Dish Name: **Italy Experience**

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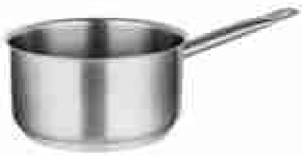
Materials and Method

Materials

Ingredient	Supplier / Source	Picture
Weighing Scales	Jadever	
Baking Tray	Unspecified	
Oven	Electrolux	
Knife, Spoons	Unspecified	
Immersion Blender	Unspecified	
Saucepan	Unspecified	
Bowls	Unspecified	
Colander	Unspecified	

Stove	Electrolux	
Pipette	Unspecified	
Whisk	Unspecified	
Italy Stencil	Homemade with carton and printed image	

Green Italy – Basil Protein Sponge

The Green Italy Basil Protein Sponge forms the visual and conceptual centrepiece of the dish. Shaped into the silhouette of the Italian peninsula using a hand-cut stencil, it functions simultaneously as the main structural element and the primary vehicle for herbaceous flavour. In conventional Italian cooking, the freshness of basil is one of the most immediately recognisable sensory cues, defined principally by the volatile compounds linalool and estragole (Belitz, Grosch and Schieberle, 2009). In this note-by-note formulation, that aromatic identity is reconstructed through commercial basil flavouring, while the structure of the component is built entirely from functional hydrocolloids and protein fractions rather than traditional baking ingredients such as flour, egg, or fat.

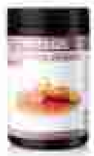
Whey protein isolate (WPI) provides the primary structural matrix. Upon heating above approximately 70–80°C, WPI undergoes irreversible thermal denaturation, causing unfolding and aggregation of β-lactoglobulin and α-lactalbumin chains to form a continuous gel network (Nicolai, Britten and Schmitt, 2011).

Methylcellulose (E461) contributes an additional, thermally reversible gel structure: unlike most hydrocolloids, it gels upon heating and melts upon cooling, a property that aids structural setting during baking (Brady, 2013).

Xanthan gum (E415) acts as a viscosity-building stabiliser, preventing phase separation during mixing and improving water immobilisation within the matrix (Sworn, 2009).

Maltodextrin functions as a bulking agent and contributes to moisture binding and textural body, while a small amount of sucrose enhances palatability and promotes light surface browning through Maillard reactions at the elevated baking temperature (McGee, 2004).

Ingredients for Basil Protein Sponge

Ingredients	Quantity	Description
Water	210g	Tap Water
Whey Protein Isolate	20g	 MyProtein – Impact Whey Isolate (natural vanilla flavour)
Methylcellulose	3g	 Sosa Metilgel
Xanthan Gum	2g	 "Msk" Xanthan Gum
Sugar	2.5g	 Gem Caster Sugar
Maltodextrin	1.5g	 Sosa Maltodextrin
Sodium Chloride	0.8g	 Table Salt
Basil Flavouring	q.s.	 Sosa Flavouring N.38 (Basil) and 130 (Lemon)
Green Food coloring	q.s.	 Green colour by "Mallard Ferriere"

Method for Basil Protein Sponge

- **Step 1:** All dry and liquid ingredients were combined and blended for 30–40 seconds to ensure full dispersion, hydration, and air incorporation.

- **Step 2:** The mixture was allowed to rest for 5 minutes to enable hydrocolloid hydration and viscosity development.
- **Step 3:** The batter was evenly spread onto baking paper in a shallow metal tray to a thickness of approximately 6–8 mm.
- **Step 4:** Baking was carried out at 160 °C (fan-assisted) for 25 minutes, followed by turning the sheet and baking for a further 10 minutes to ensure uniform dehydration and structure formation.
- **Step 5:** The sponge was cooled to room temperature before being cut into an Italy silhouette using a stencil.

Basil Protein Sponge – Process Justification

- The reduction of water content during the weeks (300 → ~210 mL) was necessary to increase the protein-to-water ratio, enabling formation of a continuous gel network and preventing a liquid final structure.
- The use of a **metal tray instead of silicone mat** improved heat transfer, allowing faster protein denaturation and more effective moisture evaporation, which directly improved structural stability.
- Spreading the mixture in a **thin layer (≤ 8 mm)** and turning it during baking promoted uniform dehydration, reducing internal moisture and allowing clean cutting of the Italy shape.

Blue Sea – Mineral Fluid Gel

The Blue Sea Mineral Fluid Gel represents the coastal dimension of the Italian landscape. Visually, it evokes the Mediterranean and Adriatic seas that define Italy's geography; sensorially, it is designed to deliver a lightly saline flavour profile with subtle herbaceous and citrus notes.

