TUS
Technological University of the Shannon:
Midlands Midwest
Ollscoil Teicneolaíochta na Sionainne:
Lár Tíre Iarthar Láir

Bachelor of Business Honours

Course Id: Business Capstone Project - (AL_BSTUD_B_4)

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Business Capstone Project – Year 4

Group Project – FlavArom International Ltd

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Abstract

This business investigation looks at *Flavarom International Ltd*, a flavour technology company based in Athlone, Ireland, working in the flavours market.

While several market applications for Flavarom's encapsulation technology were considered, this investigation concentrates on the sports nutrition and wellness sectors. These markets emerged as the most promising after a thorough assessment, showing the optimal balance between high growth potential and required investment compared to other alternatives. The report intends to explore how encapsulated flavour technology can overcome key problems found in these specific sectors.

The demand for protein, creatine, and collagen supplements is growing, pushed by trends in sports performance, health, and beauty. However, this growth is often limited by ongoing issues with taste, stability, and the use of artificial additives.

The study assesses how encapsulation methods – like spray drying, lipid-based encapsulation, and microencapsulation – address these problems. By protecting sensitive flavours, masking unpleasant aftertastes, such as the bitterness in creatine monohydrate, and improving solubility and shelf-life, encapsulated flavours make cleaner product formulations and better sensory experiences possible. Industry analysis and scientific evaluation show that these technologies improve flavour release, texture, and mixability, and they also align with clean-label trends.

Key findings highlight reduced reliance on artificial sweeteners, better heat and pH stability in ready-to-drink (RTD) beverages, and consistency in collagen products during storage. Strategic recommendations include forming partnerships with supplement brands to integrate this encapsulation technology, prioritising a clean-label market position, and a market expansion phased strategy.

For Flavarom Ltd, this represents a viable path to innovate within the sports nutrition market. It meets consumer preferences for natural ingredients and can drive growth in the rapidly evolving wellness sector.

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1. Introduction

This business strategy report has been prepared specifically on behalf of FlavArom, an Irish flavour innovation company specialising in the development of natural, clean-label flavour solutions for the food, beverage, and nutrition industries. This investigation prioritises the commercial application of FlavArom's expertise, focusing on sensory enhancement and technical formulation support for brands seeking to improve taste, stability, and consumer appeal in health-focused product categories.

Following an initial evaluation of potential applications for the company's technology, the primary commercial opportunity explored in this project was identified within the growing sports supplement market, specifically targeting protein, creatine, and collagen-based products.

While FlavArom's technology has potential applications across various food and beverage sectors, the supplement market was strategically selected following an analysis of market opportunity versus investment requirements. Factors favouring this focus include the sector's significant growth trajectory, consumer-facing challenges with taste and stability that align directly with encapsulation benefits, and the potential for FlavArom to establish a strong competitive position**.** These supplement categories have seen rapid global growth, fuelled by rising consumer awareness of health, wellness, and performance (see Figure 1 and Figure 2).

Figure 1. Global Protein Supplement Market | Source: Mordor Intelligence Research & Advisory. (2024, June). Protein Supplements Market Size & Share Analysis - Growth Trends & Forecasts (2025 - 2030). Mordor Intelligence

Figure 2. Protein Supplements Market: Forecasted Five-Year Growth Rate, By Region | Source: Protein Supplements Market Size & Share Analysis - Growth Trends & Forecasts (2025 - 2030). Mordor Intelligence

However, widely recognized issues with taste, texture, and ingredient stability remain key barriers to long-term consumer satisfaction and represent a clear commercial pain point encapsulation can address. Encapsulation offers a proven solution mechanism, enhancing flavour, protecting active ingredients, and improving overall product quality and shelf life (Persistence Market Research, 2023). While the science behind encapsulation is well-

established, the key challenge is applying it effectively for commercial success and market adoption.

This project intends to deliver strategic and commercial value by capitalizing on the expanding market opportunity for enhanced-performance sports supplements with superior taste and functionality. For FlavArom, this presents a timely opportunity to apply its flavour expertise and encapsulation technology to a high-growth sector, positioning the company as a potential leader in innovative, science-backed flavour solutions tailored to specific market needs.

The supplements are widely used by athletes, fitness enthusiasts, and individuals seeking to improve muscle recovery, strength, and overall well-being. The shift towards healthier lifestyles and proactive healthcare has driven demand for high-quality, effective, and palatable supplements.

Even with this growth, problems remain regarding taste, texture, and ingredient stability. Supplements, designed to deliver concentrated nutrients or compounds, are frequently offered in powder form for consumer convenience, though this format often presents unique taste and texture challenges.

Many consumers find protein powders chalky, creatine bitter, and collagen supplements can break down over time. For example, research shows protein powders often feel chalky in the mouth because of high protein levels and particles that don't dissolve well, which can make them less acceptable to consumers. Likewise, creatine's natural bitterness, due to its chemical makeup, is known to make it less palatable and discourages regular use for some people (Zhang et al., 2025). Collagen supplements, on the other hand, are prone to degradation, especially with moisture or heat. This leads to off-flavors and makes them less effective, which can discourage people from using them long-term (Gómez-Guillén et al., 2011).

These sensory problems can put people off long-term use, even when the supplements offer real health benefits. Studies looking at why people stop taking supplements emphasize that unpleasant taste and texture are key reasons. The taste and mouthfeel of these products are very important for customer satisfaction and brand loyalty. This makes improving the formulation a major focus for innovation. Market research also confirms that brands spending money on sensory improvements—like masking bitterness or making powders dissolve better—have higher customer retention rates.

Encapsulation technology has emerged as a key solution being adopted in the supplement industry to address these sensory and stability issues. This technique enhances flavour stability, masks undesirable tastes, and can potentially improve the bioavailability of active ingredients. By enclosing flavour compounds and nutrients in protective coatings, encapsulation shields them from oxidation, moisture, and degradation, ensuring longer shelf life and better sensory experiences. This process also enables controlled release, allowing supplements to maintain their intended taste and effectiveness across various applications, including ready-to-drink (RTD) formulations and powder blends. Examples of this technology's application are already present in the market, such as advanced creatine beadlets designed for improved taste and delivery (TrendHunter, 2023), indicating industry adoption.

Encapsulation technology is being already adopted in the supplement industry to enhance stability, mask undesirable tastes, and improve bioavailability. For example, Anabio Technologies has developed a microencapsulation process for creatine that protects the ingredient in liquid and gummy formats (Anabio Technologies Ltd., 2016). Major capsule manufacturers such as Capsugel, Soft Gel Technologies, Qualicaps and Robinson Pharma are innovating with liquid-fill and controlled-release solutions to support a range of nutritional and pharmaceutical applications (Gray, 2019). In addition, companies like Somafina and Catalyst Nutraceuticals are incorporating encapsulation into their production processes to offer consumer-friendly supplement formats with improved sensory profiles (Somafina, 2025)

FlavArom is therefore positioned to potentially capitalise on encapsulation to refine product formulations, focusing on natural, clean-label solutions that align with evolving consumer preferences. This report investigates the potential impact and market opportunity for encapsulated flavours specifically within the protein, creatine, and collagen supplement markets, focusing explicitly on developing strategic options for FlavArom's strategic positioning.

The core objective of this report is to analyse strategic market entry options for FlavArom within the identified supplement sectors and provide actionable recommendations based on market analysis, consumer insights, and the company's capabilities.

The supporting objectives required to achieve this aim are:

- Critically analyse the specific market opportunity for FlavArom, considering its technological capabilities against market needs, consumer preferences, and competitive pressures within the protein, creatine, and collagen supplement sectors.

- Develop a relevant, actionable business strategy proposal, including a phased market entry plan, for FlavArom's potential expansion into these targeted supplement categories.
- Evaluate the scientific basis and proven commercial applications of encapsulation technology in addressing prevalent industry challenges related to taste, stability, and formulation.
- Assess findings from primary consumer research regarding supplement usage patterns, sensory issues encountered, and receptiveness like encapsulation.

To achieve these objectives, this report utilises a mixed-methods approach. Primary research involved an online consumer survey exploring supplement usage habits, sensory preferences, encountered issues with current products, and attitudes towards new flavour technologies. Secondary research incorporated analysis of academic literature on encapsulation science, industry reports detailing market trends and sizes, competitor information and specific company data, including FlavArom's financial context (sourced via Orbis). Analytical frameworks including SWOT, PESTEL, and Competitor Analysis, detailed in the Appendix, guided the secondary research and following analysis.

The scope of this study concentrates on the application and market potential of encapsulated flavours within the protein, creatine, and collagen supplement sectors. It develops a market entry strategy specifically for FlavArom, initially focusing on key European markets before considering subsequent expansion into North American and Asia-Pacific regions. Key limitations primarily relate to the primary survey's sample size and its demographic composition (heavily skewed towards 18–24-year-olds), alongside potential geographic bias in sampling, which necessitates caution when generalising these specific findings to the broader global market. The following sections will detail the findings from this research.

2. Primary Research

This section provides an overview of the "Protein, Creatine & Collagen: Taste & Mixability" survey results, summarising key findings from 83 respondents which was sent out to be answered online, by group members, by The Regional Sports Centre and in the Athlone Chamber of Commerce newsletter. The survey examined consumer demographics, lifestyle habits, supplement usage, sensory experiences, and attitudes towards new flavour technology. The analysis covers respondent profiles, physical activity and nutrition views, supplement usage and purchasing behaviour, sensory feedback, interest in encapsulated flavour technology and spending habits.

