食品和飲料分析

食品和飲料
的酸度測定

滴定儀
pH計、電極

酸度測定指南

經過驗證的分析方法和結果

METTLER TOLEDO

食品的酸度是食品行業的一個重要參數。在口味方面存在個人差異和文化差異，同時考慮到耐儲藏性，因此有必要密切監測食品的酸度。以下指南介紹了根據產品和要求測定酸度和酸含量的不同方法。

目錄 **2**

1. 簡介

酸度是食品中的一項重要參數。酸度不僅如上述會影響食品的味道，同時也會影響微生物的生長能力，比如細菌和真菌。一般來說，食品的酸度越高，就越不容易受微生物腐蝕。例如，食品中最危險、也最為人熟知的微生物是肉毒桿菌，這種細菌會產生多種毒素，並且造成了無數人類死亡案例。酸有助於抑制細菌生長，這樣一來，商業食品加工企業就可以利用熱罐裝工藝，而無需達到 121 °C 以上。這樣就大大減少了灌裝成本。

酸性食品依靠一種或多種食品酸味劑來達到穩定狀態，比如檸檬酸、蘋果酸或醋酸。從古至今我們一直利用酸的特性來保藏食品。通常稱為酸洗。酸洗是一種通過在鹽水中進行厭氧發酵產生乳酸來保藏食品的工藝，或者在酸性溶液（比如醋）中儲存食品的工藝。據說這種工藝起源於4000 年前的印度，透過本地黃瓜泡製 “ 醃菜 ”。
食品中的酸需要嚴格管制。例如，美國 FDA 將 pH 值在 4.6 或 4.6 以下的食品分成了4 類：酸性、配方酸、酸化和豁免食品。

酸性食品	配製酸性食品	酸化食品	豁免食品
酸性食品的天然 pH 值不超過 4.6。比如大多數水果。	配製酸性食品是由少量的低酸性食品配製而成的酸性食品。 例如食品敷料（蛋黃醬）和調味醬（番茄醬、燒烤醬）。	“ 酸化食品 ” 為低酸食品，其中添加了酸或酸性食品，比如醋。它們的水分活性在 0.85 以上，最終的 pH 值不超過 4.6。 例如酸黃瓜和泡椒。	豁免食品是（a）保存在冰箱中，或者（b）水分活性不超過 0.85。碳酸飲料除外。 例如巧克力醬。

圖1：美國 FDA 對酸性食品的分類，酸性食品指南草案

食品的酸度通常由pH 計和滴定儀來測量。 pH 計（和電極）測量的是 pH 值。滴定儀準確測量出酸含量。酸度往往也表明食品是否新鮮或是否保藏得當。例如：

- 新鮮牛奶的 pH 值低於 6.8 則表明奶牛的白細胞受到了感染。
- 牡蠣洗滌液的 pH 值表明清潔過程是否已完成。否則致命的毒素可能會進入吃牡蠣的人體內。
- 將巴氏消毒品和冷沙拉的 pH 值（通常為 5.3）降低到 4.1 可延長保存期。
- 泉水和井水 pH 值的細微變化表明天然地層可能積存了污垢。

本指南的以下章節將深入探討酸的應用、方法和建議以及酸含量的測定。

2. 解決方案總覽

酸度和酸含量測定
滴定 - 經典的定量化學分析 - 是確定各類樣品中酸度和酸含量的理想方法。梅特勒-托利多提供的自動滴定儀類型齊全，能夠滿足食品和飲料行業所有工作場所的客戶的需求。

pH 值
pH 值是另一個經常會測量、與酸度相關的參數。雖然只有食品和飲料行業的樣品才會測量 pH 值，但實際上它在所有的實驗室都是一個基本參數。過去，往往試紙上的讀數就足夠了。現在，結果需要更精確、更準確，並且可追蹤。因此採用實驗室台面式的或者便攜式pH 計和電極。從梅特勒-托利多齊全的pH 計和電極中選擇適合的類型來滿足您的要求。

	滴定	pH 值 台面式儀錶	pH 值 攜帶型儀錶	分析天平	精密天平
酸度	■			■	■
總酸值	■			■	■
抗壞血酸（維生素 C）	■			■	
檸檬酸含量（檸檬酸）	■			■	
二氧化硫/亞硫酸	■			■	
pH 值		■	■		

3. 滴定測定

酸度

方法
食品和飲料樣品中可能含有不同的酸或者混合了各種酸。大多數酸為有機酸，比如醋酸、檸檬酸、酒石酸或蘋果酸。同時無機酸也會用作飲料成分，如磷酸。
酸度或者酸含量只需用氫氧化鈉(0.1 M NaOH) 滴定至等當點或者預定義的pH 絕對終點。與之前通過傳統的顏色指示劑方法獲得的結果相比，pH 終點更為可取。
這一結果通常指的是主要的酸性成分，比如酒中的酒石酸或醋中的醋酸。

酸度結果

樣品	平均值	RSD %	n
醋	4.74 % 乙酸	0.15	6
紅酒	5.28 g/L 酒石酸	0.24	6
白酒	4.35 g/L 酒石酸	1.03	6
蘋果汁	6.38 g/L 蘋果酸	0.17	6
柳橙汁	6.97 g/L 檸檬酸	0.14	6

提示與訣竅

- 液體通過去離子水即可稀釋。使用梅特勒-托利多的標準滴定燒杯時，建議樣品的體積為 40 – 50 毫升。這樣就可以確保 pH 指示電極恰好浸入樣品中。
- 用不含二氧化碳的去離子水稀釋樣品。
- 碳酸樣品在超聲清潔器中脫氣 5 分鐘，以去除二氧化碳。但是，可能需要煮沸才能實現完全脫氣。
- 大多數情況下，酸度測定過程輕鬆且順利。中和反應十分迅速。因此，滴定的速度會很快，從而縮短分析時間。請參閱應用說明或滴定儀操作手冊，了解最佳滴定速度控制參數。

更多詳情

食品和飲料 06 和滴定應用 M400
食品和飲料 08

圖1：適合日常基本應用的典型自動滴定儀，採用One Click®（一鍵操作）用戶界面。梅特勒-托利多精巧型滴定儀 G20

抗壞血酸（維生素 C）測定

方法

抗壞血酸在酸性溶液中會與2,6-二氯酚靛酚(DPI) 發生反應。氧化測定試驗通過伏安法來完成。由雙鉑針電極指示。在伏安法滴定中，電極加載了恆定極化電流。在等當點附近電位突越明顯。

