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Application of food preservatives and food additives in making Maldivian food products

MARIYAM ZUHA, MOHAMED SIMYAAN SHAREEF, AISHATH NAILA
The Maldives National University

ABSTRACT *Food additives play a huge role in food safety and development of various food products. Stabilizers are one of the food additives which help in increasing the stability as well as the viscosity of the food products. Stabilizers are found in almost all of the dairy products, desserts and many beverages. In addition, food colours are added to different types of foods to increase shelf life, visual attractiveness and to compensate for natural colour variations. Food dyes utilized in colouring mostly come from natural or artificial sources. The objectives of this study were to produce coconut ice cream using agar-agar stabilizer, conduct a sensory evaluation by a panel of 20 people using Likert scale to see the acceptability of the ice cream. Parameters like melting time and the presence of air bubbles were observed after freezing of the ice cream. Based on the sensory evaluation, for the overall acceptance of the ice cream a score of 9 was given. The results showed that it had a melt run of 130s/g and many air bubbles were formed before and after freezing. In the second part, a traditional Maldivian sweet known as "Ulhaali"was produced by adding beetroot extract into its key ingredient coconut honey or "Dhiyaa hakuru", and ran a sensory evaluation of the product by a group of 15 participants, in terms of colour, aroma and taste, in order to draw a conclusion regarding the acceptability of the addition of the natural food colourant into the Maldivian sweet. Factors such as the colour retention was observed before and after frying. From the results obtained for the sensory evaluation, the product was highly accepted by the participants as all three descriptors received scores of 8.5 and above out of 10, and after addressing the limitations, the success of the study was rather high.*

Keywords: stabilizer, food additives, preservatives, colour, agar-agar

Introduction

Many food products are available in the Maldivian markets, yet scientific research has not been conducted on the application of preservatives and additives in making Maldivian food products. Thus, the aim of this study was to produce novel local food products with the application of stabilizers and colouring agents. Food additives are known as the substances that are used for safety, to develop the flavour, freshness and quality of the food (Khodjaevaet al., 2013). Certain food additives such as salt and sugar have been in use for decades for conservation. Our descendants used salt in order to preserve the meats and fishes for longer durations, they also used different types of herbs and spices in bringing up the flavour of the food (Ghany, 2015). Today, food additives play a huge role in enhancing the quality of the food that we consume. There are thousands of substances that are usedin food processing. A group of compounds usually consisting of polysaccharides are known as stabilizers (Tasneem et al., 2014). It increases the stability and thickness of the food by remaining in an emulsion and holding the physical characteristics (Syed & Shah, 2016). Normally Stabilizers are used when the ingredients do not mix, like oil and water. Huge numbers of low-fat foods are highly dependent on stabilizers

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which helps in maintaining emulsions. The main purpose of stabilizers is to add viscosity to increase the flavour of the food. Various types of local food products can be produced in the Maldives using stabilizers. Therefore, the objective of this experiment is to produce coconut ice cream by using the stabilizer agar-agar. In order to achieve the objective, the measures specified below will also be analysed.

- Observing the texture of the ice cream
- Sensory evaluation
- Ice crystal growth.

Colouring agent

Food is undoubtedly a fundamental part of sustaining life. However, various qualities of the food that humans consume can alter the way in which our mind and the body perceives it. One such quality is the colour of the food. It is in fact, the initial sensory quality upon which food is judged. Though the flavour plays a vital role in perception of food, it can be easily overlooked by the consumers, if the food is visually appealing. Colour is an important factor in both unprocessed food and manufactured eatables in terms of maintaining shelf-life and food quality. Collectively with flavour and texture, colour illustrates the acceptability of food. The colours present in food can be a result of either natural or artificially added pigments. Compounds which impart colour onto foods are extremely diverse and exhibit complex physical and chemical characteristics, which are closely monitored in order to maintain the safety of the foods to which they are added, in relation to consumer health and well-being (Clydesdale, 1993).

Food colours are on the whole categorized into two main categories: natural and synthetic food colours. Natural food colours are generally derived from the extracts of fruit, vegetables, animals or minerals, whereas synthetic food colours are obtained from petroleum. Though the derivation of synthetic food dye from petroleum or crude oil has been a subject of criticism, rigorous testing of the end-product is done to ensure that no traces of the petroleum remain in the dyes (Rodriguez-Amaya, 2016).

