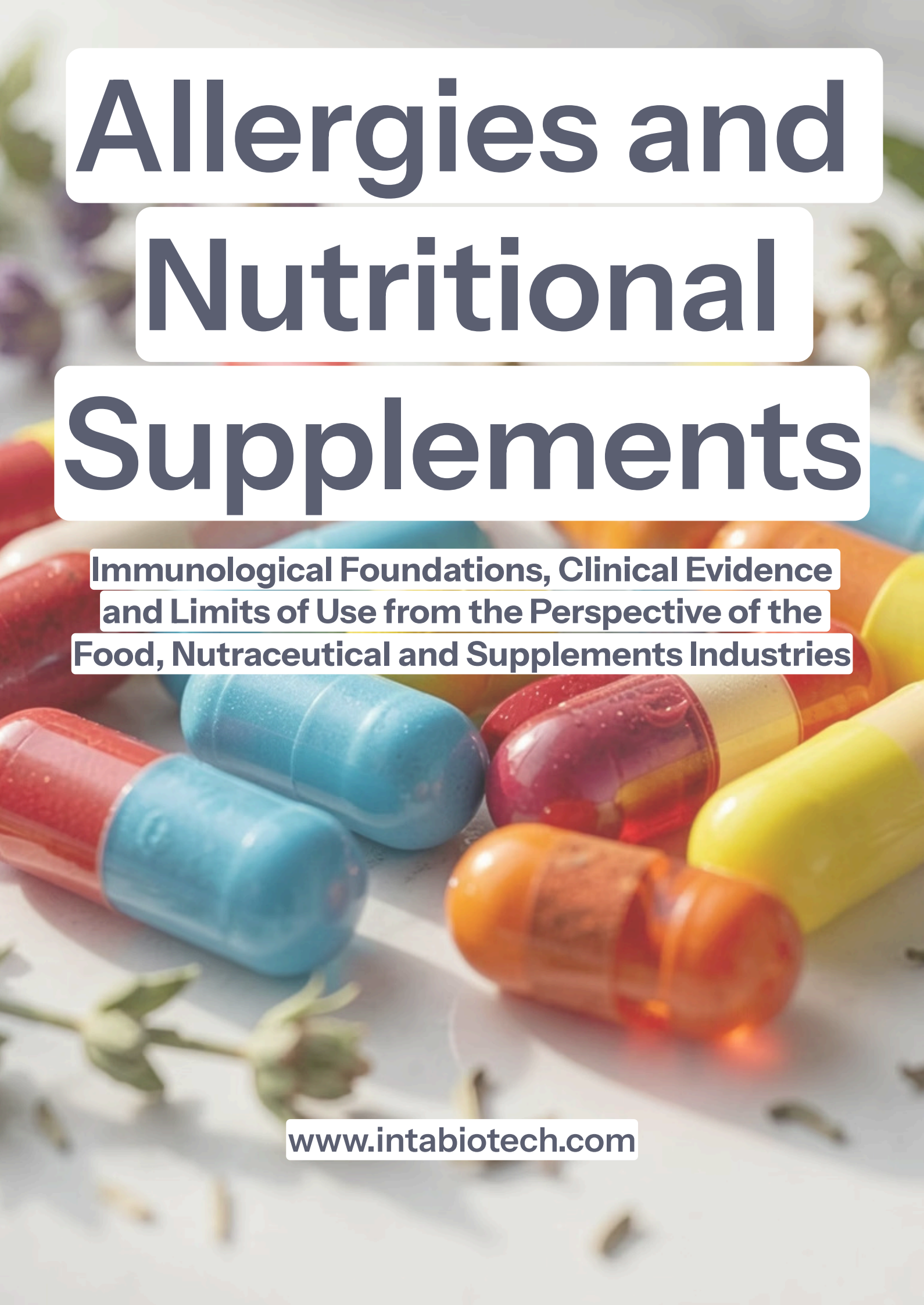
Allergies and Nutritional Supplements

Immunological Foundations, Clinical Evidence and Limits of Use from the Perspective of the Food, Nutraceutical and Supplements Industries



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Executive Summary

Allergic diseases —allergic rhinitis, conjunctivitis, allergic asthma, atopic dermatitis, urticaria and food allergy— are immune-mediated conditions in which the problem is not a 'lack of defences', but a **dysregulated immune response** to normally harmless antigens. For this reason, the commercial concept of 'immune boosting', widely used in the nutraceutical and supplements industry, must be handled with the utmost technical precision.

