HANNA instruments

Test for Salt & Acidity Using Automated Titration

We have created a practical guide on how simple and accurate titration can be.



Intro

Analytical testing is a cornerstone of the food production process. Whether a hobbyist or food scientist, many are involved in food quality and safety using a variety of analytical techniques to create safe, stable and, most of all, great tasting foods.



How salt and acidity affect food quality.



Methods for testing salt and acidity in food.



Features to consider when choosing an automatic titration system.





Why Salt and Acidity Matters



Importance of Salt in Food

When we refer to "salt," most often we are referring to sodium chloride also known as table salt. However, there are many other types of salts including potassium chloride, calcium chloride, and sodium nitrate.

The most common form of salt found in food manufacturing is sodium chloride (NaCl). Sodium can also be added in other forms including sodium nitrite, sodium bicarbonate (baking soda), sodium benzoate, and monosodium glutamate (MSG).

Naturally occurring, as well as a common additive in food products, sodium is an important mineral required by the human body.

Unfortunately, too much sodium in our diet can lead to an increase in blood pressure. Due to its hypertensive effects, it is one of the minerals that appear on product labels for people that must watch their dietary intake.



Sodium-containing compounds are added to:

Extend shelf life by inhibiting microbial growth.

Improve texture and appearance by retaining moisture and stabilizing chemical changes in finished products.

Improve flavor by promoting desired tastes while masking off-flavors.





Importance of Acidity in Food

Acidity is the concentration of acid in food. Some foods naturally have a high acidity, such as citrus fruits or tomatoes. Acidity can also be produced through microbial fermentation, such as in yogurt. Frequently, acid is added directly to foods during production. The most common organic acids include citric, malic, lactic, tartaric, and acetic acids.

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These exist primarily for fruit and dairy products, such as:

Regulations

The Code of Federal Regulations (CFR) is an annual edition of general and permanent rules produced by the FDA and other government agencies. 21CFR101.61 establishes clear criteria to nutrient content claims for the sodium content of foods.

In terms of titratable acidity, there are guidelines as to the type of acid expressed as well as the value allowed.



Which states that lemon juice must have a titratable acidity value ≥4.5% by weight expressed as anhydrous citric acid.

Which states that yogurt must have a titratable acidity of $\geq 0.9\%$ expressed as lactic acid.



21CFR131.200

Here are common methods to measure:





Potentiometric Titration Method:

A potentiometric titration uses an electrochemical sensor, such as an ion selective electrode, to determine the equivalence point.

The equivalence point is the point where the greatest change in voltage for a specific volume of titrant added (mV/mL) to the sample is observed.

Titrators determine the endpoint by detecting an equivalence point. The equivalence point is the point during the titration at which the analyte and titrant are present in equal parts.

Mathematically, the equivalence point is the point where the slope of the titration curve is the steepest. That is the maximum mV response for a fixed volume of titrant that has been added. This can be seen in the left chart on the next page.





The slope is determined by:

Slope = change in mV/change in mL

The slope calculation can be seen in the first derivative curve. This is a very important feature to have, especially when a titration curve is not steep, or when the curve is very noisy.





Salt

AOAC 983.14 is a titration method used to determine the chloride concentration in a solution. This method uses silver nitrate as a titrant. As silver nitrate is added to a solution containing chloride, a reaction takes place between the silver and chloride ions to form an insoluble silver chloride.

$$AgNO_{3 (aq)} + NaCI_{(aq)} -> AgCI_{(s)} + NaNO_{3 (aq)}$$

When performing a salt titration with silver nitrate, it is assumed that any chloride present is from sodium chloride (NaCl). This allows us to infer the sodium content. This is the most common method for testing salt in food.

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Acidity

AOAC 942.15B is a titration method used to determine titratable acidity (TA) in a sample expressed as a concentration of the predominant acid present (i.e. citric acid in orange juice). Acidity titrations measure the overall amount of acid present and cannot differentiate between specific forms (i.e. citric versus malic).

TA is measured by titration in which a base, such as sodium hydroxide as the titrant, is added to a sample of known quantity (weight or volume). The base will react with the acid to neutralize it.

Most food producers do not use an equivalence point to signal the end of an acidity titration. Instead a fixed endpoint is used to titrate the sample to a specific pH value. In most food and beverage acidity titrations, the endpoint is based on the point at which phenolphthalein, a color indicator, changes from colorless to pale pink. Depending on the sample and reference method, this corresponds to a pH value between 8.1 and 8.3.

A pH sensor, whether standalone or as a titrator, is the preferred method for determining the fixed endpoint for the titration. It is not subject to chemical interferences or the subjectivity of seeing color. Color changes can be difficult to detect in colored samples such as orange juice or milk.