2.1 Demographic and Lifestyle Profile of Respondents

Eighty-three individuals participated in the survey. The sample was predominantly adults aged 18-24 (71%). Smaller segments were 25–34 (16%) and 35-44 (9%), with very few over 45. Gender was nearly evenly split (49% male and 48% female). Occupations varied widely, reflecting a diverse sample.

Most respondents engage in regular physical activity at moderate frequency. A majority (56%) exercise 3-5 times per week, about 22% exercise daily, and 17% exercise 1-2 times weekly. Only a tiny fraction rarely or never exercises. This suggests the typical respondent is health-conscious and incorporates exercise into their routine.

2.2 Physical Activity and Views on Nutrition

The vast majority of respondents consider nutrition and supplementation to be important in their lives. Roughly 40% called it “quite important” and 16% rated it “extremely important.” The rest fell between neutral and somewhat important. These results show that most participants value diet and supplements as part of their health and fitness efforts.

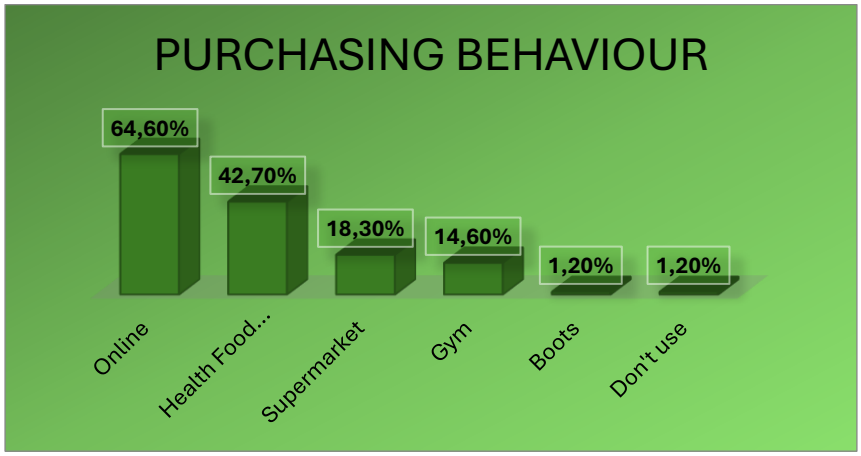
2.3 Supplement Usage Patterns and Purchasing Behaviour

Supplement use was widespread among respondents, with protein powder being the most commonly used product at 74%. 42% use creatine powder, and 12% use collagen powder.

Additionally, 20% consume ready-to-drink protein shakes. Very few use none of these, underscoring that nearly all participants incorporate some type of supplement.

Most have experience with supplements as well. Approximately 65% have been using dietary supplements for more than one year, whereas only 34% are with under six months of use.

In terms of purchasing behaviour, online channels dominate, as can be seen below. These patterns suggest consumers prefer the convenience, variety, and pricing offered online or in specialty stores.



When choosing a supplement, key decision factors include both sensory and nutritional aspects. As will be seen in the next section, taste and flavour emerged as top priorities for many, often ranked as the single most important factor. Mixability was another leading consideration. Nutritional content and price/value were also important, though often secondary to taste and mixability.

2.4 Sensory Feedback: Taste, Mixability, and Texture

Respondents reported notable shortcomings in the sensory qualities of current supplements. The leading issues were poor mixability (44%) and unpleasant taste (38%), followed by chalky or gritty texture (33%) and artificial aftertaste (20%). Only 15% reported no issues at all. Thus, the majority of users have at least one complaint about how their supplement tastes or mixes.

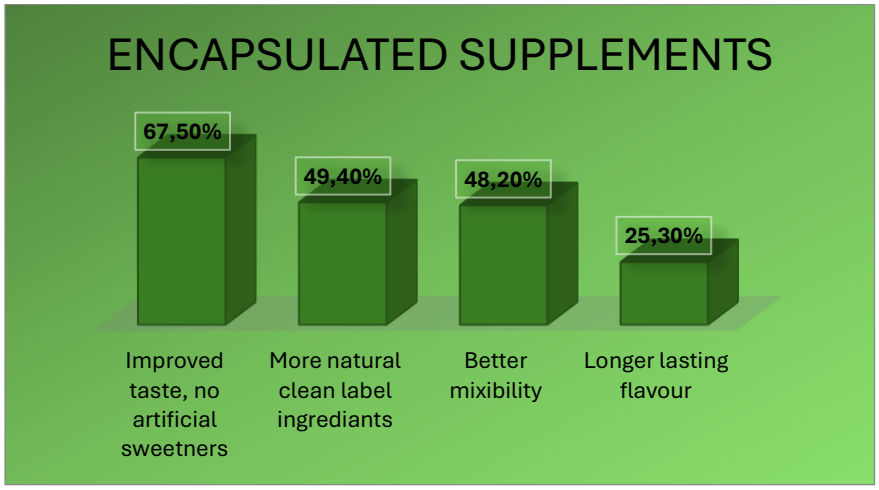
Consistent with these concerns were ratings of supplement taste and mixability. On a 5-point scale, most people rated taste and mixing ability around the middle (3 out of 5). Relatively few gave excellent (5) or very poor (1) ratings. This suggests that while products are generally deemed acceptable, they rarely delight consumers.

The survey also noted acceptable preference for natural ingredients. While 27% of respondents had no preference between natural vs artificial flavourings, those who did express a preference leaned towards natural flavours by 59%. This indicates that cleaner, more natural formulations would be viewed positively, provided they still deliver good taste.

2.5 Interest and willingness to adopt encapsulated flavour technology

Encapsulated flavour technology was a new concept to most respondents. Only about 12% had heard of it before. However, interest in trying supplements with encapsulated flavours was very high once the idea was introduced. Over half of respondents said they would "definitely" or "probably" be more likely to try a product that used encapsulated flavours to enhance taste. This strong openness indicates that consumers are willing to embrace innovative solutions if they promise a better experience.

Participants also identified which potential benefits of encapsulated flavours appealed to them most. These priorities align directly with the issues consumers currently face, suggesting that encapsulation technology addresses the improvements they most want to see.



2.6 Monthly Supplement Spending & Feedback

Monthly spending on supplements among respondents tends to be moderate. Nearly half (49%) spend about €20–€40 per month on supplements, and roughly another quarter (25%) spend €0–€20. About 22% spend under €40 monthly. Thus, most consumers allocate a moderate budget for supplements, and extremely high spending is rare. People are willing to pay for these

products as part of their routine, but they remain price-conscious and look for value within a mid-range budget.

Many respondents called for better mixability, asking for powders that do not clump and that dissolve more smoothly. Improved taste was an equally strong theme, numerous comments requested better flavour, often specifically mentioning a more natural taste and less artificial aftertaste. Some users suggested using natural sweeteners or flavours to achieve this. More flavour variety was also a common request, such as adding new flavours for products (like creatine) that often come in limited or unflavoured options.

Almost all respondents had at least one area they wanted improved, indicating few were completely satisfied. Overall, the open-ended responses underscore a desire for supplements that taste better, mix easier, offer more variety, and remain affordable.

2.7 Summary of findings and limitations

These primary research findings are highly relevant as they directly validate the core problems, such as unpleasant taste, poor mixability, and artificial aftertastes, that encapsulation technology aims to solve withing the target supplement categories. The evident consumer interest in trying encapsulated products and the preference for natural ingredients further underline the market potential for solutions like those FlavArom could offer. However, as mentioned in the introduction, the findings should be carefully interpreted due to the survey sample being heavily weighted towards the 18-24 age group and potential geographic biases. Generalising these preferences to the entire global supplement consumer base requires further validation.

3. Secondary Research

This section leverages secondary research to analyse key trends, technologies, and market dynamics shaping the supplement industry, with a focus on encapsulation science and its applications in protein, creatine, and collagen products. It incorporates market landscape data and contextualises the technical aspects of encapsulation. This section is structured and guided by key analytical frameworks (SWOT, PESTEL, Competitor Analysis), the detailed outputs of which can be found in the Appendices.

3.1 Analysis on SWOT and PESTEL

FlavArom demonstrates strong potential through its advanced technological capabilities, global sourcing strategy, and custom product solutions, supported by Ireland's favourable business environment. However, challenges such as high production costs, supply chain vulnerabilities, and market limitations due to geographic distance remain critical concerns. The PESTEL analysis reinforces these points, highlighting how political stability, economic trends favouring natural ingredients, and advancements in technology create opportunities for growth. At the same time, external threats such as fluctuating raw material prices, regulatory complexities, and environmental factors underline the importance of strategic risk management and adaptability in international markets.

Types of Sports Nutrition Products		
Name of Supplement	**Purpose**	**Picture**
Protein	Builds, maintains, and repairs muscle.	
Creatine	Helps supply muscles with energy for short-term, predominantly anaerobic activity.	

Collagen	Support joints, skin, hair, tendons.	
RTD - Ready-to-Drink	Convenient nutrition on-the-go.	
BCAAs - Branched-chain amino acids.	Can be metabolised by mitochondria in skeletal muscle to provide energy during exercise.	
Pre-Workout	Boost energy, focus, endurance.	
Electrolytes	Maintain fluid balance, prevent cramps.	
Recovery Blends	Full post-workout support.	