Fluid gels are a well-established technique in molecular gastronomy and modern cuisine, produced by forming a thermoset gel and then subjecting it to controlled mechanical shear. The result is a material that flows under stress but recovers its structure at rest — a pseudoplastic or thixotropic behaviour that makes it ideal for elegant plating (Ghebremedhin, Seiffert and Vilgis, 2021).

In this formulation, agar-agar (E406) is the gelling agent of choice. Agar is a polysaccharide derived from red algae, composed of agarose and agaropectin. When dispersed in hot water and cooled below approximately 40°C, agarose chains form double helices that associate into a firm, brittle gel through hydrogen bonding (Pandya et al., 2022). Mechanical shearing of this gel produces the characteristic fluid gel texture.

Monosodium glutamate (MSG, E621) is incorporated at a low concentration to enhance umami perception and add depth to the mineral flavour profile, consistent with the established role of free glutamate in amplifying savoury taste (Yamaguchi and Ninomiya, 2000).

Citric acid (E330) provides acidity, enhancing the perception of freshness and evoking the bright, citrus notes of lemons from the Italian coast.

Sodium chloride delivers the salinity note essential to the coastal identity of this component.

Blue food colouring completes the visual narrative.

Ingredients for Mineral Fluid Gel

Ingredients	Quantity	Description
Water	300ml	Tap Water
Agar Agar	1.8g	 Sosa Agar-Agar
Sodium Chloride	0.5g	 Table Salt
Monosodium Glutamate	0.2g	 AJI-NO-MOTO Monosodium Glutamate
Citric Acid	0.1g	 Citric acid Monohydrated E 330 by "Louis Francois"
Basil and Lemon Flavouring	q.s.	Sosa Flavouring N.38 (Basil) and 130 (Lemon)  
Blue food coloring	q.s.	 Blue colour by "Mallard Ferriere"

Method for Mineral Fluid Gel

- **Step 1:** Agar was dispersed in water together with salt and heated under constant stirring to 90–100 °C until complete hydration and dissolution were achieved.
- **Step 2:** Flavour compounds and colouring agents were incorporated and homogenised using a blender.
- **Step 3:** The hot solution was allowed to set into a gel at room temperature.
- **Step 4:** The set gel was mechanically broken and sheared using a blender to obtain a smooth fluid gel consistency.

- **Step 5:** Colour and texture were adjusted after blending if necessary to achieve the desired final appearance.

Mineral Fluid Gel – Process Justification

- Heating agar to **90–100°C ensured full hydration**, which is essential for consistent gel formation before shearing.
- The decision to **add colour after blending** corrected the initial issue of uneven colour distribution and resulted in a more homogeneous appearance.
- The combination of **salt, acid, and MSG** was adjusted to improve flavour perception, although results indicated that concentration remained below optimal sensory threshold.

Red Spheres – Tomato “Cities”

The Red Tomato Spheres represent the cities of Italy as small, vivid, concentrated nodes of flavour placed deliberately across the landscape of the plate. Conceptually, they reference Italy’s urban density and the central role of the tomato in Italian culinary identity. Sensorially, they are designed to deliver a burst of tomato flavour characterised by acidity, sweetness, and umami — the three principal taste dimensions of a ripe tomato (Tieman et al., 2017).

The technique used to produce these spheres is direct spherification, one of the foundational methods of molecular gastronomy as developed and popularised by Ferran Adrià at elBulli (Adrià, Soler and Adrià, 2006), and as demonstrated in module practical sessions (Advanced Molecular Gastronomy lecture notes, 2026).

Sodium alginate (E401), a polysaccharide derived from brown seaweed, is dissolved in the flavoured liquid phase. When droplets of this alginate solution are introduced into a calcium chloride (E509) bath, ionic crosslinking occurs at the droplet surface: calcium ions displace sodium ions and crosslink adjacent alginate chains, forming an insoluble calcium alginate gel membrane (Lee and Mooney, 2012).

This membrane encapsulates the liquid interior, producing a sphere with a defined outer skin and a fluid centre. Citric acid and sucrose are included to balance the flavour profile, and MSG reinforces the umami character of the tomato note. Tomato powder contributes to flavour intensity and colour saturation, while red food colouring completes the visual identity of the component.

