Seashells by the Sea Shore by Nerea Landa

Materials & Methods

Overview of Dish Components

The final dish, *"Seashells by the Sea Shore,"* consisted of four main elements:

- protein-based shells
- neutral mirror glaze
- toasted protein sand
- aerated foam
- water-based granita ("sea")

Each component was developed and optimised through iterative kitchen trials before final integration into a plated dish.

Materials

- Small saucepan
- Bowls
- Whisk
- Hand blender
- Spatula
- Oven and oven tray
- Oven rack
- Blast chiller / shock freezer
- Real scallop shells
- Digital weighing scale

Ingredients and Methods

Shell Base

The shell base was formulated using a protein-hydrocolloid system designed to create a stable gel structure with controlled texture, as shown in Figure 1. Agar was selected as the primary gelling agent due to its thermoreversible gelation properties, while locust bean gum was included to reduce brittleness and improve elasticity through synergistic interactions. The protein component contributes both structural support and nutritional value, while acids and salts are used to balance flavour and adjust pH (Phillips and Williams, 2009; Damodaran et al., 2017).

Table 1. Ingredients needed for the shell base and their function.

Category	Ingredient	Compound / E-Number	Function	Quantity (g)
Solvent	Water	H_2O	Continuous phase	370
Protein Structure	Whey Protein Isolate	Protein fractions	Structural matrix, protein source	13
Primary Gelling Agent	Agar-agar	E406	Thermoreversible gel formation	2.7
Texture Modifier / Synergy Agent	Locust Bean Gum	E410	Improves elasticity, reduces brittleness	0.54
Salt	Sodium chloride	NaCl	Flavour enhancement	1
Acid	Citric acid	E330 / E270	pH adjustment, flavour balance	1.2
Reducing Sugar	Dextrose	$C_6H_{12}O_6$	Flavour balance	3

Flavour profiles for the shells were constructed using key aroma compounds known to contribute to characteristic sensory perceptions, these compounds are shown in Table 2. In note-by-note cooking, flavour can be designed by combining specific volatile molecules that replicate natural aromas, allowing precise control over intensity and balance. Esters, aldehydes, terpenes, and Maillard-derived compounds were selected based on their well-documented role in fruit, nut, and caramel flavour systems. This approach enables the recreation of familiar flavours while maintaining a simplified and controlled formulation (McGee, 2004; Belitz et al., 2009; Reineccius, 2006). The amount of these compounds in each shells could not be quantified due to the low amounts that were used (just one drop of each) and therefore will be considered negligible in the final costing and nutritional considerations.

Table 2. Flavour compound table of used aromas in the shell bases.

Flavor Profile	Primary Compounds	Optional Supporting Compounds
Cotton Candy	Ethyl maltol	Vanillin
Melon	Cis-3-hexenol	(E,Z)-2,6-Nonadienal
Ripe Strawberry	Ethyl butyrate	Furaneol, Mesifurane
Lime	Limonene	Citral, β-Pinene
Toasted Hazelnut	Filbertone (5-methylhept-2-en-4-one)	Acetyl pyrazine
Toffee	Diacetyl	Acetoin, Furaneol

In order to reproduce this recipe, the following methodology was used:

1. Mix agar, locust bean gum, dextrose, salt, and protein isolate thoroughly.
2. Heat water to approximately 60°C.

3. Gradually add the dry mixture while blending until smooth.
4. Bring to a boil (100°C) and maintain for 60–90 seconds.
5. Cool to ~80°C, add flavour compounds, and mix gently.
6. Different flavour compounds were added to different portions of the mix to obtain different flavoured shells.
    1. Cotton Candy + Melon were added to one third of the mix.
    2. Ripe strawberry + Lime were added to another third of the mix.
    3. Toasted Hazelnut + Toffe were added to the last third of the mix.
7. Pour into moulds, allow to set (8–10 min).

Neutral Mirror Glaze

The glaze formulation was designed to produce a thin, flexible, and glossy coating, as shown in Table 3. Agar provides light gel structure, while glycerol acts as a plasticiser, improving flexibility and preventing cracking. Glucose contributes to viscosity and shine, resulting in a smooth, uniform coating layer. These ingredients are commonly used in food systems to control texture and surface properties (Phillips and Williams, 2009; McGee, 2004).

Table 3. Ingredients needed for the mirror glaze and their function.