抗壞血酸結果

樣品	平均值	RSD %	n
柳橙汁	42.13 mg / 100 g	0.34	3
蘋果汁	0.89 mg / 100 g	2.49	3
西柚汁	25.03 mg / 100 g	1.04	5
奇異果	102.0 mg / 100 g	0.59	3

提示與訣竅

- 抗壞血酸對光、溫度和氧氣很敏感。因此請避免或者減少樣品接觸這些。
- 果汁樣品中含有果肉或者其它不溶性微粒，需要充分攪勻，才能進行可重複的分析。用力搖晃，或者使用攪拌器。
- 大多數情況下，果汁不需要進行過濾，因為即使含有大量的果肉也不會影響試驗分析。
- 如果水果需要分析，則要切碎或者攪拌。縮短混勻過程，以防止抗壞血酸氧化。
- 分析樣品的大小取決於抗壞血酸的含量。採用0.02M DPI 滴定劑，並且滴定劑的消耗量最多不超過一管，因此可以滴定的抗壞血酸量如下：
  10 mL 滴定管 5 – 15 mg 抗壞血酸
  5 mL 滴定管 2.5 – 7 mg 抗壞血酸
- 將樣品的 pH 值調整至 pH 3。添加草酸溶液降低 pH 值，或者添加氫氧化鈉溶液增加pH 值。在DPI滴定步驟前，在滴定儀中創建 pH 電極的校正步驟。這樣，滴定程序即可完全自動運行。
- DPI 滴定溶液必須每天新鮮配置，並保存在棕色的玻璃瓶中。
- 也可利用安培法獲得試驗反應。這種情況下，在雙鉑針電極上添加恆定的極化電壓，通過電流的變化來指示終點。安培法滴定曲線需要特殊的“ 折線評估 ”模式進行正確評估。

更多詳情

食品和飲料 07 和滴定應用 M411

檸檬酸含量測定

方法

用硫酸銅 (0.05 M CuSO4) 滴定樣品。銅(II) 離子與檸檬酸鹽形成穩定的1:1 絡合物。銅離子選擇電極檢測到銅離子後則表明達到了滴定終點。
碳酸水需要脫氣。下一準備步驟是陽離子交換。接著，在樣品中加入硼砂。最後，氫氧化鈉溶液將 pH 值提高到 9.4。

檸檬酸結果

樣品	平均值	RSD %	n
含檸檬酸的礦泉水	3.068 g/L	0.44	6

提示與訣竅

- 每次滴定後，將 Cu-ISE 過段時間放在去離子水中。
- 滴定之前用電極（如DGi115-SC）測量 pH 值。這樣可以證明是否確定了正確的 pH 值。
- 現在的自動滴定儀可全自動完成整個步驟，包括添加硼砂溶液、氫氧化鈉和甲醇。
- 另外，可通過 NaOH 進行終點滴定，將 pH 值調整至9.4。在這種方法中，在硫酸銅滴定功能之前插入輔助滴定功能。

更多詳情

食品和飲料 11 和滴定應用 M472

亞硫酸/二氧化硫

方法

二氧化硫或亞硫酸通過碘量滴定法來測定。伏安法採用雙鉑針電極。滴定劑為碘溶液 (0.02 M ½ I_2) 。

2 個方法：

- 游離二氧化硫：測定直接與碘反應的二氧化硫。
- 總二氧化硫：游離二氧化硫和結合二氧化硫的總和。滴定之前添加 5 mL 氫氧化鈉(5 M NaOH)，會釋放出與醛、酮或者其它化合物結合的二氧化硫。混合過程中需等待 15 分鐘。接著，樣品被硫酸酸化，採用與游離二氧化硫相同的測定方式進行測定。

游離二氧化硫結果

樣品	平均值	RSD %	n
紅酒	10.07 mg/L	1.00	5
白酒	26.43 mg/L	1.54	4
玫瑰紅葡萄酒	14.95 mg/L	0.72	5

總二氧化硫結果

樣品	平均值	RSD %	n
紅酒，西班牙	135.28 mg/L	2.34	5
紅酒，瑞士	73.34 mg/L	0.60	4
白酒	86.42 mg/L	1.44	3

提示與訣竅

- 打開瓶子後必須立即採集樣品，進行滴定，避免二氧化硫溢出。
- 試驗僅在酸性溶液中發生反應。因此，要加入濃度為 25% 的硫酸。添加過程可用滴管手動完成，或者用自動滴定儀的外置滴定管全自動完成。
  游離二氧化硫中加入 5 mL
  總二氧化硫中加入 7 mL
- 伏安法中，雙鉑針電極上添加合適的極化電流。
- 每種樣品必須以完全相同的方式執行方法程序，以達到良好的重現性。

更多詳情

食品和飲料 09 和滴定應用 M419
滴定應用 M564

圖2：進行全自動分析和數據管理的滴定解決方案。梅特勒-托利多卓越系列 T90，和 Rondo 20 自動進樣器

4. pH 值測量

所有的食品都由我們的味覺器官進行檢驗和品嚐。因此我們會發現有些食品呈酸性，有些食品呈鹼性。這樣看來，食品 pH 值的定性測定可能是世界上最古老的分析方法。採用現代的pH 電極和pH 計，可以重複客觀地測量味覺的具體數值。

