**Science in Food – Experimenting the Functional Properties of Food**

**Functional Properties of Lipids – Emulsification**

**TASK 1: Factors affecting Emulsions**

1. There are 5 test tubes in front of you. You will need to place the following ingredients into each test tube.

   - TEST TUBE 1: 5mL oil and 5mL vinegar
   - TEST TUBE 2: 15mL oil and 5mL vinegar
   - TEST TUBE 3: 15mL oil, 5mL (1 teaspoon) egg yolk, and 5mL vinegar
   - TEST TUBE 4: 15mL oil, 5mL (1 teaspoon) egg white, and 5mL vinegar

2. Shake each test tube 100 times and note the appearance.

3. Leave for 10 minutes and note the appearance.

**RECORD YOUR OBSERVATIONS IN THE TABLE BELOW.**

<table>
<thead>
<tr>
<th></th>
<th>5mL oil and 5mL vinegar</th>
<th>15mL oil and 5mL vinegar</th>
<th>15mL oil, 5mL egg yolk, and 5mL vinegar</th>
<th>15mL, 5mL egg white and 5mL vinegar</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Appearance after shaking</strong></td>
<td>Yellow, turbid liquid</td>
<td>The oil and vinegar did not emulsify. They remained separated</td>
<td>Separated into three segments. The middle segment is emulsifying</td>
<td>The egg white has separated the vinegar from the oil</td>
</tr>
<tr>
<td><strong>Appearance after ten minutes</strong></td>
<td>Remained the same</td>
<td>Remained the same</td>
<td>Continues to emulsify</td>
<td>Remains the same</td>
</tr>
</tbody>
</table>
4. Which test tubes contained temporary emulsions and which contained permanent emulsions?

**Test Tube 3**

5. Which ingredients help immiscible liquids (oil and vinegar) stay mixed?

*The egg yolk. It contains lecithin, a natural emulsifier*
TASK 2: Making a Stable Emulsion: Mayonnaise

Use the following recipe to prepare mayonnaise using the ingredients provided.

**Ingredients:**
- 2 egg yolks
- 2 tablespoons lemon juice
- 2 teaspoons Dijon mustard
- 1 cup olive oil

**Method:**
1. Whisk egg yolks, lemon juice and Dijon mustard in a bowl.
2. Whisk in 1/4 cup olive oil, a few drops at a time – if you add the oil too quickly, the mixture may split.
3. Pour in another 3/4 cup olive oil in a thin steady stream, whisking constantly, until thick and pale. Don’t rush this step – it’s the secret to smooth, creamy mayonnaise.
4. Season with a small amount of salt and pepper.
Functional Properties of Lipids – Aeration

TASK 1: Creaming Sugar and Butter (Making Cupcakes)

Use the recipe provided to prepare a batch of cupcakes.

**Ingredients:**
- 150g butter, softened
- 1 C caster sugar
- 2 eggs
- 1 tsp vanilla essence
- 2 C SR flour
- ½ C milk

**Method:**
1. Preheat oven to 190 degrees Celsius.
2. Beat butter and sugar until creamy.
3. Add eggs, beat till thick.
4. Put mixer speed on low, add SR flour and milk/vanilla alternatively till combined. Mix for 30 seconds only.
5. Spoon into paper cases, bake for 15 minutes or until golden.

**QUESTIONS:**
1. Describe how the appearance of the butter changed after aeration.

   **Light, pale, smooth, creamy**

2. How does aeration improve the stability and consistency of a food item?

   **Helps combine ingredients together. Made cupcakes light and fluffy, not dense.**

TASK 2: Making a Foam (Whipped Cream)

Place the cream in a large bowl and use a whisk to whip the cream until you’ve formed soft peaks.

**Over whipped cream.**
Functional Properties of Carbohydrates – Gelatinisation

TASK 1: Preparing Béchamel Sauce

Use the following recipe to prepare béchamel sauce (white sauce). Prepare this TWICE, add vinegar to one of the mixtures.

Ingredients:

- 1 tablespoons corn flour
- 1 1/2 cups reduced-fat milk
- 1/3 cup finely grated parmesan cheese

Method:

1. In a bowl, combine corn flour and 1/4 cup milk. Place remaining milk in a saucepan. Heat over medium-high heat. Bring to the boil.
2. Gradually whisk in corn flour mixture. Cook, stirring, for 2 to 3 minutes or until thickened. Stir in parmesan.

QUESTIONS:

1. What are the main factors that affect the gelatinisation of a starch and liquid combination?
   **Heat, starch, liquid, agitation**

2. Describe the main differences between the two gelatinised mixtures. What ingredients was the main reason for this change? Explain why.
   **Vinegar: Set faster, less creamy, tasted different.**
   **No Vinegar: Creamy, more stable gel**

3. Describe the aroma, flavour and texture of the gelatinised mixture (one without vinegar).
   **Strong parmesan cheese aroma, creamy in texture before it set and became a gel.**
**Functional Properties of Carbohydrates – Dextrinisation**

**TASK 1: Baking Potatoes – ‘Browning Reaction’**

Cut the potato into quarters. Season with salt and place in the oven for 30 minutes or until browned.

**QUESTIONS:**

1. What type of carbohydrate is starch in potatoes? (polysaccharide, disaccharide or monosaccharide).

   **Polysaccharide**

2. Describe the aroma, texture and appearance of the potato once it has been baked.

   **Aroma – the smell of the potato was a lot stronger**
   **Texture – soft on the inside and crisp on the outside**
   **Appearance – Brown skin**
Functional Properties of Carbohydrates – Crystallisation

TASK 1: Making Toffee

Use the following recipe to prepare toffee.