In allergy, the goal is not to stimulate the immune system indiscriminately, but to **favour immunological tolerance**, modulate type 2 inflammation, protect the epithelial barrier, optimise the microbiota and correct nutritional deficiencies that may worsen immune dysfunction.

Candidates with Greatest Plausibility

- Probiotics selected by strain
- Vitamin D in deficient individuals
- Omega-3 EPA/DHA (especially early prevention)
- Vitamin C as antioxidant support
- Zinc and selenium only in deficiency
- Bioavailable quercetin

Central Treatments (Clinical Guidelines)

- Allergen avoidance
- Antihistamines and intranasal corticosteroids
- Bronchodilators where appropriate
- Allergen immunotherapy
- Adrenaline in anaphylaxis risk

Key Words

- Allergy · Nutritional supplements
- Probiotics · Vitamin D · Omega-3
- Quercetin · Allergic rhinitis
- Atopic dermatitis · Immunomodulation
- Microbiota · Regulatory claims

ⓘ The available evidence supports considering certain supplements as **adjuncts**, but never as substitutes for medical treatment and management.

1. Introduction: allergy is not immunodeficiency

Common allergies are diseases of **hypersensitivity and not immunodeficiencies**, as has become widely believed in popular culture — a notion that is profoundly ingrained yet immunologically incorrect. In many of them, a **type 2** immune response predominates, with involvement of Th2 lymphocytes, IgE, mast cells, basophils, eosinophils, histamine, leukotrienes, prostaglandins, cytokines such as IL-4, IL-5 and IL-13, and disruption of epithelial barriers. The clinical result may be sneezing, rhinorrhoea, ocular pruritus, bronchoconstriction, eczema, urticaria, oedema or, in severe cases, anaphylaxis.

Therefore, the correct question is not whether a supplement "boosts defences", but whether it can **favourably modulate any of the key axes** of allergic pathophysiology. The NIH Office of Dietary Supplements emphasises that the immune system is a complex network and that no single simple measure of "immune function" exists; it also acknowledges that vitamins and minerals such as A, C, D, E, selenium and zinc are necessary for normal immune function, but this does not equate to asserting that supplementing them beyond physiological requirements will improve an established allergic disease.

Immunological tolerance

Promoting tolerance to allergens through Th1/Th2/Treg balance

Barrier integrity

Integrity of the intestinal, cutaneous and respiratory barriers

Microbiota

Microbiota and immunoregulatory metabolites such as short-chain fatty acids

Inflammation

Control of eosinophilic and mast cell inflammation and chronic oxidative stress

2. Bidirectional relationship between allergies and supplements

Supplements as adjuvants

Some supplements may help as adjuvants in certain patients with a specific clinical profile. This possibility forms the basis of a defensible technical-commercial positioning in the space of supplements orientated towards allergic wellbeing.

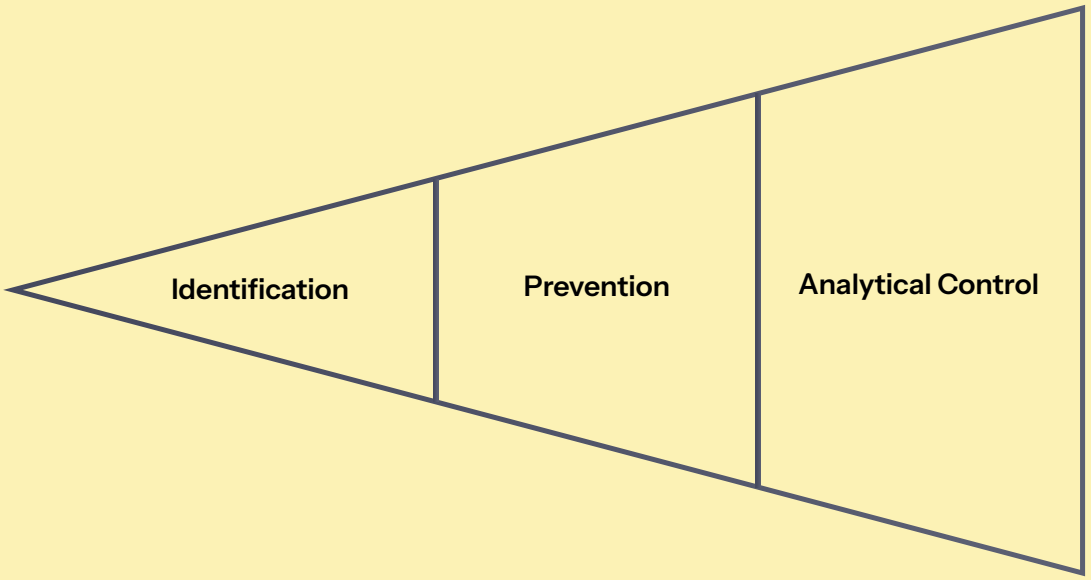
However, this adjuvant function must always be communicated with rigour, respecting European regulatory limits and without crossing the boundary towards claims of a therapeutic or preventive nature.

