Erasmus Mundus Master Course

Advanced Molecular Gastronomy

Assignment on

Note-by-Note cooking

1st year MASTER OF SCIENCE

Food Innovation and Product Design

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Advanced Molecular Gastronomy (Module Code: TFCS9025: 2021-22)

Topic: Savoury Dice

Product prepared: Spicy Cot-pie loaf

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Date: 09/05/2022

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Introduction:

Molecular gastronomy is distinct from food science, it investigates the social, artistic, and technical aspects of culinary and gastronomic phenomena. (Burke et al, 2016) As years went by, Molecular gastronomy was becoming increasingly clear that technology and education were inextricably linked, applications of science, rather than just scientific operations. The job isn't done, and the field will continue to be a source of discoveries and technological innovation through technological labour, especially because the newly built interface spans so many fields.

Molecular gastronomy is the study of the physical and chemical changes that occur in the kitchen during preparation, cooking, and eating.

Note -by-Note is one of the applications of Molecular Gastronomy. Note-by-Note cooking is a new technique introduced into the world of food innovations. Professor Hervé This, a French physical chemist and co-founder of Molecular Gastronomy, proposed the concept in 1994. He understood the need for food sustainability, and according to him note-by-note cooking was important for feeding humanity in 2050, when the world's population may exceed ten billion people. This project makes a significant contribution to the fight against spoilage while conserving water, electricity, and food while also being environmentally friendly, dealing questionable like nutrition and toxicity.

Natural science applications can be found in the kitchen (for example, molecular cooking or note-by-note cooking), as well as the utilization of culinary phenomena as scientific subjects, which is the core principle of molecular gastronomy.

Compounds can be used to make entire meals. Note after Note. In the same way that electronic music does not use trumpets or violins, but rather pure waves, cuisine does not use meat, fish, vegetables, or fruits, but rather compounds or blends.

While molecular cooking is no longer as popular as it once was (low-temperature cooking and foaming with siphons are now "traditional" techniques), molecular gastronomy continues to grow at universities across the world, with new laboratories, research groups, and instructional curricula. New facets of molecular gastronomy emerge as a result.

Because of new discoveries concerning the relevance of the microbiota, fibres are increasingly becoming more important in human meals. Considering the definition of fibres and the importance in human meals, in this assignment, we were given the task to create the shapes of the dish's various components, as well as the colours, tastes, odors, temperatures, trigeminal stimulation, consistency, and nutritional aspects. The incorporation of foods from sustainable sources that gave nutritional value is a key component of the dish.

The product I decided to make is called **Spicy Cot-pie loaf with potato and fibre topping**. Since I am in Ireland currently, I wanted to make something that was familiar locally. Got the idea from the famous dish here called Shepherd’s Pie and Cottage pie. This dish is known world-wide as well. People will be able to relate to it, but I am not promising the exact taste

of a cottage pie. That is a challenge for now, and since this is new development, I would like to create a unique taste, with just the idea derived from cottage pie. It does have a small twist to with the texture and taste. It has a bread-like texture, taste like a bread with meaty notes and a beautiful blend of spices therefore calling it a Spicy pie loaf.

It would be dull to reproduce already existing food ingredients and there is probably little value in duplicating what already exists (Burke et al., 2020). This article also emphasizes that experimenting with flavours and cuisines that were never imagined with regular food items is far more exciting. Food familiarity may be a key factor in enjoying, especially for people who are food phobic

Aim of Assignment:

- to make a **Spicy Cot-pie loaf** using molecular compounds through note-by note cooking method

Product Description:

It is a product made from pure compounds using note-by-note cooking method, trying to imitate a cottage pie. It contains all the macro nutrients like carbohydrates, proteins, fat, Dietary fiber. The product is not exactly like a cottage pie, it has a slight twist to it. As the name suggest, the product is a loaf, bread-like soft and firm texture with a smooth potato and fibre sauce topping.

