

# 1. INTRODUCTION, WATER

## introduction

food science

parts

food chemistry

static part

dynamic part

food technology (processing, storage, distribution)

microbiology

nutrition

terminology

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

olfactory

smell

gustatory

taste

aroma

visual

colour

appearance, shape (geometric aspects)

haptic (feel)

auditorial

texture

consistency (mechanical aspekts)

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 CO<sub>2</sub>)
- sparkling 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

moisturing, swelling, boiling (examples)

## **structure**

water (chemical individual)

- undissociated molecules  $\text{H}_2\text{O}$
- hydrated hydronium ion (protons)  $\text{H}_3\text{O}^+$  ( $\text{H}_9\text{O}_3^+$ )
- hydroxyl ions  $\text{HO}^-$
- their isotopes ( $^2\text{H}$ ,  $^3\text{H}$ ,  $^{17}\text{O}$ ,  $^{18}\text{O}$ )

electrically stable (permanent) dipole

## **INTERACTION OF WATER MOLECULES**

electrostatic interactions of molecules, association by hydrogen bridges

coordination number: ice = 4, water ( $1,5^\circ\text{C}$ ) = 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 hydration

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

$$a_w = (f / f_0) = p_w / p_w^0 = \varphi / 100$$

$p_w$  = 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, O<sub>2</sub>

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