Food test 1: Sensory Evaluation

In research and development of food, sensory evaluation is carried out to understand the food and food market.

Sensory evaluation of food samples involves five senses:

- Sight
- Smell
- Touch
- Taste
- Hearing

Exercise

You are given a food sample. Sample number: _____

Look at the sample. How do you name this food? _____

List all the senses you have just used. _____

Taste a bit of the sample. How do you name this food? _____

List all the senses you have just used. _____

There are various methods of sensory evaluation. In this exercise, we will work with two of the methods.

Quantitative Descriptive Analysis (QDA)

Panel of QDA is formed by a small number, usually 8 – 15 of experienced panelist. Product evaluations are performed by each panelist individually, usually in isolated booths. Standard sensory practices such as sample coding, booth lighting, expectorating, and rinsing between samples are used for the evaluation phase.

A line anchored with words generated by the panel is used. The resulting data can be analysed statistically. QDA may be used to completely describe the sensory sensations associated with a product from initial visual assessment to aftertaste, or panelists may be instructed to focus on a narrow range of attributes such as texture descriptors.

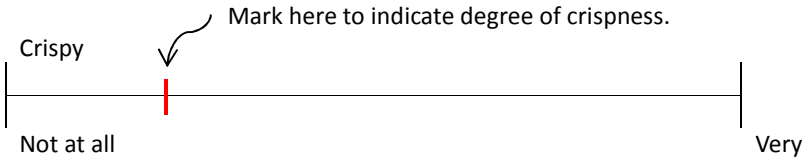
Sensory Evaluation Ballot for Quantitative Descriptive Analysis

Sample number: _____

Evaluate each sensory attribute and put a mark on each line:

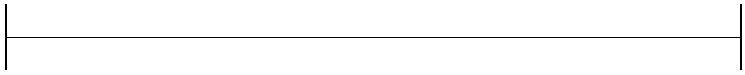
Example

a) Crispy

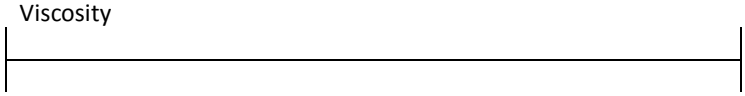


1. Appearance

a) Yellow hue

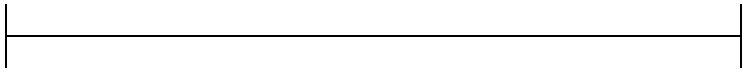


b) Viscosity

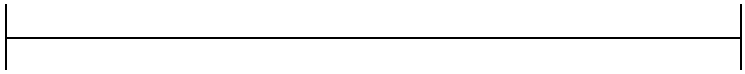


2. Aroma

a) Burnt



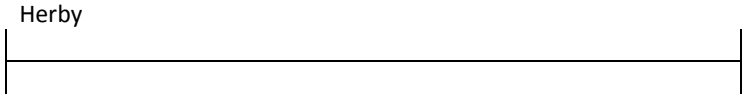
b) Coconut



3. Taste

a) Spicy

b) Herby



Paired Comparison Test

Paired comparison test is a type of discrimination test. The researcher wants to determine whether the two samples differ in a specified dimension, such as sweetness, yellowness, crispness. The two samples are presented to the panelist simultaneously and the panelist is asked to identify the sample that is higher in the specified sensory attribute.

Paired Comparison Score Sheet

Please rinse your mouth with water before starting. There are two samples for you to evaluate. Taste each of the coded samples in the sequence presented, from left to right. Take the entire sample in your mouth. NO RETASTING. Are the samples the same or different? Circle the corresponding word. Rinse with water between samples and expectorate all samples and water. Then proceed to the next set and repeat the tasting sequence.

Sample no. _____ Sample no. _____

Same Different

If you think that the two samples are different, name the different attributes. Which sample is stronger in each attribute?

Different attribute	Put a tick (✓) for the sample with stronger attribute.	
	Sample no. _____	Sample no. _____

Reference:
Lawless, H. T., & Heymann, H. (2010). *Sensory evaluation of food: Principles and practices*. New York: Springer.

SENSORY DESCRIPTORS (Tasting words)

We use our senses to evaluate what we eat, so s**ensory descriptors** are words for describing the appearance, taste and texture of food.

The following word bank gives examples of words used for food tastings. The list is not exhaustive, add your own words to the list. Some words fit under more than one heading.

