**Biotechnology lab: pH, lactic acid and Dornic degree**

The quality of a cheese depends mainly on the quality of the raw material, milk. Milk is a highly perishable product. The freshness of milk can be determined by measuring its acidity. The acidity of milk is measured in Dornic degrees (°D): 1 Dornic degree corresponds to 0.1 g of lactic acid per litre of milk.

Fresh milk has an acidity of 15 to 18 °D and contains approximately 5% lactose. The bacteria present in the milk will transform the lactose into lactic acid by the process of fermentation, which will modify the pH of the milk and increase the Dornic degree.

When the acidity exceeds 37°D, the casein will flocculate (curdle). The less fresh the milk is, the more bacterial activity increases and the greater its total acidity.

Determining the acidity of a milk is therefore a simple way to determine the freshness of the milk.

**Objective:**

Determine the freshness of milk by determining the lactic acid concentration in milk. Express the result in Dornic degrees.

**Material**

- 25 mL burette

- Burette holder

- Universal holder

- 60 mL fresh milk, 60 mL aged milk

- Sodium hydroxide solution 0.05 mol/L

- Distilled water

- Phenolphthalein (1% solution in 95% ethanol)

- 50 mL, 25 mL and 10 mL volumetric pipette and a sampling device

- Magnetic stirrer and its magnetic bar

- Graduated cylinder

- 3 erlenmeyers

- Beaker labelled “waste”

**Method**

**Part 1 — Rapid dosage**

1. **Fill** the burette with the 0.05 mol/L sodium hydroxide solution.
2. **Adjust** the liquid level to zero in the burette by pouring the overflow into the “waste” beaker
3. Using the volumetric pipette**, take** 10 mL of milk and **pour** it into the erlenmeyer #1 identified as “dosage”
4. **Add** 10 drops of phenolphthalein.
5. **Insert** the bar magnet.
6. **Place** the erlenmeyer #1 under the burette on the stirrer.
7. **Adjust** the stirrer to ensure that the mixture in the beaker does not splash to the sides.
8. **Pour** in the sodium hydroxide solution mL by mL until the solution turns (changes colour).
9. When the solution in the Erlenmeyer flask persistently changes colour where the neutralizing solution contacts the solution to be neutralized, close the tap to slow the flow rate of the neutralizing solution..
10. **Add** the neutralizing solution drop by drop, stirring continuously until the colouration is constant.
11. **Record** the value of the volume of sodium hydroxide solution added. V*e* = mL.

**Part 2: Precise dosage**

1. Repeat the same procedure as above for each of the samples provided. Pour the sodium hydroxide solution rapidly until you reach a volume (V — 1) mL. Determine in the previous step.
2. Addthe neutralizing solution drop by drop from volume (V*e* – 1), stirring continuously until the colouration is constant.
3. Record the value of the volume of sodium hydroxide solution V*e*.
4. Repeat the steps with the 3rd sample.

**Analysis**

1. Represent the structural formula of lactic acid. Identify the different characteristic groups present.
2. Write the chemical reaction of lactic acid and sodium hydroxide.
3. Determine the molar concentration of the acid in the milk, based on the data and the result of the experiment and indicate the Dornic degree of the milk used. The molar mass of lactic acid is given: M = 90 mol/L
4. For milk to be consumable, the mass of lactic acid it contains must be less than 1.8 g.L -1. Do the different samples tested meet this criteria?
5. Knowing that during the yogurt manufacturing process, lactic bacteria transform lactose into lactic acid, what can you say about the Dornic degree of yogurt? How could you validate your hypothesis?
6. In a test, the persistent pink colour is obtained for a volume of sodium hydroxide solution equal to Veq = 8.0 mL. Determine, in Dornic degrees, the total acidity of the milk. Is this milk drinkable? Explain your answer.

**Note:** the following formula is usedto calculate the Dornic degree:

 $°D= \left[NaOH\right]\*Ve\*90\*10 $

 20