بِسْمِ ٱللَّهِ ٱلرَّحْمَٰنِ ٱلرَّحِيمِ

رَبِّ اشْرَحْ لِیْ صَدْرِیْ O وَیَسِّرْلِیْ اَمْرِیْ O
وَ ا حْلُلْ عُقْدَۃً مِّنْ لِّسَانِیْ O یَفْقَھُوْا قَوْلِیْ O

اے میرے رب! میرا سینہ کھول دے اور میرے لیے میرا کام آسان کر دے اور
میری زبان کی گرہ کھول دے تا کہ لوگ میری بات سمجھ سکیں

رَّبِّ زِدْنِی عِلْمًا

MY LORD! INCREASE ME IN KNOWLEDGE.

FST-311. L # 26: PROTEINS & STRUCTURAL INTEGRITY OF FOOD SYSTEM

STRUCTURAL INTEGRITY

- The term used for the performance characteristic applied to a component, a single structure consisting of different components
- Ability of an item to hold together under a load, including its own weight, resisting breakage or bending
- The demand for healthy, natural and tasty processed foods continuously increases
- Not only for finished products, but also for ingredients to be included in complex foods such as ice-creams, cereals, dairy, confectionery and bakery products

STRUCTURAL INTEGRITY

- Over the last few decades wide prospects for osmotic dehydration, better defined as dewatering impregnation soaking in concentrated solutions, have arisen as a pre-treatment in combined techniques
- These processes use a sequence of technological steps to achieve controlled changes of the original properties of the raw material
- While some treatments such as freezing have primarily a stabilizing effect, other steps such as partial dehydration, particularly DIS allows structural, nutritional, sensory and other functional properties of the raw material to be modified

STRUCTURAL INTEGRITY; TEXTURE

- Dehydration pre-freeze treatments are a useful tool to reduce or avoid the detrimental phenomena of loss of cellular structure and exudate loss at thawing, caused by the physical and chemical actions of freezing on fruit tissues
- Convective air dehydration is usually used for partial dehydration, but the color of some fruits, such as kiwifruit, can be affected by heat modification, under any form of air drying technique.
- For these fruits, air drying must be replaced by DIS, which is effective at room temperature, and which operates away from oxygen

STRUCTURAL INTEGRITY; TEXTURE

- The combined technique of dehydro-freezing has proved to be useful even to improve the quality of a delicate tissue such as that of strawberry
- A reduction in moisture content of, at least, 60 %, is needed to improve the texture characteristics of thawed–rehydrated fruits, irrespective of the dehydration method used
- DIS
    - *Dehydration - Impregnation by Soaking*
    - *Dewatering - Impregnation by Soaking*
    - *Also known as Osmotic Treatment*

PIGMENTS, VITAMINS & AROMA COMPOUNDS

- The penetration of solutes, due to dehydration effect, could modify the fruit composition and improve pigment, colour, vitamin and aroma retention both during air dehydration and frozen storage
- According to the kinetic interpretation based on the glass transition concept, physical and chemical stability is related to the viscosity and molecular mobility of the unfrozen phase, which, in turn, depends on the glass transition temperature
- Diffusion limited changes occur at very slow rates, i.e., stability, if based on diffusion-limited events is excellent
- chemical changes are not diffusion limited

PIGMENTS, VITAMINS & AROMA COMPOUNDS

- While the kinetic interpretation, based on the glass transition temperature, holds for chlorophyll and vitamin C stabilization in kiwifruit, for the anthocyanin pigments in strawberry
- a simple relationship does not exist between the pigment loss and the difference between the storage temperature and the glass transition temperature of the maximally freeze-concentrated phase
- The incorporation by DIS of different sugars into kiwifruit slices modified their low temperature phase transitions and significantly increased chlorophyll and vitamin C stability during frozen storage at −10°C
- Kiwifruit pre-treated in maltose, showed the highest chlorophyll and vitamin C retention

FUNCTIONAL PROPERTIES; FOOD PROTEINS

- Those physical and chemical properties, which affect the behavior of proteins in food systems during storage, processing, preparation and consumption.
- It is these characteristics, which influence the 'quality' and organoleptic attributes in food
- The functional properties of a protein are affected by both intrinsic and extrinsic factors
- The intrinsic factors are: shape, size, amino acid composition and sequence, the distribution of net charges, the ration between hydrophobicity/hydrophilicity, secondary, tertiary and quaternary structures of the protein as well as the protein's capacity to interact with other components in the food system

FUNCTIONAL PROPERTIES; FOOD PROTEINS

- The extrinsic factors that affect the functionality of proteins are: pH, temperature, moisture, chemical additives, mechanical processing, enzymes and ionic strength
- There are proteins that are associated with specific functional properties, such as egg proteins with coagulation, or soy proteins for their use in forming food gels
- Proteins must show good and multiple functionalities in order to perform well in food systems