The objective of the second experiment was to use beet juice, which is a natural food colour, to colour coconut honey (Dhiyaa hakuru), and using the coloured coconut honey in the preparation of traditional Maldivian sweet known as "Ulhaali". In order to achieve the objectives, measures listed below were carried out:

- Extraction of beet juice.
- Colouring coconut honey using beet juice.
- Maintaining the colour in the end-product "Ulhaali".

Literature review

Stabilizer

The main function of stabilizers is to help in mixing of ingredients that normally would not mix such as oil and water (Tasneem et al., 2014). Usually, it is used to improve thickening and viscosity. According to Murtaza et al., (2004), stabilizers bring a creamy consistency to food products.

Another name given for stabilizers are known as hydrocolloid gums. They are called hydrocolloid gums since they produce colloidal dispersions in water (Tasneem et al., 2014). The effects of stabilizers on water mobility are derived from its high molecular weight and highly branched structure. Individual stabilizers interact with water and bring up a change in the performance of that water. The effect of stabilizers often increases with the interaction of other food components.

Stabilizers are substances that help in increasing the viscosity and thickness of the food products and it also helps in preventing the substances that are present in the food products from separating out into different layers (Tasneem et al., 2014). So, it is very important to identify how food stabilizers work. There are two parts found in the stabilizer molecules which are the water loving or hydrophilic end and the water hating or the hydrophobic end (Syed & Shah, 2016). The hydrophilic end bonds with the water molecules while the hydrophobic end bonds with the oil molecules. In this way, the oil droplets stay mixed with water molecules without separating out into different layers. For example, if stabilizers were not found in chilli sauce bottles, then the water layer, oil layer and various other layers will be separated.

Consumers usually check the ingredients before buying food products to see whether it is made from natural ingredients or not. If the food is made from natural ingredients, consumers take it as a positive factor since it is related to food security and various other health benefits. Almost all the food stabilizers are naturally occurring compounds. Various food stabilizers include alginic acid, agar-agar, carrageenan, gelatine and pectin. All these stabilizers are used in making various desserts, pudding and especially ice creams.

Food stabilizers play a huge role in controlling the growth of ice crystals in ice creams (Syed & Shah, 2016). As the ice cream freezes the food stabilizers blends with the other different ingredients in order to delay the formation of ice crystals (Murtaza et al., 2004). It is also known as the magic ingredient which brings about the smooth and creamy texture to ice creams and various other food products such as salad dressing and dairy products (Syed & Shah, 2016) .While people consume the ice cream it doesn't melt right away, the reason why it does not melt is that a stabilizer helps in slowing the melting process of the ice cream. According to the study conducted by Murtaza et al. (2004), by using stabilizers ice creams of better quality and melting quality can be produced with a low cost. It was reported by Syed & Shah (2016), that stabilizers influence the mixture viscosity. The texture smoothness effects of different ingredients on texture of ice cream and melting resistance of the ice cream are directly proportional to the viscosity increase. According to Fiol et al. (2017), the method that was used in making ice cream in their study was mixing all the ingredients in a saucepan in medium heat by using a stove. The stabilizer was added with some sucrose and it was cooked in medium

heat. After cooking, it was let to cool and freeze for about 6 to 12 hours. The ingredients that were used in this study include full cream milk, low fat milk sugar, gelatine and water (Fiol et al., 2017).

Colouring agent

According to literature, beet juice contains a pigment known as betalain, which is a widely used natural food additive that imparts a pink or reddish colour on foods when subjected to it. The pigment remains relatively stable across a pH range of 3 to 7 and hence, are preferable as colourants of low-acid food. It has been proven a healthier alternative to its synthetic counterparts due to its antioxidant and anti-inflammatory properties. Various foods have been coloured using beet juice, which itself has been extracted in a number of ways by different researchers (Aykın-Dinçer et al., 2020).

In an experiment conducted by Aykın-Dinçer et al. (2020), in the colouring of sausages, beet juice was extracted by initially peeling the beetroots and cutting them into cubes of uniform size. The cubes were then placed in water containing 0.5% of citric acid in the ratio 1:3 for beetroot and water. A shaking water bath was made use of in the extraction, in which the temperature remained at 80 °C for a period of 1 hour with a shaking rate of 150 rpm. The extract obtained was then cooled to room temperature and filtered using filter paper. The concentrated extract was then changed into powder form using freeze-drying process. The powder was diluted with water and added into the mince batter of the sausages.

In another experiment carried out by Chaudhary (2013), which aimed to improve colour in some food products using beet juice powder, a similar technique was followed as mentioned above. However, in this study, instead of citric acid, 20g of glycerol was mixed with the 100 mL of beet juice powder. Also, it is to be noted that in this study they aimed at extracting the individual pigment betalain in colouring food.