Supplements as a source of allergenic risk

Supplements can be a **source of allergenic exposure**, particularly if they contain residual proteins, botanical extracts, marine derivatives, dairy, soya, egg, pollen, royal jelly, propolis, or inadequately declared excipients.

This second point is critical in product development: a supplement orientated towards "allergic wellbeing" cannot be carelessly formulated with potentially allergenic ingredients. European legislation — Regulation 1169/2011 — requires the 14 relevant allergenic substances to be declared unambiguously on the labelling.

⚠ A product "for allergies" can become a clinical problem if it contains undeclared sensitising ingredients or uncontrolled traces. Analytical traceability and cross-contamination control are non-negotiable requirements.



3.1. Probiotics: the group with the strongest immunological plausibility

Probiotics are probably the most interesting group from an allergy standpoint, because they connect directly with the tricuspid hypothesis of **microbiota–barrier–tolerance**. The intestinal microbiota influences immune maturation, production of short-chain fatty acids, differentiation of regulatory T cells, and systemic inflammatory tone. However, the evidence does not permit speaking of "probiotics" as a homogeneous category: the effect depends on strain, dose, matrix, duration, age, clinical phenotype, and baseline microbiota status.

In paediatric allergic rhinitis, a 2024 review and meta-analysis of randomised trials concluded that probiotics were effective and safe in improving symptoms and quality of life, although they did not demonstrate prevention of the onset of allergic rhinitis. Another review found positive signals, but rated the evidence as weak due to heterogeneity of studies, strains, and outcomes. In adults, a meta-analysis of 28 studies showed significant improvement in the RQLQ in the probiotic group versus placebo, albeit with very high heterogeneity, which limits both clinical and commercial extrapolation.

In atopic dermatitis, recent reviews indicate possible utility of strains such as *Lactobacillus rhamnosus* and *Bifidobacterium lactis*, although no universal recommendation applicable to any probiotic product on the market currently exists.

> **Technical recommendation**
>
> Probiotics are reasonable candidates for adjuvant products aimed at **mild-to-moderate allergic rhinitis and atopic dermatitis**, provided that strains with human studies are selected, the full strain designation and CFU count at end of shelf life are declared, and any promises of prevention or cure are avoided.

3.2. Vitamin D: Relevant if Deficient, Not as an Anti-Allergy Panacea

Vitamin D acts on both innate and adaptive immunity, supports certain tolerance mechanisms, and can modulate inflammation. Its role in allergy is plausible, but clinically inconsistent. The most balanced interpretation is a cautious one: **correcting vitamin D deficiency is reasonable**; supplementing indiscriminately in individuals with adequate levels is not solidly justified as an anti-allergy strategy.

In allergic rhinitis, recent reviews suggest that supplementation could improve nasal symptoms in some contexts, but authors typically call for larger and better-standardised studies. In childhood asthma, a 2024 systematic review and meta-analysis examined the reduction of exacerbations with vitamin D, although applicability depends on baseline status, dose, age, and concomitant treatment. The World Allergy Organization, on the other hand, did not find sufficient support to recommend vitamin D to pregnant women, breastfeeding mothers, or healthy term infants with the specific aim of preventing childhood allergic diseases.

Priority Groups for Assessing Deficiency

- Low habitual sun exposure
- Obesity or overweight
- Advanced age
- Highly restrictive diets
- Malabsorption disorders

Safety: Limits to Observe

- Tolerable upper limit in adults: **100 mcg/day (4,000 IU/day)**
- Toxicity: hypercalcaemia, hypercalciuria, renal damage
- Arrhythmias and soft tissue calcification
- Ideally, assess 25-OH-vitamin D levels beforehand

Vitamin D3 is defensible as an adjunct under the authorised claim 'contributes to the normal functioning of the immune system', not as 'prevents allergies'.

