Effective Learning and Teaching of Home Economics / Technology and Living Series: Food Preparation and Cooking Skills with Meal Planning in Basic Food Science
6th July, 2016

Ms Lilian YEUNG

College Lecturer

HKU SPACE Po Leung Kuk Stanley Ho Community College

Topics

- Angel cake
  - Characteristics of egg
  - Functions of egg
  - Foaming properties of egg white
  - Explanation of food test
- Vanilla cupcake
  - Types of sugar and its characteristics
  - Functions of sugar
  - Aeration/ assisting in leavening
  - Explanation of food test

Topics

- Pastry
  - Types of pastry
  - Types of fat and its characteristics
  - Functions of fat
  - Flakiness in pastry
  - Explanation of food test
  - Tenderising / shortening effects of fat
  - Fruit tart with explanation of food test
  - Pastry cream
  - Egg coagulation
  - Explanation of food test

Angel cake

- Sponge cake
- With beaten egg whites and sugar
- With no butter
- Lightness in texture

Whole egg

Makeup of an egg

- 2/3 of the edible part is egg white
- 1/3 is egg yolk

Composition of egg

- ~75% is water
- ~10% is protein
- ~10% is fat

Egg white

- ~ 90% water
- ~ 10% protein

- Ovalbumin is the main protein found in egg white
- Have both thick and thin white portion
- More difficult to separate the yolk from the white when the egg ages

Functions of eggs

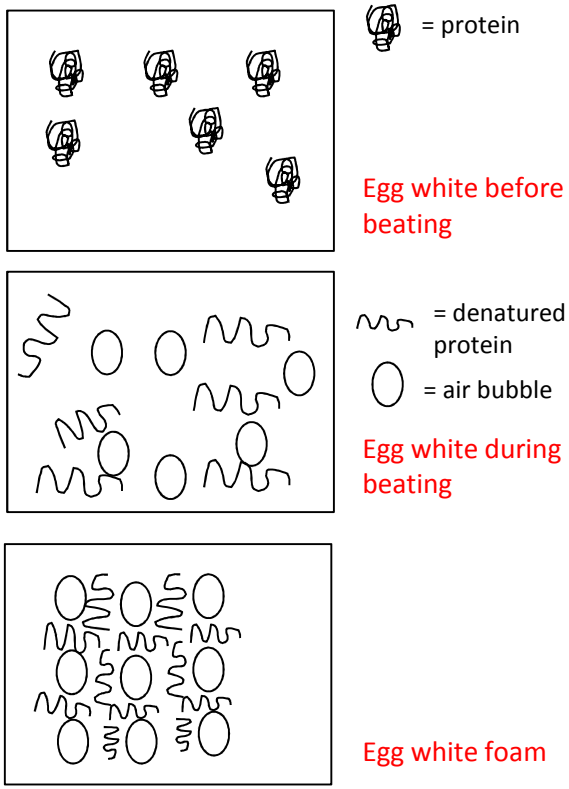
- Provide structure
  - By the coagulated egg proteins
  - Ranking for structure building abilities
    - Whites > whole > yolks
- Foaming properties
  - Foam : with aqueous continuous phase (water) and gaseous (air) dispersed phase
  - Egg proteins form a protective lining around the air bubbles to stabilise the foam
  - Create lightness in texture in food
  - Ranking for foaming power
    - Whites > whole > yolks

Other functions of eggs

- Emulsifying
- Contributing to colour and flavour
- Adding nutritional value

Foaming properties of egg white

- Process of foam formation
  - During whipping
    - Air bubbles are beaten into the egg white and egg white protein denatures
    - Unfold protein will aggregate around the air bubbles forming a protecting film to prevent air bubbles pop and foam collapse



Factors affecting foam stability

- Temperature of egg whites
  - Room temperature is better for whipping
- Thickness of whites
  - Thin older whites can whip for higher volume but stability is low
  - Thick one can form a better protective film and higher stability
- Added ingredients
  - Sugar
  - Lipids
  - Acid

