TECHNICAL UNLOCKS IN PEA PROTEIN UTILIZATION

An exploration of patent filings detailing pea protein innovation

PULSE CANADA

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EXECUTIVE SUMMARY

This report provides a comprehensive review of intellectual property (IP) activity related to pea protein technologies, identifying emerging innovation clusters, technical trends, and areas of market opportunity. A total of 177 patents were analyzed, with the majority filed within the past five years. Global activity is concentrated in China (35%), the United States (17%), France (11%), Japan (7%), and Germany (6%), reflecting strong commercial interest in pea protein as a versatile, renewable, and functional ingredient across food, non-food, and material science applications.

The findings confirm that pea protein is transitioning from a commodity ingredient to a structural and functional polymer whose properties can be tailored through physical, enzymatic, or chemical modification. Across sectors, inventors emphasize improvements in solubility, emulsification, and textural behavior, as well as novel processing approaches such as encapsulation, high-moisture extrusion, and co-networking with polysaccharides or lipids. The patent landscape collectively demonstrates a shift toward precision functionality, where protein structure and processing parameters are engineered to deliver specific sensory, nutritional, and performance outcomes.

In non-food applications, pea protein is increasingly adopted as a bio-based performance material in cosmetics, pharmaceuticals, animal health, and industrial systems. Hydrolyzed peptides and globulin fractions function as moisturizers, conditioners, and film-formers in skin and hair care formulations. Denatured and modified proteins serve as encapsulating matrices in fragrance and active-delivery systems, while enzymatically tailored isolates form biodegradable coatings and adhesive films with antimicrobial properties. These applications highlight the potential for pea protein to replace petrochemical or animal-derived components in sustainable material development.

In food applications, pea protein appears across all major product categories, demonstrating versatility in emulsification, encapsulation, flavor modulation, and structural design. Patents describe its use as an interfacial stabilizer in emulsions, microcapsule wall material in spray-dried systems, and texturizing agent in both high- and low-moisture extrusion processes. Pea protein forms the structural base of next-generation meat analogues, dairy alternatives, egg substitutes, and nutritional beverages. Its ability to interact synergistically with polysaccharides and lipids under controlled pH and thermal regimes enables development of stable foams, gels, and emulsions. Beyond formulation functionality, enzymatic hydrolysis and fermentation are leveraged to enhance digestibility, flavor, and amino acid release, further positioning pea protein as a leading plant-based alternative to animal proteins.

The **protein modification and processing** segment reflects targeted efforts to overcome inherent limitations in solubility, flavor, and gelation. Patents detail enzymatic hydrolysis, pH-shift processing, glycosylation, and crosslinking to tailor molecular weight distribution and surface charge, improving dispersibility and emulsification across diverse matrices. Controlled oxidation, calcium bridging, and mild chemical conjugation produce gels and emulsions with enhanced elasticity and stability. Collectively, these modifications illustrate how relatively mild treatments can yield functional differentiation, expanding pea protein's usability in both food and non-food systems.

Overall, the intellectual property landscape underscores the rapid evolution of pea protein technology from conventional extraction to advanced structural engineering. Continued research and commercialization in these domains will enhance Canada's strategic advantage as a producer and knowledge leader in plant protein innovation.

Technical Unlocks in Pea Protein Utilization

Key Insights

- **Rapid Global Growth:** 177 high-priority pea protein patents have been filed globally, with more than two-thirds appearing within the past five years, signaling sustained R&D investment and market confidence.
- **Shift Toward Functional Engineering:** Innovation has moved beyond basic extraction to deliberate molecular and interfacial engineering, enabling precise control of solubility, texture, and flavor.
- **Diversified Applications:** Pea protein now spans food, nutraceutical, pharmaceutical, and industrial domains, functioning as both a nutritional macronutrient and a structural biopolymer.
- **Processing-Driven Innovation:** Patent activity is concentrated around enzymatic modification, co-networking with polysaccharides, and extrusion-based structuring, underscoring process control as the key to functional differentiation.
- **Strategic Opportunity for Canada:** The evolution of pea protein from commodity to platform ingredient aligns with Canada's agri-food innovation priorities, reinforcing opportunities in sustainable processing, export diversification, and high-value applications.

BACKGROUND AND APPROACH

Pulse Canada commissioned RTI Innovation Advisors (RTI IA) to conduct a comprehensive analysis of intellectual property (IP) filings related to pea protein technologies. This in-depth review of patents allowed for the extraction of technical knowledge and derived insights on unlocking new growth opportunities in the pea protein market. This research highlights key patents, technologies, and offers a global perspective on the utilization and advantages of pea proteins across various applications, including food, cosmetics, and industrial uses. This comprehensive report was drafted by Pulse Canada leveraging the insights collected by RTI IA team.

The project followed a strategic process to enable capture and analysis of highly relevant patents starting from a broad search string to ensure comprehensive coverage. The search string returned a total of 51,008 patents which underwent an iterative, strategic filtering approach to narrow the data set to a total of 198 high-priority patents (Figure 1). Upon review of these high-priority patents, some patents were further removed as they were associated with whole pea utilization and not pea protein, making for a total of 177 patents referenced in this report.

Search String: (@(abstract,claims,title) ((pea OR pisum sativum OR lathyrus oleraceus OR yellow pea OR split pea) AND (protein OR high-protein flour OR high-protein flour OR protein concentrate OR protein isolate)

Technical Unlocks in Pea Protein Utilization

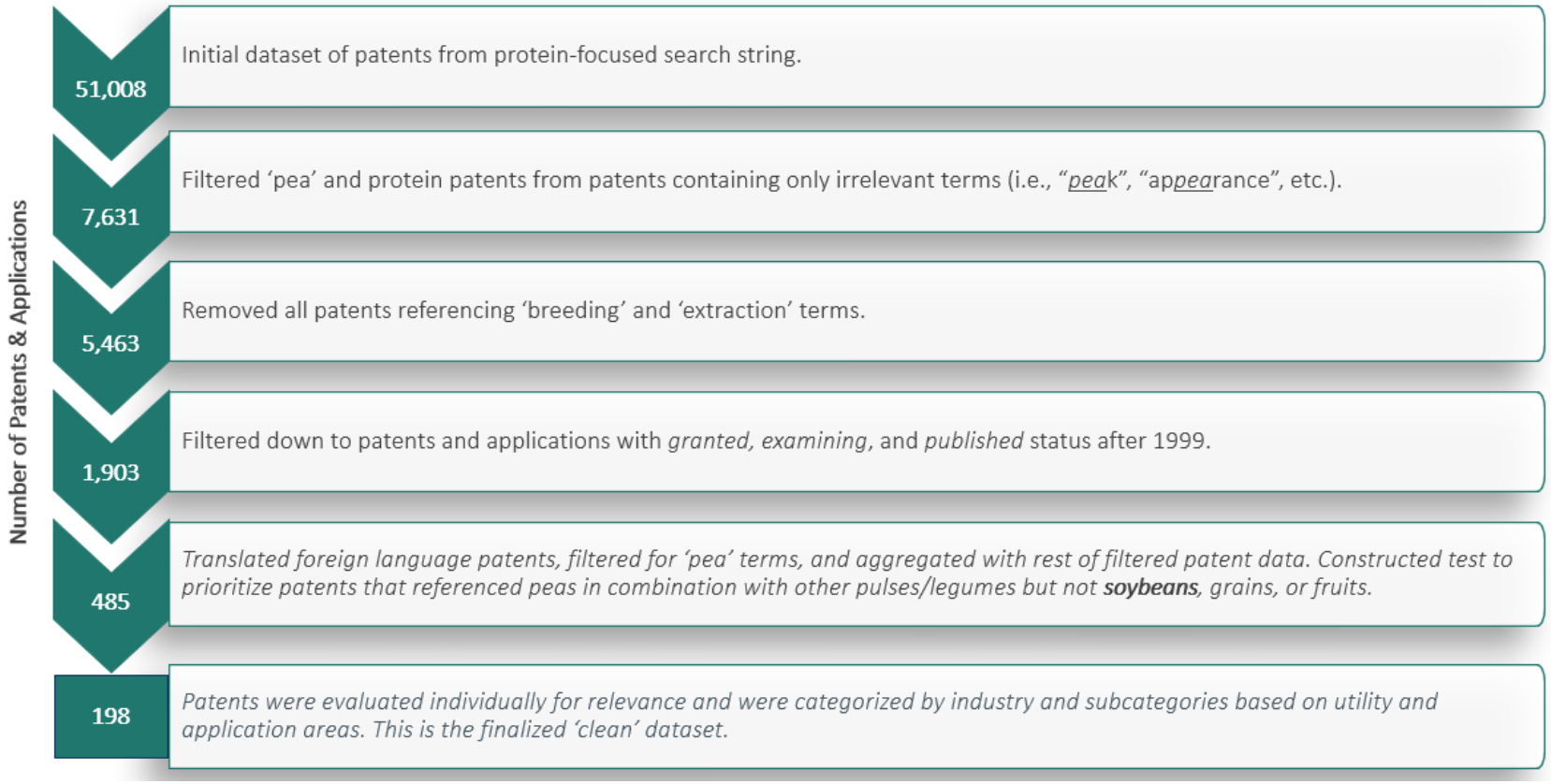

Figure 1. Filtering approach applied to the dataset of patents from protein-focused search string.

Some irrelevant patents were further removed, making

for a total of 177 patents referenced in this report.

Most of the prioritized patents and applications have been filed in the last five years (Figure 2), with activity highest in China (~35%), the United States (~17%), France, (~11%), Japan (~7%), and Germany (~6%).

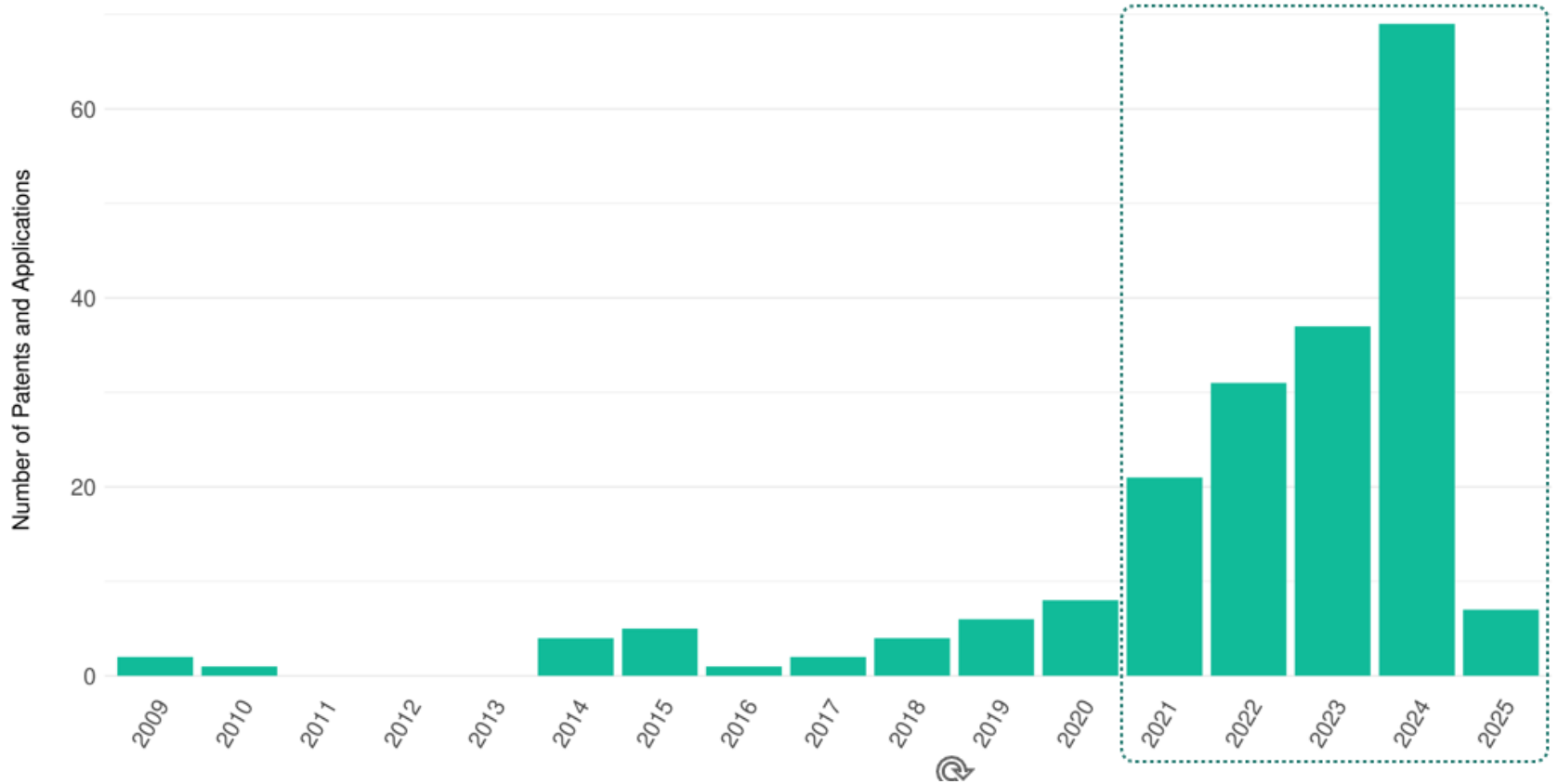

Figure 2. Number of patents and applications related to pea protein utilization filed annually.

NON-FOOD APPLICATIONS

Patent activity in non-food applications demonstrates the broad versatility of pea protein as a functional additive across cosmetic, pharmaceutical, animal health, and industrial domains. Filings reveal a shift beyond nutritional use toward bio-based, functional inclusions in formulations that demand film-forming, encapsulating, or interfacial stabilization functions.

- Within personal and home care products, hydrolyzed pea peptides (<5 kDa) and globulin fractions appear as moisturizing, tightening, or conditioning actives. Their low molecular weight, mild sensory profile, and skin compatibility support integration into sensitive-skin and anti-aging systems, while modified peptides and globulins improve film formation and texture in hair and lash care.
- In fragrance delivery and deodorant systems, native, denatured, and hydrolyzed pea proteins act as biodegradable wall materials or carriers, forming microcapsules, gels, and aerogels that control fragrance release while replacing synthetic polymers.
- The pharmaceutical and nutraceutical segment positions pea protein as a structural encapsulant or carrier enabling mild encapsulation of heat- or acid-sensitive actives. Denatured and native isolates are used for cold-set gelation, interfacial polymerization, or as self-assembled nanoparticles, providing acid resistance and controlled release in gastrointestinal or ileal environments. These functionalities extend into medical nutrition, where hydrolysates supply digestible nitrogen and anti-adhesive bioactivity against pathogens such as *H. pylori*.
- Across animal health and feed applications, pea proteins contribute digestible amino acids, serve as heat-settable binders, and even appear as sources of antiviral peptides active against porcine epidemic diarrhea virus.
- Industrially, modified pea proteins (e.g., phosphorylated, glycosylated) function as film-forming and adhesive matrices, improving hydrophobicity, mechanical integrity, and antimicrobial performance in coatings, active packaging, and preservative sprays.

Overall, the non-food patent landscape reflects growing recognition of pea protein as a multifunctional ingredient capable of replacing petrochemical or animal-derived components in health, cosmetic, and material systems. Its tunable molecular structure (native, denatured, hydrolyzed) and compatibility with standard aqueous processing methods provide a strong foundation for biodegradable and clean-label innovation beyond food use.

PERSONAL & HOME CARE PRODUCTS

Skin Care

Across these filings, pea protein is used mainly in two functional forms as a low–molecular weight peptide hydrolysates or globulin. The pes protein derivates contribute to moisturization, tightening/firming, and aesthetics. Hydrolyzed pea peptides are positioned as moisturizing actives that support hydration markers in leave-on formats (334) and appear in sensitive-skin anti-aging blends and eye-area treatments (50638, 48225). Pea globulins are paired with specific botanicals (poppy petal; mimosa seed) to enhance skin-tightening effects (43476, 43499). In oil-rich essences, hydrolyzed pea protein is included to improve rub-in and mitigate "whitening"/residue while contributing to moisturization and skin feel (48936, 49267). Pea protein is also listed within liposomal cosmetic systems, indicating compatibility with delivery formats commonly used for actives (9266).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Moisturization properties of peptide hydrolysates**: claimed improvements in skin hydration markers (e.g., AQP3, GAGs, filaggrin) at low inclusion levels in leave-on cosmetics. (334)
- **Tightening/firming properties as a co-active:** Pea globulins combined with botanical extracts obtain/enhance immediate skin-tightening effects. (43476, 43499)
- **Sensitive-area/sensitive-skin suitability**: Hydrolyzed pea protein included in eye-contour and sensitive-skin anti-aging compositions. (48225, 50638)
- **Allows for tailored sensory and appearance attributes**: Hydrolyzed pea protein used to lighten texture, reduce "white cast"/whitening, and improve overall skin feel in camellia-oil essences. (48936, 49267)
- **Formulation compatibility**: Deployment in liposomal systems and emulsions suggests good compatibility as an active or co-active within common cosmetic delivery and base formats. (9266, 48936)

PULSE CANADA

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Liposomal topical system intended to deliver cosmetic actives (e.g., small peptides) to dermal white adipose tissue via follicular targeting; focuses on nanoscale vesicle size control for enhanced penetration.	Pea-derived ingredient referenced as part of the composition (supporting component) rather than the primary active; specific format not specified.	Liposomes carrying cosmetic actives. Specific levels of pea-derived materials not specified.	Prepare liposomal dispersion containing the targeted peptide; adjust and control average particle size (~150–220 nm); topical administration to scalp/skin.	9266
Improved cosmetic moisturizing composition.	Pea protein hydrolysate (peptides <5 kDa) as the moisturizing active that upregulates hydration markers (AQP3, glycosaminoglycans, filaggrin).	Peptide hydrolysate formulated at ~0.5–1.0% w/w peptide content in finished cosmetic.	Delipidation and PVPP-assisted extraction of pea protein followed by hydrolysis at pH 7–8 with fungal protease (Aspergillus); purify to <5 kDa fraction; dilute into water-glycerol carrier.	334
Topical preparation aimed at treatment/care of eyelids and eye-contour.	Hydrolyzed pea protein included as a supportive proteinaceous component (skin-conditioning/film-forming role).	Composition includes Ophiopogon extract alongside cosmetic excipients; hydrolyzed pea protein present (level not specified).	Standard topical compounding (solution/gel/cream forms) for periocular application; no unique processing conditions disclosed in the extract.	48225
Anti-aging/tightening cosmetic compositions.	Pea globulins used in combination with the active to enhance immediate tightening effect (protein film formation).	Poppy petal extract with an added quantity of pea globulins; precise inclusion levels not specified in the extract.	Conventional emulsification/solution preparation and incorporation of botanical extract with pea globulins; no special processing parameters reported in the extract.	43476

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Anti-aging/tightening compositions with firming/lifting effects.	Pea globulins combined with the active extract to augment skin tightening and film-forming performance.	Mimosa seed extract with pea globulins; specific percentages not listed.	Standard cosmetic batching (aqueous or emulsion matrices) with gentle addition of protein fraction; no process conditions specified.	43499
Anti-age composition suitable for sensitive skin; aims to improve barrier/function while minimizing irritation.	Hydrolyzed pea protein as a mild, film-forming/conditioning protein compatible with sensitive skin.	Composition lists functional ranges for actives (e.g., 0.1–10 parts by weight for certain components); specific pea protein level not provided.	Mild processing typical of sensitive-skin formulas (low fragrance, controlled pH, standard cold/hot mixing); no further process conditions specified.	50638
Reduced characteristic odor and improved sensorials of refined camellia seed oil based skin care compositions.	Hydrolyzed pea protein added to mitigate whitening effect, improve spread/feel, and support moisturization.	Example formula indicates ~0.5% hydrolyzed pea protein together with refined camellia seed oil and standard cosmetic excipients.	Blend refined camellia oil with aqueous phase and functional additives; incorporate hydrolyzed pea protein; standard homogenization/emulsification; no atypical parameters given provided.	48936
Essence/serum designed for moisturization and regeneration.	Hydrolyzed pea protein as one of the proteinaceous actives to support moisturization/repair.	Oil essence with camellia oil and hydrolyzed vegetable proteins.	Essence/serum compounding with staged mixing of oils and aqueous actives; typical low-shear incorporation for clarity.	49267

Hair Care

Across the hair category, pea protein appears primarily as low molecular weight hydrolysates, as chemically modified peptide derivatives, and as unhydrolyzed protein in a lash serum. The hydrolysates (≤5 kDa peptides) are positioned for antioxidant protection and surface repair of keratin fibers, with claimed reductions in oxidative-stress markers during UV or chemical stress (13262). Very low-MW hydrolysates (≤2,000 Da) are used in conditioning masks which deposit into cuticle microvoids and enhance moisture retention and feel (7612). Chemically modified pea protein is employed as a conditioning base to increase hydrophobicity, smoothness, and combability of damaged hair (19627). Finally, pea protein is formulated into an eyelash compositions targeting length, density, strength, and pigmentation (49642).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Protection against oxidative stress:** Antioxidant activity of pea protein hydrolysates is specifically linked to mitigating follicle-cell oxidative stress under UV/chemical exposure (13262).
- **Improved moisture retention and hair feel:** Very low-MW pea peptides are described to fill gaps within cuticle defects and form films resulting in improvements to feel and moisture retention (7612).
- **Conditioning agent**: Succinylated, acyl-peptide amidoamine salts derived from pea protein function as conditioning bases that raise fiber hydrophobicity and improve dry/wet combing (19627).
- **Plant-based strengthening active:** Pea protein as the active in eyelash formulations aimed at strength and appearance while maintaining a plant-based positioning (49642).

