NATURALISTA CAMPANO

ISSN / eISSN
1827-7160

PUBLISHER

MUSEO NATURALISTICO
DEGLI ALBURNI, VIA FORESE 16,
CORLETO MONFORTE-SA, ITALY, 84020

http://museonaturalistico.it

NATURALISTA CAMPANO
ISSN: 1827-7160
Volume 28 Issue 1, 2024

Analysis of Psychotropic Substances by Thermal Desorption Surface Ionization Spectroscopy Method

D.A. Zulfikarieva[1], Z.U.Usmanalieva[2]
[1,2]Tashkent Pharmaceutical Institute

Abstract: Methods have been developed for the determination and identification of haloperidol and clonidine using thermal desorption surface ionization spectroscopy. It was found that alcohol solutions of haloperidol have absorption maxima at ~177±5°C, clonidine at ~118±5°C. The developed method is recommended for the express analysis of haloperidol and clonidine in biological fluids in cases of acute poisoning.

Keywords: thermal desorption surface ionization spectroscopy, haloperidol, clonidine, biofluids.

1. Introduction

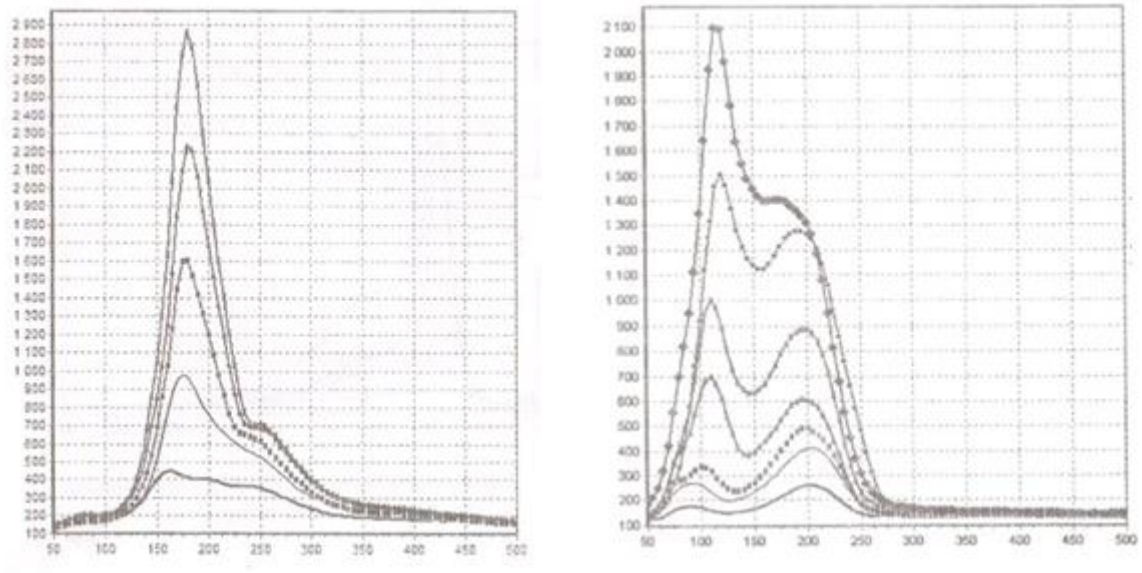
Recently, in the practice of chemical-toxicological analysis, cases of poisoning with psychotropic substances have become more frequent. The most common poisonings occur with antipsychotic substances. These include haloperidol. Haloperidol is a powerful antipsychotic. Has a sedative, antiemetic effect. Enhances the effect of narcotic, hypnotic, psychotropic, neuroleptic and analgesic substances, reduces aggression. [1]. Clonidine is one of the antihypertensive drugs that affects the central nervous system; according to its chemical structure, it is an imidazoline derivative. It has a calming effect on the central system, reduces emotional arousal in hypertension, inhibits pathological impulses from the center that move blood vessels, dilates peripheral vessels, and reduces blood pressure [2]. Increasing the dose of clonidine, especially in combination with alcohol, leads to a rapid and long-term decrease in heart rate and the development of a hypnotic effect, accompanied by prolonged loss of consciousness, which is why Clonidine is used. in serious crimes they are called the means of committing them. The use of clonidine in combination with other psychotropic substances is often fatal.

In cases of acute poisoning with these drugs, there is a need for emergency analysis of biological fluids of poisoned people. The thermal desorption surface ionization spectroscopy (TDSIS) method is a sensitive method that can be used in emergency cases of poisoning [3,4]. Detection of psychotropic substances is carried out by chemical and physical-chemical methods. However, a method for analyzing antipsychotic drugs using the TDSIS method has not yet been developed. Taking this fact into account, we set ourselves the task of developing a method for analyzing haloperidol and clonidine using the TDPIS method in biological fluids [5].
At the Department of Toxicological Chemistry, research work is being carried out within the framework of the practical project AL-4721035120 - “Creation of ultra-fast innovative examination in forensic medical examination for acute and chronic poisoning with potent psychotropic substances” for 2022-2023.