Ingredients for Red Tomato Spheres

Ingredients Alginate Phase	Quantity	Description
Water	250ml	Tap water
Sodium Alginate	2.5g	 Sosa Alginat

Monosodium Glutamate	0.2g	 AJI-NO-MOTO Monosodium Glutamate
Citric Acid	0.4g	 Citric acid Monohydrated E 330 by “Louis Francois”
Sugar	0.2g	 Gem Caster Sugar
Tomato flavourings	q.s.	 Sosa Flavouring N.63 (Green Tomato)  Tomato Powder - Sosa
Red Food Coloring	q.s.	 Red colour by “Mallard Ferriere”

Ingredients Calcium Bath	**Quantity**	**Description**
Water	625ml	Tap Water
Calcium Chloride	3.8g	 Sosa Clorur

Method for Red Tomato Spheres

- **Step 1:** Sodium alginate was dispersed in the tomato base and left to hydrate for 30–45 minutes to ensure full dissolution and deaeration.

- **Step 2:** A calcium chloride bath was prepared separately and allowed to stabilise.
- **Step 3:** The alginate mixture was carefully dropped into the calcium bath using a pipette to form spherical droplets.
- **Step 4:** Gelation was allowed to proceed for 35–45 seconds under controlled conditions.
- **Step 5:** The formed spheres were removed and rinsed in clean water to stop further gelation and remove excess calcium.

Tomato Spheres – Process Justification

- Resting the alginate solution (30–45 min) allowed full hydration and removal of air bubbles, improving sphere formation and surface smoothness.
- Controlled gelation time (35–45 s) ensured formation of a stable membrane while maintaining a liquid core.
- The addition of tomato powder enhanced flavour intensity, addressing the weak sensory profile observed in earlier trials.

White Parmesan Foam

The White Parmesan Foam represents the dairy heritage of Italy — in particular, the aged, granular character of Parmigiano Reggiano, one of the country's most internationally recognised products.
In its conventional form, Parmigiano Reggiano derives its complex flavour from a long maturation process that generates free amino acids (particularly glutamate), short-chain fatty acids (including butyric and propionic acid), and volatile compounds such as diacetyl and acetoin, which contribute buttery and fermented aromatic notes (Fox and McSweeney, 2017).
In this note-by-note formulation, these sensory attributes are reconstructed using commercial cheese and butter flavourings, without the use of any dairy ingredients.
The foam structure is produced using sucrose esters of fatty acids (E473), a class of emulsifiers derived from the esterification of sucrose with fatty acids.
Sucrose esters are highly effective foam-forming and foam-stabilising agents in aqueous systems: they reduce surface tension at the air–water interface, allowing air to be incorporated efficiently under mechanical agitation, and they form a stable interfacial film that resists coalescence and drainage (Nelen and Cooper, 2004).
The result, when blended with high shear, is a light, airy foam with a persistent structure and a strong, clean flavour delivery.
A small amount of sucrose is included to balance sweetness and improve foam stability. The foam must be served immediately upon preparation, as drainage and collapse occur progressively over time in the absence of additional stabilisers.

Ingredients for White Parmesan Foam

Ingredients	Quantity	Description
Water	100g	Tap Water

Ingredients	**Quantity**	**Description**
Sucrose ester	2g	 Special Ingredients Sucrose Ester
Sugar	8g	 Gem Caster Sugar
Parmesan Flavouring	q.s.	Sosa Formatge Tipus Cheddar and Sosa Flavouring N.47 (Butter) 

Method for White Parmesan Foam

- **Step 1:** All ingredients (water, sucrose ester, sugar, and Parmesan flavouring) were combined in a tall mixing container.
- **Step 2:** The mixture was homogenised using an immersion blender for 1–2 minutes to ensure full dispersion of solids and incorporation of air.
- **Step 3:** Blending was continued until a stable, light foam structure was formed with visible aeration.
- **Step 4:** The foam was used immediately after preparation to preserve stability and optimal texture.

Parmigiano Foam – Process Justification

- High-shear blending enabled rapid air incorporation, allowing sucrose esters to stabilise the air–water interface and form a foam structure.
- Immediate use of the foam was required due to rapid drainage and collapse, highlighting the absence of additional stabilising agents.
- The use of flavouring instead of real cheese allowed precise control of flavour intensity but resulted in a more generic “cheesy” profile rather than a specific Parmigiano note.

Figure 1. Final plated prototype of “Italy Experience”: Green Italy Basil Protein Sponge (shaped as Italian peninsula), Blue Sea Fluid Gel, Red Tomato Spheres, and White Parmesan Foam.

Flavour intensity—particularly herbaceous (basil) and tomato notes—represents the primary limitation. Future development should focus on enhancing flavour concentration and retention, while maintaining the structural and aesthetic qualities already achieved.