Caffeine	Blocks activity of the neuromodulator adenosine; reduces perceived pain and exertion.	
Multivitamins	Fill nutrient gaps.	

3.2 Key Trends

Reading a review on the trends in the sports nutrition industry, some key trends mentioned were clean label products, functional foods and plant sources proteins (sou). These are driven by evolving consumer preferences and growing health awareness. Clean label products are free from preservatives, additives, and artificial ingredients, that undergo minimal processing (source). Consumers have become more knowledgeable about food labels and ingredients (source), leading them to make more mindful purchasing decisions. This growing transparency empowers consumers to choose products aligned with their health and fitness goals. Consumers are moving away from artificial flavours and preservatives in favour of natural alternatives, reflecting a larger shift towards more health-conscious choices (source).

Another trend is the increasing demand for functional foods, which are fortified with specific nutrients to support targeted health goals, including vitamins, fibre, omegas and bacterial cultures (source). Functional foods cater to a wide range of needs, from improving gut health and cognitive function to enhancing muscle recovery, especially in athletes. As they strive to peak performance, they increasingly rely on nutrition that directly addresses their health and fitness needs. The global functional food market is around $168 billion, with an expected CAGR of 8.6% for the following ten years. The market for these products has expanded significantly due to their convenience, holistic benefits, and the ability to offer specialized support for various aspects of athletic health.

The growing popularity of plant-based products is noteworthy. Increasing consumers are turning to plant-based options, driven by ethical and environmental considerations. The current

market for plant-based proteins is around $14.3 billion, with expected CAGR growth of 7.5% to reach $20.5 billion in 2029 (source). Plant proteins have seen significant improvements in both quality and taste, offering a viable and appealing alternative to animal-based proteins, which has been proven to be of equal or higher value. As more world-class athletes including adopt and promote plant-based diets, including Lewis Hamilton and Venus Williams, the trend has gained momentum, further fuelling the demand for plant-based sports nutrition products (source). By observing these key trends, FlavArom can position itself appropriately in the sports supplement market while positioning itself for further growth and success.

3.3 Yeast Encapsulation

Yeast encapsulation refers to the process where flavour molecules are encased within the cell walls of Saccharomyces cerevisiae, commonly known as brewer's yeast (Andrea Gomez-Zavaglia, 2024) (Andrea Gomez- Zavaglia, 2024). Yeast's natural permeability and robust cell wall make it an ideal encapsulation carrier, protecting flavour molecules from degradation, particularly under thermal stress (Sereikaitė, 2021). This stability is crucial for supplements where potency and consistency are paramount. Encapsulation mitigates this problem by ensuring that the flavours remain stable over time by preventing degradation and controlling their release, providing a more consistent and desirable taste experience (Lakkis, 2007).
Yeast encapsulation enhances water dispersibility, a challenge often seen in poorly soluble ingredients like flavourings and antioxidants (Sereikaitė, 2021) for its ability to absorb water fearing ingredients by having a high loading capacity. The goal of flavour encapsulation is not only to enhance taste but also to extend shelf life and improve consumer satisfaction (Lakkis, 2007), particularly in protein, creatine, and collagen products.

One of yeast encapsulation's key advantages is its ability to reduce the need for artificial flavourings and sugar. Their natural encapsulated flavours contain no additives and are available in dry powder form. These flavours consist of 70% active flavour by weight, significantly higher than the typical 30–40% found in conventional product. As a result, up to 75% less flavouring is required in formulations (Nelson, 2003). Additionally, primary research revealed that 59% of respondents prefer natural flavours, while 67.1% cited improved taste, without artificial sweeteners, as a key factor in their preference. This reduction in flavouring usage can lead to healthier formulations with less sugar, benefiting consumers, including those with dietary restrictions such as diabetics.

In addition, yeast encapsulation has broad appeal due to its natural, dairy-free, gluten-free, meat-free, kosher, and halal properties (Gonley, 2017) For the supplement industry, these benefits make yeast encapsulation an attractive option for a wider customer base for products like protein powders, creatine, and collagen supplements. This specific technology appears central to FlavArom's potential differentiation.

3.4 Why Encapsulation is the Solution

Encapsulation technology presents a multifaceted solution to the challenges faced by the supplement industry, especially in terms of flavour enhancement. For products like protein powders, creatine, and collagen supplements, flavour encapsulation enables controlled release during consumption, ensuring optimal flavour impact at critical moments, such as after mixing with liquids. This helps mask undesirable base flavours like bitterness, a common issue with creatine, or earthy tones in plant-based proteins.

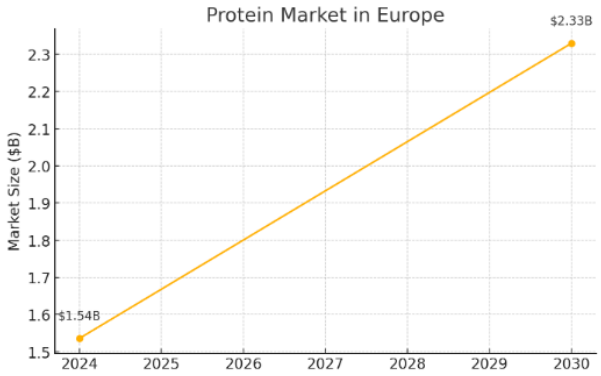
The ability to mask off-flavours is particularly important as many protein sources, especially plant-based ones, contain compounds that consumers find unpleasant. Taste remains perhaps the most significant barrier to consumer acceptance of protein, creatine, and collagen supplements. Many active ingredients inherently possess bitter, chalky, or otherwise unpleasant flavour profiles that can negatively impact the consumption experience as we have mentioned previously. Encapsulated flavours can either physically coat these compounds or provide competing flavours that dominate the sensory experience. This allows formulators to create cleaner taste profiles with minimal flavouring material.

Moreover, encapsulation technologies also improve the solubility and texture of supplements. For flavours using maltodextrins or gums can enhance powder dispersion in liquids, preventing clumping and improving wetting characteristics. These improvements contribute to a more enjoyable consumer experience without the need for additional stabilizers or texturizers. Flavour encapsulation also enhances product versatility by improving solubility, which is an evident problem stated in our primary research.

Encapsulation's versatility allows for broader application across various supplement formats. In powdered supplements, encapsulated flavours maintain stability during storage and ensure controlled release during preparation. In protein or collagen bars, lipid-based encapsulation systems help preserve flavour and improve texture. In ready-to-drink protein shakes or collagen beverages, encapsulation techniques protect flavours during thermal processing while ensuring consistency throughout the product's shelf life.

3.5 Market Landscape

The company's potential market context is characterized by significant growth across its target segments, as detailed in the following section. In Europe, the protein supplement market is valued at $ 1.536 billion in 2024 and is projected to expand to $ 2.33 billion by 2030, representing a Compound Annual Growth Rate (CAGR) of 7.2%.



While animal-based protein currently constitutes the majority share at 58%, plant-based alternatives exhibit a faster growth trend with a 7.7% CAGR. On a global scale, the market is valued at $ 27.28 billion, and projections estimate it will reach $ 52.34 billion by 2033, reflecting a 7.5 % CAGR (GlobeNewswire, 2024). In 2024, the powder formats dominated the market, holding a 56.4 % of market share, although ready-to-drink (RTD) formats are projected to experience the fastest growth rate of approximately 10% during the next 4 years (see Figure 3) (Mordor Intelligence, 2024).