Category	Ingredient	Compound / E-Number	Function	Quantity (g)
Solvent	Water	H_2O	Continuous phase	200
Primary Gelling Agent	Agar-agar	E406	Thin gel structure for coating	1.6
Plasticizer / Gloss Agent	Glycerol	E422	Improves shine and flexibility	20
Sweetener / Structure	Glucose syrup	Glucose polymers	Viscosity, gloss, sweetness	20
Salt	Sodium chloride	NaCl	Flavour enhancement	0.5
Colouring	Food colour	Various	Visual appearance	As required (small quantities)

In order to reproduce this recipe, the following methodology was used:

1. Combine water, glucose, agar and glycerol and bring to a boil.
2. Cook for 1 minute.
3. Remove from heat and add colouring.
4. Cool to 55–60°C before use.
5. Dip chilled shells for 1–2 seconds and allow to set in an oven rack.

Sand (Toasted Protein Sand)

The sand component formulation that is shown in Table 4. was developed to mimic a granular texture using a combination of protein isolate and maltodextrin. Maltodextrin acts as a bulking and textural agent, allowing the formation of small particles, while protein contributes structure and nutritional value. The addition of dextrose enhances flavour and promotes light browning during toasting through Maillard reactions (Damodaran et al., 2017; McGee, 2004).

Table 4. Ingredients used for the sand and their function.

Category	**Ingredient**	**Compound / E-Number**	**Function**	**Quantity (g)**
Protein Structure	Whey Protein Isolate	Protein fractions	Base structure, protein content	70
Bulking / Textural Agent	Maltodextrin	Glucose polymer	Powder formation, sandy texture	25
Reducing Sugar	Dextrose	$C_6H_{12}O_6$	Flavour, browning during toasting	3
Salt	Sodium chloride	NaCl	Flavour enhancement	2
Hydration Agent	Water	H_2O	Granulation of particles	10

In order to reproduce this recipe, the following methodology was used:

1. Mix dry ingredients thoroughly.
2. Add water gradually to form crumbs.
3. Spread on tray and bake at 180°C for 8 minutes.
4. Cool, break, and sieve to obtain varied particle sizes.

Foam

The foam was produced using a water-based system stabilised with a sucrose ester emulsifier, which enhances stability by preventing bubble coalescence. This combination allows the formation of a light aerated structure using relatively simple processing methods, the ingredients are shown in Table 5. (Damodaran et al., 2017; Hasenhuettl and Hartel, 2008).

Table 5. Ingredients used for the foam and their function.

Category	**Ingredient**	**Compound / E-Number**	**Function**	**Quantity (g)**
Solvent	Water	H_2O	Continuous phase	100
Emulsifier / Foaming Agent	Sucrose ester	E473	Stabilises air bubbles	2
Salt	Sodium chloride	NaCl	Flavour enhancement	7

In order to reproduce this recipe, the following methodology was used:

1. Combine ingredients and heat until dissolved.
2. Blend at high speed to form foam.

Granita ("Sea")

The granita formulation that is shown in Table 6. was designed as a water-based frozen system in which sugar plays a key role in controlling ice crystal formation and texture. By lowering the freezing point of water, sucrose enables the formation of small ice crystals, resulting in a softer and more scoopable structure. This approach is widely used in frozen desserts to control texture and melting behaviour (Hartel, 2001; McGee, 2004).

Table 6. Ingredients used for the granita and their function.

Category	Ingredient	Compound / E-Number	Function	Quantity (g)
Solvent	Water	H_2O	Continuous phase	500
Sweetener	Sucrose	$C_{12}H_{22}O_{11}$	Sweetness, freezing point depression	120
Flavouring	Watermelon flavour	Aromatic compounds	Sensory profile	2 drops
Colouring	Food colour	Various	Visual appearance	As needed (small amount)

In order to reproduce this recipe, the following methodology was used:

1. Heat water and sugar until dissolved (do not boil).
2. Cool and add flavouring and colouring.
3. Freeze in a shallow container.
4. Scrape every 5–10 minutes to form crystals.

Nutritional Value & Costing Methodology

Nutritional Value

The energy content of the final dish was estimated using the Atwater general factor system, in which protein contributes 4 kcal/g, carbohydrates 4 kcal/g, and fat 9 kcal/g (FAO/WHO, 2003). For food additives and hydrocolloids where specific energy values are documented in the literature (e.g. agar-agar at 2 kcal/g, glycerol at 3.5 kcal/g), these literature values were used in place of general factors (Belitz, Grosch and Schieberle, 2009). The total energy content of each component was first calculated for the full batch prepared, using the ingredient quantities and their respective energy values. The energy density of each component (kcal/g) was then obtained by dividing total kilocalories by total batch weight. The energy contribution per plated portion was calculated by multiplying the energy density by the quantity of each component used in a single serving. Colourings and aromatic compounds were considered calorically negligible due to the very small quantities used. The protein content per serving was estimated using the declared protein fraction of the whey protein isolate (90% w/w).

