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Commercializing Innovative Agri-Food Products: An Integrative Review of Marketing Challenges and Strategic Responses

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Abstract: *Bringing agri-food innovation to market requires more than demonstrating technical superiority. Consumers, firms, retailers, and institutions must interpret unfamiliar production methods, assess claims that are often difficult to verify, manage uncertainty about product experience, and justify higher monetary or behavioural costs. This article examines the distinctive marketing conditions surrounding innovative agri-food products and identifies responses suited to the barriers that arise during commercialization. A structured integrative review synthesized 41 peer-reviewed analytical studies, together with 10 foundational or methodological works and two authoritative institutional sources. The evidence was selected using explicit eligibility criteria, verified through publisher or DOI metadata, appraised for relevance to the synthesis, and coded across innovation type, consumer evaluation, communication, trust and risk, value, sensory experience, distribution, firm capabilities, and institutional context. The findings identify six defining characteristics of innovative agri-food marketing and organize commercialization barriers across consumer, product, communication, firm and market, and institutional and societal levels. The resulting challenge–response matrix and market-translation framework show how benefit translation, credible assurance, product trial and co-creation, value-based pricing, layered communication, staged channel development, and multistakeholder collaboration can transform innovation into understandable, trustworthy, accessible, and commercially viable consumer value.*

Keywords: agri-food innovation, commercialization, innovation marketing, market-translation framework

I. Introduction

Agri-food innovation now includes hydroponic and vertical farming, precision production, non-thermal processing, freeze-drying, alternative proteins, upcycled ingredients, smart packaging, and digital traceability. These developments may improve safety, quality, shelf life, transparency, convenience, resource efficiency, and sustainability, but they also change what consumers must understand and evaluate [1–3].

An innovative agri-food product is defined here as a market offering whose consumer value is materially affected by novelty or meaningful improvement in composition, functionality, production, processing, packaging, traceability, distribution, environmental performance, or commercialization. This definition is broader than the European Union legal category of novel food, which refers to foods without significant EU consumption before 15 May 1997 [4]. Thus, hydroponic produce, intelligent freshness indicators, and QR-enabled traceability may be innovative without being legally novel foods.

Technological novelty does not automatically create consumer value. Unfamiliar products may be perceived as risky, artificial, costly, culturally incompatible, or uncertain in taste and use. Consumers also cannot easily verify claims about safety, origin, environmental performance, ethics, or functionality; acceptance therefore depends on familiarity, naturalness, expected sensory quality, trust, perceived risk, and credible market institutions [5–10].

Recent evidence reinforces the need for product- and context-specific marketing. Cross-country data from 14,617 participants show that perceived safety, willingness to buy, advocacy, and support for public initiatives vary substantially across technologies and countries [11]. Italian studies further indicate that perceived knowledge, social norms, technology neophobia, and the psychological meaning attached to specific technologies shape acceptance [12, 13]. Familiarity can

reduce disruption when innovation is integrated into recognizable food formats [14], while a meta-analysis of blockchain food supply chains identifies trust transfer as a central mechanism linking traceability to purchase intention [15].

Information economics explains why quality uncertainty can weaken willingness to pay when producers know more than consumers about safety, origin, environmental performance, or production methods [16, 17]. Certification, traceability, reputation, and independent verification act as signals, especially for credence attributes that remain difficult to evaluate after consumption [18–22].

Adoption theory adds that relative advantage, compatibility, complexity, trialability, and observability affect diffusion [2, 23, 24], while perceived usefulness and ease of use matter when consumers must interact with a technology or new routine [22, 25, 26]. The proposed market-translation perspective integrates these mechanisms with food-specific concerns about trust, naturalness, sensory experience, risk, and value.

Research remains fragmented across food science, consumer behavior, sustainability, information systems, innovation management, and marketing. Alternative proteins, smart packaging, hydroponics, upcycled foods, processing technologies, and blockchain traceability are often studied separately, with emphasis on isolated outcomes such as willingness to pay, neophobia, trust, usefulness, or labeling. From a business-management perspective, the evidence is also dispersed across value-proposition design, organizational capabilities, market entry, retailer adoption, channel development, legitimacy, scaling, and value capture. An integrated account is therefore needed to explain how innovative agri-food marketing differs from conventional food marketing, where commercialization barriers arise, and which responses fit each barrier.