Material and Methods:

Ingredients

Ingredients	Qty
Potato starch	14.64
oil	15.8
Cellulose/dietary fibre	12
Protein powder	11
MDP	21
Gluten	20
Xanthan Gum	0.2
Capsanthin	0.01
β-carotene	0.01
capsaicinoids alkaloids	0.01
carvacrol	0.01
Glucose syrup	5
Sodium bi carbonate	0.05
Sodium chloride	0.2
Beef flavour	0.02
Carrot flavour	0.02
Peas flavour	0.02
Yellow color	0.01
Total	100

Topping	Qty
Potato starch	16
Fiber	7
MDP	13.8
Xanthan Gum	0.2
Glucose Syrup	13
Water	50
Total	100

Equipment:

Steel bowls (medium and small), Small plastic trays, spoons, whisker, weighing machine, Oven - Brodericks (Equipment Asse Tag - 44211), Small baking tins

Method:

1. Each ingredient was weighed in different containers separately as per the recipe for 100g in a 3kg weighing scale

2. The ingredients for the topping was subtracted from the main product ingredient list. Keeping aside quantities from the list of ingredients for topping, the dry ingredients were mixed well using a whisker.

3. After the dry ingredients were mixed, oil was added slowly, and mixing was continuous.

4. A small amount of water (approx. 20ml) was also added to the mixture.

5. Small lump like structure will be formed, like minced beef.

Topping preparation:

1. Once the lump like structure was formed, the topping was prepared.

2. In a small cooking pan, the potato starch and fiber were mixed with water, paste-like mixture will be formed, slightly add yellow color. This will give the mashed potato color and appearance.

3. Add more water (30ml) to the paste like mix and cook in medium flame for 5-7 minutes until it semi-solid.

4. Add the minced beef like mixture into the baking tin and top the layer with the topping

5. Bake it for 20 mins at 160 degrees Celsius in the Oven (Broderix).

6. Allow the mixture to cool and cut the structure into a cube and plate it.

Results

Below is a picture of the final product. Adding the spices and the sodium bicarbonate gave the product the puffy texture attained. The product is moist and soft and firm. The topping also had a nice smooth texture and taste. The colour of the product was mainly attained due to the gluten content and spices added.

In the sensory evaluation, a total of seven responses was received. Out of which 57.1% found the texture of the product acceptable. Only 14% found the texture not acceptable. It could be due to the puffiness. Probably they expected it to be moister.

A majority of 87.5% liked the color of the product, and rated acceptable, and the remaining said it was neither/ not acceptable and none said it was not acceptable.

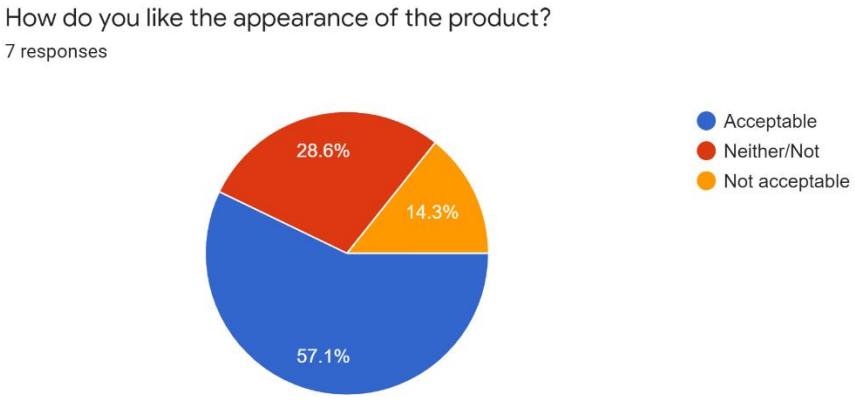
71% found the taste of the product acceptable, with the remaining chose neither/not acceptable.

For the overall acceptance, 57% said it was acceptable, 28.6% said the product needed improvement. And 14% chose neither/not acceptable.

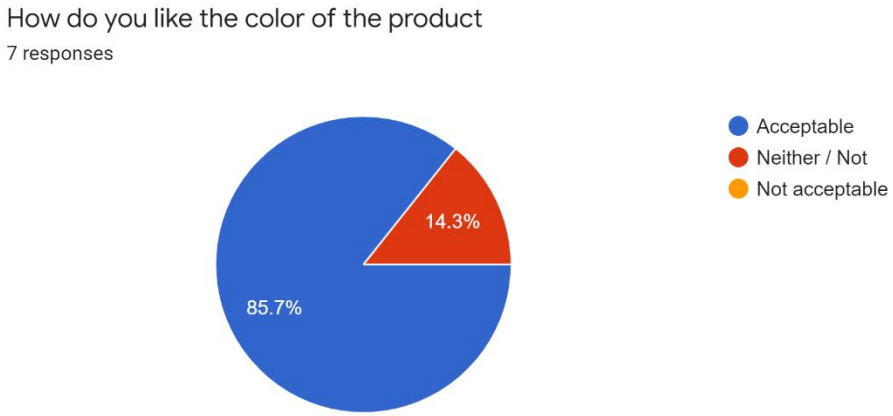
Figure 1 Final product - spicy cot pie loaf