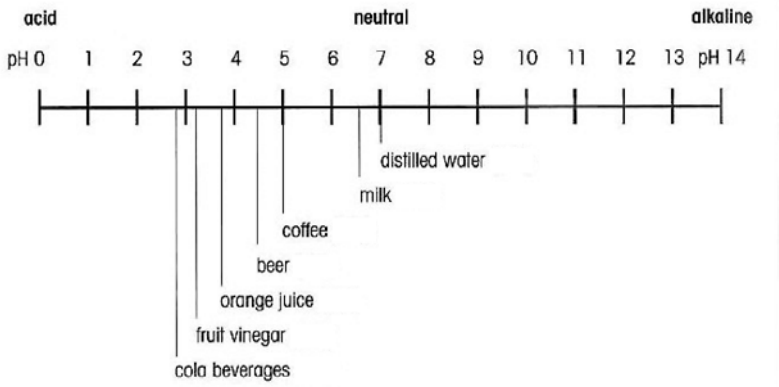


圖 2：各類食品的 pH 範圍和 pH 值

經典 pH 電極的傳感元件為球形、圓柱形、針刺形或扁平的玻璃膜。研發出的不同類型的玻璃膜具有不同的屬性，比如低溫和低離子濃度適應型、耐高溫型或寬 pH 值範圍。

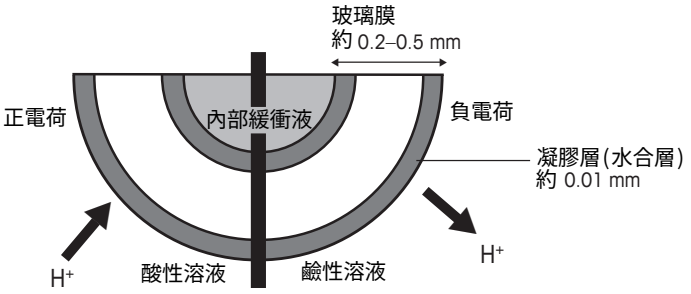


圖 3：玻璃膜圖解

校準

pH 電極需要定時校準。根據準確度需要和?品的類型可幾分鐘校準一次，也可幾小時校準一次。一點校准通常在 pH 7.00 處進行，僅補償零點漂移。可快速獲取大概結果。兩點校準還可大大補償斜率偏差，能夠提高測量的準確度。選擇校準範圍時要考慮測量值。例如，如果樣品pH 值在 4.01 和 6.99 之間，那麼 pH 緩衝液的校準範圍則在 4.00 和 7.00 之間。

溫度補償

溫度影響電極的斜率和等溫點。對斜率的影響可由pH 計的溫度補償器進行補償。現在的 pH 計具備自動溫度補償 (ATC) 功能。

如果採用的是 “ 三合一 ” 電極，則要進行溫度測量。否則需要單獨安裝溫度感測器。

但是，樣品本身 pH 值受溫度影響發生變化後不會自動補償，因為這是由樣品的化學特性決定的。

結果

樣品	pH 值 平均值	pH 值 RSD %	n
紅酒	3.74	0.04	6
白酒	3.37	0.07	6
蘋果汁	3.36	0.11	6
柳橙汁	3.89	0.02	6
蕃茄汁	4.14	0.08	6
馬鈴薯汁	4.26	0.01	6

提示與訣竅

- 為您的應用選擇合適的 pH 電極。請參見《電極選擇指南》，網址 :www.electrodes.net。
- 蛋白質接觸KCl 參考電解液可能會在液絡部形成沉澱。液絡部堵塞會造成電極響應遲鈍，不必要地延長測量時間。將電極浸入胃蛋白?液/鹽酸溶液幾個小時可清除液絡部的堵塞。但是，使用適合的電極和電解液可避免沉澱問題。
- Ag/AgCl 參考電極的參考電解液常含有溶解的銀離子。樣品中的硫化物形成不溶性硫化銀。硫化銀 Ag2S 堵塞液絡部，將其染成黑色，並且導致測量值不穩定。將電極浸入硫?溶液/鹽酸溶液可清除液絡部的堵塞。利用帶有銀離子屏障的參考系統，可保證參考電解液中沒有銀離子。
- 用乙醇沖洗電極可清除電極上的脂肪層。然後，將電極短時間置於 0.1 M 鹽酸溶液或電解液中，重新對傳感玻璃膜進行水化。
- 用穿刺電極測量魚、肉、奶酪和其它 “ 軟質固體 ” 樣品的 pH 值。
- 電極桿採用聚佩或 PEEK 材質製成，十分堅固，不會再發生破裂。
- 遵守 pH 緩衝液的有效期。
- 離子濃度低導致樣品電導率低，例如去離子水、油或酒精，從而造成 pH 值讀數不穩定。利用採用圓形套筒液絡部的電極來確保電解液順暢流動，並且保證感測元件與參考電極間保持良好的連通性。

更多詳情

滴定應用 M560
滴定應用 M494

圖3：通用 pH 計配有自定義的超大彩色顯示螢幕。梅特勒-托利多SevenCompact S220 pH 計，配有 uPlace™ 電極支架

5. 總結

本文中介紹了幾種測定不同類型酸的酸度和含量的方法。其中包括適用於現代分析儀器的方法，比如自動滴定儀和 pH 計，並且闡述了自石蕊試紙和甲基橙指示劑時代以來取得的發展。
一般情況下，自動解決方案比手動方法提供的結果準確度和可重複性更高。效率有所提高，繁瑣的日常任務轉由儀器完成。
梅特勒-托利多為食品實驗室提供適合的儀器，並選擇相應的方法。了解有關我們產品的更多訊息，並聯繫我們的專家，就如何從梅特勒-托利多在食品行業的專業知識中受益獲取建議。

6. 更多訊息

如果您喜歡這一指南，我們會很高興為大家呈現梅特勒-托利多在食品行業的一系列指南。
請點擊以下連結訪問對應的食品指南。

鹽度測定指南	**www.mt.com/salt-lab**
糖份含量測定指南	**www.mt.com/sugar-lab**
配方指南	**www.mt.com/formulation-lab**
食用脂和油脂檢測指南	**www.mt.com/fat-lab**
濕度和水含量測定指南	**www.mt.com/moisture-lab**

有關產品的更多訊息

滴定儀	**www.mt.com/titration**
pH 計和電極	**www.mt.com/pH**

應用手冊

食品和飲料滴定應用手冊，滴定應用手冊31，梅特勒-托利多30057646
橙汁的甲醛量、酸度和白利糖度值，Ti-Note 食品和飲料16 飲料測定，滴定應用手冊19，
梅特勒-托利多 51725013 pH 值測量指南，梅特勒-托利多51300047

外部資源

維基百科，如 http://en.wikipedia.org/wiki/Pickling
FDA, 如酸性和低酸性灌裝食品 (LACF)

7. 附錄

食品和飲料 06
食品和飲料 07
食品和飲料 08
食品和飲料 09
食品和飲料 11

Acetic acid content in vinegar

The acetic acid content is determined in vinegar by titration with sodium hydroxide.

