The Compound Game by Lucia Vianne Horstmann

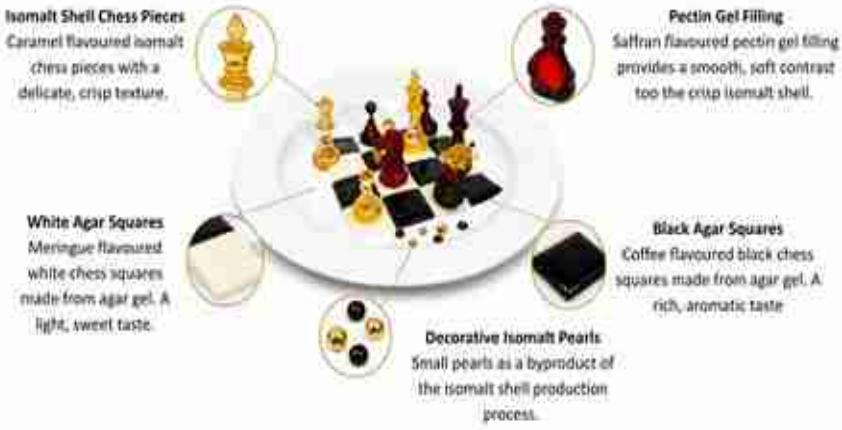
MATERIALS AND METHODS

CONCEPT OVERVIEW

The Compound Game is designed as a shared dessert experience for two. The edible chess set is presented in the centre of the table, inviting both guests to play with and consume the dish together – mirroring the social nature of chess itself. One serving, therefore, comprises the full chess set (8 white squares, 8 black squares, and 8 chess pieces), shared between two people. All nutritional values are reported per person (½ of the total dish). The dish comprises four distinct components: white agar gel squares, black agar gel squares, isomalt shell chess pieces, and a soft pectin gel filling. Each component is differentiated by flavour and colour through the selection of individual aroma and colouring compounds, creating a dish that is visually striking, texturally contrasting, and substantially reduced in both caloric content and sugar compared to a conventionally prepared equivalent. Nutritional analysis via Nutritics demonstrates 197 kcal per person, with a sugar content of 5.1g – compared to 308 kcal and 69.4g of sugar per person in the conventional sucrose-based equivalent at equivalent serving size. This represents a 93% reduction in sugar content and a 36% reduction in calories, achieved through the use of erythritol (E968) and isomalt (E953) as NbN-compliant sugar replacers.

Table 1. Concept overview – The Compound Game: components, techniques, flavour profiles, caloric content and cost per serving

Element	Technique	Flavour Profile	Colour	Kcal	Cost (€)
White Squares (×8)	Agar gel – silicone chess board mould	Meringue – Sosa Aroma	Opaque white (Special Ingredients Everest powder)	~3 kcal	~€0.49
Black Squares (×8)	Agar gel – silicone chess board mould	Coffee – Sosa Coffee Aroma	Black (Activated charcoal E153)	~3 kcal	~€0.4
Chess Pieces – shell (×8)	Isomalt hot-melt casting at 160°C	Caramel – Sosa Aroma	Transparent golden amber	~186 kcal	~€1.19
Chess Pieces – filling	Pectin gel, piped into isomalt shell	Saffron – Sosa aroma	Red (Mallard Ferrière Laque Rouge E124)	~5 kcal	~€0.57
TOTAL (per serving)				**~197 kcal**	**~€2.67**



WHITE SQUARES – MERINGUE AGAR GEL

The white squares are formed as agar gel tiles flavoured with Sosa Meringue Aroma and sweetened with erythritol (E968). Agar (E406) is dissolved in water and set in a silicone chessboard mould to produce firm yet slightly elastic tiles with a clean, ivory-white appearance. The meringue aroma imparts a soft, vanilla-cream character that contrasts with the bitter coffee flavour of the black squares. Erythritol replaces sucrose as the sweetener, reducing the caloric contribution of this component to near zero while preserving mouthfeel.