3.3. Omega-3 EPA/DHA: anti-inflammatory interest, more relevant for early prevention than as a therapeutic tool

Long-chain omega-3 fatty acids, particularly EPA and DHA, participate in the generation of pro-resolving mediators and can modulate eicosanoids, inflammation, and cell membrane function. From a mechanistic standpoint, they fit well within allergic diseases that have an inflammatory component. However, the **clinical evidence is uneven and dependent on the context of intervention**.

A systematic review and meta-analysis concluded that supplementation with long-chain n-3 fatty acids during pregnancy may reduce the risk of asthma and/or wheeze in offspring, although the strength of the evidence was rated as low. Another review found that fish oil supplementation during pregnancy and breastfeeding could reduce sensitisation to egg with moderate certainty, but it was unclear whether that reduced sensitisation translated into lower rates of clinical food allergy. The AAAAI also summarised favourable data on maternal supplementation with regard to sensitisation to egg and peanut, but did not find the same effect for subsequent infant consumption.

Sources and allergenic risk

Fish oil, krill, marine collagen, and derivatives of molluscs and crustaceans require particular vigilance in allergic individuals. Published cases of anaphylaxis caused by fish oil capsules exist. For those with fish or shellfish allergy, certified algal sources should be used or individual assessment carried out.

Most defensible positioning

EPA/DHA make greater sense as general anti-inflammatory adjuncts and within **very cautious maternal and infant health** positionings, but they are not a robust tool for directly relieving established allergic rhinitis in adults.

3.4 – 3.7. Micronutrients, Polyphenols and Prebiotics

1

Vitamin C

Antioxidant, participates in collagen synthesis and immune function. A possible antihistamine effect at high doses has been proposed, but clinical evidence in allergic rhinitis is not robust. Useful as **antioxidant nutritional support** in diets low in fruit and vegetables. Tolerable upper limit: 2,000 mg/day in adults.

2

Zinc and Selenium

Essential for immune function and antioxidant defence. Correcting deficiency is clinically logical. However, supplementing above requirements has not demonstrated any anti-allergic benefit. Zinc >50 mg/day interferes with copper absorption and reduces HDL. Selenosis: hair loss, garlic breath, neurological disturbances. **Upper limits: zinc 40 mg/day; selenium 400 mcg/day.**

3

Quercetin and Polyphenols

Flavonoid with antioxidant and anti-inflammatory activity. Experimental studies indicate the capacity to stabilise mast cells and reduce histamine release. Clinical trials remain small and heterogeneous. Low bioavailability means that standard aglycone quercetin, phytosomes, or glycosides are not equivalent formulations. **A promising ingredient for "seasonal respiratory comfort"**, but never as a natural antihistamine equivalent to pharmaceutical drugs.

4

Prebiotics and Synbiotics

Promote the production of short-chain fatty acids with effects on the intestinal barrier and regulatory T cells. The World Allergy Organization has developed specific recommendations, but the evidence is of limited certainty. FOS, GOS, inulin, PHGG, or beta-glucans are useful options as microbiota support. Synbiotic formulations should prioritise strain viability, compatibility with fibres, stability, and digestive tolerance.

4. By Allergy Type: Likely Practical Utility

The applicability of the various supplements varies significantly depending on the allergic phenotype. Below is the recommended technical prioritisation for the main clinical presentations, always under the principle that no supplement replaces the medical treatment established by clinical guidelines.

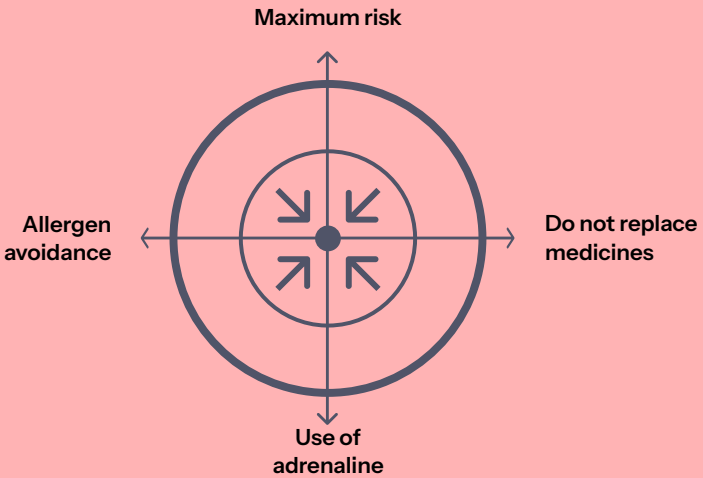
RINITIS ALÉRGICA: Probióticos documentados, vitamina D (si insuficiencia), quercetina, vitamina C.

