CASE STUDY

Topic: Original Concept for a Fortified Fartón Sweet Bun with Upcycled Tiger Nut Pulp from Horchata Production

Team № 6

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I. Executive Summary (150 words)

At the heart of Valencian culinary tradition lies horchata – a refreshing beverage with deep cultural roots, crafted from precious tiger nuts. These nuts not only provide a unique taste but also impress with their richness in fiber, vitamins, and minerals, while being suitable for people with various dietary needs. However, horchata production generates a nutritious pulp that often remains unutilized. The innovative idea of this project is to transform this pulp into a key ingredient for creating a modern, valuable product that meets the growing demand for healthy and sustainable foods. Thus, tradition blends with innovation in a product that combines authentic flavor with a commitment to waste reduction and support for sustainable production. This approach turns a by-product into a resource, enhances nutritional value, and contributes to a circular food economy.

II. Introduction (300 words)

Horchata is a traditional and refreshing beverage from the Valencian Community (Spain), with roots dating back to the 13th century following the arrival of the Arabs in the Iberian Peninsula. This beverage is protected by the “Chufa de Valencia” designation of origin, which guarantees the use of 100% locally grown tiger nuts (also referred as chufas). Tiger nuts (*Cyperus esculentus*, also known as “chufas”) are rich in fiber, unsaturated fats, vitamins C and E, and essential minerals such as iron, phosphorus, and magnesium. Moreover, they are naturally free from lactose, gluten, and cholesterol **(Chufa de Valencia, 2025)**.

Fartón is an elongated, sugar-glazed pastry traditionally consumed by dipping into horchata. They have become a hallmark pairing in Valencian gastronomy, enhancing the sensory appeal of this classic beverage (see **Figure 1**). However, the production of horchata can generate a significant amount of solid byproduct — the grinded pulp remaining after the

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tiger nuts are pressed and filtered. Despite its nutritional potential (high in fiber and residual protein), this pulp is typically discarded or underutilized.

Figure 1. From left to right, this picture shows three fartons (sweet buns), a glass of horchata, and the tiger nuts used to obtain the beverage.

This situation presents both a challenge and an opportunity: From an environmental perspective, the disposal of this byproduct contributes to unnecessary waste. From an innovation standpoint, it represents a valuable raw material that could be reintegrated into the food production cycle as a functional ingredient, supplementing the amount of fibre for instance. This idea aligns with three Sustainable Development Goals (SDGs) :

- **SDG 3**: “Good Health and Well-Being”
- **SDG 9**: “Industry, Innovation and Infrastructure”
- **SDG 12**: “Responsible Consumption and Production”

Therefore, this project aims to develop a sustainable and innovative fartón by incorporating a significant amount of tiger nut pulp into its formulation. This not only valorizes a

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nutrient-rich byproduct but also reduces waste and enhances the pastry's nutritional profile — particularly its fiber and plant-based protein content.

III. Market Analysis:

The target market for this product consists primarily of health-conscious and environmentally aware consumers from Spain who are concerned about food waste and sustainability. It also includes individuals following plant-based diets or those actively seeking locally sourced, eco-friendly food alternatives. These consumers tend to prioritize nutritional value, transparency in sourcing, and products with a reduced environmental footprint. By reshaping this typical Spanish product, we also look to make it more appealing to other regions and countries. The target audience specifically values natural and vegetable beverages, and looks for alternatives sources of fibre. They are drawn to products that combine traditional flavors with high quality and ethical production practices.

This product enters a competitive space alongside other low-sugar, sustainable plant-based beverages such as oat milk, soy milk and almond milk. Current market trends reveal a growing interest in circular economy models, with particular attention to innovative formulations that align with health and environmental goals.

Despite this competition, horchata holds a unique position as a deeply traditional, refreshing, regionally celebrated beverage with strong Mediterranean cultural roots. It remains a highly seasonal product, with peak consumption during the summer months. This seasonal nature, combined with the opportunity to revalorize its byproducts, opens the door for innovative adaptations that align with modern sustainability trends while preserving cultural identity.