Attributes	**Results**
Appearance	Soft, firm and bread-like texture
Colour	Medium brown
Taste	Spicy
Mouthfeel	Bread like

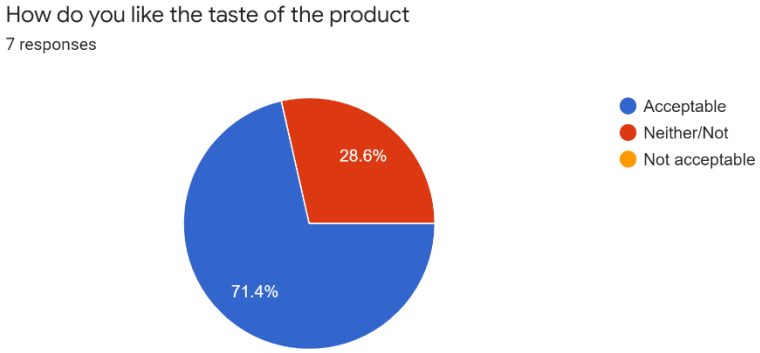
Appearance:



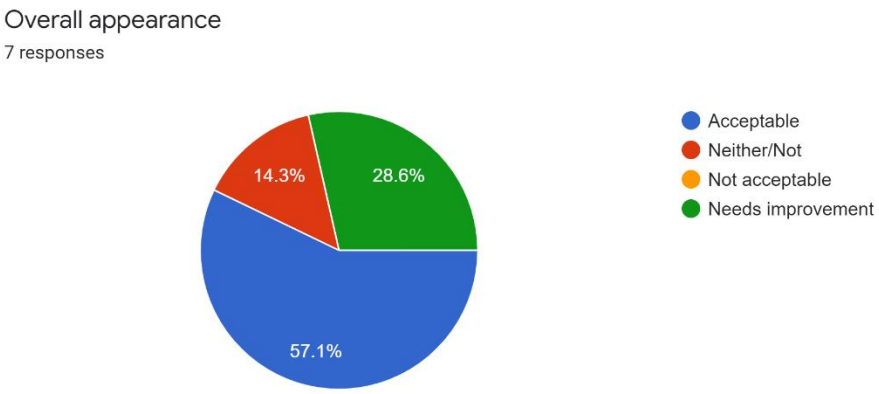
Color :



Taste:



Overall appearance:



Discussions:

Sensory characteristics and shelf life of potato products such as mashed potatoes, French fries, and potato chips are influenced by the molecular organization and interactions of potato starch with non-starch polysaccharides and sugars (reviewed in *Lisinska & Leszczynski 1989*).

Appearance: Starch and gluten, the major ingredients added to the texture of the product. Sodium bicarbonate (also known as baking soda) helped in the rising of the product. Gave the soft and moistness.

Colour: The colour of the product was due to color of gluten on mixing with the water and oil.

Texture: It is like a bread. The texture was mainly due to the protein network formed by the gluten content along with other nutrients.

Figure 2 Texture of the product

Taste: Sodium chloride is the taste enhancer in this product. Spice compounds like Capsanthin, β-carotene, capsaicinoids alkaloids, carvacrol added to the spiciness of the product, giving the product a savoury taste.

Functionality of major ingredients in the product.

Potato Starch:

Potatoes are a highly lucrative vegetable crop with numerous applications in both fresh and processed diets. Potatoes are a good source of carbs, but they also provide a lot of protein, ascorbic acid and other vitamins, phenolic compounds, and minerals including phosphorus, potassium, and calcium (reviewed in *Kadam et al. 1991*). The quality of potatoes and potato products is influenced by the chemical content and structure of potato components such as starch, non-starch polysaccharides, sugars and other carbohydrates, organic and inorganic chemicals, and proteins.

Amylose and amylopectin are two polysaccharides found in potato starch. The ratio of amylose to amylopectin, as well as the distribution of amylose chain lengths, degree of branching, and sizes of the respective branch chain lengths, influence potato starch properties such as digestibility, gelatinization temperature, and viscosity (*Leeman et al. 2006; Karlsson et al. 2007; Schirmer et al. 2013*).

