Determination of caffeine by direct titration

Fast and accurate potentiometric determination of caffeine in nonaqueous samples

Summary

Caffeine is a natural substance found in many foods including coffee, black and green tea, cola, mate, guarana, energy drinks and, to a lesser extent, cocoa and chocolate.

Chemically speaking, caffeine is considered a weak base. It can be titrated accurately in nonaqueous media if a very strong acid is used as the titrant. The strongest acid in nonaqueous media is perchloric acid ($HClO_4$) in glacial acetic acid.

Direct titration is particularly suitable for determining the purity of caffeine. Even highly concentrated caffeine samples (e.g., pharmaceuticals) or water-insoluble samples (e.g., cosmetics and oils) can be titrated well in this way.

In this Application Note, caffeine content in nonaqueous samples is accurately and reliably determined by direct titration using the OMNIS Titrator equipped with a dSolvotrode.

Configuration

2.1001.0320 - OMNIS Professional Titrator with magnetic stirrer
Innovative, modular potentiometric OMNIS Titrator for stand-alone operation or as the core of an OMNIS titration system for endpoint titration and equivalence point titration (monotonic/dynamic). Thanks to 3S Liquid Adapter technology, handling chemicals is more secure than ever before. The titrator can be freely configured with measuring modules and cylinder units and can have a rod stirrer added as needed. Including "Professional" function license for parallel titration with additional titration or dosing modules. Control via PC or local network; Connection option for up to four additional titration or dosing modules for additional applications or auxiliary solutions; Connection option for one rod stirrer; Various cylinder sizes available: 5, 10, 20 or 50 mL; Liquid Adapter with 3S technology: Secure handling of chemicals, automatic transfer of the original reagent data from the manufacturerMeasuring modes and software options:; Endpoint titration: "Basic" function license; Endpoint and equivalence point titration (monotonic/dynamic): "Advanced" function license; Endpoint and equivalence point titration (monotonic/dynamic) with parallel titration: "Professional" function license;

Samples and sample preparation

This application is demonstrated on caffeine standard, guarana extract concentrate, and jojoba cosmetic oil. Sample preparation is not required.

Experimental

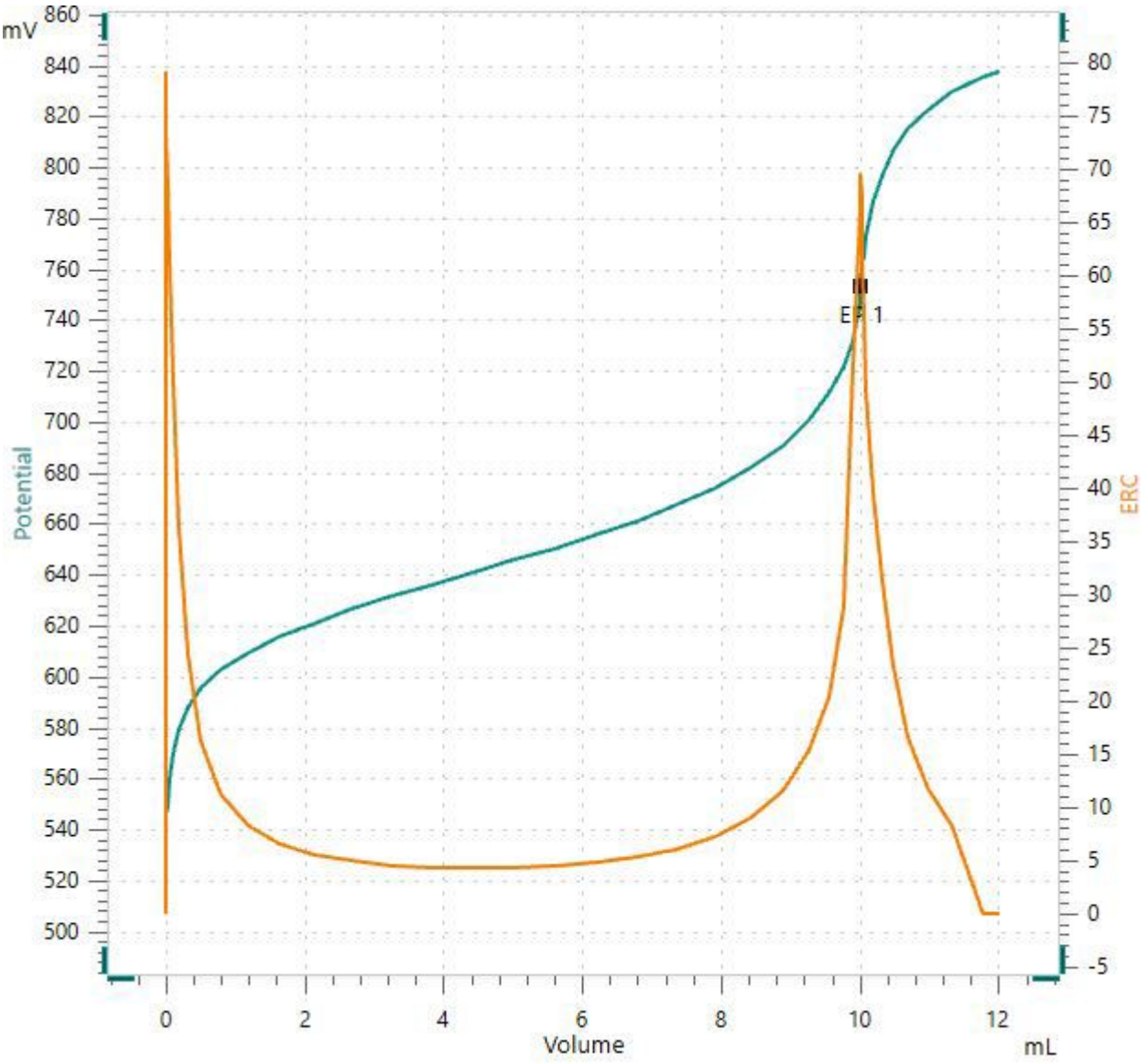

Figure 1. Exemplary titration curve of caffeine standard (Table 1) with perchloric acid in acetic acid as titrant.

An appropriate amount of sample is weighed into the titration beaker. Glacial acetic acid, acetic anhydride, and toluene are then added. While stirring, the solution is titrated until after the first equivalence point with standardized perchloric acid in acetic acid (**Figure 1**). The determination is carried out with an OMNIS Titrator equipped with a dSolvotrode (**Figure 2**).

Figure 2. OMNIS Titrator equipped with a dSolvotrode electrode for the determination of caffeine content in nonaqueous samples.

Results

This method offers very accurate results, as displayed in **Table 1**.

Table 1. Results of caffeine determination in different nonaqueous samples.

Sample (n = 6)	Caffeine in %	SD(rel) in %
Caffeine standard	100.5	0.7
Guarana extract concentrate	54.1	2.9
Jojoba cosmetic oil	0.4	4.7

Conclusion

Direct titration is a simple and precise way to accurately measure the caffeine content in different nonaqueous products. The OMNIS Titrator equipped with a dSolvotrode reliably determines caffeine through flexible analyses combined with high-end software. The dSolvotrode is optimized for nonaqueous titrations and due to its flexible ground-joint diaphragm, it is especially suitable for contaminated samples.

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