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HAZELNUTS OF GEORGIA

From Traditional Crop to High-Value Nutraceutical, Cosmetic, and Circular-Bioeconomy Resource

Corylus avellana L. and the emerging value of the whole hazelnut

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Executive Summary

Hazelnut, principally represented by *Corylus avellana* L., is one of the world's most valued tree nuts and a longstanding component of the agricultural and culinary heritage of the South Caucasus. Georgia occupies a particularly important position within this history. The country's Black Sea–influenced climate, extensive traditional cultivation, locally adapted cultivars, and established export infrastructure have made hazelnut an important agricultural commodity and source of rural income.

The commercial value of hazelnut, however, extends well beyond the edible kernel.

The kernel is a nutrient-dense food characterized by approximately 60.75% fat, 14.95% protein, 16.70% carbohydrate, and 9.7% dietary fiber per 100 g, with approximately 45.65 g of monounsaturated fatty acids per 100 g.

The lipid fraction is particularly notable for its high concentration of oleic acid, generally accounting for approximately 75–85% of total fatty acids depending upon cultivar, geography, processing, and analytical method.

Beyond the kernel, hazelnut processing produces two potentially valuable coproduct streams: shells and skins (pellicles). Hazelnut shells represent approximately 50–55% of the weight of the in-shell product and are currently used predominantly for relatively low-value applications such as fuel. Research, however, indicates that shell hemicellulose can serve as a source of xylooligosaccharides and arabino-xylooligosaccharides with potential prebiotic applications.

The thin brown skin surrounding the kernel is particularly interesting from a functional-ingredient perspective. Hazelnut skin is highly enriched in polyphenols, especially monomeric and oligomeric flavan-3-ols, as well as dietary fiber. Recent research has

examined hazelnut skin as an underutilized source of polyphenols and dietary fiber and its interactions with colonic microbiota.

Consequently, the hazelnut can increasingly be viewed not simply as a nut, but as a multi-stream botanical raw material capable of supplying food, culinary oil, cosmetic oil, dietary fiber, polyphenol extracts, prebiotic materials, and other specialty ingredients.
For Georgia, this creates an opportunity to move beyond commodity-oriented kernel exports toward higher-value utilization of the complete hazelnut biomass.

1. Introduction to Hazelnuts

Hazelnuts belong to the genus Corylus, family Betulaceae. The European or common hazelnut is generally classified as:

Scientific name: *Corylus avellana* L.
Family: Betulaceae
Genus: Corylus
Common names: hazelnut, European hazel, common hazel, filbert

The species is native across substantial portions of Europe and western Asia and has a particularly strong historical association with the Black Sea and Caucasus regions.

The South Caucasus is recognized as an important center of diversity for hazelnut. Georgia possesses endemic and locally adapted hazelnut forms and numerous farmer-selected cultivars and genotypes.

1.1 Cultivar diversity

Hazelnut is not a chemically or agronomically uniform commodity. Cultivar genetics, climate, soil, maturation, agricultural practices, and processing can all influence kernel size, kernel-to-shell ratio, oil content, oleic-to-linoleic acid ratio, tocopherol concentration, phytosterol profile, polyphenol composition, flavor characteristics, shell characteristics, and processing performance.

Reported Georgian varieties include Anakliuri, Gulshishvela, Shveliskura, Dedoplis Titi, Khachapura, Nemsa, Gavazura, Vanis Tetri, Kharistvala, and Chkhikvistava.

Recent analysis of Georgian cultivars has demonstrated meaningful variation in morphology, kernel-to-shell characteristics, oil content and protein content. This cultivar diversity represents more than agricultural heritage; it potentially constitutes a genetic and biochemical resource for specialized ingredient development.

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2. Hazelnuts in Georgia and the South Caucasus

Georgia's relationship with hazelnut is both agricultural and cultural.

The country's western regions, particularly Samegrelo-Zemo Svaneti, Guria and Imereti, provide important hazelnut-growing environments. Historical and agricultural literature describes long-standing cultivation of local hazelnut types, including forms that have undergone generations of farmer selection.

Hazelnut production is an important sector of Georgian agriculture and a significant source of livelihood for many small-scale farmers. Current initiatives supported by international agricultural-development organizations emphasize orchard management, food safety, post-harvest handling, sustainability and international competitiveness.

2.1 Georgian culinary traditions

Hazelnuts are incorporated into Georgian food culture in both traditional and contemporary preparations. They can be consumed raw, roasted, ground, incorporated into confectionery, used in sauces, combined with fruits and honey, incorporated into desserts, and used in savory preparations.