Thickening, coating, gelling, adhesion, and encapsulation are just a few of the many uses for starch in culinary and non-food applications. Because of the structure and organization of amylose and amylopectin, some of these functionalities are unique to the polymer. The most important features in starch applications are swelling, gelatinization, retrogradation, and pasting/rheological capabilities, which all underpin starch functioning. The functionality of potato starch is characterized using a variety of modern analytical techniques. The true value of potato starch functionalities, on the other hand, vary depending on the potato source and the analytical method utilized.

Swelling: When starch is cooked in excess water, its crystalline structure is broken, and water molecules form hydrogen bonds with exposed hydroxyl groups of amylose and amylopectin, causing granule swelling and solubility to rise. *Tester and Morrison (1990*) defined granular swelling as a swelling factor that only assesses intra-granular water. Swelling power, on the other hand, assesses both inter- and intra-granular water (*Leach 1959*).

Gelatinisation: Starch granules undergo an order-to-disorder phase transition when heated in the presence of water. The disturbance of molecular order within the starch granule is known as starch gelatinization. It's accompanied by irreversible property changes like

Granular swelling, crystallite melting, loss of refractive indices difference, viscosity development, and solubilization are all possible outcomes. The initial point of gelatinization, as well as the range across which it occurs, are determined by starch concentration and technique of preparation.

Pasting: The flow behaviour of a granule slurry changes dramatically when starch is cooked, as the suspension becomes a dispersion of starch. Swollen granules, next partially

disintegrating granules, and lastly granule remains, and amylose and amylopectin freed A starch paste is the finished product. It is a two-phase system with a distributed starch, swelling granules phase and a continuous leached granules phase amylose. It can be thought of as a polymeric composite. Granules that are inflated are immersed in and reinforce a continuous intertwined amylose molecules matrix (Ring 1985).

Wheat Gluten

Gluten proteins, which lend special visco-elastic qualities to wheat doughs, are largely responsible for the capacity to process wheat into such a diverse range of products.

Gluten is still formed by washing dough prepared from white flour (derived from starchy endosperm cells) with water, with the resultant fraction being around 70% protein and the rest being carbohydrate, lipids, and other ingredients. This method of gluten production results in a cohesive viscoelastic material.

The primary difference between gliadin and glutenin proteins is that the former is monomeric, while the latter is polymeric. This categorisation has been maintained for two reasons. First, both protein types are quite simple to prepare. Second, they serve a functional purpose, with glutenins principally responsible for the gluten's elasticity (strength) and gliadins for viscosity.

Gluten is traditionally split into alcohol-soluble (gliadin) and insoluble (glutenin) fractions, which are then electrophoretically separated. Gliadins are monomeric proteins that are sorted into four groups using polyacrylamide electrophoresis at low pH. Glutenins are polymeric proteins that are held together by interchain disulfide bonds.

Dietary Fiber

Dietary fiber is a carbohydrate that resists digestion and absorption and may or may not undergo microbial fermentation in the large intestine, according to a simple definition. This description serves as the foundation for the relationship between consumption levels and potential health benefits. Dietary fiber is made up of many distinct components, but arabinoxylan, inulin, -glucan, pectin, bran, and resistant starches are among the most interesting. Individual components of dietary fiber have been found to play a substantial effect in human health improvement.

Dietary fiber has long been recognized for its role in the prevention and treatment of constipation, but it is increasingly being promoted as a cure for a variety of ailments in Western countries. Although some data exists to link dietary fiber consumption to diseases, evaluating the data is problematic due to a lack of agreement on what dietary fiber is and how it should be assessed. Furthermore, not all dietary fiber is the same. Water-soluble fibers like pectin and gums have minimal influence on stool weight, therefore they're not a good choice

for constipation patients. Water-insoluble fibers like cellulose and hemicellulose are the most effective in facilitating laxation, but they may also impair mineral and vitamin absorption.

Dietary fiber components organize large intestine processes and have significant physiological impacts on glucose, lipid metabolism, and mineral absorption. Constipation, hemorrhoids, colon cancer, gastric reflux disease, duodenal ulcer, diverticulitis, obesity, diabetes, stroke, hypertension, and cardiovascular disorders are all known to be protected by dietary fibers. The physicochemical and biological features of dietary fibers, as well as their essential implications for human health, will be examined in this review.