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Cosmetic antioxidant agent to protect keratin fibers (hair, body hair, eyelashes, eyebrows)	Hydrolysate of pea proteins (low-MW peptides, primarily <5 kDa) used as the antioxidant active; intended to protect keratin fibers from UV and chemically induced oxidative stress, support follicle cell health, and reduced catalase and cleaved caspase-3 in hair follicle cells and protection during coloring, straightening, perms, and blow-dries.	Finished cosmetic compositions contain pea peptide hydrolysate at about 0.005–1.5% w/w.	Process conditions not specified.	13262
Natural, vegan hair-conditioning mask designed to repair and moisturize damaged hair; positions low-MW peptides to deposit into cuticle gaps to improve feel and moisture retention.	Hydrolyzed pea protein (≤2,000 Da) as a vegan, gluten-free reconstruction agent to fill cuticle micro-defects and improve conditioning.	Pea protein at about 0.1–5% w/w. Mask matrix can include water, emollients, conditioning agents, botanical actives (e.g., kaolin), and oils.	Disperse kaolin clay, combine with aqueous and oil components, incorporate hydrolyzed pea protein, and adjust pH with citric acid. No temperatures, shear rates, or hold times specified.	7612

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Cosmetic base materials for hair care products to improve hydrophobicity, smoothness, and combing of damaged hair.	Fatty acid amidoamine salts of succinylated pea protein. Functions as cationic/conditioning actives improving feel, manageability, and surface hydrophobicity.	Base material used at about 0.1–10% w/w in finished hair products.	The patent does not provide product-level batching steps or processing conditions for finished hair formulations.	19627
Eyelash growth liquid intended to increase eyelash length, density, strength, and pigmentation; plant-based, clean-label positioning.	Pea protein serves as a plant-derived protein active for follicle support in an eyelash serum format.	Pea protein (2–10% w/w) and typical eyelash-serum components (solvent system, humectants, botanical or vitamin co-actives, preservatives).	Dissolve azelaic acid in ethanol; add pea protein (2–10%), silkworm pupa oil, vitamin E acetate; warm to approx. 75 °C under stirring (about 450 rpm) for ~25–30 min. Dissolve xylitol and stevia in purified water to create Phase A. Disperse scleroglucan and xanthan; combine with a supramolecular gel base to create Phase B. Blend phases A and B at about 850 rpm for ~35 min. Adjust system to pH 5.3–5.5. Add pantothenate solution (phase C), make up to volume with water, mix uniformly, filter then fill.	49642

Bio-Based Encapsulation & Fragrance Delivery

Across these filings, native, denatured or hydrolyzed pea protein acts structuring material for controlled delivery of volatiles and cosmetic actives. In microcapsules, it forms part of the shell (alone or with crosslinkers such as polyisocyanates and tannic acid) to stabilize and modulate release of actives in home- and personal-care applications. In aerogels, it contributes to a lightweight, porous matrix with high loading capacity. In deodorant/odor-management systems, hydrolyzed pea protein helps to retain active ingredients within aqueous or hydroalcoholic bases. Processing is generally mild (ambient to moderate temperatures, aqueous media), aligning with clean-label and biodegradable design goals while enabling use in detergents, softeners, personal-care, and fine-fragrance products.

Pea Protein Attributes as Claimed by Patent Applicants:

- **Film/shell forming**: supports interfacial shell formation for microcapsules
- **Flexible reactivity**: the state of pea protein allows for tailored functionality, where denaturation enhances crosslink density in capsule shells and hydrolysates improve solubility in leave-on bases.
- **Compatibility with active substances**: Effectively encapsulates hydrophobic perfume oils, including low-logP fragrances, and can physically entrap volatiles within protein-based aerogel networks.
- **Controlled release & stability**: Protein matrices/shells help moderate diffusion of fragrance/actives and protect against volatilization and oxidation.
- **Process suitability**: Functions in water-based systems at ambient–moderate temperatures and near-neutral pH; tolerant of standard emulsification and homogenization steps used to form capsules or gels.
- **Biodegradability & clean-label positioning**: Replaces or reduces reliance on fully synthetic polymers in delivery systems while maintaining performance in detergents, fabric softeners, and personal-care products.

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Biodegradable microcapsules designed for controlled release of encapsulated actives/fragrances.	Denatured pea protein functions as the protein component in the shell cross-linking system to build a biodegradable capsule wall.	Core: active material. Wall: polymeric network of a polyisocyanate and cross-linker comprising protein (whey or pea) and tannic acid. The protein:polyisocyanate weight ratio is 1:1 to 10:1; where protein represents 50–90% of wall by weight.	No processing operations disclosed.	706
Biodegradable microcapsules tailored for low log P fragrances to deliver environmentally friendly fragrance release in personal care.	Native pea protein is part of a shell-forming material to create a biodegradable wall.	Core: low log P fragrance. Shell: native pea protein with polyisocyanate	No processing operations disclosed.	2319
Biodegradable fragrance microcapsules for detergents, fabric softeners, and personal care, enabling controlled fragrance release.	Pea protein included in biodegradable wall components	Other constituents not specified.	No processing operations disclosed.	3935

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Deodorant/odor-management cosmetic compositions designed to reduce body malodor through enzyme inhibition/adsorption systems; suitable for leave-on products.	Pea protein hydrolysate used as a plant-derived supportive component to help stabilize/anchor actives in the cosmetic base.	Hydroalcoholic or aqueous base; enzyme-inhibiting/adsorbent actives; optional fragrance; pea protein hydrolysate	Prepare separate polyphenol/oxidase and protein solutions; combine under controlled mixing to trigger enzymatic crosslinking and gel formation; optionally form beads/particles; fill.	9266
Aerogel carrier particles for controlled fragrance delivery with high loading capacity and low density	Pea protein as part of a protein–polysaccharide aerogel matrix that physically entraps fragrance.	Protein–polysaccharide gel network (includes pea protein), plasticizer, optional silica; fragrance	Form aqueous solution, gel at 30–60 °C and crosslink; solvent exchange; supercritical CO_2 drying at 35–50 °C, 80–120 bar; post-dry fragrance loading by vacuum/pressure impregnation as needed.	9557

PHARMACEUTICALS/NUTRACEUTICALS

Delivery & Encapsulation Systems

Pea protein is positioned as a versatile encapsulation matrix, serving as a shell-forming polymer in interfacial systems, an emulsifier for oil-in-water cores prior to drying, and a self-assembling carrier for nanoscale delivery. Denatured pea protein isolate (PPI)and native PPI are both used referenced for their cold-set gelation capacity and gastric-resistant while native PPI-stabilized emulsions function when dried as microcapsules. Several applications target site-specific release (notably ileal delivery for probiotics), oxidative stabilization of long-chain omega-3s, and controlled fragrance retention and release.

Pea Protein Attributes as Claimed by Patent Applicants:

- **Shell formation under mild conditions**: Pea protein (native or denatured) forms robust capsule walls by interfacial polymerization or ionic/phenolic cross-linking, enabling heat-sensitive actives to be encapsulated without harsh processing (706, 2319, 3935, 50371).
- **Gastric resistance with targeted ileal release**: Matrices including PPI produce acid-resistant microcapsules that release in the small intestine, suited for probiotics and oral actives (1331, 1378, 1938).
- **Emulsification**: PPI provides sufficient interfacial activity to stabilize oil-in-water cores (e.g., fish oil) before spray drying, improving oxidative stability and shelf life (49008, 49767).
- **Self-assembly into nanoparticles**: Pea protein can be modified to self-assemble into nanoparticles that increase the stability and bioavailability of embedded bioactives (48489).
- **Compatibility with polysaccharides**: Strong complexation/coacervation with alginate, pectin, and PGA yields composite carriers with enhanced encapsulation efficiency and controlled release profiles (47987, 47831, 50371).
- **Fragrance retention and controlled release**: Protein-based shells (including pea protein) provide biodegradable alternatives to synthetic polymers for fragrance delivery in detergents and personal care, balancing deposition, retention, and release (2319, 3935, 3917).
- **Clean-label and plant-based positioning**: Pea protein enables egg-/gelatin-free and synthetic-polymer-reduced delivery systems aligned with plant-based and "free-from" claims (2319, 49008, 49767).

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Probiotic microcapsules designed to survive gastric transit and release in the ileum	Denatured PPI in the encapsulating matrix; forms gastric-resistant shells.	10–15% (w/w) denatured PPI suspension, probiotic culture; calcium citrate buffer	Prepare denatured PPI suspension; hydrate probiotics; combine; form microdroplets by extrusion; polymerize in calcium citrate buffer to gel shells; collect and optionally dry.	1331
Omega-3 LC-PUFA (e.g., fish oil) microcapsules with improved oxidative stability and shelf-life for food uses.	PPI as emulsifier and wall former for spray-dried microcapsules.	fish oil, PPI	Emulsify oil with PPI; homogenize; spray-dry to form microcapsules	49008
Protein nanoparticles for bioactive delivery	PPI as nanoparticle-forming material	PPI; sulfite; bioactives	Mix sulfite with PPI to break disulfide bonds; heat to promote hydrophobic aggregation and re-form disulfides; obtain self-assembled PPI nanoparticles; load actives.	48489
Compact starch-protein nanoparticles for encapsulating bioactives; chemical crosslinkers avoided.	Pea protein (form not specified) co-assembles with modified starch to build particles.	Modified starch (e.g., OSA starch) plus pea protein solution at 5â€“10 mg/mL; bioactive payload.	Prepare starch and pea protein solutions; mix to induce starchâ€“protein complexation; form nanoparticles; load and recover particles; conditions per formulation.	49303

PPI = pea protein isolate

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Double-layer emulsions for beta-carotene delivery with improved stability and bioavailability.	Pea protein as primary interfacial layer; works with gamma-polyglutamic acid (gamma-PGA) for secondary layer.	Beta-carotene dispersed in composite emulsion of pea protein plus gamma-PGA.	Create primary pea-protein-stabilized emulsion; add gamma-PGA to form secondary coating; process as needed for storage or use.	47987
Composite nanoparticles for essential oil delivery (Chinese angelica) aimed at stability and controlled release; freeze-dried final form.	Pea protein co-assembled with plant pectin to form nanoparticle carrier.	Pea protein solution 0.0025â€"0.04 g/mL; water spinach pectin; essential oil payload.	Prepare pea protein and pectin solutions; mix; add essential oil under agitation to form composite nanoparticles; freeze-dry to obtain powder.	47831
Oral active delivery using oil-in-water nanoemulsions encapsulated within protein microcapsules; gastric protection with ileal release.	Denatured plant protein (includes pea) as shell former	O/W nanoemulsion containing active; denatured protein shell.	Form O/W nanoemulsion; mix into denatured protein solution; induce cold-set gelation to create microcapsules	1938
Vitamin delivery system using oil-based particles for controlled release.	Pea protein used in microcapsule shell material.	Oil-based vitamin; pea-protein-containing shell.	Form oil-based active; encapsulate with pea-protein-containing shell by interfacial shell formation; dry or set as required.	3917

PPI = pea protein isolate

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Microcapsules for heat- and acid-sensitive microorganisms.	Pea protein component of encapsulating wall for viability protection.	Pea protein; alginate; live microorganisms	Entrap microorganisms in pea protein-alginate matrix to form microcapsules; mild processing to maintain viability	50371
Fish-oil microcapsules using a composite wall for oxidative protection and controlled release.	PPI as primary wall component; functions synergistically with beta-cyclodextrin.	Core: fish oil (n-3 LCPUFAs). Wall: PPI plus beta-cyclodextrin	Prepare PPI/beta-cyclodextrin wall solution; emulsify fish oil; microencapsulate (e.g., spray drying) to obtain powder	49767
Gastric resistant microcapsules for protecting sensitive actives (e.g., probiotics)	Denatured pea protein as film-forming matrix component	Precursor blend contains denatured protein (includes pea protein), a polyol plasticizer (e.g., glycerol), trehalose, and a carrier; active (e.g., probiotic or hydrophobic emulsion) added prior to cross-linking.	Blend denatured protein, polyol, trehalose, carrier, add active to form precursor, introduce cross-linkable reagent and polymerize to form microcapsules; process described generically with emphasis on cold-set cross-linking	1376

PPI = pea protein isolate

Gastrointestinal Health

Pea protein is leveraged as a hydrolysate in medical-nutrition style formulas intended to control the balance of water and dissolved substance(s) and deliver readily absorbed nitrogen while supporting anti-adhesion activity against pathogens such as H. pylori (13459). Another filing uses pea protein as a carrier for proanthocyanidins, improving its stability and mucosal interaction to address diarrhea/IBS-type symptoms (625). Pea protein is also complexed with polysaccharides (e.g., xyloglucan) to form protective films/gels that reinforce epithelial barrier function under inflammatory conditions, including therapy-induced mucositis (1075). A separate multi-component anti-flatulence blend uses pea protein powder primarily as a nutritional carrier within a botanical/mineral system (49508).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Suitability for enteral use**: helps to control balance of water and concentration of the solution (13459)
- **Source of nitrogen**: delivers digestible nitrogen suitable for sensitive GI applications (13459).
- **Carrier of actives with enhance stability**: nutritional carrier of botanical/mineral systems, forms non-covalent complexes with polyphenols(625, 49508).
- **Protective coating**: blends with polysaccharides to create film/gel systems (1075)
- **Formulation versatility**: functional across powders, liquids, and composite blends (13459, 625, 1075, 49508).

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Medical nutrition composition to prevent or treat gastrointestinal infection by inhibiting pathogen adhesion (*H. pylori*); designed for enteral/oral use	Pea protein hydrolysate as a protein source; contributes anti-adhesive/anti-microbial functionality and digestible nitrogen.	Protein 5–50% of total calories; carbohydrate 10–70% kcal; fat 0–60% kcal. Hydrolysates may include pea alongside other plant/animal sources.	Blend hydrolysate(s) with carbohydrate and fat sources; adjust pH/osmolality; homogenize and UHT or HTST sterilize for enteral stability; fill aseptically.	13459
Therapeutic composition to manage gastrointestinal disorders (e.g., IBS, celiac, infectious diarrhea).	Pea protein as the carrier for proanthocyanidins to improve stability and mucosal interaction.	0.0001-40% wt proanthocyanidin-protein complex; active to protein weight ratio 1:200–1:1 Dosage forms include liquids, powders, capsules, tablets.	Prepare pea protein solution/suspension; mix with proanthocyanidin extract to form non-covalent complexes; remove solvent or dry (spray- or freeze-dry); blend with excipients and fill into oral dosage forms.	625

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Compositions providing barrier support to prevent or treat intestinal mucosal disorders (mucositis, chemotherapy-induced injury) by reducing permeability and inflammation.	Pea protein as a structural co-matrix to form protective films/gels that reinforce epithelial barrier.	Pea protein to polysaccharide ratio 30:70 to 50:50 (w/w). Optional excipients for oral liquids, suspensions, capsules, or oromucosal films.	Disperse pea protein and polysaccharide separately; combine under agitation to form a homogeneous matrix; cast or granulate depending on dosage form; dry to target moisture.	1075
Anti-flatulence composition to alleviate gastrointestinal gas and discomfort.	Pea protein powder included as a nutritional carrier and to support gastrointestinal comfort within a multi-component blend.	Pea protein powder (12–25% wt); Hericium erinaceus (10–20% wt); hawthorn (Crataegus) (8–16% wt)	Dry mix the specified powders; optionally mill/sieve; blend to uniformity; dose into sachets/capsules or compress into tablets.	49508

Metabolic & Cardiovascular Regulation

Pea protein and its peptides are positioned as a source of bioactives influencing cardiometabolic health by moderating post-prandial glycemia (8963), activating fibroblast growth factor 19 (202), inhibiting angiotensin-converting enzyme (ACE) for blood-pressure reduction (47896), and serving as a fermentable base that yields gamma-aminobutyric acid to alleviate cancer-induced fatigue (47448).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Hydrolysates (DH <10%) linked to FGF19 activation**: associated with metabolic support, specifically in relation to non-alcoholic fatty liver disease and sarcopenia (202).
- **Source of ACE-inhibitory peptides**: Hydrolysates/peptide fractions derived from pea protein contribute ACE inhibition for antihypertensive applications (47896).
- **Stabilize postprandial blood glucose**: Enzyme-treated pea protein yielded improved digestibility and supported glycemic control (8963).
- **Fermentable matrix**: support lactic fermentations (e.g., S. thermophilus, L. plantarum, L. brevis), generating GABA/peptides and improved viscosity with reduced off-notes (47448).

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Treatment to stabilize postprandial blood glucose of dietary proteins using specific proteases.	Legume protein substrate (including pea) targeted by added protease to improve digestibility and glycemic response.	Protein substrate; protease system (kumamolisin or related proteases)	Protease treatment applied to protein-containing foods or coingested; conditions tuned for activity against legume proteins.	8963
Pulse protein hydrolysate compositions that activate fibroblast growth factor 19 (FGF19) synthesis for metabolic benefits (e.g., NAFLD/NASH or sarcopenia).	Pea protein hydrolysate as the pulse protein source to stimulate FGF19 synthesis.	Legume protein with >90% globulins (by protein weight).	Controlled enzymatic hydrolysis of pulse proteins to degree of hydrolysis <10%; enrichment in globulins; formulated for oral administration.	202
Antihypertensive peptide(s) that inhibits angiotensin converting enzyme (ACE) to lower blood pressure.	Pea protein peptide(s) with antihypertensive and ACE inhibitory activity.	Peptide fraction(s) derived from pea protein	Protein extraction, enzymatic hydrolysis, peptide isolation/purification, formulation suitable for oral delivery.	47896
Fermented pea protein milk designed to alleviate cancer related fatigue via nutritional/functional enhancement.	Primary protein base for a fermented beverage rich in amino acids, active peptides, and probiotics with reduced off notes.	Pea protein milk solution	Prepare pea protein milk; inoculate with *S. thermophilus, L. plantarum, L. brevis;* controlled fermentation to increase viscosity, reduce beany notes, and develop bioactives.	47448

Immunity & Liver Protection

Pea protein is used for its complementary amino acid profile within a silkworm-based composite immune-support formulation. Another filing leverages hydrolyzed pea protein glycated (with xylose) to generate pea glycopeptides that modulates oxidative-stress pathways (Keap1–Nrf2/ARE) relevant to alcoholic liver injury. Together, these patents highlight pea protein as a nutritionally efficient co-protein within complex functional blends and a bioactive precursor whose peptide/glycopeptide derivatives exhibit targeted antioxidant and hepatoprotective activity (48775; 48790).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Improves overall protein quality** in immune-oriented blends (48775).
- **Serves as a bioactive precursor**: pea peptides and pea glycopeptides can be generated to engage antioxidant defense pathways (Keap1–Nrf2/ARE) with hepatoprotective intent (48790).

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Silkworm pupae powder formulation for enhanced immunity and functional food use.	Pea protein powder used to complement amino-acid profile and boost total protein.	Parts by weight: silkworm pupae powder 90-120; vegetable oil 10-20; cellulase 5-10; amylase 5-10; protease -10; calcium carbonate 0.1-0.3; vitamin C 0.005-0.01; zinc gluconate 0.005-0.01; soy protein isolate 5-15; pea protein powder 10-20; maltose syrup 5-20; water as needed.	Adjust with 0.5 M sodium carbonate; add water at 1-10:1 (w/w) to solids. Enzymatic hydrolysis with proteases at 40-50 °C for ~2-4h; heat to 90-100°C to inactivate enzymes; cool and neutralize. High-speed centrifugation at ~8,000-10,000rpm for 15-20min; collect supernatant. Homogenize and dry to powder.	48775
Preparation of pea glycopeptides with antioxidant and hepatoprotective activity; the glycopeptides activate the Keap1-Nrf2/ARE pathway and are proposed for antagonizing alcoholic liver injury.	Pea peptide (hydrolysate-derived) used as the substrate for glycation to form bioactive glycopeptides.	xylose:pea peptide with mass ratio of 1:1-3:1; example use levels <1000μg/mL.	Prepare pea peptides (enzymatic hydrolysis, then clarification). Glycation with xylose at pH 8.0-9.0, 80-100°C for ~1-6h; collect and purify the >200Da glycopeptide fraction.	48790

Aerosols

In aerosol delivery, native pea protein acts as the principal emulsifier for high-oil D-limonene dispersions, withstanding high-shear and high-pressure homogenization and maintaining emulsion integrity through atomization for pulmonary delivery (50553).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Strong interfacial activity**: sufficient to emulsify high-oil systems for inhalation, surviving high shear and high-pressure homogenization without phase separation (50553).
- **Clean-label, biodegradable shell/emulsifier**: alternative to synthetic polymers for controlled delivery formats (50553).

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Pulmonary D-limonene aerosol designed for inhalation therapy.	Pea protein as the primary emulsifier/stabilizer for the aerosolizable O/W emulsion.	~9-15% D-limonene, ~60% water, ~25% maltodextrin, ~6% pea protein; stabilizers/emulsifiers	High-shear premix at ~12,000 rpm for ~5 min, high-pressure homogenization at ~500 bar for ~3 min, aerosolization/atomization to generate respirable droplets	50553

ANIMAL HEALTH & NUTRITION

Pea protein appears across animal health and nutrition as a functional protein and a source of bioactive peptides. In veterinary applications, defined pea-derived peptides are claimed to inhibit porcine epidemic diarrhea virus replication and prevent apoptosis in infected cells, indicating a potential antiviral application in veterinary medicine (45514). In simple terms, the patent is aiming to use a small, targeted peptide from pea protein to help protect piglets from a severe diarrheal virus by stopping the virus from multiplying and preventing it from killing intestinal cells, illustrating how pea-derived components are also being explored for highly specialized animal health uses beyond food and feed. In pet foods, pea protein is incorporated alongside fatty acids, vitamins, and animal-derived ingredients, where it contributes to managing non-food allergies (37896) or acts as a heat-settable binder to improve texture and palatability (4304). In pet snacks, pea protein is listed as a source of plant-protein and digestible amino acids (34242, 49782). Across these examples, pea protein is leveraged as a plant-based component within broader multi-ingredient systems for animal health and nutrition, rather than as a standalone active.

Pea Protein Attributes as Claimed by Patent Applicants:

- **Source of plant protein**: Inclusion as a plant-based protein source in pet snacks to support overall nutritional content (34242, 4304, 49782)
- **Heat-stable binder:** component in formulated for improved texture with palatability; heat-settable binding functionality to structure composite wet pet foods during thermal processing/retort (4304, 49782)
- **Suitable for non-food allergens formulations**: digestible plant protein option to support amino-acid delivery in sensitive/allergy-management pet formulas (37896)
- **Source of bioactive peptides:** claimed to exhibit antiviral activity against porcine epidemic diarrhea virus for veterinary use (45514).