Sample	- Vinegar, 0.7 – 1g
Preparation and procedures	- Approx. 1g vinegar in a titration beaker. - Add 50mL of deionized water. - Titrate it with 0.1 mol/L sodium hydroxide.
Compound	- Acetic acid, CH_3COOH - M = 60.05 g/moL, z = 1
Chemicals	- Deionized water - Sodium hydroxide
Titrant	- Sodium hydroxide, NaOH - c(NaOH) =0.1 mol/L
Standard	- Potassium hydrogen phthalate,
Instruments, Accessories	- T50/T70/T90 Titration Excellence, G20 Compact Titrator, - Rondo or Rondolino Sample Changer, - DV1010 10 mL glass burette, - 100 mL PP titration beakers, XS205 Balance, LabX® pro titration software
Indication	- DG115-SC (Combined pH glass electrode)
Results	- Acid content: 4.738 ± 0.007% srel = 0.152% n = 6
Waste	- Neutralization before final disposal as aqueous solution.
Comments	- Use safety goggles, wear gloves and a lab coat. - The method parameter has been optimized for the sample used in this application. It may be necessary to slightly adapt the method to your specific sample. - Adjustment of the DG115-SC pH glass electrode. The electrode is adjusted using pH buffers 4.01, 7.00 and 9.21 before starting the analysis. - The titer of sodium hydroxide is determined using potassium hydrogen phthalate as a primary standard; 80mg is dissolved into 50mL deionized water and titrated. - The rinsing time was defined to 2s. In this way, the electrode is cleaned with deionized water before starting the subsequent sample.
Literature	- Mettler-Toledo Titration Application M400-2009
Author	Thomas Hitz, MSG, July 2006. Ralph Egli, MSG, May 2009. Compiled by: Vineesh Pallath, IMSG AnaChem, June 2012 – v1.0 Revised: V. Gärtner – MSG AnaChem, August 2012

Titration method

001 Titration

Type	General titration
Compatible with	T50/T70/T90
ID	M400
Title	Acetic acid content in vinegar
. . . .	

002 Sample

Number of IDs	1
ID 1	Vinegar
Entry type	Weight
Lower Limit	0.7g
Upper Limit	1.0g
. . . .	

003 Titration stand (Rondolino TTL)

Type	Rondolino TTL
Titration stand	Rondolino TTL1

004 Stir

Speed	35%
Duration	10 s
Condition	No

005 Titration (EQP) [1]

Titrant

Titrant	NaOH
Concentration	0.1 mol/L

Sensor

Type	pH
Sensor	DG115-SC
Unit	pH
. . . .	

Stir

Speed	35%

Predispense

Mode	Volume
Volume	1 mL
Wait time	5 s

Control

Control	User
Titrant addition	Dynamic
dE (set value)	12 mV
dV (min)	0.002 mL
dV (max)	0.5 mL
Meas. Value acquisition	Equilibrium controlled
dE	0.5 mV
dt	1 s
t (min)	3 s
t (max)	30 s

Evaluation and recognition

Procedure	Standard
Threshold	5 pH/mL
Tendency	Positive
Ranges	0
Add EQP criteria	No

Termination

At Vmax	10.0 mL
At potential	No
At slope	No
After number of recognized EQPs	Yes
Number of EQPs	1
Combined termination criteria	No

Accompanying stating

Accompanying stating	No

Condition

Condition	No

006 Calculation R1

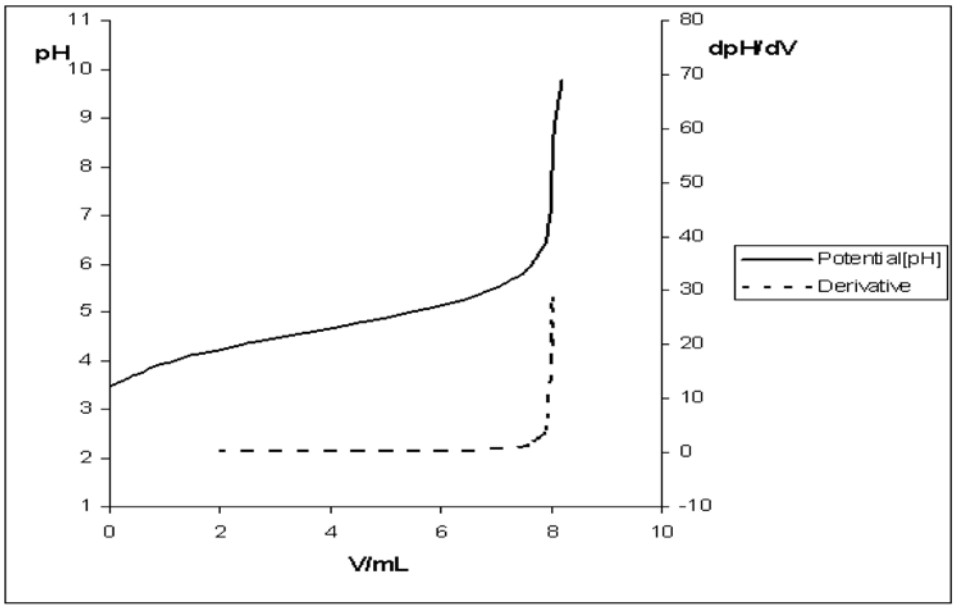
Result	Content
Result unit	%
Formula	R1=Q*C/m
Constant C	M/(10*z)
M	M[Acetic acid]
z	z[Acetic acid]
Decimal places	3
Result limits	No
Record statistics	Yes
Extra statistical func.	No
Send to buffer	No
Condition	No

007 Record

Results	Per series
Raw results	Per series
Table of meas. Values	Last titration function
Sample data	Per series
Resource data	No
E - V	Last titration function
dE/dV - V	Last titration function
log dE/dV - V	No
dE/dV - V	No
Beta - V	No
E - t	No
V - t	No
dV/dt - t	No
T - t	No
E- V & dE/dV - V	No
V - t & dV/dt - t	No
Method	No
Series data	No
Condition	No

008 End of sample

Titration curve



Vitamin C Content in Orange Juice: Voltametric Indication

Content determination of vitamin C (ascorbic acid) in orange juice by voltametric titration with DPI. The titration is monitored by a polarized DM143 electrode.

