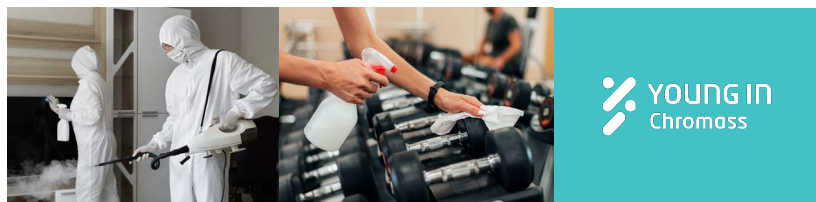


通过ChroZen HPLC分析 手部消毒湿巾中苯扎氯铵

• HPLC 应用



描述

苯扎氯铵（BKC或BAC）是一种杀菌剂，广泛应用于工业应用中的防腐剂、消毒剂、杀虫剂和防腐剂等。

苯扎氯铵作为加湿器消毒剂成分之一，是一种阳离子表面活性剂，具有季铵氯化物同系物的结构，长期接触皮肤或吸入这种化学物质会对人体产生有害影响。

在韩国，加湿器消毒剂的使用引发了严重的社会问题，导致孕妇、婴儿和体弱者患上了无法解释的肺部疾病。因此，许多国家机构严格规范其在使用家用化学品和杀菌剂时的安全管理。

在这项研究中，根据韩国药典和环境部描述的测试方法，采用ChroZen HPLC（高效液相色谱仪）测定手部消毒湿巾中的苯扎氯铵，同时确保分析效率和数据可靠性。

General Test Method & Preservative Test by Korea Pharmacopoeia

仪器和软件

Item	Description	Part No.
Pump	ChroZen HPLC Quaternary Gradient Pump with Vacuum degasser	9421011020
Autosampler	ChroZen HPLC Autosampler	5421011020
Column Oven	ChroZen HPLC Column Oven	3421011020
Detector	ChroZen HPLC UV/Vis Detector with dual wavelength	7411011020
Install. Option	HPLC Performance Kit	1601011890
CDS	YL-Clarity software for single instrument of YCM HPLC	5301011000
	Autosampler control of YL-Clarity	5301011040
Column	CN (4.6 mm x 150 mm, 5 μ m)	-

试剂和标准品

- 乙腈(CH₃ OH), HPLC 级别
- 苯扎氯铵, $\geq 50\%$
- 85%纯度的磷酸
- 磷酸氢二钠, 纯度99%
- 超纯水, 电阻率18.2 M Ω -cm

标准溶液的制备

- ① 向100 mL容量瓶中加入1 g苯扎氯铵, 然后用流动相稀释至100 mL标记处。
- ② 取0.1 mL①至另一个100 mL容量瓶中, 用流动相稀释至100 mL标记处, 使其浓度达到10 μ g/mL。

样品溶液的制备

- ① 根据成分百分比取样, 用流动相稀释至10 μ g/mL
- ② 滤液①用作样品溶液

仪器条件和色谱图

ChroZen HPLC system	
Mobile phase	ACN : 1% Na ₂ HPO ₄ = 50 : 50 (pH 5.2, phosphoric acid)
Column	CN (4.6 mm x 150 mm x 5 μm)
Flow rate	1.0 mL/min
Temperature	40°C
Injection volume	20 μL
Detection	UV/Vis detector 254 nm

