

Seasoning

## Salinity of Soy Sauce

Precipitation titration by  
Automatic Potentiometric Titrator

Standard

Japanese Agricultural  
Standard

### 1. Abstract

Salt-free soluble solid content in soy sauce can be obtained by measuring its salinity. For this purpose, silver nitrate titration using silver electrode is popularly practiced based on below quoted Japanese Agricultural Standard (JAS) – Soy sauce.

The diluted sample liquid is titrated with 0.1mol/L silver nitrate solution up to the endpoint, which is the inflexion point on titration curve.

Salinity is calculated from titration volume of silver nitrate solution.

### 2. Reference

- 1) JAS specification for measurement of Soy sauce (Bulletin No. 2596 noticed by Ministry of Agriculture, Forestry and Fisheries, Dec. 3, 2015)

### 3. Cautions in measurement

- 1) Use 1mol/L potassium nitrate for junction liquid of combination silver electrode in order to refrain from measurement error due to diffused chlorine. Or use mercury sulfate reference electrode.
- 2) Polish the tip of silver electrode with abrasive paper before use.
- 3) In this application, a convenient combination silver electrode is used, but the same result can be obtained using single silver electrode with a reference electrode in combination.
- 4) The addition reagent, Tween 20 (polyoxyethylene 20 sorbitan monolaurate) is a nonionic surfactant. Tween 20 is added as a dispersant of the precipitation of the silver chloride, and stabilized by preventing precipitation in this titration.
- 5) Add nitric acid (1 + 1) to titrate on an acid side. Titration on an alkali side leads to generate silver hydroxide, it will be silver oxide. The titration volume will be excessive because added silver ion does not react with chlorine ion.

## 4. Post-measurement care

After measurement is finished, polish the tip of electrode with abrasive paper as noted above in 3. Cautions in measurement.

## 5. Test equipment

Main unit : Automatic potentiometric titrator (Standard preamplifier: STD-)

Electrode : Option Combination silver electrode

## 6. Reagent

Titrant : 0.1mol/L Silver nitrate solution ( f = 0.9985 )

Additive : Pure water

Nitric acid (1 + 1) (add an equivalent volume of nitric acid to water)

Tween 20 solution (measure 1~2g Tween 20, and make 100mL in total by adding water)

## 7. Measurement procedure

—Pretreatment—

Add pure water to 5.0mL sample liquid and make 250mL in total.

—Measurement—

- 1) Deliver 10.0mL pretreated sample liquid to a 100mL beaker.
- 2) Add pure water to the above-mentioned beaker up to a height where an electrode is soaked.
- 3) Add 1mL nitric acid (1 + 1) and 1mL Tween 20 solution to the above-mentioned beaker.
- 4) Titrated with 0.1mol/L silver nitrate solution to obtain salinity.

## 8. Formula

$$\text{NaCl} (\%) = (\text{EP1} - \text{BL1}) \times \text{TF} \times \text{C1} \times \text{K1} / \text{S}$$

EP1 : Titration volume ( mL )

BL1 : Blank level ( 0.00mL )

TF : Factor of titrant ( 0.9985 )

C1 : Concentration conversion coefficient ( 5.844 )

{ Sodium chloride in mg equivalent to 1mL of 0.1mol/L silver nitrate solution }

K1 : Unit conversion coefficient ( 2.5 )

{ 1/1000 (g/mg) × 250/10 (dilution magnification) × 100 (%) = 2.5 }

S : Undiluted sample size ( mL )

## 9. Example of measurement

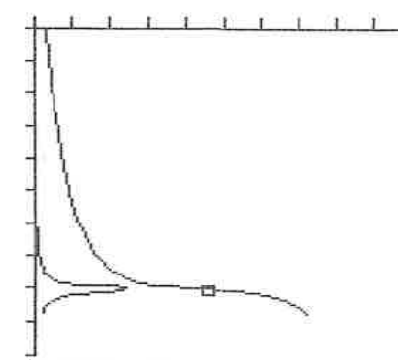
— Ambient condition —

Room temperature : 28 °C	Humidity : 57 %	Weather : Fair
--------------------------	-----------------	----------------

