Food and Technology
Teach Yourself Series
Topic 5: Physical, Sensory and Chemical Properties of Key Foods
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Physical, Sensory and Chemical Properties of Key Foods

The key foods are classified by origin, as either plant or animal origin. The key foods of plant origin are fruits, vegetables, cereals and nuts and legumes. The key foods of animal origin are meats, seafood, dairy and eggs. Each of these key foods have different physical, sensory and chemical properties. Physical properties are defined as the characteristics of a food which are visible and detectable. Examples of physical properties include colour, shape, size, viscosity, density. For example, the viscosity of custard is a physical property which can be measured. Sensory properties, also known as organoleptic properties, refer to the taste, texture, mouthfeel, aroma and appearance of a food item. For example, the texture of meat is a sensory property. Chemical properties generally refer to the nutritional value of the key food. This includes the macronutrients fat, protein and carbohydrate and micronutrients such as iron, calcium, vitamin A and vitamin C. For example, the chemical properties of meat include protein, iron and fat.

Physical properties of key foods

As it appears in Unit 1

Key foods of plant origin
Cereals: the physical properties of cereals can refer to the cereal product in its raw state or in its processed state. For example wheat in its raw state contains the outer husk and bran layer, whereas wheat processed into flour has significant changes to its physical properties and is ‘powdery’ in structure.
Fruits: the physical properties of fruits include the structure of the fruit, such as whether or not there is a core or stone in the centre of the fruit (such as pears or mangoes), whether or not the fruit is segmented (such as mandarins) and whether the fruit contains seeds (such as kiwi fruit). Additional physical properties of fruit include the skin, the flesh and colouration.
Vegetables: the physical properties of vegetables include the size and shape of the vegetable, as well as the structure of the vegetable, such as parsnips having a central core and peas being contained in a pod.
Nuts and legumes: the physical properties of nuts and legumes include the shell, the shape of the nut inside the shell and the hardness of the nut. Properties of legumes include the size and shape of the legume.

Key foods of animal origin
Meats: the physical properties of meat are largely determined by the cut of meat. For example, a leg of lamb may still have the bone attached and visible fat, whereas a lamb backstrap will be off the bone and have no visible signs of fat or muscle fibres.
Seafood: the physical properties of seafood are dependant upon the classification of seafood. For example, crustaceans such as lobster and crab have the presence of a hard outer shell, legs and claws. Whereas fish will have scales and fins visible.
Dairy: the physical properties of dairy foods vary depending on the degree of processing the product has undergone. Dairy foods close to the raw state are liquid in structure and the chemical components of fat and water may separate upon standing. Dairy foods that have undergone more processing, such as cheese are more solid in structure and hold firm in shape.
Eggs: the physical properties of the egg are characterised by a solid outer shell, air sac, chalazae, albumen and yolk. The properties of egg white and egg yolk vary considerably. Both are semi-liquid in structure whilst in their raw state, although the yolk is firmer in structure than the white.
Review Questions

1. The physical properties of nuts vary when they are removed from their outer shell.
   a. Explain the purpose of nuts having an outer shell.

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   b. Describe the differences in physical properties between a nut in its shell and one that has been removed from the shell.

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2. Cereal products rarely reach consumers in their raw state and have undergone some processing before they are available to the consumer.
   a. Explain why the physical properties of cereals are generally altered through processing before they reach the consumer.

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   b. Describe the differences in the physical properties between wholemeal flour compared with white flour.

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3. Which of the following is NOT a physical property?

A. Shape  
B. Weight  
C. Volume  
D. Mouthfeel  
E. Structure

As it appears in Unit 2

In Unit 2, the properties of key foods need to be identified and described together with the acknowledgement of how the properties impact upon each other, for example, how the physical properties of a key food impact upon the sensory properties.

The main properties (physical, sensory, chemical and functional) of the key foods are identified below.

**Key foods of plant origin**

**Cereals:** Physical: structure of the grain, wholegrain or processed. Sensory: gritty mouthfeel of wholegrain compared with processed alternative. Chemical: carbohydrate. Functional: structure, colour, thickening.


**Nuts and legumes:** Physical: shell structure and size and shape of legumes. Sensory: buttery taste of macadamia nuts, bland taste of lentils. Chemical: protein in nuts, iron and fibre in legumes. Functional: legumes used as thickeners.

**Key foods of animal origin**


**Seafood:** Physical: presence of scales or shell or absence of these for a fillet. Sensory: fishy aroma. Chemical: low in fat, good source of omega-3 fatty acids.


**Eggs:** Physical: differences between white and yolk. Sensory: rubbery texture of yolk. Chemical: protein in the white and fat and Vitamin A in yolk. Functional: binding, emulsifying, colour, setting and thickening.
Review Questions

4. The physical properties of foods often contribute to the functional capabilities of a food. An example of this is fruit.
   a. Explain how the physical properties of fruit such as the skin and pips contribute to the functional ability of fruit to thicken a substance such as jam.

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   b. Describe how the physical properties of another key food contribute to the functional properties of that key food.

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5. When describing the properties of a key food, physical, sensory, chemical and functional properties should be included.
   a. Describe the properties of the key food vegetables: potatoes.

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   b. Explain how the properties of the potato change when cooked.