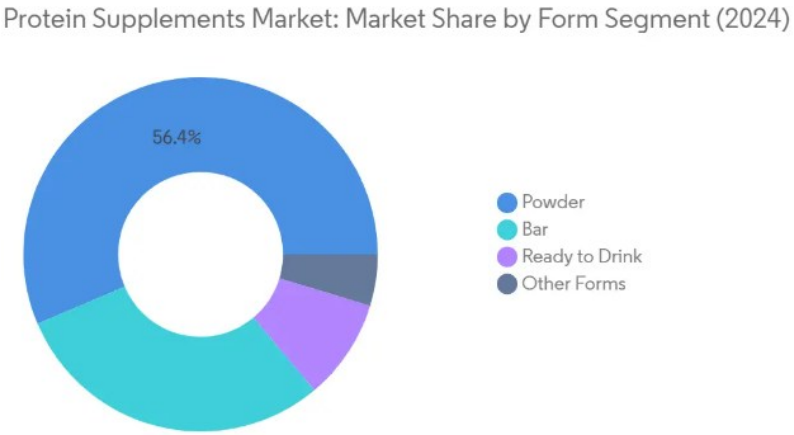
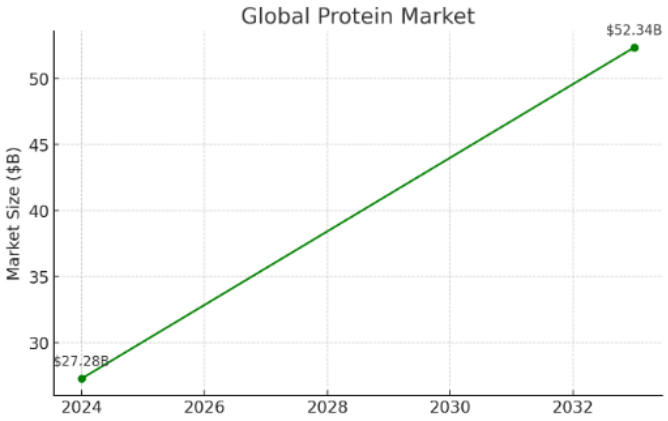
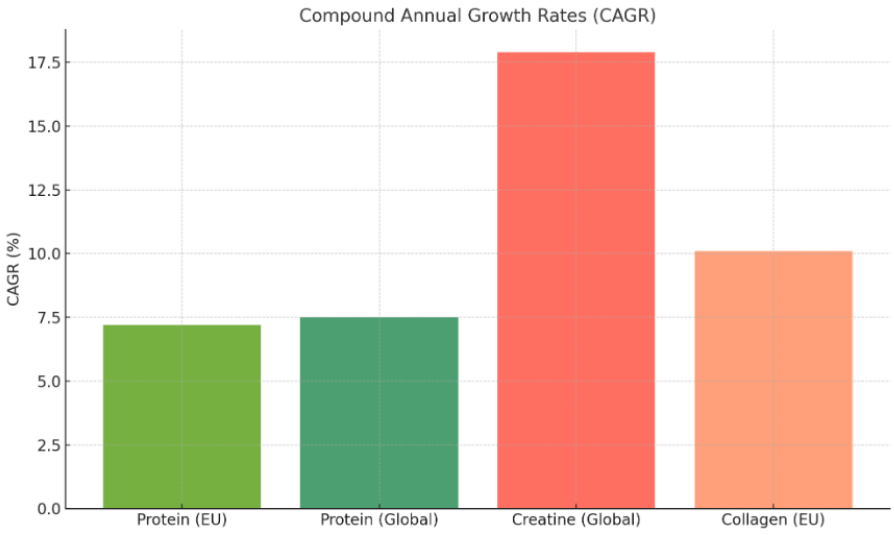


Figure 3

Regarding creatine supplements, Europe represents the second-largest global market and is forecasted to grow at a strong 14.8% CAGR from 2024 to 2030. Global estimates for this market vary but consistently indicate significant growth potential. In 2024, the market size was $ 1,053.7 million. It is projected to reach $ 2,830.5 million by 2030, with a Compound Annual Growth Rate (CAGR) of 17.9% from 2024 to 2030. Powder remains the predominant format, comprising about 80% of the market.



For collagen supplements in European market, the revenue forecast for 2030 is USD 7.2 billion, with a Compound Annual Growth Rate (CAGR) of 10.1% from 2024 to 2030.This growth is largely attributed to aging populations and increasing consumer interest in beauty-related supplements, with powder continuing as the dominant product format. The increase in consumer awareness of health and nutrition, growing disposable incomes, and the increasing mainstream acceptance of health and fitness culture, has led to these growth trends. Brands like MyProtein have capitalised on this trend by offering highly purified collagen peptides, catering not only to fitness enthusiasts but also to aging populations and beauty-conscious consumers.



3.6 Challenges and the Future of Encapsulation Technology

Despite its potential, consumer awareness of encapsulation technology is still relatively low, as confirmed by primary research. Research papers, book chapters and review articles have been published on this topic, but there are limited comprehensive reviews that cover the full extent of encapsulation methods and as well as their latest advancements even though there have been advancements since its first practical application over sixty years ago (Nelson, 2003). Our primary survey confirmed this lack of awareness, revealing that 84.3% of participants had never heard of encapsulation, although 47% expressed a strong interest in trying it, and nearly all were willing to pay a premium for products that improved taste and solubility. This indicates a clear demand for encapsulation but highlights the need for greater consumer education.

The future of encapsulation technology looks promising, particularly as more research and development efforts are made. The encapsulated flavours and fragrances market is expected to grow significantly, with a projected value of $6.4 billion by 2029, driven by the expanding food and beverage industry (Anon., 2025). As awareness of encapsulation increases and technological advancements continue, encapsulation could become a standard in supplement formulations.

However, the supplement industry faces persistent challenges, particularly around sensory attributes, formulation complexities, and competitive pressures. Major brands such as Optimum Nutrition and MyProtein dominate the market, making it difficult for smaller players to gain traction without significant investment. In addition, taste remains a significant barrier to consumer acceptance, with many active ingredients possessing unpleasant flavours. Encapsulation provides a solution by masking these off-flavours and improving the overall sensory experience.

As the demand for plant-based alternatives continues to rise, encapsulation will play a key role in overcoming the taste and texture challenges posed by plant proteins. By enhancing flavour stability and improving solubility, encapsulation technology is poised to address the evolving needs of consumers and help supplement companies stay competitive in a rapidly changing market. Ultimately, the future of yeast encapsulation technology looks promising, with the potential to revolutionise food production, improve product stability and contribute to a more sustainable and efficient industry.

4. Analysis

This section synthesizes the primary and secondary research findings to critically evaluate the market opportunity and strategic positioning specifically for FlavArom. This evaluation is informed by the strategic context provided by the SWOT and PESTEL analyses (detailed in Appendices 8.1 and 8.2), which highlight FlavArom's technological strengths and alignment with market opportunities, while also acknowledging considerations regarding operational scale and competitive intensity.

Our primary research shows that consumers are unhappy with current protein, creatine, and collagen supplements. The main problems concern taste, like bitterness or artificial ingredients, and how well they mix. At the same time, consumers have a strong preference for natural ingredients. They also express a high readiness to try products that offer better sensory qualities through new technologies such as encapsulation, even if they haven't heard of it before.

Secondary research backs this up. It confirms that these supplement categories have large and growing market sizes, especially in Europe. There's also a strong industry trend moving towards clean-label and natural formulas. Encapsulation technology directly deals with the consumer problems that were found. It masks off-tastes, improves stability, potentially improve mixability, and makes natural flavour profiles possible. This technology also fits with the market trends. When you put together these unmet consumer needs, the market growth, the favourable trends, and the technological ability, it creates a clear market opportunity.

4.1 Product Development: Encapsulated Flavours in Supplement Applications

A recent survey conducted by the group of among 83 respondents highlighted common issues such as unpleasant taste (39%) and poor mixability (44%), stressing the need for improved flavour solutions like encapsulation. The following sections detail how encapsulated flavours improve these supplement applications, with a focus on common issues and flavour solutions for each category.

4.1.1 Protein Powders

Protein powder supplements often struggle with flavour dispersion and off-tastes. Many flavour oils and aroma compounds are hydrophobic, (English, 2023), making them hard to

dissolve consistently in water-based shakes. Encapsulation solves this by increasing the solubility and dispersibility of flavouring ingredients. (Gharsallaoui, 2007). Encapsulated flavour powders are designed to mix evenly, ensuring that vanilla, chocolate, or fruit-flavoured protein blends fully dissolve without clumping. Flavour houses provide a variety of encapsulated fruit and dairy tastes, ranging from citrus to rich vanilla, with specific solubility profiles for beverage applications. (Flavours, 2021). This means consumers get a consistent taste in every sip, without gritty or uneven flavour distribution.

Another challenge is the aftertaste that protein supplements can leave, sometimes described as bitter or artificial. Bitterness can come from amino acids, or high-intensity sweeteners used in formulations. (Stogdon, 2024). Encapsulation provides a smart solution by masking these. The flavour compounds are enclosed in micro or nano-scale capsules that prevent immediate interaction with taste buds. In effect, the encapsulated flavours bind or shield the bitter components in the mouth and only release the desired flavour once the supplement is swallowed. (Coupland, 2014). This physical separation significantly reduces any lingering aftertaste. As a result, the overall flavour profile of the protein powder is more enjoyable, with the targeted vanilla, chocolate, or fruit flavours coming through strongly and any unpleasant bitterness suppressed. Survey results indicated that poor mixability and unpleasant taste are common consumer concerns with protein powders. Encapsulation addresses these by enhancing solubility and masking bitter aftertastes, aligning with consumer preferences.

In addition to improving sweet flavour profiles, encapsulation also allows protein powders to take on a neutral or even savoury character. By masking bitterness and off-notes rather than simply adding sweetness, micro- and nanoencapsulation technologies can produce protein bases that are virtually flavourless. This enables the use of protein powders in a wider range of applications, including savoury products. (Coupland, 2014), (Liu, 2022). Heat-stable encapsulation systems further support this versatility, maintaining flavour masking even in cooked products. These innovations expand the opportunity for protein beyond shakes and bars, addressing consumer interest in more varied formats.

4.1.2 Creatine Supplements

Creatine monohydrate is a popular sports supplement known for enhancing muscle energy, but it is unpleasant and unstable in liquids. (Nutritionals, 2022). Unflavoured creatine is slightly bitter and can leave a chalky mouthfeel, which manufacturers often try to cover with sweeteners

or flavours. Survey respondents reported that creatine tends to clump over time, reducing mixability and overall enjoyment. Encapsulated flavour technology helps mask the bitter taste of creatine by using protective coatings that delay the release of the creatine on the tongue. (Coupland, 2014). By encapsulating creatine, the bitterness is not immediately obvious, allowing any additional flavour to dominate during consumption.