ASMA ALÉRGICA: Corrección déficit vitamina D, omega-3, antioxidantes de soporte.

DERMATITIS ATÓPICA: Probióticos seleccionados, vitamina D (si déficit), omega-3 (ÁGE), zinc (sólo déficit).

ALERGIA ALIMENTARIA: Evitar claims de cura/prevención, sin alérgenos relevantes, trazabilidad rigurosa.

In allergic asthma and food allergy, the potential clinical risk is at its highest. No supplement should be communicated as a substitute for inhaled corticosteroids, bronchodilators, auto-injectable adrenaline, or allergen avoidance.




Quercetin
Omega 3
Probiotics

4.4 – 4.5. Food Allergy and Urticaria: Maximum Caution Required

IgE-mediated food allergy is the area where the greatest care must be taken during product development. **No supplement eliminates a food allergy or replaces allergen avoidance, an emergency action plan, or adrenaline auto-injectors** where indicated. EAACI guidelines recommend a comprehensive approach: avoidance, specialist dietary advice, written action plans, education, adrenaline auto-injectors, psychological support, omalizumab and, in certain paediatric cases, oral immunotherapy.

During pregnancy and breastfeeding, some data suggest that probiotics and fish oil may reduce eczema or food sensitisation in offspring, but this does not authorise a general claim for the prevention of clinical food allergy. In chronic spontaneous urticaria — with its complex immunological mechanisms, not always IgE-mediated — supplements play a very limited role, and formulae containing high-risk botanicals, 'detox' blends, or histamine-releasing ingredients should be avoided.

Avoid

Claims of prevention or treatment of food allergy

Formulate

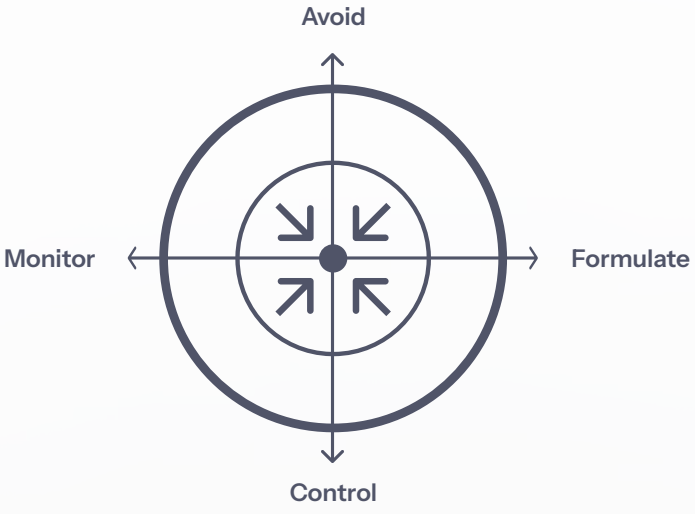
Without relevant allergens, or declaring them with the utmost rigour

Control

Analytical traceability and cross-contamination throughout the entire supply chain

Monitor

Milk, egg, soya, fish, crustaceans, tree nuts, sesame, gluten



5. Supplements That Can Worsen or Trigger Allergic Reactions

This section is essential from the perspective of product development and consumer safety. A product marketed "for allergies" can become a genuine clinical problem if it contains sensitising ingredients that are poorly declared or have uncontrolled traces. The paradox is particularly relevant in a commercial context where the target audience is precisely those individuals with allergies.

Apiary-derived products

Pollen, propolis, and royal jelly: associated with urticaria, eczema, and severe reactions. ANSES has reported serious cases involving supplements containing these ingredients.

Echinacea

ASCIA advises that it can cause anaphylaxis, asthmatic crises, severe urticaria, and swelling. Contraindicated in autoimmune disease and organ transplant recipients.