Added ingredients on foam stability

- Sugar
  - Can dissolve in the liquid film increasing the thickness of the film
    - Prevent the collapse of foam
  - Can prevent over-whipping by slowing the unfolding of protein molecules
- Remarks
  - Don’t add too quickly since it will affect the unfolding of protein
  - In angel food cake, add the sugar after beating the whites for 1-2 minutes

Added ingredients on foam stability

- Acid
  - Can stabilise the foam by lowering pH
  - The film formed by protein will be more flexible and stable against over-whipping or folding
  - Common acid used in baking : cream of tartar, lemon juice and vinegar
- Remarks
  - Too much acid will make the product too sour
  - Cream of tartar is used when making angel food cake

Added ingredients on foam stability

- Lipids
  - Can destabilise the foam
    - Prevent unfolding of protein which lengthens the time of forming foam
    - Compete with protein to form film with the air bubbles, however the film is weaker when compared to protein film and thus the foam will collapse
- Remarks
  - Any trace of egg yolk/fat can ruin the foaming process

Food test on foaming stability

- Egg white with cream of tartar and also with sugar added slowly in the later process can stabilise the foam
  - Less leakage
- Egg white contaminated with egg yolk normally cannot form stabilised foam with same time of beating
  - More leakage

Vanilla cupcake

- Small cake designed to serve one person
- Basic ingredients : butter, sugar, eggs, and flour
- Cream butter with sugar is a common process to increase the lightness in texture in the cake
- Leavening agent is commonly used

Types of dry crystalline sugar

- White and brown sugar
  - Granulated sugar
  - Caster sugar
  - Icing sugar

- The size of crystal
  - Regular > Caster > Icing

Caster sugar

- Intermediate in size between granulated sugar and icing sugar
- Dissolves more quickly in liquid than regular sugar
- Allows more incorporation of air cells into the shortening
- Can produce finer and uniform crumb in cakes

Icing sugar

- Consists of sucrose crystals in powder form
- Easily absorbs water / quickly dissolves in water
- Normally with 3% cornstarch to absorb moisture / prevent caking

Functions of sugar

- Sweetening
- Tenderising
  - Delay the gluten formation, protein coagulation by attracting water
- Contributing to brown colour
  - Caramelisation
    - Sugar undergo heating
  - Maillard reaction
    - Sugar and proteins
    - High temperature can speed up the browning
- Aerating / Assisting in leavening

Aerating /Assisting in leavening

- When sugar and fat are creamed together, air can be incorporated in the fat trapping on the face of sugar's crystals
- During baking, the air cells expand when filled with carbon dioxide from the leavening agent
- Lower the density of the product
- Only dry sugars but not syrup can assist in leavening
- Remarks
  - Creaming is the first step in making cupcakes

Crystal size on aerating power

- Size of the sugar crystal affects the amount of air that can be incorporated during the creaming of the sugar and fat

- The finer structure of caster sugar (when compared to granulated sugar) is better for creaming
  - Enough surface area for aerating the butter when beating
    - Caster sugar is finer so the texture will be less coarse when compared to granulated sugar

Food test on creaming with different sugars

- Caster sugar will give lightness in texture in the cake since the aeration is better in the batter

- Cake with no sugar will have a paler colour when compared with those having sugar

Pastry

- A mixture of flour, fat and liquid
- Five basic types
  - Short crust pastry
  - Rough puff pastry
  - Puff pastry
  - Filo pastry
  - Choux pastry

Rough puff pastry

- Light and flaky unleavened pastry
- Large amount of fat is mixed into the dough. Then roll and fold in a way similar to puff pastry(Laminated dough)
- Does not rise as effectively as puff pastry