Ingredient Costing

The ingredient cost of each component was calculated using the unit prices provided for the assignment. For each ingredient, the cost per gram was derived by dividing the purchase price by the total weight of the purchased unit. The cost of each ingredient in the batch was then calculated by multiplying the cost per gram by the quantity used. Component batch costs were summed to obtain a total cost per batch, and a cost-per-gram value was derived for each component. The cost per plated portion was calculated by multiplying the cost per gram of each component by the quantity used in a single serving and summing the contributions of all components.

Together, the glaze, sand, granita and foam supported the visual and sensory concept of *Seashells by the Sea Shore* as it can be seen in Figure 7. The glaze enhanced the appearance of the shells, the sand created a realistic beach texture, the granita represented the sea, and the foam added a light coastal effect. The first full plating trial showed that the components worked together conceptually, although the plate was overloaded and the granita was too sweet. The final version improved this by reducing the amount of each component and adjusting the flavour of the granita. To assemble the plate, the toasted sand is first spread across part of the base of the plate, leaving space for the granita. The shells are then positioned on top of the sand. Next, the granita is placed in the remaining empty section of the plate to represent the sea. Finally, the foam is added on top as a finishing element to create the effect of sea foa

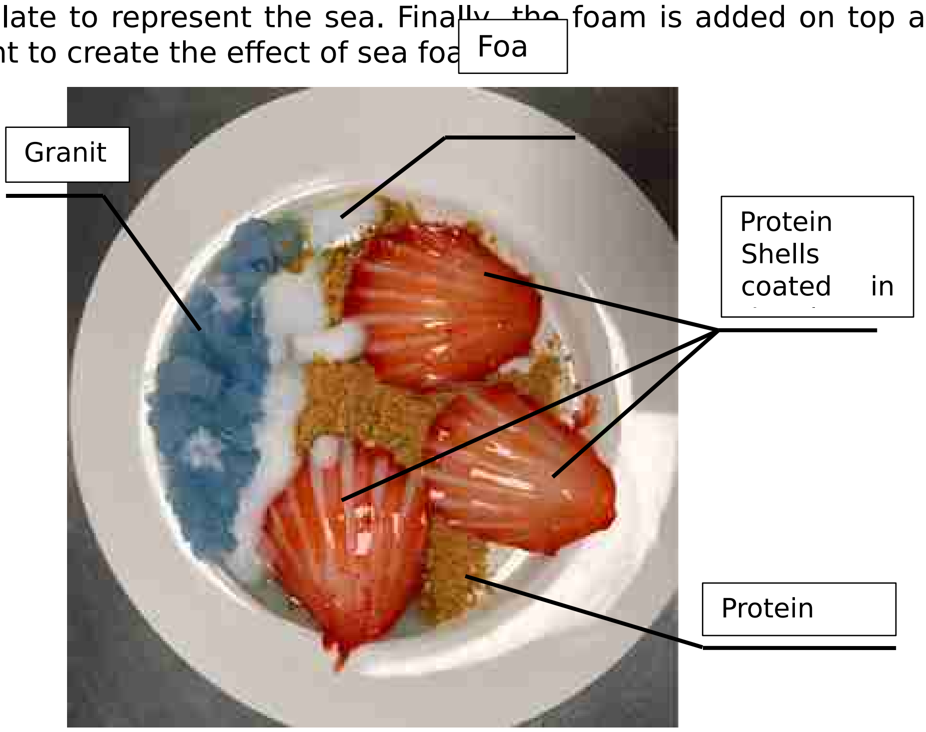

Figure 1. Final version of *Seashells by the Sea Shore*.

Nutritional Results

The nutritional value of the final dish was estimated by calculating the energy contribution of each prepared component and then scaling it according to the amount used in one plated portion. Colourings and aromatic compounds were considered negligible because they were used in very small quantities. The final foam was also considered negligible because the final version contained no sugar.

Table 7. Total energy content of each prepared component.

Component	Total quantity prepared (g)	Total kcal	kcal/g
Protein shells	391.44	72.49	0.185
Glaze	242.10	130.20	0.538
Toasted protein sand	110.00	390.20	3.547
Granita	620.00	480.00	0.774

Component	Total quantity prepared (g)	Total kcal	kcal/g
Foam	—	0	0

The toasted protein sand had the highest energy density at 3.547 kcal/g, mainly due to the whey protein isolate and maltodextrin. In contrast, the protein shells had a much lower energy density at 0.185 kcal/g because the formulation was mostly water. The granita had an energy density of 0.649 kcal/g, with all quantified calories coming from sucrose.