SENSORY DESCRIPTORS			
Appearance (Looks) – colour, aesthetics	**Texture** (Mouthfeel) – how food and drink feels in your mouth		**Taste, flavour and smell**
Appetising	Airy	Lumpy	Acid
Attractive	Brittle	Mushy	Bitter
Boring	Chewy	Powdery	Bland
Bright	Cold	Rubbery	Burnt
Clear	Crispy	Slimy	Creamy
Cold	Crumbly	Smooth	Dry
Colourful	Crunchy	Soft	Fatty
Crumbly	Dry	Soggy	Fishy
Dry	Fine	Springy	Fruity
Dull	Firm	Sticky	Herby
Fattening	Fizzy	Stiff	Old
Fresh	Flaky	Stringy	Peppery
Fruity	Foamy	Tender	Salty
Glowing	Greasy	Thick	Sharp
Greasy	Gritty	Thin	Sickly
Healthy	Hard	Tough	Smoky
Hot	Hot	Watery	Soggy
Moist	Juicy	Warm	Sour
Mouth-watering			Spicy
Smooth			Stale
Soggy			Sweet
Tasty			Watery
			Wet
			Tasteless
			Tasty
			Undercooked

Food test 2: Thermal decomposition of baking soda (Practical)

Objective

To investigate the physical and chemical transformations of baking soda and sugar that occur in heating.

Principles

Baking soda, or sodium bicarbonate is a chemical compound with the formula $NaHCO_3$. It is a salt composed of sodium ions and bicarbonate ions. Above 50°C, sodium bicarbonate gradually decomposes into sodium carbonate, water, and carbon dioxide. Sodium bicarbonate is even less stable with respect to heating. Solid $NaHCO_3$ begins to lose carbon dioxide and water around 100°C, with complete conversion to sodium carbonate by 200°C:

$$2\ NaHCO_3 \rightarrow Na2CO_3 + H_2O + CO_2$$

The refined form of sucrose is commonly referred to as sugar. Sucrose is a disaccharide molecule combined by the monosaccharides glucose and fructose with the formula $C_{12}H_{22}O_{11}$. Maltose is a disaccharide formed from two units of glucose. Honey contains fructose, which caramelises at lower temperatures than glucose. The process of caramelisation consists of heating sugar slowly to around 170°C. As the sugar heats, the molecules break down and re-form into compounds with a characteristic colour and flavour.

Honeycomb toffee is a sugary toffee with a light, rigid, sponge-like texture. Sugar mixture is heated to produce a viscous liquid. The baking soda releases carbon dioxide which is trapped in the highly viscous mixture. The lattice structure is formed while the sugar is liquid, then the toffee sets hard.

Practical Session (1): Food Test 2

Observe physical and chemical transformations of baking soda and sugar by making honeycomb toffee.

Equipment & materials

Equipment	Materials	
Stainless-steel saucepan	Spraying oil	
Scale	Water	40 g
Sieve	Sugar	200 g
Bowl x 1	Maltose	70 g
Thermometer	Honey	50 g
Wooden spoon	Baking soda	6 g
Baking tray		
Aluminium foil		
Heat-proof rack		

Procedures

1. Line baking tray with aluminium foil, spray with oil, and put it on a heat-proof rack.
2. Sieve baking soda.
3. Measure water, sugar, maltose, and honey into a stainless-steel saucepan.
4. Heat the mixture, stir with a wooden spoon.
5. Continue heating until mixture reaches around 150^{o}C. Remove from heat.
6. Sprinkle baking soda, and mix immediately.
7. Pour into baking tray.
8. Let cool completely.
9. Observe.

Results

The temperature at which the sugar mixture begins to turn brown:	
What happens after adding baking soda?	
What is the physical state of mixture at the end of heating?	
What is the physical state of mixture after cooling?	
What is the colour of honeycomb toffee?	

Questions

1. What causes browning of toffee?
2. How can honeycomb toffee be used?

Food test 3: Change of texture of a sugar alcohol (Practical)

Objective
To investigate the physical transformations of a sugar alcohol that occurs in heating.

Principles
Isomalt is the popular name for isomaltitol which is a sugar alcohol made from beet sugar. It is used primarily for its sugar-like physical properties.

In food production, there are many advantages of isomalt over sugar especially when making cake decorations, dessert garnishes and candy. The very low hygroscopic tendency is very important. Unlike conventional sugar, *isomalt* is much more resistant to humidity and crystallisation so decorative elements made with it have a longer shelf life and structural integrity. It is stable at high temperatures (150^{o}C). This property makes it appropriate for sweet products without giving them the typical colour of burnt caramel.

In terms of sweetness, it is 0.5 times that of sugar (sucrose). It has lower energy than sugar, only 2 kcal/g, and therefore used in sugar-free sweets. However, it can have laxative effect when intake in high concentration. The ADI is 0.25 mg/kg body weight.

Practical Session (2): Food Test 3

Observe physical transformation of isomalt by making olive oil pouch.

Equipment & materials

Equipment	Materials
Stainless-steel saucepan Stainless-steel cookie cutter Spoon Thermometer	Isomalt Olive oil

Procedures

1. Heat isomalt in a stainless-steel saucepan until it reaches 170^{o}C.
2. Reduce heat immediately, and let cool to 120^{o}C.
3. Dip a cookie cutter inside the melted isomalt, and then hold it above the table.
4. Slowly pour a spoonful of olive oil into the cookie cutter.
5. Close the "sugar pouch" by pressing with fingers.
6. Observe.

