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Candidate session number

Candidate name

School number

School name

Examination session (May or November)

MAY

Year

2013

Diploma Programme subject in which this extended essay is registered: Design technology: Food.
(For an extended essay in the area of languages, state the language and whether it is group 1 or group 2.)

Title of the extended essay: Investigating the use of sugar alternatives in the production of a basic cookie. What is the effect of these alternatives on a) the nutritional value and B) sensory characteristics of the cookie?

Candidate's declaration

This declaration must be signed by the candidate; otherwise a grade may not be issued.

The extended essay I am submitting is my own work (apart from guidance allowed by the International Baccalaureate).

I have acknowledged each use of the words, graphics or ideas of another person, whether written, oral or visual.

I am aware that the word limit for all extended essays is 4000 words and that examiners are not required to read beyond this limit.

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Supervisor's report and declaration

The supervisor must complete this report, sign the declaration and then give the final version of the extended essay, with this cover attached, to the Diploma Programme coordinator.

Name of supervisor (CAPITAL letters)

Please comment, as appropriate, on the candidate's performance, the context in which the candidate undertook the research for the extended essay, any difficulties encountered and how these were overcome (see page 13 of the extended essay guide). The concluding interview (viva voce) may provide useful information. These comments can help the examiner award a level for criterion K (holistic judgment). Do not comment on any adverse personal circumstances that may have affected the candidate. If the amount of time spent with the candidate was zero, you must explain this, in particular how it was then possible to authenticate the essay as the candidate's own work. You may attach an additional sheet if there is insufficient space here.

has worked with interest on her EE and is satisfied with her finished essay / investigation.

has taken Higher Food Technology for her Diploma and is therefore interested in making food products as a hobby so she has extended her interest into her EE. Her understanding and knowledge of the effects different sugars have on the sensory and nutritional content of a cookie has concluded in knowing which sugar makes a successful cookie product. especially enjoyed the practical aspect of the investigation and analysing the results of her practical work although on reflection she realises that she could have included more investigations into her practical work and used a wider range of variables so that she could have gained more specific results. It is obvious from her final document that has gained a greater insight into the effects different sugars have on the quality of a cookie product and that she has a better understanding of how academic research is carried out, evidenced and concluded. For these reasons, I feel has achieved a middle C grade overall for her EE.

This declaration must be signed by the supervisor; otherwise a grade may not be issued.

I have read the final version of the extended essay that will be submitted to the examiner.

To the best of my knowledge, the extended essay is the authentic work of the candidate.

I spent hours with the candidate discussing the progress of the extended essay.

Supervisor's signature:

Date:

Assessment form (for examiner use only)

Criteria	Achievement level					
	Examiner 1	maximum	Examiner 2	maximum	Examiner 3	
A research question	2	2		2		
B introduction	1	2		2		
C investigation	2	4		4		
D knowledge and understanding	2	4		4		
E reasoned argument	2	4		4		
F analysis and evaluation	2	4		4		
G use of subject language	2	4		4		
H conclusion	1	2		2		
I formal presentation	3	4		4		
J abstract	2	2		2		
K holistic judgment	2	4		4		
Total out of 36	21					

Extended Essay

Investigating the use of sugar alternatives in the production of a basic cookie. What is the effect of these alternatives on a) the nutritional value and B) the sensory characteristics of the cookie?

Abstract word count: 294words

EE Word count: 3989words

Candidate name:

Candidate number:

Submission date: 17/05/12

Supervisor name:

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Abstract

When sugars are changed in an ingredient, it's likely that some aspect of the cookie will change therefore to find out which types of sugar can have least changes or more positive changes to its nutritional and sensory qualities, it is essential to find out what will change and to reason why. Therefore to devise ways to change sugars effectively, I have decided to look at, **'Investigating the use of sugar alternatives in the production of a basic cookie. What are the effect of these alternatives on a) the nutritional value and B) the sensory characteristics of the cookie?'**

To investigate on the nutritional aspects and sensory aspects of changing the sugar in a basic cookie product, I have used the source of books and internet sites which will help me find information on sugars and their nutritional values. I have also conducted practical recipe modifications of sugars, getting feedback from my taste testers on how the changes in sugar have changed the sensory qualities of the cookie and to see if they have been successful. There are many functions of sugar, in a baked product as it adds to color and flavor, including texture by aiding the rise of the cookie and the level of moisture provided. Most sugars are made up of only carbohydrate and the amount in different types of sugar differ slightly; however in honey are some traces of protein and in golden syrup there are some amounts of fat.

From the sensory analysis I have found out that liquid sugars are not good in replacing sugar in a cookie as it becomes too moist, yet when artificial sugar is added, it becomes dry. Therefore Muscovado and Honey would be the best sources of substitute for the original cookie product.

Investigating the use of sugar alternatives in the production of a basic cookie. What is the effect of these alternatives on a) the nutritional value and B) the sensory characteristics of the cookie?