The article addresses four research questions:

RQ1. What characteristics distinguish the marketing of innovative agri-food products from conventional food marketing?

RQ2. What consumer-, product-, communication-, firm-, market-, and institution-related challenges affect their commercialization?

RQ3. Which marketing responses can reduce uncertainty and facilitate acceptance, trial, purchase, and continued use?

RQ4. Which theoretical and empirical gaps should guide future research?

The article advances a central argument: the distinctive task of innovative agri-food marketing is to translate technically complex, unfamiliar, and frequently invisible attributes into benefits that consumers can understand, trust, experience, and consider worth their monetary and behavioral cost. Three contributions follow from this argument: a classification of distinctive marketing characteristics, a multilevel systematization of challenges, and a challenge–strategic response matrix.

II. Review Methodology

2.1 Review Design and Scope

An integrative literature review was selected because the topic spans heterogeneous products, theories, methods, and market contexts. The design supports conceptual integration and theory development rather than pooled estimation [27–29]. Transparency was guided by established review principles concerning explicit scope, eligibility, source verification, coding, and synthesis [29–31]. The unit of analysis was the publication and its documented contribution to one or more research questions.

2.2 Search Strategy

The search was conducted from September 2025 and updated on 3 August 2026. The core publication window covered English-language peer-reviewed journal articles from 2015 to August 2026; earlier empirical studies were retained selectively when foundational. Searches used ScienceDirect, SpringerLink, Emerald Insight, Wiley Online Library, PubMed/PubMed Central, MDPI, Frontiers, supplementary scholarly discovery tools, and backward and forward citation chaining. The core Boolean logic was: ("novel food*" OR "innovative food*" OR "agri-food innovation" OR hydroponic* OR "vertical farm*" OR "controlled-environment agriculture" OR "non-thermal processing" OR "smart packaging" OR "intelligent packaging" OR "alternative protein*" OR "upcycled food*" OR traceability OR blockchain) AND (consumer* OR market* OR commercialization OR acceptance OR trust OR risk OR naturalness OR "purchase intention" OR "willingness to pay" OR label* OR pricing OR distribution OR adoption). Platform-specific syntax was adapted without changing the conceptual blocks.

2.3 Eligibility, Verification, and Corpus Composition

Studies were included when they examined an identifiable agri-food innovation and a substantive consumer, marketing, managerial, or market-system dimension. Purely technical studies, conference abstracts, preprints, non-food applications, records without verifiable publication metadata, and sources lacking a clear link to the research questions were excluded. Each retained source was checked against DOI, official publisher, institutional, or bibliographic metadata. The final

analytical corpus comprised 41 peer-reviewed journal studies. Ten foundational theoretical or review-methodology works and two authoritative institutional sources supported interpretation and definition, yielding 53 cited sources overall.

2.4 Coding, Appraisal, and Synthesis

The literature was coded through a hybrid deductive-inductive procedure covering innovation type, consumer evaluation, communication, trust and risk, price and value, sensory experience, firm capabilities, distribution, and institutional context. A fit-for-synthesis appraisal considered five dimensions: verification of peer-reviewed status, relevance to the research questions, transparency of design or conceptual basis, traceability of claims to reported evidence, and explicit recognition of limitations. Because the corpus included reviews, conceptual studies, surveys, experiments, and other empirical designs, no single risk-of-bias instrument was imposed across all sources; weaker or indirect evidence was used for contextual support rather than decisive propositions. Synthesis produced the innovation classification, distinctive marketing characteristics, multilevel challenge framework, challenge-response matrix, and market-translation framework. Appendix A provides a source-level evidence matrix for all 41 analytical studies.