Figure 2. White gel squares on the silicone chess board mould

Equipment

- Digital weighing scales (0.01 g precision)
- Heavy-bottomed stainless steel saucepan
- Refrigerator
- Whisk, spatula, mixing bowls

Ingredients

Table 2. Ingredients – White Squares (Meringue Agar Gel)

Ingredient / Compound	Function	Qty	Unit	E-No / CAS
Agar-agar powder – En Place (E406)	Gelling agent – thermoreversible cold-set gel	1.5	g	E406
Water (distilled)	Solvent / dispersion medium	100	ml	—
Sosa Meringue Aroma (50g)	Primary aroma compound – meringue / vanilla-cream profile	10	drops	—
Special Ingredients Everest White Colouring Powder	Whitening agent – TiO_2-free white opacifier	0.5	g	—
Erythritol – Pura Vie	Zero-calorie sweetener; NbN-compliant bulking agent; ~0.2 kcal/g	20	g	E968

Figure 5. Ingredients used for black agar squares.

4.3.3 Method

- Disperse 1.5 g agar and 0.5 g bamboo charcoal powder in 100 ml of cold distilled water. Whisk thoroughly until charcoal is evenly distributed.
- Heat to 90°C with continuous stirring until agar is fully dissolved (~3 minutes). Solution will appear jet black.
- Cool solution to 70°C.
- Add 20 g erythritol (Pura Vie) and 0.05 g NaCl. Stir until dissolved.
- Add coffee extract. Mix well.
- Pour directly into the silicone chess board square mould cavities.
- Refrigerate for 20 minutes until fully set.
- Unmold by gently flexing the silicone. Store refrigerated until assembly.

Storage: refrigerate in airtight container; consume within 48 hours.

CHESS PIECES – ISOMALT SHELL

The chess pieces are a two-component structure: a thin, rigid outer shell of hot-cast isomalt (E953) enclosing a soft, yielding pectin gel filling. The shell is produced by melting an isomalt–fondant blend and casting it directly into 3D one-piece silicone chess piece moulds. Two colour variants are produced in separate batches — pale golden pieces cast at 160°C and deep amber-brown pieces at approximately 175–180°C, exploiting controlled thermal browning as an NbN-compliant colouring technique. The interplay of textures — the snap of the isomalt shell against the yielding gel interior — is a central design feature of the dish.

Figure 8. Isomalt chess pieces – two colour variants side by side: pale golden (~160°C, left) and deeper amber (~170°C+, right). Both cast as knight pieces. The colour differential was engaged as a design feature to differentiate the two chess piece sets.

Equipment

- Digital weighing scales (0.01 g precision)
- Calibrated sugar/candy thermometer
- Heavy-bottomed stainless steel saucepan
- Silicone chess mould - AKOLAFE Chess Board Resin Mould, 16-piece (Amazon.ie, €18.69)
- Silpat mat (for draining excess isomalt - hollow shell technique)
- Piping bag or syringe (for pectin filling)

Ingredients

Table 4. Ingredients – Chess Pieces (Isomalt Shell)

Ingredient / Compound	Function	Qty	Unit	E-No / CAS
Isomalt (E953)	Casting base – transparent glass-like structure; ~2 kcal/g	150	g	E953
Fondant – Ingave Fondant Blanc Pâtissier	Assists flow and mould detail; reduces brittleness	100	g	—
Caramel Flavouring – Sosa Caramel Aroma	Aroma – add off-heat at ~140°C; per supplier dosage	per spec	ml	—

Figure 3. Ingredients used for the chess pieces.

Method

- Combine isomalt (150 g) and fondant (100 g) in a heavy-bottomed saucepan.
- Heat over medium flame, stirring until isomalt is fully dissolved.
- Increase heat. Cook without stirring until isomalt reaches 160°C (sugar thermometer).
- Remove from heat. Allow bubbles to subside (~1 min).
- Cool to ~140°C. Add NaCl (0.2 g) and caramel flavouring (per supplier dosage). Stir gently.
- Working quickly, pour into the silicone chess piece mould cavities.
- Immediately invert the mould over a Silpat mat – allow excess isomalt to drain for 10–15 seconds. A thin shell (~1–2 mm) will remain adhered to the mould walls.
- Set the mould upright. Allow to cool at room temperature for 10 minutes. Do not refrigerate (thermal shock cracks the shell).
- Leave open for Part 2 – pectin filling.

Colour differentiation: To produce the two colour variants required for the final dish (4 pale golden pieces + 4 amber-brown pieces), two separate batches are cast at slightly different temperatures. The pale golden set is cast at the target temperature of 160°C and removed from the heat immediately. The amber-brown set is cast from a batch heated to approximately 175–180°C, producing a visibly deeper amber-brown colouration through thermally induced browning reactions at elevated temperature (Sengar and Sharma, 2014; Quintas et al., 2007; Cammenga and Zielasko, 1996). As discussed in Section 5.3.2, thermal decomposition of isomalt occurs significantly above this temperature range; the colour change is therefore attributed to early-stage browning rather than bulk decomposition. This higher-temperature batch was also found to be more fluid at the time of casting, flowing more readily into fine mould details and producing sharper definition in the chess piece features than the standard batch. Both batches are otherwise processed identically.