Results

What colour is heated isomalt?	
Are there bubbles in the heated isomalt?	
What is the physical state of isomalt at the end of heating?	
What is the physical state of isomalt after cooling?	

Questions

1. What other ingredient can substitute olive oil?
2. How can isomalt be applied in food production?

Food test 4: Transforming a liquid into solid by hydrocolloids (Practical)

Objective
To investigate the physical transformations of liquid into solid by hydrocolloids upon cooling.

Principles
Hydrocolloids, often called gums, are hydrophilic polymers, of vegetable, animal, microbial or synthetic origin, that generally contain many hydroxyl groups and may be polyelectrolytes. They are naturally present or added to control the functional properties of aqueous foodstuffs. Most important amongst these properties are solubility, viscosity (including thickening and gelling), water binding, and many others. Examples of hydrocolloids are carrageenans, alginate, agar, gelatin, pectin, and starch.

Carrageenans are linear polymers of about 25,000 galactose derivatives, and can be prepared by alkaline extraction from red seaweed. Different seaweeds produce different carrageenans. Their functions are mainly thickening, suspending and gelling. Some carrageenans form thermoreversible gels on cooling.

Carrageenan can stabilise milk products by preventing whey separation and is also used as a binder in cooked meats, to firm sausages and as a thickener in toothpaste and puddings.

Practical Session (3): Food Test 4

Observe physical transformation of beverage into spaghetti by carrageenan.

Equipment & materials

Equipment	**Materials**	
Scale	Liquid	500 ml
Stainless-steel saucepan	E.g.	Cranberry juice
Spatula		Mango juice
Funnel		Soya milk
Syringe		Chocolate milk
Tube, 1m in length		24-herbs herbal tea
Basin	Carrageenan	25 g
Ice and cold water		

Procedures

1. Insert syringe tip into tube.
2. Prepare a basin of ice water.
3. Heat liquid to around 80^{o}C.
4. Add carrageenan and mix well until dissolved.
5. Remove from heat.
6. Transfer the liquid to syringe with a funnel.
7. Plunge liquid into long tube. Cool tube in ice water by submerging under water for 2 minutes.
8. Continue plunging to remove content.
9. Observe.

Results

What is the consistency of the liquid before heating?	
What is the consistency of the liquid after adding carrageenan?	
What is the texture of the spaghetti?	
Is any liquid seen when spaghetti is extruded?	

Questions

1. Why should liquid be heated?
2. What other ingredient can substitute carrageenan?
3. Other than juice, what types of liquid can be used?

Food test 5: Spherification (Practical)

Objective
To investigate how chemical reactions transform the physical properties of food.

Principles
Alginates are refined from brown seaweeds. It absorbs water quickly. Alginate has a wide use across a wide variety of industries including food, textile printing and pharmaceutical. In the food industry, it is used as a thickening agent for drinks and ice cream, and as a gelling agent for jellies.

Calcium alginate is a water-insoluble, gelatinous, cream-coloured substance that can be created through the addition of aqueous calcium chloride to aqueous sodium alginate. When liquid containing sodium alginate is dropped into another liquid containing calcium chloride, a thin membrane surrounding the droplets will be formed instantaneously. Spherification is the culinary process of these droplets that visually and texturally resemble roes.

There are two main methods for creating such spheres, spherification and reverse spherification. The use of method is dependent on the pH and calcium content of liquid.

Practical Session (4): Food Test 5

Observe formation of a thin, gelatinous membrane surrounding a drop of liquid.

Equipment & materials

Equipment	Materials	
Scale	Instant coffee powder	8 g
Stainless-steel saucepan	Sugar	4 g
Spatula	Hot water	500 ml
Hand-held beater	Alginate	2.5 g
Dropper	Distilled water	1 L
Basins x 2	Calcium salt	10 g
	Potable water (for rinsing)	

Procedures

1. Add alginate to heated coffee.
2. Blend with hand-held beater to dissolve alginate in coffee completely.
3. Add calcium salt into a basin of distilled water.
4. When coffee temperature reduces to 50-60^{o}C, drop slowly into water with a dropper.
5. Remove coffee droplets into another basin containing potable water for rinsing.
6. Observe.

Results

What is the consistency of the coffee after heating?	
What is the state of coffee and alginate mixture before dropping into water?	
How does a coffee mixture droplet look like after dropping into water?	
How does the coffee droplet taste in your mouth?	

Questions

1. What may happen if a beverage containing calcium is used instead of coffee?
2. What other ingredient can substitute coffee?

Food test 6: Tempering of chocolate (Practical)

Objective

To investigate how tempering of chocolate affects the texture of chocolate.

Principles

The purpose of tempering chocolate is to develop an even and smooth colour with a shiny gloss, a higher melting point, and a longer shelf-life chocolate. Proper tempering is also what gives high quality chocolate that “snap” when broken in half. Improperly tempered chocolates may exhibit grey patches on their surface when hardened.