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Veterinary antiviral peptide for porcine epidemic diarrhea virus (PEDV); inhibits viral replication and reduces virus-induced apoptosis in infected cells.	Pea protein as source of defined antiviral peptide; peptide functions as the active agent in veterinary therapy.	Formulations comprising the KYGPTPVRDGFk peptide	Peptide obtained via synthesis or purified from pea protein hydrolysates; blended with pharmaceutically acceptable carriers; standard sterile preparation and packaging	45514
Wet or dry pet food designed to manage non-food allergies by supporting skin barrier function	Pea protein as a digestible plant protein fraction contributing to amino acid supply in hypoallergenic pet formulas.	Pea protein, omega-3/omega-6 fatty acids, vitamins, and minerals;	Conventional pet food manufacture: batching, mixing, thermal processing (e.g., retort for cans/pouches or extrusion for kibbles), then cooling and packaging.	37896
Wet pet food comprising a composite meat matrix, vegetable material and a heat-settable binder for improved texture and palatability.	Pea protein as a heat-settable binder; enhances gel/structure post-thermal set.	Composite of ground animal material, vegetable material; pea protein (40-75% protein purity), yeast extract for palatability; typical pea inclusion 2-15% of formula (wet basis).	Blend ground animal and vegetable phases; add pea protein binder; form; heat/retort to set the matrix and achieve commercial sterility; then cool and package.	4304

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Crispy, air-dried pet snack with animal meat and plant powders	Pea textured/tissue protein as an adjunct improve protein content, protein density, bite and structure.	Meat base combined with powders (incl. pea tissue protein) and seasonings;	Form into strips/chips; air-dry at controlled temperature and airflow to target low moisture; package under low water activity conditions to ensure shelf stability.	49782
Animal-free food and supplement formulations for companion animals; aim to match or exceed nutritional features of animal-based products while using non-animal sources.	Pea protein included within the plant-based products category to contribute digestible amino acids and protein density. Plant based fraction is claimed at substantial inclusion to carry the main protein load.	Algae ≥0.5% (dry weight), hydrocolloid >10%, insect based products 2-50%, fungus products 2-50%, plant-based products 25-50%, ptional vitamin B > 30mg per 100g and palatant coating.	Blend selected algae, yeast, insect, fungus and plant-based components to target the claimed ranges. Apply palatant coating after forming the product.	34242

OTHER NON-FOOD

A small number of patents describe non-food industrial applications where pea protein is incorporated alongside other functional materials to provide structural or protective properties. In these cases, pea protein is chemically modified, hydrolyzed, or combined with other bio-based components to contribute to the mechanical or antimicrobial performance of the overall system. For example, phosphorylated pea protein is used with essential oils to coat down feathers, where it is claimed to improve adhesion to feather keratin, enhance hydrophobicity, and support antimicrobial resistance (50482). In another patent, pea protein is incorporated with anthocyanins to reinforce the structure of pH-sensitive food packaging films, improving their mechanical strength and stability (50090). Additionally, hydrolyzed pea protein is included at low levels within composite preservative sprays applied pre- and post-harvest to sprouts, where it is claimed to contribute to shelf-life extension when combined with plant-derived actives (50532).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Film-forming/coating matrix**: Compatibility with phenolics/anthocyanins, enabling pH-responsive yet color-stable films (50090); adheres to complex substrates (keratin, plant tissues) and retains small-molecule actives (essential oils, pigments) (50482, 50090, 50532); clean-label, biodegradable alternative to synthetic binders (50090, 50482)
- **Spray-aid/carrier**: Improved antimicrobial resistance of feather materials through protein–essential oil coatings, distribute and hold actives on delicate plant surfaces without heavy synthetic polymers. (50482, 50532)
- **Adhesive properties**: Strengthened adhesion to keratin structures (down feathers) to support durable coating performance (50482)
- **Durability**: Contributes structural integrity and mechanical strength for pH-sensitive anthocyanin-based packaging films (50090)
- **Hydrophobic properties**: enhanced hydrophobicity and water resistance when phosphorylated pea protein is used as a coating on down feathers with essential oils (50482)
- **Preservative effects:** contribution to the extension of shelf life of fresh sprouts when included at low levels in multi-component pre- and post-harvest preservative sprays, potential role in inhibiting respiratory metabolism and slowing senescence when used as part of a preservative system (50532)

PULSE CANADA

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Durable, antibacterial and water-repellent finish for down feathers; process integrates surface activation to improve fixation and wash durability.	Phosphorylated pea protein as a film-forming/coating matrix to anchor essential oils on keratin fibers and improve durability and water repellency.	Phosphorylated pea protein solution, essential oils (e.g., thyme, oregano or citrus family) and surfactants/solvents	Degrease, wash, and dry feathers; prepare an emulsion of essential oils in a phosphorylated pea protein solution via high-shear or ultrasound; apply to feathers (spray/soak); plasma or other surface-activation step to enhance adsorption; cure/dry under controlled temperature to fix the coating.	50482
Active packaging film to balance pH sensitivity and color stability while providing mechanical integrity.	Pea protein (isolate/concentrate) as the primary film-forming polymer; contributes tensile strength and barrier properties.	Aqueous blend of pea protein, anthocyanins (plant extract), plasticizer (e.g., glycerol), buffer/acid (e.g., citric acid) and water; optional dextrin/Sephadex treatment to remove free pigment before casting.	Dissolve pea protein in water; add anthocyanin extract and acid; mix to homogeneity; adjust pH near neutral (~7) for color stabilization; add glycerol; optionally pass through dextrin/Sephadex to reduce free anthocyanin; cast the film and dry at ~60°C to form continuous films.	50090
Dual-stage freshness system for sprouts using a preharvest spray to slow respiration and a postharvest antimicrobial/anti-browning spray to extend shelf life.	Pea protein (unmodified or hydrolysate) included in the preharvest spray as a film-forming/emulsifying aid and carrier for actives; supports adherence and mild barrier effects on plant tissue.	Preharvest spray: methyl jasmonate + pea protein in water. Postharvest spray: phytic acid, carboxymethyl chitosan, citral essential oil, glycerin, water	Prepare preharvest aqueous spray containing methyl jasmonate and pea protein; apply to sprouts in-field or immediately preharvest. After harvest, mix phytic acid, CMC, citral oil, and glycerin into water under agitation to form a uniform spray; apply to sprouts and allow to dry under ambient cold-chain conditions.	50532

FOOD

Pea protein is a multifunctional ingredient whose patent activity spans a wide range of food categories, demonstrating its adaptability as both a nutritional macronutrient and a functional polymer within complex formulations. Across these filings, pea protein is employed as an emulsifier, encapsulant, thickener, flavor modifier, and structuring agent, frequently replacing or complementing animal- and synthetic-derived ingredients to meet performance and clean-label requirements.

In functional ingredient systems, pea protein serves as a key emulsifier and interfacial stabilizer, either in native or modified forms. Glycosylated or enzyme-treated isolates show improved solubility and film formation, supporting stable oil-in-water emulsions and spray-dried powders containing bioactive compounds such as curcumin or omega-3 fatty acids. Pea protein combined with amylopectin, β-glucan, or gellan gum enhances oxidative stability and interfacial strength in high-fat or acidic systems. Hydrolyzed fractions are leveraged as precursors for Maillard reaction products or fermentation substrates, generating umami and salt-enhancing peptides that allow for sodium reduction of up to 40% while maintaining flavor intensity.

Pea protein is also used as a structural polymer **in encapsulation and delivery systems** that improve oxidative and gastrointestinal stability of sensitive actives. Denatured or cross-linked isolates form microcapsules through mild interfacial polymerization or ionic gelation, supporting the controlled release of probiotics, oils, or lipophilic compounds. Synergistic interactions with polysaccharides such as pectin, alginate, and nanocellulose further enhance capsule integrity and retention of volatile components, illustrating the growing role of pea protein as a clean-label replacement for gelatin and synthetic wall materials in food and nutraceutical applications.

In **texturizing and thickening systems**, pea protein is used to provide viscosity and structure without reliance on modified starches or gums. Controlled heat–cool processing and calcium-induced aggregation generate stable gels with defined rheology, while co-networking with nanocrystalline cellulose enables aroma retention and controlled volatile release in liquid and semi-solid foods. These properties support the development of clean-label thickeners and gelling agents suitable for dairy analogues, sauces, and desserts.

Most filings in the food sector focus on structuring and texturization for **meat analogues,** where pea protein is the dominant plant protein used across both high-moisture and dry extrusion systems. In high-moisture extrusion (HME), pea protein functions as the primary structuring agent capable of forming fibrous, anisotropic textures with controlled water-holding and chew characteristics. When co-extruded with complementary proteins such as whey or rapeseed, the resulting networks exhibit tunable hardness, cohesiveness, and elasticity. Equipment modifications, including tailored cooling-die configurations, enable the production of fibrous structures from 100% pea protein formulations. In low or intermediate-moisture extrusion, formulations containing 70–95% pea protein yield textured pieces with adjustable density, water-holding, and expansion properties, optimized through precise control of barrel temperature, moisture, and pH. Inclusion of hydrophilic polymers such as psyllium or alginate further enhances hydration capacity and resilience during reconstitution.

Beyond meat analogues, pea protein is incorporated across **dairy and egg substitute** systems. In plant-based milks, creamers, yogurts, and cheeses, pea protein provides emulsification, foaming, and stabilization under acidic and thermal conditions. Enzymatic modification and controlled fermentation reduce off-flavors and improve colloidal stability, allowing use in barista-style and cultured applications. In egg replacers, pea protein replicates the structural and emulsifying roles of albumen and yolk through heat-induced gelation or aeration, often in combination with starches and lipids. These functionalities also extend to **baked goods**, where pea protein supports gas retention, crumb structure, and moisture control in both conventional and gluten-free systems.

In **clinical, sports, and wellness nutrition**, pea protein functions as a hypoallergenic, digestible protein source used in ready-to-drink beverages, powdered mixes, and enteral formulas. Denatured or hydrolyzed forms improve solubility in acidic beverages and promote rapid amino acid absorption. Composite formulations containing pea protein, fibers, and lipids (e.g., MCT oil) are designed for metabolic regulation, satiety, and sustained energy release. Patents emphasize process control during homogenization and spray drying to achieve dispersibility and sensory quality equivalent to dairy-based formulations.
Pea protein is also applied in **confectionery, bakery, and snack systems** as a foaming and film-forming protein compatible with sugar and low-moisture environments. In savory and extruded snacks, textured or native pea protein contributes to expansion control, protein fortification, and crisp structure, while also reducing oil uptake**. Hybrid meat and fish systems** incorporate pea protein to improve texture, water-binding, and cost efficiency without compromising sensory characteristics.

Overall, food-related patents demonstrate how pea protein is being engineered across multiple processing pathways (thermal, enzymatic, and mechanical) to tailor solubility, emulsification, and structural performance. The diversity of applications underscores pea protein's evolution from a nutritional ingredient to a category-spanning functional platform, capable of delivering stability, texture, and sensory quality across plant-based and hybrid food systems.

FUNCTIONAL INGREDIENTS

Emulsifiers & Emulsion Stabilizers

Several patents use pea protein as part of multi-component emulsifier systems, typically combined with other polysaccharides, starch derivatives, or glycosylated modifications. Formulators either use native/unhydrolyzed soluble pea protein directly (261, 4588) or modify it to enhance interfacial functionality. Glycosylated pea protein is described to improve the stability and bioavailability of oil-dispersed bioactives like curcumin (47405), while pea protein–amylopectin mixtures are claimed to improve emulsification in food systems (261). Other patents highlight pea protein's ability to stabilize emulsions in acidic beverages (4588) and to create high-oil content, shelf-stable spray-dried powders (47789).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Improved emulsion stability:** in acidic or high-oil systems (4588; 49879; 47789) oxidative stability in spray-dried high-oil powders (47789)
- **Enhanced emulsifying performance** when pea protein is combined with amylopectin (261)
- **Stabilize lipophilic actives**: chemical conjugation (glycosylation) of pea protein isolate improves interfacial performance and stabilizes bioactives like curcumin (47405).
- **Formation of foamable oil-in-water emulsions** potentially applicable to beverages or culinary systems (49879)
- **Emulsification at low use levels**: functions as primary/co-emulsifier at with polysaccharides (amylopectin) to stabilize oil-in-water systems (261).

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Foamable oil-in-water emulsion for food/beverage applications targeting stable foams and aeration.	Pea protein (70% purity) as a plant emulsifier/stabilizer for foamable emulsions.	Emulsion oil & fat phase with plant protein	Prepare oil-in-water emulsion; incorporate gas/foaming step.	49879
Compound curcumin oil suspension with improved stability and bioavailability	Glycosylated pea protein isolate used as the emulsifier to stabilize curcumin in an oil phase.	Oil phase containing curcumin; aqueous phase with glycosylated pea protein isolate	Glycosylate pea protein isolate; form oil-in-water system and homogenize to suspend curcumin.	47405
Emulsifier system based on pulse proteins with amylopectin for food emulsions.	Unhydrolyzed soluble pea (or chickpea) protein as co-emulsifier with amylopectin.	Emulsifier mixture: 13% pea/chickpea protein and 25% unmodified amylopectin (aqueous).	Prepare aqueous emulsifier premix; add oil to form emulsion and homogenize.	261
Oil-in-water emulsion tailored for acidic beverages (e.g., coffee/tea) with improved dispersibility and stability.	Pea and/or fava protein as the proteinaceous emulsifier used with sucrose fatty acid esters.	Water; oil/fat; pea and/or fava protein; sucrose fatty acid ester with 345% monoester; SFAE at 130 parts per 1 part total protein.	Blend water, oil, protein, and sucrose fatty acid ester; emulsify for beverage use under acidic conditions.	4588

Encapsulation & Delivery Systems

Patents describe pea protein as a structural material in multi-component encapsulation and delivery systems, often combined with polysaccharides, starches, fibers, or emulsifiers. These systems are claimed to enhance stability, bioavailability, and controlled release of sensitive actives such as probiotics (1331; 48074), curcumin (49777), lipids (50078; 50651; 49773), or flavour/aroma compounds (46190). Pea protein is typically processed (denatured, ultrasonic-treated, or dispersed under controlled pH/heat conditions) to form microcapsules or emulsions. These patents highlight its functional role as a plant-based wall or carrier material rather than as an active itself.

Pea Protein Attributes as Claimed by Patent Applicants:

- **Encapsulating agent:** Formation of microcapsules, gels, or powders to encapsulate and protect bioactives or lipids (1331; 48074; 49777; 50078; 50651; 49243; 49773; 46190)
- **Improved bioavailability and controlled release** of encapsulated compounds (1331; 49777; 48074; 50078; 49773)
- **Enhanced aroma retention and slow-release** of volatile flavor compounds (46190)
- **Stabilization and survivability of probiotics** calcium-responsive, acid-resistant matrices after denaturation enable targeted ileal delivery of probiotics (1331; 48074)
- **Robust interfacial films** as a primary/co-emulsifier that tolerate shear, thermal treatment, oxidative stress, and (in some cases) acidic environments. (48074, 49773, 50078)
- **Synergistic assembly with polysaccharides:** (gellan, beta-glucan, konjac, nanocellulose, starch) to strengthen gels, improve aroma retention, and enhance GI survivability. (48074, 50651, 49777, 46190)

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Probiotic microcapsules designed for gastric resistance and targeted ileal release.	Denatured pea protein isolate (dPPI) as plant-based wall matrix enabling calcium-crosslinked, acid-resistant shells.	Protein suspension at ~10–15% (w/w) dPPI combined with hydrated probiotic; calcium citrate buffer for polymerization.	Prepare dPPI suspension; blend with probiotic; form microdroplets by extrusion; crosslink in calcium citrate buffer to gel shells; collect and dry as needed for food/nutra use.	1331
Composite gel carrier that slowly releases tea-derived aroma compounds.	Pea protein isolate co-networked with nanocrystalline cellulose (NCC) to trap and release volatiles.	PPI, NCC; tea aroma actives	Dissolve PPI; disperse NCC; mix with tea volatiles; set gel (cooling or ionic/thermal setting) to trap aroma	46190
Probiotic oil-in-water emulsion that enhances Lactobacillus plantarum survival.	Pea protein isolate as co-emulsifier with casein; complexes with gellan gum to stabilize droplets.	Protein blend casein:pea ~2:1 in PBS (20 and 10 g/L respectively); gellan 4–20 g/L; oil phase contains probiotic; final emulsion oil:aqueous ~1:4.	Hydrate casein and pea protein (4060 °C, stir 2–5 h; cold-hold 8–16 h); prepare gellan solution (40–50 °C, 0.5–3 h); combine protein and gellan (1:1 v/v) at 40–60 °C for 2–4 h; disperse probiotic into melted oil; emulsify at 8,000–16,000 rpm for 2–6 min.	48074
Protein-rich granules designed for improved handling and delivery of bioactives in foods.	Pea protein as primary structural matrix interacting with tannins and complex carbohydrates to form compact granules.	Granules contain >=40% protein by mass (pea protein), plus tannins and complex carbohydrates; tailored for taste-masking/flow.	Blend dry pea protein with tannins and carbohydrates; hydrate to controlled moisture; agglomerate/granulate; dry to target water activity; sieve to uniform size.	49243

PPI = pea protein isolate, MCT = medium-chain triglycerides, OPO = 1,3-dioleoyl-2-palmitoyl-glycerol

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
High-fat, low-carbohydrate instant powder delivering medium-chain triglycerides (MCT) for ketogenic nutrition.	Pea protein (isolate/concentrate/hydrolysate) as encapsulating/emulsifying protein around MCT oil.	Typical ranges (w/w): MCT 45-74%, pea protein 5-25%, soluble fiber 5-40%, emulsifier 0.1-2%, lecithin 0.1-5%, anti-caking 0.1-2%.	Hydrate pea protein and adjust pH; heat-hold for emulsification stability; high-shear 8,000-22,000 rpm (5-15 min); add soluble fiber (shear 5-15 min); emulsify MCT at controlled temperature with emulsifier; two-stage high-pressure homogenization (40-45 MPa then 50-70 MPa); co-spray-dry with lecithin (inlet 140-160 C, outlet 80-100 C) with in-line anti-caking; sieve 20-40 mesh.	49773
Curcumin microcapsules for improved stability and controlled GI release.	Pea protein as primary wall protein	Wall: pea protein in water; co-formulated with polysaccharides (inulin/konjac/pullulan) and optional EDTA protectant. Core: curcumin dispersed in vegetable oil with antioxidant (e.g., rosemary extract/resveratrol) and emulsifier (sucrose fatty acid ester and/or sodium caseinate).	Ultrasonicate pea protein solution (150-300 W, 55-70 C); prepare curcumin oil (50-150 W, 35-45 C); mix to form emulsion and ultrasonicate (50-150 W, 35-45 C) with polysaccharide and EDTA; spray-dry (atomization 0.08-0.10 MPa, feed 50-650 mL/h, inlet 120-140 C, outlet 70-90 C, dry air 40-55 m3/h).	49777

PPI = pea protein isolate, MCT = medium-chain triglycerides, OPO = 1,3-dioleoyl-2-palmitoyl-glycerol

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Sugar-free encapsulation of MCT oil for ketogenic applications.	Pea protein as wall/coating protein to encapsulate MCTs; combined with whey protein and dextrin	Embedding matrix pea:whey:dextrin ~1:1.5:2.5 (within 0.5–1.5:1–1.8:2–3 range); secondary lecithin coating, MCT oil as core; optional botanicals and polydextrose.	Make dextrin solution; pre-emulsify MCT with emulsifier; prepare pea-protein solution, shear (8,000–22,000 rpm, 5–15 min); high-pressure homogenize (40–45 MPa then 50–70 MPa); co-spray-dry with lecithin dispersion (inlet 140–160 °C, outlet 80–100 °C) with in-line anti-caking; sieve 20–40 mesh.	50078
Prebiotic-OPO structured lipid microcapsules for improved delivery in foods.	Pea protein as part of composite wall as emulsifier and film-former.	Wall: pea protein:oat beta-glucan mass ratio ~1–3:3 with konjac glucomannan; core: OPO structured lipid.	Dissolve wall biopolymers in buffer; add lipid to form oil-in-water emulsion via shearing and homogenization; dry (e.g., spray-dry) to obtain microcapsules.	50651

PPI = pea protein isolate, MCT = medium-chain triglycerides, OPO = 1,3-dioleoyl-2-palmitoyl-glycerol

Salt Reduction

Pea protein is leveraged as a substrate to generate salty/umami flavor enhancers either via controlled Maillard reaction or lactic fermentation. In hydrolysate form it supplies reactive amino acids for light-colored Maillard products that enhance saltiness while allowing sodium reduction, and it remains compatible with alkaline salt matrices and cooking conditions (49612). When hydrolyzed and fermented with selected Lactobacillus strains, it yields glutamate-rich peptides and metabolites that boost perceived saltiness in low-sodium foods (855).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Enhance umami and salt perception** with Maillard reaction or fermentation-derived peptides from hydrolyzed pea protein enabling up to 40% sodium reduction (49612; 855)
- **Controlled flavour release retention** process-compatible with high-pH salt systems and heat, enabling stable flavor delivery in culinary use (49612)
- **High glutamic acid content** supports umami and saltiness enhancement targets (855).

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Flavor-controlled release salt system to enhance umami/saltiness and enable sodium reduction.	Pea protein hydrolysate as Maillard reaction precursor to generate flavor peptides/intermediates for saltiness enhancement and controlled release.	Two-stage Maillard reaction products blended with high-pH processed salt; formulation designed for up to ~40% sodium reduction	Enzymatic hydrolysis of pea protein; staged Maillard reaction to obtain light-colored peptides; blend with alkalized (high-pH) processed salt; engineered for sustained flavor release during cooking.	49612
Ingredient to boost salty taste perception in low-sodium foods.	Pea protein hydrolysate as fermentation substrate; lactobacillus-driven conversion yields umami/salt-enhancing metabolites.	Hydrolyzed pea protein (noted ~13% glutamic acid in pea protein)	Enzymatic or acid hydrolysis of pea protein; inoculation with Lactobacillus spp.; fermentation under controlled pH/temperature; downstream concentration/drying to produce a flavor ingredient.	855

Fried Foods Coatings

Two patents describe using pea protein as a pre-treatment coating on uncooked foods to reduce oil uptake during frying. Acidified or pH-adjusted pea protein dispersions are applied by dipping, spraying, or mixing, and are claimed to reduce fat absorption by 20–50% and improve moisture retention (80; 307). These approaches position pea protein as a functional barrier material to improve the nutritional profile of fried foods.

Pea Protein Attributes as Claimed by Patent Applicants:

- **Reduced oil and fat absorption by 20-50%** during frying when used as a pre-treatment coating (80; 307)
- **Improved moisture retention** in fried products (80)
- **Film formation:** at acidic pH supports an oil-blocking surface layer on foods during frying (307, 80).
- **Thermal resilience**: of the formed protein film during short, high-temperature exposure, maintaining barrier integrity (307, 80).
- **Compatibility with antioxidants** in the coating to mitigate oxidative effects during frying (307).
- **Effective performance at low application levels** (down to 0.03% w/w of food) and over a wide use-range (up to 15% w/w), enabling formulation flexibility (80).

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Coating treatment applied to uncooked foods to reduce oil uptake during frying and improve moisture retention; targets healthier fried products without altering core formulation.	Pea protein (typically isolate) acidified or adjusted to mildly acidic pH to form a surface film; acts as a barrier/emulsifying coat that limits oil ingress and water loss.	Pea protein solution; includes at least one antioxidant.	Prepare pea protein solution in water and/or acid, adjust to pH 4–6; apply by dip, spray, or via breading matrix; dry as needed; fry in oil/fat. Reported a 20% reduction in fat transfer versus control.	307
Method for substantially reducing oil and fat absorption in fried foods while improving moisture retention and protein content.	Acidified pea protein isolate used solely as the surface treatment to create a protective film prior to frying.	Acidic pea protein solution at pH 2.0 (phosphoric acid)	Dissolve pea protein in water; acidify with phosphoric acid to pH ~2.0; apply 0.03–15% w/w to food surface; proceed with standard oil/fat frying. Reported 30–50% reduction in fat transfer versus untreated control.	80

Texturizing & Thickening Agents

Pea protein is used in texturizing systems both as a primary network former and as a clean-label thickener. In composite gels, it co-structures with polysaccharides to retain and slowly release volatiles, while in thickener systems it leverages calcium-induced aggregation and heat setting to deliver viscosity and body without gums or modified starches. Across the patents reviewed, the processing emphasis is on creating stable protein networks via controlled hydration, homogenization, ionic bridging (Ca^{2+}), and a defined heat–cool sequence to lock in texture and stability (46190, 47771).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Clean-label thickeners** for vegetarian liquid/semi-solid foods, builds viscosity via Ca^{2+}–induced aggregation at neutral pH and withstands thermal set/cool cycles, enabling clean-label thickening without hydrocolloids (47771).
- **Improved gel stability** when combined with nanocellulose (46190)
- **Modulate release of aroma compounds** though co-networks with insoluble polysaccharides (e.g., nanocrystalline cellulose) that entrap and modulate their release while reducing volatilization, supporting sustained flavor delivery (46190).