Dias et al. (2019) who studied the use of beetroot as a source of natural dye for ham, obtained the dry extract of the beet juice via freeze-drying method. In their method, the beetroot cubes were mixed with water, ethanol and acetic acid in the ratio 66.6:33:0.33 and made up to 100mL and kept for 48 hours in room temperature, after which, the extract was filtered and partially evaporated at 40°C. Finally, the extract was freeze-dried and changed to powdered form.

Jill Frank (2021) who is a food industry expert also suggested a simple method of obtaining the beet juice colour which involved pressing of the beetroots to extract the juice at low pH. The extract is then ultra-filtered and the obtained juice is spray dried onto a carrier like corn-starch and used after dilution (Frank, 2015).

Materials and methods

Materials and methods are divided into section A (agar-agar application) and section B (colouring agent application).

A. Coconut ice cream production using agar-agar

Materials

Agar-agar, coconut milk, blender, sauce pan, spatula and stove.

Methods

Coconut milk was extracted by mixing the coconut meat with water in a blender. The slurry was then pressed and filtered by using a sieve to remove the solid residue (Figure 1).

Figure 1. Coconut milk extraction

- Agar-agar strips were blended so that it will be easier for the agar-agar to dissolve in the mixture by using a blender before adding into the coconut milk mixer. After blending, 2 teaspoons of agar-agar were added into the coconut milk mixture and stirred by using the spatula for 3 minutes (Figure 3). After coconut milk extraction one cup of coconut milk was measured and placed into a sauce pan. Then it was cooked by using a stove in medium heat before adding the agar-agar stabilizer (Figure 2)

Figure 2. Cooking coconut milk with agar-agar

• Agar-agar strips (Figure 3a) were blended (Figure 3b) so that it will be easier for the agar-agar to dissolve in the mixture by using a blender before adding into the coconut milk mixer. After blending, 2 teaspoons of agar-agar were added into the coconut milk mixture (Figure 3c) and stirred by using the

spatula for 3 minutes (Figure 3).

Figure 3 (a) agar-agar strips

Figure 3 (b) blending agar-agar

Figure 3 (c). adding agar-agar into the coconut milk

- After 3 minutes, one spoon of condensed milk was added into the mixture (Figure 4). This was added in order to bring a sweet taste to the ice cream.

Figure 4. Adding condensed milk into the coconut milk mixture

- The stove was turned off and the mixture was let to cool for 10 minutes (Figure 5). After it was cooled, it was poured into a container and stored in the freezer for 4 hours.

Figure 5. Cooked coconut mixture left to cool down

- After 4 hours, the texture of the ice cream was observed and recorded. A sensory evaluation and a melting run was also conducted.

Section B. Application of beet juice in colouring coconut honey used in the preparation of "Ulhaali"

Materials

- 1 Beetroot
- 1 cup Flour
- 200 ml Coconut honey
- 50 ml water
- 1 teaspoon corn starch
- Oil as per required

Method

- The colouring procedure which was followed in this practical was carried out with modifications to the procedures outiled in prior literature. Initially, the beetroots were peeled and thoroughly washed, after which, it was cut into cubes of uniform size (Figure 6a), and ground using a blender (Figure 6b).

Figure 6. (a) beetroot cubes

Figure 6. (b) ground beetroot

- The ground beetroot pulp was then transferred into a linen cloth and squeezed to extract the juice (Figure 7). Once the juice was extracted, it was sieved to collect any residue. The beet juice was then diluted with 50mL of water, and corn starch was added to thicken and convert the beet juice into a gel-like form.

Figure 7. Beetroot juice

- Once the beet juice gel was prepared, it was added drop-by-drop into the previously made coconut honey (Figure 8a), and the mixture was stirred until the colour deepened, and was uniformly distributed all over the coconut honey (Figure 8b). This mixture of the coloured coconut honey was then added into the flour (Figure 8c), and the dough was kneaded.