Table 1. Review Protocol and Methodological Transparency Measures

Stage	Procedure	Methodological Transparency Measure
Review design	Structured integrative review of heterogeneous evidence.	Conceptual integration and theory development rather than pooled estimation.
Search window and platforms	September 2025–3 August 2026; core publication window 2015–August 2026; publisher platforms, PubMed, scholarly discovery tools, and citation chaining.	Dates, platforms, and supplementary search procedures are stated explicitly.
Search logic	Innovation block combined with consumer, marketing, commercialization, and adoption block; platform syntax adapted.	The full conceptual Boolean string is reported in the text.
Inclusion criteria	Peer-reviewed English-language studies on an identifiable agri-food innovation with a substantive consumer, marketing, managerial, or market-system dimension.	Each retained study maps to at least one research question.
Exclusion criteria	Purely technical studies, abstracts, preprints, non-food applications, unverifiable records, and sources without a substantive market dimension.	Exclusions prevent technical novelty from being mistaken for market evidence.
Verification and corpus	41 analytical journal studies; 10 foundational or methodological works; two institutional sources; 53 cited sources overall.	DOI, publisher, institutional, or bibliographic metadata checked.
Coding and appraisal	Hybrid coding of innovation, evaluation, communication, trust/risk, value, experience, firm capabilities, distribution, and institutions; five-dimension fit-for-synthesis appraisal.	Evidence was interpreted according to relevance, transparency, traceability, and limitations.
Synthesis outputs	Classification, six marketing characteristics, multilevel barriers, challenge-response matrix, and market-translation framework.	Appendix A links each analytical source to its evidence type and synthesis role.
Boundary conditions	Heterogeneous designs precluded pooled effects and one universal risk-of-bias tool; early record counts were not retained.	The review is not presented as exhaustive, PRISMA-compliant, or meta-analytic.

Note: The procedure follows established integrative-review and evidence-synthesis guidance [27–31].

III. Conceptual Scope and Classification

Innovation may be embedded in the product or in how it is produced, preserved, packaged, documented, distributed, and experienced. Consistent with the Oslo Manual, it involves a new or improved product or process that differs significantly from previous offerings or practices and has been introduced to users or brought into use [32].

Product innovation changes composition, nutrition, functionality, sensory attributes, or use. Alternative proteins and upcycled foods illustrate its marketing tension: environmental or functional benefits may attract consumers, while unfamiliarity, disgust, naturalness concerns, expected taste, or associations with waste can reduce acceptance [9, 24, 33–35]. Recent evidence also shows that acceptance differs across upcycling, biostimulants, artificial intelligence, and familiar product reformulations, confirming that "innovation" is not a uniform consumer category [13, 14].

Production innovation includes hydroponics, vertical farming, controlled-environment agriculture, precision production, and digitally enabled agricultural systems. Although the final product may look familiar, consumers must evaluate an unfamiliar process. Willingness to pay for hydroponic tomatoes depends on familiarity and perceived safety,

sustainability, and quality [36], while perceived knowledge, social norms, technology neophobia, and national context influence acceptance of enabling and controlled-environment technologies [11, 12].

Processing innovations such as high-pressure processing, pulsed electric fields, non-thermal plasma, and freeze-drying can improve safety, shelf life, or quality. Because consumers know little about these methods, they evaluate them through perceived benefit, risk, naturalness, and trust; technical terminology alone may increase anxiety [37–39].

Packaging innovation includes active systems that interact with the product and intelligent systems that monitor freshness, temperature, or condition. Acceptance depends on usefulness, familiarity, trust, environmental implications, and interpretability, not only technical performance [40–43].

Information and traceability innovations—such as QR codes, blockchain, RFID, and digital product records—create value only when information is relevant, usable, and trusted [20, 22, 26, 44]. Marketing innovation changes positioning, pricing, distribution, participation, or experience through approaches such as co-creation, digital storytelling, subscriptions, and direct channels, but must remain supported by credible product performance [45].

The classification and principal marketing implications are summarized in Table 2.