Introduction

When the sugars are changed in an ingredient, it can alter the texture of the cookie or the flavor, color and such in terms of sensory aspects. All sugars have different nutritional value, though all sugars will have a high carbohydrate level, however their levels differ and so do the presence of other nutrients, like Honey. To find out whether it is possible to change the sugar in a basic cookie without too much effect on the sensory aspects and the nutritional aspect or to have positive changes, prior to this researching the different effect it could have, I have set my research question as **'Investigating the use of sugar alternatives in the production of a basic cookie. What is the effect of these alternatives on a) the nutritional value And B) the sensory characteristics of the cookie?'**

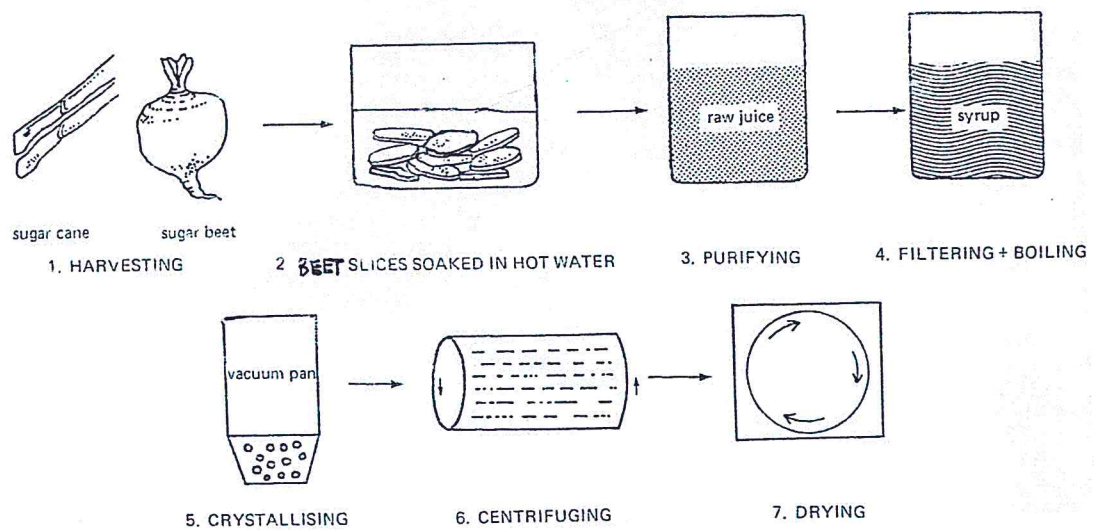
Investigation

Research & Methods of collecting data

Sugar is a refined product that provides only energy (100% carbohydrate) and no other supplies of nutrients, though it may affect the fat content in a baked recipe. Sugars are found in two forms, monosaccharide, with just one sugar molecule and disaccharides, with two molecules.

To investigate the change sugar alternatives have on the nutritional value and sensory aspects of a basic cookie ingredient, I have conducted research from books and websites to find information on the different types of sugar forms and what sugars exist in that category as well as conducting practical tests by modifying the sugar in the recipe with the help of 6 different taste testers, I have received sensory feedback from. I will be using these following sweeteners: Demerara, Muscovado, Cane sugar, Honey, Golden syrup, Aspartame, Sucralose, and Saccharin.

Sugar and how it is extracted



(Food and nutrition, 1998, Deirdre Madden)

Sugar is made from two different sources sugar canes or sugar beets, they are cut and squeezed to extract juices known as cane juice, in many cases using large rollers. As there are remaining dirt and impurities the liquid substance is filtered than heated to its boiling point so that the water would evaporate and chemicals are added to ensure the cane juice is unaffected by impurities, this does not remove the water completely thus leaving a syrup. The syrup is set to boil again, to remove even more water making the conditions just right for the sugar crystals to grow, this process is known as crystallisation. Lastly for the food to be edible it goes through a refinery process after it has been stored at a country where it will be sold.

(<http://www.bigsiteofamazingfacts.com/how-is-sugar-made>, 07/06/12, Big site of amazing facts)

(<http://www.sucrose.com/lcane.html>, 07/06/12, SKIL)

Collection of results & analysis of data

Functions of sugar

The purpose of sugars being added into a baked good is for several reasons:

- It adds color to the baked good because when heat is applied, it causes the sugar to thicken and change to a brown color, which can be seen from syrups.
- It makes the product rise, during the creaming process as sugar is beaten into fats; air is incorporated into the mixture. Therefore when the mixture is heated air is released out, causing the mixture to rise when baking.
- It adds moisture, from the ability to attract water from the air. This assists in tenderizing the product by developing the gluten more and helps form a well risen product.
- It adds flavor to the goods, in which makes them more appealing.
- It stabilizes the mixture, where referring to meringues as an example the foam is spread without rupturing the air that had been captured as bubbles.

(Food technology, 1997, Collins Educational)

Forms of sugar

Forms of monosaccharide

Fructose: - Originated from fruits, plants, honey, the sweetest of their kind.

Galactose: - Natural sugar present in milk



Glucose: - Found in fruits, honey, onions or sweet corn.


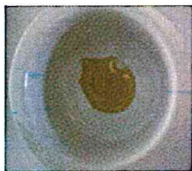
Forms of disaccharides	Structure	Extracted/ originated from
<i>Sucrose</i>	Made from a unit of glucose and fructose to form a complex structure	Extracted from sugar cane and sugar beet plants
<i>Lactose</i>	Combining a unit of galactose with a unit of glucose	Known as milk sugar as it is originated from milk.
<i>Maltose</i>	Combining two units of glucose	In germinating cereals and malt products



(Food technology, 1997, Collins Educational)



Alternative natural sweeteners

I have chosen to experiment with the following sugars because they are commonly used and are easier to purchase.