Sodium bicarbonate:

It's a white crystalline powder that's inherently alkaline, or basic. It's also known as sodium bicarbonate (1). When baking soda is combined with both an acidic and a liquid, it becomes activated. Carbon dioxide is created when the enzyme is activated, allowing baked foods to rise, and become light and fluffy.

Sunflower oil

Sunflower oil also includes a considerable quantity of liposoluble vitamin E, which is found in tocopherols, which are chemical molecules. In nature, there are numerous forms of tocopherols; alpha-tocopherol is the most potent form of vitamin E, with a high biological and nutritional value. The oxidation of fat produces free radical soluble molecules, which have an electron in the centre and are exceedingly unstable and reactive, causing everything from cancer to thrombosis to DNA damage. Vitamin E is an important antioxidant in the prevention of polyunsaturated fatty acid oxidation (lipid peroxidation).

Conclusions

Many after tasting the product commented it was a good product. They liked the overall taste and texture. One of the panellists gave feedback that I could work on the presentation of the product. Due to time constraints, presentation could not be worked upon. With further research, the product can be improved and presented well, with all nutritional qualities. It can be consumed for a meal or as a savoury snack.

The topping could be improved. Instead of translucent, it could be made more opaque and mashed potato like. This can be done by increasing the potato starch or potato powder and reducing the malto dextrin content in the topping.

The product appearance was improved. It had the texture of bread, soft and slightly spongy. The change in method of preparation of topping gave the desired texture and mouthfeel as shown in the picture above.

Few random people were asked to do the sensory. All of them liked the taste of the product. One commented that the presentation can be worked upon.

The desired product was developed. There is a scope of improvement for the presentation of the product.

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LOGBOOK

MODULE CODE: TFCS9025: 2021-22

MODULE TITLE: Advanced Molecular Gastronomy

STUDENT NAME: _____ Nisha Sunil David**_____**

FOOD PRODUCT: ___Spicy Cot-pie loaf_____

WEEK NO.: __12_____ **DATE: _**28/03/2022**____**

Weekly Aims and Objectives

Aim: to make a product like cottage pie using note-by-note cooking.

Objective:

To make a similar product like cottage pie.

To understand how the ingredients react

To analyze if the composition will give a structure like beef in a cottage pie.

Materials and Method (Ingredients, Equipment and Method)

Ingredients

Ingredients	Qty
Potato starch	34.8
oil	15
Cellulose/dietary fibre	5
Protein powder	20.16
Gluten	25
Beef flavour	0.01
Carrot flavour	0.01
Peas flavour	0.01
Yellow color	0.01
Total	100

Topping	Qty
Potato starch	9
Fiber	7
protein powder	7
Water	27
Total	**50**

Equipment:

Steel bowls (medium and small), Small plastic trays, spoons, whisker, weighing machine, Oven - Brodericks (Equipment Asse Tag - 44211), Small paper baking tins

Method:

1. Weigh each ingredient separately as per the recipe for 100g. From these quantities, use the ingredients for the topping. Keep them separately

2. After keeping aside the quantities of ingredients from the list of ingredients for pie for, mix all the dry ingredients well and whisk with a whisker in a medium sized bowl by adding water (50ml) and oil.

3. Small lump like structure will be formed, looking like minced beef.

4. Now, mix the potato starch and fiber with water, make it like paste, slightly add yellow color. This would look like mashed potato.

5. Add the minced beef like mixture into the baking tray and top the layer with the potato starch and fiber paste.

6. Bake it for 20 mins at 160 degrees Celsius in the Oven (Broderix).

7. Allow the mixture to cool and cut the structure into a cube and plate it.

Results and discussion

Below are the pictures of the product. Sensory was conducted among random people in the lab. The appearance of the product or the plating was good. However, the feedback was that the product was too dry. It tasted very synthetic.

Figure 4 Day 1, picture of the product after plating

Figure 3 Day 1 picture of the product after baking

Conclusions

The product was very dry for a cottage pie like product. Needs improvement and further work needs to be done on binding properties to attain soft texture and good meaty flavour. The flavours were added in very minute quantities, being highly volatile, they vaporised due to the heat in the oven.

Recommendations for following week.

Increase the oil to make the product softer and get the meaty texture.

