Lesson 1.

Introduction to engineering properties of biological materials and food quality

This chapter deals with the introduction to engineering properties of biological materials, classification of food properties, food quality and safety and regulations. Knowledge of properties of materials gives insight how the materials behave in different conditions and how it affects the final product quality. On the other hand, quality is a manifestation of human perception about the characteristic feature of a product. Quality and properties are interlinked and are often complementary to each other in as far as food is concerned. Product quality and safety is of utmost concern as it directly related to the wellbeing of human being, is not limited to microbial safety now.

1.1 INTRODUCTION:

Biological materials especially that are consumed as food or feed undergo various unit operations right from the pre-harvest to post harvest processing, primary, secondary and tertiary processing, formulation, preservation, packaging, storage distribution, retailing, domestic storage and finally consumption. Scientists and engineers need to know and understand the characteristics of the material to be processed, preserved and consumed to solve the problems while designing and selecting the means and modes of preservation, packaging, processing, storage, marketing, and consumption. Each of these unit operations has unique characteristics and need special tools and equipments. Designing and selecting such tools and equipments require information regarding various properties.

1.2. CLASSIFICATION OF FOOD PROPERTIES:

There are many classifications of properties of biological materials, which can generally be grouped under physical properties, mechanical properties, rheological properties, textural properties, electrical and dielectric properties, optical properties, acoustic properties, chemical, and nutritional properties etc. A more realistic approach was compiled by Rahman & McCarthy (1999) is presented here:

List of four classes of food properties

i. Physical and Physico-chemical Properties

A. Mechanical properties

- Acoustic properties
- Mass-volume-area-related properties

- Morphometric properties
- Rheological properties
- Surface properties

B. Thermal Properties

C. Thermodynamic properties

D. Mass transfer properties

E. Electromagnetic properties

F. Physico-chemical constants

ii. Kinetic Properties

A. Quality kinetic constants

B. Microbial growth, decline and death kinetic constants

iii. Sensory Properties

A. Tactile properties

B. Textural properties

C. Color and appearance

D. Taste

E. Odor

F. Sound

iv. Health Properties

A. Positive health properties

- Nutritional composition
- Medical properties
- Functional properties

B. Negative health properties

- Toxic at any concentration
- Toxic after critical concentration level
- Excessive or unbalanced intake

In nutshell the properties and their applications in various agro processing, storage is presented in the following sections:

Physical properties like size, shape, density, porosity has great implication in deciding the equipment for screening, separation, handling and storage of materials, they also come handy in calculating the heat transfer and mass diffusion rates. Frictional properties are useful in designing discharge and conveying devices; whereas, aerodynamic and hydrodynamic properties are useful in designing spouted bed, fluidized bed dryers, aspirators and pneumatic conveying system. Knowledge of thermal properties aids in designing thermal process and calculating thermal load for canning, retorting, sterilization, pasteurization, blanching, cooking and extrusion process. Electric and dielectric properties can be useful in designing and controlling thermal processing and moisture content determination. Optical properties are used widely in deciding the quality of food thus aiding in sorting, grading, contamination detection and food composition determination. Acoustic properties are also useful in determining non-destructive quality determination and pretreatment for various thermal processes and plant material extraction. Rheological properties give information how the product will behave in different systems and how consumer is going to be affected. It is useful in designing new product and product constituent, its stability and storability at different conditions. Since, the viscosity is of material is affected by temperature and most importantly the constituent of material; it has direct implication on the acceptability, storability and quality of the product.

Food consumption pattern is affected by cultural practices, climate and in many cases personal choice. Food is considered as a mean for psychological and emotional fulfillment and its relation to divinity is not exaggerating as this is the basic requirement for any life to exist. The information about consumers' preferences is relevant for the food industry both for modifying/improving the product according to these preferences and for the development of new products. Besides, knowledge about customers' age, gender, demographics, etc. is itself relevant: indeed, an important area for strategic product development is the identification of possible consumers segments and the evaluation of the influence of their individual characteristics on the liking patterns and on the uncertainty in the choice. The quality characteristics are often judged by instrumental methods of measurement and by sensory panel, where trained personnel act as human instrument.

Food laws and safety regulations are essential to provide consumer food that is safe to consume and cater the needs of various sections. Allergenicity of some naturally

occurring chemicals from plant and animal sources, host metabolism, microbial contamination, non-biological contamination such as glass, metal pieces, chemicals entering into the food chain from various steps of processing also pose great risk to human safety and well being.

Sensory descriptive tests are among the most sophisticated tools used by sensory scientists and involve the discrimination and description of both the qualitative and quantitative sensory components

. **Assignment NUMERICAL**

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The following are the observations of sieve analysis of wheat flour. Find out the Fineness Modulus and average particle size.

Size of opening (Microns)	Geometric Mean Diameter(microns)	Weight of material retained(gm))(w_i)	Multiplying Factor (m_i)	Product($w_i \times m_i$)
3000		-		
2500	**2738.6**	5	**8**	**40**
1900	**2179.4**	16	**7**	**112**
1400	**1631**	32	**6**	**192**
1000	**1183.2**	46	***5***	**230**
700	**836.7**	34	***4***	**136**
400	**529.1**	21	**3**	**63**
200	**282.8**	12	**2**	**24**
100	**141.42**	6	**1**	**6**
PAN		3	**0**	**0**
		$\Sigma(w_i)$=175		Σ ($m_i \times w_i$) =**803**

Fineness Modulus (FM) = Σ ($m_i \times w_i$) / $\Sigma(w_i)$ =**803/175 =4.588**

[GMD for *M/F 5=1183.2] –[*GMD for *M/F 4=836.7] = [Difference =346.5]*

*[Difference =346.5]***× 0.588 =** ***203.7, Add this value to*** *[*GMD for *M/F 4=836.7]*

Therefore GMD for **Fineness Modulus of 4.588 =(***836.7) +(**203.7)= 1040.4 microns***

Answer, ***Average Particle Size*** of wheat flour =***1040.4 microns***