Name of sugar (image)	Properties	Functions/Uses												
 Demerara	Demerara is a large, light brown crystal with molasses present which makes the texture sticky and creates nice aroma. 'It is extracted from raw sugar or sugar syrup remaining after the white sugar has been extracted.' <i>(Cooking explained, 1998, Jui Davis/Barbara Hammord)</i>	Sweetening tea, coffee, apple crumble, hot food or before food is cooked/baked. <i>(Food technology, 1997, Collins educational)</i>												
Nutritional value/ Health benefits or threats	<table border="1"> <thead> <tr> <th colspan="4"><i>Serving size 1 cube (4g)</i></th> </tr> <tr> <th>Calories</th> <th>Fat</th> <th>Carbs</th> <th>Protein</th> </tr> </thead> <tbody> <tr> <td>15</td> <td>0g</td> <td>4g</td> <td>0g</td> </tr> </tbody> </table> <p><i>(http://www.fatsecret.com/calories-nutrition/gihvay/demerara-sugar, 16/05/12, Member Dude)</i></p>		<i>Serving size 1 cube (4g)</i>				Calories	Fat	Carbs	Protein	15	0g	4g	0g
<i>Serving size 1 cube (4g)</i>														
Calories	Fat	Carbs	Protein											
15	0g	4g	0g											
Muscovado 	Dark brown, soft and sticky texture due to the presence of more molasses and coarser texture, therefore it has a stronger distinct flavor.	Sauces, rich fruitcakes, gingerbreads, spice cakes, puddings.												
Nutritional value/ Health benefits or threats	<table border="1"> <thead> <tr> <th colspan="4"><i>Serving size 1 tsp (4g)</i></th> </tr> <tr> <th>Calories</th> <th>Fat</th> <th>Carbs</th> <th>Protein</th> </tr> </thead> <tbody> <tr> <td>15</td> <td>0g</td> <td>4g</td> <td>0g</td> </tr> </tbody> </table> <p>Muscovado contains minerals and vitamins from where it was extracted. They contain minerals like phosphorus, iron, potassium e.t.c.</p> <p><i>(http://www.livestrong.com/article/403293-the-health-benefits-of-muscovado-sugar/, 16/05/12, by Kim Ford)</i></p> <p><i>(http://www.fatsecret.com/calories-nutrition/big-chief/light-brown-muscovado-sugar, 16/05/12, member hzl)</i></p>		<i>Serving size 1 tsp (4g)</i>				Calories	Fat	Carbs	Protein	15	0g	4g	0g
<i>Serving size 1 tsp (4g)</i>														
Calories	Fat	Carbs	Protein											
15	0g	4g	0g											

 <p>Cane sugar</p>	<p>Similar to powder as sugar crystals are grinded to smallest of sugars, therefore making it more easily bonded.</p>	<p>Icing, some biscuit, making sweets or sprinkling on cakes</p>												
<p>Nutritional value/ Health benefits or threats</p>	<table border="1"> <thead> <tr> <th colspan="4"><i>Serving size 1 tsp (4g)</i></th> </tr> <tr> <th>Calories</th> <th>Fat</th> <th>Carbs</th> <th>Protein</th> </tr> </thead> <tbody> <tr> <td>15</td> <td>0g</td> <td>4g</td> <td>0g</td> </tr> </tbody> </table> <p><i>(http://www.fatsecret.com/calories-nutrition/n-joy/cane-sugar, 15/05/12, source Mobile user)</i></p>		<i>Serving size 1 tsp (4g)</i>				Calories	Fat	Carbs	Protein	15	0g	4g	0g
<i>Serving size 1 tsp (4g)</i>														
Calories	Fat	Carbs	Protein											
15	0g	4g	0g											
<p>Honey</p> 	<p>Made from units of glucose and fructose, is extracted from bees hives where bees and insects collect nectar from flowers and store then in the beehive. Rare type of sugar as it contains traces of minerals.</p>	<p>Tea, preserving jam/fruits, baking muffins/cakes/cookies, Meat sauces, barbecuing meat, cold dishes e.t.c.</p>												
<p>Nutritional value/ Health benefits or threats</p>	<table border="1"> <thead> <tr> <th colspan="4"><i>Serving size 100g</i></th> </tr> <tr> <th>Calories</th> <th>Fat</th> <th>Carbs</th> <th>Protein</th> </tr> </thead> <tbody> <tr> <td>304</td> <td>0g</td> <td>82.4g</td> <td>0.3g</td> </tr> </tbody> </table> <p>Honey is known to be a good natural sugar as it contains variety of minerals and nutrients that help your health. Honey is known to help reduce cholesterols as well as a great immunity builder, it is recommended for health benefits. There are a lot of natural remedies built on the base of using sugar. On the other hand it is essential to not feed honey to a baby under 1 year old or 18months.</p> <p><i>(http://www.benefits-of-honey.com/health-benefits-of-honey.html, 16/05/12)</i> <i>(http://www.fatsecret.com/calories-nutrition/usda/honey?portionid=62267&portionamount=100.000, 15/05/12, source USDA)</i></p>		<i>Serving size 100g</i>				Calories	Fat	Carbs	Protein	304	0g	82.4g	0.3g
<i>Serving size 100g</i>														
Calories	Fat	Carbs	Protein											
304	0g	82.4g	0.3g											