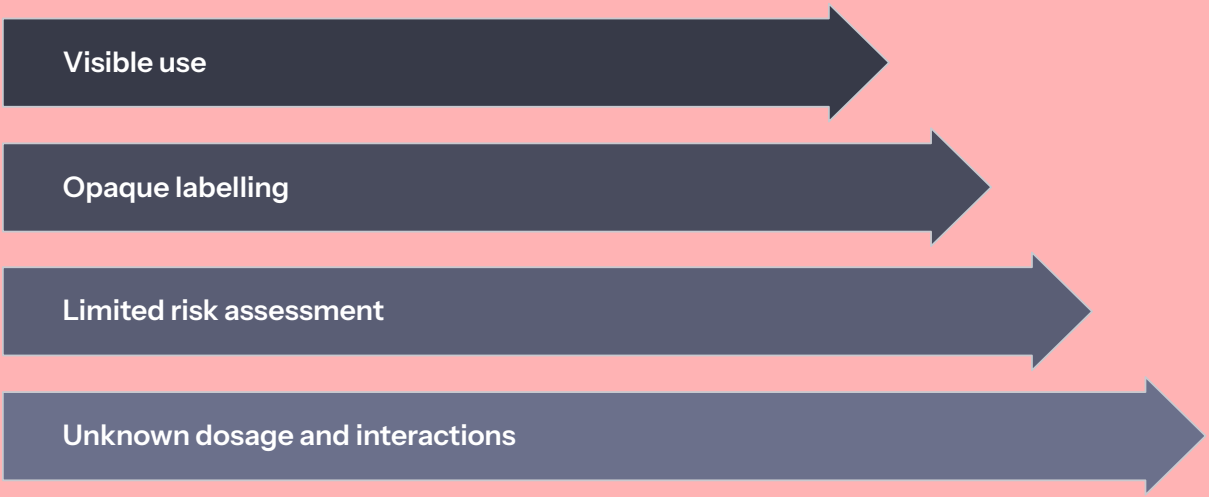
Fish oil and marine derivatives

Risk in individuals allergic to fish, crustaceans, or molluscs. Published cases of anaphylaxis from capsules exist. Purification does not guarantee the complete absence of residual allergenic protein.

Probiotics in dairy matrices

Probiotics with traces of milk or soya are relevant for individuals allergic to these proteins. Gelatine, soft capsules, flavourings, and colorants can be equally problematic.

⊗ **Proprietary blends** with opaque compositions make it difficult to evaluate risk, dosage, and interactions. Their use in products intended for allergic populations is particularly inadvisable.

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6. Regulatory Framework and Claims in the European Union

In the European Union, food supplements are regulated as **foods, not medicines**. Directive 2002/46/EC establishes the framework for food supplements, and Regulation 1924/2006 governs nutritional and health claims. This has a fundamental practical consequence: it is not permissible to communicate that a supplement «prevents», «treats» or «cures» allergies without specific authorisation to do so — something which in practice does not exist in the European register.

Regulation 432/2012 lists authorised claims for nutrients such as vitamin D, vitamin C, zinc and selenium in relation to normal immune function. The most defensible approach is to use these claims only when the product strictly meets the established conditions of use, including minimum doses per serving and relevant warnings. The regulatory boundary is clear, and transgressing it exposes the manufacturer or distributor to legal action by food control authorities.