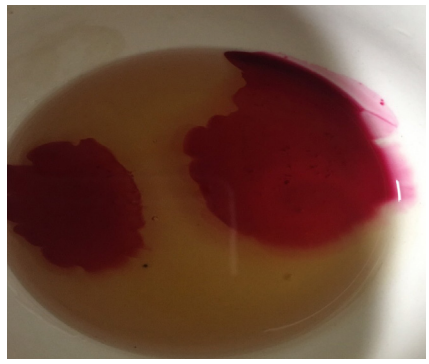

Figure 8 (a). Adding beetroot juice into coconut honey

Figure 8 (b). Coloured beetroot coconut honey

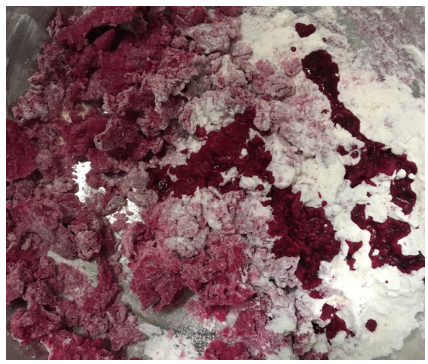

Figure 8 (c). Coloured beetroot honey added into flour to make a dough

- The kneaded dough (Figure 9a) was shaped into a spiral or the shape of "Ulhaali" (Figure 9b) and fried in oil (Figure 9c).

Figure 9 (a). Kneaded dough

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Figure 9 (b. Dough shaped into a spiral or shape of "Ulhaali"

Figure 9 (c). Fried Ulhaali

Results and discussion

This section is divided into A and B

A. Coconut ice cream production using agar-agar

Sensory evaluation

Figure 10 shows how the coconut ice cream looks after freezing.

Appearance

- Before freezing and after freezing many air bubbles were found on the ice cream.
- Very little ice was formed in the ice cream after freezing.
- It had a soft and creamy texture after freezing.

Figure 10. Ice cream after freezing

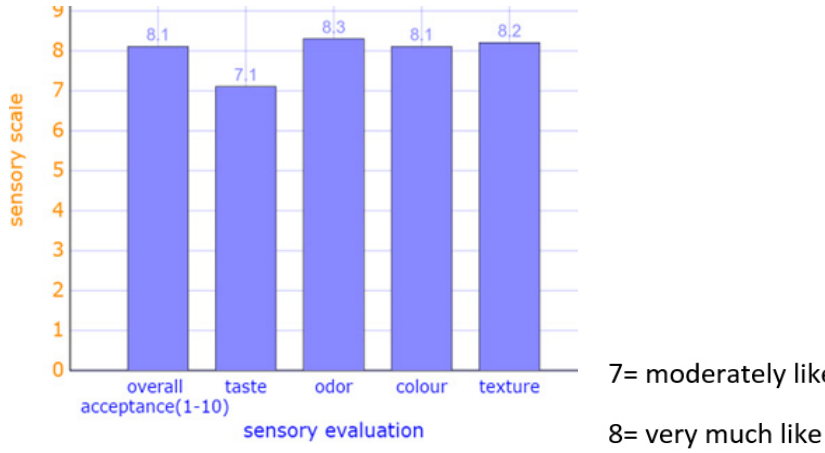

Figure 11. Sensory evaluation of coconut ice cream

Colour

For the colour parameters, the highest score was 9.

Odour

The highest score that was given for the odour was 9 while the lowest was 6. Since the ice cream was made using coconut milk some people did not prefer the coconut smell while others loved the smell of the ice cream.

Taste

For the taste parameters the highest score was 9 while the lowest score was 6. Most of the people liked the coconut ice cream because it brought a very unique taste to their tongue. .

Texture

For the texture parameter the highest score was 9. Most of the people liked it due to the creamy texture that was produced by the agar-agar stabilizer. The addition of agar-agar was tending to increase the softness of ice cream texture. The texture of ice cream is also influenced by the types of stabilizers used. The greater the viscosity value of the stabilizer used, the softer the texture of the ice cream produced.

The limitation of this study is that not being able to measure certain parameters like pH, temperature and viscosity due to unavailability of the devices.

While making the ice creams, the separation of molecules in the coconut milk mixture was prevented by the addition of agar-agar stabilizers. Air bubbles were observed in the ice cream before and after freezing, which may be due to the low viscosity of the agar-agar. According to Syed & Shah (2016), stabilizers with higher viscosity have the ability in making a more thicker dough which will cause the surface tension to be higher and it will make the air to become more difficult to penetrate into the dough hence decreasing the number of air bubbles present in it.

Melting run

Melting run is the time required for the ice cream to melt perfectly. The results of the analysis of the melting run of ice cream range from 130s/g – 226s/g. The melting speed of this ice cream is very much determined by the total solids, the texture of the ice cream and the intensity of sweetness (Murtaza et al., 2004). Ice cream that has low total solids will cause the texture of the ice cream to be rough, causing the ice cream to melt easily (Syed & Shah, 2016).

