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Edible Ideas/Recipes

Adaption of an American pancake recipe to a fortified pancake recipe suitable for dysphagia patients at level 6 on the IDDSI scale

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Abstract

In this project-based learning assignment, an American traditional pancake recipe was adapted to make it suitable for consumption by people suffering from 'dysphagia'. The aim was to produce a pancake matching the International Dysphagia Diet Standardisation Initiative (IDDSI) level 6, also known as 'soft and bite-sized', but without compromising on the main sensory attributes of the dish. A two-stage process was used to soften the pancake. Firstly, whipped egg whites were included in the recipe, and the resulting batter was put into a siphon, and nitrous oxide gas was dispensed into the mixture to produce a foam. The next stage involved soaking the cooked pancake in a calcium and vitamin D3 fortified maple flavoured liquid. Comparative sensory analysis was carried out by 14 experienced panellists who determined consistency ($p < 0.001$) to be the only significantly different sensory attribute. A successful adaption of the traditional recipe, was achieved, using a culinary innovative two stage process.

Keywords

project-based learning, dysphagia, consistency, pancakes, traditional

1. Introduction

Dysphagia is a condition that affects the ability to swallow (Mayo Clinic, 2024). Over time, dysphagia can also cause symptoms such as weight loss, dehydration and repeated chest infections (NHS, 2023).

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The International Dysphagia Diet Standardisation Initiative (IDDSI) committee came together in 2013 with a goal of developing international standardized terminology and descriptors for dysphagia diets that would meet the needs of individuals with dysphagia across the age span, across all care setting and across all cultures (Dysphagia Research Society, 2025). The IDDSI framework consists of a continuum of 8 levels (0 - 7), where drinks are measured from levels 0 - 4, while foods are measured from levels 3 - 7. A common terminology is provided, to describe food consistencies and drink thicknesses. For liquids the IDDSI flow test is performed using an IDDSI funnel. For dessert style puddings the IDDSI framework fork-drip and spoon-tilt tests are used (International Dysphagia Diet Standardisation Initiative, 2026). IDDSI provides testing methods that use forks and/or spoons to minimize the need for subjectivity that often accompanies description-based methods.

Most texture-modified foods currently available do not provide an enjoyable eating experience for those with dysphagia (Liu *et al.*, 2025). Designing specialized foods for individuals with dysphagia entails considering numerous factors, from the rheology in the oral phase to the tribology in the swallowing phase (Sarkar *et al.*, 2021). Malnutrition is another factor to consider. It induces dysphagia, and dysphagia also induces malnutrition (Ueshima *et al.*, 2022).

Taking these factors into consideration, a recipe for an innovative traditional-based American pancake was adapted using specific culinary ingredients and techniques. The aim was to have a soft consistency and to provide a nutritional benefit by fortification with calcium and vitamin D_3 while at the same time not compromising on the sensory attributes that make the eating experience enjoyable.

2. Ingredients, materials and methods

The concept of the dish was to adapt a traditional American pancake recipe (BBC Good Food, 2024) and produce a breakfast dish with