Short crust pastry

- Used for the base of a tart or pie
- Contains no leavening agent
- Normally follow "half-fat-to-flour" ratio
- Fat is rubbed into plain flour and then small amount of ice water is added to form a dough. Then rolled out without folding to form the tart

Types of fat

- Butter
- Lard
- Margarine
- Shortening
- Oil

Butter

- Made from heavy cream
- 80% fat and 20% water
- High in saturated fat
- Good flavour and mouth feel
- More expensive than margarine
- Narrow plastic range
  - Plasticity of fat refers to its ability to hold its shape but still be shaped under light pressure
  - Melts quickly in hand or warm environment

Lard

- Pork based product
- 100% fat
- With unique crystalline structure
  - Ideally for separating layers of dough in laminated product creating flakiness
  - Not good for creaming

Margarine

- Hydrogenation from vegetable oils
- 80% fat and 20% water
- Cheaper than butter
- No cholesterol
- Poorer flavour and mouth feel than butter
- With trans fat

Shortening

- Major difference between shortening and margarine : 100% fat with no water
- White and bland taste

Oil

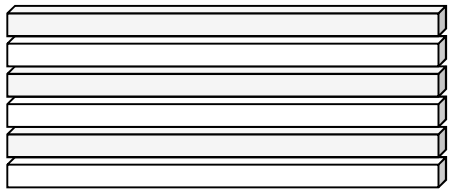
- Liquid in nature
- 100% fat
- High in monounsaturated and polyunsaturated fatty acids
- Does not contribute to leavening because it cannot trap air

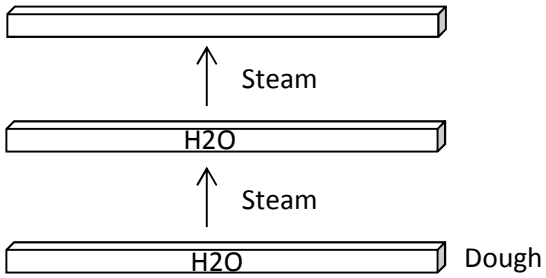
Functions of fat

- Contributes to flavour
  - Butter has the best flavour
- Provides flakiness in pastries
- Provides tenderness/shortening
- Prevents staling
- Contributes to colour

Fat - flakiness in pastries

- Flakiness refers to the tendency to form thin and flat layers in the pastries
- Layers of dough are separated by the layers of plastic fat
- During heating in the oven, water in the dough evaporates as steam and the layers of fat melt
- Melted fat can prevent the escape of steam while the steam pressure can push apart the dough layer from each other and create the flakiness in pastries





During heating

Fat - flakiness in pastries

- Melting of fat before baking will lose the flakiness because the fat blend with the dough

- In general, the higher the melting point of fat, the more flaky the pastries

Ham and mushroom vol au vents /Food test on flakiness in pastry

- Oil does not have plasticity and low melting point
  - Not effective in making flaky pastry
  - No layer can be formed in the pastry
- Butter is more difficult to handle when compared to lard and margarine due to narrow range of plasticity. Melts easily during mixing, rolling and folding

Ham and mushroom vol au vents/ Food test on flakiness in pastry

- Lard
  - Easier to handle
  - Less water when compared to butter
  - With large beta crystals
  - Can create flakiness in pastry

- However, pastry made with butter has better flavour
  - Pastry will use half butter and half lard

Fat - Tenderness/shortening

- Shortening is the ability of fats to shorten gluten strands
- Fat can coat the gluten proteins preventing them from hydrating
  - Less able to form large and extended network
  - Increase the tenderness of the bakery products
- The shortening ability depends on the plasticity and degree of saturation of fat
- In general, more fat or the softer the fat coats the flour particles, the more it tenderises

Fat - Tenderness/shortening

- Water content in fat affects the shortening effect
- Butter and margarine have 20% water which can be used by the gluten in the flour to form gluten network while lard has 100% fat
  - Pie with lard will be more tender than using pure butter