Table 2. Classification and marketing implications of innovative agri-food products

Innovation category	Primary location of novelty	Examples	Main consumer value	Main marketing issue
Product	Composition, nutrition, functionality, sensory or usage attributes	Functional foods, alternative proteins, upcycled products	Health, functionality, convenience, differentiation	Unfamiliar benefits, sensory uncertainty, difficult-to-verify claims
Production	Agricultural production method	Hydroponics, vertical farming, controlled-environment agriculture	Resource efficiency, controlled quality, local availability	Process is invisible and may be perceived as unnatural
Processing	Preservation or manufacturing technology	HPP, freeze-drying, pulsed electric fields, non-thermal processing	Safety, shelf life, quality preservation	Technical terminology must be translated into benefits
Packaging	Material, protection, monitoring, or interaction	Active, intelligent, biodegradable, and QR-enabled packaging	Freshness, safety, convenience, waste reduction	Complexity, low familiarity, cost, and environmental trade-offs
Information and traceability	Product and supply-chain information	Blockchain, QR codes, RFID, digital product records	Transparency, origin verification, authenticity, trust	Information may not be accessed, understood, or trusted
Marketing	Positioning, pricing, communication, distribution, or experience	Co-creation, digital storytelling, subscriptions, direct channels	Engagement, access, personalisation, differentiated experience	Novel methods must remain consistent with actual product value

Note: Categories are based on the dominant location of innovation and are not mutually exclusive. A single product can combine several forms of innovation.

Source: Authors' synthesis based on [1, 3, 9, 13, 14, 32–34].

Sustainability is treated as a cross-cutting dimension because it may be embedded in ingredients, production, processing, packaging, traceability, or distribution. Neither every sustainability-oriented product nor every environmental claim represents genuine innovation. Claims should therefore identify the specific improvement and supporting evidence to reduce greenwashing and skepticism [46].

IV. Distinctive Marketing Characteristics

4.1 Information-Intensive Marketing

Innovative products often require explanation before persuasion: consumers need to know what the innovation is, why it matters, whether it is safe, and how it differs from or is used relative to conventional alternatives. Yet technical detail may increase uncertainty when it ignores heuristics, emotions, familiarity, and socio-cultural expectations [7].

Marketing must therefore translate technology into outcomes: controlled and resource-efficient production, freshness and safety, convenient preservation, freshness monitoring, waste reduction, or verified origin. Technology should remain visible but subordinate to a clear consumer benefit.

4.2 Credence-Attribute Dependence

Many innovation benefits are credence attributes that consumers cannot verify readily, including environmental performance, origin, ethical sourcing, and some safety or health claims. This creates information asymmetry and makes certification, brand and retailer reputation, regulatory approval, traceability, and expert evidence important signals [16–19].

Certification reduces uncertainty only when consumers understand and trust both the standard and certifier [17, 47]. Likewise, blockchain and other traceability systems can strengthen origin or organic signals only when data entry,

governance, information quality, and communication are credible [20–22]. The central task is to convert invisible attributes into interpretable evidence.

4.3 Trust-Based Evaluation

Trust is distributed across brands, retailers, technologies, experts, regulators, and certification bodies. It concerns competence, honesty, benevolence, and procedural reliability and is built through consistent performance, independent assurance, transparent origin, responsible claims, and accessible responses to concerns [10].

Trust can lower perceived risk, while failures, inconsistent quality, or exaggerated claims can damage it rapidly. Digital traceability may improve transparency, but usefulness, safety, risk, and willingness to pay remain important even when blockchain is used [22]. A 2026 meta-analysis further identifies trust transfer as the core mechanism through which blockchain traceability affects food purchase intention, with stronger effects for higher-risk and less familiar products [15].

4.4 Experience-Sensitive Marketing

Food innovation remains dependent on taste, texture, aroma, appearance, preparation, and convenience. Sustainability or health benefits may encourage trial, but disappointing experience undermines repeat purchase.

Sampling, tasting, demonstrations, recipes, and trial-size packages can reduce performance uncertainty. Tasting, for example, can correct unfavorable visual judgments of suboptimal produce, provided trial is followed by reliable availability and consistent quality [48].