Encapsulation noticeably improves creatine's stability and absorption in liquid formats. Traditionally, creatine supplements were limited to dry powders because creatine degraded quickly once dissolved. When mixed with water or acidic liquids, creatine monohydrate breaks down into creatinine. (Nutritionals, 2022).

Encapsulation forms a barrier around the creatine, preventing its conversion to creatinine before the body can absorb it. Dr. Sinéad Bleiel, who led one such study, noted that encapsulated creatine remained stable in a finished drink product, survived exposure to stomach acid, and successfully entered the bloodstream. (Cash, 2017).

Thanks to these advancements, encapsulated creatine can be included in pre- and post-workout drinks without worry of degradation. Manufacturers have even developed ready-to-drink "creatine shots" using this technology. (Cash, 2017). The microcapsule protects creatine in liquid, only releasing it for absorption at the appropriate time.

4.1.3 Collagen Supplements

Collagen supplements, often sold as a powder for skin and joint health, (Professional, 2025), present unique flavour challenges. Collagen itself has a mild taste, but the flavoured versions (strawberry) need to maintain flavour over a long shelf life. Over time, exposure to air, moisture, or light can degrade flavour compounds in these products, leading to an off taste. Collagen products are sometimes added to hot drinks which can further break down flavour components. Encapsulation reduces taste degradation in collagen supplements by protecting the sensitive flavour molecules from external influences. Research in food technology highlights that during product production and storage, flavours can change, so encapsulating flavour compounds is necessary for their retention. (Buljeta, 2021).

Another benefit is the heat and pH stability provided by encapsulated flavours in collagen formulations. Unlike regular flavour additives, encapsulated flavours can withstand higher temperatures and a range of pH levels without breaking down. Many encapsulation techniques produce flavour particles with "outstanding temperature stability". (Flavours, 2021). This is

crucial for collagen-enriched beverages that might be mixed into hot liquids or juices. The encapsulated flavour remains intact during heating or in low pH, only releasing its aroma and taste when consumed. For example, if a user stirs a vanilla-collagen supplement into hot coffee, the encapsulated vanilla flavour will resist being destroyed by the heat and acidity of coffee, ensuring the final drink still has a strong vanilla taste.

4.1.4 Ready-to-Drink (RTD) Shakes

RTD beverages are convenient but must undergo processing like pasteurisation or aseptic treatment, which often involves heat and sometimes acidic conditions. Such processes can alter flavours, and the sealed bottles may sit for months before consumption, risking flavour loss. (Murali, 2025). Encapsulated flavours offer an effective strategy to overcome these heat and acidity challenges. (Madene, 2005). By covering flavour oils and essences with encapsulation, the flavour compounds are insulated from harsh processing conditions. (English, 2023). Encapsulation improves stability, which ensures that the RTD shake retains its intended flavour even after heating and long storage. (English, 2023). For example, an encapsulated banana flavour in an RTD protein shake will survive the pasteurisation and still smell and taste like fresh banana when the consumer opens the bottle weeks later.

Encapsulation enables controlled release of flavours in RTD shakes. Instead of all the flavour being immediately available, a portion of the flavour is released gradually as the beverage is consumed. Encapsulated flavour systems (e.g. FlavourCell) are designed to deliver extended flavour impact and controlled release in beverages. (Flavours, 2021). This means as you drink an RTD shake, the flavour can unfold in stages, the aroma when opening, followed by taste as you sip, and a pleasant aftertaste. Such phased release keeps the flavour lively and satisfying from the first sip to the last. It also helps mask any lingering protein or supplement aftertastes by continuously refreshing the flavour. In a practical sense, a chocolate protein RTD with controlled-release flavour might have an immediate cocoa aroma when opened, a rich chocolate taste during drinking, and no chalky aftertaste afterward, thanks to encapsulation.

Finally, encapsulated flavours contribute to the extended shelf life of RTD products. Because the flavours are protected, the product can have a longer expiration date without the risk of flavour deterioration. (Flavours, 2021). Given that 46% of respondents expressed interest in trying supplements with improved taste and mixability, encapsulated flavours present a promising solution for enhancing RTD beverages.

For consumers, the benefit is clear, supplements that are not only effective for health and performance goals, but also delicious, reflecting the significant improvements that encapsulated flavour technology has brought and can bring to the industry. (B F Gibbs, 1999), (English, 2023). Survey data revealed that consumers are willing to pay more for supplements with improved taste and mixability, reinforcing the value of investing in encapsulated flavour technologies for enhanced product satisfaction.

In summary, the technical capabilities of encapsulation, particularly features like taste masking, stability enhancement (heat, pH, shelf-life), improved solubility/mixability, and controlled release, directly address the major pain points identified in the primary research across key supplement categories (protein, creatine, collagen, RTDs).

5. Recommendations

To take advantage of the market opportunities for encapsulated flavours in the supplement industry, FlavArom needs a focused strategy. This strategy should concentrate on the company's unique technology and the clear needs of customers. The following recommendations outline a strategic course of action that integrates market entry, operational considerations, and ongoing development, consistently leveraging FlavArom's core value proposition and identifying potential grant opportunities for key initiatives.

5.1 Strategic positioning and financial aspects

FlavArom should position itself as a premium B2B supplier of high-quality, science-driven flavour solutions, particularly for the health and wellness sector. It should use its encapsulation technology, specifically highlighting the benefits of its yeast-based encapsulation if applicable, to address key industry problems: better taste masking, improved stability and mixability, and supporting clean-label products. These capabilities make FlavArom an ideal partner for supplement brands seeking innovative, functional, and label-friendly flavour options. Product offerings should consistently be positioned around key attributes:

- Premium: Backed by scientific research and demonstrable R&D.
- Clean-label: Free from artificial colours, flavours, or preservatives, meeting consumer trends.
- Functional: Designed to deliver tangible improvements in taste, stability, solubility, or masking.
- Customisable: Offering tailored solutions for specific customer needs and supplement formats.

The company's total assets fluctuated between approximately € 200k and € 350k from 2019-2023 (according to Orbis data). Given FlavArom's size, reaching large economies of scale is a complicated challenge as competing directly on price with bigger flavour companies probably will not work.

Therefore, a value-based pricing strategy [1] is suggested. Highlighting the real benefits of the technology – such as enhanced stability delivering longer shelf-life, improved solubility/mixability, superior taste masking, and enabling clean-label formulations (absence of artificial additives) – will justify a higher price compared to standard flavourings. A differentiated (tiered) pricing system based on order size, degree of customization level, and potentially exclusivity can meet different partner needs while getting the most value. The suggested B2B partnership approach keeps initial market entry costs lower than selling directly to consumers. This fits well with FlavArom's reported financial limits on money available for large marketing and distribution systems.

Exploring available grants can provide crucial financial support to bridge resource gaps for implementing these strategies.

5.2 Recommended Target Product Areas & Phased Market Entry

FlavArom should prioritise developing and promoting flavour solutions for the following high-demand product categories where its technology offers clear advantages:

- Protein Powders: Addressing off-notes (e.g., bitterness in plant proteins) and improving mixability.
- Creatine Supplements: Masking inherent bitterness and potentially improving stability.
- Collagen Products: Enhancing the palatability, especially for unflavoured or marine-based options.

Ready-To-Drink (RTD) Beverages: Providing stable, high-quality flavour solutions for this rapidly growing liquid format.

A step-by-step B2B plan, keeping resources in mind, is recommended for market entry. This approach manages growth based on FlavArom's financial situation and allows for learning and changes at each step:

- **Phase 1 (Years 1-2) - European Focus**
  Start by concentrating efforts on getting established in key European markets. To be specific, Germany, the UK, and Spain were identified as markets with a strong demand for clean-label products (Allied Market Research, 2024).

[1] Value-based pricing strategies set prices primarily according to the customer-perceived value of the offering, in contrast to approaches centered mainly on production costs.

First, use a direct sales approach combined with participation in key B2B trade events (e.g., Vitafoods Europe) to build close relationships and get key initial clients. Target both well-known and newer (innovative and mid-sized) supplement brands that fit the clean-label idea. Success in this phase will show the product fits the market and give us important insights.

Initial market research, consultancy and feasibility testing could potentially be supported by funding like the LEO Feasibility Study Grant (Local Enterprise Office, n.d.).

- **Phase 2 (Years 2-3)- Category and Capability Expansion**

  Based on early success, broaden the range of flavour options within the prioritized product areas (Protein, Creatine, Collagen, RTDs). Strategically develop specific solutions, with R&D support, for difficult but growing formats like RTDs and functional drinks. Also, improve solutions for the current powder formats (protein, creatine, collagen). To reach more customers than the initial direct clients, look into partnerships with specialized ingredient distributors who have connections to more manufacturers in Europe. Funding opportunities like the LEO Innovation Grant or Enterprise Ireland's Agile Innovation Fund could support this product/capability development**.**

- **Phase 3 (Years 3-5) - Geographic Expansion**

  Assuming favourable market acceptance, good profitability, and confirmed operational readiness resulting from prior phases, the organization could proceed with expansion into major international markets. Focus first on North America, the biggest global market, and then moving to the fast-growing Asia-Pacific region. Understand that success in these areas will likely mean setting up strategic distribution partnerships or having dedicated regional sales teams to handle the size and complexity of these larger markets well.