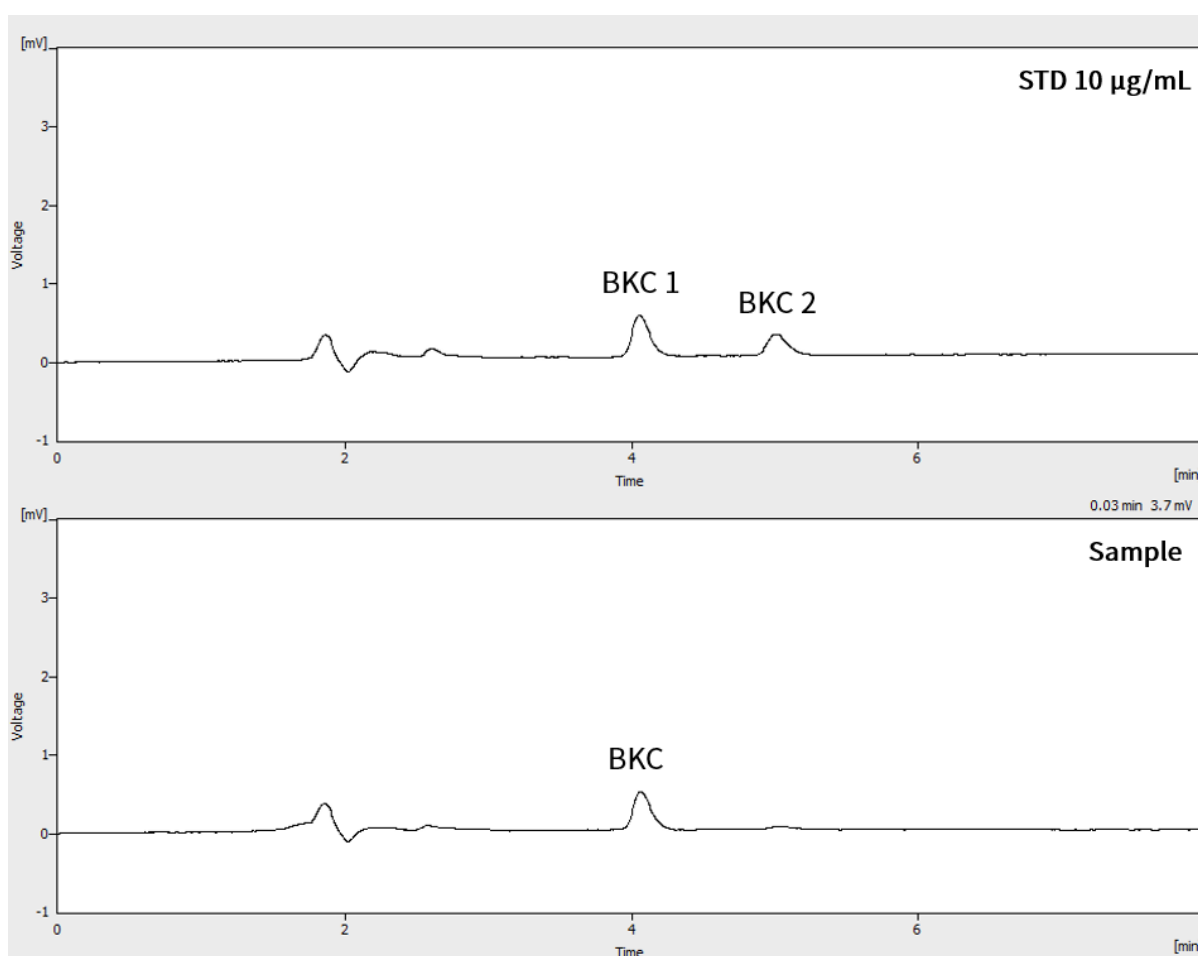


图1. 苯扎氯铵标准品和样品色谱图

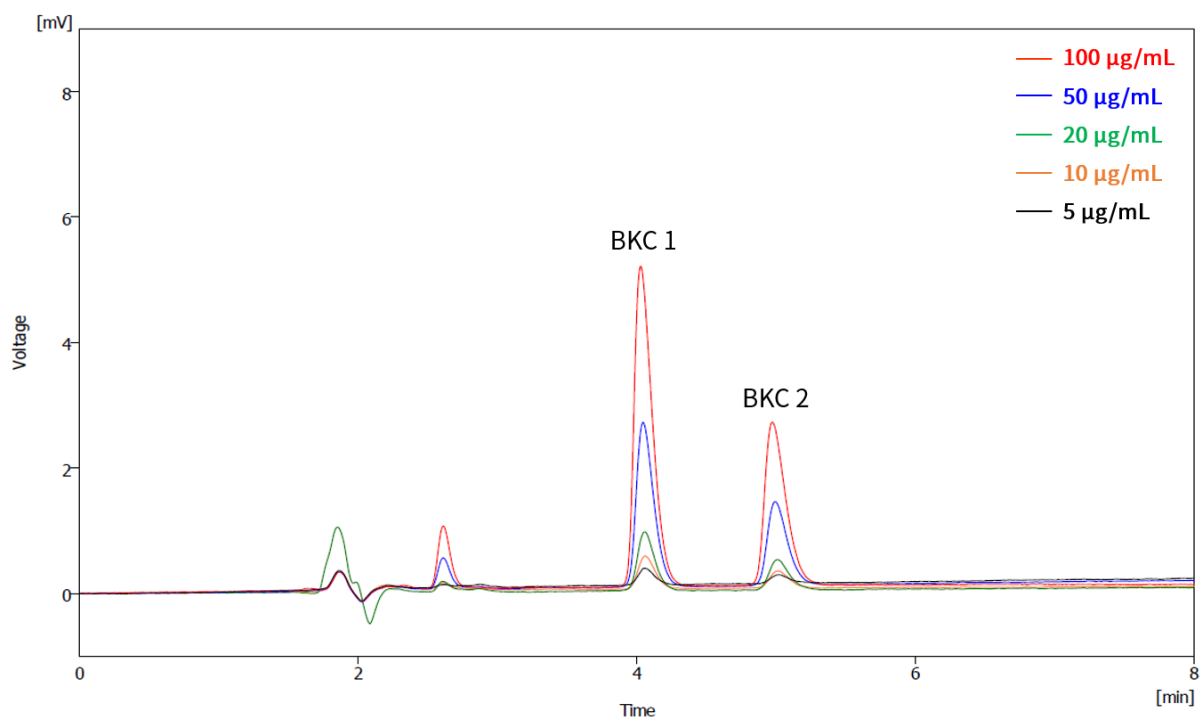
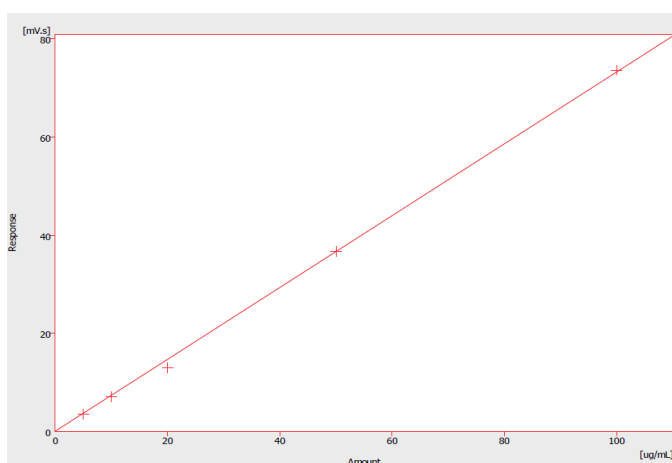


图2. 苯扎氯铵标准品的色谱叠加



STD	Standard Concentration (µg/mL)	Area (mV.s)
1	5	3.5105
2	10	7.0135
3	20	12.8988
4	50	36.6985
5	100	73.6270
Linearity		0.9997043

图3. 校准曲线的验证

计算

Amount of Benzalkonium Chloride(mg)

$$= \text{Concentration of Standard (mg/mL)} \times \text{Dilution Ratio of Sample (mL)} \times \frac{A_T}{A_S}$$

A_T = Peak Area of BKC in Sample (Sum of BKC 1 & BKC 2)

A_S = Peak Area of BKC in Standard (Sum of BKC 1 & BKC 2)

$$\text{Ex. } 0.01 \text{ mg/mL} \times 100 \times \frac{3.708}{7.060} = 0.525 \text{ mg}$$