Sample	- Orange Juice, 5 g
Preparation and procedures	- The juice is well homoginised and is weighed directly into the titration beaker and diluted with 50mL deionised water. - After addition of 50mL deionised water the sample can be purged with nitrogen gas to avoid oxidation of vitamin C - The pH value is adjusted to pH 3 with 2% oxalic acid by titrating the sample using an EP titration function.
Compound	- L(+) ascorbic acid, $C_6H_8O_6$ - M = 176.13 g/moL, z = 2
Chemicals	- 50mL Deionized water, - 2% Oxalic acid for adjustment to pH 3
Titrant	- 2,6-dichlorophenolindophenol, DPI - c(1/2 DPI) = 0.01 mol/L
Standard	- Ascorbic acid, 0.01 mol/L
Instruments, Accessories	- T50/T70/T90 Titration Excellence, G20 Compact Titrator, - Rondo Sample Changer, Cover Up,T-Box with connecting cable - DV1010 10 mL glass burette, - 100 mL PP titration beakers, XS205 Balance, LabX® pro titration software
Indication	- DM143-SC (Double pin platinum electrode)
Results	- Vitamin C: 34.816 ± 0.334 mg/100g srel = 0.960% n = 5
Waste	- Neutralization before final disposal as aqueous solution.
Comments	- Use safety goggles, wear gloves and a lab coat. - The method parameters have been optimized for the sample used in this application. It may be necessary to slightly adapt the method to your specific sample. - Both DPI and ascorbic acid standard solution are not stable. To get accurate results, it is recommended to prepare them fresh before use. - The DPI titrant has to be stored in brown glass bottles to protect it from light. - Ascorbic acid is sensitive to light, temperature and oxygen. Titration beakers with light protection as well as use of purge gas are recommended. Keep in the dark. - The sample size depends on the amount of vitamin C: 1 -15 mg vitamin C corresponds to 0.5 – 8.5mL 0.01 mol/L ½ DPI - This method describes the voltametric determination of L(+) ascorbic acid with a polarized sensor DM143-SC. An alternative the current of 10 -12 µA is applied to the double pin platinum electrode and the potential is measured.
Literature	- Mettler-Toledo Titration Application M411-2006
Author	Thomas Hitz, MSG, July 2006. Compiled by: Vineesh Pallath, IMSG AnaChem, June 2012 – v1.0 Revised: V. Gärtner – MSG AnaChem, August 2012

Titration method

001 Titlе

Type	General titration
Compatible with	T50/T70/T90
ID	M411
Title	Vitamin C content
. . . .	

002 Sample

Number of IDs	1
ID 1	Orange Juice
Entry type	Weight
Lower Limit	0.0g
Upper Limit	10.0g
. . . .	

003 Titration stand (Manual stand)

Type	Manual stand
Titration stand	Manual stand1

004 Stir

Speed	35%
Duration	10 s
Condition	No

005 Titration (EQP) [1]

Titrant

Titrant	½ DPI
Concentration	0.01 mol/L

Sensor

Type	Polarized
Sensor	DM143-SC
Unit	mV
Indication	Voltametric
Ipol	12 µA

Stir

Speed	35%

Predispense

Mode	Volume
Volume	1 mL
Wait time	2 s

Control

Control	User
Titrant addition	Incremental
dV	0.05 mL
Meas. Value acquisition	Equilibrium controlled
dE	2.0 mV
dt	1 s
t (min)	2 s
t (max)	30 s

Evaluation and recognition

Procedure	standard
Threshold	500 mV/mL
Tendency	Negative
Ranges	0
Add EQP criteria	No

Termination

At Vmax	10.0 mL
At potential	No
At slope	No
After number of recognized EQPs	Yes
Number of EQPs	1
Combined termination criteria	No

Accompanying stating

Accompanying stating	No

Condition

Condition	No

006 Calculation R1

Result	Content
Result unit	mg/100g
Formula	R1=Q*C/m
Constant C	100*M/z
M	M[Ascorbic acid]
z	z[Ascorbic acid]
Decimal places	3
Result limits	No
Record statistics	Yes
Extra statistical func.	No
Send to buffer	No
Condition	No

007 Calculation R2

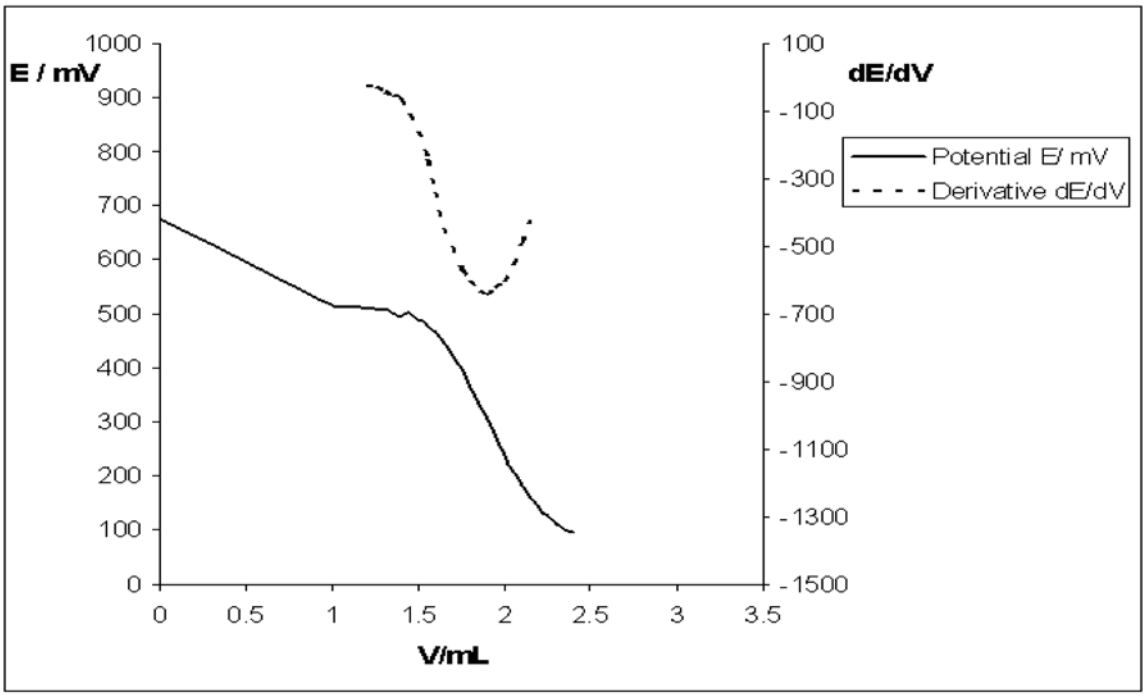
Result	Content
Result unit	%
Formula	R2=Q*C/m
Constant	C=M/(10*z)
M	M[Ascorbic acid]
Z	z[Ascorbic acid]
Decimal places	4
Result limits	No
Record statistics	Yes
Extra statistical function	No
Send to buffer	No
Condition	No

008 Record

Results	Per series
Raw results	Per series
Table of meas. Values	Last titration function
Sample data	Per series
Resource data	No
E - V	Last titration function
dE/dV - V	Last titration function
log dE/dV - V	No
dE/dV - V	No
Beta - V	No
E - t	No
V - t	No
dV/dt - t	No
T - t	No
E- V & dE/dV - V	No
V - t & dV/dt - t	No
Method	No
Series data	No
Condition	No

009 End of sample

Titration curve



Acid Content in Wines and fruit juices

General method for the determination of acidity of wines and juices. The method could easily be adapted for other acid determinations.