4.5 Value-Justification Orientation

Innovative products often cost more because of research, specialized production, certification, advanced packaging, traceability, or limited scale. Consumers weigh these costs against functional, economic, environmental, emotional, and social value.

Hydroponic technology does not create willingness to pay by itself; value emerges through familiarity and perceived safety, sustainability, and quality [36]. Segmentation, smaller packages, introductory formats, and product tiers can reduce first-purchase risk when linked to a clear benefit.

4.6 Digitally Enabled Marketing

Digital media can explain technologies, visualize production, demonstrate use, and extend traceability beyond the label. Enriched QR information can help consumers identify and evaluate product attributes more effectively than conventional labels [44].

Digital communication must be concise, accessible, credible, and easy to use. These conditions are especially important for QR codes, smart packaging, unfamiliar preparation, or new purchasing routines [21, 25, 26]. Layered design should present one primary benefit, concise evidence, and optional deeper information [49].

The six distinctive marketing characteristics are summarized in Table 3.

Table 3. Distinctive marketing characteristics

Characteristic	Central problem	Marketing requirement	Intended outcome
Information-intensive	Consumers do not understand the innovation or its relevance	Accessible education and benefit translation	Comprehension and consideration
Credence-attribute-dependent	Important benefits are invisible or difficult to verify	Certification, evidence, traceability, and credible signals	Reduced information asymmetry
Trust-based	Consumers depend on firms and institutions to validate claims	Transparency, independent assurance, and consistent performance	Lower perceived risk and stronger credibility
Experience-sensitive	Taste, usability, and product performance are uncertain	Sampling, demonstration, sensory testing, and guidance	Trial and repeat purchase
Value-justification-oriented	A premium price must be explained	Segmentation, benefit-based positioning, and risk-reducing price formats	Greater perceived value
Digitally enabled	Traditional labels cannot carry all relevant information	QR codes, video, social media, and layered digital content	Engagement and informed choice

Source: Authors' synthesis based on [10, 15, 17, 18, 20–22, 36, 42–44, 47].

V. Key Marketing Challenges

The distinctive characteristics create barriers across consumers, products, communication, firms and markets, and institutions. Because visible resistance may originate outside consumer psychology, commercialization requires a multilevel diagnosis.

5.1 Consumer-Level Barriers

Low familiarity, food or technology neophobia, perceived risk, naturalness concerns, habits, weak trust, and price sensitivity are recurring barriers [5, 6, 8, 35]. Their importance varies by product category, country, perceived knowledge, social norms, and the degree to which an innovation remains connected to familiar food meanings [9, 11, 12, 14, 39].

Unfamiliarity may activate disgust, anxiety, or concerns about technological interference with naturalness. Consumers must also see compatibility with ordinary meals, preparation practices, and cultural meanings. Upcycled foods illustrate this tension: waste reduction is attractive, but "waste" associations can weaken expected quality or safety [34].

Favorable attitudes may still fail to become purchases when direct benefits are unclear, prices are high, products are unavailable, or conventional alternatives are easier to choose.

5.2 Product-Level Barriers

Products can combine too many innovations and create an unfocused proposition. Consumers usually need one primary reason to buy, with secondary attributes serving as evidence rather than competing for attention.

Sensory uncertainty, inconsistent quality, and scaling constraints can undermine repeat purchase. Larger-scale production may affect texture, shelf life, supply reliability, or packaging, while agri-food SMEs often face resource, management, logistics, and distribution limitations [50].

5.3 Communication-Level Barriers

Technical terms such as pulsed electric fields, non-thermal plasma, controlled-environment agriculture, or blockchain can obscure consumer benefits. Terminology and perceived risk shape interest in emerging processing technologies, while multiple claims, labels, certifications, and QR codes can create information overload [37–39].

Unsupported sustainability claims further increase skepticism. Greenwashing commonly involves vague language, selective disclosure, weak verification, and consumer confusion; claims should therefore specify the improvement, comparison, life-cycle stage, and evidence [46].