✓ Regulatorily acceptable

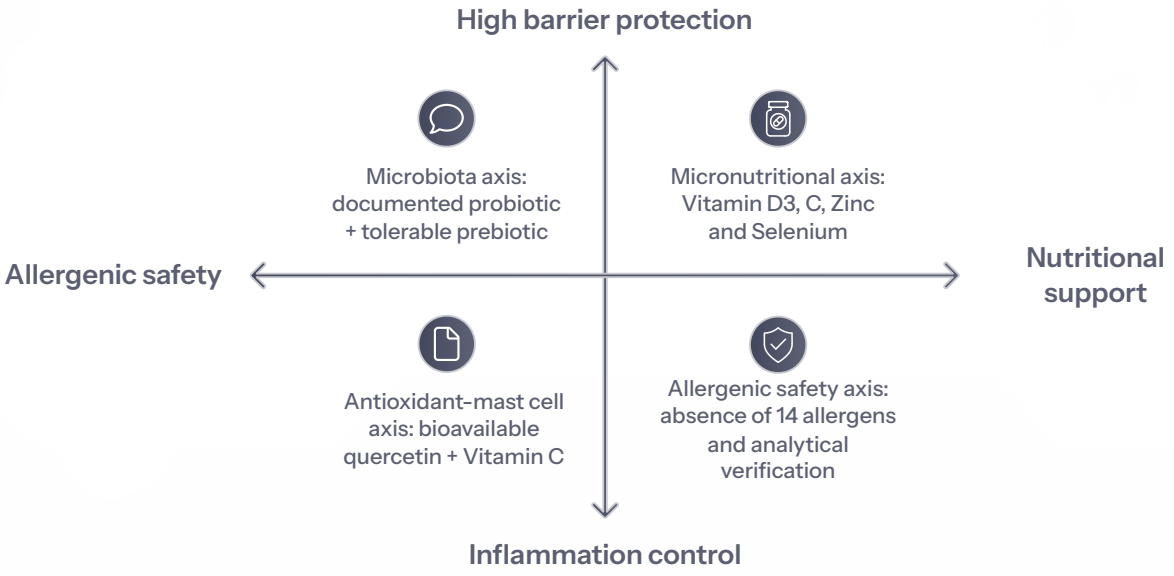
- «With vitamin D, zinc and selenium, which contribute to the normal functioning of the immune system»
- «Seasonal comfort and microbiota balance»
- «Antioxidant support»
- «Contributes to maintaining the skin barrier»

□ Problematic or unlawful

- «Prevents seasonal allergies»
- «Reduces pollen allergy»
- «Replaces antihistamines»
- «Strengthens defences against allergens»
- «Natural treatment for rhinitis»

7. Proposed Reasonable Formulation for Allergic Wellbeing

A technically defensible formulation must avoid the «immunostimulation» approach and focus on **nutritional immunomodulation, barrier protection, and seasonal comfort**. Each axis of action must be supported by selected ingredients, evidence-based doses, and a fully controlled allergenic profile.



The conceptual adjuvant formula integrates the four axes in a coherent manner. The microbiota-barrier axis is underpinned by probiotics combining strains of *Lactobacillus* and *Bifidobacterium* with evidence in rhinitis or atopic dermatitis, plus a tolerable prebiotic (acacia fibre, PHGG, low-dose inulin, or GOS/FOS). The micronutritional axis incorporates vitamin D3 at a safe nutritional dose, moderate vitamin C, zinc close to the NRV, and selenium at a prudent dose. The antioxidant/mast cell axis adds quercetin in a bioavailable form, optionally accompanied by vitamin C. Finally, the allergenic safety axis ensures the absence of lactose, milk protein, egg, fish, crustaceans/molluscs, tree nuts, sesame, and gluten, with analytical verification and cross-contamination controls.

A formulation of this type can be legitimately communicated under authorised claims of «normal immune function», «seasonal comfort», and «antioxidant support», without crossing regulatory boundaries into therapeutic-type claims.


Pollen Levels

8. Conclusions and Technical-Business Recommendations

From a scientific and clinical standpoint, certain supplements may contribute to the wellbeing of people with common allergies, but their role cannot exceed the legal limits established: it is **adjuvant, selective, and dependent on the patient's phenotype**. The academic and technical-business recommendation is clear: formulate with precision, document strains and doses, avoid allergens, make no medical claims, and communicate in terms of 'normal immune function', 'seasonal comfort', 'microbiota balance', and 'antioxidant support'.

Specific Probiotics

Best candidate for allergic rhinitis and atopic dermatitis. Always with a documented strain, CFU at end of shelf life, and no allergens in the matrix.

Vitamin D3

Useful where deficiency or insufficiency exists. Should not be marketed as universal prevention of allergies. Ideally supported by prior analytical assessment.

Omega-3 EPA/DHA

Plausible as a nutritional anti-inflammatory. Evidence more interesting in early life stages than in direct symptomatic treatment. Monitor allergenic source.

Vitamin C, Zinc, and Selenium

Nutritional antioxidant and immune support. Useful for normalising immune function when dietary intake is insufficient. Avoid megadoses and direct anti-allergic claims.

Bioavailable Quercetin

A promising ingredient in allergic rhinitis, but not yet equivalent to pharmacological treatment. Bioavailability is critical for any clinical extrapolation.

> 'Formulating products for allergic wellbeing demands scientific precision, regulatory rigour, and communication that does not place the risk at the boundaries of products with purported therapeutic intent — a space reserved for medicines and certain medical devices.'

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