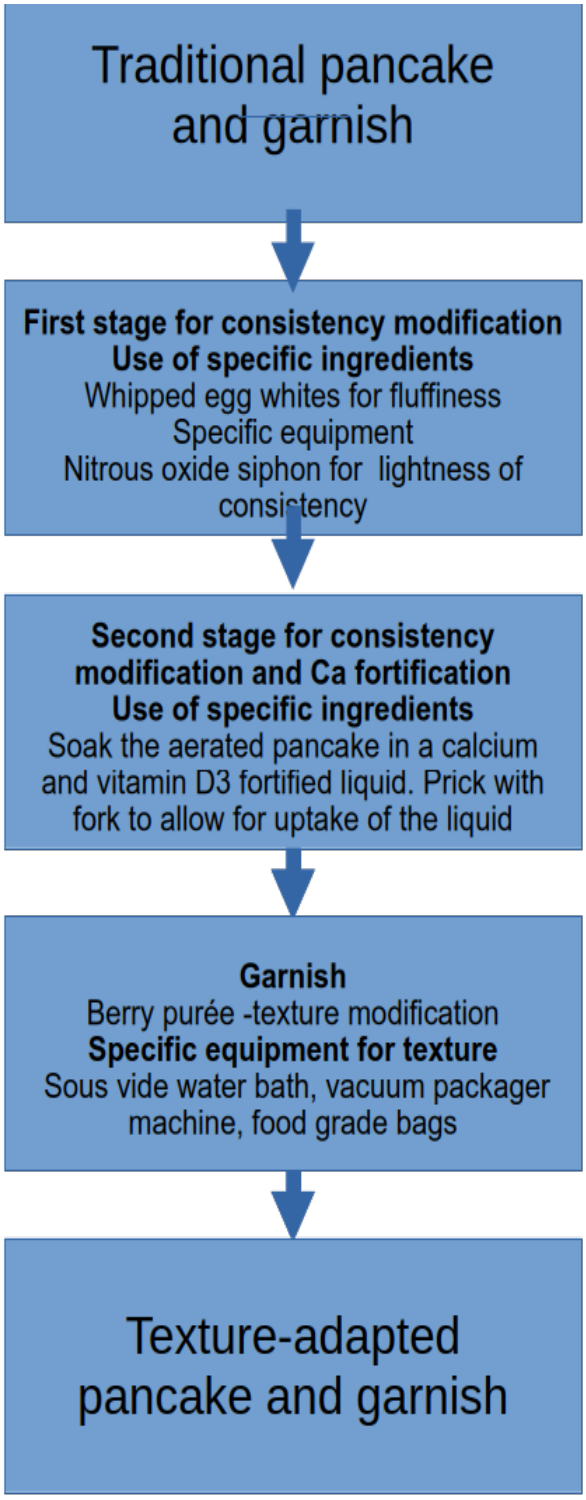

Figure 1. Stages in the texture modification of an IDDSI level 6 pancake.

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accompaniments of a mixed berry purée (blueberry, strawberry and raspberry) and Chantilly cream.
The consistency of the pancake was softened in a two-stage process. Firstly, the inclusion of whipped egg whites in the recipe served to make the texture of the pancake fluffier. The consistency was further softened by piping the pancake batter mixture from a siphon which had been filled with nitrous oxide gas. The second softening step involved soaking the pancake with a maple flavoured liquid which was fortified with calcium and vitamin D_3. The pancake was pricked with a fork, to improve absorption of this liquid.

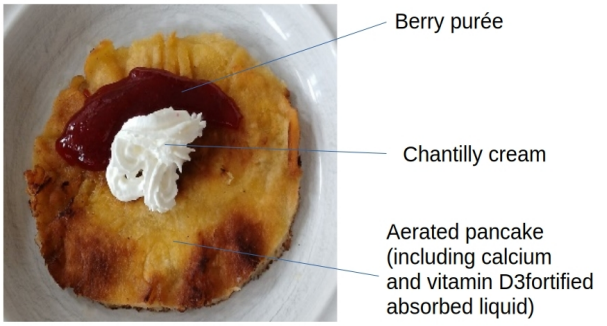

Figure 2. Aerated pancake with berry purée and Chantilly cream.

2. 1. Recipes

2.1.1 Aerated pancakes

Ingredients (for 4 small pancakes of 12 cm diameter):
• 2 egg yolks
• 15 mL milk
• 2.5 mLvanilla extract
• 30 g all purpose flour
• 2.5 g baking powder (GemTM)
• 5 mL white vinegar
• 50 g table sugar
• 7 g cornstarch
• 3 egg whites

Special equipment:
1 litre siphon
1 nitrous oxide (N_2O) cartridge

Process:
1. Combine all the ingredients except the egg whites.
2. Whip the egg whites and add to the combined ingredients.
3. Allow the batter to rest, uncovered in a fridge at 4 °C, for 15 minutes and then add the pancake batter mixture to the siphon.
4. Insert the N_2O charger into the charger holder and invert the charger holder over the opening in the lid. Screw the charger closed which will cause the gas to inject into the siphon.
5. Shake the siphon briskly three to four times to release the gas.
6. Remove the charger holder and cartridge and press the dispensing button/lever to release the batter.
7. Pipe the batter straight onto the preheated pan (gas mark 6, 200 °C) coated with melted butter to reduce sticking.
8. Flip occasionally and once finished, soak the pancake in 50 mL of the fortified liquid in a fridge at 4 °C for 30 minutes.

