Determination of quaternary ammonium salts and veterinary drugs in food
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There is widespread interest in the reliable and sensitive determination of residues in food and beverages. Although the analytical instrumentation is getting more sensitive the need of a good chromatographic separation is nevertheless necessary and important to produce reliable results.

In this work a new chromatographic sorbent NUCLEODUR® is tested for the determination of veterinary drug residues and quaternary ammonium compounds. NUCLEODUR® is a silica based chromatographic support with biphenylpropyl groups. Stationary phases with alternative separation mechanisms are still of interest for HPLC. Aromatic ligands on the sorbent are particularly suitable for this. Because they are chemically inert and provide as hydrocarbons sufficient hydrophobicity. However, due to the n,n-interactions their selectivity is different compared with alkyl modified silicas [2,3].

Due to the large aromatic system in combination with the flexible propyl spacer n,n- and hydrophobic interactions of NUCLEODUR® are both enhanced [4].

Results
Multi veterinary drug residues
Several different veterinary drug residues are used for prevention and treatment of disease in animal production. This use often leads to drug residues in food. Usually for each group of veterinary drug residues an individual method for analysis is applied. First NUCLEODUR® is tested for the analysis of mectins. Figure 1 shows the separation of mectins on a conventional C18 phase and on NUCLEODUR®. Except for Emamectin the peaks of NUCLEODUR® are quite higher and show a better peak shape.

Figure 1: Separation of mectins

NUCLEODUR®

Conventional C18 phase

1. Emamectin
2. Epamectin
3. Abamectin
4. Doremection
5. Ivermectin

Conclusion
NUCLEODUR® is a good choice for the analysis of different compound classes in foodstuff. A multi-veterinary drug method which includes mectins, tetracyclines, chinolones, sulfonamides and mycins and a separation of quaternary ammonium salts could be successfully developed. The peak shape and selectivity of NUCLEODUR® are equal or better in comparison to conventional RP columns.

Figure 2: Separation of tetracyclines

NUCLEODUR®

Conventional C18 phase

1. Doxycycline
2. Tetracycline
3. Chlorotetracycline
4. Doxychloromycin
5. Oxytetracycline

Figure 3: Separation of veterinary drugs

Conventional C18 phase

1. Doxycycline
2. Minocycline
3. Dorchloromycin
4. Cyprofloromycin
5. Tetracycline
6. Doxychloromycin
7. Spirochomycin
8. Erythrochomycin
9. Sulfonylamethine
10. Sulfonylaminomethine
11. Sulfolaminomethine
12. Sulfonylaminolactone
13. Chlorotetanylicyclic
14. Difloromycin
15. Erythromycin
16. Sulfafloromycin
17. Rosacteryclomycin
18. Sulfafloromycin
19. Oxidocinacid
20. Emamectin
21. Sulfafloromycin
22. Abamectin
23. Doremection
24. Ivermectin

Quaternary ammonium salts
Quaternary ammonium salts are classified as biocides because of their disinfecting effects. They are found in disinfectants, fabric softeners and surfactants among other things. The most common substances are diocetyl- and tetradecyltrimethylammonium chloride (DDAC) and benzalkonium chloride (BAC). Both DDAC as well as BAC are mixtures of quaternary ammonium salts with different alkyl chain lengths. Figure 4 shows the chemical structure of DDAC-C12 and BAC-C12.

Figure 4: Chemical structure of DDAC-C12 and BAC-C12

Figure 5: Separation of quaternary ammonium salts

Conventional PFP phase

1. BAC-C8
2. BAC-C10
3. DDAC-C8
4. BAC-C12
5. BAC-C14
6. DDAC-C10
7. BAC-C16
8. BAC-C18
9. DDAC-C12

NUCLEODUR®

Conventional C18 phase

1. Emamectin
2. Epamectin
3. Abamectin
4. Doremection
5. Ivermectin

References