Sample	- Wines and Juices, 10mL
Preparation and procedures	- Place 10mL of well homogenized juice or wine into a titration beaker. - Add 40mL of deionized water. - Titrate with 0.1 mol/L NaOH.
Compound	- Malic acid, M = 134.09 g/moL, z = 2 - Citric acid, M = 192.13 g/moL, z = 3 - Tartaric acid, M = 150.09 g/moL, z = 2
Chemicals	- 40mL Deionized water,
Titrant	- Sodium hydroxide, NaOH - c(NaOH) = 0.1 mol/L
Standard	- Potassium hydrogen phthalate
Instruments, Accessories	- T50/T70/T90 Titration Excellence, G20 Compact Titrator, - Rondo or Rondolino Sample Changer, - DV1010 10 mL glass burette, - 100 mL PP titration beakers, XS205 Balance, LabX® pro titration software
Indication	- DG111-SC (Combined pH glass electrode)
Results	- Acid content: 6.380 ± 0.01076 g/L srel = 0.169% n = 6
Waste	- Neutralization before final disposal as aqueous solution.
Comments	- Use safety goggles, wear gloves and a lab coat. - The method parameters have been optimized for the sample used in this application. It may be necessary to slightly adapt the method to your specific sample. - The sample was degassed in an ultrasonic bath for 5 minutes, in order to get rid of CO_2. - Temperature was measured before the titration and the endpoint values were automatically corrected accordingly.
Literature	- Mettler-Toledo Titration Application M561
Author	A.Aichert, N.Spiru, MSG, Compiled by: Vineesh Pallath, IMSG AnaChem, June 2012 – v1.0 Revised: V. Gärtner – MSG AnaChem, August 2012

Titration method

001 Title

Type	General titration
Compatible with	T50/T70/T90
ID	M561
Title	Acid content
. . . .	

002 Sample

Number of IDs	1
ID 1	Apple Juice
Entry type	Fixed volume
Volume	10 mL
. . . .	

003 Titration stand (Manual stand)

Type	Manual stand
Titration stand	Manual stand1

004 Stir

Speed	50%
Duration	60 s
Condition	No

005 Titration (EP) [1]

Titrant

Titrant	NaOH
Concentration	0.1 mol/L

Sensor

Type	pH
Sensor	DG111-SC
Unit	pH

Stir

Speed	35%

Predispense

Mode	Volume
Volume	3 mL
Wait time	0 s

Control

Mode	Absolute
Tendency	Positive
End point value	8.1 pH
Control band	1.0 pH
Dosing rate [max]	1.0 mL/min
Dosing rate [min]	10 µL/min

Termination

At EP	Yes
Termination delay	0 s
At V max	20.0 mL
Max.time	infinite

Accompanying stating

Accompanying stating	No

Condition

Condition	No

006 Calculation R1

Result	Volume
Result unit	mL
Formula	R1=VEQ
Constant C	1
M	M[None]
z	z[None]
Decimal places	3
Result limits	No
Record statistics	Yes
Extra statistical func.	No
Send to buffer	No
Condition	No

007 Calculation R2

Result	Acid content
Result unit	g/L
Formula	R2=Q*C/m
Constant	C=M/z
M	M[Malic acid]
Z	z[Malic acid]
Decimal places	3
Result limits	No
Record statistics	Yes
Extra statistical function	No
Send to buffer	No
Condition	No

008 Record

Results	Per series
Raw results	Per series
Table of meas.Values	Last titration function
Sample data	Per series
Resource data	No
E - V	Last titration function
dE/dV - V	Last titration function
log dE/dV - V	No
dE/dV - V	No
Beta - V	No
E - t	No
V - t	No
dV/dt - t	No
T - t	No
E- V & dE/dV - V	No
V - t & dV/dt - t	No
Method	No
Series data	No
Condition	No

009 End of sample

Titration curve

Not Available

Free Sulphur Dioxide (SO_2) content in Wine

The content of free sulphur dioxide (SO_2) in wine is determined by redox titration with iodine as a titrant. The titration is monitored using a Pt double pin electrode DM143-SC at a fixed polarization current (voltametric indication)

Sample	- 50 mL White wine
Preparation and procedures	- 50mL wine is transferred into a titration beaker with a pipette. - 5mL of 10% potassium iodide solution is added. This step has been performed using an additional dosing unit. It can be performed manually using a pipette. - 5mL 20% sulfuric acid is added to the titration beaker. This step has been performed using an additional dosing unit. If this is not possible, this step can be done manually with a pipette.
Compound	- Sulphur dioxide, SO_2, - M = 64.06 g/moL, z = 2
Chemicals	- 5mL 10% Potassium iodide, KI - 5mL 20% Sulfuric acid, H_2SO_4
Titrant	- Iodine, I_2 - c(1/2 I_2) = 0.02 mol/L
Standard	- Ascorbic acid, $C_6H_8O_6$,
Instruments, Accessories	- T50/T70/T90 Titration Excellence, G20 Compact Titrator, - 2 Additional dosing units. - DV1010 10 mL glass burette, - 100 mL PP titration beakers, XS205 Balance, LabX® pro titration software
Indication	- DM143-SC (Double pin platinum electrode)
Results	- Sulphur dioxide content: 21.185 ± 0.067 mg/L srel = 0.315% n = 6
Waste	- Neutralize the acid waste before final disposal.
Comments	- Use safety goggles, wear gloves and a lab coat. - The method parameters have been optimized for the sample used in this application. It may be necessary to slightly adapt the method to your specific sample. - The titer determination is performed using pure ascorbic acid as a primary standard. - In order to avoid loss of SO_2, the sample must be taken from a freshly opened bottle. After opening the bottle, free SO_2 can evaporate with CO_2 or be oxidized while in contact with air resulting in too low values. - Working with the sample changer leads to SO_2 losses from the sample beakers already prepared on the rack. Therefore, it is recommended to work without a sample changer to achieve a higher accuracy. - Iodine is also reduced by other wine components. These competing reactions can partly be delayed by the addition of 5 mL 10% potassium iodide solution. - The reaction only takes place in acidic medium. Therefore, 5 mL 20% H_2SO_4 must be added immediately before titration.
Literature	- Mettler-Toledo Titration Applications M419-2006, M563 and M564
Author	Claudia Schreiner, MSG, July 2006. Compiled by: Vineesh Pallath, IMSG AnaChem, June 2012 – v1.0 Revised: V. Gärtner – MSG AnaChem, August 2012

Titration method

001 Title

Type	General titration
Compatible with	T50/T70/T90
ID	M419
Title	Free SO_2 content in wine
. . . .	