2.1.2. Fortified liquid

Ingredients
• 50 g butter
• 50 g maple syrup
• 100 mL whole milk
• 4 calcium & vitamin D_3 tablets (Holland & Barrett)

Special equipment:
1 mortar and pestle

Process:
1. Melt the butter, maple syrup and milk in a pot at medium heat.
2. Grind the calcium and vitamin D_3 tablets with a mortar and pestle into a fine powder and add to the liquid.
3. Stir the liquid until the calcium and vitamin D_3 powder has dissolved.

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Figure 3. Pricking the pancake with a fork and "the fork test".

2.1.3. Poached berries

Ingredients
• 100 g blueberries
• 100 g strawberries
• 100 g raspberries
• 50 g sugar

Special equipment:
Water bath with circulator
Vacuum packaging machine
Vacuum pack food grade bags

Process
1. Add the blueberries to a vacuum pack and vacuum seal in the vacuum packaging machine.
2. Place the sealed bag in a water bath for 30 minutes at 84 °C.
3. Repeat the steps above but adding the raspberries and the strawberries together in one bag and cooking for 20 minutes in the water bath.
4. Separate the berries in each of the two bags from the sous-vide liquid.
5. Separate the strawberries from the raspberries and blend the strawberries and blueberries together into a fine purée.
6. Add the raspberries to the purée but do not blend, in order to provide some slight consistency.

2.1.4. Chantilly Cream

Ingredients:
• 100 mL fresh cream
• 10 g icing sugar
• 5 g vanilla extract

Special equipment:
• balloon whisk
• precision weighing scales

Process:
Combine all ingredients in a large bowl and whisk until soft peaks have formed.

2.1.5. Assembly

Equipment
• 1 offset spatula
• 1 piping bag and nozzle

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Process:
1. Using an offset spatula, transfer the pancake from the plate it was soaking in, to the serving plate.
2. Remove excess liquid with a tissue.
3. Using the piping bag, pipe a small amount of Chantilly cream onto the pancake and spread evenly across the surface with a palette knife.
4. Place a spoonful of the berry purée on top and spread evenly across the surface with a palette knife.
5. Cut the pancake with toppings into 1.5 cm x 1.5 cm squares ensuring that there is no excess liquid.
6. Carry out the fork test on a selected sample.

3. Fork test and serving

1. Carry out the fork test according to IDDSI (2019) instructions (Figure 4).
2. Once the adapted pancake has complied with the IDDSI fork test for level 6, it is ready to serve.

4. Sensory analysis

In this study, a test method was required which would allow a comparison between a conventional pancake and an adapted pancake from a sensory point of view. This involved a preference and liking, and therefore an affective test was chosen. Hedonic rating scales are used to quantify affective dimension of the consumer perception of foods (Tuorila *et al*., 2008). Among the hedonic rating scales, the 9-point degree of liking scale, also called the 9-point hedonic scale, is commonly used (Tuorila *et al.*, 2008; Lawless and Heymann, 2010). In the test, participants/consumers are asked to give their hedonic opinion to a product sample by choosing and marking one of nine alternatives, (e.g. ranging from 1 = dislike extremely to 9 = like extremely).
An issue with consumer panels is that the panellists may not understand the method, or the questions being asked of them, and this can lead to unreliable results. However, studies involving

Figure 4. IDDSI Fork Pressure Test (IDDSI, 2019).

trained panellists are time consuming and expensive due to the long training period (Sáenz-Navajas *et al.*, 2015). Another group of panellists that can be considered for sensory panels is experienced panellists. Experienced panellists are individuals who are highly experienced with the food product being tested, the method being used or have received extensive training before the testing (Michon and McDonnell, 2008). Significant differences in liking and preference can be seen in test groups of only ten participants (Svensson, 2012).