Table 8. Estimated nutritional value of one plated portion.

Component	Quantity used (g)	kcal/g	kcal per serving	Protein per serving (g)
Protein shells	117.432	0.185	21.747	3.90
Glaze	12.000	0.538	6.454	0
Toasted protein sand	25.000	3.547	88.682	15.91
Granita	100.000	0.649	64.865	0
Foam	10.000	0	0	0
Total	264.432	0.735	181.747	19.81

One plated portion of *Seashells by the Sea Shore* was estimated to provide approximately 182 kcal and 19.8 g of protein. The overall energy density of the plated dish was approximately 0.735 kcal/g. The main contributor to calories was the toasted protein sand, followed by the granita, while the main contributor to protein was also the toasted protein sand. The shells contributed relatively little energy but still added 3.9 g of protein per portion. Detailed ingredient-level nutritional calculations are provided in Appendix B.

Costing Results

The cost of the final dish was estimated using ingredient prices provided for the assignment. Each component was costed by calculating the price of the ingredients used in the full batch and then dividing the total component cost by the batch weight to obtain a cost per gram. This value was then multiplied by the quantity of each component used in one plated portion.

Table 9. Cost of each prepared component.

Component	Total quantity prepared (g)	Total cost (€)	Cost per gram (€/g)
Protein shells	391.44	0.835	0.00213
Glaze	242.40	0.821	0.00339
Toasted protein sand	110.00	3.572	0.03247
Granita	740.00	0.985	0.00133

Component	Total quantity prepared (g)	Total cost (€)	Cost per gram (€/g)
Foam	109.00	0.410	0.00377

The most expensive component per gram was the toasted protein sand, with a cost of €0.03247/g, mainly due to the high quantity of whey protein isolate and maltodextrin. The protein shells were relatively inexpensive at €0.00213/g, despite containing whey protein isolate, because the formulation was mostly water. The granita had the lowest cost per gram, as it was mainly water and sucrose.

Table 10. Estimated cost of one plated portion.

Component	Quantity used (g)	Cost per gram (€/g)	Cost per serving (€)
Protein shells	117.432	0.00213	0.251
Glaze	12.000	0.00339	0.041
Toasted protein sand	25.000	0.03247	0.812
Granita	100.000	0.00133	0.133
Foam	10.000	0.00377	0.038
Total	264.432	0.0049	1.274

The estimated ingredient cost of one plated portion of *Seashells by the Sea Shore* was approximately €1.27. The overall cost density of the dish was approximately €0.0049/g. The main cost contributor was the toasted protein sand, which accounted for approximately €0.81 of the total cost, representing around 64% of the final plate cost.

This result supports the assignment theme because the final dish was produced at a relatively low ingredient cost while still providing visual complexity, textural contrast and a high-protein nutritional profile. The use of water-based systems, powdered ingredients and small quantities of functional compounds helped reduce cost and minimise waste. Detailed ingredient-level nutritional calculations are provided in Appendix C.

Conclusions

Overall, this project demonstrates that note-by-note cooking can be applied to produce a structured plated dessert with reduced caloric content, competitive ingredient cost and acceptable sensory quality using relatively accessible processing methods. In relation to the stated aim, the final dish achieved a caloric content of approximately 182 kcal per serving, substantially lower than comparable conventional desserts such as chocolate mousse or cheesecake, at an ingredient cost of €1.30 per portion, while receiving positive sensory scores across all four evaluated attributes. The coastal concept was successfully realised through the combination of four structurally distinct components, each fulfilling a specific visual and textural role within the plate.

Considering the specific objectives, the texture and structure of the shells and sand were successfully optimised through iterative reformulation: reducing whey protein concentration in the shell base resolved the graininess observed in Week 1, and the synergistic use of agar and locust bean gum produced a gel with adequate flexibility and mould fidelity. The processing methods employed, namely dissolution, gelation, granulation, blast-chilling and blending, were simple, scalable and required no highly specialised equipment, fulfilling the efficiency objective. The iterative kitchen trial process across four weeks enabled systematic identification and resolution of formulation problems, including excessive sweetness in the granita and colour control in the glaze.

However, not all objectives were fully met. The sensory evaluation, while providing useful directional feedback, was limited in scope and rigour, and the foam stability objective was only partially achieved, as the blender-produced foam lacked the structural consistency of a siphon-based system. Further work should therefore focus on improving foam stability and granita melt resistance through targeted reformulation, refining flavour balance through more systematic aroma dosing, and validating sensory outcomes through a larger and more controlled evaluation.

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