002 Sample

Number of IDs	1
ID 1	White wine
Entry type	Fixed volume
Volume	50mL
Density	1.0 g/mL
. . . .	

003 Titration stand (Manual stand)

Type	Manual stand
Titration stand	Manual stand1

004 Dispense (normal) [1]

Titrant	10%KI
Concentration	1 mol/L
Volume	5.0 mL
Dosing rate	60.0 mL/min

005 Dispense (normal) [2]

Titrant	20% H_2SO_4
Concentration	1 mol/L
Volume	5.0 mL
Dosing rate	60.0 mL/min

006 Stir

Speed	50%
Duration	10 s
Condition	No

007 Titration (EP) [1]

Titrant

Titrant	½ I_2
Concentration	0.01 mol/L

Sensor

Type	Polarized
Sensor	DM143-SC
Unit	mV
Indication	Voltametric
Ipol	10 µA

Temperature acquisition

Temperature acquisition	No

Stir

Speed	50%

Predispense

Mode	None
Wait time	10 s

Control

Control	User
End point type	Absolute
Tendency	Negative
Endpoint value	100 mV
Control band	30 mV
Dosing rate (max)	1.25 mL/min
Dosing rate (min)	100 µL/min

Termination

At EP	Yes
Termination delay	5 s
At Vmax	20.0 mL
Max. time	600 s

008 Calculation R1

Result	Content
Result unit	mg/L
Formula	R1=Q*C/m
Constant C	M*1000/z
M	M[Sulfur dioxide]
z	z[Sulfur dioxide]
Decimal places	3
Result limits	No
Record statistics	Yes
Extra statistical func.	No
Send to buffer	No
Condition	No

009 Record

Results	Per series
Raw results	Per series
Table of meas. Values	Last titration function
Sample data	Per series
Resource data	No
E - V	Last titration function
dE/dV - V	Last titration function
log dE/dV - V	No
dE/dV - V	No
Beta - V	No
E - t	No
V - t	No
dV/dt - t	No
T - t	No
E- V & dE/dV - V	No
V - t & dV/dt - t	No
Method	No
Series data	No
Condition	No

010 End of sample

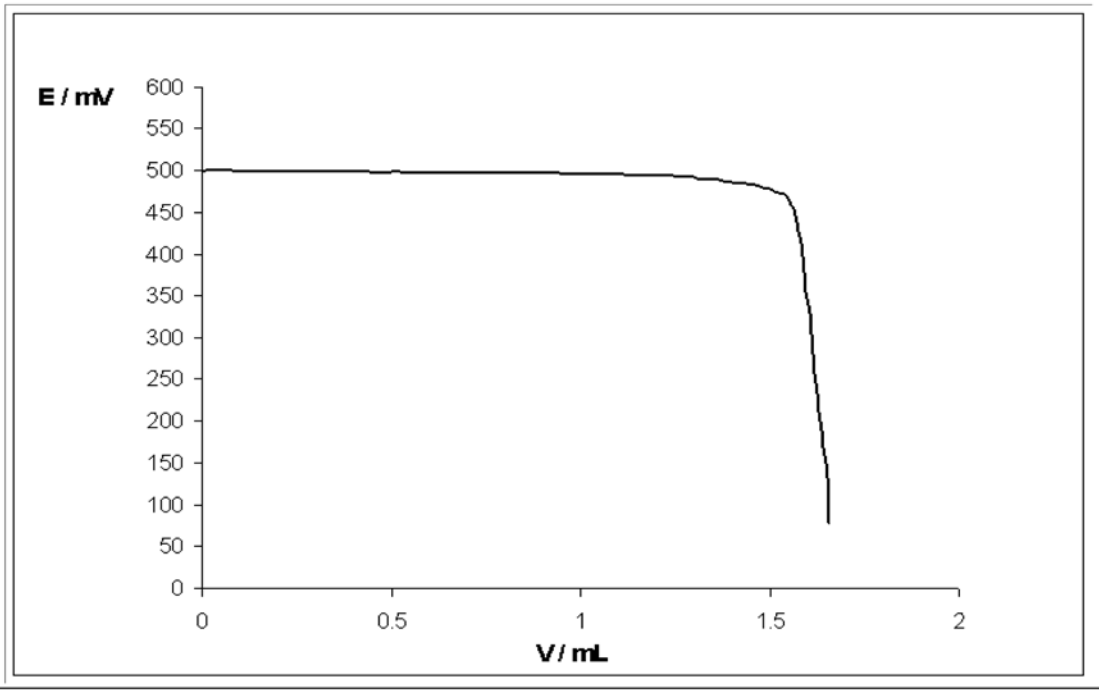
G20 Compact Titrator Method

The G20 method includes slightly modifications

008 Calculation R1

Result type	Predefined
Calculation type	Direct titration
Formula	R1=Q*C/m
Result	Content
Result unit	mg/L
Constant C	M*1000/z
M	M[Sulfur dioxide]
z	z[Sulfur dioxide]
Decimal places	3
Result limits	No
Record statistics	Yes

Titration curve



Citrate content determination using a Cu-Ion selective electrode

Determination of citrate content in mineral water drinks by Potentiometric titration with copper sulphate and a copper ion selective electrode (Cu-ISE) as indicating electrode.