环境部风险关注产品的测试方法

仪器和软件

Item	Description	Part No.
Pump	ChroZen HPLC Quaternary Gradient Pump with Vacuum degasser	9421011020
Autosampler	ChroZen HPLC Autosampler	5421011020
Column Oven	ChroZen HPLC Column Oven	3421011020
Detector	ChroZen HPLC UV/Vis Detector with dual wavelength	7411011020
Install. Option	HPLC Performance Kit	1601011890
CDS	YL-Clarity software for single instrument of YCM HPLC	5301011000
	Autosampler control of YL-Clarity	5301011040
Column	C18 (4.6 mm x 250 mm, 5 μ m)	-

试剂和标准品

- 苯扎氯铵， $\geq 50\%$
甲醇，HPLC级
- 高氯酸钠， $\geq 98.0\%$
超纯水，电阻率 $18.2 \text{ M}\Omega\text{-cm}$

标准溶液的制备

- ① 向100 mL容量瓶中加入0.1 g苯扎氯铵，然后用纯水稀释至100 mL标记处，使其浓度达到1000 mg/L
- ② 取0~5 mL①，增量1 mL至50 mL容量瓶中，用纯水稀释至50 mL刻度。

样品溶液的制备

- ① 取1~4 g样品至50 mL容量瓶中，加入10~20 mL甲醇，然后超声处理以有效提取样品。
- ② 滤液①用作样品溶液。

仪器条件和色谱图

YL9100Plus HPLC system			
Mobile phase	A : 1% NaClO ₄ B : MeOH		
Column	C18 (4.6 mm x 250 mm x 5 μm)		
Flow rate	0.7 mL/min		
Temperature	30°C		
Injection volume	20 μL		
Detection	UV/Vis detector 220 nm		
Gradient programs	Time (min)	% A (1% NaClO ₄)	% B (MeOH)
	Initial	35	65
	20	5	95
	25	5	95
	30	35	65
	40	35	65