IV. Research and Development: (500 words)

To create this new type of fartón with tiger nut pulp, we firstly studied the tiger nut pulp by-product (solid waste) that is left over after making horchata. We wanted to know its composition and how it works in a recipe. To conduct the new formulation incorporating the solid waste, **Table 1** compiles the selected recipe of traditional fartón used as template **(López-Alt, 2022)**.

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Note that the glaze commonly added to the top of fartons is omitted for the formulations of this study.

Table 1. Traditional fartón recipe selected for this work (for 1 serving).

Ingredient	Amount (g)
Water	25
Dry yeast	1.75
Wheat flour	142.50
Sugar	25
Eggs	30
Olive oil	25
Salt	1.25

Next, different recipes using the solid waste were needed to understand the impact of the solid waste addition on fartón properties. Using 2.5%, 5%, 10% and 25% of the pulp to replace some of the wheat flour (**Table 2**) are suggested based on prior studies with coffee cherry pulp for fibre-supplemented bread **(Calvo-Lerma et al., 2021)**. To do so, the dough needs to be

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mixed, let rise, and baked. Although we aimed for high supplementation percentages, we assume the 25% fartón needs to be discarded due to the inability of the dough to rise.

Table 2. Experimental approach to explore the contribution of tiger nut's solid waste to the traditional recipe of fartón.

Experiment	Wheat flour (g)	Solid waste (g)	Substitution (%)
E0 (control)	142.50	0.00	**0**
E1	138.94	3.56	**2.5**
E2	135.38	7.13	**5**
E3	128.25	14.25	**10**
E4	106.88	35.63	**25**

Solid waste used in **Table 2** is presumably required to be grounded in order to facilitate fermentation and rising of the dough. In this step, water contribution of solid waste was not considered to the total moisture of the dough since the pulp lost most of the retained water

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during the grinding process. The output of each experiment was compared with the control (E0) by sensory panels. This sensory can be assessed via 3 different tests :

- **7-point hedonic scale**: to assess the overall acceptability of each sample. Each participant rates the samples with 1 = I dislike it very much; 4 = I neither dislike or like it; 7 = I like it very much.
- **Evaluation of specific attributes** (appearance, odour, taste, texture): to evaluate the effect of the solid waste on the fartón's sensory properties. From 1 (lowest) to 7 (highest).
- **Triangular tests**: to detect whether the tasters sense differences between samples. Two samples are the same, and one is with different formulations.

V. Product Description: (500 words)

As detailed in **Table 3**, the pulp still has a lot of total dietary fiber (TDF; 59.71 g/100 g), composed mainly of insoluble dietary fiber (99.8%), and some protein (1.75 g/100 g) and fat (8.85 g/100 g) **(2)**. This makes it interesting as a healthy ingredient.

Table 3. Proximate composition of tiger nut's solid waste, tiger nuts, and horchata (adapted from **Codina-Torrella et al., 2009**).

	Tiger nut (g /100 g fresh weight)	**Solid waste** (g /100 g fresh weight)	**Solid waste vs. Tiger nuts contents** (%)
Moisture	6.72	61.23	**+811.46%**
Protein	5.05	1.75	**−65.35%**
Fat	24.50	8.85	**−63.88%**
Ash	0.25	0.99	**−30.77%**
TDF	10.30	59.71	**+480.68%**

TDF: total dietary fiber.

Although the TDF content is low, this solid waste exhibits high water-holding and oil-holding capacities in contrast to other dietary fibre sources (*e.g.*, chia fibrous fraction, coconut fibre, orange by-products, etc.), therefore its addition as a supplement may be of interest in

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fartón and other products. In fact, this supplementation has been studied in several meat products, showing that additions of 5.0 and 7.5% of solid waste to Spanish chorizo did not alter its traditional characteristics **(Domínguez et al., 2014)**. Furthermore, its color parameters (high *L** value, and low *a** and *b** values) implied that its incorporation would not greatly alter the yellowness of meat products, so its addition to fartón would be possible without altering the final product's color.