The distinction between acidity and pH is very important. Acidity refers to titratable acidity (TA), or the concentration of acid in a solution, while pH refers to the strength of the acid present. TA is more useful as a predictor of how an acid will impact the flavor of a food product.





What You Need



Food manufacturers use automated titration due to the consistent and accurate results it produces.

Analytical testing is a cornerstone of the food production process. Whether a hobbyist or food scientist, many are involved in food quality and safety using a variety of analytical techniques to create safe, stable and, most of all, great tasting foods.

Here are three major advantages



Optimized

You do not want to have to figure out the best setup. The provider should develop the best configuration to achieve your objectives of throughput, accuracy, and ease of operation.



Automated

Make sure that the system offers the necessary features to maximize the benefits of automation.



Fully Supported

There's no point in having amazing features if you are not using them correctly. Make sure that you are getting comprehensive setup, training, and support to guarantee that you get the most from your investment.





1. Automated Why Automate:

You should consider automating your titration processes if you have:

- High sample throughput more than 10 samples per day
- High accuracy requirements
- Automatic reporting requirements





i. Dual Analysis Setup

Look for titration systems that can be set-up for both salt and acidity titrations at once. This means that the setup can be left in place without swapping out chemicals or electrodes.

Result: Save set-up time.



ii. Exchangeable Burettes

Additional titrations may require different types of titrants. Exchangeable burettes mean that you can switch between titrants without the need to purge and rinse the burette.

Result: Save time and reduce consumption of expensive chemicals

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iii. Availability of Endpoint and Equivalence Titration

Acidity requires a fixed endpoint titration, while salt needs equivalence point titration. Your automated titration system needs to perform both to give you the flexibility that you need.

Result: One titrator for many types of titrations.

Titration End Point Mode

Select the end point detection.

Equivalence End Point (pH) Equivalence End Point (mV) Fixed End Point (pH) Fixed End Point (mV)





iv. Dynamic Dosing

Dynamic dosing adjusts the volume of titrant dose based on the mV response, speeding up the titration while increasing precision.

Result: Faster titration without compromising accuracy.



vi. Automatic GLP Data Capture

Having the ability to record GLP (Good Laboratory Practice) data with every sample improves the integrity of traceability and record keeping processes. Look for data collection including company and operator name, sample ID, date, time, electrode ID codes, and calibration information.

Result: Save time with easy QC checks and auditing.

Review Result

Method Time & Titrati	HI902 - Name: Date: on ID:	Titration 12:40 PM	n Report Aci 1 Feb 08, Ti_C	dity 2010 00039
Titration Results Method Name: Acidity Time & Date: 12:40 PM Feb 08, 2010 Analyte Size: 10.000 mL End Point Volume: 2.637 mL pH Fixed End Point: 8.300 Results: 13 mg/L				
View Graph	Escars	Print Report	Page Up	Page Down





Easy Integration with Time Saving Equipment

Look for the ability of your titration system to easily integrate with other systems.

Result:

- Analytical Balance
- Printer
- Keyboard
- Monitor

Sequential Linked Methods

Preparing samples takes time and also wastes valuable product. With Hanna's unique linked methods you can measure both your salt and acidity in one sample.

Result: One Sample + One Method = Two Results

Watch how easy titration can be!

Salt & Acidity in Acidified Foods

HI932 with the HI5148 Silver Billet







2. Optimized

The optimal setup depends on your priorities, whether it be quantity, accuracy, sample efficiency, or operational simplicity. Make sure that

your titration package includes expert help.

Check that the following is included:

a. Expert Consultation

It's important to have access to a technical expert experienced with titrations in food production environments.

The consultation should take place upfront so you can make sure that you get the right equipment and configuration for your needs.

b. Installation

You should get onsite setup and installation support. Make this option is available to you.

c. Training

It is important to get onsite training for your startup process. Ensure that you have an option. The focus should be your success.

d. Ongoing Support

Insist that you get regular maintenance and calibration. You are likely to need calibration certificates from the vendor for SQF audits.

3. Fully Supported

Ongoing operational success is important. Its helpful to work with a vendor that can support your needs and your investment. This means having easy access to your support team when you need it.

Make sure any vendor you work with has:

a. Clear Contact Information

Look for a dedicated phone number and email address so you are not left wondering how to reach your vendor.

b. Top Notch Technical Personnel

Having a smart technical resource that knows your analysis and your business goes a long way to quickly troubleshooting any problems you have.

c. Dedicated Account Representatives

Nobody wants to be a nameless customer. Your analysis is important to you and should be important to your vendor. Having an account person dedicated to your business is helpful to resolve concerns quickly and provide clear escalation when required.







Our experts are here to help you.

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