 Corn syrup (Golden syrup)	Also much sweeter than normal sugar, it is manufactured from the waste liquor of the final crystallisation process.	On pancakes, candy, jam, frosting, jellies, rice crispies, ice creams, sorbets, cereals, chocolates, sorbets, nutritional bars e.t.c.												
Nutritional value/ Health benefits or threats	<table border="1"> <thead> <tr> <th colspan="4"><i>Serving size 100g</i></th> </tr> <tr> <th>Calories</th> <th>Fat</th> <th>Carbs</th> <th>Protein</th> </tr> </thead> <tbody> <tr> <td>284</td> <td>0.2g</td> <td>76.79g</td> <td>0g</td> </tr> </tbody> </table> <p>There are many health threats about corn syrups, they would cause obesity and may lead to type two diabetes when consumed frequently and this is because corn syrup contains bad cholesterol levels. It can cause fatty livers and hearts, as it is especially damaging to the liver.</p> <p>(http://www.globalhealingcenter.com/natural-health/high-fructose-corn-syrup-dangers/, 16/05/12, Dr. Edward group)</p> <p> (http://www.fatsecret.com/calories-nutrition/usda/light-corn-syrup?portionid=62297&portionamount=100.000, 15/05/12, source USDA)</p>		<i>Serving size 100g</i>				Calories	Fat	Carbs	Protein	284	0.2g	76.79g	0g
<i>Serving size 100g</i>														
Calories	Fat	Carbs	Protein											
284	0.2g	76.79g	0g											
Artificial sweeteners														
Aspartame 	It is an artificial sweetener however it may lose its sweetness at a high temperature.	Cold food, warm food, cold desserts.												
Nutritional value/ Health benefits or threats	<table border="1"> <thead> <tr> <th colspan="4"><i>Serving size 1 packets</i></th> </tr> <tr> <th>Calories</th> <th>Fat</th> <th>Carbs</th> <th>Protein</th> </tr> </thead> <tbody> <tr> <td>0g</td> <td>0g</td> <td>0g</td> <td>0g</td> </tr> </tbody> </table> <p>When not taken with amino acids, aspartame can have the consequences of neuro- toxic effects. This means that you may face memory loss(Alzheimer disease), stomach seizures, hearing loss and such serious disorders.</p> <p> (http://articles.mercola.com/sites/articles/archive/2011/11/06/aspartame-most-dangerous-substance-added-to-food.aspx, 17/05/12, Meracola.com)</p> <p> (http://www.fatsecret.com/calories-nutrition/equal/equal/3-packets, 15/05/12, source Member)</p>		<i>Serving size 1 packets</i>				Calories	Fat	Carbs	Protein	0g	0g	0g	0g
<i>Serving size 1 packets</i>														
Calories	Fat	Carbs	Protein											
0g	0g	0g	0g											

 Sucralose (Splenda)	It is 600 times sweeter than sucrose. It's most important property is that it has been refined multiple times and is an extremely stable substance which is hard to change, being unable to be absorbed by the human body, though it can be excreted from the urine.	Desserts, confections and non- alcoholic beverages.												
Nutritional value/ Health benefits or threats	<table border="1"> <thead> <tr> <th colspan="4"><i>Serving size 1 packet</i></th> </tr> <tr> <th>Calories</th> <th>Fat</th> <th>Carbs</th> <th>Protein</th> </tr> </thead> <tbody> <tr> <td>3</td> <td>0g</td> <td>0.9g</td> <td>0g</td> </tr> </tbody> </table> <p>It is a base of chlorine in sucrose; this sweetener is often used as it is 600times sweeter than normal sugars and gives a really dry texture which extends the shelf life. Nonetheless it is indigestible and can give side effects like gastrointestinal, skin irritations, runny nose, dizziness and could decrease your blood cells.</p> <p>(http://www.buzzle.com/articles/sucralose-side-effects.html, 17/05/12, Rutujar Jathar)</p> <p>(http://www.fatsecret.com/calories-nutrition/usda/sweeteners-(splenda-packets-sucralose), 15/05/12, source USDA)</p>		<i>Serving size 1 packet</i>				Calories	Fat	Carbs	Protein	3	0g	0.9g	0g
<i>Serving size 1 packet</i>														
Calories	Fat	Carbs	Protein											
3	0g	0.9g	0g											
 Saccharin	Usually 300 times sweet than regular sugar, it can leave a bitter after taste.	Beverages, jams, baked goods,												
Nutritional value/ Health benefits or threats	<table border="1"> <thead> <tr> <th colspan="4"><i>Serving size 1 packet (1g)</i></th> </tr> <tr> <th>Calories</th> <th>Fat</th> <th>Carbs</th> <th>Protein</th> </tr> </thead> <tbody> <tr> <td>2</td> <td>0g</td> <td>0.9g</td> <td>0g</td> </tr> </tbody> </table> <p>There was a big issue during 60's as it was said to have caused cancer however, evidence from lab results suggest that bladder cancer and such cancer disorders are only caused from large doses of this artificial sugar.</p> <p>(http://www.boxingscene.com/nutrition/41772.php, 17/05/12,)</p> <p>(http://www.fatsecret.com/calories-nutrition/sweetn-low/sweet-n-low, 15/05/12, source Member)</p>		<i>Serving size 1 packet (1g)</i>				Calories	Fat	Carbs	Protein	2	0g	0.9g	0g
<i>Serving size 1 packet (1g)</i>														
Calories	Fat	Carbs	Protein											
2	0g	0.9g	0g											

Sugar from original recipe				
Granulated sugar	Fine crystals, being small and therefore dissolving easily compared to other sugars. It is ideal for creamed mixtures.	Creaming mixture, cakes, cookies, biscuits, sweetening drinks etc.		
Nutritional value/ Health benefits or threats	<i>Serving size 100g</i>			
	Calories	Fat	Carbs	Protein
	387	0g	99.98g	0g
	<i>(http://www.fatsecret.com/calories-nutrition/usda/granulated-sugar?portionid=62290&portionamount=100.000, 15/05/12, source USDA)</i>			

(<http://diabetes.webmd.com/artificial-sweeteners-diabetes-patients>, 15/05/12, WEBMD)

To investigate the effect of sugar alternatives on the sensory analysis of a basic cookie, I have done experiments to find out the changes, and the effect it has on the cookie, from texture to flavor to aroma and such using a basic cookie ingredient.