The sensory panel, composed of 50 people, tasted all versions without knowing which was which. According to a similar study with coffee cherry pulp in bread, we estimate the best performing formulation is the **5% solid waste formulation**, as this was the highest amount of pulp that could be incorporated without disturbing the tasters' preferences.

The final recipe is: 25 g of water, 1.75 g of dry yeast, 135.38 g of wheat flour, 7.13 g of solid waste, 25 g of sugar, 30 g of eggs, 25 g of olive oil, and 1.25 g of salt. Approximate nutritional values (per total batch): ~865 kcal energy, ~18.5 g protein, ~30.0 g fat (of which saturates ~4.4 g), ~129.2 g carbohydrates (of which sugars ~28.6 g), ~4.3 g fibre, ~1.25 g salt.

The final product is healthier and more sustainable, and still tastes good. We believe it is a good example of how we can reuse food waste and make new, modern products that still keep our traditions.

VI. Marketing and Promotion: (300 words)

The marketing strategy for the fartón enriched with tiger nut pulp focuses on combining traditional values with sustainability and nutritional innovation. The product targets environmentally conscious and health-aware consumers who seek functional foods aligned with plant-based and circular economy principles.

Branding could highlight both cultural heritage and eco-innovation. The product could be marketed as a modern reinterpretation of the traditional horchata-fartón pairing, emphasizing the use of an upcycled ingredient. The visual identity could incorporate Mediterranean elements with a clean, contemporary design to appeal to a wide audience.

Packaging could be sustainable, using recyclable or compostable materials to reinforce the environmental narrative. The labeling could include nutritional and sustainability claims such as “high in fiber,” “plant-based,” and “made with upcycled tiger nut pulp.” A QR code on the

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package could link to educational content about the origin of the ingredients, the horchata production process, and the valorization of food byproducts.

The pricing strategy could position the product within the premium segment, justified by its functional and sustainable qualities. The estimated price range for the horchata-fartón combination is €4.90–€6.50, with individual items priced around €2.90.

Distribution could be focused on organic and specialty food retailers, sustainable e-commerce platforms, and local markets, with emphasis on regional and summer-season availability. Select cafés and culinary stores could also be targeted for placement.

Promotion could combine digital outreach and experiential marketing. Online campaigns could involve collaborations with influencers focused on sustainability and nutrition, while in-store tastings, pop-up events, and partnerships with educational institutions could reinforce consumer engagement and awareness of the product's sustainable innovation.

This strategy supports the product's positioning as both a nutritious food innovation and a practical example of circular economy application in gastronomy.

VII. Financial Analysis: (300 words)

The financial viability of the fartón product was assessed through the key production costs including raw ingredients (wheat flour, tiger nut pulp, eggs, oil, sugar), labor, packaging, energy, and logistics. Incorporating tiger nut pulp — a byproduct from horchata production — reduces raw material costs, as this ingredient is typically discarded and requires minimal post-processing.

On average, the cost of manufacturing one unit (a set of three fartóns with horchata) is estimated at €2.10, including ingredients, sustainable packaging, and distribution. Fixed costs (equipment, licensing, development) for the initial year are projected at €20,000, with variable costs scaling with output. The project anticipates a break-even point after the sale of approximately 8,000 units, considering a projected retail price of €4.90 to €6.50 per unit depending on distribution channel and region.

Market research suggests strong seasonal demand for horchata and increasing consumer interest in sustainable, functional food products. Assuming modest market

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penetration within regional organic retailers, cafés, and local markets, the first-year sales volume is estimated at 15,000 units, generating between €73,500 and €97,500 in revenue.

