³ of a solution A and fill up to the mark with S.E.S. (solution B).

Solution B was put into a polarographic cell and after blowing of nitrogen for about ten minutes polarography began.

RESULTS AND DISCUSSION

In these experiments we polarographically followed the reaction between a solution of PdCl_2 and urine taken from 56 different patients suffering from diabetes. The results of the diffusion currents measured are given in Table I.

Table I.

Experimental results for the diffusion current, I_d , obtained by reaction of 56 samples of urine with PdCl_2

n	I_d/nA	n	I_d/nA	n	I_d/nA	n	I_d/nA
1	296	15	346	29	362	43	382
2	310	16	346	30	364	44	384
3	314	17	346	31	366	45	386
4	318	18	348	32	366	46	388
5	320	19	348	33	368	47	388
6	324	20	352	34	370	48	390
7	326	21	354	35	372	49	392
8	326	22	356	36	372	50	394
9	330	23	356	37	374	51	394
10	336	24	356	38	374	52	400
11	340	25	356	39	376	53	400
12	340	26	360	40	380	54	404
13	342	27	360	41	380	55	408
14	342	28	360	42	382	56	414

From the data obtained it can be concluded that the urine of diabetics binds with a larger quantity of Pd(II) ions than the urine of normal persons. All measurements were performed under the same experimental conditions, but the values of diffusion current varied between one minimal and maximal value. Consequently in this case the diffusion current should be treated as a random variable which, according to the laws of statistics, must have some most probable value.

If the values of diffusion current I_d i.e. mass m' of reacting Pd(II) ions are treated as random variables, a more detailed statistical treatment of data could be done.

Later, a Gauss curve was constructed using the statistical data. It shows the dependence of experimental frequency (f_i) of diffusion current value (Tab. II, Fig. 1).

The maximum of this Gaussian distribution curve corresponds to the most probable value of the dif-

The obtained polarogram was analysed by the tangent cut method [7].

fusion current which is $I_d = 368 \text{ nA}$. This amount of current converted to the mass of unreacting Pd(II) ions $m = 480 \mu\text{g}$, i.e. the mass of reacting Pd(II) ions, $m' = 850 \mu\text{g}$.

Therefore of 1330 mg of Pd(II) ions a mass $m' = 850 \mu\text{g}$ reacted with the same amount of urine.

The value obtained for standard deviation was $s = 38 \mu\text{g}$.

On the other hand with the given number of degrees of freedom and chosen level of probability p ,

Table II.

The diffusion currents grouped by intervals

I_d/nA	\bar{I}_d/nA	f_i
295 - 305	300	1
305 - 315	310	2
315 - 325	320	3
325 - 335	330	3
335 - 345	340	5
345 - 355	350	7
355 - 365	360	9
365 - 375	370	8
375 - 385	380	6
385 - 395	390	7
395 - 405	400	3
405 - 415	410	2

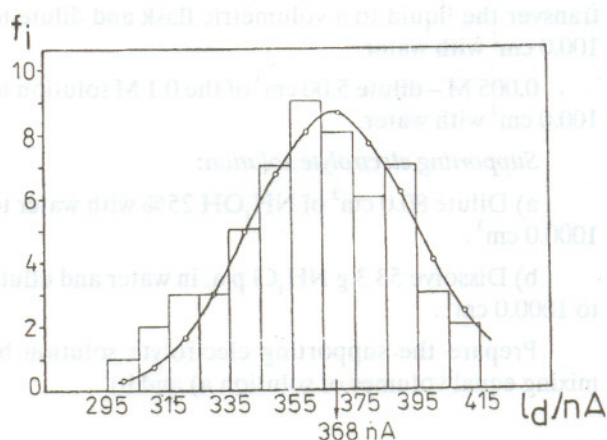


Fig. 1 - The Gauss curve of normal distribution calculated from the experimental data of I_d

the real mean value m and mass m' of Pd(II) ions will be between two limited values given in the following expression [8].

$$m' - \frac{t_{v,p} S_{m'}}{\sqrt{n}} \leq \mu \leq m' + \frac{t_{v,p} S_{m'}}{\sqrt{n}}$$

$t_{v,p}$ – table value of Student's t-test

n – number of measurement

In our case the real value of mass m' of Pd(II) ions which reacted with a probability of 95% is between the following limits:

$$\mu = |850 \pm 8| \mu\text{g}$$

$$P = 95\%$$

Comparing these results with the results obtained from the reaction of palladium chloride in the urine of normal persons [6], in which case 60.05% of Pd(II) ions reacted, we believe that the keto-compounds in the urine of diabetic persons, are the cause of the reduction of Pd(II) ions

REFERENCES

- [1] J. Baumler, S. Rippstein, *Helv. Chim. Acta.* **44**, 1162 (1961).
- [2] M. Zeigler, H. Schreeder, *Z. Anal. Chem.*, **226**, 405 (1966).
- [3] Lj. Stojadinović, doktorska disertacija, VMA, Beograd 1976.
- [4] К. Стојанова, Б. Топузовски, Љ. Стојадновиќ, Д. Јовановиќ, Год. зборник на Хем. фак. , **32**, 79 (1982).
- [5] Б. Топузовски, Год. зборник на ПМФ, **17/18**, 67 (1966).
- [6] К. Стојанова, докторска дисертација, ПМФ, Скопје 1983.
- [7] I. Filipović, P. Sabiončelo, *Laboratoriski priručnik, I dio, knjiga druga*, Zagreb, 1960, s. 113.
- [8] А. М. Герасимович, Математическая статистика, Изд. 2-е, Высшая школа, Минск, 1983, с. 181.

Резиме

ПОЛАРОГРАФСКО ИСПИТУВАЊЕ НА РЕАКЦИЈАТА НА ПАЛАДИУМ ХЛОРИД СО УРИНА ОД ДИЈАБЕТИЧАРИ

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Клучни зборови: Паладиум хлорид, урина, поларографско испитување

При стандардни услови вршени се поларографски испитувања на реакцијата на паладиум хлорид со урина, земени од лица заболени од дијабетис.

Добиените резултати статистички се обработени и добиено е дека 64.0% од Pd(II) изреагирале со урината. Споредувајќи ги овие резултати со резултатите добиени при

реакцијата на паладиум хлорид со урина од здрави лица, при што изреагирале 60.05%, сметаме дека кетосоединенијата во урината од дијабетичарите се причина за поголемата редукција на Pd(II) јоните.