Tempering is a process of heating and cooling chocolate to specific temperatures, making it more resistant to melting and impairing a smooth, glossy, hard finish. The steps in tempering chocolate are complete melting of chocolate at 50^{o}C, and cooling to the point of crystallisation (around 30^{o}C). Cocoa butter can solidify into several different crystal forms. A stable crystal form has one of the highest melting points; it melts at 33.8^{o}C. Tempering promotes the formation of smaller crystals that act as seeds for further crystal growth. Ultimately, this results in a smoother chocolate with an increased melting point that is resistant to temperature changes.

Practical Session (5): Food Test 6

Observe how tempering of chocolate affects the texture of chocolate.

Equipment & materials

Equipment	**Materials**
Scale Wok Mixing bowl Stainless-steel spoon x 2 Thermometer	Milk chocolate 200 g

Procedures

1. Melt milk chocolate in a warm water bath.
2. When chocolate is completely melted (around 50^{o}C), remove from water bath.
3. Let cool slowly. Stir occasionally.
4. Dip a spoon into chocolate when it reaches 40^{o}C and 30^{o}C.
5. Let both spoons sit on bench for 10 minutes.
6. Observe.

Results

Describe the following attributes of chocolate:	Removed at 40^{o}C	Removed at 30^{o}C
Colour		
Shininess		
Texture		

Questions

1. Name some different types of chocolate.
2. How can chocolate be used in culinary?

Food test 7: Dehydration of oil by maltodextrin (Practical)

Objective
To investigate how oil is dehydrated by maltodextrin.

Principles
Maltodextrin is a polysaccharide that is used as a food additive. It is produced from starch by partial hydrolysis and appears as very light-weight, white hygroscopic powder.

Maltodextrin can easily dissolve in water with a mildly sweet taste. In manufacturing, spray-drying creates a powder that is very porous on the microscopic level. Because of this structure, maltodextrin is able to soak up fatty substances, making it useful for working with fats when designing food. It absorbs water, so it is used as an emulsifier and thickener, as well as a fat substitute. Once maltodextrin is hydrated, it mimics the viscosity and texture of fats.

Practical Session (6): Food Test 7

Investigate how techniques involved with chemical and physical properties of food can be applied in food production.

Equipment & materials

Equipment	**Materials**	
Mixing bowl (medium) Mixing bowl (large) Gloves	Maltodextrin Dark chocolate	5 g 25 g

Procedures

1. Melt dark chocolate in a warm water bath.
2. When chocolate is completely melted (around 50^{o}C), add maltodextrin bit by bit. Mix with hand each time after adding.
3. Observe.

Results

Describe the following attributes of chocolate:	
Shape	
Texture	
Mouthfeel	

Questions

1. Why should chocolate be melted before mixing with maltodextrin?
2. What other ingredient can substitute chocolate?

Recipe
Chocolate Dirt Pot

Food test 6 and Food test 7 are both applied in making a chocolate pot.

Ingredients (make 4 pots)

Pot	
Chocolate	200 g
Spraying oil	
Soil	
Chocolate	25 g
Maltodextrin	5 g
Garnish	
Mint	1 sprig

Pudding		
Mix	Sugar	25 g
	Cocoa	15 g
	Cornstarch	8 g
Milk		1 cup
Mix	Egg	½ (~25 g)
	Sugar	3 g
Butter		4 g
Chocolate, chopped		40 g

Preparation

1. Spray pudding mold with oil.
2. Whisk egg with sugar.

Procedures - pot

1. Temper chocolate.
2. Brush chocolate inside the mold. Freeze.
3. Repeat step 2.

Procedures - pudding

1. Mix sugar cocoa and cornstarch in a saucepan.
2. Whisk in milk until combined.
3. Heat over medium heat until scalding, stirring occasionally.
4. Put about one quarter of chocolate milk into egg mixture, whisk.
5. Empty the egg mixture into the saucepan of chocolate milk, continue heating until mixture just comes to boil.
6. Remove from heat, and whisk in chocolate and butter until smooth.
7. Cover with plastic wrap, and chill until set.

Procedures - soil

1. Mix chocolate with maltodextrin until crumbly.

Assemble

Remove chocolate pot from mold, add pudding and soil. Garnish with a sprig of mint.

食物實驗 1：感官評估

在食品的研究和發展中，進行感官評估可以了解食品和食品市場。

食品樣本的感官評估涉及五種感官：

- 視覺
- 嗅覺
- 觸覺
- 味覺
- 聽覺

練習

你得到一個食物樣本。樣本編號：_____

看看樣品。你怎麼命名這個食物？ _____

列出所有你剛剛使用的感官。 _____

品嚐一點這個樣本。你怎麼命名這個食物？ _____

列出所有你剛剛使用的感官。 _____

進行感官評估有多種方法，在本練習中，我們將使用兩種方法。

定量描述分析（QDA）

QDA 評估小組由具有經驗的成員組成，通常是 8-15 人。產品評估由每位評味員單獨進行，通常在隔離的測試間中進行。評估階段使用標準做法，如樣本編碼、測試間照明、評估樣本之間吐出樣本和沖洗口腔等。