The control cookie



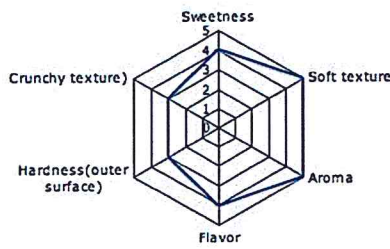
Equipments

- Oven
- Fork
- Electric whisk
- Mixing bowl
- Electric balance
- Baking tray
- Baking paper
- Teaspoons
- Sieve

Ingredients	Functions	Tolerance
30g Unsalted butter, cubed, at room temperature	This fat will assist the sugar during the creaming process when the sugar is beaten into the mixture to create a lighter texture and to incorporate air.	+/-0.2g
20g Granulated sugar	Will add colour, enhance flavor and texture of the product.	+/-0.1g
1/4 tsp vanilla essence	Will enhance the aroma and the flavor of the cookie.	+/-0.1g
30g Self-rising flour	Will help make the cookie rise, giving it a lighter, softer and smoother texture.	+/-0.2g
20g Plain flour	Will help bind the ingredients (keep the mixture/cookie) together when it is baking.	+/-0.2g
1/2 tbsp milk	Will help tenderize the cookie, giving it a smoother and softer texture.	+/-0.1g

Method

- 1) Preheat the oven to 160°C
- 2) Line baking tray with non-stick baking paper.
- 3) Use an electric whisk to beat the sugar into the butter with vanilla essence in a medium sized bowl.
- 5) Add milk into the mixture.
- 4) Sift the self-raising and the plain flours together into the bowl, mix using a wooden spoon. (If too dry add more milk)
- 5) Use hands when the mixture becomes hard to mix with a wooden spoon.
- 6) Roll the dough into balls about tablespoon size.
- 7) Flatten out on the non-stick baking paper using a fork.
- 8) Bake the biscuits, for 18-20 minutes, until it is light golden underneath the cookie and are slightly cracked on top.
- 9) Transfer to a cooling rack and leave it to cool for 3 minutes.



Weight	Height	Width
24g	0.8cm	5.3cm, 5.8cm

Comments from taste testers

The cookie had been rated out of 5, 5 being highest and 1 being the lowest, or the taking smooth texture as an example 5 being extremely smooth and 1 being rough texture, in other words a non soft texture. According to the feedback received from the taste testers they had commented that the sweetness was just right. It also had a good aroma and texture. The flavor was plain but simple and appealing, they had stated that the crunchy texture and the hard outer surface was present but not dominant therefore more appealing to them.

Self review

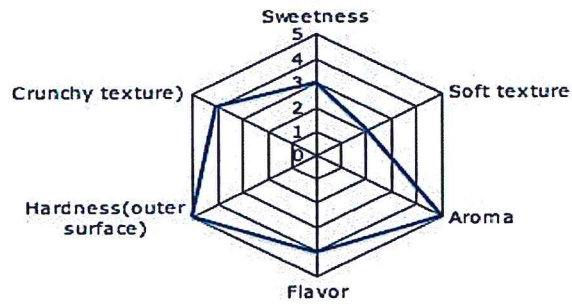
The cookie was light yellow, displaying a very pale color, it was soft containing a soft inner texture yet crunchy texture from the harder outer layer. This made the cookie appealing and the smell of the vanilla aroma had made the flavor seem more appealing.

Technique

I have used a creaming based recipe, as sugar was beaten into the butter, thus air is incorporated into the mixture making the texture become light and fluffy, also aiding the sugar to dissolve into butter.

Modification	Type	Amount (portion) used
Basic recipe	Granulated sugar	20g
Demerara	Light Demerara	20g
Muscovado	Dark Muscovado	20g
Cane sugar	Fine cane sugar	20g
Honey	Honey	20g
Corn syrup	Golden syrup	20g
Aspartame	Equal	Spoon for spoon
Sucralose	Splenda	Spoon for spoon
Saccharin	Sweet n' low	Spoon for spoon

Cane sugar



Weight	Height	Width
23g	0.5cm	5cm, 4.5cm

Comments from taste testers

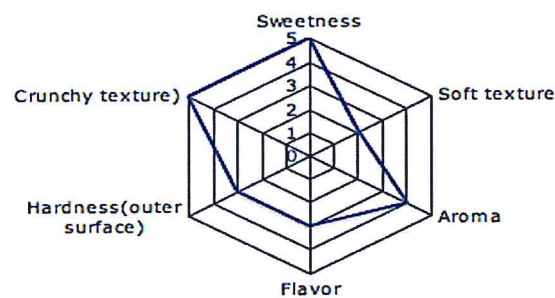
The cookie had just the right amount of sweet flavor, this made the cookie more appealing to more consumers as they had said they preferred a ‘less sweet cookie over an intensively sweet flavored cookie’.

Self review

The cane sugar had harden quickly when it had cooled after it had been baked, this made the cookie more hard on general but generally only on the outer surface, therefore altering texture by causing a reduction in the softness. As well as the aroma, the flavor remained the same.

Overall Rating: 6/10 (considering both nutritional and sensory aspects)

Demerara



Comments from taste testers

The taste testers had commented that the softness in texture had reduced because it had non dissolved sugar pieces inside of the cookie which had increased the sweetness of the cookie. This in turn has reduced the hardness of the outer surface. They had disliked the change in texture and flavor as they had stated that it became ‘too sweet’.

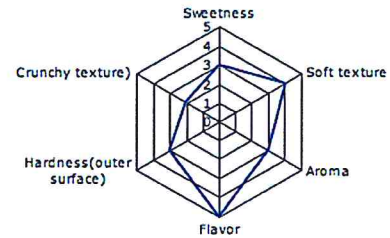
Weight	Height	Width
26g	0.8cm	5.2cm, 4.8m

Self review

The Demerara had big sugar crystals therefore they did not dissolve into the butter nor did it dissolve when heated during the baking process leaving the sugar crystal as little crunchy chunks, which altered the texture and the flavor of the cookie. This made the cookie irregularly sweeter at some parts.

