Investigation 2

Aim

Investigating the effects of temperature, cooking time and additional ingredients when making a baked egg custard.

(Note: you are going to make a control sample, following the standard recipe. You will then make additional samples with variations to ratio of ingredients, cooking temperature, cooking time and additional ingredients, and you will compare these results with your control – you can select some variables if all variables are not practicable.)

Equipment

- Digital scales
- Digital timer or stopwatch
- 1 oven preheated to 160°C or 140°C if using a fan oven
- 1 oven preheated to 250°C or 230°C if using a fan oven
- Ovenproof dishes (ramekins are ideal)
- Measuring jug
- Fork
- Saucepan
- 4 shallow metal baking tins
- Kettle, with freshly boiled water (water needs to be warm rather than hot)
- Sticky labels and marker pen
- Oven gloves
- Digital camera

Ingredients

Control sample:
- 25g whole egg (beaten)
- 12g caster sugar
- 100ml milk

Variations
- Variation 1 – omit the sugar from control recipe
- Variation 2 – increase the sugar from control recipe to 25g
- Variation 3 – use 1 egg white instead of 25g whole egg (approx. 25 to 30g egg white)
- Variation 4 – use 1 egg yolk instead of 25g whole egg (approx. 12 to 15g egg yolk)
- Variation 5 – use 50g whole egg instead of 25g whole egg
- Variation 6 – increase the milk from control recipe to 200ml
- Variation 7 – use the control recipe, but add cold milk
- Variation 8 – use the control recipe, but do not cook in a water bath (cook at 160°C or 140°C if using a fan oven)
- Variation 9 – use the control recipe, but increase the oven temperature to 250°C (230°C if using a fan oven), in a water bath
- Variation 10 – use the control recipe, but increase the oven temperature to 250°C (230°C if using a fan oven)
using a fan oven), this time without a water bath

- **Variation 11** – use the control recipe, but increase the cooking time by an additional 30 minutes
- **Variation 12** – use the control recipe, but also add in 15ml freshly squeezed lemon juice. Stir this in once the warm milk has been added to the egg and sugar mix

### Method

**Control sample:**
Preheat oven 1 to 160°C (or 140°C if using a fan oven) and oven 2 to 250°C (or 230°C if using a fan oven)

In the measuring jug, lightly beat the egg and sugar together with a fork.

Warm the milk in the saucepan until it steams – approx. 80°C.

Pour the warm milk into the egg and sugar mix and stir until well mixed.

Pour the mixture carefully into the ramekin style ovenproof dish.

Label the sample, then prepare the remaining samples.

When all the samples are made:
- stand the samples in the shallow metal baking tin. Pour in warm (not hot) water from the kettle so that it comes up the side of each ovenproof dish – this acts as a bain-marie (water bath). The samples are baked at 160°C (oven 1 to 160°C or 140°C if using a fan oven) in a water bath, so that they can all be cooked together
- bake the custards until set – approx. 40 minutes.

**How will you know when the custard is set?**
It should have a very slight wobble in the centre. It should not appear as a liquid.
Allow the samples to cool. Then, review the sample and complete the results table.