Georgia's broader culinary tradition is characterized by extensive use of nuts, herbs, fruits and plant-derived ingredients. Hazelnuts therefore occupy a natural position within a cuisine built around concentrated botanical flavors.

Hazelnut also participates in the broader Georgian tradition of churchkhela, in which nuts are threaded onto a string and coated with a concentrated grape-based mixture. Although walnuts are particularly common, hazelnuts can also be utilized.

This connection between hazelnut, grape, traditional agriculture and Georgian food culture provides an interesting foundation for contemporary positioning of Georgian botanical ingredients.

3. Nutritional Value of Hazelnuts

Hazelnuts are exceptionally energy-dense because of their high lipid content, but their nutritional value extends well beyond calories.

Typical nutritional composition per 100 g of raw hazelnut:

- Energy: 628 kcal
- Protein: 14.95 g
- Total fat: 60.75 g
- Carbohydrate: 16.70 g

- Dietary fiber: 9.7 g
- Saturated fatty acids: 4.46 g
- Monounsaturated fatty acids: 45.65 g
- Polyunsaturated fatty acids: 7.92 g

Values are based on USDA-derived compositional data and can vary according to cultivar, growing conditions and processing.

Hazelnuts additionally provide vitamin E, folate, magnesium, phosphorus, potassium, copper, manganese and phytosterols. They also contain a diverse collection of phenolic compounds and other phytochemicals, with particularly high concentrations occurring in the pellicle surrounding the kernel.

3.1 Protein

At approximately 15 g/100 g, hazelnut protein contributes meaningfully to the nutritional density of the kernel. Although hazelnuts are not generally regarded as a primary protein source, their protein contributes to the nutritional value of plant-forward diets.

3.2 Dietary fiber

Approximately 9.7 g of dietary fiber occurs in 100 g of raw hazelnut. This fiber exists within a complex food matrix containing lipids, proteins, polyphenols and micronutrients. Additional fiber is concentrated in the hazelnut skin, opening opportunities for development of fiber-rich coproduct ingredients.

4. The Unique Fatty Acid Profile of Hazelnut

The lipid fraction is one of hazelnut's most commercially important characteristics.

Hazelnuts are particularly rich in monounsaturated fatty acids (MUFAs), principally oleic acid (18:1 cis-9).

Hazelnut oil typically contains approximately 66–83% oleic acid, although values vary with cultivar and origin. A detailed study of Tombul hazelnut oil found oleic acid at 82.78% of total fatty acids.

The principal fatty acids generally include oleic acid, linoleic acid, palmitic acid, stearic acid, and smaller quantities of other fatty acids.

4.1 Importance of monounsaturated fats

Oleic acid is important nutritionally and technologically. From a nutritional perspective, replacing dietary saturated fats with unsaturated fats—particularly cis-monounsaturated fats—can contribute to favorable blood-lipid profiles. Human intervention research on hazelnut

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consumption has reported improvements in certain cardiometabolic markers, although the evidence base remains heterogeneous and additional well-controlled trials are warranted.

From an ingredient perspective, high oleic content contributes to pleasant sensory characteristics, favorable oxidative characteristics relative to highly polyunsaturated oils, skin-conditioning properties, and broad culinary applications.

The combination of oleic acid, linoleic acid, tocopherols and phytosterols makes hazelnut oil a particularly interesting specialty vegetable oil.

5. Hazelnut Oil: Culinary Value and Applications

Hazelnut oil is produced by mechanical pressing or other extraction processes from the kernel.

It possesses a characteristic aromatic profile ranging from delicate and nutty to pronounced and roasted, depending upon the raw material and processing conditions.

Culinary applications include salad dressings, vinaigrettes, finishing oil, pastry, chocolates and confectionery, bakery products, nut butters, sauces, marinades, and specialty culinary formulations.

Cold-pressed hazelnut oil is particularly attractive for premium culinary markets because the objective is to retain its characteristic aroma and minor bioactive components.

Hazelnut oil should generally be regarded as a specialty culinary oil rather than simply another edible vegetable oil. Its value lies in the combination of high oleic acid content, distinctive sensory profile, vitamin E/tocopherols, phytosterols, premium botanical origin, and association with high-quality confectionery and gastronomy.

6. Cosmetic-Grade Hazelnut Oil

A separate and potentially higher-margin opportunity exists in cosmetic-grade hazelnut oil.

The cosmetic ingredient is generally identified by the INCI designation *Corylus avellan*a (Hazelnut) Seed Oil.