Ingredients:

- 1 cup caster sugar
- 1/4 C water

Method:

1. Stir water and sugar in a saucepan over low heat until the sugar dissolves. Don’t bring it to the boil until all the sugar is dissolved.
2. Increase heat to high. To dissolve any sugar left on the side of the pan, brush down with a wet pastry brush. Bring to boil.
3. Cook until the mixture is a rich golden colour - don’t let it burn. Remove from heat - the residual heat continues to colour toffee.

QUESTIONS:

1. What type of carbohydrate is sugar? (polysaccharide, disaccharide or monosaccharide).

Sucrose is a disaccharide

2. What would happen if you added a lipid instead of a liquid to the sugar? Describe the changes in appearance, flavour, and texture.

The colour of the sugar would not be as dark, it would be soft and creamy
**Functional Properties of Proteins: Non-Enzymic Browning of Red Meat**

**TASK 1: Applying Heat to Red Meat**

In a large fry pan, cook each of the three steaks using the information in the table below. Test the doneness of the meat using a meat thermometer.

<table>
<thead>
<tr>
<th>Steak</th>
<th>Cooking Time</th>
<th>Doneness</th>
<th>Temperature it should be (test with meat thermometer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2-3 minutes per side.</td>
<td>Medium Rare</td>
<td>55-60 degrees celsius</td>
</tr>
<tr>
<td>2</td>
<td>High heat for 1 minute per side then medium heat for 5-6 additional minutes per side.</td>
<td>Medium Well</td>
<td>65-69 degrees celsius</td>
</tr>
<tr>
<td>3</td>
<td>10-12 minutes per side.</td>
<td>Well Done</td>
<td>71-100 degrees celsius</td>
</tr>
</tbody>
</table>

**RECORD YOUR RESULTS**

<table>
<thead>
<tr>
<th>Steak</th>
<th>Colour</th>
<th>Flavour</th>
<th>Texture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Light brown on the outside, bright red on the inside</td>
<td>Strong meaty flavour</td>
<td>Tender, melts in the mouth, moist</td>
</tr>
<tr>
<td>2</td>
<td>Medium brown with a pale red in the centre. Not as much red</td>
<td>Strong meaty flavour</td>
<td>A little dry and chewy, however, still tender</td>
</tr>
<tr>
<td></td>
<td>Dark brown on the outside and brown in the centre</td>
<td>Caramelised flavour</td>
<td>Dry, does not melt in the mouth</td>
</tr>
<tr>
<td>---</td>
<td>--------------------------------------------------</td>
<td>---------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>3</td>
<td><img src="image.png" alt="Image" /></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Functional Properties of Proteins: Formation of Protein Gels

TASK 1: Making Jelly – Gel Formation

Use the instructions on the packet to prepare the jelly.

QUESTIONS:

1. Look at the ingredients on the packet, which ingredient is a protein? Why?

The gelatin in the ingredients list is a globular protein. It comes from collagen in animal meat.

2. What are the main factors affecting the gelation of the jelly?

To make a jelly, you need acid (from the fruit), temperature, agitation. It also sets in the fridge.
**Functional Properties of Proteins: Coagulation**

**TASK 1: Poaching an Egg**

Poach two eggs. Place the vinegar in one saucepan of boiling water but not the other.

**Ingredients**

- 2 eggs
- 1 tsp vinegar
- pinch of salt

**Method**

1. Bring a large frying pan of salted water to the boil over medium-high heat
2. Add the vinegar to the water in pan. Reduce heat to medium-low. Crack 1 egg into a small bowl. Use a spoon to stir the water to make a whirlpool. Carefully pour the egg into the centre of the whirlpool. Cook for 4 minutes for a soft yolk or until cooked to your liking. Use a slotted spoon to transfer to a plate.

**QUESTIONS:**

1. What happened to the egg once it was exposed to heat?

   The egg white went from a viscose to a semi solid. The egg white was no longer runny and it was a bright white colour rather than transparent.
   The inside yolk was nice and runny.

2. Describe the difference in appearance between the two poached eggs. Which is better? Why?

   The one without the vinegar was better. The egg white stayed together and didn’t disperse as much.
Functional Properties of Proteins: Denaturation

TASK 1: Denaturing egg whites by creating foam

1. Add the following ingredients in each measuring jug.

   MEASURING JUG 1: 35mL egg white
   MEASURING JUG 2: 35mL egg white and 5mL cold water
   MEASURING JUG 3: 35mL egg white and 10g sugar
   MEASURING JUG 4: 35mL egg white and 2.5mL egg yolk

3. Whisk the egg whites in each jug to a soft peak stage, which is the point at which, when the whisk is lifted out of the foam, the peak formed will flop over, just holding its shape.

4. Note the volume of foam in each jug using the table below.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Volume of foam immediately after whisking</th>
<th>Volume of foam 15 minutes after whisking</th>
<th>Liquid seepage from foam after 15 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>35mL egg white</td>
<td>There was a foam</td>
<td>Remained the same</td>
<td>No seepage</td>
</tr>
<tr>
<td>35mL egg white and 5mL cold water</td>
<td>There was a foam, however, not as much as the first one</td>
<td>The foam began to decrease in size</td>
<td>There was liquid seepage - water</td>
</tr>
<tr>
<td>35mL egg white and 10g sugar</td>
<td>There was a glossy foam</td>
<td>The foam remained the same</td>
<td>No liquid seepage</td>
</tr>
</tbody>
</table>
### QUESTIONS:

1. Which jug produced the most stable foam with the greatest volume? Why?

   **The egg white only. There were no other ingredients interrupting the process.**

   **The egg white and the sugar. The sugar helped to maintain stability of the foam**

2. Why is it important to be careful when separating egg yolks from egg whites?

   **Denaturation (the egg whites won’t foam) will not occur if there is fat present. Egg yolk contains fat.**