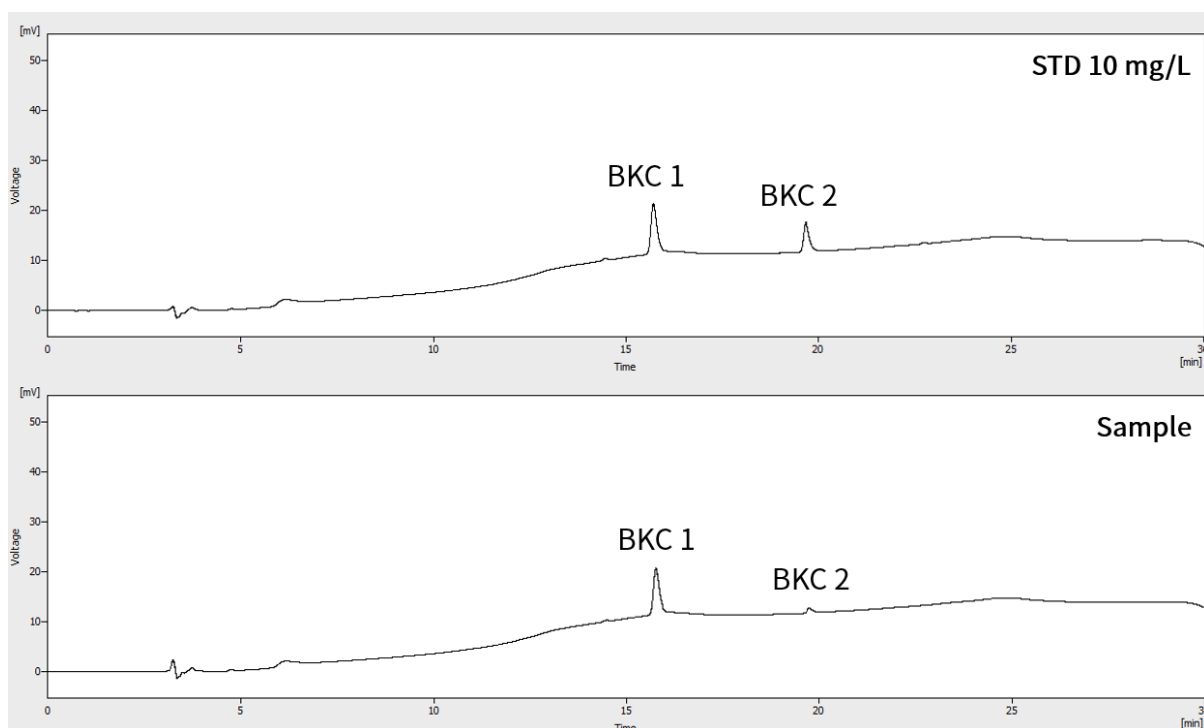


图 4. 苯扎氯铵标准品和样品色谱图

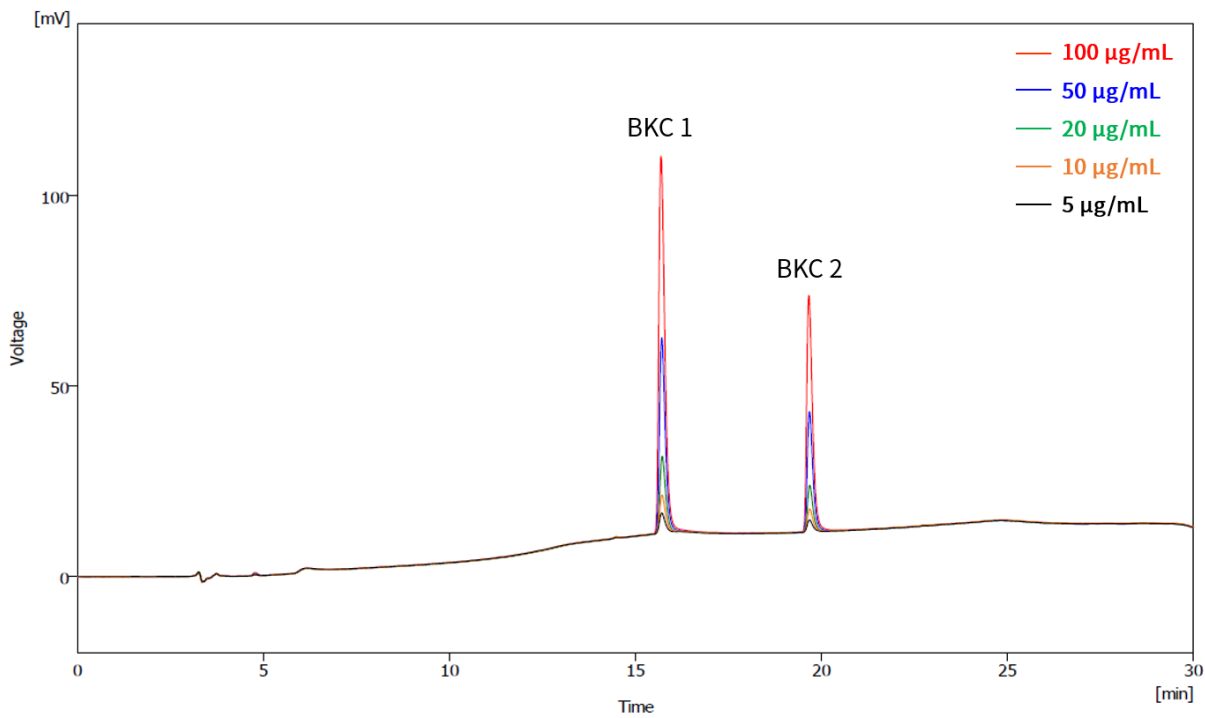


图 5. 苯扎氯铵标准品的色谱叠加

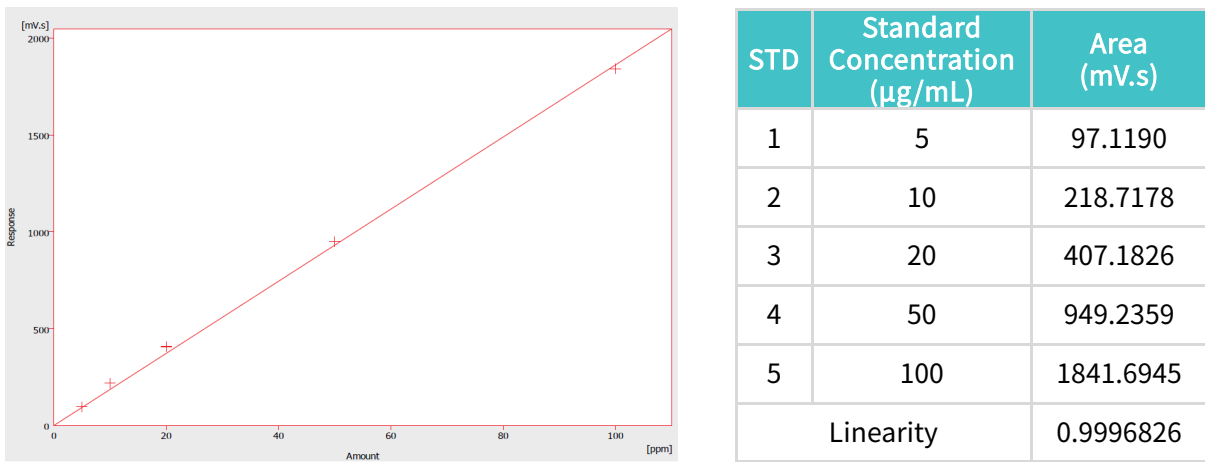


图6. 校准曲线的验证

表1. 试验方法的有效性

	MDL (mg/kg)	Linearity (R ²)	RSD (%)	Accuracy (%)
Regulation by Products of Risk Concertn	50	> 0.98	≤ 30	70 ~ 130
Result	0.13	0.99968	0.043	100.30
	Pass	Pass	Pass	Pass

计算

$$\text{Amount of Benzalkonium Chloride in the Sample (mg/kg)} = \frac{(C_1 - C_0)}{W_d} \times f \times V$$

C_1 = Concentration of BKC in the Sample (mg/L)

C_0 = Concentration of BKC in Method Blank (mg/L)

f = Dilution Rate (In case of out of linear range)

V = Volume of Extracted Sample (mL)

W_d = Amount of Sample(g)

$$\text{Ex. } \frac{(6.242 - 0)}{1\text{g}} \times 1 \times 50 = 312.1 \text{ mg/kg}$$

有前景的测试方法解决方案

环境部风险认定产品

仪器条件和色谱图

ChroZen HPLC system	
Mobile phase	1% NaClO ₄ : MeOH = 35 : 65
Column	CN (4.6 mm x 150 mm x 5 μm)
Flow rate	1.0 mL/min
Temperature	30°C
Injection volume	20 μL
Detection	UV/Vis detector 220 nm