Hazelnut oil is used as an emollient, skin-conditioning agent and carrier oil in personal-care formulations. Its fatty-acid profile and relatively light sensory character make it attractive for formulations designed to leave a relatively dry, smooth skin feel.

Potential applications include facial oils, moisturizers, serums, body oils, cleansing oils, hand creams, body butters, anti-aging formulations, hair conditioners, hair masks, scalp

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formulations, leave-in treatments, hair oils, lip products, foundations, soaps, bath products and massage oils.

6.1 Carrier-oil potential

Hazelnut oil can function as a carrier for other lipophilic botanical constituents and essential oils. This creates opportunities for multi-botanical cosmeceutical systems in which hazelnut oil combines carrier functionality with the biological or sensory characteristics of additional botanicals.

Cosmetic-grade oil should be produced, refined, filtered, stored and documented according to the specifications required by the intended cosmetic market rather than treating culinary and cosmetic oils as interchangeable commodities.

7. Hazelnut Shells: From Agricultural Waste to Functional Biomaterial

Hazelnut shells are the hard lignocellulosic structure surrounding the kernel. They are generated in substantial quantities during commercial processing. Research estimates that shells may represent approximately 50–55% of the weight of the in-shell hazelnut.

Historically, this material has often been regarded as a low-value residue. That perspective is changing.

7.1 Natural abrasive

Ground hazelnut shell has a useful combination of hardness, particle structure and biodegradability that permits use as a natural abrasive. Potential applications include industrial cleaning, surface preparation, polishing, blasting media, abrasive formulations and, where appropriately processed and regulated, personal-care exfoliation.

7.2 Mulch and horticulture

Coarsely ground shells can also be used as landscape mulch, soil-cover material, moisture-retention material, horticultural biomass and pathway material.

7.3 Livestock and agricultural applications

Shell biomass can also be incorporated into certain agricultural utilization systems, including animal-feed research and bedding or litter applications. However, feed applications require particular attention to digestibility, particle size, contamination, nutritional composition and applicable feed regulations.

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8. Hazelnut Shell Fiber and Emerging Prebiotic Applications

The more technologically interesting opportunity may be the conversion of shell lignocellulose into functional oligosaccharides.

Hazelnut shell hemicellulose contains structural carbohydrates that can serve as precursors for xylooligosaccharides (XOS) and arabinoxylooligosaccharides (AXOS). These compounds are increasingly investigated as prebiotic substrates capable of interacting with the intestinal microbiota.

The commercial significance is considerable because the original material is inexpensive agricultural biomass, whereas a purified and standardized oligosaccharide can occupy a substantially higher-value functional-ingredient category.

The opportunity lies not simply in selling powdered shell, but potentially in biorefining shell biomass into standardized functional carbohydrate fractions. Extraction and purification remain technically important considerations, and the structure of the resulting oligosaccharides influences their biological properties.

9. Hazelnut Skin/Pellicle: A Concentrated Phytochemical Resource

The hazelnut pellicle is the thin brown skin surrounding the edible kernel. It is frequently removed during industrial processing, particularly when blanched kernels are required.

Historically, this material has been treated as a processing coproduct. Scientifically, however, hazelnut skin is one of the most interesting components of the hazelnut.

9.1 Polyphenol concentration

Research has demonstrated that hazelnut skin contains high concentrations of polyphenolic compounds, particularly flavan-3-ols. Detailed analytical work has identified monomeric and oligomeric flavan-3-ols as dominant polyphenolic constituents.

These compounds include catechin, epicatechin, procyanidins and other flavan-3-ol oligomers. The exact composition varies with cultivar, origin and processing.

This makes hazelnut pellicle a potentially valuable raw material for polyphenol extracts, antioxidant ingredients, functional foods, dietary supplements, botanical concentrates, and fiber-polyphenol complexes.

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10. Hazelnut Skin and the Gut Microbiome

One of the most compelling contemporary research directions concerns the interaction between hazelnut skin constituents and the intestinal microbiome.

Hazelnut skin contains both polyphenols and dietary fiber. This combination is particularly interesting because dietary polyphenols and fiber can undergo microbial transformation in the gastrointestinal tract.

Recent review literature identifies hazelnut skin as a rich source of dietary polyphenols and fiber and examines interactions between its dietary fiber and colonic microbiota.

This creates a potential biological sequence:

> *Hazelnut skin* → dietary fiber + polyphenols → colonic microbial metabolism → microbial metabolites → host biological signaling

The downstream metabolites generated from polyphenol and fiber metabolism may include various short-chain fatty acids and other microbial-derived metabolites, depending upon substrate composition and individual microbiota.