評味員擬定詞彙，詞彙鎖定在直線上，可以就評估得到的數據進行統計分析。QDA 可以用於對產品全面的描述，由最初的視覺評估到最後的後味相關聯的感覺，或者也可以指示評味員集中於狹窄範圍的屬性，例如質感的描述。

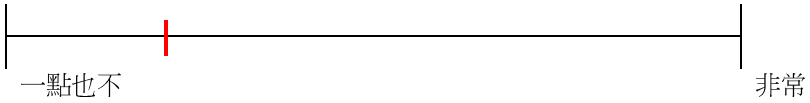
定量描述分析的感覺評估表

樣本編號：_____

評估每個感覺屬性，並在每一行上加上標記：

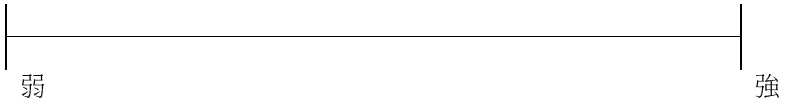
例子

a) 酥脆 在這裡標記以指示酥脆程度。

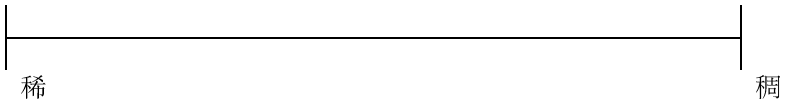


1. 外觀

a) 黃色色調

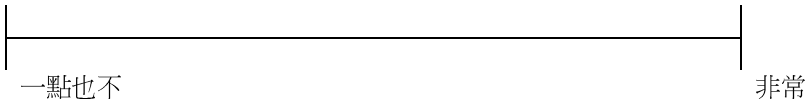


b) 稠度

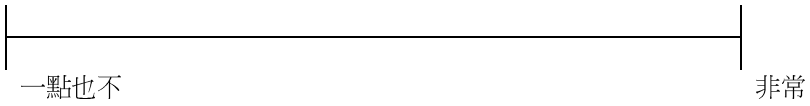


2. 香氣

a) 燒焦

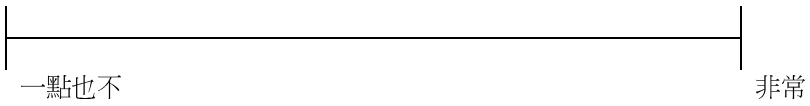


b) 椰子

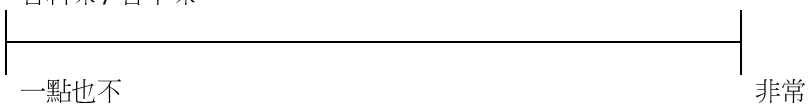


3. 味道

a) 辛辣



b) 香料味 / 香草味



配對比較測試

配對比較測試是一種判別測試。研究人員想要確定兩個樣本是否在指定尺度上有所不同，例如甜度、黃色程度和酥脆度。兩個樣本會同時呈上給評味員，要求評味員鑑定哪一個樣本指定的感覺屬性較高。

配對比較分數表

開始之前請用水沖洗口腔。有兩個樣本供你評估。按照次序從左到右品嘗每個已有編碼的樣本。把整個樣本放在嘴裡。不要重試。兩個樣本是相同還是不同？圈選相應的單詞。在品嘗樣本之間用水沖洗口腔，並將所有樣本和水吐出。然後繼續下一組並重複品嘗序列。

樣本編號	樣本編號	相同	不同
_____	_____		

如果你認為兩個樣本不同，請列出不同的屬性。哪個樣本在每個屬性比較強？

不同的屬性	在較強屬性的樣本加（✓）。	
	樣本編號 _____	樣本編號 _____

參考：
Lawless, H. T., & Heymann, H. (2010). *Sensory evaluation of food: Principles and practices*. New York: Springer.

感官描述語（形容味道的詞語）

我們使用感官評估食物，因此感官描述語指用來描述食物的外觀、味道和質感的詞語。以下詞庫列舉部分用來形容食物味道的詞語，部分詞語可用來描述食物的多項特質。列表並未納入所有感官描述詞語，請自行添加。

感官描述語			
外觀（外表）- 顏色、美感	質感（口感）- 食物和飲品在口中的感覺		風味、味道和香味
開胃 / 刺激食慾	輕型	多塊狀	醋酸味
吸引 / 引人注目	薄脆易碎	稀爛糊狀	苦
單調	有嚼勁	粉狀	淡而無味
明亮	冰凍	橡膠狀	焦味
清澈 / 分明	酥脆	黏糊糊	奶香味
冰冷	鬆脆	順滑	乾身
色彩繽紛	香脆	柔軟	肥膩
鬆脆	乾身	濕軟	魚腥味
乾身	精細	有彈性	果味濃郁
暗沉	結實	黏牙	香料味
肥膩	起泡	僵硬	過老
新鮮	易碎成小薄片 / 易脫落	柴硬 / 多筋	胡椒味 / 辣味
果味濃郁	冒泡	幼嫩	鹹
亮眼	油膩	濃稠	濃烈刺激
油膩	砂礫狀	稀薄	令人作嘔
健康	堅硬	硬又嚼不動	煙燻味
熱 / 辛辣	熱 / 辛辣	水淋淋	濕軟
濕潤	多汁	溫熱	酸
令人垂涎欲滴			辛辣
光滑			變質走味
濕軟			甜
美味可口			水淋淋 / 味道淡
			濕潤
			無味
			美味可口
			火候不足 / 沒煮熟

