Tutorial (TD) - Chapter 1: Water in Food

Module : Food Biochemistry - Agronomy

Part 1: Theoretical Questions

1. Explain the difference between free water and bound water in a food product. Give two examples of foods where this distinction is crucial for their stability.

2. Why is measuring water activity (aw) more relevant than measuring total water content for assessing the microbiological stability of a food product?

Part 2: Numerical Exercises

Exercise 1: Calculation of Water Activity (aw)

A cheese sample has a measured water vapor pressure of 2.1 kPa at 25°C. The saturated water vapor pressure of pure water at 25°C is 3.17 kPa.

a) Calculate the water activity (aw) of this cheese.
b) According to microbiological thresholds, is this cheese likely to support bacterial growth? Justify your answer.

Part 3: Case Study - Tomato Preservation

An agri-food company wants to develop two tomato-based products:

1. **Dried tomatoes** (final water content : 15%)
2. **Jarred tomato sauce** (water content : 85%)

Data :

- $a_{(W)}$ of fresh tomato: 0.98
- Critical $a_{(W)}$ for mold growth: 0.80
- $a_{(W)}$ for bacterial growth: >0.9

1. For the dried tomatoes:

a) What is the main microbiological risk if the drying process is not properly conducted?

b) Propose a target $a_{(W)}$ value to ensure product stability.

c) What complementary treatment (other than drying) could enhance the product's safety?

2. For the jarred tomato sauce :

a) Why is thermal processing (pasteurization/sterilization) essential ?

b) How do solutes (sugar, salt) influence the sauce's $a_{(w)}$?

c) Calculate the approximate $a_{(w)}$ if 10% NaCl is added to the sauce (consider the lowering of $a_{(w)}$ by salt).

Part 4: Quick Quiz

1. Water activity ($a_{(w)}$) is defined as:

a) The total water content of the food

b) The ratio P/P_0 of the water vapor pressure in the food to that of pure water

c) The amount of free water in the food

d) The moisture content at hygroscopic equilibrium

2. The minimum $a_{(w)}$ value for bacterial growth is generally:

a) 0.6

b) 0.7

c) 0.8

d) 0.9

3. The BET model is used to determine:

a) The desorption curve

b) The monolayer moisture content

c) The latent heat of vaporization

d) The moisture content at saturation

4. The hysteresis phenomenon shows :

a) The same curve for sorption and desorption

b) A desorption curve always below the sorption curve

c) A desorption curve always above the sorption curve

d) No difference between sorption and desorption