FUNCTIONAL PROPERTIES; FOOD PROTEINS

- This requires a deeper understanding of the structure-function relationship, which sometimes can be hard to determine
- Proteins possess different functional properties is the fact that all proteins are built up by different amino acids
- The amino acid composition affects the functional properties of a protein according to how they are disposed in the polypeptide chain, as well as what type and how many of those amino acids that are present

FUNCTIONAL PROPERTIES; FOOD PROTEINS

- Something worth mentioning, but that will not be discussed further in this study, is that to improve the functionality and nutritional quality of the protein, modification of the proteins can be applied
- Enzymatic hydrolysis is the most common and simplest method
- During this process the protein is treated with an enzyme, acid or alkali that degrades the protein to its amino acid constituents

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MY LORD! INCREASE ME IN KNOWLEDGE.

FST-311. L # 27:
PROTEINS &
STRUCTURAL INTEGRITY OF FOOD SYSTEM-I

ROLE OF PROTEINS; SOLUBILITY

- The solubility of a protein is the most important functional property since the protein needs to be soluble in order to be applicable in food systems
- Other functional properties like emulsification, foaming, and gelation are dependent on the solubility of proteins
- Solubility can be described as when equilibrium exists between hydrophilic and hydrophobic interactions
- The solubility of a protein is related to the pH, where it is minimal at the isoelectric point, making the environmental pH the most important factor when it comes to the degree of protein solubility

ROLE OF PROTEINS; SOLUBILITY

- The protein solubility in food systems is also influenced by temperature and ionic strength, freezing, heating, drying and shearing
- Insoluble proteins are not good for food applications and thus it is important that denaturation caused by heat is controlled so that the protein solubility not will be affected in a negative way

ROLE OF PROTEINS; EMULSIONS

- Emulsions consist of two liquids that are immiscible, where one of the liquids is dispersed in the other in form of small droplets & classified according to the distribution of the oil and the aqueous phase
- A system where the oil droplets are dispersed in the aqueous phase is called oil-in-water emulsion (O/W). Examples are mayonnaise, milk, cream, soups and sauces
- The opposite of an O/W emulsion is water-in-oil (W/O) but there are also water free emulsions and multiple emulsions (O/W/O or W/O/W)
- The droplets in an emulsion are called the dispersed (or internal) phase, whereas the surrounding liquid is referred to the continuous (or external) phase

ROLE OF PROTEINS; EMULSIONS

- When water and oil are homogenized they rapidly separate into two layers, one layer of oil, which has high density, and one layer with water that has low density. This is called phase separation
- To get a stable emulsion (both in a short and long term perspective) it is of great importance to add an emulsifier
- An emulsifier is a surface-active molecule that allows the two phases to homogenize.
- Surface-active molecules are mostly amphiphilic i.e. they have both hydrophobic and hydrophilic parts, which allow the two liquids to blend together

ROLE OF PROTEINS; FOAMING

- Foams consist of a gas phase, a liquid phase and a surfactant (e.g. proteins) and whipping or shaking form foams
- Foods made up by foams are e.g. whipped toppings, ice creams, chiffon desserts and angel cakes
- Angel cakes and other baked goods are solid foams
- Foams are formed through unfolding and absorption of the protein, at the air-water interface, as well as film formation around the air bubbles

ROLE OF PROTEINS; FOAMING

- Different proteins have different abilities to form and stabilize foams, and just as in the case of proteins and their different emulsifying properties, this is related to different physical properties of the proteins
- For a protein to have superior foaming properties, it must possess high solubility in the liquid phase as well as the ability of quickly forming a film around the air bubbles in the food system

ROLE OF PROTEINS; GELLING / COAGULATION

- The globular proteins' gelling properties are of big importance in foods
- Protein gelation one of the most important functional properties when it comes to modify the structure and texture of foods
- One example is the importance of the gelation properties of egg in foods like cakes, omelets and confectionary
- The texture of foods and thus, the gelation properties of a protein, affect consumer acceptability. Globular proteins, such as egg white and soybean protein, are able to form gels upon heating
- For a gel to form it is important that the functional groups (e.g. hydrophobic groups) within the protein are exposed

ROLE OF PROTEINS; GELLING / COAGULATION

- This makes it easier for the groups to interact and form a three dimensional network
- Gel formation is complicated, and affected by the concentration of protein, amount of water, ionic strength, time and temperature as well as pH and interaction with other components in the food system. The process for gelation in short, is: Gel / coagulum formation Heat Protein denaturation Native protein
- The heat will make the native protein to denaturant, and during the denaturation disulfide bonds will be formed and hydrophobic amino acid residues are exposed
- After denaturation and further heating, the proteins will aggregate and interact with other proteins and form either a gel or a coagulum

ROLE OF PROTEINS; GELLING COAGULATION

- Which type that is formed depends on conditions like molecular weight, heating time and protein concentration
- The gel structure is a more structured network compared to the coagulum that is a disorganized aggregation

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