  Funding for this expansion phase, including support for international sales teams, regulatory compliance, and market localisation, could align with supports such as the LEO Business Expansion Grant, and potentially InterTrade Ireland funding (e.g., Acumen or Elevate programs) due to the involvement of cross-border activities (Bord Bia, n.d.).

5.3 Strategic Partnerships

Building strong working relationships with leading and new supplement brands, ingredient suppliers, contract manufacturers specializing in clean-label/functional products, and possibly research groups/academic institutions is key for market access, credibility, cost control, and innovation.

One limitation of this recommendation is the limited timeframe available to establish a strategic partnership for the client. We reached out to several leading protein, collagen, and creatine manufacturers in Ireland, including Carbery Group, All Real Nutrition, Glanbia Nutraceuticals, Fulfil Nutrition, Kinetica Sports, ABC Nutrition, and The Protein Works. While some companies did not pursue further discussions due to their private nature, one manufacturer expressed interest in receiving additional information, potentially paving the way for a future partnership with FlavArom.

5.4 Operational excellence, compliance, and innovation

The company has to make sure to strictly follow all relevant EU, UK and global food safety rules. Getting relevant certifications early (like clean-label, organic, or specific dietary ones) can build consumer trust, make offerings stand out, and help enter international markets.

It would also be crucial to keep investing in R&D to improve the encapsulation technology, look into new bases (like plant-based ones), and create solutions for new market needs such as better solubility or specific release times.

Targeted financial support for these crucial R&D activities may be available through channels like LEO Innovation support or Bord Bia's Step Change Programme for significant new technology adoption.

Consider leveraging LEO Innovation Vouchers for specific R&D collaborations with academic institutions. Additionally, R&D investments may be eligible for tax relief under Ireland’s Corporation Tax incentives, improving cost efficiency

5.5 Consumer education and marketing support

Even though FlavArom is B2B, it should help its partners educate consumers about the benefits of its encapsulated flavour technology. This could mean giving partners clear messages for

their own marketing and packaging or pointing out improvements in taste, solubility, or stability from encapsulation. Indirectly educating end-consumers through partner channels can improve product acceptance and steadily increase demand.

Marketing efforts to enhance brand visibility, potentially including participation in trade fairs, could be partially funded through Bord Bia's Marketing Assistance Programme (MAP) Grant. Consider also developing case studies and technical resources for B2B marketing.

5.6 Website Enhancement Recommendations

To reflect its B2B focus, scientific capabilities, and premium positioning, FlavArom's website should be enhanced to incorporate:

- Dedicated "Solutions" or "Applications" Pages: Clearly detailing specific offerings tailored for different supplement formats (e.g., Protein Powders, RTDs, Creatine, Collagen).
- Case Studies & Performance Data: Showcasing successful flavour masking, stability improvements, or solubility enhancements in real-world or model formulations.
- Technical Resources Section: Providing downloadable data sheets, whitepapers, relevant research findings, or technical articles.
- Partner/Client Focus: Potentially including testimonials, partner spotlights, or a blog discussing successful collaborations and industry trends.
- Highlighting Innovation: Mentioning grant-supported R&D projects or unique aspects of the technology.
  Optional features to consider:
- Live chat function for direct B2B inquiries.
- Newsletter sign-up for industry insights, new product launches, or research updates.
- A secure portal for existing partners or distributors to access specific documentation or place sample requests

By following these enhanced recommendations and leveraging potential grant funding and tax incentives where applicable, FlavArom can effectively use its encapsulation technology and strategically find its way through the market. This will set the company up for steady growth and help build strong partnerships in the rapidly changing health and wellness industry.

6. Conclusion

Encapsulation technology represents a transformative innovation in the supplement industry, offering key advantages in improving flavour stability, enhancing ingredient bioavailability, and extending product shelf life. By addressing taste challenges, encapsulation enables protein, creatine, and collagen products to achieve superior consumer acceptance. With the rise of health-conscious consumers and the clean-label movement, the demand for natural and functional nutrition solutions continues to grow.

One of the main benefits of encapsulation is its ability to mask undesirable flavours and prevent oxidation, ensuring a more enjoyable consumption experience. This is particularly crucial for creatine and protein supplements, where bitterness and chalkiness are common barriers to consumer preference. Moreover, the controlled release of encapsulated ingredients enhances product functionality, allowing for better absorption and sustained nutrient availability.

Despite these advantages, several challenges remain, including regulatory compliance, cost implications, and consumer education. Companies must navigate varying international standards to ensure their encapsulated products meet safety and labelling requirements. Additionally, the higher production costs associated with advanced encapsulation technologies must be carefully managed to maintain product affordability. Educating consumers on the benefits of encapsulation will be essential in driving demand and justifying premium pricing.

Future research should focus on expanding the applications of encapsulation beyond flavour enhancement, such as incorporating functional ingredients for added health benefits. Studies on plant-based encapsulation carriers could further align with sustainability trends and consumer preferences for natural products. The continued development of multi-layer encapsulation techniques could optimise the stability and efficacy of supplements, making them more appealing to a wider demographic.

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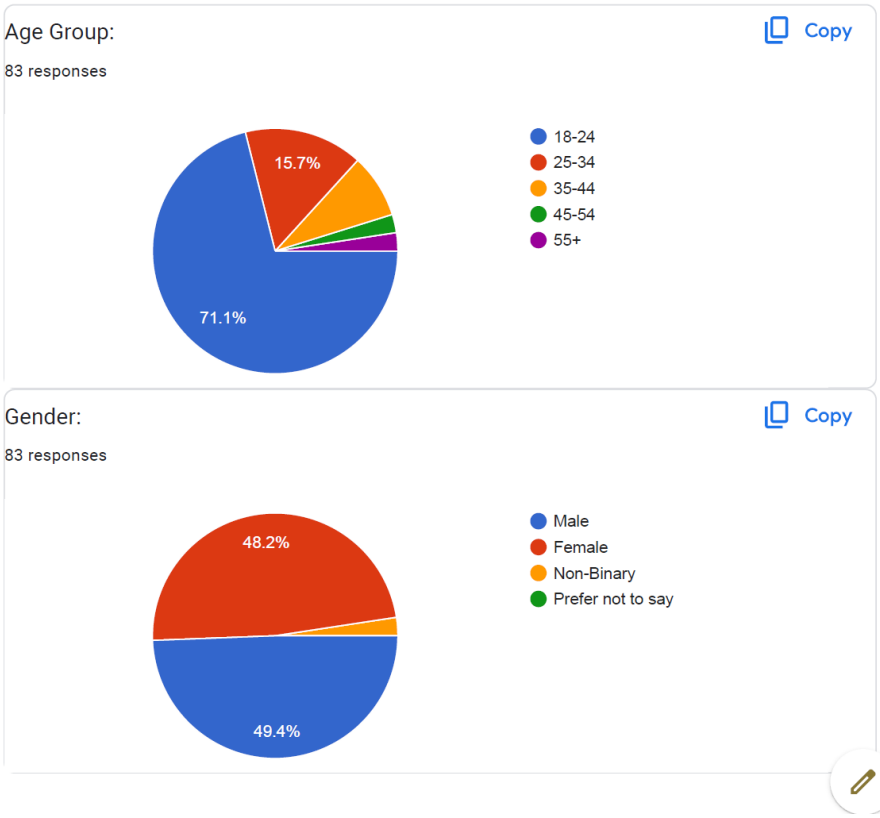
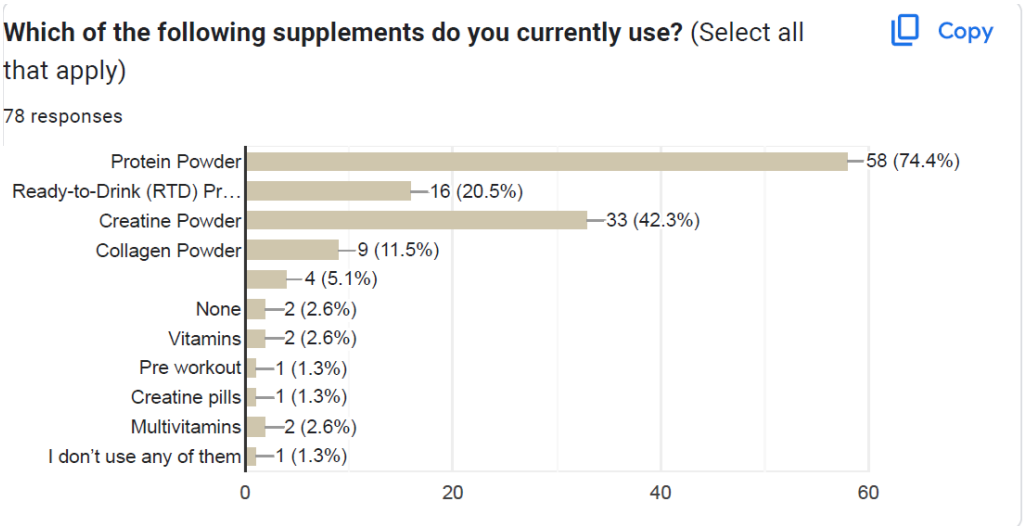
8. Appendices

Survey's results





What factors influence your supplement purchase decision? (Rank from 1 to 5, with 1 being most important)