### -Titration parameter-

Model : AT-610	
Method No. : 03	
Titr. mode : Auto Int.	
Titr. form : EP Stop	
[Titration parameter]	[Calculation parameter]
Burette No. : 1	Calc. Type : Sample
Max volume : 20.0000mL	CO1 : On
Channel, Unit	Unit : %
ctrl. : Ch1, mV	Formula :
ref. : Off	(EP1-BL1)*TF*C1*K1/S
pH polarity : Standard	EP position : EP1
Direction : Auto	Decimal : 2
Wait time : 5s	Fraction : Half adjust
Dose mode : None	Evaluation: Off
[Control parameter]	Active constant
Number of EP : 1	C1 : 5.84400
End sense : Auto	K1 : 2.50000
Gain : 1	Temp. comp. : Off
Data sampling : Std.	[Reagent parameter]
Ctl. speed mode : Std.	Burette No./Reagent name
Other control : Std.	01/0.1M AgNO3
Stir. Speed : 4	[Titr. constant]
	TF : 0.9985
	[Blank list]
	Blank : 0.0000

### -Titration curve-

Level<ctrl.>[mV]	23.8	386.0
0.0000 mL		
		
8.0000 mL		
*** R e s u l t ***		
Method No. / Name :	03/ Auto Int.	
Titr. mode :	Auto Int.	
Titr. form :	EP Stop	
Sample No. :	22-01	
Sample name :		
Sample ID :		
Date :	2010/08/03 11:17	
Titr. reagent name :	0.1M AgNO3	
Titr. time :	00:03:21	
Size :	<u>5.0000 mL</u>	
End point 1		
Volume :	<u>6.3459 mL</u>	
Potential :	190.8 mV	
Conc1 :	<u>18.51 %</u>	

(The above printout data were obtained from titration by AT-610)

#### « Titration parameter »

Burette No.: the burette used in titration/ Max Volume: of titration  
 Channel, Unit: detector number and unit of detection potential / pH polarity: direction of pH potential  
 Direction.: of titration / Wait Time: before titration starts / Dose mode: **fixed dose**

#### « Control parameter »

Number of EP: number of detected EPs / End sense: EP direction / Gain: sensitivity of detection signal  
 Data sampling: conditions / Ctl. speed mode: controlled speed / Other control: / Stir. Speed: speed of stirrer

#### « Calculation parameter »

Calc. Type: of titration / CO1: formula 1 / Unit: of result / Formula: equation / EP1: titration volume 1  
 BL1: blank level 1 / TF: reagent factor / C1: concentration conversion coefficient  
 K1: unit conversion coefficient / S: sample size / EP position: for calculation /  
 Decimal: number of digits after decimal point / Fraction: how to round fraction / Evaluation: of calculated results

—Measurement results—

n	Sample (mL)	Titration (mL)	NaCl (%)
1	5.0	<u>6.3459</u>	<u>18.51</u>
2	5.0	6.3561	18.54
3	5.0	6.3480	18.52

Statistical calculation	
Mean	18.52 %
SD	0.015 %
RSD	0.083 %

\* The data were obtained from 3 tests of the same sample.

\* Red underline shows the data from page 3/4.

## 10.Saummary

Soy sauce, the Japanese popular cooking and table sauce is made from soy bean and wheat. The secret of tasty quality of soy sauce is a bit of saltiness and attractive flavor due to fermentation caused by enzyme and yeast in ageing process.

When “Light” and “Strong” soy sauce are compared with, “Light” looks light in color with less flavor but salinity is higher than “Strong”.

Quality control and evaluation is made by analysis of salinity, which is of extreme importance.

Result of measurement shows good repeatability with 0.08% relative standard deviation.