Fruit tart/ Food test on shortening in pastries

- Short crust pastry can be used to make fruit tarts
- Pastry with less fat cannot coat the flour completely and thus the texture will be tough
- Pastry with more fat, the more tender the texture is
- However, too much fat will make the tart collapse or mealy

Pastry cream

- A cooked mixture of milk or cream, egg yolk and sugar
- Widely used in dessert
- Mixture is thickened by the coagulation of egg protein induced by heat

Egg coagulation in pastry cream

- When egg yolks are heated, the proteins denature and unfold. Then the denatured protein will aggregate (egg coagulation)

- The longer the proteins are heated, the more firm and rigid the network forms. It will lead to over coagulation. It is also known as curdling
  - Product will shrink with dry and rubbery texture

Factors affecting egg coagulation

- Proportion of egg
  - Dilute the egg with milk or water can reduce the risk of over coagulation by
    - Increasing the coagulation temperature
    - Making more difficult for the protein to find each other
- Sugar
  - Can be added to reduce the risk of over coagulation by
    - Preventing the proteins from unfolding and thus slower rate of coagulation

Factors affecting egg coagulation

- Lipids
  - Can be added to reduce the risk of over coagulation by
    - Preventing the proteins from unfolding and thus slower rate of coagulation
- Starch
  - Can be added to prevent curdling by
    - Increasing the coagulation temperature
    - Preventing the proteins from unfolding and thus slower rate of coagulation
  - Remarks :Starch is being added to the pastry cream to prevent curdling

Food test : added ingredients on egg coagulation

- The one with egg only curdled significantly
- The one with added sugar or water curdled less when compared to the one with egg only
- The one with added cream (fat and water) had much slower coagulation. Texture was very smooth and some egg still not yet thickened

Food test : temperature effects on browning of sugar and flour

- Sugars contributes to brown color of the bakery product through the processes of caramelization and Maillard reaction
- High oven temperatures increase the browning of the rough puff pastry as well as the filling of the egg tart

Q&A

家政科／科技與生活科有效的學與教系列：處理和烹調食物的技巧與膳食計畫 - 食品科學基礎
2016年7月6日

Ms Lilian YEUNG

College Lecturer

HKU SPACE Po Leung Kuk Stanley Ho Community College

課題

- 天使蛋糕
  - 雞蛋的特性
  - 雞蛋的功能
  - 蛋白的起泡特性
  - 食物實驗的說明
- 香草蛋糕
  - 糖的種類和它的特性
  - 糖的功能
  - 膨鬆
  - 食物實驗的說明

課題

- 批皮
  - 批皮的種類
  - 脂肪的種類和它的特性
  - 脂肪的功能
  - 批皮的層片狀
  - 食物實驗的說明
  - 脂肪的起酥性
  - 新鮮水果撻和食物實驗的說明
  - 吉士糊
  - 雞蛋的凝結
  - 食物實驗的說明

天使蛋糕

- 海綿蛋糕
- 發打蛋白和糖而成
- 不含牛油
- 輕盈的質感

全蛋

雞蛋的構造

- 2/3可食用部分是蛋白
- 1/3是蛋黃

雞蛋的成分

- ～75％ 水
- ～10％ 蛋白質
- ～10％ 脂肪

蛋白

- ～90％ 水
- ～10％ 蛋白質

- 卵白蛋白是蛋白中的主要蛋白質
- 有厚和薄的蛋白部分
- 雞蛋老化會令蛋黃和蛋白比較難分離

雞蛋的功能

- 提供結構
  - 透過雞蛋中的蛋白質的凝結
  - 建構能力的排序
    - 蛋白>全蛋>蛋黃
- 起泡特性
  - 泡沫：水連續相(水)和氣體分散相(空氣)
  - 雞蛋中的蛋白質形成的保護膜包圍氣泡以穩定泡沫
  - 形成輕盈的質感
  - 起泡能力的排序
    - 蛋白>全蛋>蛋黃