**Task 2 - Results**
Create a table to record your results:
<table>
<thead>
<tr>
<th></th>
<th>Image of baked egg custard</th>
<th>Colour of surface</th>
<th>Texture of skin on top</th>
<th>Does the custard appear to have shrunk?</th>
<th>Remove custard from oven proof dish</th>
<th>Describe the texture of the set custard when removed from the dish. Smooth and even? Any bubbles and if so describe their size?</th>
<th>Cut the egg custard in half – is it firmly or softly set?</th>
<th>Is there any sign of syneresis? (water seepage)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control</strong></td>
<td><img src="image" alt="Control" /></td>
<td>Pale yellow, with a few patches of darker yellow</td>
<td>Smooth, soft, velvety</td>
<td>No</td>
<td></td>
<td>It's very smooth and even on the outside. It has a glass like appearance.</td>
<td>It's set, yet soft.</td>
<td>No</td>
</tr>
<tr>
<td><strong>Variation 1</strong></td>
<td><img src="image" alt="Variation 1" /></td>
<td>Pale yellow</td>
<td>A little rough, thin skin</td>
<td>No</td>
<td></td>
<td>As control</td>
<td>As control</td>
<td>No</td>
</tr>
<tr>
<td>Variation 2</td>
<td>Image of baked egg custard</td>
<td>Colour of surface</td>
<td>Texture of skin on top</td>
<td>Does the custard appear to have shrunk?</td>
<td>Remove custard from oven proof dish</td>
<td>Describe the texture of the set custard when removed from the dish. Smooth and even? Any bubbles and if so describe their size?</td>
<td>Cut the egg custard in half – is it firmly or softly set?</td>
<td>Is there any sign of syneresis? (water seepage)</td>
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</tr>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td>Very pale yellow</td>
<td>No</td>
<td>As control</td>
<td>As control</td>
<td>No</td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
<td>No</td>
</tr>
<tr>
<td>Variation 3</td>
<td>Colour of surface</td>
<td>Texture of skin on top</td>
<td>Does the custard appear to have shrunk?</td>
<td>Remove custard from oven proof dish</td>
<td>Describe the texture of the set custard when removed from the dish. Smooth and even? Any bubbles and if so describe their size?</td>
<td>Cut the egg custard in half – is it firmly or softly set?</td>
<td>Is there any sign of syneresis? (water seepage)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td><a href="image1.png">Image</a></td>
<td>Creamy white</td>
<td>Thin skin, a little bumpy</td>
<td>No</td>
<td><img src="image2.png" alt="v3" /></td>
<td>It looks smooth and even but, on further glance, if you look closely there are very small surface holes. This is difficult to see in the photograph.</td>
<td><img src="image3.png" alt="v3" /></td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Variation 4</td>
<td><strong>Image of baked egg custard</strong></td>
<td><strong>Colour of surface</strong></td>
<td><strong>Texture of skin on top</strong></td>
<td><strong>Does the custard appear to have shrunk?</strong></td>
<td><strong>Remove custard from oven proof dish</strong></td>
<td><strong>Describe the texture of the set custard when removed from the dish. Smooth and even? Any bubbles and if so describe their size?</strong></td>
<td><strong>Cut the egg custard in half – is it firmly or softly set?</strong></td>
<td><strong>Is there any sign of syneresis? (water seepage)</strong></td>
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<tr>
<td><img src="image1.png" alt="Image of baked egg custard" /></td>
<td>Deeper yellow than control</td>
<td>Smooth</td>
<td>No</td>
<td>It didn’t keep its shape. It spread when removed.</td>
<td>Smooth, glossy, no visible bubbles.</td>
<td>No</td>
<td></td>
<td></td>
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<tr>
<td>Variation 8</td>
<td><strong>Image of baked egg custard</strong></td>
<td><strong>Colour of surface</strong></td>
<td><strong>Texture of skin on top</strong></td>
<td><strong>Does the custard appear to have shrunk?</strong></td>
<td><strong>Remove custard from oven proof dish</strong></td>
<td><strong>Describe the texture of the set custard when removed from the dish. Smooth and even? Any bubbles and if so describe their size?</strong></td>
<td><strong>Cut the egg custard in half – is it firmly or softly set?</strong></td>
<td><strong>Is there any sign of syneresis? (water seepage)</strong></td>
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<tr>
<td></td>
<td><img src="image1.png" alt="Image of baked egg custard" /></td>
<td>Deeper yellow than control</td>
<td>smooth</td>
<td>Yes, and it has dipped in the middle</td>
<td></td>
<td>It’s not smooth, it looks grainy and has lots of holes</td>
<td>Lots of holes, broke apart easily when cut, almost crumbled</td>
<td>Yes</td>
</tr>
<tr>
<td>Variation 9</td>
<td>Image of baked egg custard</td>
<td>Colour of surface</td>
<td>Texture of skin on top</td>
<td>Does the custard appear to have shrunk?</td>
<td>Remove custard from oven proof dish</td>
<td>Describe the texture of the set custard when removed from the dish. Smooth and even? Any bubbles and if so describe their size?</td>
<td>Cut the egg custard in half – is it firmly or softly set?</td>
<td>Is there any sign of syneresis? (water seepage)</td>
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<tr>
<td>Variation 9</td>
<td>图片</td>
<td>Creamy white</td>
<td>Thin skin, a little bumpy</td>
<td>No</td>
<td>图片</td>
<td>It's not smooth, it looks grainy and has lots of holes, even more than V8</td>
<td>图片</td>
<td>Yes</td>
</tr>
<tr>
<td>Variation 10</td>
<td>Image of baked egg custard</td>
<td>Colour of surface</td>
<td>Texture of skin on top</td>
<td>Does the custard appear to have shrunk?</td>
<td>Remove custard from oven proof dish</td>
<td>Describe the texture of the set custard when removed from the dish. Smooth and even? Any bubbles and if so describe their size?</td>
<td>Cut the egg custard in half – is it firmly or softly set?</td>
<td>Is there any sign of syneresis? (water seepage)</td>
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<tr>
<td></td>
<td>Very dark brown, almost black, darer than V10</td>
<td>Very bumpy, more than V9</td>
<td>Yes, and its dipped in the middle</td>
<td>It's not smooth, it looks grainy and has significant holes, even more</td>
<td>Lots of holes, broke apart easily when cut, almost crumbled, even more</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Summarise your findings here.
The control recipe produced the best quality baked egg custard. It produced pale yellow and tender set baked custard, free from any toughening of the protein. The finished internal texture was smooth, velvety and shiny.