With production costs around €31,500 for 15,000 units and accounting for fixed expenses, the net profit is estimated between €22,000 and €46,000, yielding a return on investment (ROI) ranging from 110% to 230% by the end of the first year.

This analysis indicates a promising financial outlook, particularly due to the low cost of upcycled ingredients and the premium consumers are willing to pay for sustainable and health-oriented products. Further scalability and brand development may significantly enhance profitability in future phases of commercialization.

VIII. Challenges and Risks: (200 words)

The development and commercialization of the sustainable fartón enriched with tiger nut pulp presents several challenges and potential risks. One primary concern is consumer acceptance, particularly regarding texture and flavor changes due to the incorporation of pulp.

Another risk is related to the seasonality of horchata consumption, which may limit demand outside the summer months. This could impact consistent sales and distribution throughout the year. Additionally, sourcing and standardizing the pulp from horchata producers may present logistical difficulties, particularly in ensuring quality and safety across batches.

From a business perspective, entering a competitive plant-based snack market may require significant branding and promotional investment to differentiate the product effectively. There is also a risk of regulatory hurdles, particularly concerning labeling claims and novel ingredient approval in export markets.

To mitigate these risks, the project could implement seasonal product bundling strategies, expand distribution to cafés and eco-stores beyond summer, and establish agreements with certified horchata producers to secure a consistent pulp supply. Continuous

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sensory testing and consumer feedback could inform iterative improvements in formulation and communication strategies.

XI. Internationalization strategy (max. 250 words)

The upcycled tiger nut fartón has limited potential for international expansion, although particularly interesting across Mediterranean and European markets where sustainability and functional foods are growing trends, and the weather tends to encourage the consumption of refreshing products. Scaling the product beyond Spain would require collaboration with local distributors and adaptation to regional consumer preferences while maintaining the brand's core identity rooted in Valencian tradition and circular economy values.

Cultural and dietary considerations are key. The product's plant-based composition and absence of lactose and animal fats make it suitable for diverse consumers, including vegetarians, vegans, and individuals following halal or kosher diets, pending appropriate certification. Packaging and communication should emphasize these attributes and the sustainable origin of the tiger nut pulp, resonating with global eco-conscious audiences.

Regulatory requirements vary by region and must be addressed early. In the European Union, compliance with Regulation (EU) 1169/2011 on food information to consumers is essential, especially regarding allergen labeling and claims like "high in fiber" or "made with upcycled ingredients." For export to markets such as the United Kingdom or North America, labeling adjustments and additional quality certifications (e.g., organic, non-GMO, or sustainability seals) may be necessary.

Finally, adapting the product's format and marketing, such as offering smaller snack versions or pairing with local beverages, could facilitate entry into cafés and specialty retailers, positioning the fartón as a symbol of sustainable Mediterranean innovation with global appeal.

XII. Sustainability impact (max. 300 words)

Sustainability is the core of the fortified fartón concept, as it transforms a food byproduct (tiger nut pulp) into a valuable ingredient, directly reducing waste from horchata production. By

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reintroducing this nutrient-rich material into the food chain, the product supports circular economy principles and minimizes environmental burden associated with waste disposal.

The environmental impact across the product's lifecycle is carefully considered. Ingredient sourcing needs to prioritize local tiger nuts from the Valencian Community, minimizing transportation-related emissions and supporting regional farmers. The substitution of part of the wheat flour with upcycled tiger nut pulp not only reduces agricultural resource demand but also decreases the overall carbon and water footprint of the formulation. As the product is fully plant-based, its environmental impact is considerably lower than equivalent animal-based bakery goods.

Packaging is designed with sustainability in mind, using recyclable or compostable materials that align with eco-friendly branding. Lightweight designs help reduce transport emissions, and the inclusion of QR codes minimizes the need for printed promotional materials while educating consumers on the product's environmental benefits.

