Laboratory 7

Determination of the acidity of bakery products using the standard titrimetric method.

Acidity Indicator and Its Importance in Bakery Products

The acidity indicator characterizes the quality and hygienic aspect of bakery products. This indicator can also be used to evaluate the correctness of the technological process in the preparation of baked goods, since acidity mainly reflects the presence of products formed in the dough as a result of alcoholic and lactic acid fermentation.

Acidity is expressed in degrees (Grad). The acidity level refers to the volume (in cubic centimeters) of a solution with an exact molar concentration of 1 mol/dm³ sodium hydroxide or potassium hydroxide required to neutralize the acids in 100 grams of the product.

According to standards, the maximum acidity level for certain types of bakery products made from rye flour and its mixtures with wheat flour is 9-12 Grad, and for bakery products made from wheat flour it is 2-6 Grad, depending on the type of product.

Scope of Application

This method is applied to baked products, as well as to pastries with low moisture content, and establishes methods for determining acidity.

Essence of the Method

The essence of the method is to extract acids from the bread using room temperature water.

The water-soluble acid-reactive substances are then titrated with a 0.1 mol/dm³ alkaline solution.

Measuring Instruments, Laboratory Equipment, Reagents, and Materials:

- Laboratory scales with a maximum weighing limit not exceeding 1 kg and an allowable error margin of ±75 mg
- Grater, lime or mechanical grinder
- Sieve

- Mechanical stopwatch with signal
- Thermometer
- Bottles with a capacity of 500 cm^3 (for example, milk bottles)
- Stoppers with capacities of 50, 100, 150, and 250 cm^3
- Conical flasks and beakers
- Pipettes of class 4 accuracy with a capacity of 25 cm^3
- Burette of class 4 accuracy with a capacity of 50 cm^3
- Wooden spatula or glass rod with a rubber tip
- Medical gauze
- Sodium hydroxide solution with molar concentration 0.1 mol/dm^3
- Potassium hydroxide solution with molar concentration 0.1 mol/dm^3
- Phenolphthalein, 1% alcoholic solution by mass
- Distilled water
- Drinking water

It is permitted to use similar instruments, laboratory glassware, and reagents with technical and metrological specifications not lower than those listed above.

Preparation for Analysis:

a) **Procedure for preparing bread products weighing more than 0.5 kg and with a coarse (grainy) texture for analysis.**

From whole product samples, the product is cut in half lengthwise, and a piece weighing approximately **70 grams** is cut from one half. From this piece, the **crust and the sub-crust layer** with a total thickness of about **1 cm** are removed.

For samples consisting of part of the product, a slice approximately **0.5 cm thick** is cut from one side of the crumb as a continuous section. Then a piece weighing about **70 grams** is cut out, and from this piece, the **crust and the sub-crust layer** of approximately **1 cm** total thickness are removed.

b) Procedure for preparing bread and bakery products weighing between 0.5 and 0.2 kg for analysis:

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The product is cut in half lengthwise, and a piece weighing approximately **70 grams** is cut from one half. From this piece, the **crust and sub-crust layer** with a thickness of about **1 cm** are removed.

c) Procedure for preparing bread and bakery products weighing less than 0.2 kg for analysis:

The **entire product** is taken and the **crust is cut off** in a **layer about 1 cm thick**.

d) The procedure for preparing shaped or specialty baked bread products for analysis is defined in the **normative documents** specific to those products.

From the product pieces prepared according to **sections a), b), and c)**, the crust is removed, then the inner parts are **quickly cut into small pieces**, **mixed thoroughly**, and **weighed immediately**.

In low-moisture bakery products, **except for products containing poppy seeds and nuts**, any **additives are removed**, and the product is **ground** using a mechanical grinder such as a **grater, mortar and pestle, or electric coffee grinder**. The **ground crumbs are mixed thoroughly and weighed immediately**.

Conducting the Test

Verification (Arbitral) Method

25 g of **crumbled bread**, prepared according to methods a), b), or c), is **weighed with an accuracy of 0.01 g** and placed into a **dry 500 cm³ glass container**.

A **250 cm³ volumetric flask** is filled with **distilled water** at a temperature of **18–25 °C**. Approximately **¼ of the distilled water** is poured into the glass container containing the crumbled bread.

Then, using a **wooden spatula or glass rod**, the mixture is stirred and **rubbed thoroughly** until a **uniform mass** is obtained.

Continuation of the Test Procedure

The **remaining distilled water** from the **volumetric flask** is added to the prepared mixture.

The glass container is **sealed with a lid**, and the mixture is **vigorously shaken for 2 minutes** to ensure proper mixing.
Then, the mixture is **left to stand at room temperature for 10 minutes**.
After that, it is **shaken again for 2 minutes** and allowed to **settle for 8 minutes**.