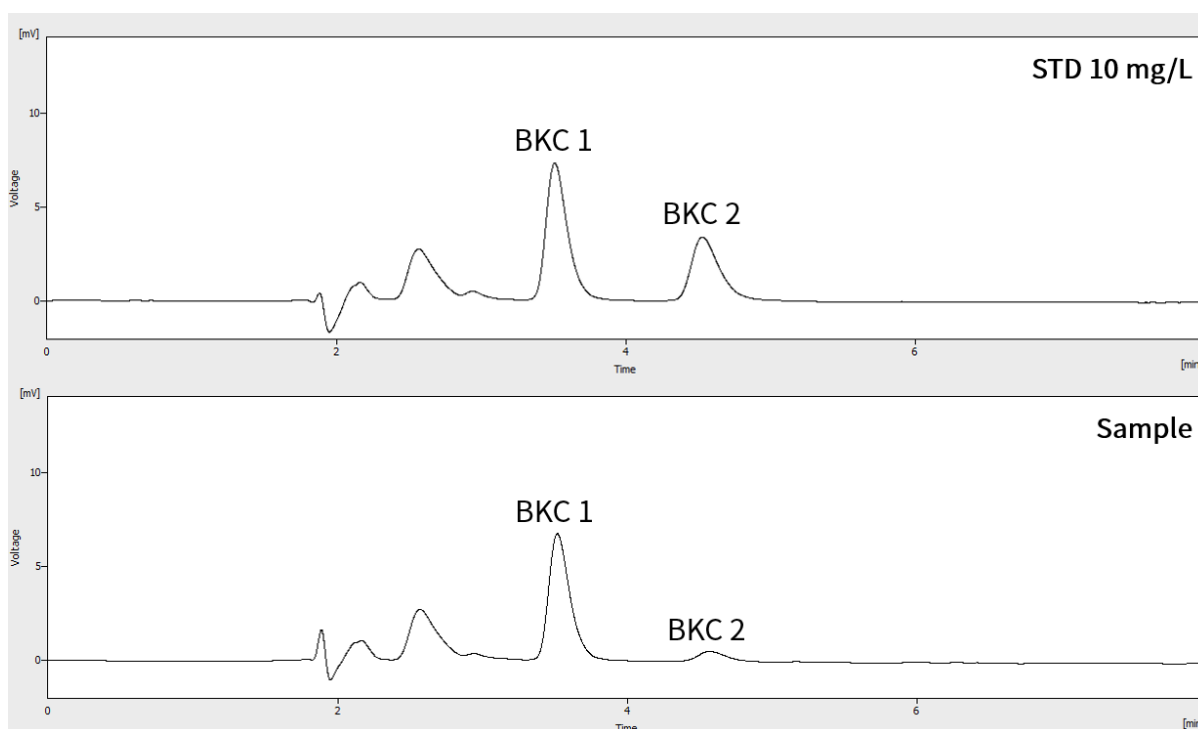


图7. 苯扎氯铵标准品和样品色谱图

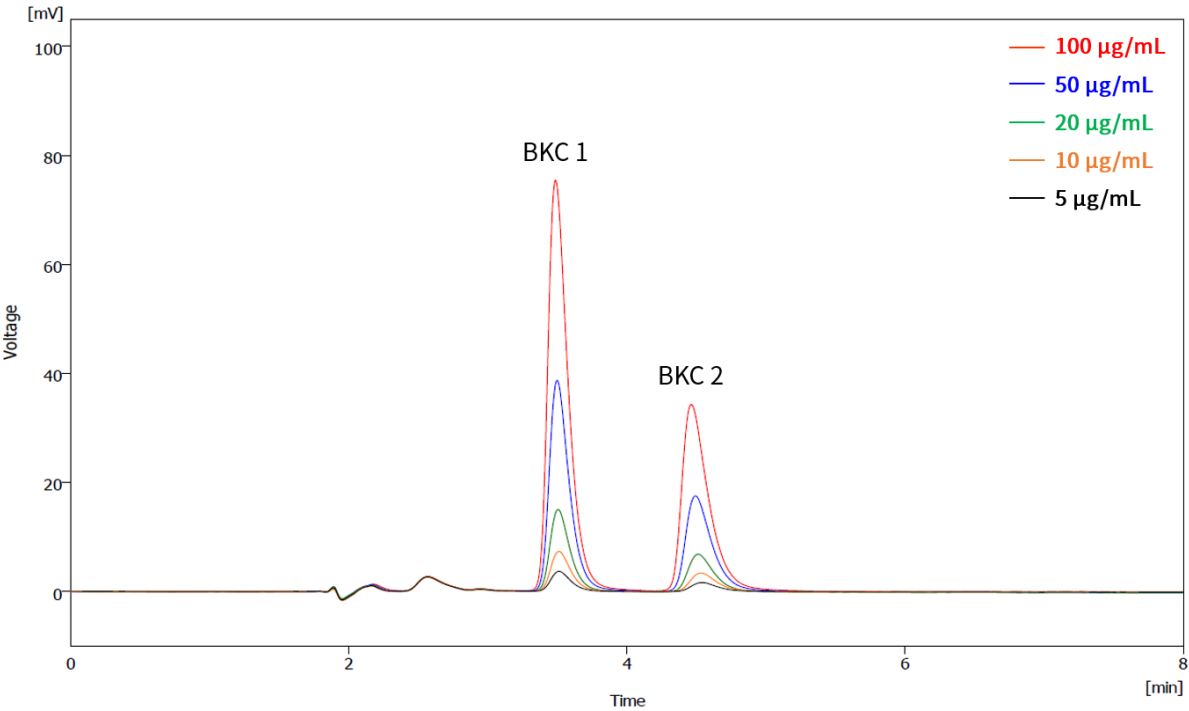
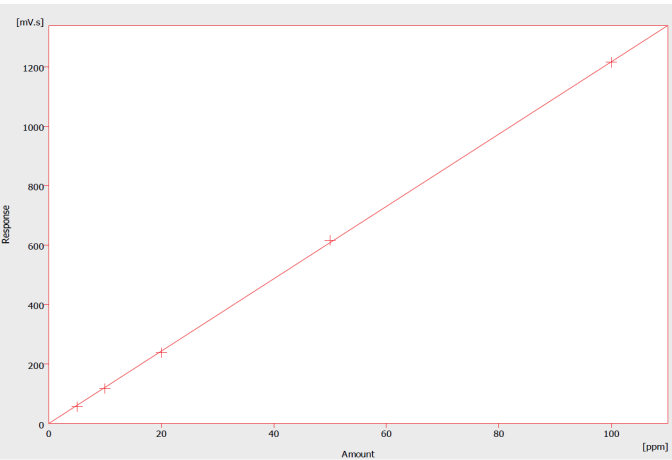


图8. 苯扎氯铵标准品的色谱叠加



STD	Standard Concentration (µg/mL)	Area (mV.s)
1	5	56.3969
2	10	117.2638
3	20	238.2750
4	50	616.2953
5	100	1215.1720
Linearity		0.9999506

图9. 校准曲线的验证

表 2.试验方法的有效性

	MDL (mg/kg)	Linearity (R ²)	RSD (%)	Accuracy (%)
Regulation by Products of Risk Concertn	50	> 0.98	≤ 30	70 ~ 130
Result	0.63	0.99995	0.346	95.98
	Pass	Pass	Pass	Pass

结论

本研究采用YoungIn Chromass的新型高效液相色谱法ChroZen HPLC，参照几种韩国标准方法，对苯扎氯铵进行了测定。评估每种分析物的线性，以验证分析结果的有效性。按照质量控制方法计算方法检测限（MDL）和精密度（RSD%）。所有3种测试方法的线性度均大于0.999。参考韩国环境部测试方法的测试结果符合规定标准，精度为0.043%，准确度为100.30%，如[图6]和[表1]所示。

将分析时间缩短到标准方法的5倍的有前景的解决方案证实了结果；精密度为0.346%，准确度为95.98%，均完全符合规定水平。

根据样品基质和杂质的存在，可以推荐本申请中描述的分析条件，以优化测试结果。

参考

- Act on the Safety Management of Household Chemicals and Biocides'
- General test methods & preservative test methods by Korean Pharmacopoeia
- Evaluation for products of risk concerns for safety by the Korean ministry of environment
- Guidelines for the safe use of COVID-19 sterilization and disinfection products
- Study on the Respiratory Toxicity of Biocide, Benzalkonium Chloride



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