The Purpose of the Work is to develop analytical conditions for the thermal desorption surface ionization spectroscopy method (TDSIS), which is one of the express analysis methods for the determination of potent psychotropic substances, and its application in forensic chemical practice.

Research Methods: To detect haloperidol and clonidine using the TDSSI method, the following analysis conditions were selected:
emitter – oxidized molybdenum containing iridium; emitter voltage – 405 V; emitter temperature –200-300 °C; evaporation temperature – 20-505°C; air flow – 50 l/hour (compressor voltage 12 V); the volume of the test sample taken for analysis is 0.1 ml; analysis time – 3 minutes; The spectra are recorded directly using a computer program.
For the research, solutions of standard samples of haloperidol and clonidine were prepared. Using these solutions, thermal desorption surface ionization spectra of haloperidol and clonidine were obtained. The appearance of linear spectra of haloperidol at ~177±5°C and clonidine at ~118±5°C was observed. Thermal desorption spectra of these substances were used to determine haloperidol and clonidine isolated from biological fluids.

A series of solutions of haloperidol and clonidine were then prepared at varying concentrations. The thermal desorption spectra of the substances under study and the current values corresponding to these spectra are shown in Fig. 1 and in tables 1 and 2.



1 2

Fig. 1. Spectra of haloperidol (1) and clonidine (2)

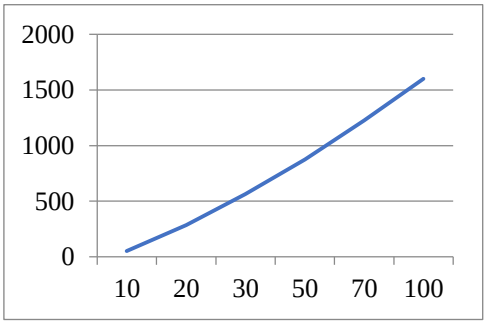
Table 1 Dependence of TDSI current on the content of haloperidol in solution

№	Haloperidol content, ng	Current strength I, A
1	20	400
2	40	998
3	60	1600
4	80	2200
5	100	2880

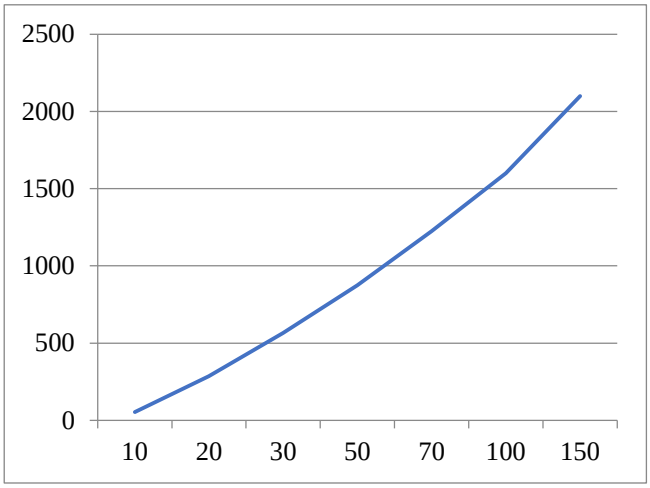
Table 2 Dependence of TDSI current on clonidine content in solution

№	**Clonidine content, ng**	**Current strength I, A**
1	10	54
2	20	286
3	30	565
4	50	875
5	70	1225
6	100	1600

The detection limit of haloperidol and clonidine was 5 ng. Based on the data obtained, calibration graphs of the dependence of the TDPI current of the spectra of haloperidol and clonidine on their concentration in solution were constructed (Fig. 2).



1



2

Fig.2. Calibration graph for quantitation of haloperidol (1) and clonidine (2)

At the next stage of research, the developed method was tested in the analysis of haloperidol and clonidine isolated from biofluids (blood and urine).

Isolation of Haloperidol from Blood and Urine.
To model blood samples (volume 5 ml), urine (25 ml) etched with 0.1 μg droperidol, a 10% sodium hydroxide solution was added to a pH value of 10 (according to a universal indicator), the resulting mixture was heated in a boiling water bath with an air cooler for 30 minutes. After cooling, the resulting mixture was extracted using a separating funnel with 20 ml of ethyl acetate three times for 5 minutes on a stirrer. The resulting extracts were filtered through a filter with anhydrous sodium sulfate and evaporated in a stream of warm air to a dry residue.
The dry residue of the blood extraction was dissolved in 5 ml of alcohol. The dry residue of the urine extract was dissolved in 10 ml of alcohol. 1 μl of the resulting solution was introduced into the cylindrical cavity of the vapor-generating tape of the PII-N-S "Iskovich-1" apparatus and thermal desorption surface ionization spectra were obtained. At a temperature range of 170-180°C, the appearance of a peak characteristic of haloperidol was observed.

2. Research Results

The results of the studies showed that in the analysis of haloperidol isolated from a biofluid, the TDPIS method is suitable for both detection and quantitative determination of the substance under study. Using a calibration graph, the quantitative content of haloperidol extracted from model samples was calculated. The results obtained were statistically processed and presented in Table 3.