雞蛋的其他功能

- 乳化作用
- 提供顏色和味道
- 添加營養價值

蛋白的起泡特性

- 形成泡沫的過程
  - 攪拌發打中
    - 氣泡被打進蛋白中
    - 蛋白中的蛋白質變性
    - 變性蛋白形成保護膜包圍氣泡，防止氣泡破裂以穩定泡沫

影響蛋白泡沫穩定性的因素

- 蛋白的溫度
  - 在室溫會比較容易發打
- 蛋白的厚度
  - 薄/老化的蛋白可以打發出更高體積的泡沫，但穩定性比較低
  - 厚的蛋白可以形成更好的保護膜有更高的穩定性
- 添加物
  - 糖
  - 脂肪
  - 酸性成分

添加物對蛋白泡沫穩定性的影響

- 糖
  - 能在保護膜中溶解，增加保護膜的厚度
    - 防止泡沫破裂和崩塌
  - 減慢蛋白質的變性，能防止過度發打
- 備註
  - 加入糖的速度不宜太快，因為會影響蛋白質的變性
  - 製作天使蛋糕時，發打蛋白1-2分鐘後才加入糖

添加物對蛋白泡沫穩定性的影響

- 酸性成分
  - 可以通過降低酸鹼值來穩定泡沫
  - 保護膜會更加有彈性和穩定性來防止過度發打
  - 在烘焙中常用的酸性成分：撻撻粉，檸檬汁和醋
- 備註
  - 使用過多的酸性成分會使產品太酸
  - 製作天使蛋糕時，使用撻撻粉

添加物對蛋白泡沫穩定性的影響

- 脂肪
  - 破壞泡沫的穩定性
    - 阻礙蛋白質變性，延遲泡沫的形成
    - 與蛋白質爭奪氣泡，但形成的薄膜比蛋白質形成的薄膜弱，泡沫將容易破裂和崩塌
- 備註
  - 微量的蛋黃已能破壞泡沫形成

食物實驗：泡沫的穩定性

- 蛋白加入撻撻粉和在發打蛋白1-2分鐘後才慢慢加入糖可以穩定泡沫
  - 滲漏的體積比較少
- 用相同時間發打，被微量的蛋黃污染的蛋白不能形成穩定的泡沫
  - 滲漏的體積比較多

香草蛋糕

- 一人份量的小蛋糕
- 基本材料：牛油，糖，雞蛋和麵粉
- 擂油法：用擂油法混合脂肪和糖是一種製作蛋糕的常見方法，以增加蛋糕輕盈的質感
- 製作時會加入膨脹劑

結晶糖的種類

- 白糖和黃砂糖
  - 砂糖
  - 幼砂糖
  - 糖霜

- 晶體的大小
  - 砂糖>幼砂糖>糖霜

幼砂糖

- 晶體的大小是在砂糖和糖霜的中間
  - 比砂糖更快溶於液體
- 容許更多空氣摻入酥油
- 可製作細膩而均勻的蛋糕

糖霜

- 粉末狀的蔗糖晶體
- 容易吸收水分/迅速溶於水中
- 通常含3%的粟粉，用來吸潮/防止結塊

糖的功能

- 甜味劑
- 令食物嫩化
  - 通過吸引水份，延緩麵筋的形成和蛋白質凝結
- 褐變令食物表面金黃色
  - 焦糖化
    - 糖受熱時褐變
  - 梅納反應
    - 糖和蛋白質
    - 高溫可以加快褐變
- 膨鬆

膨鬆

- 打勻脂肪和糖時，空氣的泡沫會被困藏在脂肪和糖的結晶面之間。
- 烘烤加熱時，由膨脹劑釋放的二氧化碳會進入氣泡使其膨脹
- 能降低產品的密度
- 糖漿不可以困住空氣和使食物膨鬆，只有乾爽的糖才可以
- 備註
  - 擂油法是製作香草蛋糕的第一步