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Composite gel system that entraps tea-derived aroma compounds to enable controlled, sustained release in foods and beverages.	Pea protein isolate (PPI) as the primary gelling/encapsulation matrix co-networked with nanocrystalline cellulose to retain and slowly release volatile flavors.	PPI + nanocrystalline cellulose + tea aroma actives (e.g., tea polyphenol/essential oil fractions)	Prepare PPI dispersion; blend with nanocrystalline cellulose to form a composite network; incorporate tea aroma under mixing; set into a gel to provide slow-release behavior	46190
Clean-label thickener for liquid and semi-solid vegetarian foods, delivering viscosity and body after a controlled heat/cool cycle.	Pea protein isolate (PPI) as the thickening/structuring agent; viscosity built via Ca2+ induced protein network formation.	PPI:water volume ratio ~3.5:100; CaCl2 adjusted to 6-10 mM; sucrose 10-20% w/w in the mix.	Disperse PPI in deionized water; magnetic stir ~3 h; high pressure homogenize twice (~200 MPa, ~6 L/h); add 1 M CaCl2 to reach 6-10 mM; add sucrose (10-20%); adjust pH to ~7.0; heat to 75-95°C (hold ~15 min after reaching temp); rapid ice-water cool to set the thickener.	47771

MEAT ANALOGUES

High-Moisture Extrusion

Across these filings, pea protein is positioned as the core structuring agent in high-moisture matrices that are sheared and set to create aligned, meat-like fibers. Applicants blend pea with other proteins (e.g., whey) and functional adjuncts (minerals, fibers) to tune chew, cohesiveness, and water management during cook and reheat. One disclosure even centers on equipment tailored to run pure pea protein at high moisture, underscoring a push to minimize formulation crutches. Overall, pea protein is being processed and/or combined with complementary ingredients to reach targeted textural metrics for formed "protein meat" and piece-style formats (297; 47706; 47894). While blends are used (e.g., with whey), pea protein is framed as a major contributor to gelation and texture metrics, while some filings emphasize equipment designed to run pure pea at high moisture. One filing targets broad product archetypes (chicken-, beef-, fish-style pieces, patties, jerkies), indicating confidence in pea protein's ability to span texture requirements across formats (297)

Pea Protein Attributes as Claimed by Patent Applicants:

- **Provides gelation/texturization** gelation/texturization that delivers specified hardness, cohesiveness, and chewiness when co-formulated (47706)
- **Fiber-forming** under combined heat, shear, and cooling-die alignment, producing anisotropic "muscle-like" textures (293, 297, 47894)
- **High water-binding** to support juiciness and target water-holding capacity in high-moisture matrices (293, 47706).
- **Blending compatibility with other proteins** (e.g., whey) to tune gel strength, cohesiveness, and chewiness without losing structure (47706).
- **Robustness across wide moisture windows** (about 40–80 percent in-barrel) and elevated barrel temperatures used for HME (297)

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
HME structured meat analogues using protein compositions to produce aligned, fibrous textures with improved juiciness and thermal stability.	Pea protein isolate or concentrate as primary structuring protein; selected for fiber-forming under heat/shear and water-binding to support HME alignment.	Protein content targeted at 20-60%of total solids; moisture in final extrudate 40-80%. Auxiliary lipids or binders may be included per specific formulation.	Twin-screw compounding at elevated barrel temperatures followed by cooling-die set to lock in fiber orientation; process emphasizes high-moisture feed and controlled shear to generate anisotropy.	293
Twin-screw extrusion of pea protein blended with whey protein to form a 'protein meat' with specified texture metrics (hardness, cohesiveness, chewiness) and high water-holding.	Pea protein isolate as main plant protein in a blend with whey to tune network formation and elasticity.	Pea:whey protein ratio about 85-90:10-15 by weight; water added at 1.0-1.4x the protein blend during processing.	Hydrate proteins; twin-screw extrusion (e.g., FMH22-32); adjust feed moisture to 1.0-1.4x protein blend; form and set via die/cooling; targeted WHC 35-45 percent; texturization index ~1.20-1.30.	47706
HME using rapeseed protein with a single legume protein to produce meat alternatives across formats (e.g., chicken-, beef-, fish-style).	Pea protein (as the legume protein) serves as the fiber-forming fraction; compatible with oil/fiber and mineral salts.	Protein 50-75% of dry mix; water 40-80% in extruder; rapeseed:legume protein ratio 5:95 to 40:60; optional calcium salt 1-5%; optional plant fiber 5-40%.	Premix dry proteins/minerals/fibers; feed to twin-screw; heat to a maximum of 100-180 °C; pass through cooling die to align and set fibers; moisture controlled to 40-80%.	297

HME = High moisture extrusion, WHC = water holding content

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Double-screw extrusion equipment specialized for producing HME from pure pea protein, improving throughput and textural definition.	Pea protein as sole structuring protein in HME, demonstrating ability to form fibrous matrices without other protein sources.	100% Pea protein	Use of tailored double-screw configuration and cooling section to stabilize aligned structures from pea protein; high-moisture, high-shear, followed by controlled cooling/setting.	47894
Preparation method for high-moisture artificial meat using a double-screw extruder and mixed plant proteins to obtain fibrous texture and high water-holding capacity.	Pea protein as a main plant protein with whey to build fibrous structure.	Protein blend; optional salt and flavorings per formulation.	Twin/double-screw extrusion with controlled feed rate, temperature profile along barrel, and cooling die to set fibrous structure; parameters tuned for target WHC and hardness.	46365

HME = High moisture extrusion, WHC = water holding content

Texturized Pea Protein

Across these patents, pea protein is the dominant fraction used for dry or intermediate-moisture texturization in twin-screw extrusion systems, often combined with other proteins or fibres in formulation. Typical in-barrel moisture targets are 20.5 to 26%, with barrel temperatures ranging from 100 to 180 °C at 1,200 to 1,800 rpm (214, 1149, 37876, 3377). Several disclosures optimize specific energy and outlet pressure to control expansion and density prior to compression or drying stages (3377). One filing explores an alkali adjustment (pH 7.0 to 7.5) and/or inclusion of hydrophilic polymers (at 3-10% of protein) to strengthen water binding and texture profile of extrudates (591). Other claims in this subsection assemble hydrated, texturized pea protein with other ingredients in formulation (e.g. pea protein isolate as binder) to create finished meat alternative products (710, 50689).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Texturization at low moisture** with controllable firmness and density windows
- **High water-holding capacity** of textured particles (1149; 3377)
- **High-protein pieces** (70-95% protein) suitable for intermediate-moisture products with robust handling. (591)
- **Process stability under higher shear and pressure** supports consistent fiber formation. (1149)

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Dry-extruded legume and rapeseed protein system to produce texturized vegetable protein pieces for meat alternatives.	Pea protein (isolate or concentrate) as the legume fraction; provides bulk protein and texture.	Rapeseed protein, legume protein, pea fiber, water, optional sodium chloride (0.1-5.5%). Particle size of final pieces 1 to 80 mm.	Low moisture extrusion: feed water (5-30%); barrel temperature 100-180 °C; 100-3000 rpm; extrude through die; cut	214
Twin-screw, low-moisture extrusion of pea-based formulations with alkali and hydrophilic polymers to yield intermediate-moisture, texturized pieces suitable for further hydration, battering, or saucing.	Pea protein as primary protein source	Protein 70-95%; hydrophilic polymer (e.g., maple fiber, psyllium, alginate, pectin) 3-10% (of protein); yeast extract 5-12%; alkali to reach pH 7.0 to 7.5	Twin-screw; barrel temperature 130-65 °C (preferred 155-162 °C); slotted die; pieces up to 25.4 cm; dry extrusion and optional drying; grinding or packaging in sauce.	591
Dry-textured legume protein particles with defined water-holding capacity and density for use across food applications	Pea or faba proteins as main legume sources; pea protein content 70-85% (dry matter) preferred	Protein 60 -80% (dry basis); dry matter > 80% (preferably >90%); particle size 2- 5 mm; density 190-230 g/L; WHC >3.5 g water/g protein.	Twin-screw; L:D 35-45 (about 40); screw speed 1000-1100 rpm; element distribution: 85-95 feeding, 2.5-10% kneading, 2.5-10% reverse; temperature profile: feed 20-70 °C, kneading 90-150 °C, reverse 100-120 °C; in-barrel moisture 20.5-26%; die with holes; cut at 1200-1800 rpm; outlet pressure 10-25 bar; dry after cutting.	1149

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Pea and faba mixtures co-textured to increase firmness; for robust particles suited to meat substitutes.	Pea protein isolate	Total protein content (pee + faba) 55–75% (preferably 60–70%); pea:faba mass ratio 70:30 to 45:55; optional legume fibers 10–30% (total solids); bulk density at die 225–375 g/L;	Extrusion cooking with water to reach in-barrel moisture 20.5–26% (preferably 22%); optional knife cutting at die; drying to reach 90–95% solids.	37876
Textured legume protein composition with specified water retention and density; includes a compression step after extrusion to tailor structure.	Pea or faba as legume source; pea protein commonly used.	WHC >3 g water/g protein (preferably 4– 5 g/g); protein 60–80%; dry matter >80% (preferably >90%); density of textured pea protein 40–120 g/L before compression.	Twin-screw extrusion with specific energy 20–30 kWh/kg and outlet pressure 70 –90 bar; compression in drum dryer at 40 °C, drum diameter 300 mm, speed 10 –20 rpm (~16 rpm), four satellite cylinders 75 mm, gap 0.5–1.5 mm (~1 mm); optional drying.	3377
Plant-based meat analog formulation; process defines hydration, particle size, and inclusion windows for the particulate matrix.	Hydrated texturized pea protein and pea protein isolate to boost protein and bind matrix.	Hydrated textured protein 25 – 50% (of final product); pea protein isolate, dry matter 0.5–10% (preferably 3–4%); lipids, polysaccharides, flavor, lecithin, fibers, colorants and or salts	Hydrate texturized pea protein at protein:water 1:2 to 1 :4; chop to target mean particle size 0.4–4.0 mm (preferably 0.7 to 2.0 mm); mix with other ingredients; final texturization step to set structure.	719

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Preparation of plant meat; flavor marination at low temperature followed by forming and baking to set fibrous bite.	Texturized pea protein as the primary structured protein; gluten to reinforce elastic network; sweet potato starch for binding; rapeseed oil and monascus red for lubrication and color.	Texturized pea protein and gluten at weight ratio of 9:1 to 5:5 (preferably 7:3); sweet potato starch for binding 4-8% (preferably 6%); rapeseed oil 3 -15% (preferred 10%); monascus red 0.01 to 0.05% (preferably 0.03%).	Soak texturized pea protein 1-4 h; marinate 8-4 h at 0-4 °C; mix with oil and gluten; add starch and color; press to shape; bake 15 min at 100-120 °C	50689

3D-Printed Products

In the 3D printing space, pea protein is formulated into printable gels/inks by pairing with hydrocolloids (e.g., κ-carrageenan, galactomannans) or by embedding into high-internal-phase emulsions that are later enzymatically cross-linked. Applicants target fish/seafood-type formats and easy-to-swallow products: the shape comes from hydrocolloid-driven rheology and a final set step (steam/heat or transglutaminase-mediated cross-linking). Lipid phases (including DHA/EPA oils) are used where a richer mouthfeel is needed. Pea protein is thus the protein framework around which flow, print precision, and set are orchestrated via co-ingredients and controlled processing (46874; 50372; 47746).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Printable rheology:** Pea protein supports extrusion-friendly viscosities when combined with structured fats/emulsions or hydrocolloids, enabling accurate layer building (46874, 47746, 50372).
- **Thermal/enzymatic set flexibility:** Networks can be fixed by steam heating or transglutaminase cross-linking at mild temperatures prior to enzyme inactivation (46874, 47746).
- **Synergy with polysaccharides:** Interactions with galactomannans and k-carrageenan improve yield stress, elasticity, and post-printing stability, including freeze–thaw performance (46874, 50372).
- **Emulsion capability**: As a co-emulsifier/protein matrix around HIPEs, pea protein helps maintain geometry in high-oil inks while enabling soft-gel textures suitable for dysphagia applications (47746).

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
3D-printed raw fish analogue using plant proteins	Pea protein (primary matrix protein) providing gelation and structure for 3D printability and post-steam set.	Dry mix per batch: pea protein 12.5 g; mung bean protein 3.75 g; salt 0.5 g; k-carrageenan 0.225 g. Oils: kombu & wakame extracts 40 mL total, flaxseed oil 10 mL, sunflower oil 2 mL, vegan DHA/EPA oil 1.204 g.	Mix dry ingredients; add oils; 3D print with custom nozzle to 5x3x1 cm geometry; steam at 120 °C for 40 min to set structure; optimize formulation for organoleptics and nutrition.	46874
High internal phase emulsion (HIPE) based gel inks for 3D printed, easy-to-swallow foods	Pea protein solution acts as protein network/co-emulsifier; enzymatic crosslinking with transglutaminase to strengthen printability and set.	Edible oil, xanthan gum + beta-cyclodextrin to form HIPEs;HIPEs blended with pea protein solution; TGase added to crosslink. (HIPEs:pea protein solution up to 20:100).	Prepare HIPEs by homogenizing oil into xanthan/beta-cyclodextrin aqueous phase; blend HIPEs with pea protein solution; add TGase; crosslink 35-45 °C for 30-90 min; heat to inactivate enzyme; cool to set 3D printing gel.	47746
3D-printable gel for artificial seafood/surimi; designed for freeze-thaw stability and precise printing.	Pea protein isolate as primary protein forming heat-set gel and interacting with galactomannan for rheology suitable for extrusion printing.	Pea protein suspension at 0.02-0.06 g/mL; galactomannan 0.04-0.08 g/mL (e.g., fenugreek, guar, locust bean); shepherds purse powder mixed at mass ratio 1:4 with the pea protein-galactomannan solution.	Hydrate pea protein (pH 7-8), high-speed homogenize 5-10 min, stir 4-6 h; add galactomannan, homogenize 7000-10000 rpm 5-10 min; water-bath 82-88 °C for 10-20 min; prepare shepherds purse powder (ultrasound, vacuum microwave + far-IR dry); combine, homogenize 3-5 min, water-bath 82-88 °C for 3-5 min; cool 3-4.5 h; printing accuracy >95%; stability >92% after freeze-thaw.	50372

Enzyme-Aided Structuring

This subsection covers processes that use enzymatic cross-linking, primarily transglutaminase, to structure pea-protein systems into meat-like matrices. Across the set, pea protein serves as the substrate for cross-linking. Typical outputs include crumbles, patties, links, and extruded analogues with improved cohesion, chew, and water retention (40), (125), (48774).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Readily cross-links with TG** to build elastic, cohesive networks that withstand forming and cooking (40, 125, 48774).
- **Clean-label binder** when incorporated via solid-state emulsions that rehydrate and set with TG (40).
- **Compatible with multiphase systems** (oil-in-water emulsions, crumbles plus binder), enabling modular assembly of formats (40).
- **Supports moisture retention and shape stability** through enzymatically reinforced matrices (40,48774)

PULSE CANADA

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Solid-state pea protein emulsions set with transglutaminase to create meat-substitute textures suitable for patties, links, nuggets, and similar formats; emphasis on minimal ingredients.	Pea protein powder; protein used as substrate for TG cross-linking, emulsifier in the initial emulsion, and binder in final matrix.	Emulsion: 65–95% water (about 85% typical); oil:pea protein ratio 1:19 to 1:0.5 (about 1:3 typical). Binder: water 55–95% of binder; TG 0.01–0.2% of admixture. Pea protein in final product ~10–40%	Admix water + pea protein to form slurry; homogenize with fat to form emulsion (heat to 160–170 °F, then to about 175 ° F; homogenize at 3000–4000 psi). Spray-dry to solid-state emulsion. Rehydrate with water and TG; incubate 15 min to 8 h at 0–70 °C to set; optionally crumble (1–30 mm) and form. Cook 122–375 °F to inactivate TG and set shape; binder-to-crumble ratios 20/80 to 60/40.	40
Transglutaminase-induced gelation of pea protein forms a gelatinized cake that is ground and dried to yield a textured, meat-like ingredient without high-temperature extrusion.	Pea protein as the primary protein substrate for TG cross-linking to build cohesive, elastic texture.	Pea protein + water + TG to form a gelatinized protein matrix; composition tailored to target formats (e.g., meatballs, patties, sausages, crumbles, nuggets).	Combine pea protein with water and TG; allow enzyme-driven gelation to set; grind the gelled cake to particles; dry to the desired moisture for stable textured granules; rehydrate and form as needed.	125
Plant-based meat analog is produced by pre-cross-linking pea protein isolate with gluten using transglutaminase, then adding starch, salt, and pea fiber before extrusion and sterilization to obtain fibrous texture and improved chew.	Pea protein isolate as the main TG cross-link substrate to strengthen the protein network prior to extrusion.	Initial enzyme-modified mix (mass ratio): pea protein:gluten:water:TG = 500:500:1000:20–80. Post-cross-linking additions (relative to water): starch 0.10–0.15x; salt 0.02–0.03x; pea fiber 0.05–0.06x.	Mix pea protein isolate + gluten + water + TG; allow cross-linking; heat to inactivate TG. Add starch, salt, and pea fiber; mix to uniformity; extrude with shear to form structure; sterilize the extrudate.	48774

TG = transglutaminase

Use as Functional Additive

Pea protein is deployed in auxiliary roles to modify sensory and textural attributes in meat analog applications beyond its use as a primary structuring agent. These include aroma generation during cooking via Maillard and sulfur chemistry (347), composite texture enhancement in comminuted products (50355), fat mimicry through colloidally stabilized high-internal-phase emulsions (47733), and binder networks when paired with recombinant proteins to improve cohesion and moisture management (594).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Maillard reaction substrate**: supporting beef-like aroma development when combined with sugars, sulfur donors, and heme sources (347).
- **Binder**: contributes to composite texture systems by reinforcing water binding and gel strength in processed meat matrices (50355).
- **Emulsion properties**: Forms or participates in colloidal particles suitable for Pickering-stabilized HIPEs, enabling fat substitution with thermal and ionic resilience (47733).
- **Compatible within mixed protein** networks to improve cohesion, moisture retention, and heat stability (594).

PULSE CANADA

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Method to impart beef-like aroma to plant-based meat replicas that generates characteristic volatile compounds during cooking.	Pea protein substrate providing amino acids and precursors for Maillard/sulfur chemistry; structural protein within the matrix.	Plant proteins 1–30% w/w; sugars (e.g., glucose, ribose, sucrose, fructose, xylose, maltodextrin); sulfur sources (methionine, cysteine, thiamine); 0.01–5% non-animal heme protein.	Blend dry plant proteins, sugars, and sulfur compounds; incorporate non-animal heme protein; form meat replica matrix; upon cooking, matrix generates beef-like volatiles via Maillard and sulfur reactions.	347
Texture improving agent for processed meats and meat alternatives delivering meat-like chew and juiciness.	Functional protein fraction in a composite texture improver that augments gel strength and water retention.	Oil-processed starch + pea protein + calcined calcium	Prepare dry or premixed texture improver; dose into minced or comminuted matrices during mixing; proceed with standard forming and cooking steps (e.g., patty forming, thermal set).	50355
Preparation of modified pea protein–chitosan nanoparticles to stabilize high-internal-phase Pickering emulsions used as fat substitutes in low-fat meat products.	Pea protein (alkali pH-shift and heat modified) as the colloidal particle phase that, with chitosan, forms interfacial solids for Pickering emulsion stabilization.	Modified pea protein : chitosan mass ratio 1:3–1:7; HIPE oil phase 60–80% v/v; nanoparticles formed post pH-shift, heating, and ultrasound.	Adjust pea protein solution to pH 12–13 (NaOH), stir 1 h; neutralize to pH 7–8 (HCl), stir 1 h; heat 60–100°C for 30 min then ice-bath; add chitosan and ultrasonicate (20 kHz, 225–525 W, 4 s on/2 s off, 3–15 min); emulsify oil (60–80% v/v) to form HIPE; use as lipid substitute in meat systems.	47733
Recombinant ovomucoid (rOVD) protein compositions combined with plant proteins to bind and improve texture, moisture, and stability of meat analogs such as nuggets and strips.	Plant protein component in the matrix that pairs with rOVD to enhance binding and texture	rOVD at ~2–50% of protein phase; matrix may include pea proteins, yeast extract, starch, methylcellulose, oils	Produce rOVD via microbial expression; blend with plant proteins and other binders; form into meat-analog pieces; cook to set; options include drying, breading, saucing; process designed for improved shelf life and texture robustness.	594

PLANT-BASED DAIRY

Plant-Based Milks & Barista/Coffee Beverages

Pea protein is positioned as the primary or sole protein in several plant-based milks and coffee beverages, where applicants leverage it for protein fortification, emulsification/foam support, and stability. Pea protein is often combined with buffers, mineral salts, and hydrocolloids, or modified chemically/enzymatically to improve performance. Formulations frequently target "barista" functionality (foam, micro-bubbles, pourability) and stability in hot, acidic coffee without gums/synthetic emulsifiers, or with minimal stabilizer systems. Sensory mitigation work appears in parallel, with approaches that modulate lipoxygenase activity or matrix interactions to reduce off-notes.

Pea Protein Attributes as Claimed by Patent Applicants:

- **Flavor management** in pea milk when pea protein participates in additive systems that modulate flavour interactions (e.g., with Na_2SO_4/propylene glycol) or when off-note generation is addressed upstream via lipoxygenase (LOX) inhibition; pea protein is part of the matrix whose interactions are being tuned. (48643)
- **Protein fortification** of plant milks with minimal/defined stabilizers; pea protein used for nutritional contribution and body. (1180; 43454; 44095)
- **Foaming & emulsification**: applicants position pea protein as providing foam and emulsion stability **without** added emulsifiers, stabilizers, thickeners, foaming agents, or external fats/oils. (43553)
- **Heat/acid stability without gums**: buffering plus calcium citrate and controlled agglomerate size maintain dispersion and foam in coffee systems (889); chemical modification (succinylation) markedly improves solubility and dispersion (94).
- **RTD process compatibility**: homogenization/UHT regimes yield shelf-stable coffee beverages with balanced mouthfeel (29059).