Table 3 Results of quantitative analysis of haloperidol isolated from biofluids

Amounts of haloperidol		Statistical processing of results
μg	%	
blood		
0,0561 0,0577 0,0559 0,0566 0,0583	56,18 57,74 55,94 56,67 58,33	f=4; T (95%, 4)=2,78; X=56,97; S^2=1,0543; S=1,0268; S_x=0,4592; ΔX=2,8545; ΔX=1,2766 E=5,0104%; ε=2,2407%
urine		

0,0781 0,0798 0,0762 0,0772 0,0796	78,12 79,85 76,28 77,29 79,64	f=4; T (95%, 4)=2,78; X=78,23; S^2=2,3276; S=1,5256; S_x=0,6822; ΔX=4,2413; ΔX=1,8967 E=5,4211%; ε=2,4244%

Isolation of Clonidine from Blood and Urine.
10 ml of test blood was taken into a flask (100 ml), 30 ml of a 0,02 N H_2SO_4 solution was added dropwise and a 20% H_2SO_4 solution was added dropwise until pH = 2 and left for 2 hours (continuously stirring). Then centrifuged. The centrifugate was separated, the volume was adjusted from 0,02 N H_2SO_4 to 100 ml. NaOH solution was added to 50 ml of the mixture until pH-7.5 and extracted 3 times with 10 ml of chloroform. The resulting extracts were filtered through a filter with anhydrous sodium sulfate and evaporated in a stream of warm air to a dry residue.
The dry residue of the blood extract was dissolved in 5 ml of alcohol. The dry residue of the urine extract was dissolved in 10 ml of alcohol. 1 µl of the resulting solution was introduced into the cylindrical cavity of the vapor-generating tape of the PII-N-S "Iskovich-1" apparatus and thermal desorption surface ionization spectra were obtained. At a temperature range of 118-120°C, a peak characteristic of clonidine appeared.

Research Results. The results of the studies showed that in the analysis of clonidine isolated from a biofluid, the TDPIS method is suitable for both detection and quantitative determination of the substance under study. Using a calibration graph, the quantitative content of clonidine extracted from model samples was calculated. The results obtained were statistically processed and presented in Table 4.

Table 4 Results of quantitative analysis of clonidine isolated from biofluids

Amount of clonidine		Statistical processing of results
µg	%	
blood		
0,0481 0,0476 0,0465 0,0468 0,0474	48,14 47,65 46,57 46,81 47,49	f=4; T (95%, 4)=2,78; X=47,3320; S^2=0,4080; S=0,6387; S_x=0,2856; ΔX=1,7757; ΔX=0,7941 E=3,7517%; ε=1,6778%
urine		
0,0746 0,0736 0,0725 0,0728 0,0744	74,63 73,65 72,57 72,81 74,49	f=4; T (95%, 4)=2,78; X=73,6300; S^2=0,8840; S=0,9402; S_x=0,4204; ΔX=2,6137; ΔX=1,1689 E=3,5499%; ε=1,5875%

3. Conclusions

A method has been developed for detecting antipsychotic drugs included in the list of psychotropic substances, haloperidol and clonidine, using thermal desorption surface ionization spectroscopy. The possibility of using this method in the detection and quantitative analysis of haloperidol and clonidine isolated from biofluids has been demonstrated. At the same time, haloperidol is isolated from blood and urine in amounts of 56,97% and 78,23%; clonidine is isolated in amounts of 47,33% and 73,63%, respectively. It is proposed to use the TDPIS method for express analyzes of biological fluids in cases of poisoning with psychotropic substances.

Literature

[1] Береговых Г.В., Вавин Г.В., Мартыненко Н.Б. Исследование клофелина в химико-токсикологическом анализе экстракционно-спектрофотометрическим методом//Медицина в Кузбассе. — 2005. № 4. –С.24-25.

[2] Великанова Л.П., Меснянкин А.П., Каверина О.В., Бисалиев Р.В., Чернова М.А. Избранные вопросы наркологии: учебное пособие / Под редакцией Л.П. Великановой. — Астрахань, 2005. — 365 с.
[3] Об анализе опиатов в крови, моче и в трупных материалах методом термодесорбционной поверхностно-ионизационной спектроскопии /Гиясов З.А., Шахитов М.М. и др.;– Ташкент, 2003. – 12 с.
[4] Zulfikarieva D.A., Yuldashev Z.A. Application of the method of thermal-security surface-ionization spectroscopy in analysis of alkaloids of conium maculatum / World journal of pharmacy and pharmaceutical sciences. Vol.8, Issue 6. Indiya, 2019. pp.48-53.
[5] Usmanalieva Z.U., Abdugaffarov M. The development of analytical conditions of levamizole by thermodesorption surface ionization spectroscopy /Asian Journal of Research in Social Sciences and Humanities. – 2021. - V.11, N 11. – P. 295-298.