食物實驗 2：食用梳打粉的熱分解（實習）

目的

研究食用梳打粉和糖在加熱中發生的物理和化學轉化。

原理

食用梳打粉，即碳酸氫鈉，化學式 $NaHCO_3$ 的化合物。它是由鈉離子和碳酸氫根離子組成的鹽。在 50°C 以上，碳酸氫鈉逐漸分解成碳酸鈉，水和二氧化碳。加熱會導致碳酸氫鈉更不穩定。固體 $NaHCO_3$ 在約 100°C 開始流失二氧化碳和水，在 200°C 完全轉化為碳酸鈉：

$$2\ NaHCO_3 \rightarrow Na2CO_3 + H_2O + CO_2$$

蔗糖經精製後成為糖。蔗糖的化學式是 $C_{12}H_{22}O_{11}$，是由單醣葡萄糖和果糖組合的雙糖分子。麥芽糖是由兩個葡萄糖形成的雙糖。蜂蜜含有果糖，比葡萄糖的焦糖化溫度更低。焦糖化的過程包括將糖緩慢加熱至約 170°C。隨著糖的加熱，分子分解並重新形成獨特的顏色和風味的化合物。

蜂窩拖肥糖是一種輕而堅硬、有海綿狀紋理的拖肥糖。糖的混合物加熱後會形成粘稠液體。食用梳打粉釋放二氧化碳，並被截留在高粘度的混合物中。液態的糖形成晶格結構，然後拖肥糖變硬。

實習環節(1)：食物實驗2

通過製作蜂窩拖肥糖觀察食用梳打粉和糖的物理和化學轉化。

用具與材料

用具	材料	
不銹鋼煲	噴油	
磅	水	40 克
篩	糖	200 克
碗 x 1	麥芽糖	70 克
溫度計	蜜糖	50 克
木匙	食用梳打粉	6 克
焗盤		
鋁箔		
隔熱架		

步驟

1. 將鋁箔墊在焗盤上，噴油並放在隔熱架上。
2. 食用梳打粉篩勻。
3. 量度水、糖、麥芽糖和蜂蜜並放入不銹鋼煲中
4. 把混合物加熱，用木匙攪拌。
5. 繼續加熱，直到混合物達到約 150°C，離火。
6. 撒上食用梳打粉，並立即攪拌。
7. 倒進焗盤。
8. 待完全冷卻。
9. 觀察。

結果

糖混合物開始變棕色的溫度：	
添加食用梳打粉後發生什麼事？	
加熱結束時，混合物的物理狀態是怎樣？	
冷卻後，混合物的物理狀態是怎樣？	
蜂窩拖肥糖是什麼顏色？	

思考問題

1. 導致拖肥糖褐變的原因是什麼？
2. 如何使用蜂窩拖肥糖？

食物實驗 3：糖醇的質地變化（實習）

目的

研究糖醇在加熱中發生的物理轉化。

原理

異麥芽糖醇是異麥芽酮糖醇的俗名，是由甜菜糖製成的糖醇。使用它的主要原因是基於其糖狀的物理性質。

在食品生產中，異麥芽糖醇有許多比糖優勝之處，特別是當製作蛋糕裝飾品、甜點裝飾品和糖果時。 非常重要的是它的吸濕能力很低。異麥芽糖醇抵禦濕度和結晶的能力比一般的糖強得多，因此由其製成的裝飾部分具有更長的保質期和完整的結構。它能在高溫（150°C）下穩定，這個屬性使它適合用於甜的產品，而不會形成焦糖的典型顏色。

在甜度方面，異麥芽糖醇是糖（蔗糖）的 0.5 倍。它的能量比糖更低，每克僅 2 千卡，因此用於無糖的糖果。然而，當攝入高濃度時，它可以具有輕瀉作用。每日攝取容許量（ADI）為每千克體重 0.25 毫克。

實習環節(2)：食物實驗3

通過製作橄欖油小囊觀察異麥芽糖醇的物理轉化。

用具與材料

用具	材料
不銹鋼煲 不銹鋼鍋曲奇模具 匙 溫度計	異麥芽糖醇 橄欖油

步驟

1. 在不銹鋼煲中加熱異麥芽酮糖醇，直至達到 170ºC。
2. 立即降低溫度至 120ºC。
3. 取曲奇模具在異麥芽糖醇中浸一下，然後把它握住在桌子之上。
4. 慢慢地把一匙橄欖油倒入曲奇模具中。
5. 用手指按壓把「糖小囊」封好。
6. 觀察。