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A comparative sensory analysis was carried between the traditional American pancake and the adapted pancake. The appearance, sweetness, odour, consistency, flavour balance (between the fruit flavours of the purée and the maple flavour of the fortified liquid, i.e. were the fruit flavours overwhelming the maple flavour or vice versa or were they in balance with each other), aftertaste (the taste that a particular food leaves in your mouth after swallowing it) and overall acceptability were assessed by 14 experienced panellists, using a 9-point hedonic scale. The panellists were culinary arts students, who were not involved in the study itself. Having made traditional pancakes and fruit purées in their course, they were familiar with recipes and methods for the foods being tested (pancakes, purée, Chantilly cream). They were not given details of the differences between the samples. They worked in a single area under defined conditions of 18-20 °C and white light. Approximately 10 g of each of the two samples (topped with the berry purée and Chantilly cream garnishes) was placed in sample containers coded with three-digit random numbers which were 245 (traditional pancake) and 673 (texture modified pancake). Panellists were instructed to judge appearance, ante-nasal odour, sweetness, consistency, flavour balance, aftertaste, and overall acceptability on a scale of 1-9, where 1 = dislike extremely; 2= dislike very much; 3= dislike moderately; 4= dislike slightly; 5= neither like nor dislike; 6= like slightly; 7= like moderately; 8= like very much; 9= like extremely.

Table 1. A comparison of sensory attributes of a traditional American pancake and an adapted pancake for level 6 Dysphagia patients.

Sensory attributes and overall acceptability	245	673	*p*-value
Appearance	7.50 ± 1.02	6.71 ± 1.49	> 0.05
Aroma	7.43 ± 1.28	7.00 ± 1.47	> 0.05
Flavour balance	6.71 ± 1.31	6.93 ±1.49	> 0.05
Sweetness	6.71 ± 1.38	7.43 ± 1.16	> 0.05
Consistency	4.50 ± 1.91	8.14 ± 0.86	**< 0.001**
Aftertaste	7.86 ± 1.17	7.93 ± 1.07	> 0.05
Overall acceptability	7.21 ± 1.76	7.21 ± 1.48	> 0.05

5. Results and discussion

In order to increase the safe ingestion processes and adequate nutrition of dysphagia patients, the development of texture-modified foods is needed (Cichero *et al.*, 2017). Most texture-modified foods currently available do not provide an enjoyable eating experience for those with dysphagia (Liu *et al.*, 2025).

According to IDDSI (2019) foods at level 6 are soft, moist, and bite-sized with no thin liquid leaking / dripping from the food. 'Bite-sized' pieces should be no bigger than 1.5 cm x 1.5 cm in size and can be mashed/broken down with pressure from fork.

When flour is mixed with the wet ingredients of eggs and milk, gliadin and glutenin proteins form a network (gluten), which results in elastic, cohesive and viscous properties of the batter (Sun *et al.,* 2019). In this recipe the acetic acid in the vinegar reacted with the baking powder (sodium bicarbonate and disodium diphosphate). The mixing causes carbon dioxide gas to be trapped by these networks, which causes the pancake to rise and creates its chewable texture. Eggs provide more protein, while sugar and butter give tenderness to the texture and the fluids help the mixing process and enable chemical reactions to occur (Cotton, 2023). However, as a chewable texture was not desired, a recipe was developed which included whipped egg whites. These were incorporated into a batter, which would foam further, when injected with nitrous oxide gas from a siphon. Foaming of egg white proteins is an important

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element in the manufacture of the foods such as cakes, bread, meringues, and cookies. Foamability and foam stability are two critical functionalities of egg white that play a vital role in food processing and the final quality of food products (Razi *et al.*, 2023). Incorporating the uniformly distributed gaseous phase leads to modifying product texture, mouthfeel, and flavour (Sangamithra *et al.*, 2015). The use of siphons in food processing is an established technique to create foams (Getz *et al.*, 1937; Blankart *et al.*, 2020).