Further sustainability improvements could involve optimizing production efficiency and implementing renewable energy sources in bakeries. Establishing partnerships with local horchata producers ensures a steady, low-impact supply chain, while exploring carbon footprint certifications or environmental product declarations could strengthen consumer trust.

Overall, the upcycled fartón demonstrates how traditional foods can be reimagined through sustainable innovation, reducing waste, conserving resources, and contributing to the broader goals of responsible production and consumption (SDG 12), good health and well-being (SDG 3), and industry innovation (SDG 9).

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XV. Conclusion: (150 words)

The study demonstrated that adding 5% tiger nut pulp to fartón can increase fiber content more than fivefold (59.7 g/100 g) without compromising taste or texture. Financial analysis forecasts a return on investment (ROI) of 110–230% with sales exceeding 15,000 units. The product reduces food waste and contributes to achieving SDGs 3, 9, and 12. In this research we emphasized tradition and eco-innovation and we obtained an organic/vegan product. Certification, using QR codes to share ingredient origins, and building a recognizable brand targeting health-conscious and environmentally engaged consumers, are the next step.

XVI. References and Appendices (up to 20 references)

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xx. Digital and technological integration (max. 250 words)

The integration of digital tools plays a central role in the development and promotion of our sustainable horchata. From the earliest stages of design, the use of AI to analyse market data helps identify consumer trends related to plant-based beverages, sustainability and circular economy products. This data guides decisions on formulation, packaging and market positioning, ensuring optimal alignment with modern consumer expectations.

On the marketing side, each bottle features a smart QR code that links to an interactive and engaging platform. Consumers can discover the origin of the ingredients, the production process, nutritional values, as well as the story behind the project and its environmental commitment. This transparency builds trust and transforms each purchase into a meaningful and educational experience.

In addition, digital traceability enables comprehensive product tracking from harvest to distribution, while monitoring key sustainability indicators such as waste reduction and carbon footprint in real time.

Our digital-first strategy encompasses social media storytelling, influencer collaborations, and immersive content campaigns that highlight our mission to blend tradition and innovation. These tools help us build an active and loyal community of conscious consumers who share our values of health, authenticity, and sustainability.

Finally, the distribution strategy relies on integrated digital channels, including e-commerce and delivery partnerships, offering convenience, personalisation and connection.

Technology is becoming a key driver of transparency, engagement and impact in the modern horchata and fartón experience.

xx. Make a consumer communication plan (max. 250 words)

Our communication strategy aims to connect consumers emotionally and intellectually with our innovative horchata & farton concept — a product that fuses Spanish tradition with modern sustainability. The visual and textual communication will emphasize three key pillars: authentic taste, health benefits, and environmental responsibility.

Visually, the brand identity will combine natural, earthy tones with clean and modern design elements to reflect the purity and freshness of the ingredients. The packaging will highlight the product's eco-friendly approach and its origin story, reinforced through a recognizable logo that symbolizes both heritage and innovation. QR codes on the labels will lead consumers to digital storytelling content — short videos, recipes, and behind-the-scenes clips — showing how the product is made and how it helps reduce food waste.

Textually, our message will focus on "Tradition Reinvented Sustainably." Communication materials — including social media campaigns, newsletters, and website content — will educate consumers about the nutritional value of the beverage and its role in promoting a circular food economy. Engaging posts, influencer collaborations, and community events will encourage consumer participation and brand advocacy.

Additionally, our strategy will leverage story-driven advertising and sensory marketing, inviting consumers to experience the flavor, culture, and craftsmanship behind each sip. Partnerships with eco-conscious retailers and cafés will amplify visibility and credibility.

By blending transparency, storytelling, and digital innovation, the campaign builds trust, engagement, and emotional resonance. Ultimately, our communication plan positions horchata & farton as not only a delicious, authentic drink but also a symbol of mindful consumption and sustainable innovation.

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