Conclusion

Adding agar-agar increases the stability of the ice cream. It also helped in bringing up a smooth texture to the ice cream. Based on the sensory evaluation most of the people liked the taste as well as the texture of the ice cream.

Section B. Colouring agent

Sensory evaluation

Sensory evaluation of the product was done with a panel size of 15 people. A total of 3 descriptors were generated and scored by the participants. These were grouped into aroma, colour and taste. The panel was provided a 10-point scale where "0" represented "strongly dislike" and "10" represented "strongly like".

Figure 12 shows the sensory evaluation of the "Ulhaali" product by 15 participants.

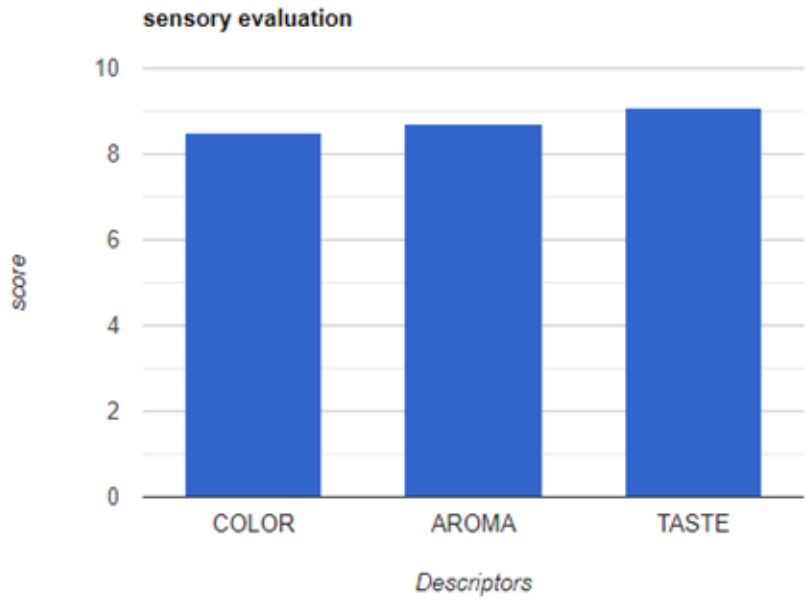

Figure 12. Results of the sensory evaluations of "Ulhaali"

Colour

The colour of the "Ulhaali" was deep pink and was a factor of fascination for almost all of the participants. An average score of 8.5 was received for this descriptor which was considered a high value and therefore represented an overall acceptability of the colour of the product.

Aroma

The aroma of the "Ulhaali" was described by the majority as having no significant change compared to the normal "Ulhaali". One reason for this was the mildness of the scent of beetroot extract, as well as the overpowering odour of the coconut

honey. An average score of 8.7 was received for this descriptor which was again considered a high value and therefore represented an overall acceptability of the aroma of the product.

Taste

When it came to the taste, the product received an overall positive review with an average score of 9.1 by the participants. According to the review comments of the participants, no significant alteration was observed in the taste, and instead, the mild sweet flavour of the beetroot extract enhanced the taste of the "Ulhaali".

Hence the acceptability of the product in all three aspects were considered well above the acceptable range.

The results were consistent with the literature review as the beet juice coloured the coconut honey. Due to the lack of necessary laboratory equipment such as freeze-dryer and reagents such as citric acid ethanol and glycerol, the beet juice had to be used in gel or liquid form instead of powdered form. However, the colour of the coconut honey, and the end-product "Ulhaali" after the addition of beet gel was in the range of pinkish red, which was observed in literature as well. The reason for darker colour than the actual colour of the beet gel could be as a result of degradation of betanin due to the product being subjected to extremely hot oil and due to the dough being overcooked. Nonetheless, one reason for the colour retention in the product could be assumed due to the high sugar content of the coconut honey, which is considered a factor that prevents colour loss by protecting betanin present in beet juice.

Conclusion

This practical revealed that beet juice extract can be used to colour coconut honey, and that coloured coconut honey can be used to make "Ulhaali" which would exhibit the colour after being cooked. The beet juice for the study was extracted and used in a diluted form although in most literature it is shown to have used in powdered form. When a sensory evaluation of the product was done, the participants gave an average score of 8.5 for the colour, while they scored on average 8.7 and 9.1 for the aroma and taste respectively. Thus, the product was considered well accepted by all of the participants.

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