CHESS PIECES – PECTIN GEL FILLING The pectin gel filling serves both textural and visual functions within the chess piece. Amidated pectin (E440) is dissolved in water with erythritol (E968) and activated by citric acid (E330) at low pH to produce a soft, thermoreversible gel that melts on the palate. Sosa Saffron Natural Aroma provides a warm, floral-spiced flavour note, while Mallard Ferrière Laque Rouge Fraise (E124) gives the filling its vivid red colour. The filling temperature must remain below 65°C when introduced to the shell to prevent thermal deformation of the isomalt (Cammenga and Zielasko, 1996).

Figure 8: Pectin Gel Filling in Isomalt Shell

Equipment

- Weighing scales (0.01 g resolution)
- Small saucepan (stainless steel)
- Whisk
- Syringe or piping bag with narrow nozzle (for filling shell cavities)
- Refrigerator (for setting)

Ingredients

Table 5. Ingredients – Chess Pieces (Pectin Gel Filling)

Ingredient / Compound	Function	Qty	Unit	E-No / CAS
Water (distilled)	Continuous phase / solvent	60	ml	—
Yellow pectin HM – Sosa (E440)	Primary gelling agent – soft gel core	1.0	g	E440
Erythritol – Pura Vie (E968)	Sweetener / co-solute	45	g	E968
Citric acid (E330)	pH reduction for pectin activation; acid note	0.2	g	E330
Saffron aroma (liquid) – Sosa	Flavour – per supplier dosage	0.3–0.5	g	
Laque Rouge Fraise – Mallard Ferrière (E124)	Red colourant – visual contrast within shell	max 0.05	g/kg	E124

EU HYPERACTIVITY ADVISORY

Laque Rouge Fraise (E124, Ponceau 4R) carries a mandatory EU hyperactivity warning under Regulation (EC) No 1333/2008, Annex V (European Parliament and Council, 2008): "may have an adverse effect on activity and attention in children" (McCann et al., 2007). This must be declared on the final dish. Maximum permitted dosage: 0.05 g/kg.

Figure 9. Ingredients used for pectin gel filling

Method

- Combine erythritol and pectin as a dry premix in a small bowl to prevent lumping.
- Heat 60 ml of distilled water to a gentle simmer.
- While whisking, slowly sprinkle the erythritol-pectin premix into the simmering water in a thin stream.
- Continue whisking at a gentle simmer for 1 minute until pectin is fully hydrated.
- Remove from heat. Add citric acid (0.2 g) and stir – this activates pectin gelation.
- Add aroma compounds and Laque Rouge Fraise (E124) at a maximum of 0.05 g/kg. Stir to combine.
- Allow to cool to 38–40°C – still pourable but beginning to set.
- Using a piping bag or syringe, fill each isomalt shell cavity to the rim.

ASSEMBLY

Figure 10. The Compound Game – fully assembled: 8 white + 8 black agar gel squares (16 squares total, 4×2 per colour in a checkerboard pattern) with 8 isomalt chess pieces – 4 pale golden and 4 deep amber-brown (pectin-filled).

Remove gel squares from the refrigerator and isomalt chess pieces from storage. Allow gel squares to reach room temperature for 5 minutes. On a white plate, arrange alternating white and black gel squares in a checkerboard pattern (16 squares total – 8 white, 8 black). Position 4 pale golden isomalt pieces on the white squares and 4 amber-brown pieces on the black squares, or arrange freely for maximum visual contrast. The decorative pearls are a by-product of the isomalt shell casting process, which are scattered around the board for a colour-coordinated garnish. Pro tip: arrange taller pieces (King, Queen) towards the back and smaller pieces towards the front for best visual depth. The dish should be served promptly after assembly: the pectin gel filling inside the isomalt chess pieces retains moisture, which over time may migrate outward and soften the surface of the agar gel squares, compromising both texture and visual presentation.