晶體的大小對膨鬆能力的影響

- 晶體大小會影響擂油法時所加入空氣的多寡
- 結構較精細的幼砂糖更適用於擂油法（與砂糖比較）
  - 在攪打時有足夠的表面積來令牛油膨鬆
  - 幼砂糖比砂糖精細，蛋糕的質感會比較柔滑

食物實驗：使用不同糖的擂油法

- 用幼砂糖製作的質感會比較輕盈，因為麵粉糊的膨鬆能力比較好
- 沒有糖的蛋糕顏色會比較淺

批皮

- 麵粉，脂肪和液體的混合物
- 五種類型
  - 普通批皮
  - 簡單鬆皮
  - 鬆皮
  - 千層酥皮
  - 蛋油鬆皮

簡單鬆皮

- 輕盈和層片狀，沒有膨脹劑的批皮
- 混合大量脂肪而成的粉團。輾開及折疊的方法和製作鬆皮相似
- 膨脹效果較鬆皮弱

普通批皮

- 用作撻或批的底層
- 不含膨脹劑
- 通常脂肪：麵粉的比例是 1 ：2
- 脂肪被揉入麵粉，然後加入少量冰水形成粉糰。隨後可輾開形成撻，不用折疊

脂肪的種類

- 牛油
- 豬油
- 人造牛油
- 酥油
- 植物油

牛油

- 由鮮奶油製成
- 80%脂肪和20%水
- 含豐富飽和脂肪
- 味道和口感好
- 比植物牛油貴
- 可塑性範圍窄
  - 脂肪的可塑性是指在輕的壓力下能夠定形也能保持其形態
  - 在手或溫暖的環境下容易溶化

豬油

- 由豬肉提取的產品
- 100%脂肪
- 有獨特的晶體結構
  - 適用於疊層產品中，令粉糰分為多層形成片狀
  - 不太適合用於擂油法

人造牛油

- 氫化了的植物油
- 80%脂肪和20%水
- 比牛油便宜
- 不含膽固醇
- 味道和口感較牛油差
- 含反式脂肪

酥油

- 酥油和人造牛油主要區別是：酥油是100%脂肪，沒有水份
- 白色和味道淡

植物油

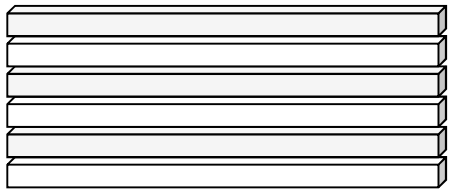
- 液體
- 100%脂肪
- 含豐富單元不飽和脂肪酸和多元不飽和脂肪酸
- 不能有效地困住空氣，所以不能使烘焙產品膨脹

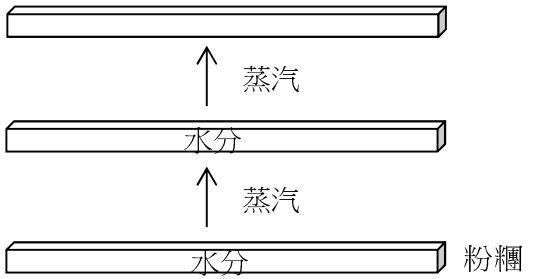
脂肪的功能

- 令食物有味道
  - 牛油的味道最香
- 能製作片狀的批皮
- 提供起酥性
- 防止變乾
- 令食物有顏色

脂肪 - 批皮的片狀

- 片狀是指批皮中形成了多層薄和平坦的粉糰。
- 脂肪把粉團分隔成多層
- 在加熱過程中，粉糰中的水份會蒸發為蒸汽而且脂肪會開始溶化
- 溶化的脂肪可以防止蒸汽離開，蒸汽壓力會把每一層的粉團分開，形成片狀