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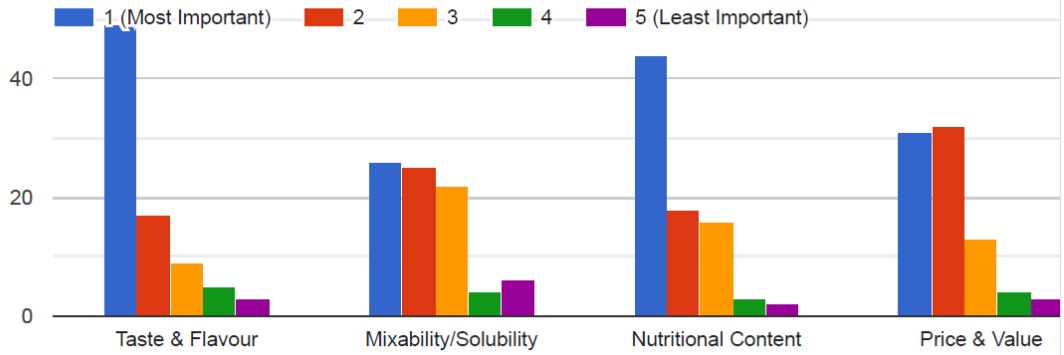

What is the biggest issue you've encountered with your current supplement? (Select all that apply)

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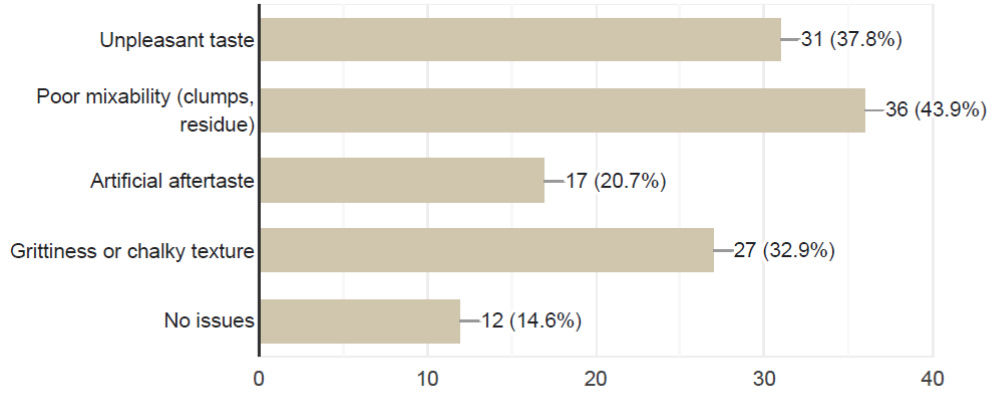
82 responses



If encapsulated flavours improved the taste and mixability of your supplement, would you be more likely to try it?

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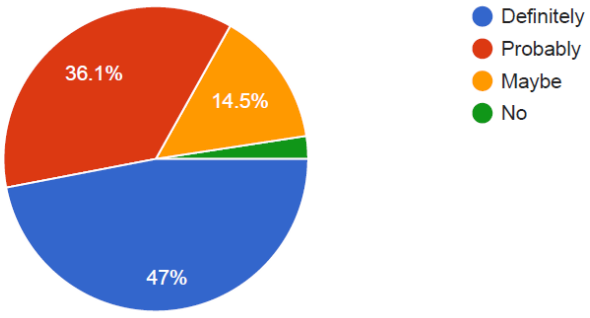
83 responses



8.1 SWOT ANALYSIS

Strengths

Technological and Process Advantages - Leveraging high-end technologies such as spray-drying, FlavArom efficiently preserves the natural flavours of raw materials, ensuring consistent product quality and stability. The company continually invests in research and development, taking advantage of Ireland's vibrant innovation environment and strong higher education resources to optimise production processes.

Global Raw Material Sourcing and Supply Chain Management - By sourcing high-quality raw materials from around the globe, the company maintains a significant edge in raw material quality and diversity. As an EU member, Ireland offers convenient international logistics channels, facilitating the import of raw materials and the export of finished products.

Customised Product Solutions and Brand Influence - FlavArom meets the varied needs of industries such as food, beverages, and personal care, thereby enhancing customer loyalty and market recognition. Benefiting from Ireland's favourable business environment and globally recognised management practices, the company strengthens its brand image and international competitiveness.

Favourable Business Environment - Ireland's low corporate tax rates and business-friendly policies provide an excellent development environment and attract capital. As an EU member, Ireland enjoys political stability and a mature market economy, which supports long-term planning and strategic implementation.

Weaknesses

Supply Chain and Logistics Risks - While global sourcing ensures high-quality inputs, it also exposes the company to uncertainties stemming from international political situations and climate-related disruptions. Despite Ireland's excellent port facilities and air transportation, there remains a risk of logistical delays in the event of global supply chain disruptions.

High Production and R&D Costs - To maintain superior product quality, significant investments in raw materials and process improvements are required, which may impact short-term profitability. The continuous need for technological innovation and equipment upgrades can place financial strain in the short term.

Market Limitations - The limited size of the Irish domestic market means that the company relies heavily on international markets, making it more sensitive to global market fluctuations. Although Ireland boasts strong international logistics, its distance from major production and consumption centres in Asia could affect supply chain responsiveness.

Opportunities

Global Market Demand and Consumption Upgrades - As global food, beverage, and personal care industries increasingly demand high-quality, natural flavourings, a vast market opportunity is available. The rising consumer preference for natural and environmentally friendly products drives demand for innovative flavouring solutions.

Advantages of Ireland and the EU - Leveraging the EU market allows FlavArom to enter multiple European countries seamlessly and utilise EU standards to enhance its product competitiveness. Innovation funds and export support policies provided by Ireland and the EU offer additional resources for technological improvements and market expansion.

Cross-border Collaboration and Supply Chain Integration - By capitalising on Ireland's role as a transatlantic hub, the company can establish strategic partnerships with European, American, and other international enterprises to broaden its market influence. Through international mergers, acquisitions, or strategic alliances, FlavArom can integrate resources and expand its product lines, further bolstering its market competitiveness.

Threats

Fluctuations in the Global Raw Material Market -Variations in global raw material prices can increase production costs, exerting pressure on profitability. International political and economic uncertainties, and unpredictable weather conditions, could disrupt the supply chain.

Intense Market Competition - The global flavour and fragrance market is highly competitive, and the technological and scale advantages of other international and regional competitors may impact the company. In a highly price-competitive market, maintaining quality while making concessions on price could affect profit margins.

Changes in Regulations and the International Trade Environment - Increasingly strict requirements for food safety, environmental protection, and product compliance may drive up

operational costs. While Ireland benefits from its EU membership, trade disputes and policy shifts, especially with the UK and other markets, could introduce export uncertainties.

Macroeconomic and Geopolitical Risks - Economic downturns or global market turbulence may lead to reduced downstream consumer demand. Unstable international relations and geopolitical risks could affect supply chains and market expectations, indirectly impacting the company's operations.

8.2 PESTEL ANALYSIS

Political Factors

Regulatory Compliance in Ireland and the EU - FlavArom operates in the highly regulated food industry, meaning compliance with EU food safety standards (e.g., EFSA regulations) is critical. These regulations cover food additives, processing methods, and labelling requirements. Any non-compliance could result in penalties, product recalls, or reputational damage. For international expansion, differences in food regulations, such as the FDA in the USA, must be carefully navigated to ensure products meet varying international standards.

Trade Policies and Brexit Implications - Ireland remains a member of the EU, providing seamless access to a single market of over 440 million consumers. However, Brexit has led to increased customs checks and tariffs when exporting to the UK. While Ireland has a Common Travel Area (CTA) with the UK, businesses still face potential delays and added costs when trading across the Irish Sea. Expanding into other non-EU markets (such as the USA or Asia) would require navigating different tariff rates, import duties, and product regulations, which could impact pricing and competitiveness.

Economic Factors

Market Demand for Natural Flavourings and Additives - There is a growing global demand for natural and clean-label food ingredients, with consumers increasingly avoiding artificial additives. This trend aligns well with FlavArom's core product offering, allowing for potential growth both domestically and internationally. The Irish food industry is a key export-driven sector, with companies like Kerry Group and Glanbia leading the way. Ireland is well known for its high food safety standards, which can be leveraged to build trust in international markets.

Currency Fluctuations and Financial Risks - As an exporter, FlavArom faces exchange rate risks, particularly with the Euro fluctuating against currencies such as the US Dollar and British Pound. A weaker Euro could benefit exports, making Irish products more competitive abroad, but volatility in currency markets could affect profit margins. Economic downturns, inflation,

or recessions in key markets (such as the UK, USA, or China) could also reduce consumer spending on premium food products, impacting sales.

Social Factors

Health and Wellness Trends Driving Consumer Behaviour - Irish and global consumers are increasingly health-conscious, preferring natural ingredients over synthetic additives. This shift benefits FlavArom, as it produces encapsulated essential oils with natural flavour retention and improved shelf life. The rise of vegan, organic, and plant-based diets further enhance demand for clean-label food solutions, providing FlavArom with a strategic advantage in Ireland and internationally.