Overall Rating: 5/10 (considering both nutritional and sensory aspects)

Muscovado



Comment from taste testers

The taste testers liked how the texture was smooth and soft, the taste testers thought that the texture was richer, and the flavor appealed more to them as it was the sweetness was fine and had a nice aroma.

My review

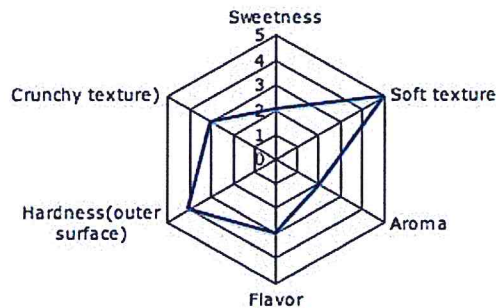
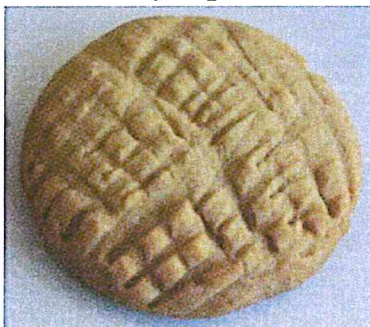
I felt the texture had become richer and smoother as a

Weight	Height	Width
18g	0.5cm	5.2cm, 4.5m

consequence of the smaller sugar crystals. The Muscovado were a lot smaller in comparison to normal granulated sugar and had this sticky texture originally. This in turn contributed to the color of the cookie, giving it a darker brown shade.

Overall Rating: 8/10 (considering nutritional and sensory aspects)

Golden syrup



Comment from taste testers

Weight	Height	Width
20g	0.7cm	5cm, 4.9cm

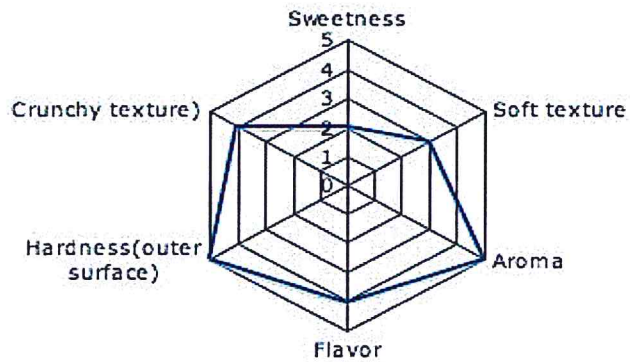
‘It wasn’t as sweet as it were to be with the basic recipe.’

My review

The golden syrup had a really light color, similar to product from the basic recipe. It added to the soft texture, as it is syrup making the texture cakey. This made the cookie less appealing than the original recipe because it became too soft.

Overall Rating: 5/10 (considering both nutritional and sensory aspects)

Honey



Comment from taste testers

‘It had a distinct honey flavor and it became really soft, a bit too soft, it doesn’t taste as good as the normal sugars.’

‘Its outer surface is the same but it’s a lot more moist.’

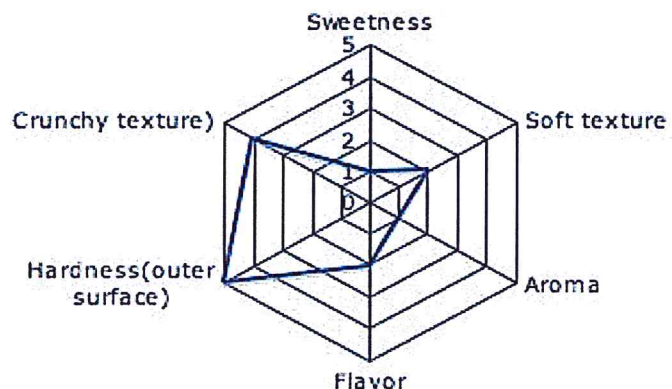
My review

The honey had a large impact on the cookie as it brought new strong flavors, overdoing the flavor of the cookie itself. It had a large effect on the texture of the cookie, as it added a lot more moisture to the inner layers of the cookie, therefore the crunchy texture of the cookie was not strong but the outer surface had hardened during the cooling process and kept the cookie together.

Weight	Height	Width
20g	0.9cm	5cm, 4.9cm

Overall Rating: 7/10 (considering the nutritional and sensory aspects)

Aspartame (Equal)



Comment from taste testers

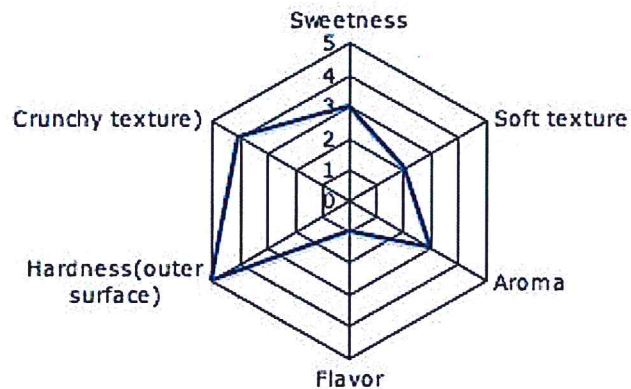
'It was very dry.' 'It was not sweet at all, but rather tasteless and of butter.' 'It had a really crunchy texture.'