Table 6. Nutritional comparison – Note by Note vs. conventional equivalent (per 100g)

	The Compound Game (NbN)	Conventional Equivalent
Energy (kcal/100g)	176 kcal	275 kcal
Sugars (per 100g)	4.6 g	62g
Fat (per 100g)	1.7 g	1.7g
Nutri-Score	C	D
HFSS Status	Pass	Restrictions apply

5.2 COST ANALYSIS

The cost per shared dish is approximately €2.67 based on confirmed KitMan order prices. The dominant cost driver is the isomalt shell at ~€2.39 per batch of 16 pieces, reflecting the cost premium of Note by Note methodology for this element. For comparison, an equivalent conventionally prepared dish – sucrose-based agar gel squares with a sucrose caramel shell – is estimated at approximately €1.20 per shared dish using standard supermarket ingredient prices, suggesting that the Note by Note version carries a cost premium of approximately 120% relative to its conventional equivalent. This premium is attributable almost entirely to the substitution of sucrose with isomalt (E953) and erythritol (E968), both of which command significantly higher market prices than sucrose despite their functional and nutritional advantages. Nevertheless, at €2.67 per shared dish, The Compound Game remains within a commercially viable price range for a premium dessert experience, directly addressing the competition theme of cost-conscious Note by Note cuisine.

CONCLUSIONS

A note-by-note edible chess set was successfully designed and produced over four laboratory sessions. The dish comprises four elements – white meringue agar squares, black coffee agar squares, transparent isomalt chess piece shells and a red pectin gel filling – all constructed exclusively from molecular compounds compliant with EU Regulation (EC) No 1333/2008. The dish demonstrates measurable reductions in both calories and production cost compared to a conventional equivalent. The defined serving (8 white squares, 8 black squares, and 8 isomalt chess pieces with pectin filling (4 pale golden, 4 amber-brown)) contains approximately 176 kcal and costs approximately €2.67 in confirmed ingredient costs, with assembly achievable in under 10 minutes post-preparation – directly fulfilling the contest theme of reducing calories, costs, and time while maintaining flavour. The key technical decisions of the project – the use of isomalt hot-melt casting in place of sucrose caramelisation, the adoption of erythritol as the universal sweetener across all elements, the selection of Sosa Meringue Aroma for the white squares after a four-trial optimisation, and the confirmation of 0.5 g/100 ml bamboo charcoal as the optimal colourant concentration for the black squares – are each grounded in the iterative laboratory record and supported by peer-reviewed literature. A further design decision emerged from the Week 3 isomalt trials: thermal browning at temperatures above 160°C produced a deep amber-brown colour variant alongside the standard pale golden piece, and this colour differential was deliberately adopted to differentiate the two sets of chess pieces without the use of any additional colourant — an outcome that exemplifies the exploratory character of Note by Note methodology. The project demonstrates that Note by Note cooking, while demanding in terms of regulatory and technical rigour, is capable of producing a visually compelling and

conceptually coherent dish from first principles. The edible chess set realises the aesthetic programme of Note by Note cuisine – visual contrast, multiple textures, and layered aromatic complexity – entirely without recourse to traditional ingredients.

REFERENCES

Armisén, R. and Galatas, F. (2009) Agar. In: Phillips, G.O. and Williams, P.A. eds. Handbook of Hydrocolloids. 2nd ed. Cambridge: Woodhead Publishing, pp. 82–107.

Borde, B. and Cesàro, A. (2001) A DSC study of hydrated sugar alcohols: isomalt. Journal of Thermal Analysis and Calorimetry, 66, pp. 179–195.

Burke, R.M., Danaher, P. and Hurley, D. (2020) Creating bespoke note by note dishes and drinks inspired by traditional foods. Journal of Ethnic Foods, 7(1), p. 33.

Cammenga, H.K. and Zielasko, B. (1996) Thermal behaviour of isomalt. Thermochimica Acta, 271, pp. 149–153. Available at: https://doi.org/10.1016/0040-6031(95)02560-x

EFSA ANS Panel (2017) Re-evaluation of pectin (E 440i) and amidated pectin (E 440ii) as food additives. EFSA Journal, 15(7), e4866.

European Commission (2011) Commission Regulation (EU) No 1129/2011 of 11 November 2011 amending Annex II to

Regulation (EC) No 1333/2008 of the European Parliament and of the Council by establishing a Union list of food additives. Official Journal of the European Union, L295, pp. 1–177.

European Commission (2012) Commission Regulation (EU) No 232/2012 of 16 March 2012 amending Annex II to Regulation (EC) No 1333/2008 as regards the conditions of use and use levels for Quinoline Yellow (E 104), Sunset

Yellow FCF (E 110) and Ponceau 4R (E 124). Official Journal of the European Union, L78, pp. 1–6.