Consumer Preferences and Cultural Considerations - Expanding into new markets requires localisation of flavours to meet regional taste preferences. For example, European markets may prefer subtle, natural flavours, Asian markets may favour stronger, herbal, or spice-infused flavours and North American consumers often look for bold, artificial-replacement flavours in snacks and beverages. FlavArom must conduct market research and adapt its flavour profiles accordingly when entering different regions.

Technological Factors

Encapsulation Technology as a Competitive Advantage - FlavArom's spray-drying encapsulation technology enhances flavour retention, making it attractive for food and beverage manufacturers looking for long-lasting, natural ingredients. Continued investment in R&D could lead to improved microencapsulation techniques, increasing product stability and extending shelf life, which is highly valuable for export markets.

Adoption of Automation and AI in Food Processing - Automation in food manufacturing can improve efficiency, reduce costs, and ensure consistent product quality. Analytics from AI can also provide market insights and consumer trend predictions, helping FlavArom make data-driven decisions for international expansion. Ireland's strong focus on tech-driven food innovation, with support from agencies like Enterprise Ireland and Teagasc, can help FlavArom stay ahead in a competitive industry.

Environmental Factors

Sustainability and Ethical Sourcing - Consumers and regulatory bodies are increasingly prioritising sustainable sourcing of raw materials. Given that FlavArom's essential oils are derived from natural sources, sustainability in sourcing and processing is crucial. Ireland has a strong reputation for sustainable food production, and positioning FlavArom's products as eco-friendly could enhance its international appeal. Using biodegradable or recyclable packaging can also add to its environmental credentials.

Climate Change and Supply Chain Risks - Global climate shifts could affect the availability and pricing of essential oils, as extreme weather conditions impact crop yields. For example, disruptions in the supply of citrus fruits used in flavourings due to droughts or flooding could increase raw material costs. FlavArom must establish diversified supplier networks to mitigate risks and ensure a stable supply of ingredients.

Legal Factors

Compliance with International Food Safety Standards - Ireland enforces strict food regulations under the Food Safety Authority of Ireland (FSAI) and EU legislation. When expanding internationally, FlavArom must ensure compliance with the FDA for US regulations for food additives, the Food Standards Agency rules post-Brexit in the UK and GB food safety for China's standards for imports. Failure to meet these standards could lead to export restrictions, fines, or product recalls.

Intellectual Property and Product Protection - Protecting unique encapsulation techniques and formulations through patents and trademarks can help FlavArom maintain a competitive edge. Many large multinational food companies invest heavily in R&D protection, so ensuring proprietary technology is safeguarded is crucial. Additionally, FlavArom must be aware of labelling laws when selling internationally. Some markets require different ingredient disclosures, which may impact packaging design and marketing strategies.

8.3 COMPETITOR ANALYSIS

The following companies are major competitors in the flavour encapsulation industry:

Kerry Group - Indirect Competitor

- A global leader in food ingredients, expanding aggressively in Africa, Asia, and South America.
- Offers spray drying and encapsulation technologies but focuses on a broad range of food solutions beyond encapsulated flavours.

TasteTech - Direct Competitor

- Specialises in controlled-release flavourings and encapsulation technologies.
- Strong in confectionery, bakery, and nutrition sectors, making them a close competitor to FlavArom.

Glanbia Nutritionals - Adjacent Competitor

- Provides spray drying solutions, focusing more on nutritional applications rather than dedicated flavour encapsulation.
- While not a direct competitor in flavours, they compete in functional food ingredients.

North Cork Creameries - Adjacent Competitor

- Focuses on dairy-based powders rather than specialised flavour encapsulation.
- Primarily serves Europe with functional food and beverage ingredients.

Perfumer & Flavourist - Leaders in Flavour Encapsulation - Direct Competitor

- Global companies involved in advanced spray drying and microencapsulation techniques.
- Larger players with significant R&D investment.

Givaudan - Direct Competitor

- A global leader in flavours and fragrances, offering advanced encapsulation technologies to enhance flavour stability and controlled release.
- Developed technology for plant-based products to enhance juiciness.

Firmenich - Direct Competitor

- A Swiss company specialising in the creation of fragrances and flavours, investing in innovative encapsulation techniques.

Symrise - Direct Competitor

- A global supplier of fragrances, flavours, and raw materials.
- Provides solutions for continuous flavour release and visually appealing flavour particles.

Cargill - Indirect Competitor

- An international provider of food, agricultural, and industrial products.
- Offers a portfolio of flavour encapsulation and emulsion technologies, but with a broader focus beyond flavours.

Sensient Technologies - Direct Competitor

- A global manufacturer of colours, flavours, and fragrances.
- Provides encapsulated flavours designed to improve stability and control the release of flavours.

Robertet Group - Direct Competitor

- A French fragrance and flavour manufacturer specialising in natural raw materials.
- Offers encapsulated flavour solutions to enhance product performance.

International Flavours & Fragrances Inc. - Direct Competitor

- A leading innovator in the flavour and fragrance industry.
- Provides advanced encapsulation technologies to enhance flavour delivery and stability.

Aromsa - Direct Competitor

- A creative flavour partner offering encapsulated flavours tailored to meet new product requirements.

Competitive Analysis: FlavArom vs. Competitors

Factor	FlavArom	Direct Competitors
Encapsulation Expertise	Specialises in encapsulated flavours with high retention rates	Large-scale encapsulation providers, but often part of a broader flavour portfolio
Technology and Innovation	Opportunity to improve by adopting multi-layer encapsulation and lipid-based systems	Larger competitors invest heavily in advanced encapsulation R&D
Sustainability	Needs to increase efforts in natural encapsulation & biodegradable carriers	Some competitors already have strong clean-label and eco-friendly solutions
Market Expansion	Opportunity to grow in Asia, Africa, South America	Larger competitors already have strong distribution networks in emerging markets
Customisation and Agility	More flexible, faster response times, and tailored solutions	Larger competitors have rigid production processes
Brand Visibility and Partnerships	Needs stronger marketing & digital presence	Competitors have extensive strategic partnerships with food & beverage brands
Cost Efficiency	Potential to be cost-effective compared to global giants	Kerry, IFF, and Givaudan benefit from economies of scale

Areas for Improvement to Overcome Competitors

Technology and Innovation - Investment in advanced encapsulation techniques like multi-layer encapsulation, lipid-based systems, and hybrid encapsulation. As well as
Increasing research and development efforts to develop patentable solutions beyond standard spray drying.

Sustainability and Clean Label Trends - Exploring biodegradable encapsulation materials and natural carrier and reduce reliance on synthetic carriers and align with global sustainability initiatives.

Market Expansion and Diversification - Strengthen presence in Asia, Africa, and South America, where demand for innovative food ingredients is growing and expanding beyond food & beverage into pharmaceuticals, nutraceuticals, and cosmetics.

Brand Visibility and Strategic Partnerships - Improve marketing efforts and digital presence to differentiate FlavArom. Partner up with food manufacturers, research institutions, and tech companies to develop co-branded products.

Customisation and Flexibility – Offering tailored encapsulation solutions including custom particle size, release mechanisms, and solubility and providing smaller batch production capabilities to attract niche brands and start-ups.

8.4 Yeast-Based Flavour Encapsulation

Flavour Encapsulation

Flavour encapsulation is an innovative technique where natural flavour molecules, which are delicate and volatile (Andrea Gomez-Zavaglia, 2024), are protected by an encapsulating layer. These molecules are vulnerable to degradation from environmental factors like oxygen, light, moisture, pH, and heat, without encapsulation, which can reduce their effectiveness and quality (Andrea Gomez-Zavaglia, 2024). Yeast's ability to encapsulate both hydrophilic (water-loving) and hydrophobic (water-fearing) active ingredients providing a high loading capacity, implying it can absorb substances efficiently (source student).

Manufacturing, storage processes, packaging materials and ingredients in foods often cause modifications in overall flavour by reducing aroma intensity or producing off-flavour components (Madene, 2005). FlavArom typically uses polyethylene bags for packaging, which are stored in kegs depending on the product size.

Yeast also supports the body's metabolism by balancing gut bacteria having probiotic effects that aid in combating gut-related diseases (Moslehi-Jenabian, 2010). It also aids digestion, which is especially beneficial in food applications requiring higher thermal stability (Andrea Gomez-Zavaglia, 2024). In addition to improving flavour longevity, it holds promise in reducing toxicity, lowering production costs, and enhancing the bioavailability of nutrients (Sereikaitė, 2021).

Spray Drying

Spray drying is a highly versatile method of encapsulation, offering advantages over other methods, (Nelson, 2003) and is the method used by FlavArom. It is a more commonly used encapsulation technique in the food and pharmaceutical industries. This method is highly automated making it ideal for larger-scale production of encapsulated flavours. Spray drying offers low operating costs achieving economies of scale while providing a good quality product. Its accessibility, coupled with a wide range of carrier solids, ensures excellent flavours retention and reliable stability of the finished product according to (Teixeira, 2004), Spray drying is particularly effective for heat-sensitive materials due to the lower temperatures that the core material reaches.

Yeast is a highly suitable material for spray drying as its properties align with the requirements of the process. The wall materials optimal for spray drying includes high solubility in water, a low viscosity at high concentration, effective emulsification and efficient drying properties. The fine powder is easily dispersible makes it suitable for its application in sports nutrition products also making it easier to store and transport (Madene, 2005)