Nutritional Analysis

The nutritional profile of the dish was estimated based on the composition and quantities of the individual ingredients used. Overall, the plate presents a low energy value of approximately 100 kcal per serving (≈455 g), corresponding to 5% of the Reference Intake (RI) for an average adult (2000 kcal). This reduced caloric content aligns with the objective of developing a dish that minimises energy intake while maintaining sensory impact.

Protein content is relatively significant, at approximately 9.5 g per serving (19% RI), primarily derived from whey protein isolate used in the sponge component. This contributes to the nutritional value of the dish and supports satiety despite the low caloric density. Carbohydrate levels are minimal (≈4.5 g per serving, 2% RI), with sugars accounting for approximately 2.7 g (3% RI), mainly from added sucrose and maltodextrin. Fat content is also low (≈1.5 g per serving, 2% RI), reflecting the limited use of lipid-based ingredients.

Salt content is estimated at approximately 1 g per serving (17% RI), largely originating from sodium chloride and monosodium glutamate used to enhance flavour perception. While this contributes positively to taste intensity, it represents the most significant nutritional consideration in the formulation.

Overall, the dish can be characterised as a low-calorie, moderately high-protein preparation with minimal fat and carbohydrate content. These results demonstrate the potential of note by note cuisine to deliver nutritionally efficient dishes that balance reduced energy intake with targeted flavour design.

	Per 100g	**Per serving (1 plate ≈ 455 g)**
Energy	22 kcal (1% RI)	100 kcal (5% RI)
Fat	0.3 g (<1% RI)	1.5 g (2% RI)
Carbohydrates **Of which sugars**	1.0 g (<1% RI) 0.6 g (<1% RI)	4.5 g (2% RI) 2.7 g (3% RI)
Protein	2.1 g (4% RI)	9.5 g (19% RI)
Salt	0.22 (4% RI)	1.0 g (17% RI)

Table 1. Nutritional Values of “Italy Experience” per 100g and per serving (1 plate ≈ 455 g)

Cost Analysis

A detailed ingredient costing was conducted for one serving of the "Italy Experience" dish, with full data presented in Appendix B. All unit prices were standardised to cost per gram to ensure accuracy and comparability across ingredients.
The total production cost was calculated at **€1.88 per plate**. Despite incorporating specialised functional ingredients — including hydrocolloids, whey protein isolate, and food-grade colourants — their very low inclusion levels meant their individual contributions to the overall cost remained minimal. The highest single line cost was whey protein isolate at €0.65, reflecting its relatively higher unit price rather than excessive quantity.
This outcome supports a key advantage of note-by-note cuisine: targeted sensory properties can be achieved using highly concentrated compounds in small quantities, reducing reliance on expensive bulk raw materials such as fresh dairy, oils, or produce. The result is a cost-efficient formulation that aligns with the project objective of maintaining sensory quality while minimising production expenditure, reinforcing the broader feasibility of note-by-note cooking as a scalable food design strategy.

6. Conclusion

Over four weeks of iterative practical development, the note-by-note dish “Italy Experience” was successfully formulated, trialled, and evaluated, demonstrating the capacity of compound-based cuisine to reconstruct a coherent national culinary identity from functional ingredients and flavouring fractions alone.

The final dish — comprising a basil protein sponge shaped as the Italian peninsula, a mineral blue fluid gel, red tomato spheres, and a white Parmesan foam — achieved high scores for visual presentation and overall acceptability in sensory evaluation, confirming that the conceptual objective of translating Italian geography and gastronomy into a note-by-note format was accomplished.

Technically, the project confirmed both the strengths and the limitations of current note-by-note methods: structural components based on protein–hydrocolloid matrices require careful calibration of water content and processing conditions, while flavour delivery in thermally processed aqueous systems remains a challenge that warrants further research into encapsulation and post-assembly aroma application strategies.

In the broader context of the “*Reduce production costs and time, reduce calories, but maintain flavour.*” theme, “Italy Experience” provides compelling evidence of the nutritional and practical potential of note-by-note cuisine. At approximately 100 kcal per serving — a reduction of approximately 75–85% relative to a conventional equivalent — it demonstrates that high-quality, multi-sensory dining experiences can be delivered at dramatically reduced caloric cost, without sacrificing creativity, cultural resonance, or sensory richness.

As global population growth, food security pressures, and the continuing rise of diet-related illness place increasing demands on food systems, the precision and efficiency of note-by-note cooking offer a genuinely promising contribution to the future of food design, both within professional gastronomy and in the wider context of sustainable, health-conscious food production (This, 2014; World Health Organization, 2024).

