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WHITE PAPER

Electrolytes in Drinks

INTRODUCTION

Electrolytes are minerals that carry an ionic charge when dissolved in solution. Many key electrolytes are lost during exercise, as well as with dehydration and/or rapid loss of fluids. There are various ways to replenish these electrolytes, one being consumption of electrolyte beverages. Many drinks are advertised to replenish electrolytes, but to accurately evaluate electrolyte content in these popular drinks, proper analytical tools are necessary. Eurofins EAG can identify and quantify the different electrolytes using Ion Chromatography (IC). This white paper demonstrates the capabilities that Eurofins EAG has to screen for key electrolytes quickly and accurately in solid (powder) and liquid sample matrices.

In this study, the objective was to screen five popular drinks for electrolytes by ion chromatography (IC). Ion chromatography is a technique that separates ions based on their interaction with the stationary phase of a specific column and the eluent, or mobile phase. IC can separate anions using an anion column, which attracts anions, and can also separate cations using a cation column, which attracts cations. As the eluent passes through the column, ions with a weaker affinity for the stationary phase will move through the column faster and elute first. Ions with a stronger affinity for the column will move through the column more slowly. The chromatographic separation allows for the quantitation of specific ions.

ANALYSIS

For analysis, the samples were diluted in water and analyzed against mixed cation and anion standards. The anion mixed standard is composed of fluoride, chloride, nitrite, sulfate, bromide, nitrate, and phosphate. The cation standard is composed of lithium, sodium, ammonium, potassium, magnesium, and calcium. For solid samples, the tablets were ground into a fine homogenous powder prior to dilution. A summary of test samples is presented in Table 1.

Table 1: Description of samples containing electrolytes

Sample ID	Sample Description
S3	Sports drink #1
S8	Powder sports drink #1
S11	Powder sports drink #2
S16	Sports drink #2
S17	Coconut water

A comparison of the experimentally determined electrolyte concentrations with their label claims are presented in Table 2 – Table 6 below. The identity of the unknown ions is confirmed by matching the retention times of the unknown peaks against the expected peaks from a mixed reference standard. The data suggests all label claimed electrolytes were detected by this technique, with some drinks containing additional electrolytes that were not listed on the label claim; the additional electrolytes are mostly low-level and possible break down of other ingredients. Additional analysis can be performed using the known label claim ingredients to identify each component.

Table 2. Comparison of electrolyte concentrations in S3, sports drink #1

Electrolyte	Label Claim Weight (mg)	Label Claim Calculated Concentration (wt%)[1]	Experimental Concentration (wt%)[1]	%RPD[2]
Sodium	270	0.03%	0.04%	57%
Potassium	80	0.01%	0.01%	64%
Calcium	Not listed label		0.001%	N/A
Chloride	Not listed label		0.04%	N/A
Phosphate	Not listed label		0.03%	N/A

[1]wt % = weight percent; [2]% RPD = Relative Percent Difference

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Table 3. Comparison of electrolyte concentration in S8, powdered sports drink #1

Electrolyte	Label Claim Weight (mg)	Label Claim Calculated Concentration (wt%)[1]	Experimental Concentration (wt%)[1]	%RPD[2]
Sodium	55	1.7%	1.4%	16%
Phosphate	Not listed label		9.7%	N/A
Calcium	Not listed label		0.9%	N/A
Magnesium	Not listed label		3.5%	N/A
Phosphate	Not listed label		N/A	N/A
Nitrite	Not listed label		5.1%	N/A

[1]wt % = weight percent; [2]% RPD = Relative Percent Difference

Table 4. Comparison of electrolyte concentration in S11, powdered sports drink #2

Electrolyte	Label Claim Weight (mg)	Label Claim Calculated Concentration (wt%)[1]	Experimental Concentration (wt%)[1]	%RPD[2]
Sodium	300	5.5%	5.8%	6.6%
Potassium	150	2.7%	3.1%	13.0%
Calcium	13	0.2%	0.3%	15.6%
Magnesium	25	0.5%	0.6%	23.0%
Chloride	40	0.7%	Not detected	N/A
Phosphate	Not present on label		35%	N/A

[1]wt % = weight percent; [2]% RPD = Relative Percent Difference

Table 5. Comparison of electrolyte concentrations in S16, sports drink #2

Electrolyte	Label Claim Weight (mg)	Label Claim Calculated Concentration (wt%)[1]	Experimental Concentration (wt%)[1]	%RPD[2]
Sodium	110	0.01%	0.02%	118%
Potassium	340	0.03%	0.07%	92%
Calcium	35	0.004%	0.003%	8%
Magnesium	20	0.002%	0.002%	12%