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Plant-based beverage composition using plant protein and a thickening system to deliver a protein-rich drink without dairy.	Pea protein concentrate; provides primary protein source and contributes emulsification/viscosity in a clean-label matrix.	Pea protein concentrate ~4-7 wt% plus a food-grade thickener (not specified); water and standard beverage adjuncts as needed.	Blend aqueous phase with pea protein concentrate and thickener; hydrate and homogenize to form a stable beverage base; fill under standard beverage conditions.	43454
Flavor-improved pea milk via lipoxygenase suppression and additive-mediated binding control to reduce beany off-notes.	Pea protein additive to modulate interactions with flavor compounds; supports body and protein claims.	Additives: Na2SO4 0.01-0.1 g/kg, propylene glycol 1-3 g/kg, pea protein 1-8 wt%; Inhibitors: quercetin/EGCG/reduced glutathione 0.01-1 g/L.	Ultra-high-pressure treatment 500-600 MPa for 10-15 min; prepare first/second inhibitor solutions at stated concentrations; combine with pea matrix, adjust pH/ionic strength to suppress lipoxygenase activity.	48643
Enzymatic improvement of plant beverages by reducing phytic acid to enhance taste and mouthfeel.	Pea protein as the beverage protein system benefitting from reduced astringency after enzyme treatment.	Pea protein beverage; phytase and protein arginine deiminase (PAD); typical protein use 0.5-1.0 g per 100 g beverage.	Dose phytase and PAD into the beverage mix; incubate under conditions suitable for phytate hydrolysis and deimination; proceed to standard thermal processing for beverage safety.	1062

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Non-dairy cappuccino premix designed for foam formation and emulsification without conventional emulsifiers or stabilizers.	Pea protein as the sole/primary foaming and emulsifying protein to achieve stable crema and mouthfeel in a clean-label premix.	Premix with pea protein, sugars/cocoa/coffee solids as applicable; explicitly free from added emulsifiers, stabilizers, thickeners, and added oils.	Dry blending of premix components; on reconstitution, hydrate and shear to develop foam; no chemical emulsifiers used.	43553
Barista-style plant milk stabilized in coffee without flocculation and capable of foaming for latte art.	Pea protein as the only protein source providing emulsification, body, and foam stability in coffee matrices.	Plant protein 2–8 wt%; plant oil/fat 1–5 wt%; natural sweetener 1–10 wt%; calcium citrate tetrahydrate 0.18–1.8 wt%; buffers (e.g., dipotassium phosphate) 0.5–1.8 wt%; water; no gums/hydrocolloids/synthetic emulsifiers.	Mix all ingredients; adjust pH to 6.7–7.8; homogenize or shear; thermal treatment; aseptic fill; protein–fat agglomerates 1–30 m targeted by process.	889
Pea-based liquid food compositions with specific nutrient targets and excluding dairy proteins.	Pea protein isolate as primary protein delivering nutrition and body in dairy-free milks.	Per 100 mL: pea protein isolate 2.5–3.0 g; sunflower oil 1.1–1.5 g; sugar 1.8–2.4 g; gellan gum 0.1–0.2 g; inulin 2.0–3.0 g; tribasic calcium phosphate 0.3–0.5 g; dipotassium phosphate 0.5–0.9 g; optional flavors; overall protein 2.0–2.6 g/100 mL.	Hydrate and mix dry and liquid ingredients; homogenize; thermal process as required for safety; fill; no dairy proteins used.	1180

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Shelf-stable ready-to-drink coffee beverage with balanced mouthfeel and emulsion stability.	Pea protein as plant protein stabilizer contributing to emulsion stability and sensory body.	Coffee 0.5–2.5 wt%; MCT oil 5–10 wt%; pea protein 0.3–1 wt%; high-acyl gellan 0.01–0.04 wt%; buffer; sugar 0–10 wt%; sodium bicarbonate 0–0.3 wt%.	Add gellan, sugar, buffer; add protein and coffee; add MCT; homogenize at ~135/35 bar at 70–80 °C; UHT 141–148 °C for 2–6 s; cool to 15–25 °C; aseptic fill.	29059
Non-dairy analog beverages for superior dispersion and reduced feathering in acidic/hot matrices.	Succinylated pea protein to increase solubility and stability in challenging beverage conditions.	At least 2 wt% refined protein with 30 wt% succinylated fraction; 1–10 wt% non-animal lipid; 0.01–10 wt% emulsifier; pH 4.0–10.2; optional vitamins/minerals/carbohydrates.	Blend lipid, protein, and water; emulsify; adjust pH; thermal process as needed; designed to minimize feathering/precipitation on mixing.	94
Pea-based plant milk combining protein with hydrolyzed syrups and optional enzyme-assisted fermentation to improve flavor and nutrition.	Pea protein isolate or concentrate as main protein; benefits from enzymatic pretreatment and fermentation for off-note reduction and stability.	Pea protein 2–12 wt% (preferably 6–8 wt%); hydrolyzed syrup 1–8 wt% (preferably 3–6 wt%); optional starter cultures; optional enzymes (glycoside hydrolases, phytase, proteases).	Optionally apply enzyme pretreatments; ferment with vegan starter cultures; homogenize/pasteurize per plant milk standards; fill.	44095

Powdered Coffee Creamer

This patent describes a plant-based coffee creamer that uses pea protein to stabilize an oil in water emulsion for whitening, opacity and mouthfeel in hot and cold coffee. Pea protein forms the interfacial film around oil droplets, supports buffering near neutral pH and improves feathering resistance in acidic coffee.

Pea Protein Attributes as Claimed by Patent Applicants:

- **Forms monodisperse microgels** (0.5–10 μm) that deliver emulsion-like mouthfeel without triglyceride fat (49639).
- **Provides emulsification and whitening** while remaining dispersible and stable after granulation/coating (49639)
- **Heat stability and reduced feathering** in acidic coffee (49639)
- **Compatible with common vegetable oils and stabilizer systems** (49639)
- **Plant based** clean label positioning for dairy free creamers (49639)

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Plant based coffee creamer to provide whitening, opacity and mouthfeel in hot and cold coffee. The invention targets heat stability, feathering resistance and good dispersion without dairy.	Pea protein isolate as the primary emulsifying and whitening protein in the emulsion. Selected for interfacial film formation around oil droplets and for buffering that reduces feathering in acidic coffee.	Water as the continuous phase; vegetable oil such as coconut or high oleic canolat 5-20%; pea protein about 0.5-3.0%; emulsifier mono and diglycerides and/or polysorbate at guideline levels; stabilizers such as gellan, carrageenan or microcrystalline cellulose; buffer salts-manage pH near 6.6-7.0; sweetener and flavor as desired.	Hydrate pea protein in water; add oil and emulsifiers under high shear; two stage homogenize to target mean droplet size; heat treat by pasteurization or UHT for shelf stability; for powders, concentrate and spray dry with controlled inlet and outlet temperatures; for liquids, cool, add flavors and fill aseptically.	49639

Yogurt & Fermented Dairy Analogues

Pea protein enables development of cultured, dairy-analog products with controlled acidity, stable gel structures, and clean-label formulations. Across yogurt and fermented bases, formulations typically combine pea protein with defined thermal treatments, homogenization, and lactic fermentations to reach target pH and viscosity, while optional co-protein and/or hydrocolloid addition tune astringency, water holding, and syneresis. Several filings specify pea protein as the single plant protein source, pointing to its role in delivering protein targets and contributing to set and mouthfeel in dairy-style fermented matrices.

Pea Protein Attributes as Claimed by Patent Applicants:

- **Set/viscosity contribution** in cultured gels at 1–10% pea protein, sometimes as the single plant protein; applicants describe defined viscosity and firmness without, or with minimal, added stabilizers. (2685; 734)
- **Protein enrichment** in mixed cereal/legume fermentations (e.g., oat + pea); pea protein provides targete texture and nutrition. (9858)
- **Probiotic-friendly matrix** where pea protein is one element of a "dairy-like" base with inulin/probiotics. (49757)
- **Acid gelation and stability** in the yogurt pH window, formulations reach pH 3.0–6.0 and ferment to pH < 4.7 while maintaining coherent gels and reduced syneresis (361, 734).
- **Thermal process tolerance**: Heat treatments of 65–120 deg C for 1–30 min support microbial safety and microstructure without heavy stabilizer use (734).
- **Synergy with other proteins to reduce astringency**: Blends with rapeseed protein lower astringency and improve mouthfeel and viscosity (361).

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Plant-based yogurt combining rapeseed and pea protein isolates to reduce astringency and improve stability across pH 3.0-6.0.	Pea protein isolate as part of the protein base to modulate astringency and contribute to body/texture.	Total protein 1-10% w/w; rapeseed:pea protein weight ratio 80:20 to 5:95; optional vegetable oil or fat and emulsifier; optional hydrocolloid 0.02-2% w/w; optional micronutrients, sugars, flavors, colors.	Hydrate and blend proteins; homogenize as needed; pasteurize; inoculate with yogurt cultures; ferment to target acidity within pH 3.0-6.0; cool and pack.	361
Dairy-like fermented product with added pre- and pro-biotics to deliver a dairy-style texture and flavor without dairy.	Pea protein and fiber to build viscosity and nutritional protein.	Chickpeas, pea protein, pea fibers, inulin, coconut oil, tapioca starch, salt, flavored yeast, Lactobacillus bulgaricus, water.	Hydrate and mill base; heat treat for safety; homogenize; inoculate with probiotic culture; ferment to desired acidity and gel strength; cool and pack.	49757
Non-dairy fermented product to create yogurt-like products with improved nutritional and sensory properties.	Pea protein isolate as all or part of the vegetable protein to improve gel formation and mouthfeel.	Oat-derived material dry matter 5-20% w/w; fat up to 15% w/w; vegetable protein up to 6% w/w; starch 1-7% w/w.	Prepare liquid base; pasteurize; optionally homogenize; inoculate with lactic culture; ferment to target acidity and viscosity; cool and pack.	9858

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Plant-based yogurt analog designed to hit specific protein and lactic acid ranges.	Pea protein isolate as the sole plant protein to build a fermented gel and provide protein targets.	Plant protein 1–10% w/w, lactic acid 0.35–0.95%; carbohydrate 1–10%; oil 0.5–8%; emulsifier 0.05–0.3%; optional amino acids 0–1%; buffer 0.1–1%; yogurt cultures (Lactobacillus and Streptococcus).	Blend and hydrate; heat treat; inoculate; ferment to lactic acid, set; cool; fill.	2685
Non-dairy fermented product with low added stabilizers and defined texture targets	Pea protein to form the fermented gel, achieve viscosity and firmness targets.	Pea protein 3–12% w/w; sugar 0.5–10% optional; optional non-dairy milk up to 60%; optional fiber up to 3%; fat up to 15%.	Method A: heat liquid mix 90–120 °C for 30 sec to 30 min; inoculate; ferment to pH < 4.7. Method B: homogenize 100–250 bar; heat 65–120 °C for 1–30 min; inoculate; ferment to pH < 4.7.	734

Cheese Analogs

Applicants deploy pea protein in stretchable, sliced, soft-ripened, and high-protein analog cheeses, commonly co-formulating with starches/hydrocolloids, oils/fats, and proteases or transglutaminase (TGase). Across filings, pea protein is positioned to provide the primary protein network that accepts enzymatic modification (protease/TGase) for stretch or firmness, and functionally supports emulsification/gelation alongside plant fats. Filings also leverage modified pea protein derivatives (e.g., shiitake-fermented pea protein) to improve flavor neutrality, solubility, and processability (12052).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Forms enzyme and/or acid induced crosslinked network**: transglutaminase builds firm, cohesive, high-protein cheeses without added starches/hydrocolloids; optional protease tuning for softness (1363); soft-ripened analogues where pea protein contributes to curd formation and water binding in stabilizer-free "legume milk" bases. (2055)
- **Increased stretchability & melt** when pea protein is protease-treated and combined with starches; applicants target mozzarella-like stretch. (22331; 225101)
- **Emulsification**: pea protein stabilizes protein, fat, and starch emulsions for sliceable and stacked products (8833) and supports starch-driven melt in oat-based systems (3700, 30468).
- **Fermentable**: pea protein forms fermentable curds and withstands brining and optional ripening (3700, 2055).

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Stretching plant-based cheese substitute; protease treatment enhances stretch and melt.	Pea protein as core protein; enzymatically modified with protease to increase extensibility.	Plant protein 1–15% w/w; starch present; remaining matrix includes water and fats as formulated.	Hydrate proteins and starch; add protease and incubate under controlled pH/temperature; heat to inactivate enzyme; emulsify, mold, and cool to set.	22331
Stretchable cheese alternative produced by protease-treated plant proteins at higher protein contents.	Pea protein as primary protein; protease treatment to increase stretchability and melt behavior.	Total plant protein 15–30% w/w; other components (starch/fat/water) per target functionality.	Prepare hydrated protein slurry; add protease; incubate; heat-inactivate; form and cool.	225101
Oat-based cheese analogue to replicate melt and texture.	Vegetable protein fraction includes pea protein providing structure within starch–fat matrix.	Oat base (dry matter) 2–8%; vegetable fat 20–30%; starch 20–30%; vegetable protein 1–4%; stabilizer 0.2–1% (xanthan); water 35–45%.	Combine ingredients; heat 50–90 °C to gelatinize starch and emulsify fat; homogenize as needed; pour, set, and cool.	30468
High-protein analog cheese; clean-label (no added starch/hydrocolloid/fiber).	Pea protein is 50–80% of plant protein; crosslinked by transglutaminase; optional protease (bromelain) treatment to modulate texture.	Fat 20–30%; crosslinked plant protein 15–25%; TG 0.40–0.60%; optional protease up to 0.85%. Variant (cheese mass): fat 10–20%, protein 10–20%, TG 0.20–0.50%.	Form emulsified fat–protein blend; add ripening agent and TG; rest 0.5–2 h; heat to inactivate protease; press to shape; cool.	1363

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Stacked, sliced cheese analogue; sliceable after cooling.	Pea protein within protein fraction to support emulsification/gelation and slice integrity.	Example: 5% pea protein, 25% coconut oil, 7.5% modified tapioca starch, 3% modified potato starch, 1.6% carrageenan; protein ≥5%, fat ≥25%, thickener ≥10%, gelling agent ≥1.5%.	Heat mix to >80 °C to form emulsion; homogenize; cool to <20 °C; sheet, cool, and stack 50+ slices.	8833
Mozzarella-style cheese	Fermented pea protein with neutral taste/solubility	Cultured cashew/oat base with shiitake-fermented pea protein: protein source ~22.76%, emulsifier ~53.7%, flavorings ~1.5%, gelling agents ~21.63%.	Soak and ferment base; blend with fermented pea protein pre-blend; heat with agitation up to ~190 °F; extrude at >170 °F; set and cool.	12052
Fermented non-dairy cheese analogue; optional ripening.	Vegetable protein fraction includes pea; provides gel network; TG crosslinks glutamine/lysine residues.	Oat material 3–15%; vegetable fat 10–25% (often 17–25%); vegetable protein 10–25% (often 10–17%); water 40–70%; calcium salt; optional hydrocolloids.	Mix oat material with water; heat 50–90 °C; add protein under heat then fat; emulsify/homogenize; add culture and TG; ferment to curd; dewater and brine; optional ripening.	3700
Soft, optionally ripened cheese equivalent without texturizers.	Pea protein isolate (≥80% protein; DH <6); provides curd formation and firmness.	Legume milk solids 15–50%; dry solids comprise 25–75% legume protein and 25–75% fat; sugars 0–5%	Prepare legume milk; heat above 38 °C then cool below 38 °C; inoculate thermophilic/mesophilic cultures; ferment; optional concentration; ripen with *Penicillium camemberti* and/or *Geotrichum candidum*.	2055

Frozen Desserts

Pea protein appears in anti-freezing gelato compositions as a minor protein component within broader cryoprotectant systems. In this filings, pea protein is co-formulated with sugars, stabilizers, emulsifiers, and antifreeze peptides/polysaccharides to support body and overrun while the main freezing point–depressing and stabilization function is result of the broader matrix.

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Anti-freezing gelato formulation that maintains scoopability and reduces ice crystal growth in frozen storage.	Pea protein used to aid structure and freeze-thaw stability in combination with other hydrocolloids and emulsifiers.	Parts by weight: glucose 40–60%; maltodextrin 25–35%; guar gum 1–3%; sodium carboxymethyl cellulose 1.5–3.5%; monoacylglycerides 0.5–2.5%; lactic acid monoglycerides 1–2.5%; DATEM 0.8–3.2%; salt 1.5–4%; coconut oil 2–6%; potato protein 0.2–0.9%; pea protein 0.3–1.0%; antifreeze peptide from fish skin 0.2–0.6%; antifreeze polysaccharide from white mushroom 0.1–0.4%.	Not specified	50139

Milk Ingredient Substitution

Applicant positions pea protein as a functional stand-in for milk proteins in confectionery (caramels, toffees, milk chocolate) and as a glazing cream protein in bakery. Pea protein is leveraged for Maillard browning, emulsification, and solubility, enabling dairy-free/egg-free positioning while maintaining processability and characteristic color/flavor development. (49207).

Pea Protein Attributes as Claimed by Patent Applicants:

- **High solubility (20–99%)** cited by applicants for smoother processing in confections and glazes; clean-label/allergen management. (49207)
- **Provides stable oil-in-water** emulsions suitable for glazing creams at practical solids and fat levels (4–7% protein; 5–20% fat) (49207).
- **Delivers Maillard browning and flavor development** comparable to milk proteins in baked applications (49207).

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Use of pea protein to replace dairy proteins in confectionery and as a glazing cream for baked goods, enabling comparable processing and sensory performance.	Pea protein isolate (75% purity) used as functional protein for emulsification and Maillard-driven browning; plant-based replacement for milk proteins.	Emulsion: 4–7% pea protein and 5–20% fat/oil; balance water and minor ingredients.	Prepare an oil-in-water emulsion by hydrating pea protein, blending with fats/oils, and homogenizing; apply as a glazing cream to baked goods pre- or post-bake to promote browning and sheen.	49207

EGG ANALOGS

Whole Egg Replacers

This subsection covers liquid egg alternatives that use pea protein to reproduce whole-egg functionality in cooking and baking. The systems pair pea protein with carefully balanced hydrocolloids (notably dual gellan gums), controlled pH, and mild heat steps to deliver emulsification, foaming, gelation, and set.

Pea Protein Attributes as Claimed by Patent Applicants:

- **Primary emulsifying and gelling protein** in pourable egg analog bases (5575; 1314; 14450).
- **Heat-setting** reliably in mildly acidic-to-neutral systems (pH ~5.0–7.0), compatible with gellan gel networks and vegetable oils (1314).
- **Colour neutral option** for "white" phases to mimic egg white (14450)

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Liquid whole-egg substitute that replicates binding, emulsifying, and leavening; designed for direct cooking and baking applications.	Pea protein isolate as the primary protein in the protein isolate composition; provides emulsification, gelling and structure when combined with thickeners and emulsifier.	Protein isolate composition 8–16% w/w; vegetable oil 8–16%; thickeners 0.5–2% (two types; e.g., high-acyl and low-acyl gellan); emulsifier 0.1–1% (e.g., lecithin with mono- and diglycerides); acidity regulator 0.01–1% (e.g., sodium citrate); at least one organic acid (e.g., acetic and citric); water balance; optional color, flavor, and preservative.	Prepare two aqueous streams: dissolve acidity regulator and first thickener (solution A); dissolve second thickener and protein isolate composition (solution B). Combine A and B, then emulsify in vegetable oil and emulsifier. Add salt and organic acids. Heat to 70–75 °C, then cool to set final viscosity; target final pH 5.0–7.0.	1314
Liquid egg analog formulated to behave like shell eggs in scrambling and baking	Pea protein isolate (often paired with lupin protein) supplies foaming, emulsification and gel matrix formation; works synergistically with high- and low-acyl gellan.	Combined pea + lupin protein around 10–15% w/w; high- and low-acyl gellan with a combined-gellan to total protein ratio of ~0.06–0.08; includes dispersant, emulsifier, texturizing agents, and a glucose, fructose or sucrose derivative.	Form a protein mixture by dosing proteins, texturizer and emulsifier into a dispersant at ≤55 °C. Separately prepare a gellan gel mixture (high- and low-acyl) in dispersant. Combine gel and protein mixtures under low shear, then pasteurize the combined mix at ≤65 °C with gentle agitation; fill and chill.	5575

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Molded egg yolk and egg white egg analog that is mycoprotein-free; a hydrocolloid white layer supports a frozen yolk ball	Pea milk used as a protein source in the white layer to build body and gel structure	White layer: one or more nut milks (may include pea milk), vegan thickener (agar, psyllium, tapioca, arrowroot, or a fermentation byproduct), fired salt (e.g., black salt). Yolk ball: nut blend (e.g., cashew flour, navy bean flour, pea hull fiber), vegan colorant (turmeric, carrot, sweet potato, tomato), fired salt; optional flax seed, coconut oil, probiotic, or nutritional yeast.	Form yolk ball by combining nut blend, fired salt, and vegan colorant; hydrate, mix, then freeze portions sized to the mold. Prepare white mixture by heating nut milks, thickener, and fired salt to a boil; cool to an annealing temperature. Place frozen yolk ball into the white layer at annealing temperature to suspend; cool to ambient. Optional high-pressure processing; optional second pour to fully surround the yolk.	14450

Yolk Analogues

This filing describes plant-based yolk systems that reproduce egg yolk's emulsification, viscosity, and appearance using pea-derived ingredients. The approach builds a liquid or spherified yolk from a protein–oil emulsion structured by a paired hydrocolloid system, vegetable oil, and pea protein. The process splits pea protein into two parts, mixing with a different hydrocolloid at different temperatures before recombining and creating an emulsion with oil and colorants. The yolk is described as free-forming or encapsulated in an alginate or kappa-carrageenan shell for a yolk "core".

Pea Protein Attributes as Claimed by Patent Applicants:

- **Gelling synergy** with thermoreversible networks (methyl cellulose, carrageenan; alginate shells) for yolk texture and cut/rupture behavior (699).
- **Supports emulsification and fat holding** for creamy, stable protein–oil systems without animal yolk phospholipids (699).

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Vegan egg-yolk substitute designed to mimic yolk functionality	Pea protein as the vegetable protein option (raw, hydrolyzed, fermented; concentrate or isolate) supplying the primary protein matrix and aiding emulsification	Water; vegetable oil (corn, rapeseed, coconut, sunflower) with optional emulsifier; protein 1%–35% by weight; hydrocolloids 0.5%–5% by weight combined thermogelling agent (methyl cellulose) and reversibly gelling agent (carrageenan); carotenoid or natural color (e.g., beta-carotene); optional partially pregelatinized starch; salt; optional shell of calcium alginate or kappa-carrageenan.	Prepare two streams: mix protein with thermogelling hydrocolloid at 40 °C or higher to make solution B; mix protein or water with reversibly gelling hydrocolloid at up to 30 °C to make solution C. Combine B and C; add oil plus emulsifier, colorant, and salt with stirring; optionally homogenize. Optionally encapsulate the core in an alginate or kappa-carrageenan shell.	699

Egg White Replacers

This filing uses pea albumin protein to deliver similar interfacial behavior as egg whites when paired with a pregelatinized, acetylated waxy corn starch. Intended uses span sauces (including vegan mayonnaise), beverages and clinical/enteral drinks, fermented and frozen desserts, baked goods, bars, breads, high-protein cereals, cheeses and meat or fish analogues.

Pea Protein Attributes as Claimed by Patent Applicants:

- **High emulsifying activity:** 600 mL corn oil/g albumin; often >800 or >1000 mL/g specified, enabling stable O/W systems in diverse foods
- **Rapid rehydration:** in ≤15 min supports efficient incorporation into wet systems.

