1. INTRODUCTION, WATER

introduction

termology

food
food supplements (nutritional factors)
foods for special nutrition
    functional food
    nutraceuticals

chemical composition of food

nutrients
    nutritive value
    energy value
    basic nutrients
        proteins
        lipids
        saccharides
    essential nutritive factors,
        vitamins
        minerals

water
    nutritive and energy value depend on:
        content of nutrients,
        digestibility
        resorption
        content of other components
        eating regime
        health and psychic state
        heat of combustion

sensory active compounds
    organoleptic properties
    sensory value (quality)

perceptions
    olphactoric
    gustative
    visual
    smell
    taste
    aroma
    colour
    appearance, shape (geometric aspects)
haptic (feel)  texture
auditorial  consistency (mechanical aspects)

sounds

antinutritive factors
natural toxic compounds

food, additives
contaminants
  exogenic
  endogenic

hygienic-toxicological quality
food safety

other components influencing food quality
Water

- the only one inorganic compound in biosphere in huge amount
- present in all living organisms
- often the main component
- human body contains cca 60% water as:
  - intracellular water (25 kg)
  - extracellular liquid (15 kg of which 12 kg in tissues, 3 kg in plasma)

function
- heat managing of organism
- transport medium
- stabilizer of biopolymers
- solvent
- reaction medium
- reactant

classification
- endogenous water: oxidation of main nutrients, 300-400 g/day
- exogenous water: drinks, meals, 2000-2800 g (average 2500 g/day)

  drinking water
  water in food

DRINKING WATER

quality requirements (book 2, table 7.1)
surface water (~ 80%)
- very pure water
- pure water

underground water (~ 20%)
- suitable for waterworks
- plain (< 1 g/l)
- minerals (> 1 g/l)

quality requirements for drinking water:
- microbiological
- physical
- chemical
- radiological

production of drinking water

requirements by food industry
- water hardness, content of some cations and anions
- for baby feeding (special sort of water from underground sources)
- drinking water (a sort of drinking water)
- soda water (from table or drinking water and CO₂)
- sparking saturated
- natural, spring water
requirements

utility water, operational water

WATER IN FOODS

content in foods (book 2, table 7.2)
- organoleptic properties (texture, taste, ….)
- resistance against microorganisms
- biochemical (enzymatic) and chemical reactions

classification
- foods with high water content
- foods with medium water content
- foods with low water content

changes during storage and processing (book 2, 7.3)
- spontaneous (natural)
- intentional (prolongation of storage time)

losses
- drying, cooking, roasting, thawing

accumulation
- moisturizing, swelling, boiling (examples)

structure

water (chemical individual)
- undissociated molecules H₂O
- hydrated hydronium ion (protons) H₂O⁺ (H₃O⁺)
- hydroxyl ions HO⁻
- their isotopes (²H, ³H, ¹⁷O, ¹⁸O)

electrical stable (permanent) dipole

INTERACTION OF WATER MOLECULES

electrostatic interactions of molecules, association by hydrogen bridges

coordination number: ice =4, water (1,5°C) = 4,4

association structure: lattice, defects of structure: nonelectrolytes, electrolytes, ions

PROPERTIES

at common temperatures: 3 states (phase diagram)

unique, anomalous properties

technological consequences and utilisation
INTERACTION IN FOOD

interactions water-minerals
- dissolving and formation of true solution
- ion hydratation

interactions water-proteins
- native conformation
- enzyme activity
- denaturation
- formation of disperse system (gels, foams, etc.)

interactions water–lipids
- formation of biomembranes
- formation of disperse system (emulsions)

interaction water-saccharides
- dissolving of crystals
- stabilisation of anomers, conformers
- formation of disperse system (gels)

free water (mobilised)

bound water (immobilised)

categories (ordinary food with > 90% water)
- monomolecular layer (vicinal water)
- multilayer water
- condensation water (bound, free)

WATER ACTIVITY
in food (book 2, table 7.10)
requirements of microbes (book 2, table 7.11)

water quantity related to:
- growth of microorganisms
- biochemical and chemical reactions
- sensory properties

accessibility

water activity

approximation of Lewis law for low pressure

\[ a_w = \frac{f}{f_0} = \frac{p_w}{p_w^0} = \frac{\varphi}{100} \]

\( p_w \) = partial pressure of water vapour over foods
\( p_w^0 \) = partial pressure of pure water vapour at the same temperature
\( \varphi \) = equilibrium of relative air humidity

others factors: pH, O₂
dependence on temperature: Clausius-Clapeyron equation
\(\Delta H = \) isosteric heat of sorption
\[
d\ln a_w/d(1/T) = -\Delta H/R
\]
influence of \(a_w\) on microorganisms and mutual reactions
sorption isotherms

relation between water content in foods and their water activity