[1]wt % = weight percent; [2]% RPD = Relative Percent Difference

Table 6. Comparison of electrolyte concentrations in S17, coconut water

Electrolyte	Label Claim Weight (mg)	Label Claim Calculated Concentration (wt%)[1]	Experimental Concentration (wt%)[1]	%RPD[2]
Sodium	65	0.007%	0.02%	231%
Potassium	646	0.06%	0.200%	209%
Calcium	40	0.004%	0.01%	178%
Magnesium	33	0.003%	0.009%	158%
Phosphate	33	0.01%	0.02%	125%
Chloride	Not listed label		0.1%	N/A
Sulfate	Not listed label		0.01%	N/A

[1]wt % = weight percent; [2]% RPD = Relative Percent Difference

Representative chromatograms from the analysis are presented in Figure 1 and Figure 2 below. Confirmation of peaks is determined based on matching retention times with reference standards. In some cases, the retention time of peaks in the sample chromatograms exhibit a shift compared with the reference standards (often called a matrix effect). As a result, spiking studies are performed to confirm or deny the presence of that analyte. A spike is performed by fortifying a known amount of the suspected analyte to the sample matrix and assessing if the suspect peak increases: an increase confirms the presence of the suspect analyte and the emergence of a new peak suggests two different analytes.

SUMMARY

In summary, ion chromatography is a chromatographic technique that can separate different electrolytes across various samples matrices. Overall, the data suggests most electrolytes in sample are present at comparable values with the label claim. By comparing all the tested electrolytic drinks, sports drink #2 offers the highest number of electrolytes. Interestingly, additional electrolytes were detected in the samples; however, these could stem from other ingredients. Eurofins EAG Laboratories has the experience, tools, and the analytical approach to both confirm the identity and quantity of individual components per label claim and identify unknown ingredients in a variety of products, per client request.

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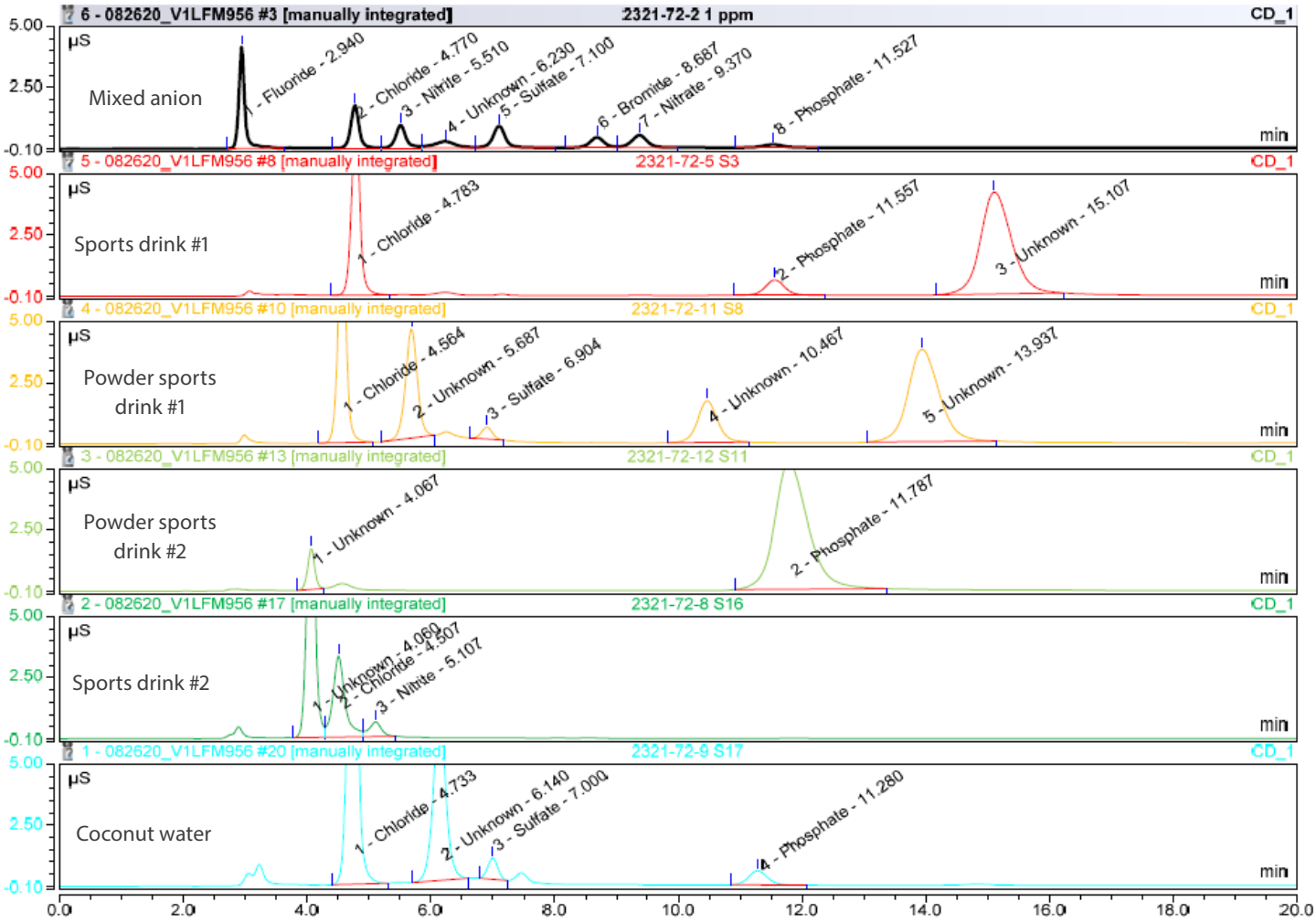