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Plant-based egg albumin replacement to deliver egg-like emulsification and functionality in foods.	Pea albumin (legume albumin) as the primary protein; used to replicate egg albumin functionality, specifically emulsification.	Legume albumin : pregelatinized starch weight ratio 0.9:0.1 to 0.6:0.4 (pref. 0.75:0.25); albumin emulsifying activity >600 ml oil/g (pref. >800 or >1000 ml oil/g); pregelatinized starch from waxy corn, acetylated; composition excludes non-starch polysaccharides.	Rehydrate albumin (<=15 min), then mix in liquid medium to combine; optional addition of other compounds; optional final treatment post-mixing.	598

Eggless Condiments

These patents rebuild mayonnaise-type, high-oil, acidic O/W emulsions (oil-in-water) without eggs. Pea protein, including pea albumin or hydrolyzed pea protein, is leveraged for interfacial stabilization under low pH while maintaining clean ingredient lists and textures.

Pea Protein Attributes as Claimed by Patent Applicants:

- **Low-pH emulsion stability**: pea protein (especially pea albumin fraction) sustains emulsions at pH ~2–5 with 60–85% oil (308, 818).
- **Improved solubility at acid pH via controlled hydrolysis** (degree of hydrolysis ~2.2–5%) to reduce precipitation /feathering in acidic systems (363).
- **Enables egg-free labels** and in some cases starch/gum-free formulations (308, 818).

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Mayonnaise-type, egg-free oil-in-water emulsion to deliver classic mayo texture and sensory experience without egg.	Pea protein (isolate or concentrate) as the sole plant protein to provide emulsification/foaming in an egg-free system.	Oil 60-80 wt%; water; pea protein 0.4-1.5 wt%; flaxseed fiber 0.1-1.5 wt%. Optional: starch 0.5-2 wt% (cold-water swelling).	Create aqueous phase (water + pea protein +/- fiber +/- buffers). Slowly add oil while high-shear mixing to form O/W emulsion; homogenize as needed; adjust pH for taste and stability. Formulate to remain stable in acidic dressings and spreads.	818
Egg-free acidic emulsion (mayonnaise/salad dressing) to match conventional mouthfeel and stability.	Pea albumin-rich fraction representing >60% of plant protein fraction; functions as key emulsifier effective at low pH.	Vegetable oil 65-85 wt%; plant protein 0.3-5 wt%; pH 2-5. optionally free of starch/gum.	Prepare water phase with plant albumin; prepare oil phase. Combine phases under shear to form O/W emulsion at target pH 2-5; no egg. Process designed to remain stable without added gum/starch (optionally).	308
Egg-free acidic emulsion to achieve stable mayonnaise-like texture without starch/gum.	Hydrolyzed pea protein (degree of hydrolysis 2.2-5%) with globulin level >80% of the protein to improve interfacial activity at low pH.	Vegetable oil 65-80 wt%; hydrolyzed protein 0.66-1.0 wt%; pH 2.4-4.5. Free of egg; optionally free of starch/gum.	Provide separate water and oil phases; dissolve the specified hydrolyzed protein in oil phase per claims; mix with water phase under shear to form stable O/W emulsion at pH 2.4-4.5.	363

CLINICAL, SPORTS, & WELLNESS NUTRITIONAL PRODUCTS

Enteral, Clinical & Therapeutic Nutrition

Pea protein is used across enteral (tube feeding) and clinical formats as a primary or complementary protein source in liquid and powdered medical nutrition. Globulin-rich fractions are leveraged to reach PDCAAS 1.0 while balancing electrolytes and mineral delivery in liquid formulas (1758). In mixed protein systems for enteral or oral use, pea protein supplies a sizable share of the protein blend to improve amino acid profile (6680, 91). Pea protein is added as a plant protein source within complex, enzyme-treated bases, then homogenized and sterilized for nasogastric administration (49895). It also appears in ketogenic beverages where hypoallergenic character and dairy-like functionality are desired in the high-lipid macro profile (27789).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Meet amino acid & protein digestibility targets**: pea protein used with dairy proteins (whey/caseinate) to meet targets in enteral/oral formulas (49895; 6680; 91)
- **Ketogenic diet compatibility & "hypoallergenic" positioning**: selected as the plant protein in keto liquids; applicants describe pea protein as having "properties common to milk proteins" and suggest potential cholesterol-lowering positioning in this context. (27789)
- **Tolerance and osmolar control for pediatrics**: Included as concentrate or isolate within hypocaloric complete feeds designed for osmolality less than or equal to 400 mOsm per kg (91).

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Powdered enteral nutrition for nasogastric delivery; aims for nutrient stability, easy absorption, and clinical suitability for patients with limited digestive capacity.	Pea protein powder as a plant protein component added post-hydrolysis to complement amino acid profile and contribute to protein content	Includes chicken breast and cod hydrolysates, pea protein powder, whey protein powder, yam powder, inulin, stachyose, lactic acid, glucosyl nobiletin, DHA powder, punicalagin, hydroxytyrosol; water added to adjust solids.	Enzymatic hydrolysis of animal proteins at 42–62 °C and pH 6.5–7.8; enzyme inactivation at 68–74 °C and 0.02–0.06 Pa; maturation at 120.5–121 °C and 0.20–0.22 Pa; cool to 56 °C, add dry ingredients including pea protein, homogenize, then sterilize and fill.	49895
Liquid food composition with improved mineral profile and protein quality for general or clinical nutrition; targets PDCAAS 1.0 and balanced electrolyte content.	Globulin-rich pea protein as the main protein source (at least 60–75% of total protein) to reach PDCAAS 1.0 and provide desirable functionality.	Mineral system: magnesium carbonate 0.15–0.35% and tricalcium phosphate 0.4–1.2% (dry basis); potassium salts: pyrophosphate or tripolyphosphate 1.0–2.0% or metaphosphate 1.5–2.5% (dry basis); proteins consist primarily of pea globulins; optional cereal proteins and pea albumin.	Prepare protein suspension and mineral solution separately; mix; high pressure homogenization 15–50 MPa (~20 MPa typical); heat to inactivate enzymes and microorganisms; optionally add fibers, oils, emulsifiers, colors, preservatives, sweeteners.	1758
Balanced enteral or oral nutrition formula for malnutrition or specific metabolic needs; provides complete macro and micronutrients.	Pea protein isolate in protein blend; contributes to amino acid profile and digestibility.	Protein 4.0–6.3 g per 100 mL product; protein blend: 50% caseinate, 25% pea proteins, 25% whey proteins; lipid mixture (MUFA ~ 45–55% of lipids; PUFA ~22–25%); protein-lipid ratio 1.0–1.5; caloric density 1.0 or 1.5 kcal per mL.	Blend protein, lipid, carbohydrate, vitamins, and minerals; homogenize; thermal process for shelf stability; aseptic fill	6680

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Hypocaloric complete daily tube feeding for pediatric patients using processed whole foods and mixed protein sources; targets controlled osmolality.	Pea protein concentrate or isolate as the vegetable protein component within the total protein blend; plant-based alternative for tolerance and nutrition.	Protein provides 18–35% of total energy; caloric density 0.5–0.8 kcal per mL; osmolality less than or equal-400 mOsm per kg; includes processed whole food component plus vitamin and mineral premix.	Prepare processed whole food base; combine with protein blend and micronutrients; adjust to target osmolality and caloric density; package for enteral use; sterilization conditions not specified.	91
Liquid product to support ketogenic diet compliance in clinical or dietary settings; macro profile oriented toward high lipids with controlled protein and carbs.	Pea proteins listed as preferred protein source for hypoallergenic properties and dairy-like functionality; used as part of total protein.	Protein 5–10% by weight; lipids and carbohydrates adjusted for ketogenic targets	Mix lipid, protein, and carbohydrate phases; homogenize and heat treat as needed for stability and safety	27789

Clear & Acidic Protein Beverages

These filings position hydrolyzed pea proteins for clear, low-pH or sparkling beverages, with claims centered on solubility, low "protein taste," and reduced purine content; co-ingredients (e.g., fructo-oligosaccharides, acids, vitamins, flavors) complete the systems (47310; 47619).Hydrolyzed pea protein enables a transparent, water-like drink at ~pH 3.5 with good solubility and no chalkiness; typical formulas include ~1.9% hydrolyzed pea protein alongside fruit acids and prebiotic FOS (11–13%) to support mouthfeel and sweetness (47310). For consumers managing purine intake (e.g. management of kidney stones/gout), a pre-wash plus enzymatic hydrolysis process yields pea-protein hydrolysates with very low total purines (≤0.65% by weight), while preserving favorable foam for sparkling formats; dosage in finished beverages ranges from 0.0002 to 10 parts per 100 parts beverage (47619).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Acid solubility and clarity**: Hydrolyzed pea protein supports clear, low-pH beverages with neutral taste (47310).
- **Clean sensory profile**: hydrolysis reduces typical legume notes; avoids chalkiness in transparent drinks (47310).
- **Low-purine options**: Pre-wash + enzymatic hydrolysis reduces total purines to ≤0.65% in the hydrolysate (47619).
- **Formulation flexibility**: Compatible with acids, vitamins, flavors, and prebiotic FOS in clear beverage systems (47310).

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Clear, fruit-flavored acid beverage for high solubility and neutral taste at low pH.	Hydrolyzed pea protein as the sole plant protein for clarity and acid solubility.	Water 84.5-86.325 wt%; fruit concentrate 0.28-0.47 wt%; hydrolyzed pea protein 1.9 wt%; citric acid 0.15-0.20 wt%; vitamin powder 0.03 wt%; synthetic flavor 0.13-0.16 wt%; fructo-oligosaccharides 11-13 wt%; pH 3.5.	Blend ingredients; adjust to pH about 3.5; homogenize and fill as clear beverage.	47310
Low-purine pea protein hydrolysate for beverages, enabling reduced purine burden while retaining foam properties (suitable for sparkling drinks).	Pea protein and its enzymatic hydrolysate after a pre-wash step to reduce purines.	Use level in beverages: add 0.0002-10 parts hydrolysate per 100 parts beverage; purine total (adenine + guanine + hypoxanthine + xanthine) ≤ 0.65 wt% in hydrolysate.	Pre-wash: suspend powdered pea protein in aqueous solvent at >0 °C, remove supernatant; enzymatically hydrolyze washed protein; formulate beverages with the hydrolysate; optional carbonation; improved foam	47619

Ready-to-Mix Powder Beverages

Pea protein is used as the primary protein base in ready-to-mix beverage powders and meal replacements, often at high concentrations (≥50%) and in multi-component blends. One approach pairs high pea-protein levels with a targeted emulsifier system to overcome dispersion, chalkiness, and stability issues in water and in the presence of oils (49628). Pea protein also appears as the dominant protein in powdered health foods positioned for immunity/memory support, co-formulated with DHA algae oil and phosphatidylserine for functional positioning while maintaining good dispersibility (49390). In meal-replacement style powders, pea protein integrates cleanly with soluble/insoluble fibers, oil powders, and micronutrients while preserving flow and instantization, supporting balanced nutrition and satiety (50352). Formulators emphasize digestibility and solubility in water to support shake style delivery, while maintaining clean label positioning. Some compositions focus on functional adjuncts such as prebiotics, electrolytes or phytoactives that are blended with pea protein to target recovery, wellness and satiety outcomes. These works rely on controlled blending and gentle thermal handling to preserve heat sensitive actives and achieve rapid dispersion during consumer preparation. (46741).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Supports high protein content** in dry blends while maintaining acceptable dispersibility upon reconstitution (46741;49628; 493390; 50351).
- **High digestibility** in supplement-style powders, supporting nutrition and recovery narratives (493390).
- **Dry-flow and handling suitability** for granular powders intended for easy mixing and dosing (49628).
- **Compatible with lipid-actives and phospholipids** (e.g., DHA algae oil, phosphatidylserine) in powdered supplements without compromising dry flow or reconstitution. (49390)

PULSE CANADA

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
High-pea-protein beverage powder that uses a defined emulsifier system to improve dispersion, mixability and stability in water and in the presence of oils.	Pea protein as the primary protein	Pea protein≥50% of composition; emulsifiers include glycerin fatty acid ester (degree of polymerization 2-10), sorbitan fatty acid ester (HLB 1-10), and sucrose fatty acid ester (HLB 14-17); may contain oil/fat.	Select emulsifiers by HLB/DP as above; dry blend with pea protein (and optional oil) to form a free-flowing powder/granule; reconstitute in water for use.	49628
Powdered health food to support immunity and memory; designed for good dispersibility and palatability.	Pea protein powder as a main protein base (protein content ≥70%).	Pea protein powder 60-85%; whey protein powder (protein ≥80%); DHA algae oil; phosphatidylserine 20-30% purity; optional vitamins/minerals.	Dry blend powdered ingredients to a homogeneous powder; pack for oral use.	49390
Meal-replacement style powder with high fiber and fat components to deliver balanced macros and satiety.	Pea protein powder as primary protein fraction in a multi-ingredient blend.	Pea protein powder 20-35 parts; konjac powder 10-20; blackcurrant fiber 3-10; chia seeds 9-20; resistant dextrin 2-10; inulin 3-8; steviol glycosides 0-3; flaxseed oil powder 1-4; coconut oil-butter mixed oil powder 1-5; alkalized cocoa 8-15; psyllium husk 3-9; oat fiber 3-10; arginine 0.3-1.2; tryptophan 0.1-0.8; complex minerals 1-5; multivitamins 0.1-3; edible sea salt 0.3-2.	Dry blending and granulation as needed for flow; pack as an instant beverage powder.	50352
High protein supplement powder	Yellow pea protein as the primary protein source. Selected for plant-based positioning	Yellow pea protein 70-100% by weight, flavor masking agent 0.8-1.0%, sucralose 0.2-0.4%, guar gum 2.0-3.0%, optional beet ingredient, citric acid and or flavor.	Dry blend yellow pea protein with the masking agent, sucralose and guar gum until uniform. If used, incorporate beet ingredient and citric acid.	46741

Sports Nutrition, Performance, & Recovery

In sports performance and recovery applications, pea protein is positioned both as a functional partner to prebiotic fibers to support muscle mass preservation and nitrogen balance (359) and as a primary protein in extruded blends that deliver dense, vegan nutrition in ready-to-mix or solid formats (46738). One filing emphasizes synergies between inulin–pea protein blends, claiming benefits for sarcopenia and performance (359). Another leverages pea protein as one of several plant proteins to raise protein density and support a creamy, milkshake-like body for vegan beverages with enhanced antioxidant capacity for active or wellness consumers. (46738)

Pea Protein Attributes as Claimed by Patent Applicants:

- **High protein vegan formats:** used with other plant matrices (e.g., extruded chickpea, amaranth) to raise protein density while aiming for a creamy, milkshake-like body. (46738)
- **Muscle preservation / recovery support** when paired with inulin; applicants assert effects on muscle loss prevention, nitrogen balance, and protein utilization (359).

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Protein composition to prevent or reduce muscle mass loss and improve nitrogen balance	Pea protein as the protein component in an inulin protein premix; synergy claimed between inulin and protein; positioned for sarcopenia, clinical nutrition and muscle recovery benefits.	Premix ratio (inulin:protein) 5/95 to 75/25 w/w; composition ≥98% inulin + protein. Food or beverage products may include 10-65% of the inulin protein premix.	Blend inulin with protein to the specified ratio; incorporate premix into food, beverage, or supplement formats; no specific thermal conditions required.	359
High nutrition vegan products, includes shake formulations with amino acids and sweetener.	Pea protein as a major component of an extruded protein flour mix (isolated pea ~ 68% within the protein flour portion) for protein density and functionality in sports and recovery foods.	Protein flour mix 89%, active ingredients citrulline and stevia 0.8 to 1.2 percent; Shake type composition ~ 11% protein flour mix and ~1.0% stevia;	Extrude pea, chickpea and amaranth protein flours to develop functional properties; dry blend with actives such as citrulline and sweetener for ready to mix shakes or foods.	46738

Bars & Solid Formats

Solid bars leverage pea-based crisps and protein powder to increase protein content and improve bite/texture as part of a multi-component bar matrix with other proteins, sweeteners, binders, and fats (44009). The filing focuses on composition to achieve texture, protein delivery and water activity management during storage. Overall, the approach positions pea protein for balanced amino acid delivery with acceptable chew and shelf stability in portable formats that serve sports and recovery use cases as well as general snacking.

Pea Protein Attributes as Claimed by Patent Applicants

- **High protein contribution** per serving with plant-based positioning (44009)
- **Structure support and cohesion** in a low moisture matrix (44009)
- **Shelf-life support** via controlled water activity and reduced stickiness during storage (44009)

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
High sulfur-rich protein bar that carries naturally occurring sulforaphane from broccoli ingredients.	Pea protein crisp and protein powder listed as the protein sources. Crisp provides structure and bite while the powder increases plant protein density in the bar matrix.	Carbohydrates oatmeal or rye flakes; fats canola oil or shea oil; fibers resistant starch or inulin syrup; proteins pea protein crisp and protein powder; sweeteners apple pieces and concentrated apple juice; flavoring agents broccoli powder salt and lemon. Percent inclusion levels not reported.	Combine dry ingredients and wet ingredients to form a cohesive mass; press into a rectangular block; bake at 200°C for ~ 5 min; cool at room temperature for ~15 min; cut into 40 g bars.	44009

BAKERY

Yeast-Leavened Breads & Rolls

Pea protein is incorporated to elevate total protein and improve amino-acid balance in wheat-based doughs (49295). Because added plant protein can reduce loaf volume, enzyme systems are used to maintain gas retention and crumb quality. One filing leverages lipase/phospholipase and optional maltogenic α-amylase to preserve volume and texture (59). Another approach optimizes inclusions levels for protein and water that maintains machinability and dough gas retention through careful mixing, proofing and bake controls (49295).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Improves overall protein level with amino acid complementarity to wheat** (49295).
- **Contributes water binding and film formation around gas cells**, supporting volume when paired with lipase/ phospholipase (59).
- **Acceptable sensory performance** in standard straight dough or sponge processes (59, 49295)

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Yeast leavened bread system with enriched protein, preserved loaf volume and soft crumb	Pea protein isolate or concentrate blended with wheat flour to raise protein content while mitigating gluten dilution via water management and optional emulsifier use.	Typical base wheat flour with pea protein at 5–15% (flour weight); sugar 2–5%; salt 1–2%; oil 1–3%; yeast 1–2%; water adjusted to dough yield 60–65%.	Mix to full dough development then bulk ferment 60–90 min; degas, shape and proof about 30–50 min; bake at 180–200 °C to internal temperature ~95 °C; cool before slicing.	49295
Bread or roll formulation with protein using enzyme support to improve gas retention, softness and shelf life	Pea protein used as partial replacement of gluten protein to increase plant protein; synergy with amylase and protease systems to support dough handling and volume.	Wheat flour base with pea protein at 3–12% (flour weight); enzymes at label guideline levels; sugar and oil typical of soft rolls; water set for target dough yield.	Straight dough process mix, ferment, divide, intermediate proof, shape and final proof to target height; bake at standard bread temperatures then cool before packaging.	59

Gluten-Free Systems

Pea protein functions as a structuring aid in gluten-free bakery products, often paired with starch rich flours and hydrocolloids to build a gas holding network without gluten. One filing targets pan bread style batters where pea protein contributes structure and water binding alongside xanthan or guar to support rise and slice integrity (23998). Another emphasizes roll and bun doughs using pea protein with enzyme aids and emulsifiers to increase specific volume and maintain tenderness in storage. In both, process control is critical: smooth batter development, proof management and baking to an internal set point protects crumb and prevents collapse while delivering clean slices and soft bite (5478).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Homogenizing agent** to stabilize gluten-free matrices and support even cell structure during gas injection (23998).
- **Protein source** with very low digestible carbohydrates (as isolate) for gluten-free items targeting specific nutrition profiles (5478).
- **Contributes to batter/dough viscosity and water binding** that complement hydrocolloids in the absence of gluten (5478).