This area remains an active research field and should not be presented as proof that hazelnut skin produces a particular clinical outcome.

11. From Prebiotics to Postbiotics

The emerging value proposition of hazelnut skin becomes particularly interesting within the broader evolution of microbiome science.

A simplified conceptual framework is:

> *Prebiotic substrate* → microbial fermentation/transformation → microbial metabolites → host signaling

The term postbiotic should be used carefully. Under contemporary scientific definitions, a postbiotic is not simply any metabolite produced by bacteria; the terminology has specific requirements concerning the preparation and demonstrated health effects.

Consequently, commercial development should distinguish among prebiotic potential, microbiota modulation, microbial metabolites, postbiotic preparations, and clinically demonstrated postbiotic effects.

Hazelnut skin presently provides a strong research rationale for microbiome-oriented ingredient development, but further characterization and human intervention studies are required before broad health claims can be made.

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12. Hazelnut Skin and the Emerging Longevity Market

The longevity industry is increasingly moving beyond traditional antioxidant positioning toward biological pathways associated with cellular stress resistance, mitochondrial function, autophagy, mitophagy, metabolic flexibility, inflammation, redox homeostasis, and gut–organ communication.

Hazelnut skin is potentially relevant to this trajectory because it provides a complex mixture of polyphenols and fiber rather than a single isolated molecule.

12.1 Mitochondrial-health hypothesis

The concept of using hazelnut pellicle as a longevity-oriented ingredient is scientifically intriguing, but it should presently be described as an emerging research hypothesis, not an established clinical claim.

A future development program could investigate whether standardized hazelnut-skin fractions influence pathways associated with mitochondrial oxidative stress, cellular redox signaling, AMPK-related signaling, mitochondrial biogenesis, mitophagy, Nrf2-associated antioxidant responses, gut microbial metabolism and other relevant biomarkers. Potential research tools include metabolomics, microbiome sequencing, short-chain-fatty-acid analysis, cellular mitochondrial assays, AMPK signaling, Nrf2 signaling, mitochondrial membrane potential, ATP production, ROS measurement, mitophagy markers and human pilot studies.

This is potentially one of the most scientifically differentiated directions for high-value hazelnut coproduct utilization.

13. The Whole-Hazelnut Opportunity

The greatest commercial opportunity may ultimately lie in treating hazelnut as a platform raw material rather than a single commodity.

Kernel → *Food; confectionery; nutritional products; nut butter; protein/fiber ingredients.*
Kernel oil → Culinary oil; specialty food ingredient; cosmetic-grade oil; carrier oil; personal care.
Pellicle/skin → Polyphenols; flavan-3-ols; procyanidins; dietary fiber; functional food ingredient; prebiotic research; microbiome-oriented ingredient; emerging longevity ingredient.
Shell → Fuel; mulch; abrasive; biomass; fiber; XOS/AXOS; emerging prebiotic ingredients.

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This approach represents a circular-bioeconomy model in which the economic value of the crop increases as more components of the agricultural biomass are converted into specialized products.

14. Georgia as a Strategic Hazelnut Resource

Georgia possesses several characteristics that make it particularly interesting as a source of hazelnut-derived ingredients.

Geographic position: Georgia lies within the broader South Caucasus/Black Sea region historically associated with hazelnut diversity and cultivation.

Local genetic resources: Georgia possesses numerous locally adapted cultivars, providing opportunities for cultivar-specific agricultural and phytochemical characterization.

Established production base: Hazelnut is already an established agricultural commodity rather than a crop requiring an entirely new supply chain.

Existing export infrastructure: Georgia has established commercial channels for exporting hazelnut kernels, particularly into European markets.

Potential for vertical valorization: An established kernel industry creates a ready source of coproduct biomass. Instead of Kernel → commodity → shell/skin waste, the model can become Hazelnut → multiple standardized ingredient streams.

This distinction has substantial implications for rural economics and ingredient manufacturing.

15. Quality, Traceability and Sustainability

The future value of Georgian hazelnut ingredients will depend not only on botanical identity but also on quality assurance and traceability.

Important parameters include correct botanical identification, cultivar identification, geographic origin, agricultural practices, harvest date, drying conditions, storage conditions, moisture, oxidative stability, microbiological quality, mycotoxin/aflatoxin control, pesticide-residue compliance, heavy metals, polyphenol standardization, fatty-acid profile, tocopherol profile and batch-to-batch consistency.

