Application Note AN-S-376

医薬用フッ化ナトリウムケル中のフッ化物の測定

Method validation according to the U.S. Pharmacopoeia

フッ化物は、水や一部の食品に自然に含まれるミネラルてす。歯のエナメル質を強化し、腐食から保護することか証明されています[1]。たたし、過剰なフッ化物にさらされると、歯の外観に影響を与える歯のフルオローシスという状態を引き起こす可能性かあります。そのため、シェルや歯磨き粉なとの歯科ケア製品中のフッ化物の量を監視することか重要てす。

ナトリウムフッ化物シェルは、虫歯(カリエス)を効果的に予防する有益な製品てす。米国薬局方・国家規準(USP-NF)の権威あるモノクラフ「ナトリウムフッ化物シェル」[2]て指定されているように、抑制導電度検出を備えたイオンクロマトクラフィ(IC)は、ナトリウムフッ化物シェル中のフッ化物および不純物を測定するための信頼性の高い方法てす。

本研究ては、米国薬局方・国家規準の基準を満たすMetrosep A Supp 16 - 250/4.0 カラムと水酸化物溶出剤を使用したIC法を検証しています。フッ化物は、シェル歯磨き粉中の塩化物や他の不純物から高い精度と正確さて分離されます。IC法は、米国薬局方一般章<621>クロマトクラフィ[3]および<1225>薬局方手続きの検証[4]に従って検証されています。

SAMPLE AND STANDARD PREPARATION

Commercial gel toothpaste was diluted to a known concentration of approximately 2 µg/mL sodium fluoride (NaF). Here, 1.585 g of a gel toothpaste containing 331.5 mg NaF/100 g was diluted in 500 mL ultrapure water (UPW). The solution was sonicated for 10 minutes and further diluted 1:8.8 with UPW. Afterwards, the diluted solution was filtered using 0.2 µm pore size filters. The nominal sodium fluoride concentration for these samples was 1.19 µg/mL.

No additional sample preparation is required.

The standard solutions and the system suitability solutions are prepared from the respective 1000 µg/mL certified standards by dilution with UPW.

For the assay, the standard solution is obtained by diluting a sodium fluoride solution to 2 µg/mL. The system suitability solution contains 2 µg/mL sodium fluoride and 1 µg/mL sodium acetate. For the impurity test, the standard solution consists of 0.2 µg/mL sodium chloride in UPW. The system suitability solution for the impurity test contains 1 mg/mL sodium fluoride and 1 µg/mL sodium chloride in UPW.

EXPERIMENTAL

Samples and standard solutions were directly injected into the IC using a 919 IC Autosampler plus (Figure 1).

Figure 1. Instrumental setup including a 930 Compact IC Flex, 919 IC Autosampler plus, and an 800 Dosino for automatic regeneration of the Metrohm Suppressor Module (MSM).

Fluoride was separated from acetate and chloride by using a potassium hydroxide eluent and the Metrosep A Supp 16 column (column material, Table 1). The analytes were quantified by evaluating their conductivity signal after chemical suppression.

The calibration was performed using a single 2.0 µg/mL sodium fluoride standard injected six times. The sample was analyzed in duplicate.

Table 1. Requirements for IC method as per USP Monograph «Sodium Fluoride Gel» [2].

Column with L91 packing	Metrosep A Supp 16 - 250/4.0
Eluent	15 mmol/L potassium hydroxide
Flow rate	1.0 mL/min
Temperature	40 °C
Injection volume	20 µL
Detection	Conductivity with suppression

RESULTS

The IC assay for fluoride content was validated according to the USP Monograph «Sodium Fluoride Gel» [2]. Suitability requirements for resolution, tailing factor, and relative standard deviation were fulfilled (Table 2).

Table 2. Suitability requirements for the fluoride assay.

Parameter (assay)	Actual	USP requirement	Status
Resolution F^- /acetate	5.9	NLT 1.5	Pass
Tailing factor	1.1	NMT 2.0	Pass
RSD fluoride (%, n=5)	0.52	NMT 0.73	Pass

Commercial gel toothpaste samples were analyzed for their sodium fluoride content and the results showed the concentration at 104% of the label claim (Figure 2). The recovery of fluoride for the sample analysis was within the USP acceptance criteria of 90–110%.