加熱過程中

脂肪 - 批皮的片狀

- 如果脂肪在烤焗前已經溶化，脂肪便會和粉糰混合在一起，這便不能形成片狀

- 脂肪的溶點愈高，鬆皮/酥皮的層數會愈多。製成的批皮會較酥脆

火腿和蘑菇酥盒/ 食物實驗: 批皮的片狀

- 植物油沒有可塑性和溶點低
  - 不能形成片狀
  - 不能用來製作酥皮
- 牛油是比較難處理
  - 和豬油，人造牛油相比，由於可塑性範圍窄。在混合，輾開和折疊過程中會很容易溶化

火腿和蘑菇酥盒/ 食物實驗: 批皮的片狀

- 豬油
  - 較容易處理
  - 較牛油少水份
  - 擁有大粒β晶體
  - 可以製作片狀批皮，較酥脆
- 然而，用牛油製作的糕點會更好味道
  - 批皮會用一半牛油和一半豬油製作

脂肪 - 起酥性

- 起酥性是指脂肪使麵筋起酥的能力
- 脂肪可覆蓋在麵筋中的蛋白質的表面形成防水層
  - 阻礙組成大及可延伸的網絡
  - 這樣使烘焙產品更鬆軟和酥脆
- 脂肪的可塑性和飽和度影響它起酥的能力
- 愈多脂肪或質地愈軟的脂肪更能覆蓋在麵粉顆粒表面，使烘焙產品更鬆軟

脂肪 - 起酥性

- 脂肪的含水量會影響起酥性
- 牛油和人造牛油有20%水份，可給麵粉的麵筋使用來形成麵筋網絡而豬油100%是脂肪沒有水分
  - 用豬油製作的批皮比用純牛油較酥

新鮮水果撻/食物實驗：不同份量牛油的起酥性

- 普通批皮可以用來製作水果撻
- 如果用少一點脂肪用來製作批皮，麵粉不能完全被脂肪包圍，批皮的質感便會較韌
- 使用愈多脂肪，質感會愈鬆軟
- 然而，過多的脂肪會使撻皮崩塌

吉士糊

- 牛奶或忌廉，蛋黃和糖混合後煮成
- 常用於甜品中
- 混合物是通過雞蛋中蛋白質受熱凝結而凝固

吉士糊 -雞蛋凝結

- 當加熱蛋黃時，蛋黃中的蛋白質會變性，使蛋白質硬化及凝固(雞蛋凝結)
- 受熱時間愈長，蛋白質凝結而成的網絡愈硬及堅固，導致過度凝結。
- 產品會收縮和變乾，形成膠狀質地

影響蛋白質凝結的因素

- 雞蛋的比例
  - 用牛奶或水稀釋雞蛋可以減低過度凝結的風險
    - 提高凝結所需的溫度
    - 使蛋白質更加難找到其他蛋白質
- 糖
  - 加入糖可以減低過度凝結的風險
    - 延遲蛋白質變性，因此減慢凝結的速度

影響蛋白質凝結的因素

- 脂肪
  - 加入脂肪可以減低過度凝結的風險
    - 延遲蛋白質變性，因此減慢凝結的速度
- 澱粉
  - 加入澱粉可以減低過度凝結的風險
    - 提高凝結所需的溫度
    - 延遲蛋白質變性，因此減慢凝結的速度
  - 備註:製作吉士糊時加入澱粉可防止過度凝結

食物實驗：添加物與雞蛋凝結

- 沒有添加物的雞蛋有顯著的過度凝結和收縮
- 添加了糖或水的雞蛋凝結比較慢
- 添加了忌廉的雞蛋凝結得最慢。質感是非常順滑沒有變得黏稠

食物實驗：
溫度對糖和麵粉褐變的影響

- 糖通過焦糖化及梅納反應令食物表面金黃色
- 高的烘焙溫度會加快批皮及葡撻蛋漿的褐變

問與答