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Gluten-free bread system to deliver gas retention and soft crumb without gluten. The formulation targets doughs that proof and bake into volumetric loaves with resilient crumb.	Pea protein isolate or concentrate acts as a structuring and nutritional protein in a gluten-free matrix. It interacts with hydrocolloids to support gas cells and improve slice integrity.	Rice or corn flour base with pea protein 3–10% (flour weight); starches such as tapioca or potato; hydrocolloids such as xanthan or guar at 0.2–1%; yeast 1–2%; sugar 1–4%; salt 0.8–1.8%; oil 1–3%; water to batter style consistency suited to pan breads.	Mix to a smooth batter; deposit in pans; proof until height is achieved; bake at 170–190 °C to internal temperature ~95 °C; cool in pan to set crumb then de-pan and cool fully before slicing or wrapping.	23998
Gluten-free roll and bun formulations that achieve tender bite and good specific volume in the absence of gluten.	Pea protein provides amino acids and water binding to reinforce a hydrocolloid starch network. Used alongside emulsifier and enzyme aids to stabilize gas cells and improve softness.	Starch blend from tapioca and potato with rice flour; pea protein 2–8% (total dry mix); hydrocolloids xanthan or hydroxypropyl methylcellulose 0.3–1.2%; enzymes at guideline activity; oil 1–3%; sugar 1–4%; salt ~1%; yeast 1–2%; water to reach target batter viscosity for deposit and proof.	Prepare batter in planetary or spiral mixer; short rest; deposit or pipe; proof in warm humid conditions; bake at typical roll temperatures; cool before packaging to prevent collapse.	5478

Egg Substitution in Baked Goods

For cakes, cookies, and confectionery, dry blend inventions are proposed to replace whole eggs' emulsifying, foaming, thickening, coagulating, and leavening properties. In glazing applications, a pea protein-based oil in water cream is applied to dough to deliver shine, color and adhesion in place of egg wash, with viscosity targeted for even coverage (49207). In cake mixes, pea protein is paired with rapeseed protein at controlled ratios to reproduce emulsification, foaming and crumb structure typically provided by eggs (410). A dedicated egg substitute composition uses a high pea protein fraction combined with a chemical leavening system to provide aeration, binding and lift when mixed into batters and doughs (2547

Pea Protein Attributes as Claimed by Patent Applicants:

- **Emulsification & foaming** to stabilize aerated cake batters when used with rapeseed protein isolates at specified blend ratios (410).
- **Heat-set coagulation and thickening** to replace whole-egg functionality in bake-ready systems (2547).
- **High solubility and emulsifying capacity** to stabilize O/W glaze emulsions and deliver dairy-like Maillard browning (49207).
- **Egg- and dairy-free positioning** providing label flexibility while preserving conventional unit operations (410; 2547; 49207).
- **Aeration and binding** within egg replacement premixes (2547)

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Glazing cream for baked goods intended to replace traditional egg wash. Targets uniform gloss, color and adherence without using egg, and specifies a flowable cream viscosity at about 20 °C.	Pea protein isolate (purity ≥75%) used as the emulsifying and film forming protein in the cream. Chosen to deliver surface shine and adhesion without allergen from egg.	Oil in water emulsion with edible oil phase and aqueous phase containing pea protein isolate. Viscosity target about 20–500 cP at 20 °C	Prepare an oil in water emulsion by hydrating pea protein in water, adding oil with high shear to form a stable cream, and adjusting viscosity to target range. Apply cream to dough surface then bake to set gloss.	49207
Dry cake mix designed to substitute egg functionality using a blend of plant proteins. Focus is on achieving volume, crumb and emulsification in cakes without whole eggs.	Pea protein used together with rapeseed protein as a plant protein system that provides foaming and emulsifying functions typical of eggs.	Dry mix includes sugar, flour and a protein blend of pea protein:rapeseed protein at a mass ratio of 60:40 – 95:5.	Combine dry mix with water and or fat per package directions; whip or mix to incorporate air; deposit batter and bake under standard cake conditions.	410
Egg substitute composition for baking and confectionery. Formulation supplies aeration, binding and leavening to replace whole eggs in batters and doughs.	Pea protein at a substantial fraction of the composition provides the primary protein for foam and structure in the egg replacement system.	30–40% pea protein (dry weight). Leavening portion includes sodium acid pyrophosphate, dicalcium phosphate, monocalcium phosphate and about 10–20% sodium bicarbonate. Other carbohydrate or starch components present.	Dry blend the egg substitute composition; incorporate into bakery mixes in place of eggs; mix to develop foam and structure; bake using standard times and temperatures for the target product.	2547

DAIRY PRODUCTS

These applications blend pea protein with dairy proteins to balance nutrition and deliver texture without sacrificing familiar dairy sensory cues. In beverages, pea protein is combined with casein/whey to mitigate coarse mouthfeel while maintaining 4–8% (w/w) protein content as well as confer heat and neutral pH stability under pasteurization or UHT processing conditions (46732). Pea protein inclusion in fermented products (e.g. yogurt) reinforces gel structure and limits syneresis so dairy solids can be partially reduced while retaining spoonable texture (48630). In cheese sticks, pea protein is incorporated as a co-structuring protein alongside casein to optimize firmness, sliceability and melt without excessive oiling while also providing reported odor-masking during processing (49097). Another filing describes pea protein isolates with low viscosity, high solubility, and neutral flavor to allow for partial or total milk-protein replacement across yogurts, creams, and frozen desserts; supporting emulsification in all product formats in addition to aeration control to achieve stable overrun and slower meltdown in frozen desserts, specifically (2685).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Source of plant-protein** that partially substitutes dairy proteins and/or total dairy solids in formulation while maintaining desired organoleptic properties (48630;2685)
- **Emulsifying properties:** and dispersibility at neutral pH contributes to stable, homogenized emulsions through rotor–stator pre-shear and high-pressure homogenization (46732); emulsification and aeration support in frozen desserts with improved overrun control and meltdown resistance (2685)
- **Fermentation-compatible**: sustains texture and processability after ≥20 MPa homogenization and through lactic fermentation across wide plant:dairy ratios (48630)
- **Odor-masking in dairy matrices**: partial substitution with pea protein was claimed to temper animal-protein processing odors in a cultured cheese-stick process (49097).
- **Heat processing stability** and smooth mouthfeel in pasteurized or UHT beverages (46732)
- **Gel reinforcement and reduced syneresis** in fermented yogurt style products (48630), go-structuring for cheese style firmness, slice and controlled melt (49097)

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Hybrid dairy beverage that combines milk components with plant protein while maintaining smooth mouthfeel and heat stability in UHT or pasteurized formats.	Pea protein isolate used alongside whey or casein as a complementary protein to improve amino acid profile and support emulsification and stabilization.	Milk or permeate base with pea protein as a secondary protein; optional sugars or lactose, stabilizers such as pectin or carrageenan, and minerals or vitamins tailored for dairy beverage nutrition.	Hydrate pea protein, blend with dairy phase, homogenize in two stages, heat treat by pasteurization or UHT, then fill; for flavored variants, add flavors after heat treatment under aseptic conditions.	46732
Fermented hybrid yogurt style product where pea protein is co formulated with dairy proteins to achieve target gel firmness and low syneresis.	Pea protein contributes water binding and gel reinforcement in the fermented matrix, enabling reduced dairy solids while maintaining texture.	Milk solids plus pea protein with starter culture; stabilizers such as pectin or starch may be included; sugar and flavor optional.	Pre hydrate pea protein, standardize mix, homogenize, heat treat to yogurt conditions, inoculate with cultures, ferment to target pH, cool and hold; fruit preparation can be blended post fermentation.	48630

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Hybrid cheese style product using pea protein with dairy proteins to deliver sliceable or shreddable textures and improved melt control.	Pea protein used as a structuring co protein with casein to tune firmness and melt stretch; can reduce dairy content while maintaining functionality.	Dairy protein base with added pea protein, emulsifying salts, fat phase and water; flavors and colorants optional; salt level set for cheese style taste and preservation.	Cook stretch or processed cheese style method where proteins and salts are heated and mixed to form a homogeneous melt, then formed and cooled to set; shred or slice after cooling.	49097
Frozen dessert or ice cream type hybrid product where pea protein supports overrun and meltdown control in combination with dairy components.	Pea protein adds emulsification and partial aeration support, allowing reduction of egg or some dairy protein while stabilizing the mix.	Milk or cream, sugars, fat source, pea protein and stabilizer emulsifier system such as guar, locust bean gum and mono diglycerides; flavors added per style.	Hydrate and blend mix, homogenize, pasteurize, age cold, then freeze with controlled overrun and harden; pea protein is pre hydrated to ensure smooth body and avoid graininess.	2685

CONFECTIONERY

Foams & Mousses

Pea protein is implemented as the primary structuring agent for foam-based sweets where traditional egg or added hydrocolloids are absent. Pea protein is referenced to deliver a fine bubble structure and with slow drainage. Where a mousse is desired, the foam is folded into a fat or gel base and set cold to lock in air cell architecture (288).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Builds a stable aggregated protein network** that maintains aeration without added emulsifiers or hydrocolloids.
- **Fine bubble structure with sustained overrun and reduced drainage** (288)
- **Compatibility with stabilizers and acid** to tune foam strength (288)
- **Plant based positioning with low allergen profile** for dessert applications (288)
- **Process fit for cold set systems with refrigerated stability** (288)

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Aerated dessert foam or mousse system that replaces egg whipping agents with pea protein to create stable, light textures with fine bubble structure and slow drainage.	Pea protein isolate as the primary foaming protein to generate and stabilize air cells in sugar and fat containing mixes; selected for plant based positioning and low allergen profile.	Representative formulation: aqueous phase with sugar and pea protein 1-4%; optional cocoa or flavor; fat phase from vegetable cream or coconut; stabilizers such as methylcellulose or xanthan at label levels; acidity adjusted for optimal foam stability.	Pre hydrate pea protein; whip under controlled shear to incorporate air while cooling; for mousse, fold into fat phase or gel base; set under refrigeration to stabilize air cell network; serve chilled.	288

Gummies

In gummy formats, pea protein is co-formulated with hydrocolloid gel networks to balance chew, elasticity, and moisture. Pea protein acts within carrageenan/pectin systems and helps to stabilize the aerated gel and reduce water separation, especially in sugar-alcohol matrices. This patent describes an aerated gummy confection in which pea protein is used as the foaming and film forming agent to stabilize fine air cells inside a gelatin or pectin gel, producing a lighter, marshmallow like bite at lower density while retaining gummy chew (50083). The method whips a pea protein solution to achieve overrun before or during combination with the hot gel mass, then deposits and sets to target water activity and texture (50083).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Co-structuring agent in gel systems**: with carrageenan, LBG, and pectin, improving water binding and reducing syneresis.
- **Compatible with sugar-alcohol** systems, supporting reduced-sugar claims
- **Primary foaming and air cell stabilization agent** for confection aeration (50083)
- **Supports plant-based positioning** without egg derived foaming agents (50083)

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Aerated gummy confection that incorporates pea protein to create light, marshmallow like texture while retaining gummy chew. System targets stable microbubbles and reduced density compared to standard gummies.	Pea protein isolate as the primary foaming and film forming agent to stabilize air cells within a gelatin or pectin gel network. Selected for plant-based positioning and to support overrun without egg proteins.	Representative formulation: sugar and glucose syrup base; gelling agent gelatin or high methoxyl pectin; pea protein 0.5–2% (w/w); acidulants citric or malic; flavors and colors per style. Target finished product density reduced relative to control gummies to reflect aeration.	Cook sugar syrup to target solids; hydrate and disperse pea protein; whip to incorporate air achieving desired overrun; blend with dissolved gelling agent; deposit into starch or silicone molds; set and dry to target water activity.	50083

Chocolate

Pea protein is incorporated for develop a protein-fortified chocolate confectionary while preserving essential chocolate attributes (flow, snap, melt). The filing emphasizes particle-size control and staged refining/tempering so that high protein levels are accommodated without gritty texture or impaired rheology, enabling meaningful protein claims in a conventional chocolate experience.

Pea Protein Attributes as Claimed by Patent Applicants:

- **Protein enrichment** (20–40% by dry weight) without excessive thickening and acceptable rheology and sensory quality.
- **Maintains clean melt and snap** when finely refined and properly tempered, maintains clean melt and snap comparable to standard chocolate. Protein enrichment in chocolate without excessive thickening (3905)
- **Compatibility with lecithin or PGPR** for rheology control (3905)
- **Fine dispersion** to limit grittiness and preserve snap and gloss (3905)
- **Partial replacement for milk solids or filler** in milk style products (3905)

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Chocolate or chocolate like confection with increased protein content while maintaining viscosity, gloss, snap and clean melt. Formulation describes how to disperse low moisture plant protein into the fat continuous phase without grittiness.	Pea protein isolate used as a finely milled, low moisture protein to partially replace milk solids or filler in chocolate. Selected for neutral taste after flavor masking and for compatibility with lecithin or polyglycerol polyricinoleate (PGPR) to control flow.	Typical chocolate components cocoa liquor, cocoa butter, sugar and optional milk powder with added pea protein isolate. Emulsifier lecithin and/or PGPR included for viscosity control. Exact percent inclusion of pea protein and other components are not reported in the excerpt.	Blend dry ingredients into part of the fat phase. Refine to target particle size ~20 μm. Conche at elevated temperature to develop flavor and to reduce moisture and acidity. Add remaining fat and emulsifier near the end of conching to tune rheology. Temper using a standard seed profile heat to full melt, cool to induce crystal formation, then reheat to working temperature and mold.	3905

Puddings & Gel Desserts

These filings position pea protein as a co-gelling or gel-strengthening component alongside classical gelling agents (agar, gelatin, carrageenan, locust bean gum, gellan) to deliver firmer textures at relatively low total hydrocolloid concentrations (48984). In a chestnut-based pudding, pea protein is used to reinforce gel elasticity and raise protein content while maintaining a smooth spoonable texture with stable purge over shelf life (49272). In sweet gel desserts, pea protein is dispersed into gelatin or carrageenan systems at low percentages to maintain clarity and avoid graininess while improving water binding (48984).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Contributes to gel hardness/elasticity** when paired with hydrocolloids, enabling firmer set at equal or lower gelling-agent levels (48984, 49272).
- **Protein enrichment** without compromising gel clarity or set (48984, 49272).
- **Tolerates thermal/shear processing** used in gel preparation (e.g., thermal shear before fill/sterilize), maintaining structure after cooling (49272).

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Protein-enriched gel dessert system that incorporates pea protein into a gelatin or carrageenan gel to deliver clean slice and low syneresis.	Pea protein isolate as the added protein to raise nutritional value and contribute water binding. Selected to integrate into the gel network without graininess.	Water as the main phase; sugar or sweetener; gelling agent gelatin or kappa carrageenan at about0.5–1.5%; pea protein 1–4%; acidulant such as citric; flavors and colors as needed.	Hydrate gelling agent in water with heat; disperse and pre hydrate pea protein; combine and mix under moderate shear until uniform; fill into molds; cool to set to target gel strength; store cold to minimize syneresis.	48984
Gel food composition such as aspic or savory jelly where pea protein is used with agar or konjac to produce an elastic, cuttable gel with stable purge over shelf life.	Pea protein provides protein fortification and interacts with hydrocolloids to strengthen the gel matrix. Supports clarity and reduces free water release in savory gels.	Broth or flavored aqueous phase; agar or konjac glucomannan 0.3–1.0%; pea protein 1–3%; salt and seasonings; optional oil droplets for aspic style inclusions.	Dissolve agar or konjac with heat to full hydration; disperse pea protein by pre hydration to avoid clumps; mix and deaerate; pour into trays or molds; chill to set; hold refrigerated to maintain gel texture and purge control.	49272

EXTRUDED PRODUCTS

Savory Snacks

This patent describes high protein savory snacks in expanded or baked formats where pea protein is incorporated to deliver crisp bite, balanced expansion and clean flavor (2715). Pea protein is formulated to interact with the starch matrix during expansion or baking, supporting structure and enabling seasoning adhesion (2715).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Protein enrichment** without compromising dough handling and expansion and providing crisp, low density textures in puffs or crackers (2715).
- **Structure and water binding**: contributes to shelf life through water activity management (2715)
- **Maillard reaction substrates** for toasted notes and color development (2715)

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Savory high protein snack system in expanded and baked formats such as puffs, curls and crackers. The invention targets balanced expansion, crisp bite and clean flavor while delivering elevated plant protein per serving.	Pea protein isolate or concentrate included as a major fraction of the dry mix to raise protein and to interact with starch during expansion. Provides structure, water binding and Maillard browning for toasted notes.	Corn or rice flour or starch; pea protein 10–30% (of dry mix); minor leavening or emulsifier as needed; salt and spices per flavor. Finished product may receive post bake oil spray at 5–10% and dry seasoning.	Two routes are described. Direct expansion extrusion: hydrate to target moisture then extrude at elevated barrel temperature and high shear, cut and dry to final crunch. Sheeted and baked: blend and laminate dough, sheet, cut and bake to target moisture and blister pattern, then apply oil and seasoning. Manage water activity for shelf life.	2715

Breakfast Cereal

This patent describes ready-to-eat cereal products where pea protein is blended into the cereal base to raise protein while maintaining crispness in milk and acceptable bowl life. Formats include extruded shapes and flaked cereals, with processing tuned to control expansion, cell wall strength and surface texture (46381).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Protein enrichment and amino-acid complementation** with corn to raise overall quality (46381).
- **Participates in expansion and film formation on cell walls** during low-moisture extrusion while delivering target puff and structure (46381).
- **Neutral flavor** after appropriate processing and drying (46381)

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Ready-to-eat breakfast cereal fortified to deliver higher protein per serving while maintaining crispness in milk and pleasant bowl life.	Pea protein isolate or concentrate incorporated into the cereal base to raise protein content and participate in expansion and film formation on the cell walls. Selected for neutral flavor after proper processing and for compatibility with extrusion conditions.	Cereal flour such as corn, wheat or rice; pea protein 8–25% (of dry mix); sugars 2–10%; salt ~1%; optional fiber 2–6%t; oil 1–3%; vitamin and mineral premix; water adjusted for extrusion to target specific mechanical energy and expansion index.	For extruded shapes, hydrate dry mix to target moisture; extrude under elevated temperature and shear; cut and dry to final moisture for crispness; apply coating syrup and/or oil as needed. For flaked formats cook grains with pea protein, roll into flakes, toast to final color and texture, then fortify.	46381

MEAT/FISH PRODUCTS

In processed meat systems, pea protein functions as a binder and emulsifier to stabilize water and fat, maintain slice integrity and improve bite in patties, nuggets and deli style logs (49482). In fish and seafood applications including surimi like gels, pea protein acts as a co gelling protein with myofibrillar proteins to raise gel strength, reduce syneresis and support elasticity, enabling partial replacement of fish proteins or egg white (48371). Typical processes hydrate pea protein before mixing with salted meat or surimi, then form and heat set to the appropriate core temperature or gel endpoint (49482; 48371).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Crosslinking gelation**: participates in transglutaminase (TGase)-mediated networks that support surimi gel strength and overall sensory quality (48731).
- **Water binding, fat emulsification and improved slice integrity** in comminuted meat systems (49482)
- **Co gelling with fish myofibrillar proteins** for higher gel strength and elasticity (48371)
- **Reduced syneresis and better freeze thaw stability** in surimi like pastes (48371)
- **Enables partial meat or fish protein replacement while preserving texture** (49482; 48371)

Technical Unlocks in Pea Protein Utilization

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
Meat analog and processed meat extender for patties, nuggets and deli style products to bind water and fat and to improve bite while enabling partial meat replacement.	Pea protein isolate or concentrate as the primary functional protein to supply gelation, emulsification and water binding. Selected to stabilize fat in a chopped meat matrix and to maintain slice integrity.	Representative mix lean meat or comminuted meat base with pea protein 2–8% (of total formulation); starches or fibers 1–4%; salt 1–2%; phosphate at guideline level; fat phase from meat fat or vegetable oil 5–25%; seasonings per style; water or ice to target batter viscosity.	Pre hydrate pea protein; chop meat with salt and phosphate to extract myofibrillar proteins; emulsify fat while adding hydrated pea protein and water; form into patties or logs; thermally process by steam or oven cook to core 72–75 °C; chill before slicing or packaging.	49482
Fish and seafood style products including surimi like gels where pea protein reinforces gel strength and reduces reliance on fish proteins while maintaining elasticity and low syneresis.	Pea protein as a co gelling and emulsifying agent with fish myofibrillar proteins to enhance heat set network and water holding. Can also replace part of egg white or soy proteins traditionally used in surimi processing.	Representative composition minced fish or surimi paste with pea protein 1–6%; starch 2–6%; cryoprotectants such as sorbitol or sugar 2–8% for frozen paste; salt 1–2%; optional transglutaminase at guideline activity; water to processing viscosity.	Chop or mix surimi with salt to solubilize proteins; incorporate hydrated pea protein, starch and cryoprotectants; vacuum mix to reduce air; set by two step heating for kamaboko style gels first at 45–50 °C then to 80–90 °C; cool rapidly to set texture; slice or form as required.	48371

3D-PRINTED FOOD INKS

This patent outlines a printable food paste that uses pea protein to tune shear thinning and recovery, so the paste extrudes cleanly, holds its shape during the build, and sets into a stable structure post-processing (49089). Pea protein contributes viscoelasticity and water binding as a binder and structure former, working with starches and hydrocolloids to meet target yield stress and deposition adhesion (49089).

Pea Protein Attributes as Claimed by Patent Applicants:

- **Provides electrostatic/hydrogen-bonding interactions with alginate** to yield printable, shape-retaining gels (49089).
- **Supports oil structuring within the ink**, aiding feature definition and stability after extrusion (49089).
- **Rheology control** for extrusion based printing including shear thinning and fast recovery (49089)
- **Acts as a protein binder** to support layer adhesion and shape fidelity (49089)

Patent Summary	Pea Protein Use	Product Composition	Processing Method	ID
3D printable food paste that uses pea protein to tune rheology for extrusion based printing. System is designed to maintain shape during build and for stable texture after post processing.	Pea protein isolate or concentrate provides viscoelasticity and water binding to achieve shear thinning during extrusion and rapid recovery after deposition. Acts as a protein binder and structure former compatible with starches or hydrocolloids.	Pea protein 5-5% (of total formulation); starch or flour base such as rice or potato; hydrocolloid such as methylcellulose or xanthan 0.2-1.0%; oil 1-3%; salt and flavors as needed; water adjusted to target yield stress and viscosity for printing.	Pre hydrate pea protein; mix with starch and hydrocolloids to a homogeneous paste; load into a syringe or screw extruder; print at controlled temperature and speed with layer height set for adhesion; post process by baking, steaming or infrared to set structure and reduce water.	49089

PROTEIN MODIFICATION TREATMENTS

The patents target molecular and physicochemical engineering of pea protein to enhance solubility, flavor, emulsification, and gelation—properties that govern its performance across food and non-food systems. The disclosed approaches reflect a systematic effort to overcome intrinsic limitations of legume proteins, particularly low solubility near the isoelectric point, off-flavors, and variable thermal behavior.

Three dominant modification strategies emerge:

1. **Flavour reduction and sensory optimization** — Enzymatic hydrolysis, pH-shift processing, and controlled Maillard reactions are used to reduce beany or bitter volatiles and generate mild flavor peptides. Certain patents pair these with glycation or fermentation steps to further suppress off-notes while maintaining nutritional integrity.
2. **Enhancement of solubility and emulsification** — Pea protein is subjected to enzymatic, ultrasonic, or mild chemical modification (e.g., succinylation, glycosylation) to increase surface charge and hydrophilicity, improving dispersion in acidic or high-salt systems. Crosslinking or conjugation with saccharides and polysaccharides strengthens interfacial films and stabilizes emulsions under thermal or mechanical stress.
3. **Improving gelation and network formation** — Controlled denaturation, oxidation–reduction modulation, and calcium bridging are used to refine gel strength and elasticity. These treatments yield heat- or cold-set gels with tunable hardness and cohesiveness suitable for structured products and meat analogues.

Collectively, these strategies indicate a transition from simple extraction toward targeted molecular tailoring, aligning with trends in precision ingredient design. The patents underscore that functional performance is highly responsive to protein conformation, molecular weight distribution, and interfacial behavior, and that relatively mild chemical or enzymatic treatments can dramatically expand the usability of pea protein across formulation types.

FLAVOUR REDUCTION

This set targets off-note mitigation in pea protein by removing or transforming beany, grassy and earthy volatiles and lipid-derived aldehydes. Approaches include aqueous alcohol washes, steam or vacuum stripping, or enzymatic treatments that interrupt lipoxygenase pathways, controlled fermentations, membrane filtration, adsorptive cleanup using carbon or cyclodextrins, and pH-shift rinses followed by neutralization. The aim is a cleaner sensory profile with minimal loss of native functionality, enabling higher protein inclusion in flavor-sensitive applications.