The resulting mixture is **filtered through gauze (cheesecloth)** into a **dry beaker**.

From the beaker, **50 cm³ of the filtrate** is taken using a pipette and transferred into **two conical flasks** (each with a volume of 100–150 cm³).
Then, **2–3 drops of phenolphthalein** solution are added.

The solution is **titrated with 0.1 mol/dm³ sodium hydroxide or potassium hydroxide solution** until a **faint pink color** appears.

If the pink color **disappears within 1 minute**, and does **not reappear after adding 2–3 more drops of phenolphthalein**, **titration is continued**.

Accelerated Method

A **sample of 25.0 g** of **crushed bread crumbs** obtained according to procedures **a), b), or c)** is placed into a **dry glass container** with a **capacity of 500 cm³ and a stopper**.

A **volumetric flask** with a **capacity of 250 cm³** is **filled to the mark** with **distilled water heated to 60°C**.

Approximately **one-quarter of the heated distilled water** is poured into the container holding the **crushed bread crumbs**.
The mixture is **quickly ground** using a **wooden spatula** until a **uniform mass** is obtained.

Continued Steps of the Accelerated Method (Titration Stage)

The **remaining portion** of the **distilled water** from the volumetric flask is **added to the mixture** in the container.

The **container is sealed with a stopper** and the **mixture is vigorously shaken for 3 minutes**.

After shaking, the mixture is **allowed to stand for 1 minute**, and the **liquid layer** is then **carefully filtered through gauze** into a **dry beaker**.

From the beaker, **50 cm³ of the filtrate** is **transferred using a pipette** into **two conical flasks** (each with a capacity of 100–150 cm³).

Then, **2–3 drops of phenolphthalein** are added.

The solution is titrated with a **0.1 mol/dm³ solution of sodium hydroxide (NaOH) or potassium hydroxide (KOH)** until a **faint pink color** appears.

If the pink color disappears after 1 minute and does not reappear even after adding 2–3 more drops of phenolphthalein, **titration should be continued**.

Procedure for Analyzing Low-Moisture Bakery Products

- Weigh **10.0 g** of ground sample obtained from step (g).
- Place the sample into a **dry conical flask with a volume of 250 cm³**.
- From a **pre-measured 100 cm³ of distilled water** (at a temperature of 18–25°C), pour approximately **30 cm³** into the flask containing the sample.
- Mix the contents and **shake until a uniform mass** is obtained.
- Add the **remaining portion of the distilled water**, making sure that **no particles remain stuck to the flask walls**.
- Let the mixture **stand for 15 minutes**.
- After standing, **filter the liquid through gauze into a dry flask**.
- Using a pipette, **transfer 25 cm³ of the filtrate** into **two conical flasks**, each with a capacity of **100–150 cm³**.
- Add **2–3 drops of phenolphthalein**.
- Titrate with a **0.1 mol/dm³ sodium hydroxide (NaOH) or potassium hydroxide (KOH)** solution **until a faint pink color appears**.

If the pink color disappears after 1 minute, and **does not reappear** even after adding 2–3 more drops of phenolphthalein, **continue titration** until a stable pink color forms.

Note:

If **drinking water** is used instead of **distilled water**, it must be **pre-titrated**.

Processing the Results

The **acidity**, denoted as **X**, is calculated using the following formula:

$$X = \frac{V \cdot a \cdot K \cdot 10^{-3}}{m \cdot V_2} \cdot V_1$$

Where:

- **V** – Volume (in cm^3) of **0.1 mol/dm^3** sodium hydroxide (NaOH) or potassium hydroxide (KOH) solution used in titration;
- **V_1** – Volume of **distilled water** (in cm^3) used to extract acids from the product sample;
- **a** – Conversion coefficient for recalculating the result to **100 g of product**;
- **K** – Correction coefficient to convert the actual molar concentration of the NaOH or KOH solution to a standard **1.0 mol/dm^3** solution;
- **10^{-3}** – Coefficient to bring molar concentration to **mol/dm^3**;
- **m** – Mass of the sample (in grams);
- **V_2** – Volume (in cm^3) of the test solution used for titration.

If the two parallel titration results for one filtrate fully coincide, or if the difference does not exceed 0.30 degrees for bread and bakery products, and 0.40 degrees for low-moisture bakery products, the acidity determination is considered accurate.

The final result of the analysis is taken as the arithmetic mean of the two parallel determinations.

Acidity is expressed with an accuracy of 0.5 degrees. Fractions up to 0.25 degrees are discarded, values between 0.25 and 0.75 degrees are rounded to 0.5 degrees, and fractions above 0.75 degrees are rounded to 1.0 degree.