References

1. Adrià, F., Soler, J. and Adrià, A. (2006). elBulli 2005: 1846 Recipes. Ecco.
2. Advanced Molecular Gastronomy (TFCS9025) lecture notes. Unpublished teaching material, FIPDes Programme.
3. Belitz, H.-D., Grosch, W. and Schieberle, P. (2009). Food Chemistry. 4th edn. Berlin: Springer.
4. Brady, J. (2013). Introductory Food Chemistry. Ithaca: Cornell University Press.
5. Dickinson, E. (2003). Hydrocolloids at interfaces and the influence on the properties of dispersed systems. Food Hydrocolloids, 17(1), pp. 25–39.
6. Dovey, T.M., Staples, P.A., Gibson, E.L. and Halford, J.C.G. (2008). Food neophobia and 'picky/fussy' eating in children: a review. Appetite, 50(2–3), pp. 181–193.
7. Fox, P.F. and McSweeney, P.L.H. (2017). Cheese: Chemistry, Physics and Microbiology. 4th edn. London: Academic Press.
8. Ghebremedhin, M., Seiffert, S. and Vilgis, T.A. (2021). Physics of agarose fluid gels: rheological properties and microstructure. Current Research in Food Science, 4, pp. 436–448.
9. ISO 5492:2008 (2008). Sensory Analysis — Vocabulary. Geneva: International Organization for Standardization.
10. Lawless, H.T. and Heymann, H. (2010). Sensory Evaluation of Food: Principles and Practices. 2nd edn. New York: Springer.
11. Lee, K.Y. and Mooney, D.J. (2012). Alginate: properties and biomedical applications. Progress in Polymer Science, 37(1), pp. 106–126.
12. McClements, D.J. (2015) *Food emulsions: Principles, practices, and techniques*. 3rd edn. Boca Raton: CRC Press.
13. McGee, H. (2004). On Food and Cooking: The Science and Lore of the Kitchen. New York: Scribner.
14. Nelen, V. and Cooper, A. (2004). Sucrose esters. In: Emulsifiers in Food Technology. Oxford: Blackwell, pp. 131–161.
15. Nicolai, T., Britten, M. and Schmitt, C. (2011). β-Lactoglobulin and WPI aggregates: formation, structure and applications. Food Hydrocolloids, 25(8), pp. 1945–1962.
16. Pandya, J.K., Decker, E.A., McClements, D.J. and Bhatt, S. (2022). Agar-based food hydrocolloids. In: Handbook of Hydrocolloids. 3rd edn. Cambridge: Woodhead Publishing, pp. 751–773.
17. Phillips, G.O. and Williams, P.A. (2009). Handbook of Hydrocolloids. 2nd edn. Cambridge: Woodhead Publishing.
18. Spence, C. (2015). Multisensory flavor perception. Cell, 161(1), pp. 24–35.
19. Spence, C., Okajima, K., Cheok, A.D., Petit, O. and Michel, C. (2014). Eating with our eyes: from visual hunger to digital satiation. Brain and Cognition, 90, pp. 53–63.
20. Sworn, G. (2009). Xanthan gum. In: Handbook of Hydrocolloids. 2nd edn. Cambridge: Woodhead Publishing, pp. 186–203.
21. Szczesniak, A.S. (2002). Texture is a sensory property. Food Quality and Preference, 13(4), pp. 215–225.

22. Taylor, A.J. and Linforth, R.S.T. (2010). Food Flavour Technology. 2nd edn. Oxford: Wiley-Blackwell.
23. This, H. (2006). Molecular Gastronomy: Exploring the Science of Flavor. New York: Columbia University Press.
24. This, H. (2013). Note-by-Note Cooking: The Future of Food. Translated by M. DeBevoise. New York: Columbia University Press.
25. This, H. (2014). Note-by-Note Cooking: The Future of Food. New York: Columbia University Press.
26. Tieman, D., Zhu, G., Resende, M.F.R., Lin, T., Nguyen, C., Bies, D., Rambla, J.L., Beltran, K.S.O., Taylor, M., Zhang, B., Ikeda, H., Liu, Z., Fisher, J., Zemach, I., Monforte, A., Zamir, D., Granell, A., Kirst, M., Huang, S. and Klee, H. (2017). A chemical genetic roadmap to improved tomato flavor. Science, 355(6323), pp. 391–394.
27. United Nations (2024). World Population Prospects 2024. New York: UN Department of Economic and Social Affairs.
28. World Health Organization (2024). Obesity and Overweight. Available at: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight [Accessed 3 May 2026].
29. Yamaguchi, S. and Ninomiya, K. (2000). Umami and food palatability. Journal of Nutrition, 130(4), pp. 921S–926S.