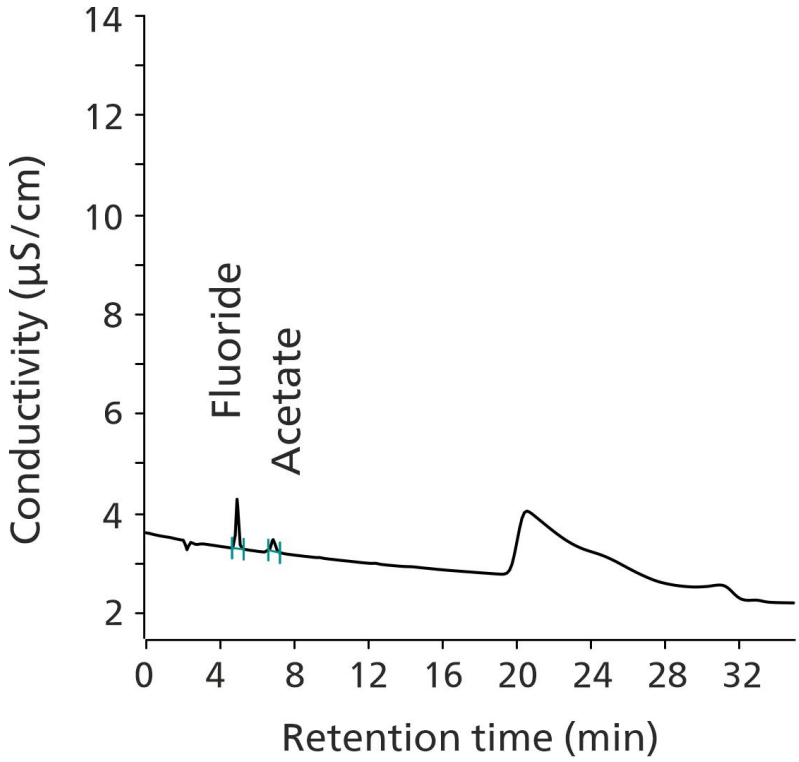

Figure 2. Chromatogram of a commercial toothpaste sample containing 1.24 µg/mL sodium fluoride (104% of the label claim).

When performing the impurity tests for potential contamination with chloride, the IC method showed excellent compliance with the USP requirements (Table 3).

Table 3. Suitability requirements for the chloride impurity in sodium fluoride gel.

Parameter (impurity)	Actual	USP requirement	Status
Resolution F^- /Cl^-	7.7	NLT 4	Pass
RSD fluoride (%, n=5)	4.2	NMT 5	Pass
S/N ratio Cl^-	>740	NLT 20	Pass

概要

The presented IC method complies with the USP General Chapters <621> and <1225> [3,4]. It is suitable to determine sodium fluoride in gels containing sodium fluoride according to the USP Monograph «Sodium Fluoride Gel» [2].

REFERENCES

1. Yeung, C. A. A Systematic Review of the Efficacy and Safety of Fluoridation. *Evid Based Dent* **2008**, *9* (2), 39–43. https://doi.org/10.1038/sj.ebd.6400578.
2. *Sodium Fluoride Gel*; Monograph; U.S. Pharmacopeia/National Formulary: Rockville, MD. https://doi.org/10.31003/USPNF_M3947_02_01.
3. *〈621〉 Chromatography*; General Chapter; U.S. Pharmacopeia/National Formulary: Rockville, MD. https://doi.org/10.31003/USPNF_M99380_01_01.
4. *〈1225〉 Validation of Compendial Procedures*; General Chapter; U.S. Pharmacopeia/National Formulary: Rockville, MD. https://doi.org/10.31003/USPNF_M99945_04_01.

CONTACT

メトロームジャパン株式会社
143-0006 東京都大田区平和島6-1-1
null 東京流通センター アネックス9階
metrohm.jp@metrohm.jp

CONFIGURATION

930 Compact IC Flex Oven/ChS/PP/Deg

930 コンパクト IC Flex Oven/ChS/PP/Deg は**カラムオーフン**、**ケミカルサフレッション**、サフレッサー再生のための**ヘリスタリックホンフ**、内蔵式**脱気装置**を備えたインテリシェントコンパクトIC装置です。この装置は任意の分離メソットおよび検出メソットによって使用することかてきます。

典型的な使用領域:

- ケミカルサフレッションと電気伝導度検出器による陰イオンの測定
- イオン排除クロマトクラフィーおよび逆のサフレッションを用いた有機酸

919 IC Autosampler plus

919 ICオートサンフラフラスは、中程度のサンフル量におけるラホの要求を満たします。本製品によってメトローム製品の様々なイオンクロマトクラフを自動化することかてきます。

800 Dosino

高機能電動ヒュレットのトーシンクユニット用書き込み・読み取り用ハートウェア付き駆動部。固定されたケーフル付き (長さ150 cm)。