When the sugar was removed or increased there was no adverse effect to the finished quality, although this could change if the sugar was increased significantly. I would need to conduct another experiment to find this out.
Whole egg produced the best quality custard. Egg white on its own, without the yolk, makes
tougher set custard and egg yolk on its own, without the egg white, is less likely to set the custard.
The final colour is also affected.

It is important to warm the milk before adding it to the egg and sugar mix, because cold milk
causes small bubbles in the baked custard. This is not aesthetically desirable.

Cooking the egg custard in a water bath is the most effective way of achieving a smooth, velvety
and shiny finished custard, free from holes.

The optimum temperature for cooking the egg custard is 160°C (140°C if using a fan oven). This
prevents the sugar present from caramelising and changing the colour of the egg custard. If the
temperature is increased, not only will the surface form a crust and darken, but syneresis will
occur. Increasing the cooking time by 30 minutes has little effect on the finished quality of the egg
custard, providing that the egg custard is cooked in a water bath and at 160°C (140°C if using a
fan oven). I would need to conduct an additional experiment to find out what happens if I cooked
the egg custard for significantly longer.

The addition of acid, such as lemon juice, reacts with the egg proteins and causes a reaction – it
gives the uncooked egg custard a curdled appearance, and the cooked egg custard is not fully set.
It also gives an unattractive grainy internal texture. This is because the acid begins to denature the
raw egg.

What happens to the finished egg custard

• if it’s cooked at a higher temperature? – the egg custard is likely to toughen, this will not give
the best eating quality

• if the water bath is removed? – when the water bath is removed, you see the beginnings of
small holes and the egg protein is likely to toughen

• If the cooking time is extended? – providing there is a water bath, the egg custard can be
cooked for longer periods that the 30 minutes without an adverse effect to the finished texture.

What happens if the egg custard is cooked for longer than is needed for the egg custard to
set?
The protein in the egg and milk will over-coagulate and will result in a finished egg custard with a
less desirable texture (you want the finished egg custard to have a firm and very smooth finished
texture). The excessive cooking time is likely to produce an egg custard with large holes and the
custard will separate easily, especially when cut. The milk proteins may also curdle.

Is a water bath really necessary? Explain your answer.
A water bath (bain-marie) gives a more even heat transfer. It also gives the egg custard time to
slowly coagulate, as the water initially slows down the heat transfer. It ensures that the egg custard
is less likely to overheat, and therefore reduces the risk of the cooked egg custard being tough
and rubbery, and reduces the chance of syneresis.

What has caused holes in some of the samples?
The mix has started to set (coagulate) too early. For example, when you use cold milk rather than
warming the milk first, which causes early setting (coagulation), and even possible curdling.
**Explain the differences caused by variations in sugar and egg.**

In Variation 2, where the sugar is increased from the control recipe to 25g, there is no significant difference to the control. However, if the sugar is increased significantly it is likely that the sugar will cause the temperature at which coagulation occurs to be raised. It will also affect the colour (browner) and flavour (more caramel like) of the finished egg custard.

In Variation 5, where the quantity of egg is doubled, as the proportion of whole egg is increased the coagulation temperature is lowered and the increased amount of egg protein present will produce a firmer set. This is why there are very small holes present.
Extension task

Consider the following questions:
What do you think is the effect of sugar on the final egg custard? If you experimented with cooking times, do you think you could perfect the finished result?

Discuss and explain the differences in texture and flavour between Variation 3 (egg whites) and Variation 4 (egg yolks).

Do you think that it is possible to make an acceptable egg custard with egg white only? How would you do this, and what changes would you make to the control recipe?

Develop your results to include sensory testing of the baked egg custard samples. Consider the different methods of sensory testing you can include.

http://www.foodafactoflife.org.uk/Sheet.aspx?sitId=19&sectionId=83&contentId=308