結果

異麥芽糖醇加熱後是什麼顏色？	
加熱的異麥芽糖醇中有沒有氣泡？	
加熱結束時，異麥芽糖醇的物理狀態是什麼？	
降溫後，異麥芽糖醇的物理狀態是什麼？	

思考問題

1. 有什麼其他材料可以替代橄欖油？
2. 如何應用異麥芽糖醇於食品生產？

食物實驗 4：運用水狀膠體將液體轉化為固體（實習）

目的

研究水狀膠體冷卻時將液體轉為固體的物理轉化。

原理

水狀膠體，通常稱為樹膠，是植物、動物、微生物或合成來源的親水性聚合物，通常含有許多羥基，並且可以是高分子電解質。它們是天然存在或添加以控制水性食品的功能性質。在這些性質中，最重要的是溶解性、黏度（包括增稠和膠凝）、保水力和許多其它性質。水狀膠體的例子有卡拉膠（菜膠）、藻酸鹽、瓊脂、明膠、果膠和澱粉。

菜膠是由約 25,000 個半乳糖衍生物組成的線性聚合物，並且可以紅海藻鹼提取製備。不同的海藻產生不同的菜膠。它們的功能主要是增稠、懸浮和膠凝。一些菜膠在冷卻時形成熱致可逆的凝膠。

菜膠可以防止乳清分離，令乳製品穩定。並且可以在熟肉中作為黏合劑，令香腸堅固，而且可以用於牙膏和布丁中作增稠劑。

實習環節(3)：食物實驗4

觀察菜膠將飲料轉為"意大利麵條"的物理轉化過程。

用具與材料

用具	材料	
磅	液體	500 毫升
不銹鋼煲	例如：	蔓越莓汁
刮劑		芒果汁
漏斗		豆奶
針筒		朱古力牛奶
膠管，長 1 米		24 味涼茶
水盆	菜膠	25 克
冰和冷水		

步驟

1. 將針筒尖端插入膠管中。
2. 準備一盆冰水。
3. 將液體加熱至 80ºC 左右。
4. 加入菜膠，充分混合至溶解。
5. 離火。
6. 用漏斗將液體轉移到針筒。
7. 將液體灌入長管中，把膠管浸在冰水中冷卻 2 分鐘。
8. 繼續灌注，把成分擠出。
9. 觀察。

結果

液體加熱前的稠度是怎樣？	
添加菜膠後，液體的稠度是怎樣？	
"意大利麵條"的質地是怎樣？	
當擠出"意大利麵條"時，有沒有看到任何液體？	

思考問題

1. 為什麼要把液體加熱？
2. 有什麼其他材料可以替代菜膠？
3. 除了果汁以外，還可以使用什麼液體？

翻譯參考：Zhou, Z., & Guan, H. (2005). *A glossary of food science and technology*. Hong Kong: The Chinese University Press.

食物實驗 5：球化（實習）

目的

研究化學反應如何改變食物的物理性質。

原理

藻酸鹽由棕色海藻精製而成。它能迅速吸水。藻酸鹽廣泛用於各種行業，包括食品、紡織印刷和製藥。在食品工業中，藻酸鹽用作飲料和冰淇淋的增稠劑，以及用作果凍的膠凝劑。

藻酸鈣是非水溶性、凝膠狀的奶油色物質，可以通過將氯化鈣水溶液加入到藻酸鈉水溶液中而產生。當含有藻酸鈉的液體滴入另一含有氯化鈣的液體中時，液滴的周圍將瞬時形成一層薄膜。球化是這些液滴的烹飪過程，在視覺和質地上和魚子相似。

產生這樣的球體有兩種主要的方法，球化和反向球化。使用哪種方法取決於液體的酸鹼度和鈣含量。

實習環節(4)：食物實驗5

觀察一滴液體外層的凝膠狀薄膜的形成。

用具與材料

用具	材料	
磅	即溶咖啡粉	8 克
不銹鋼煲	糖	4 克
刮劑	熱水	500 毫升
手提式拌打機	藻酸鹽	2.5 克
滴管	蒸餾水	1 升
水盆 x 2	鈣鹽	10 克
	飲用水（用於沖洗）	

步驟

1. 將藻酸鹽加入已加熱的咖啡中。
2. 用手提式拌打機攪拌直至藻酸鹽完全溶解於咖啡中。
3. 將鈣鹽和蒸餾水加入水盆中。
4. 當咖啡溫度降至 50-60°C 時，用滴管緩慢地把咖啡滴入水中。
5. 將咖啡液滴移入另一個含有飲用水的盆中，用於沖洗。
6. 觀察。