N_2O, dissolves readily in both hydrophilic and hydrophobic substances such as water and oil (O'Neil *et al.*, 2001). When you flip the siphon upside down and pull the lever, the liquid rushes out through the nozzle and hits normal air pressure. That sudden pressure drop causes the dissolved N_2O gas to burst out of solution, forming thousands of tiny bubbles that expand into a stable foam (Scienceinsights, 2026).

Calcium ions are essential for many physiological functions in the human body. Vitamin D_3 aids in raising blood serum calcium levels from calcium ingestion Since bones act as the primary reservoir of calcium, adequate dietary intake is crucial to prevent the mobilization and depletion of calcium from bone tissue (Barbosa-Nuñe *et al.*, 2025). According to Holland and Barrett (2026) each calcium and vitamin D_3 tablets contains 600 mg of calcium (75 % of the recommended daily allowance) and 3µg (120 international unit (I.U.)) of vitamin D_3 (60 % of the recommended daily allowance). A study by Bosworth *et al.,* (2012) found that daily supplementation with 1,200 mg of calcium in combination with 800 I.U. of vitamin D_3, either as a fixed or separate combination, significantly increased vitamin D levels in blood serum and radius bone mineral density (BMD) in elderly institutionalized women with moderate chronic kidney disease (CKD) and severe vitamin D_3 deficiency. The recipe for the fortified maple liquid included four powdered calcium and vitamin D_3 tablets. The liquid was evenly divided between four pancakes so that each pancake was supplemented with 600 mg of calcium and 3 µg of vitamin D_3.

Stage two had a triple effect of further softening the pancake consistency while at the same time providing a nutritional benefit and improving the flavour. Prinz and Lucas (1997) pointed out the importance of cohesiveness in oral processing. Even though cohesiveness is more of a concept than a well-defined measurable parameter, this property describes the degree of coherency provided by the internal structure of a material against its fractional breakup (Nishinari *et al.*, 2019). In our study a fork test was used as recommended for determining cohesiveness and adhesiveness by IDDSI (2019). When the food was squashed, it did not return to its shape. These characteristics result in a moist, cohesive bolus that is not sticky or adhesive. The IDDSI method contains no measuring equipment and, as a result, no numerical criteria for textural and rheological attributes; thus, it can be used by caregivers, speech therapists and patients.

Sous-vide cooking leads to changes in consistency, appearance, nutrient availability i.e., degradation of thermo-labile components (Rekhy and McConchie, 2014). The fruit purée complied with the instructions for IDDSI level 6 fruit i.e., that it should be soft, with no fibrous pieces, and chopped to pieces no bigger than 1.5 cm x 1.5 cm pieces (any excess liquid drained).

A comparative sensory analysis was carried between the traditional American pancake and the adapted pancake, both with accompaniments of a mixed berry purée and Chantilly cream. The appearance, sweetness, aroma, consistency, flavour balance, aftertaste and overall acceptability were assessed by 14 experienced panellists. As shown in Table 1, apart from texture there were no significant differences for the other attributes tested ($p > 0.05$). The texture of the adapted pancake was preferred to the traditional pancake ($p < 0.001$). Panellists

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preferred a softer consistency which was easier to swallow.

6. Conclusion

This study demonstrates how culinary technology and gastronomic innovation can bridge clinical nutritional requirements and pleasurable eating experiences in the development of dysphagia-oriented foods.
Limitations to the study: there were only 14 experienced panellists who performed the sensory evaluations, and these did not include dysphagic patients. Future studies, including the target population and larger panels, would strengthen the applicability of the findings. Instrumental texture/rheological analyses were not carried out and it is recommended that future studies use techniques such as Texture Profile Analysis (TPA) to complement IDDSI testing.

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Authors declare no conflict of interests.

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