My review

The aspartame had no flavor because when it is heated the sweetness had disappeared as can be seen from my analysis of alternative sweetening ingredients, when aspartame is heated it loses its sweetness. It does not have the normal properties of a natural sugar crystal therefore it did not aid the creaming process of the cookie, leaving it only risen by the aid of the self-rising flour. The artificial sweetener also does not provide moisture into the cookie unlike natural sugars, therefore leaving the texture dry, crunchy and hard. The aroma of the cookie was almost gone as the sugar is supposed to help enhance the aroma of the cookie. The color of the cookie was unaffected by the artificial sugar itself however the length of baking time took a lot longer than a normal cookie therefore it was left in the oven to cook longer making it more yellow.

Overall Rating: 2/10 (considering the nutritional and sensory aspects)

Saccharin (Sweet n' low)



Comment from taste testers

'It was really dry and had a crunchy texture.' 'It had a really bad and strong chemical flavor and scent.' Most taste testers could not bear to eat this cookie.

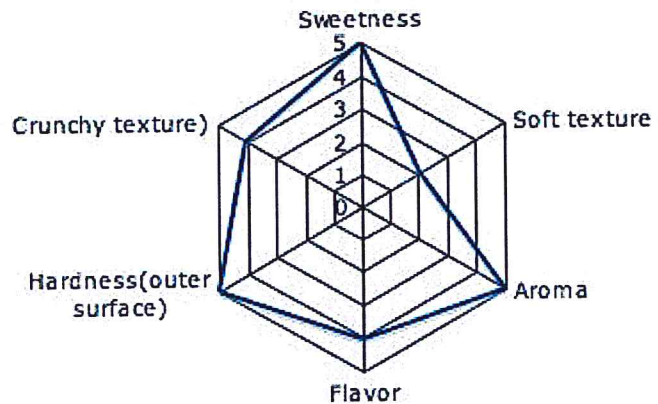
My review

The cookie had a strong bad chemical flavor that had really altered the flavor, though it made the cookie sweet in comparison to the 'Equal' as it added flavor. However as

it is still an artificial sugar it affected the texture in the same way as the aspartame making it dry, hard and crunchy.

Overall Rating: 1/10 (considering the nutritional and sensory aspects)

Sucralose (Splenda)



Comment from taste testers

‘It was really sweet.’ ‘It was dry and hard on the outer surface with a crunchy texture.’ ‘It had a really good scent.’

My review

The cookie was really sweet as Splenda, or Sucralose in this case is 600 times sweeter than other sugars. This made the cookie extremely sweet even though we put the same amount of sucralose as the other artificial sweeteners.

Overall Rating: 6/10 (considering the nutritional and sensory aspects)

Side view of all my cookies



Original cookie (Granulated sugar)



Cane sugar



Demerara



Muscavado



Corn syrup
(Golden syrup)



Honey



Aspartame
(Equal)



Saccharin
(Sweet n' low)



Sucralose
(Splenda)

Analysis of the cookies from the side view

The **original cookie** is very light in color and has a small particle that makes the texture of the cookie

smooth and soft as well. The outer layers are crunchy as it is hard and keeps the shape of the cookie stable as it is.

The **cane sugar** being a very dry sugar and having smaller sugar crystals than granulated sugar in comparison from the original recipe had reduced the height of the

cookie as it could not rise as much. Yet its texture should still be soft but crunchy as the cookie is more packed together.

The **demerara sugar** is a lot taller than the other cookies as the sugar particles are big and did not dissolve into the mixture while baking thus leaving little chunks of sugar inside the cookie. Making the texture crunchier and giving it a more intense sweet flavor.

The **muscovado sugar** has a rich and soft texture due to the original sugar being sticky and therefore making the texture smoother. It is also very dark in color as its original dark color of the sugar had added more color to the cookie.

The **corn syrup** has a similar color to the original recipe as it does not have a particularly strong color. Its inner surface looks moist and altered the texture.

The **honey** had added a lot of color into the cookie and had changed the texture of the cookie immensely as can be seen from the picture, the inner layers of the cookie look really moist and the cookie has risen quite a lot.

The **aspartame sweetener** has a really hard outer surface and inner layer as can be seen from the picture it also has a lot of crumbs from being sliced into peices, this displays the hardness of the overall texture of the cookie.

The **saccharine sweetener** does not look as though it is equally as hard as the outer surface of the aspartame however it also displays no existence of moisture from the picture of the side view of the cookie.

The **Sucralose sweetener** also displays similar results to the aspartame sweetener as a lot of crumbs are also shown from being dissembled, but it has not risen as much.

reduce the most sugar content. Due to the use of small quantities of sugar being used for the flavor of the cookie, not even being 1 gram, it did not affect the nutritional value of the cookie at all, its nutritional values were the same as not including any sugar.

Conclusion

I have clearly answered my research question being, **‘Investigating the use of sugar alternatives in the production of a basic cookie. What is the effect of these alternatives on a) the nutritional value and B) the sensory characteristics of the cookie?’** I have found out that some there are no sugar alternative that can replace the original granulated sugar recipe as they will have many changes to the nutritional aspects and will have different results in the sensory aspect.

I have found out that the artificial sweeteners are not good to use as an alternative sugar especially for a cookie unless you require a longer shelf life because they all artificial sugars have consequences though it may be that more portions have to be consumed to face these risks. Nonetheless, they can trigger extremely dangerous disorders that you would normally face at old age but earlier when these artificial sugars are consumed. Disorders like Alzheimer diseases are very serious as the brain is dying and you slowly die, this will cause the loss of memories leading to the point where you do not remember who you are as referred to on the analysis of Aspartame as an individual ingredient.