Aflatoxin prevention is particularly important because inadequate drying and storage can compromise marketability and international acceptance.

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For premium ingredient markets, traceability from Georgian orchard to finished ingredient can therefore become a commercial differentiator rather than merely a compliance requirement.

16. Potential Market Architecture

The hazelnut value chain can support multiple market categories simultaneously.

Whole hazelnut → Food → Premium Georgian-origin foods

Kernel → Food/confectionery → Functional foods and nutrition

Hazelnut oil → Culinary → Premium specialty oil

Cosmetic-grade oil → Cosmetics → Skin and hair formulations

Pellicle → Byproduct → Polyphenol/fiber ingredient

Pellicle extract → Nutraceutical → Standardized polyphenol ingredient

Shell → Biomass → Circular-material applications

Shell fiber → Functional ingredients → Prebiotic research

XOS/AXOS fractions → Nutrition → Prebiotic ingredients

Polyphenol fractions → Nutraceutical → Microbiome/longevity research

The commercial strategy is therefore not necessarily to identify a single best hazelnut product. It is to maximize the value recovered from every fraction of the crop.

17. Research and Development Opportunities

A Georgian hazelnut ingredient platform could support a sophisticated research program involving several standardized materials.

A. Georgian Hazelnut Kernel: macronutrients, fatty acids, tocopherols, phytosterols, polyphenols and minerals.

B. Georgian Hazelnut Oil: oleic acid, linoleic acid, saturated fatty acids, tocopherols, phytosterols and oxidative stability.

C. Georgian Hazelnut Pellicle: total polyphenols, catechins, epicatechin, procyanidins, total fiber, soluble/insoluble fiber, microbiome interactions and metabolomics.

D. Georgian Hazelnut Shell: cellulose, hemicellulose, lignin, XOS, AXOS, fiber characteristics and functional properties.

E. Advanced Biological Research: gut microbiome composition, microbial metabolites, SCFA production, oxidative stress, AMPK, Nrf2, mitochondrial membrane potential, ATP production and mitophagy.

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Such work could ultimately transform a conventional agricultural commodity into a scientifically differentiated botanical ingredient platform.

18. Conclusion: The Emerging Value of Georgian Hazelnut

Hazelnut represents considerably more than a traditional tree nut.

It is a nutrient-dense food, high-oleic specialty oil, cosmetic raw material, source of polyphenols and dietary fiber, and potentially valuable source of functional carbohydrate and phytochemical coproducts.

The kernel provides a combination of protein, fiber, vitamin E, minerals, phytosterols and predominantly monounsaturated lipid. Its oil is distinguished by a high proportion of oleic acid and has applications spanning premium culinary products, cosmetics and personal care.

The shell presents an additional opportunity within the circular bioeconomy, ranging from conventional biomass applications to emerging research into XOS and AXOS prebiotic compounds.
The pellicle may be even more strategically significant. Rich in flavan-3-ols, procyanidins and dietary fiber, it represents a concentrated phytochemical coproduct with growing scientific interest in functional foods and interactions with the intestinal microbiota.

For Georgia, these characteristics converge with an existing agricultural tradition, extensive cultivar diversity, favorable growing regions, established processing infrastructure and an expanding international quality-assurance framework.

The strategic opportunity is therefore to move from a commodity hazelnut model to a whole-crop valorization model:

Kernel → Oil → Skin → Polyphenols → Fiber → Shell → Functional Biomass

In this model, Georgian hazelnut is not simply an agricultural export. It becomes a platform for food, nutrition, nutraceutical, cosmetic, functional-fiber, microbiome and circular-bioeconomy products.

Georgia's combination of Black Sea–Caucasus terroir, indigenous genetic resources, traditional agricultural knowledge, established hazelnut production and proximity to European markets provides a compelling foundation for developing premium, traceable, scientifically characterized hazelnut-derived ingredients.

The future opportunity may ultimately be measured not by how many kilograms of hazelnuts Georgia exports, but by how much value can be recovered from every kilogram produced.

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Scientific positioning note: The nutrition, fatty-acid, culinary, cosmetic, polyphenol and shell-valorization sections are supported by established literature. The proposed connections involving prebiotic activity, microbiome-derived metabolites, postbiotic development, mitochondrial signaling, mitophagy and longevity should presently be treated as research and product-development opportunities rather than established clinical effects of hazelnut skin. This distinction is important for regulatory, investor, B2B ingredient-sales and scientific-marketing applications.

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