



Application Note AN-V-235

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Determination using anodic stripping voltammetry after dry ashing in a muffle furnace

The element cadmium (Cd) is toxic to humans and can be found in the environment as a natural contaminant. Some soils contain increased cadmium concentrations in combination with high bioavailability. Under such conditions, the cacao tree can accumulate cadmium, mainly in the beans, which are then processed into cocoa. Chocolate produced from the affected beans will contain elevated cadmium levels.

To reduce the risk for consumers the maximum concentration in chocolate and other foods is often limited by the government. Typical limit values in the European Union are between 100

$\mu\text{g}/\text{kg}$ and 800 $\mu\text{g}/\text{kg}$ (EU Commission Regulation 1881/2006) depending on the cocoa content of the chocolate. Chocolate produced from cocoa beans with increased cadmium concentrations may exceed the maximum concentration limit.

Anodic stripping voltammetry (ASV) can be used to accurately determine trace quantities of cadmium in chocolate down to approximately 10 $\mu\text{g}/\text{kg}$. The method is simple to perform, specific, and free of interferences. Prior to determination the samples are ashed in a furnace at 450 ° C.

SAMPLES

Dark chocolate, milk chocolate, cocoa powder

EXPERIMENTAL

First, the samples are mineralized by dry ashing in a furnace at 450 ° C for 16 hours. The remaining ash is then dissolved in a small amount of concentrated nitric acid and diluted with ultrapure water. The cadmium determination is carried out on the 884 Professional VA with the Multi-Mode Electrode pro as working electrode using the parameters listed in **Table 1**. The concentration of Cd is determined by two additions of Cd standard addition solution.



Figure 1. 884 Professional VA

Table 1. Parameters for ASV analysis of Cd in chocolate

Parameter	Setting
Working electrode	HMDE
Mode	DP – Differential Pulse
Deposition potential	-0.8 V
Deposition time	60 s
Start potential	-0.8 V
End potential	-0.2 V
Peak potential Cd	-0.55 V

ELECTRODES

- Working electrode: Multi-Mode Electrode pro with silanized glass capillaries
- Reference electrode: Ag/AgCl/KCl (3 mol/L) reference electrode with electrolyte vessel. Bridge electrolyte: KCl (3 mol/L)
- Auxiliary electrode: Platinum rod electrode

RESULTS

The determination of Cd in dissolved ash of chocolate samples can be carried out in a simple and straightforward manner with ASV. The method is selective and free of interferences. It is

suitable for cadmium concentrations down to 10 $\mu\text{g/kg}$ with respect to the solid chocolate sample.

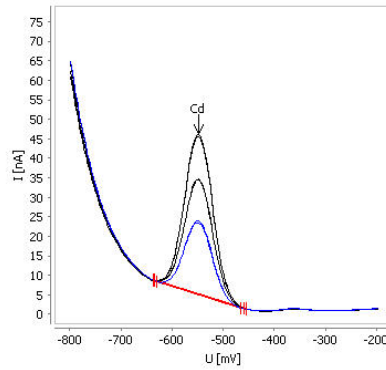


Figure 2. Determination of Cd in dark chocolate (72% cocoa).

Table 2. Results of Cd analysis with the 884 Professional VA

Sample	Cd [$\mu\text{g/kg}$]
Milk chocolate (29% cocoa)	10.4
Milk chocolate (34% cocoa)	37.0
Dark chocolate (72% cocoa)	164
Dark chocolate (87% cocoa)	346
Cocoa powder	98.2

Internal reference: AW VA CH4-0579-032019

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CONFIGURATION



(MME) 884 Professional VA manual

用于多模式 (MME) 的 884 Professional VA manual 是借助多模式 pro 或 scTRACE Gold 或液滴使用伏安法和法行痕量分析的入器。此已的瑞士万通技与恒位/恒位以及外接的活 viva 件用,在重金属定域中展了新的前景。有的校准器的恒位在每次量之前均自冲洗行校准,保可能的高精度。

通此器也可使用旋行定,例如借助«循伏安溶出法»(CVS)、«循脉冲伏安溶出法»(CPVS)和位法(CP)定池中的有机添加。借助可更的量,可在使用不同的各用之快速切。

使用 viva 件行控制、数据采集和估。

用于 MME(多模式)的 884 Professional VA manual 供配大量附件,包括用于多模式 pro 的量。和 viva 可独。



VA pro Professional VA

整套,用于和伏安定。包含多模式 pro、参比、助、量杯、拌器、解溶液和其它用于建工作台以及行多模式的附件。