Liquid sweeteners like corn syrup (with the product named Golden syrup) and honey which we have worked with and others like maple syrup, and natural syrups make the cookie more moist. This can be rather unappealing as the texture becomes too cake like soft. However liquid sweeteners like Honey are exceptionally good for the body because it is rich in vitamins and minerals which promotes this product to be a recommended replacement for regular sugar.

Brown sugars like muscavado are also high in minerals as it contains a good amount of phosphate, iron, magnesium and such. It also benefits the cookie by adding color and flavor to the cookie itself which makes it more appealing for especially those whom enjoy a soft, smooth texture of a cookie. On the other hand brown sugars like

demerara only contain carbohydrates and no minerals which only suggest that it is not much better than regular sugar. Also its sugar crystals are too big that it did not dissolve into the mixture during the creaming process as it was beaten into the butter. This makes demerara sugar highly unappealing to be used as an alternative in a cookie recipe.

The cane sugar really did not appeal much to me personally however there were those taste testers that preferred the cane sugar as it had hardened the cookie more and gave a nice crunchy texture. It was just sweet enough which made it more appealing. However nutritionally I don't recommend that you add cane sugar as an alternative into your original recipe as it has 4 times more carbohydrates than normal granulated sugar as can be seen from the analysis of the ingredient cane sugar.

From these results I can say that Muscovado, Honey, Cane sugar and Sucralose (Splenda) would be a successful replacement for caster sugar in this cookie recipe but Demerara, Corn syrup, Aspartame (Equal) and Saccharin (sweet n' low) would not be because Muscovado and Honey add a good nutritional value. Cane sugar gives good sensory results and though Sucralose may not benefit you in a healthy way little consumption will not harm you and its flavors are rather appealing. On the other hand Corn syrup and Aspartame are known to have serious side effects if consumed often. Saccharin leaves strikingly bad after tastes, Aspartame similarly having effects on sensory aspects lose its sweetness when in high temperature cause them to become extremely unappealing and Demerara especially as it has bad quality sensory affects.

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Appendix

Original cookie					
Flavor	Aroma	Sweetness	Hardness (outer surface)	Soft texture	Crunchy texture
5	5	3	3	5	4
4	5	4	4	5	4
4	4.5	5	3	4	3
3	5	5	3	5	3
4	4	4	3	5	3
4	5	4	4	5	3

Comments

‘Perfect sweetness’ –

‘I love the texture of the cookie and the aroma is really good.’

‘The flavor is plain but it tastes SO GOOD!’

Cane Sugar					
Flavor	Aroma	Sweetness	Hardness (outer surface)	Soft texture	Crunchy texture
4	5	3	5	3	4
4	5	4	4	2	4
4	4	3	5	2	3
3	5	3	5	2	4
4	5	4	4	3	3
4	5	3	5	2	4

Comments

‘Just right sweetness, I prefer the cookie being less sweet because it’s not as overwhelming to eat when you eat a lot.’ –

‘It is a lot more crunchier than the original cookie.’ –

Muscovado					
Flavor	Aroma	Sweetness	Hardness (outer surface)	Soft texture	Crunchy texture
5	3.5	3	3	5	2
5	4	3	4	4	1
5	4	3	4	4	2
5	3	3	3	5	3
5	3	4	4	3	3
4	2	4	4	4	2

Comments

‘I like how the texture is so smooth and rich compared to the original one.’ –

‘It’s just sweet enough and has a good smell!’ –

Golden Syrup					
Flavor	Aroma	Sweetness	Hardness (outer surface)	Soft texture	Crunchy texture
3	2	2	4	5	3
2.5	3	3	3	5	4
3	2.5	2	4	5	3
2.5	3	2	3	5	3
4	2	1	4	4.5	3
4	2	3	4	5	3

Comments

‘It was not as sweet as the original recipe’ –

‘It has a really cakey texture.’ –

Honey					
Flavor	Aroma	Sweetness	Hardness (outer surface)	Soft texture	Crunchy texture
4	5	1	4	5	4
4	5	3	5	5	4
4	4.5	2	5	4	3
3	5	4	5	5	4
4	4	2	4	5	4
4	5	2	4.5	5	3

Comments

‘It has really distinct honey scent, and it became really soft, too soft.’ –

‘It doesn’t taste as good as the normal sugars, bit disappointing.’ –

Aspartame					
Flavor	Aroma	Sweetness	Hardness (outer surface)	Soft texture	Crunchy texture
2	1	1	5	2	4
1	2	2	5	2	4
2	1.5	1	5	2	3
2	1	2	5	2	3
1	1	1	5	1	3
2	1	1	4	1	3

Comments

‘It was very dry.’ –

‘It was not sweet at all, but rather tasteless and of butter.’ –

‘It had a really crunchy texture.’

Saccharin					
Flavor	Aroma	Sweetness	Hardness (outer surface)	Soft texture	Crunchy texture
1	3	3	5	2	4
1	3	3	5	2	4
1	2.5	3	5	1.5	4
1	3	4	5	2	5
1	3	4	5	1	4
1	2	3	4	1	4

Comments

‘It was really dry and had a crunchy texture.’ –

‘It had a really bad and strong chemical flavor and scent.’

Sucralose					
Flavor	Aroma	Sweetness	Hardness (outer surface)	Soft texture	Crunchy texture
4	5	5	5	2	4
3	4	4	5	2	4
3	5	5	5	2	3
4	5	4.5	5	2	4
4	4	5	5	1	4
4	5	5	4	1	4

Comments

‘It was really sweet.’ –

‘It was dry and hard on the outer surface with a crunchy texture.’ –

‘It had a really good scent.’ –