結果

咖啡加熱後的稠度是怎樣？	
在滴進水之前，咖啡及藻酸鹽混合物的狀態是怎樣？	
滴入水後，咖啡混合物液滴的狀態如何？	
咖啡液滴在嘴裡的味道怎麼樣？	

思考問題

1. 如果使用含鈣的飲料而不是使用咖啡，可能會發生什麼事？
2. 有什麼其他材料可以替代咖啡？

食物實驗 6：朱古力的調溫（實習）

目的

研究朱古力的調溫如何影響朱古力的質感。

原理

朱古力調溫的目的是為了令朱古力有一種均勻及平滑並帶有光澤的顏色、有更高的熔點和更長的保質期。適當地調溫能令高品質的朱古力一截即斷。不適當地調溫的朱古力在硬化時，表面可能呈現灰色斑點。

調溫是將朱古力加熱和冷卻至特定溫度，使其更能抵禦熔化及損害，並且保持表面的光滑、光澤和硬度。朱古力調溫的步驟是在 50°C 下完全熔化朱古力，並冷卻至結晶點（約 30°C）。可可脂可以固化成幾種不同的晶型。穩定的晶型具有其中之一個最高熔點；它在 33.8°C 熔化。調溫促進較小的結晶體形成，並作為種籽令結晶體進一步生長。最終，朱古力的表面更平滑，熔點更高，並且能抵禦溫度變化。

實習環節(5)：食物實驗6

觀察朱古力的調溫如何影響朱古力的質-感。

用具與材料

用具	材料
磅 粉盤 (中型) 粉盤 (大型) 不銹鋼匙 x 2 溫度計	牛奶朱古力 200 克

步驟

1. 把牛奶朱古力座於溫水中溶化。
2. 當朱古力完全溶化（約 50ºC）時，從溫水中取出。
3. 慢慢冷卻，偶爾攪拌。
4. 冷卻至 40ºC 和 30ºC 時，將匙放入朱古力中浸一下。
5. 把兩隻匙放在桌子上待 10 分鐘。
6. 觀察。

結果

描述朱古力以下的屬性：	40ºC 時取出	30ºC 時取出
顏色		
光澤		
質感		

思考問題

1. 舉出不同類型的朱古力。
2. 如何於烹飪中使用朱古力?

食物實驗 7：用麥芽糊精令油脂脫水（實習）

目的

研究麥芽糊精怎樣令油脂脫水。

原理

麥芽糊精是一種多醣，用作食品添加劑。它是由澱粉經過部分水解而產生的，重量非常輕、吸濕力強的白色粉末。

麥芽糊精容易溶解於微甜的水中。製造麥芽糊精時，噴霧乾燥法在微觀層面產生非常多孔的粉末。因為這種結構，麥芽糊精能夠吸收脂肪物質，在設計食品會時常與脂肪一起使用。它吸收水分，因此被用作乳化劑和增稠劑，以及脂肪替代品。一旦麥芽糊精水合，它的黏度和質地都和脂肪十分相似。

<u>實習環節(6)：食物實驗7</u>

研究如何將涉及食品的化學和物理性質的技術應用於食品生產。

用具與材料

用具	**材料**	
粉盤 (中型) 粉盤 (大型) 手套	麥芽糊精 黑朱古力	5 克 25 克

步驟

1. 把黑朱古力座於溫水中溶化。
2. 當朱古力完全溶化（約 50°C）時，逐少添加麥芽糊精。每次添加後用手拌勻。
3. 觀察。

結果

描述朱古力以下的屬性：	
形態	
質感	
口感	

思考問題

1. 為什麼朱古力要先溶化，再與麥芽糊精混合？
2. 有什麼其他材料可以替代朱古力？

食譜
朱古力泥盆栽

食物實驗 6 和食物實驗 7 都用於製作朱古力盆栽。

材料（4 盆）

盆	
朱古力	200 克
噴油	
泥	
朱古力	25 克
麥芽糊精	5 克
裝飾	
薄荷	1 枝

布丁		
混合	糖	25 克
	可可粉	15 克
	粟粉	8 克
牛奶		1 杯
混合	蛋	½ (~25 克)
	糖	3 克
牛油		4 克
朱古力，切碎		40 克

預備

1. 把油噴在布丁模具上。
2. 蛋和糖一起發打。

步驟 - 盆

1. 把朱古力調溫。
2. 在模具中掃上朱古力，冷凍。
3. 重複步驟 2。

步驟 - 布丁

1. 在一個鍋中，把糖、可可粉和粟粉混合。
2. 拌入牛奶。
3. 用中火加熱，直至燙熱，偶爾攪拌。
4. 把大約四分之一的朱古力奶放入雞蛋混合物中，攪拌。
5. 將雞蛋混合物倒入鍋中，繼續加熱直至混合物沸騰。
6. 離火，拌入朱古力和牛油，攪至滑。
7. 蓋上保鮮紙，冷卻至凝固。

步驟 - 泥

1. 把朱古力與麥芽糊精混合，直到鬆脆。

組合

從模具中取出朱古力，加入布丁和泥。用薄荷小枝裝飾。