Enhance the flavour of the product by adding appropriate quantities flavours

Improve the topping by adding albumin to improve the texture and appearance

Ingredients required for the following 2 weeks.

- potato powder – for the topping

- Egg albumin

MODULE CODE: TFCS9025: 2021-22
MODULE TITLE: Advanced Molecular Gastronomy

STUDENT NAME: _____Nisha Sunil David_____

FOOD PRODUCT: ___Spicy Cot-pie loaf_____

WEEK NO.: __13_____ **DATE:** _28/03/2022____

Weekly Aims and Objectives

Aim:

to make a product like cottage pie using note-by-note cooking.

Objective:

Increase the oil to make the product softer and get the meaty texture.

Enhance the flavour of the product by adding appropriate quantities flavours

Improve the topping by adding albumin to improve the texture and appearance

Materials and Method (Ingredients, Equipment and Method)

Ingredients

Ingredients	Qty
Potato starch	14.77
Potato powder	20
oil	15
Cellulose/dietary fibre	5
Protein powder	15.16
Albumin	5
Gluten	25
Beef flavour	0.02
Carrot flavour	0.02
Peas flavour	0.02
Yellow color	0.01
Total	100

Topping	Qty
Potato powder	20
albumin	10
yellow colorant	0.01
fibre	9.99
Potato Starch	10
Water	50
Total	100

Equipment:

Steel bowls (medium and small), Small plastic trays, spoons, whisker, weighing machine, Oven - Brodericks (Equipment Asse Tag - 44211), Small baking tins

Method:

1. Weigh each ingredient separately as per the recipe for 100g

2. Keeping aside the quantity for topping as given above, mix all the dry ingredients well and whisk with a whisker in a medium sized bowl by adding water (50ml) and oil.

3. Small lump like structure will be formed, looking like minced beef.

4. Now, mix the potato starch and albumin and fiber with water, whisk it, slightly add yellow color. This would look like foamy mashed potato.

5. Add the minced beef like mixture into the baking tray and top the layer with the potato starch and fiber paste.

6. Bake it for 20 mins at 160 degrees Celsius in the Oven (Broderix).

7. Allow the mixture to cool and cut the structure into a cube and plate it.

Results and discussion

The foamy structure on top of the mixture had become hard and did not add to the aesthetics of the product. Since the flavours were increased this time, the product tasted very synthetic. Most of the attributes of the product from the appearance to the taste were not acceptable for consumption.

Conclusions

The product needs improvement. Flavours needs to be reduced. Since the flavours were added to the mixture directly, it did not blend very well. The foamy structure cannot be used for the topping.

Recommendations for following week.

Mix the ingredients one by one rather than all together.

Add the flavours into the oil as some of them are oil soluble.

Improve the topping by adding maltodextrin as carrier agent

Ingredients required for the following 2 weeks.

- Maltodextrin powder – to reduce the chemical taste, as a carrier to the topping.

- Xanthan gum – to stabilize the topping.

- Glucose syrup – to prevent hardening.

Erasmus Mundus Master Course

Advanced Molecular Gastronomy

Assignment on

Note-by-Note cooking

MODULE CODE: TFCS9025: 2021-22

MODULE TITLE: Advanced Molecular Gastronomy

STUDENT NAME: _____ Nisha Sunil David**_____**

FOOD PRODUCT: ___Spicy Cot-pie loaf_____

WEEK NO.: __14_____ **DATE:** _11/04/2022____

Weekly Aims and Objectives

Aim: to make spicy cot-pie loaf using compounds using note-by note cooking method

Increase the oil to make the product softer and get the meaty texture.

Enhance the flavour of the product by adding appropriate quantities flavours

Add the flavours into the oil as some of them are oil soluble.

Objective:

Materials and Method (Ingredients, Equipment and Method)

Ingredients

Week 3	
Ingredients	**Qty**
Potato starch	14.64
oil	16
Cellulose/dietary fibre	12
Protein powder	11
MDP	21
Gluten	20
Xanthan Gum	0.2
Capsanthin	0.01
β-carotene	0.01
capsaicinoids alkaloids	0.01
carvacrol	0.01
Glucose syrup	5
Sodium bi carbonate	0.05
Beef flavour	0.02
Carrot flavour	0.02
Peas flavour	0.02
Yellow color	0.01
Total	100

Topping	Qty
Potato starch	16
Fiber	7
MDP	13.8
Xanthan Gum	0.2
Glucose Syrup	13
Water	50
Total	100

Equipment:

Steel bowls (medium and small), Small plastic trays, spoons, whisker, weighing machine, Oven - Brodericks (Equipment Asse Tag - 44211), Small baking tins

Method:

1. Each ingredient was weighed in different containers separately as per the recipe for 100g in a 3kg weighing scale

2. The ingredients for the topping was subtracted from the main product ingredient list. Keeping aside quantities from the list of ingredients for topping, the dry ingredients were mixed well using a whisker.

