Natural background levels of primary biogenic amines:

In water samples from lakes and rivers around Stoke-on-Trent

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Introduction

Searching for victims of crime who have been buried in shallow hidden (clandestine) graves or dumped into water courses currently utilises a number of techniques such as Victim Recovery Dogs or Ground Penetrating Radar. The development of chemical techniques would offer complimentary further assistance in body location. Previous research has demonstrated that primary biogenic amines are potential chemical markers of decomposition [1].

However, there is limited of information about the natural abundance of the primary biogenic amines cadaverine, methylamine and putrescine in different water courses and an understanding of this natural abundance would allow for more accurate detection. This work aimed to chemically detect the natural background levels of primary biogenic amines (cadaverine, methylamine, and putrescine) in water samples taken from lakes and rivers around Stoke-on-Trent (UK). These amines were quantified using Gas Chromatography-Mass Spectrometry (GC-MS) [2].

The expectation for this study was that the concentration of the primary biogenic amines cadaverine, methylamine and putrescine is higher with wild life and vegetation than a water site with less wild life and vegatation.

Materials and Methods

- First set of water samples were taken from four different water sites from one lake and examined with a pH meter, conductivity meter and with a dissolved oxygen meter.
- At the same day the water samples were derivatised for the analysis with the GC-MS.
- A storage experiment was conducted at room temperature of 20.7 ° C .
- Second set of water samples were collected from a river and obtained from Home Office Centre for Applied Science and Technology (CAST).

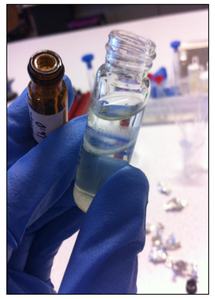

Figure 1: Development of the organic layer

Derivatisation process

- Water samples were adjusted to a pH of 11 for the derivatisation process and put in different vials.
- In each vial an amount of 500µl Pentafluorobenzaldehyde /Acetonitrile solution was added
- The vials were placed in oven at 60˚C for 1 hour.
- After the 1 hour, 1ml of 0.1M sodium hydroxide was added.
- The derivatives were separated through 1 ml of 0.5% undecane/hexane solution .
- The organic layer was transferred to suitable GC-MS vials and injected into the GC-MS.

Surroundings of the collected water samples

Figure 2: Coded lake area HP1 with north coordinates of 53° 00'44.6" and west coordinates of 2° 10'35.0"

Figure 3: Coded lake area HP2 with north coordinates of 53° 00'45.2" and west coordinates of 2° 10'36.1"

Figure 4:Coded lake area HP3 with north coordinates of 53° 00'47.9" and west coordinates of 2° 10'40.6"

Figure 5: Coded lake area HP4 with north coordinates of 53° 00'47.1" and west coordinates of 2° 10'35.7"

Results natural background levels water samples

Quantification primary biogenic amines in four different lake ares

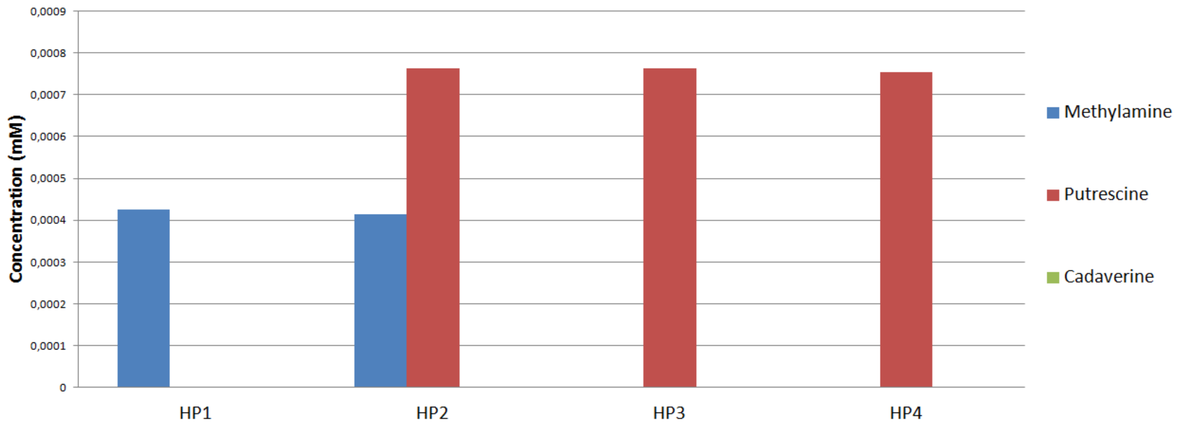

Figure 6: Column chart of putrescine, cadaverine and methylamine in the collected water samples from The Hanley Park. On the x-as is the retention time in minutes is shown and on the y-as is the concentration in millimolar.

References

[1] L. Nakovich, "Analysis of Biogenic Amines by GC/FID and GC/MS. A Thesis Submitted in partial fulfilment of the Requirements of Virginia Polytechnic Institute and State University," Virginia Polytechnic Institute and State University, Virginia, 2003

[2] K. K. Ngim, S. E. Ebeler, M. E. Lew, D. G. Crosby and J. W. Wong, "Optimized procedures for analyzing primary alkylamines in wines by pentafluorobenzaldehyde derivatization and GC-MS," *Journal Agric Food chemistry,* vol. 48, pp. 3311-3316, 2000

Results CAST Samples

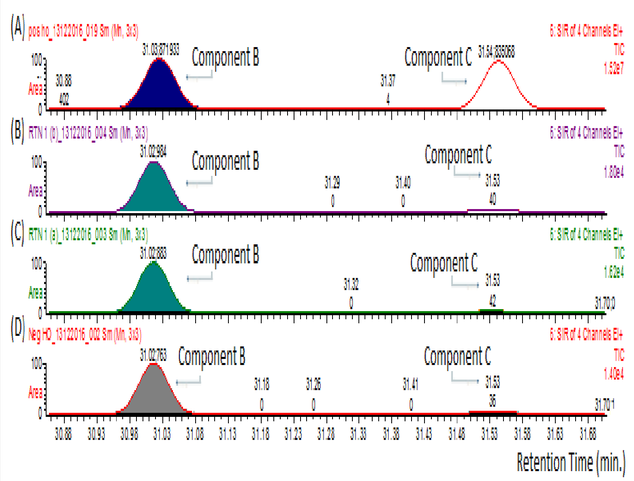

Figure 7: SIR scan focused on component B (putrescine) and component C (cadaverine) with the masses 181.10m/z, 209.10m/z, 249.10m/z and 263.20m/z. (A) Positive control, (B) Duplicate of water sample RTN 1, (C) Water sample RTN 1 and (D) is the negative control. On the x-as the retention time in minutes is shown and on the y-as is the area of the peaks in percentage.

Conclusion

- With the first set of water samples it be can suggested that methylamine was present in the natural environment with a concentration of 0.00042 mM and putrescine was present with a concentration of 0.00075 mM.
- From the river samples obtained from the Home Office CAST the primary biogenic amines were not detected.
- Cadaverine was not found in the natural environment and therefore may be a useful marker of decomposition, methylamine and putrescine may be found at low levels and should be used with comparison to control samples.

Further Research

- Analyse and quantity water samples collected from different depths and from various water bodies during different times of the year (Winter and Summer).
- Research on the different type of storage bottles.