Figure 1. IC chromatogram of mixed anion standard and prepared samples

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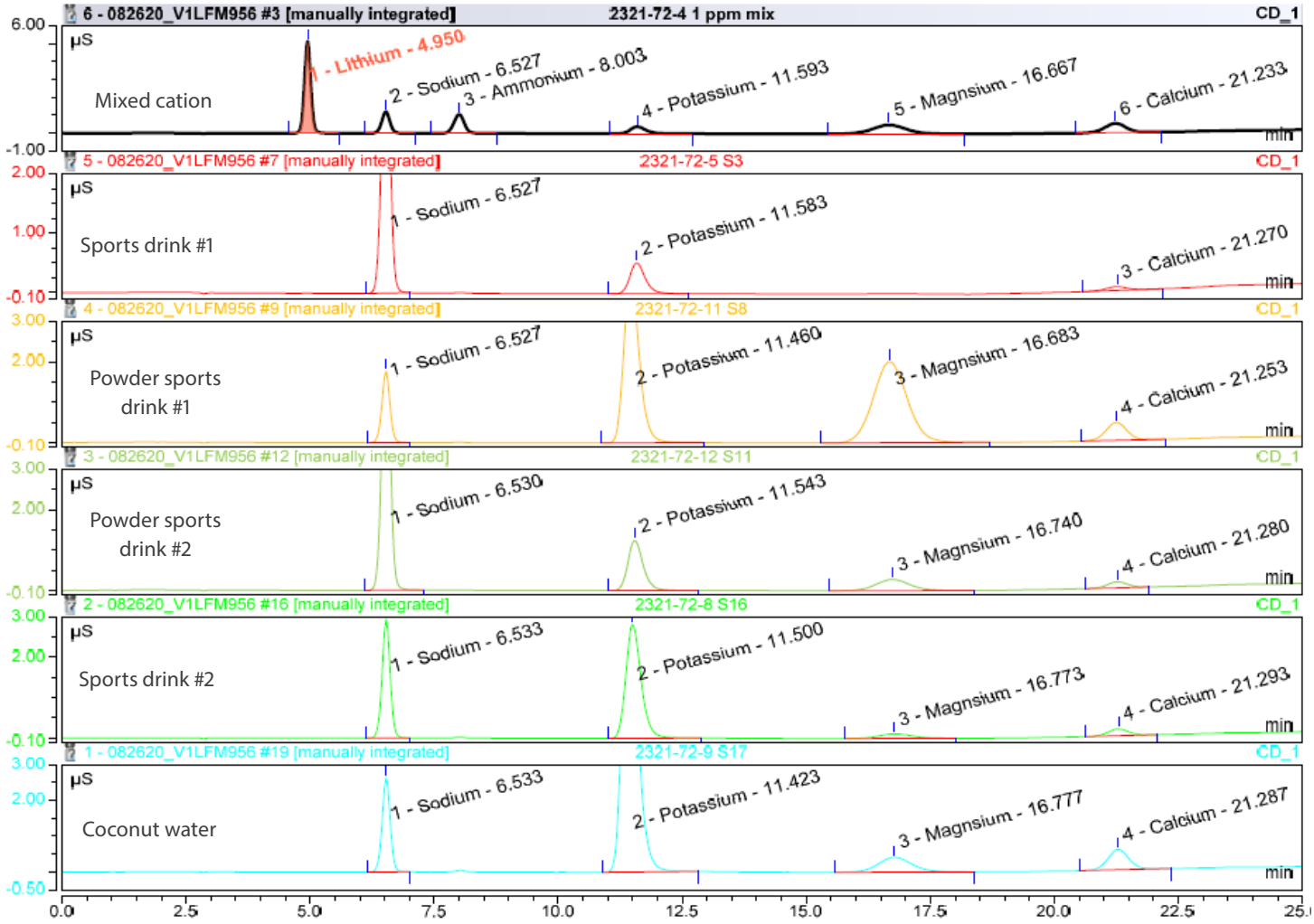

Figure 2. IC chromatogram of mixed cation standard and prepared samples