3. After the dry ingredients were mixed, oil was added slowly, and mixing was continuous.

4. A small amount of water (approx. 20ml) was also added to the mixture.

5. Small lump like structure will be formed, like minced beef.

Topping preparation:

1. Once the lump like structure was formed, the topping was prepared.

2. In a small cooking pan, the potato starch and fiber were mixed with water, paste-like mixture will be formed, slightly add yellow color. This will give the mashed potato color and appearance.

3. Add more water (30ml) to the paste like mix and cook in medium flame for 5-7 minutes until it semi-solid.

4. Add the minced beef like mixture into the baking tin and top the layer with the topping

5. Bake it for 20 mins at 160 degrees Celsius in the Oven (Broderix).

6. Allow the mixture to cool and cut the structure into a cube and plate it.

Results and discussion

Figure 5 The final product

The product appearance was improved. It had the texture of bread, soft and slightly spongy. The change in method of preparation of topping gave the desired texture and mouthfeel as shown in the picture above.

Few random people were asked to do the sensory. All of them liked the taste of the product. One commented that the presentation can be worked upon.

Conclusions

The desired product was developed. There is a scope of improvement for the presentation of the product. Exact structure of cottage pie could not be attained.

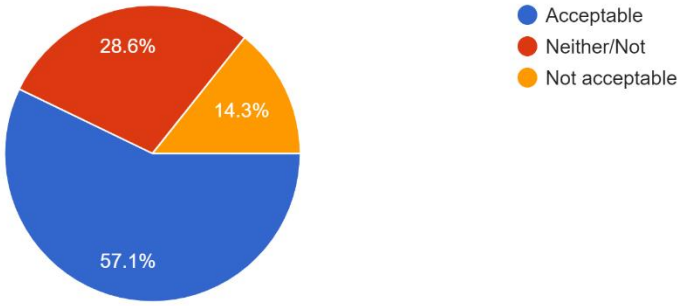
Sensory Evaluation – Spicy cot-pie loaf

Product Description

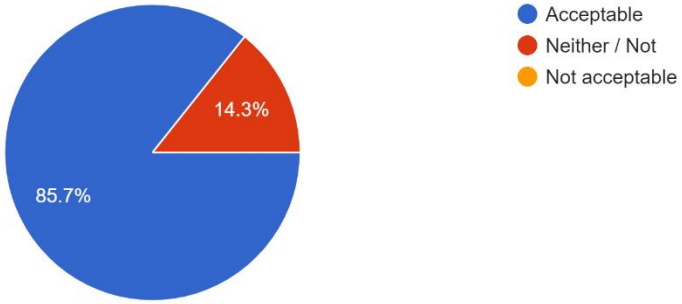
The product is made from pure food compounds using note-by-note cooking (the future of food science). Th e product imitates traditional cottage/shepherd's pie recipe. It has all the macro nutrients like protein, fat, barbs and dietary fibre.

The responses

How do you like the appearance of the product?
7 responses

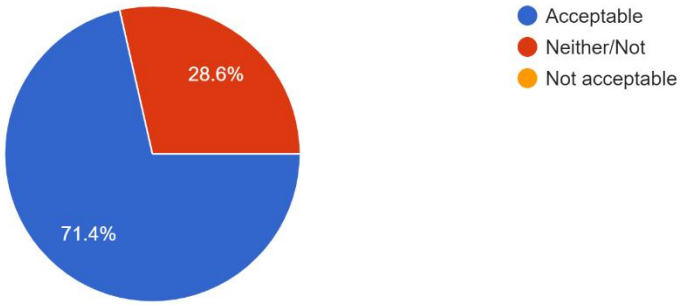


How do you like the color of the product
7 responses



How do you like the taste of the product

7 responses



Overall appearance

7 responses