Patent Summary	Processing Method	Changes to Pea Protein	Intended Use	ID
Aqueous ethanol wash to strip grassy aldehydes and lipid carriers from pea protein while retaining functionality.	Disperse protein, wash with 20–40% ethanol at 15–25 °C, separate, rinse with water to low residual solvent, gentle drying <60 °C.	Lower hexanal and related volatiles; reduced beany aroma and bitterness; minimal loss of solubility with controlled drying.	Neutral flavored bases for ready to drink beverages and creamers; fruit or coffee systems sensitive to off notes.	45692
Steam stripping and vacuum deodorization of hydrated pea protein slurries to remove volatile off notes.	Hydrate to 8–12% solids; sparge with live steam under 100–200 mBar vacuum; hold 30–60 min; cool and dry.	Marked reduction in grassy aldehydes and ketones; cleaner aroma without added flavors.	High protein neutral beverages and medical nutrition bases requiring low aroma.	7147
Controlled lactic fermentation to biotransform lipid oxidation products and mask beany notes in pea protein.	Inoculate hydrated protein with *Lactobacillus* culture; ferment at 30–37 °C to pH 4.8–5.2; heat inactivate; neutralize; dry.	Reduced aldehydes; added mild dairy like notes; potential improvement in digestibility.	Hybrid dairy beverages and cultured style products where slight tang is acceptable.	48027
Enzymatic mitigation targeting lipoxygenase pathway substrates to limit formation of grassy volatiles.	Treat pea flour slurry with lipase and/or glucose oxidase at 35–50 °C; pH 5.5–6.5; deactivate enzymes; isolate protein.	Lower precursor lipids and peroxides; reduced beany development during storage.	Shelf stable powders with reduced off note accrual over time.	45885

PULSE CANADA

Technical Unlocks in Pea Protein Utilization

Patent Summary	Processing Method	Changes to Pea Protein	Intended Use	ID
Cyclodextrin inclusion complex and carbon adsorption to capture hydrophobic odorants from pea protein solutions.	Add beta cyclodextrin 0.2–1%; mix 30min; filter with food grade carbon; desorb and recover protein; rinse; dry.	Lower headspace intensity of aldehydes and terpenes; cleaner flavor with minimal color change.	Flavored waters, clear beverages and light flavored nutrition drinks.	47646
pH shift rinse protocol to solubilize and wash off flavor actives followed by neutralization.	Raise pH to 10–11to solubilize protein; decant supernatant containing volatiles; neutralize to pH 7; wash; dry.	Cleaner aroma; partial unfolding that can aid solubility when carefully controlled.	Neutral beverages and powdered drink mixes with delicate flavors.	47901
Defatting of pea flour prior to protein isolation to reduce lipid bound off flavors.	Hexane free supercritical CO2 or aqueous ethanol defatting at low temperature; proceed to isolation; dry <60 °C.	Lower lipid content; reduced beany carryover; improved oxidative stability.	Shelf stable high protein powders and bars with cleaner flavor.	47673
Membrane filtration and diafiltration to raise protein purity and remove small molecule off notes.	Ultrafiltration ten to fifty kDa cut off; diafilter to target conductivity; concentrate and spray dry at modest outlet temperature.	Higher protein purity; lower salts and off flavors; better reconstitution.	Clinical and sports nutrition isolates; bases for further functionalization.	47705

IMPROVING SOLUBILITY & EMULSIFICATION

These disclosures optimize solubility, clarity and interfacial activity across wide pH, but especially under acidic conditions. Methods span enzymatic hydrolysis with controlled degree of hydrolysis, pH-shift processing, complexation with pectin or gum arabic, glycation under low water activity, and physical treatments like microfluidization, ultrasonication, and fluid bed agglomeration. Net effects include higher solubility, wettability, dispersibility, and emulsion characteristics, better low-pH clarity, smaller emulsion droplet size, and reduced aggregation near the isoelectric point.

Patent Summary	Processing Method	Changes to Pea Protein	Intended Use	ID
Mild enzymatic hydrolysis to increase cold water solubility and reduce haze at neutral pH.	Protease treatment (DH 2–5%) at 50–55 °C; pH 7; rapid enzyme deactivation; spray dry.	Smaller peptides; improved solubility; lower viscosity at use level.	RTD shakes and instant powders that must disperse in cold liquids.	200
Low pH clarity improvement by limited hydrolysis and microfiltration.	Hydrolyze (DH 3–6%); microfilter to remove insolubles; adjust to pH 3–4; dry.	Clear solutions at acidic pH; reduced sediment; stable on storage.	Clear or translucent acidic drinks and fortified waters.	28
Protein polysaccharide complexation to enhance emulsion stability under acid and salt.	Form complexes with pectin or gum arabic at pH 3.5–4.5; homogenize 100–150MPa; dry or use liquid.	Stronger interfacial films; smaller droplets; slower creaming at low pH and elevated salt.	Acidic emulsions such as juice beverages and dressings.	1221
Glycation via controlled Maillard conjugation to improve solubility and reduce astringency.	Dry heat pea protein with reducing sugars at 40–60% RH and 60–80 °C for 2–8h; remove unreacted sugars.	Improved solubility and emulsification; lower astringency; mild color increase.	Creamers and opaque beverages where slight color is acceptable.	105
High pressure microfluidization to unfold proteins and improve interfacial activity.	Process dispersions at 75–150 MPa with two to four passes while cooling to avoid denaturation.	Greater emulsion stability; smaller droplet size; better dispersion.	Emulsified beverages and flavor emulsions needing fine droplets.	267

PULSE CANADA

Technical Unlocks in Pea Protein Utilization

Patent Summary	Processing Method	Changes to Pea Protein	Intended Use	ID
Ultrasonication to disrupt aggregates and enhance solubility near isoelectric point.	20–25 kHz probe; 10–30 min; ice bath to hold <35 °C.	Reduced aggregates; higher solubility around pH 4.5–5; improved clarity.	Low pH beverages and sauces sensitive to haze.	1103
pH shift processing to solubilize at high pH then rapidly neutralize to lock in solubility.	Adjust to pH 10–11 for solubilization; hold 15min; fast neutralize to pH7 under shear; dry.	Higher cold-water solubility; improved dispersibility; lower sediment.	Instant drink powders and liquid concentrates.	1172
Salt shield strategy using phosphate and citrate to minimize aggregation near isoelectric point.	Blend protein with sodium phosphate and citrate buffers; homogenize; hold at pH 6–7; dry if desired.	Less aggregation and haze formation; more stable suspensions on storage.	Neutral pH beverages and meal replacement bases.	4527
Agglomeration and lecithination to create instant pea protein with fast wetting and dispersion.	Fluid bed agglomerate with fine mist of lecithin or carbohydrate binder; control granule size 200–800 μm; dry to stable water activity.	Improved wettability and dispersibility; reduced dust; better flowability.	Instant drink mixes and ready to mix powders for shaker preparation.	5

IMPROVING GELATION

This group adjusts network formation and macro-texture. Tools include transglutaminase crosslinking, ionic gelation with calcium or salts, heat-moisture treatments at limited moisture, extrusion texturization at defined specific mechanical energy, cold atmospheric plama, and high-pressure processing. Outcomes include higher gel strength, improved water holding, sliceability and resilience, with reduced syneresis—useful for meat analogs, cheese or yogurt-style gels and high-protein snacks.

Patent Summary	Processing Method	Changes to Pea Protein	Intended Use	ID
Transglutaminase crosslinking to increase gel strength and water holding.	Hydrate protein to 8–12% solids; add TGase 5–15 units per g protein; incubate at 40 °C for 30–90 min; heat set.	Stronger elastic gels; improved sliceability; lower syneresis.	Yogurt and cheese style gels; structured deli slices.	46084
Calcium mediated ionic gelation combined with heat to build firm elastic networks.	Add calcium salts 30–100 ppm; heat to 70–85 °C; controlled cool.	Enhanced firmness and resilience; better water retention.	Cuttable gels and plant based cheeses.	46095
Heat moisture treatment at limited moisture to modify functionality and texture.	Condition protein to 10–20% moisture; hold at 90–120 °C for 10–40 min; cool and temper.	Altered hydration and gelation behavior; denser, more resilient textures.	High protein snacks and bars requiring cohesive bite.	633
High pressure processing to induce cold set gelation and improve water holding.	Apply 200–600 MPa for 2–10 min at ambient to 40 °C; optional salt co factors.	Cold set gel networks with reduced purge; improved slice quality.	Delicate gels and fillings where heat is undesirable.	25087
Pulse protein gelation method using atmospheric cold plasma and/or pH shifting to create gels at lower temperatures without crosslinkers	Treat with atmospheric cold plasma for 20 min and/or shift to pH greater than 9.0 or less than 5.0 then neutralize; optional hold at pH about 12.0 for up to 48 hours; optional heating to induce gelation.	Enhance protein reactivity, promote unfolding and aggregation, and enable gel formation below 95 °C. defines gel compressive strength thresholds 1.0–3.0 kPa	Meat analogues, beverages, and other high-protein formulations.	55

PATENT IDS

ID	Publication Number	Assignee	ID	Publication Number	Assignee
5	US10143226B1	INNOVATIVE PROTEINS HOLDING, LLC	361	US20240122194A1	DSM IP ASSETS B.V.
28	EP4373291A2	DSM IP ASSETS B.V.	363	US20220022506A1	CONOPCO INC.
35	US20240099350A1	ROQUETTE FRERES	410	EP4104680A1	DSM IP ASSETS B.V.
40	US20220117261A1	GLANBIA NUTRITIONALS LIMITED	591	US11484044B1	NOWADAYS INC., PBC
55	US20240130395A1	THE GOVERNORS OF THE UNIVERSITY OF ALBERTA	593	EP4467625A1	EVERTREE
59	US20230276811A1	NOVOZYMES A/S	594	US20240206509A1	CLARA FOODS CO.
80	US9028905B2	KEMIN PROTEINS LLC	598	US20230165287A1	ROQUETTE FRERES
91	US9486003B2	SOCIÉTÉ DES PRODUITS NESTLÉ S.A.	619	EP4467626A1	EVERTREE
92	EP4467304A1	EVERTREE	625	US9901613B2	DEVINTEC SAGL
93	EP4384022A1	COSUCRA GROUPE WARCOING S.A.	633	US20220295840A1	SODIMA | INSTITUT DES SCIENCES ET INDUSTRIES DU VIVANT ET DE L'ENVIRONNEMENT | INSTITUT NATIONAL DE RECHERCHE POUR L'AGRICULTURE
94	US20210289804A1	RIPPLE FOODS, PBC	699	US20250017245A1	NEGGST FOODS GMBH | FRAUNHOFER-GESELLSCHAFT ZUR FÖRDERUNG DER ANGEWANDTEN FORSCHUNG E.V.
105	US11744271B2	KELLANOVA	706	US20220250025A1	INTERNATIONAL FLAVORS & FRAGRANCES INC.
125	US20220117262A1	GLANBIA NUTRITIONALS LIMITED	719	US20220279816A1	ROQUETTE FRERES
200	US11134705B2	BURCON NUTRASCIENCE (MB) CORP.	734	US11419343B2	SODIMA
202	US20240335497A1	ROQUETTE FRERES	818	EP4432858A1	H.J. HEINZ COMPANY BRANDS LLC
214	US20230172229A1	DSM IP ASSETS B.V.	855	US9693576B2	GIVAUDAN SA
259	EP4467627A1	EVERTREE	889	US20220386641A1	SOCIETE DES PRODUITS NESTLE S.A.
261	US20230127140A1	CORN PRODUCTS DEVELOPMENT, INC	1062	US20230085259A1	DSM IP ASSETS B.V.
267	US11337440B2	ROQUETTE FRERES | INGREDIA | INSTITUT NATIONAL DE RECHERCHE POUR L'AGRICULTURE	1063	US20230134795A1	SOCIETE DES PRODUITS NESTLE S.A.
288	EP4391818A1	SOCIÉTÉ DES PRODUITS NESTLÉ S.A.	1075	US10780146B2	DEVINTEC SAGL
293	US20240277004A1	AIR PROTEIN, INC.	1103	US20220218010A1	ROQUETTE FRERES
297	US20240373873A1	DSM IP ASSETS B.V.	1149	US20230106315A1	ROQUETTE FRERES
307	US20230086767A1	KEMIN INDUSTRIES, INC.	1172	US20210259294A1	ROQUETTE FRERES
308	US20220240556A1	CONOPCO, INC., D/B/A UNILEVER	1180	US20230082031A1	SOCIETE DES PRODUITS NESTLE S.A.

334	US9199101B2	ISP INVESTMENTS LLC	1221	US20240277016A1	GIVAUDAN SA
ID	**Publication Number**	**Assignee**	**ID**	**Publication Number**	**Assignee**
1314	EP4494477A1	LOVELY DAY FOODS GMBH	7147	EP4508988A1	DAFLORN LTD.
1331	EP4469026A1	Anabio Technologies Limited	7612	US10016347B2	NIUCOCO INC.
1363	US20240008503A1	CORN PRODUCTS DEVELOPMENT, INC.	8833	US20240000092A1	KERRY GROUP SERVICES INTERNATIONAL LIMITED
1376	US10188609B2	PROGEL PTY LTD	8963	US11821013B2	DIGESTIVA, INC.
1758	US20220408760A1	ROQUETTE FRERES	9266	US11103455B2	ALASTIN SKINCARE, INC.
1938	EP4469025A1	Insucaps Limited	9858	US20240156119A1	OATLY AB
2055	US20240251815A1	ROQUETTE FRERES	12052	US20230309574A1	VERTAGE, INC.
2319	EP4406641A1	INTERNATIONAL FLAVORS & FRAGRANCES INC.	13262	EP2588075B1	ISP INVESTMENTS LLC
2547	US20230172241A1	MANTIQUEIRA ALIMENTOS LTDA.	13459	US9078466B2	N. V. NUTRICIA
2685	US11571002B2	RIPPLE FOODS, PBC	14450	US20230106086A1	SNEAKY APRON, LLC
2715	US12022836B2	FRITO-LAY NORTH AMERICA, INC.	19627	EP2682096B1	SEIWA KASEI COMPANY, LIMITED
2759	US10609943B2	KIKKOMAN CORPORATION	22155	US20230354844A1	THE HERSHEY COMPANY
3377	US20220046950A1	ROQUETTE FRERES	22331	US20240138431A1	AMANO ENZYME U.S.A. CO., LTD. | AMANO ENZYME INC.
3608	US11696596B2	SOCIETE DES PRODUITS NESTLE S.A.	23998	US11889841B2	PHYTOBOKAZ
3700	US20240215597A1	OATLY AB	25087	ZA202209559B	SERICULTURAL & AGRI-FOOD RESEARCH INSTITUTE GUANGDONG ACADEMY OF AGRICULTURAL SCIENCES
3905	US20210400995A1	ROQUETTE FRERES	25101	US20240122197A1	AMANO ENZYME U.S.A. CO., LTD. | AMANO ENZYME INC.
3917	US11344502B1	TRUCAPSOL LLC	25822	GB2437179B	I'ANSON BROS LIMITED
3935	US20240368502A1	INTERNATIONAL FLAVORS & FRAGRANCES INC.	27789	US20240130992A1	DR. SCHAR S.P.A.
4304	US20190343146A1	MARS	28059	US20200236962A1	SOCIETE DES PRODUITS NESTLE S.A.
4527	US11957140B2	ROQUETTE FRERES	30468	US20240130386A1	OATLY AB
4588	US20250017229A1	MITSUBISHI CHEMICAL CORPORATION	34242	US20230363414A1	SUSTENTO INC.
4859	US11291229B2	SOCIÉTÉ DES PRODUITS NESTLÉ S.A.	36432	US10369094B2	INTERNATIONAL FLAVORS & FRAGRANCES INC.
5478	EP3685670B1	NUVOLA ZERO SRL	36433	US11224569B2	INTERNATIONAL FLAVORS & FRAGRANCES INC.
5575	CA3123907A1	NABATI FOODS INC.	37876	EP4510843A1	ROQUETTE FRERES
6680	EP1972345B1	VEGENAT, S.A.	37896	US10842169B2	HILL'S PET NUTRITION, INC.

Technical Unlocks in Pea Protein Utilization

ID	Publication Number	Assignee	ID	Publication Number	Assignee
43454	IN202441060126A	AISHWARYA BASKARAN | ARTHI DEIVA SIGAMANI | PLANTBYTE FOODS AND NUTRITION PVT. LTD.	47405	CN116114879A	Dalian University of Technology
43476	EP2229145B1	SOCIETE DE RECHERCHE COSMETIQUE SARL	47448	CN118749626A	Shenzhen Second People's Hospital (Shenzhen Institute of Translational Medicine)
43499	EP2046281B1	SOCIETE DE RECHERCHE COSMETIQUE	47511	RU2819066C1	FGBNU KNTSZV
43553	IN202541005677A	NATIONAL INSTITUTE OF FOOD TECHNOLOGY, ENTREPRENEURSHIP AND MANAGEMENT – THANJAVUR (NIFTEM-T)	47514	CN118767104A	Animal Husbandry Research Institute, Henan Academy of Agricultural Sciences
44009	IN202411051922A	CHHATRAPATI SHAHU JI MAHARAJ UNIVERSITY	47619	JP6648977B2	Sapporo Beer Co., Ltd. | Okuno Pharmaceutical Co., Ltd.
44095	EP4000423A1	VF NUTRITION GMBH	47646	CN114027392A	Jiangnan University | Jiangsu Teweinong Food Co., Ltd.
45692	CN116268172A	Anhui Agricultural University	47673	CN114946995A	Shanghai Jiao Tong University
45885	CN113170832A	jiangnan university	47705	CN118452304A	Henan University of Technology
46084	CN115736084A	Shenzhen Acoustic Resonance Technology Co., Ltd.	47706	CN118415271A	China Agricultural University
46095	CN115836706A	Shenzhen Acoustic Resonance Technology Co., Ltd.	47733	CN114947107A	Shenyang Agricultural University
46190	CN117581939A	Anhui Agricultural University	47746	CN118680277A	Huazhong Agricultural University
46282	CN113170834A	jiangnan university	47771	CN118511983A	Northeast Agricultural University
46365	CN118892161A	China Jiliang University	47789	JP7628778B2	Miyoshi Oil Co., Ltd.
46381	CN115918849A	Shenyang Agricultural University	47831	CN118286162A	Institute of Testing and Analysis, Guangdong Academy of Sciences (Analysis and Testing Center, Guangzhou, China)
46732	CN109349352A	Guangzhou Fengxing Dairy Co., Ltd. | South China University of Technology	47894	CN113951372A	Harbin Liangsu Agricultural Technology Co., Ltd.
46738	MX2020009259A	MACFRUT SPR DE RI	47896	NL2031293C	SHANDONG UNIVERSITY OF TECHNOLOGY
46741	ES1295401U	BLANCO MAYO, VIRGINIA	47901	CN113812511A	Northwest A&F University
46874	IN202341067032A	ANNA UNIVERSITY, CHENNAI	47987	CN117016784A	Henan Agricultural University
46918	FR2938734A1	SEMREH EUROPE	47988	CN117562168A	Anhui Shunxin Shengyuan Biological Food Co., Ltd.

47310	KR1020210092438A	IOIN Corporation Co., Ltd.	48027	CN116250591A	Inner Mongolia Mengniu Dairy (Group) Co., Ltd.

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48074	CN115558659A	Northeast Agricultural University	49059	RU2814264C1	FEDERALNOE GOSUDARSTVENNOE BYUDZHETNOE OBRAZOVATELNOE UCHREZHDENIE VYSSHEGO OBRAZOVANIYA "ROSSIJSKIJ GOSUDARSTVENNYJ AGRARNYJ UNIVERSITET - MSKHA IMENI K.A. TIMIRYAZEVA" (FGBOU VO RGAU - MSKHA IMENI K.A. TIMIRYAZEVA)
48225	EP4479074A1	Laboratoires THEA	49089	CN116941753A	Northwest A&F University
48371	CN118000390A	Jiangnan University | Golden Monkey Food Co., Ltd.	49097	CN113826705A	Northeast Agricultural University
48489	CN113332165A	Hefei University of Technology	49207	JP5521704B2	Kaneka Co., Ltd.
48494	CN116725157A	Tianjin University of Science and Technology	49243	JP7465617B2	Morinaga & Co., Ltd.
48630	JP2024052611A	Megmilk Snow Brand Co., Ltd.	49267	CN113041174A	Zhongkai Agricultural Engineering College
48643	CN113439824A	China Agricultural University	49272	CN113796494A	South China University of Technology
48649	CN112931783A	Heilongjiang Bayi Agricultural University	49295	RU2785464C1	FEDERALNOE GOSUDARSTVENNOE BYUDZHETNOE OBRAZOVATELNOE UCHREZHDENIE VYSSHEGO OBRAZOVANIYA "ORLOVSKIJ GOSUDARSTVENNYJ UNIVERSITET IMENI I.S. TURGENEVA" (OGU IM. I.S. TURGENEVA)
48774	CN118743428A	Henan Agricultural University	49303	CN114957808A	Hefei University of Technology
48775	CN118575958A	China Business Silk Road IoT Technology Co., Ltd.	49390	CN103315299B	Beijing Dongfanghong Aerospace Biotechnology Co., Ltd.
48790	CN116496340A	Qiqihar University	49482	CN116458609A	Hefei University of Technology
48936	CN113057901A	Zhongkai Agricultural Engineering College	49508	CN118556871A	Jilin Hengmei Yuchuang Health Technology Co., Ltd. | Zhejiang Hengmei Health Technology Co., Ltd.
48981	RU2807627C1	FEDERALNOE GOSUDARSTVENNOE BYUDZHETNOE OBRAZOVATELNOE UCHREZHDENIE VYSSHEGO OBRAZOVANIYA "ROSSIJSKIJ GOSUDARSTVENNYJ AGRARNYJ UNIVERSITET - MSKHA IMENI K.A. TIMIRYAZEVA" (FGBOU VO RGAU - MSKHA IMENI K.A. TIMIRYAZEVA)	49612	CN112690434A	Anhui Qiangwang Bioengineering Co., Ltd.

48984	JP2019170326A	Morinaga Milk Industry Co., Ltd.	49628	JP7485269B2	Morinaga & Co., Ltd.
49008	NL2034548B1	CHONGQING UNIVERSITY OF EDUCATION, CQUE	49639	CN115428850A	Yantai University
ID	**Publication Number**	**Assignee**	**ID**	**Publication Number**	**Assignee**
49642	CN119112698A	Shanghai Xiafei Daily Chemical Co., Ltd.	50150	CN118766054A	Shanghao Technology Co., Ltd. | Jiangsu Academy of Agricultural Sciences
49757	BG3400U1	"EKO PRODUKTI.BG" OOD	50352	CN113080437A	Nakaaki
49767	CN117256857A	Zhejiang University | Zhejiang Ocean University	50355	JP2024124023A	Riken Vitamin Co., Ltd.
49773	CN111802648A	Nanjing Newbond Biotechnology Co., Ltd.	50371	MY181454U	UNIVERSITI TEKNOLOGI MARA
49777	CN113647624A	Yantai Institute of Coastal Zone Research, Chinese Academy of Sciences | China Institute of Marine Microbial Industry Technology (Shandong) Co., Ltd.	50372	CN113712160A	Shanghai Jiao Tong University
49782	CN119054832A	Zhongpet Technology (Yantai) Co., Ltd.	50482	CN118745669A	Gaofan (Zhejiang) Information Technology Co., Ltd.
49784	CN117441877A	jiangnan university	50532	CN115005269A	Jilin Normal University of Engineering and Technology
49829	CN112931701A	Qingyuan Shipu Biotechnology Co., Ltd. | Xinjiang Shipu Biotechnology Co., Ltd.	50553	CN115919768A	Shanghai Tongren Hospital
49854	RU2344627C1	SHCHEPOCHKINA JULIJA ALEKSEEVNA	50638	CN118121503A	Stay Up Late System Engineering (Shanghai) Co., Ltd.
49879	JP2024047396A	ADEKA Co., Ltd.	50651	CN118648698A	Henan University of Science and Technology
49895	CN112021447A	Yu Yuxiang	50689	CN117958348A	Pu'er Tea College of West Yunnan University of Applied Technology
50078	CN118556865A	Jilin Hengmei Yuchuang Health Technology Co., Ltd. | Zhejiang Hengmei Health Technology Co., Ltd.	50150	CN118766054A	Shanghao Technology Co., Ltd. | Jiangsu Academy of Agricultural Sciences