European Parliament and Council (2008) Regulation (EC) No 1333/2008 of the European Parliament and of the Council of 16 December 2008 on food additives. Official Journal of the European Union, L354, pp. 16–33.

European Parliament and Council (2011) Regulation (EU) No 1169/2011 of the European Parliament and of the Council of 25 October 2011 on the provision of food information to consumers. Official Journal of the European Union, L304, pp. 18–63.

Feng, J., Cheng, H., Shi, J., Zhang, Y. and Ye, X. (2023) Coffee melanoidins as emulsion stabilizers. Food Hydrocolloids, 139, p. 108522. Available at: https://doi.org/10.1016/j.foodhyd.2023.108522

Hartel, R.W. and Shastry, A.V. (1991) Sugar crystallization in food products. Critical Reviews in Food Science and Nutrition, 30(1), pp. 49–112. Available at: https://doi.org/10.1080/10408399109527541

Lahrech, K., Safouane, A. and Peyrellasse, J. (2005) Sol state formation and melting of agar gels rheological study. Physica A: Statistical Mechanics and its Applications, 358(1), pp. 205–211. Available at: https://doi.org/10.1016/j.physa.2005.06.022

Illy, E. and Navarini, L. (2011) Neglected food bubbles: the espresso coffee foam. Food Biophysics, 6(3), pp. 335–348. Available at: https://doi.org/10.1007/s11483-011-9220-5

McCann, D., Barrett, A., Cooper, A., Crumpler, D., Dalen, L., Grimshaw, K., Kitchin, E., Lok, K., Porteous, L., Prince, E., Sonuga-Barke, E., Warner, J.O. and Stevenson, J. (2007) Food additives and hyperactive behaviour in 3-year-old and 8/9-year-old children in the community: a randomised, double-blinded, placebo-controlled trial. The Lancet, 370(9598), pp. 1560–1567.

Nadernezhad, A., Ryma, M., Genç, H., Cicha, I., Jüngst, T. and Groll, J. (2021) Melt electrowriting of isomalt for highresolution templating of embedded microchannels. Advanced Materials Technologies, 6(10). Available at: https://doi.org/10.1002/admt.202100221

Nishinari, K. and Fang, Y. (2016) Relation between structure and rheological/thermal properties of agar: a mini-review on the effect of alkali treatment and the role of agaropectin. Food Hydrocolloids, 67, pp. 11–19.

Nunes, F.M., Coimbra, M.A., Duarte, A.C. and Delgadillo, I. (1997) Foamability, foam stability, and chemical composition of espresso coffee as affected by the degree of roast. Journal of Agricultural and Food Chemistry, 45(8), pp. 3238–3243.

Ozcan, O., Yildirim, R.M., Toker, O.S., Akbas, N., Ozulku, G. and Yaman, M. (2019) The effect of invertase concentration on quality parameters of fondant. Journal of Food Science and Technology, 56(9), pp. 4242–4250. Available at: https://doi.org/10.1007/s13197-019-03894-4

Petković, M. (2019) Alternatives for sugar replacement in food technology: formulating and processing key aspects. In: Coldea, T.E. ed. Food Engineering. London: IntechOpen. Available at: https://doi.org/10.5772/intechopen.82251

Quintas, M.A.C., Brandão, T.R.S. and Silva, C.L.M. (2007) Modelling colour changes during the caramelisation reaction. Journal of Food Engineering, 83(4), pp. 483–491. Available at: https://doi.org/10.1016/j.jfoodeng.2007.03.036

Said, N.S., Olawuyi, I.F. and Lee, W.Y. (2023) Pectin hydrogels: gel-forming behaviors, mechanisms, and food applications. Gels, 9(9), p. 732.

Sengar, G. and Sharma, H.K. (2014) Food caramels: a review. Journal of Food Science and Technology, 51(9), pp. 16861696. Available at: https://doi.org/10.1007/s13197-012-0633-z

This, H. (2014) Note-by-Note Cooking: The Future of Food. New York: Columbia University Press.

Zumbé, A., Lee, A. and Storey, D. (2001) Polyols in confectionery: the route to sugar-free, reduced sugar and reduced calorie confectionery. British Journal of Nutrition, 85(S1), pp. S31–S45.

Ziesenitz, S.C. (1996) Basic structure and metabolism of isomalt. In: Grenby, T.H. ed. Advances in Sweeteners. London: Blackie Academic and Professional, pp. 109–133.