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5.  
   a. The physical properties of a potato include: solid in structure, release of starch when cut, high starch density, fibrous skin. The sensory properties include: unpleasant to consume in raw state, crisp and crunchy, slimy as starch is release. The chemical properties include: carbohydrate in the form of fibre. Functional properties include starch, which has thickening properties, enzymes, which cause the raw potato to discolour when exposed to oxygen for a period of time and dextrin, which is responsible for colouring the potato when cooked.
   b. The most significant changes in the properties of the potato are in the physical and sensory properties. The physical properties change from a solid mass to one that is softer in texture. The sensory properties change from something that is largely unpalatable to something that can be crispy, soft, fluffy or golden brown.

6.  
   The following are properties of the key food lemon:
   A. Functional property: acid  
   B. Chemical property: Vitamin C  
   C. Sensory property: sour  
   D. Physical property: tough outer skin  
   E. Physical property: structure contains segments.

7.  
   a. The raw egg white is viscose in nature and although smooth, can be stringy and separate in clumps. The egg white is opaque in colour. The egg yolk is contained within the vitelline membrane, which prevents the yolk from discolouring the white and changing the structure of the egg. If the vitelline membrane is broken, the yolk is less viscose than the egg white.
   b. When cooked, the egg white coagulates at a faster rate than the yolk and becomes firm in structure as the protein sets. The yolk will also coagulate and become firmer in structure, although this happens at a slower rate than the white as it is higher in fat and lower in protein. In conclusion, the physical properties change by the egg become set and more stable in structure.

8.  
   a. The cut of meat will determine the physical properties of the meat. A lamb mid loin chop still contains a bone and has a visible layer of fat. Compared with a fillet of lamb, which is removed from the bone, has a higher proportion of flesh and is generally free from visible fat and connective tissue.
   b. Raw meat is soft and pliable, with visible fat being firm and rigid. Once cooked, meat becomes less pliable as the muscle fibres contract, resulting in a firmer piece of meat. The colour of the meat changes due to the Maillard reaction.

9.  
   Answer: A, D and E could all be described as viscose.
   Explanation: A- eggs can have the viscosity described and measured when they are denatured via heat. This is often the case if eggs are used in the production of custard or ice cream.
   D- dairy foods can be described as viscose. This would generally be for cream products, where the high proportion of fat globules suspended in the solution contribute to a thick and ‘viscose’ product.
   E- cereals could be describe as viscose if they are used for the purpose of thickening. Using flour to thicken a sauce contributes to the viscosity of the sauce by the process of gelatinization.

10.  
    a. Spinach when it is raw is crisp, vibrant, odourless and slightly chalky in mouthfeel.
    b. Spinach when it has been cooked has a wilted appearance, softer mouthfeel, slimy in texture and darker in colour or loss of colour if overcooked.
11.  
   a. When meat is cooked using wet techniques such as stewing or braising the sensory properties include: soft and moist mouthfeel, tender, grayish in colour and melting in texture.  
   b. Meat cooked using dry techniques is firm to touch, golden in colour, crisp exterior due to browning of fat, potentially dryer and more tough.  

12.  
   a. Fruit that is raw is generally crisp in texture, sweet and slightly sour in taste, firm in texture and with a crunchy mouthfeel. When fruit is cooked, the sensory properties change, the taste intensifies and the fruit becomes more sweet, the crisp texture changes to something that is softer and mushier and the colour deepens and becomes more intense.  
   b. The change in texture and mouthfeel are as a result of the changes in physical properties of the fruit. As the fruit is cooked, the physical structure breaks down as the cell walls allow for the uptake of liquid, making the flesh softer and mushy. It is this change in physical properties which allows for the variation in sensory properties.  

13.  
   a. Arborio rice is high in starch, which when cooked, this starch is released. This results in the risotto having a creamy texture without the actual addition of cream. The rice, despite providing the creaminess, also provides the body and texture to the risotto as it does not completely breakdown in structure.  
   b. The functional property of starch contributes to the sensory properties of the risotto through the process of gelatinization. As the rice is cooked, the starch is released, therefore thickening the risotto and resulting in the desirable thick and creamy texture.  

14.  
   a. The main nutritional component in cereals is carbohydrate, providing energy for the body. Rice and pasta are examples of processed cereals which provide the body with energy through carbohydrate.  
   b. Wholegrain cereals retain much of their natural chemical composition, whereas refined or processed cereals have had this removed and are largely left with just the energy remaining. Wholegrain cereals contain dietary fibre and b-group vitamins which are important for energy metabolism. Wholegrain cereals are therefore the healthier alternative.  

15.  
   a. Carrots contain the following chemical properties: carbohydrates (sugars) and carbohydrates (fibre- if skin is left on), Vitamin A, Vitamin C and b-group vitamins.  
   b. Vegetables such as carrots contain vitamins which are sensitive to heat. When the carrots are cooked, particularly when cooked using a wet cooking technique, if they are overcooked, there is a loss of heat sensitive vitamins which include Vitamin A and C. Baking the carrot or steaming for a short period of time helps to minimize the nutrient loss.  

16.  
   Answer: A, C and D  
   Explanation: Fruits contain dietary fibre, largely in the skin of the fruit. Cereals contain dietary fibre, wholegrain cereals have much of the bran layer intact and are therefore higher in fibre. Nuts and legumes are high in dietary fibre, unlike fruit where fibre is in the skin or cereals where the fibre can be removed, all nuts and legumes are naturally high in fibre.