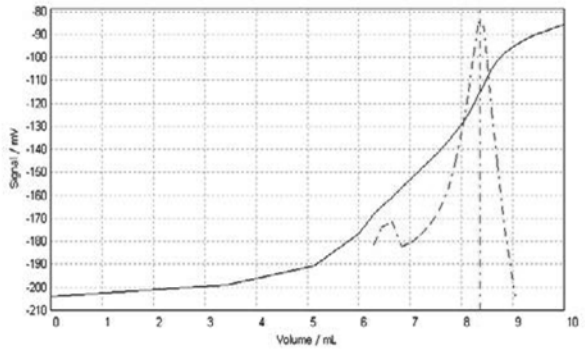
Sample	- Mineral water drinks, containing citrate or citric acid.
Preparation and procedures	- Degas the mineral water for 5 mins first then pass it through a cation exchange resin (Fill a glass tube with approx. 20 g strongly acidic cation exchange resin i.e. Dowex 50 WX8 and rinse it with deionised water, eg. 10 mL. Mineral water drink is run through the column containing the exchange resin, and collected into a beaker. The column is then rinsed with 10 mL deionised water). - Transfer 25mL of sample into a titration beaker. - Methanol, borate buffer and NaOH solutions are added by additional dosing units.
Compound	-Citric acid, $C_3H_5O(COOH)_3$ -M= 192.12 g/mol z = 1 (1:1 soluble complex in solution)
Chemicals	- Deionised water, Methanol. - 0.025 mol/L borax ($Na_2B_4O_7$*$10H_2O$), pH adjusted to 9.0 with 0.1 mol/L HCl. - Strongly acidic cation exchange resin (Dowex 50 WX8) - 1.0 mol/L Sodium Hydroxide (NaOH), 0.1 mol/L Hydrochloric acid (HCl)
Titrant	-Copper sulphate, $CuSO_4$ -c($CuSO_4$) = 0.05 mol/L
Standard	-Sodium thiosulphate
Instruments, Accessories	- T50/T70/T90 Excellence Titrator. - 2 X DV1020 20 mL glass burette, 2 X DV1010 10 mL glass burette, 3 additional dosing units, Rondo 20 sample changer with powershower™ SP250 Peristaltic pump. - 100 mL PP titration beakers(ME-101974), LabX® pro titration software.
Indication	- DGi115-SC pH glass electrode, perfectION™ combination Cu-ISE
Results	-Citrate content : 3.068 ± 0.013 g/L srel = 0.437 % n =6
Waste	- Comply with Federal, State and local regulations. Sweep up crystals, powder or insoluble copper carbonate and dispose as special waste.
Comments	- Use safety goggles, wear gloves and a lab coat. - It may be necessary to adapt the method to your specific sample. - Maintain the sample solution at pH 9.4 with 1 mol/L sodium hydroxide. Borate buffer is used to avoid interferences. - Copper(II) ions Cu^{2+} forms 1:1 stable complex with citrate anions. The free copper(II) concentration is monitored with the combined Cu-ISE. - The electrode is conditioned in deionised water after every titration. If necessary gently polish the Cu-ISE solid state membrane.
Literature	- Mettler-Toledo Titration Application M472-2010
Author	Vineesh Pallath/Claudia Schreiner/Cosimo DeCaro. Compiled by: Sohel Ansari, IMSG AnaChem, April 2012 - v1.0 Revised: V. Gärtner – MSG AnaChem, August 2012

Titration method

001 Title	
Type	General titration
Compatible with	T50/T70/T90
ID	VP0076dispNAOH
Title	Citrate Content
. . . .	
002 Sample	
Number of IDs	1
ID 1	7UP with extraction
Entry type	Fixed Volume
Volume [mL]	25
. . . .	
003 Titration stand (Rondo 60)	
Type	Rondo/Tower A
Titration stand	**Rondo60/**1A
Lid handling	No
004 Dispense (normal) [1]	
Titrant	Methanol
Concentration	100
Volume [mL]	25
. . . .	
005 Dispense (normal) [2]	
Titrant	Borax Buffer 9
Concentration	100
Volume [mL]	25
. . . .	
006 Dispense (normal) [3]	
Titrant	NaOH
Concentration	1
Volume [mL]	2.5
. . . .	
007 Stir	
Speed	35%
Duration	10 s
. . . .	
008 Measure (normal) [1]	
Sensor	
Type	pH
Sensor	DGi115-SC
Unit	pH
Temperature acquisition	
Temperature Measurement	No
Stir	
Speed	35%
Acquisition of measured values	
Acquisition	Equilibrium controlled
dE [mV]	0.5
dt [s]	1
t(min) [s]	2
t(max) [s]	30
Mean value	Yes
No of measured values	4
dt [s]	1
Condition	
Condition	No
009 Titration (EQP) [1]	
Titrant	
Titrant	$CuSO_4$
Concentration[mol/L]	0.5
Sensor	
Type	ISE
Sensor	Cu ISE
Unit	mV
Ion Charge	2
Temperature acquisition	
Temperature Measurement	No
Stir	
Speed	30%
Predispense	
Mode	Volume
Volume [mL]	6
Wait time [s]	10

Control	
Control	User
Titrant addition	Dynamic
dE(set value)[mV]	6.0
dV(min) [mL]	0.02
dV(max)[mL]	0.2
Mode	Equilibrium controlled
dE[mV]	0.5
dt[s]	2.0
t(min)[s]	10
t(max)[s]	30
Evaluation and recognition	
Procedure	Standard
Threshold[mV/mL]	35
Tendency	Positive
Ranges	0
Add. EQP criteria	No
....	
Termination	
At Vmax[mL]	10
At potential	No
At slope	No
After number of recognized EQPs	No
Combined termination criteria	No
Accompanying stating	
Accompanying stating	No
Condition	No
....	
010 Calculation R1	
Result	Content
Result unit	g/L
Formula	R1=QEQ*C/m
Constant C=	M/z
M	M[Citrate]
z	z[Citrate]
Decimal places	3
. . . .	
011 Calculation R2	
Result	pH value
Result unit	
Formula	R2=E[1]
Constant C=	1
M	M[None]
z	z[None]
Decimal places	2
. . . .	
012 Rinse	
Auxiliary reagent	Water
Rinse cycles	1
Vol. per cycle[mL]	10
Position	Current position
Drain	Yes
Drain pump	Drain pump 1
Condition	No
013 Conditioning	
Type	Fix
Interval	1
Position	Conditioning beaker
Time[s]	60
Speed[%]	30
Condition	No
014 End of sample	
015 Park	
Titration stand	Rondo60/**1A**
Position	Conditioning beaker
Condition	No

Titration curve



優良測量管理規範
改善測量結果五步驟

梅特勒-托利多執行的“優良測量管理規範”是一項全球性計劃，憑借天平、衡器、移液器和分析儀器的質量保證措施，在實驗室中和生產環境下為您提供支援。
“優良測量管理規範”的五步驟首先要評估您的過程測量需求及相關風險。我們還會考慮監管要求和行業相關標準。
利用這些信息，“優良測量管理規範”會直接為稱量儀器和測量裝置的選擇、安裝、校準和操作提供建議。

- **www.mt.com/gwp** 用於稱量
- **www.mt.com/gtp** 用於滴定
- **www.mt.com/gpp** 用於移液
- **www.mt.com/gdrp** 用於測定密度和折射率

www.mt.com

更多訊息

Mettler-Toledo AG
實驗室部門
Im Langacher
CH-8606 Greifensee, Switzerland