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Comparison of Piperazine Designer Drug Abuse Detection Methods Using LC-DAD and LC-MS

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Introduction

Designer medications containing piperazine pose a major threat to human health when used recreationally. Similar to illegal narcotics, these substances have an effect on the body. They cause varied degrees of visual and auditory hallucinations as well as psychostimulatory effects. It has been proven that two or even more psychoactive drugs were present in numerous poisoning and death instances. Such mixes frequently contain piperazine derivatives, which present a significant analytical challenge for their identification. In addition, several piperazine compounds can be found in biological material as a result of metabolic modifications brought on by associated medications.

Description

New psychoactive substances (NPS), sometimes known as designer drugs, are growing in number and chemical variety, according to the literature and data that are currently available. These products are promoted as a cutting-edge substitute for illegal narcotics, the possession and sale of which are forbidden by law. An obvious issue in Europe and around the world is the rising use of NPS, the availability of internet shopping and the vast number of persons experimenting with these substances. Due to their behavioural, neuroendocrine, psychostimulatory and hallucinogenic characteristics, piperazine derivatives from this class of designer medicines sparked interest [1].

They first surfaced as altered analogues of narcotic substances like amphetamine on the black market for narcotics. Piperazine derivatives and well-known drugs produced from amphetamine share comparable structural changes. These substances are generated chemically from piperazine, an organic heterocyclic molecule containing two nitrogen atoms arranged in the opposite positions. All piperazine derivatives can be divided into two groups based on their structural similarities: benzylpiperazines, such as N-benzylpiperazine (BZP), 1-(3,4-methylenedioxybenzyl)piperazine (MDBP), 1-(4-fluorobenzyl)piperazine (pFBP) and 1,4-dibenzylpiperazine (DBZP); and phenylpiperazines, such as 1-(3- (MeOPP) [2].

The capacity to identify the designer drug piperazine was compared between the newly created LC-MS method and the new LC-DAD approach. For each approach, optimal analytical conditions were developed.The LC-MS method took 15 minutes to complete the analysis. By identifying a precursor ion and two product ions at the right retention time, all test substances could be recognised. Deuterated analogues including BZP-D7, mCPP-D8 and TFMPP-D4 were utilised as internal standards.

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The buffer concentrations of 10 mM, 20 mM and 100 mM were used for the analyses in the research that were reported. The findings obtained at a concentration of 10 mM were unsatisfactory. However, although being able to identify distinct chemicals at 100 mM, the mixture of benzyl and phenylpiperazine from a single sample could not be separated. For both the individual chemicals and the mixture, a concentration of 20 mM produced the best chromatographic separation results [3].

The data shown show that, in the case of benzylpiperazine derivatives, a change in pH significantly affects the retention duration of these molecules. The retention time of benzylpiperazine derivatives increases with increasing pH. The retention time of phenylpiperazine derivatives is not significantly influenced by pH changes. The percentage of the mobile phase's components was crucial for the prolongation of the phenylpiperazine derivatives' retention period.

In an experimental manner, pentedrone was selected as the internal standard. It belongs to the class of chemical compounds known as ketoarylamines. This substance is well separated from the tested analytes, has chemical and physical properties akin to piperazine derivatives and its retention period is comparable to that of the sample's constituents. Finding an internal standard that will be detectable under the defined conditions and vary from piperazine derivatives required a number of tests. The following were also examined among the ketoarylamine derivatives: Butylon, Bufedrone, Flephedrone, MDPV and Metedron. Additionally, the following synthetic cannabinoids were examined: AM 694, JWH 250, UR 144 and XLR 11 [4].

Based on the uniformity of the retention periods of the analytes present in the test sample and the reference sample, the described methodologies allowed for the identification of piperazine designer medicines. Piperazine derivatives have unique UV-VIS spectra, with their absorption maxima occurring at various wavelengths. These characteristics were utilised to verify that the tested substances were present in biological material. Two MRM transitions were then watched for precise quantification in the LC-MS technique for the examined substances [5].

Conclusion

Synthetic stimulants like piperazine are abused in designer medications. Due to their similar effects on the central nervous system, consumers view these substances as alternatives to MDMA and amphetamines. Acute or chronic toxicity can ensue from the recreational use of piperazine derivatives. The approaches for the independent detection of piperazine designer pharmaceuticals in biological and non-biological matrices using liquid chromatography techniques are described in the paper. While the LC-DAD approach assures great consistency of results, the advantage of the LC-MS method is the high sensitivity of determinations.

Conflict of Interest

No potential conflict of interest was reported by the authors.

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