5.4 Firm- and Market-Level Barriers

Many innovations are developed by start-ups or small, technology-oriented firms with limited capacity in segmentation, branding, pricing, consumer research, retailer negotiation, and channel management. Commercialization also requires a coherent business model, a credible value proposition, market-entry sequencing, demand learning, supply reliability, and mechanisms for value capture. High development costs, small scale, uncertain demand, and unstable supply can restrict distribution, retailer adoption, repeat purchase, and profitable scaling [50].

Direct and short supply chains may strengthen proximity, local identity, and trust but still require convenience and reliable availability [51]. Education cannot sustain adoption when products are difficult to find, retailers cannot explain or categorize them, and firms cannot maintain consistent quality. Conversely, distribution expansion cannot compensate for weak sensory performance, unclear value, or a price architecture that prevents trial and repeat purchase.

5.5 Institutional and Societal Barriers

Regulatory uncertainty, fragmented certification, labeling inconsistency, and uneven standards can delay entry and weaken legitimacy. Digital traceability also faces cost, interoperability, scalability, governance, and regulatory constraints, while cultural differences limit message transferability [52].

Premium pricing, specialist retail, and smartphone-dependent information may also exclude lower-income or less digitally connected consumers, confining food-system innovations to narrow segments.

The multilevel challenge structure is summarized in Table 4.

Table 4. Multilevel classification of marketing challenges

Level	Principal barriers	Illustrative examples	Likely commercial consequence
Consumer	Low familiarity, neophobia, risk, unnaturalness, habits, weak trust, price sensitivity	Alternative proteins, hydroponic products, non-thermal processing	Low trial and weak willingness to pay
Product	Complexity, invisible benefits, sensory uncertainty, inconsistency, category ambiguity	Upcycled foods, smart packaging, functional products	Weak positioning and repeat purchase
Communication	Technical language, information overload, unsupported claims, greenwashing	Blockchain information, environmental labels	Confusion, skepticism, and credibility loss

Level	Principal barriers	Illustrative examples	Likely commercial consequence
Firm and market	Limited marketing capability, high costs, small scale, restricted distribution, retailer resistance	Innovations developed by agri-food SMEs	Low visibility, high prices, and weak scalability
Institutional and societal	Regulatory uncertainty, fragmented certification, cultural differences, unequal access	Novel foods and digital traceability systems	Delayed market development and weak legitimacy

Source: Authors' synthesis based on [5, 6, 11, 12, 37–39, 43, 46, 50, 52].

VI. Strategic Responses and Marketing Implications

Strategic responses must fit the dominant barrier. Education cannot repair weak taste, certification cannot correct inconsistent quality, and sampling cannot resolve regulatory ambiguity. Interventions should therefore be coordinated across the consumer journey.

6.1 Education and Benefit Translation

Category education should explain what the innovation is, why it exists, how it is evaluated, and what benefit it provides. Messages should move from familiar comparisons to optional technical detail—for example, freshness and safety rather than processing terminology, or verified origin rather than blockchain architecture.

Communication should acknowledge uncertainty rather than portray concerns as irrational. Accessible framing is often more effective than technical density [7], while consumer empowerment can strengthen sustainability messages when informed choice is framed as rewarding responsible practice rather than fulfilling a moral obligation [53].

6.2 Evidence, Certification, and Trust Architecture

Claims about safety, sustainability, origin, or functionality require independent, understandable evidence. Certification should explain what is verified and by whom; traceability should disclose data sources and verification rather than imply that technology guarantees truth. Because trust mediates the commercial effect of blockchain-enabled information, firms should communicate the governance and credibility of the information system, not only the presence of the technology [15].

Trust architecture also includes credible partnerships, consistent quality, transparent responses, and alignment across packaging, websites, and social media. No single assurance signal can compensate for contradictory performance.

6.3 Product Trial, Design, and Co-Creation

Trial is appropriate when uncertainty concerns taste, texture, preparation, or packaging performance. Tasting and demonstrations should answer a specific question and be followed by reliable availability and value confirmation [48].

Consumer involvement should begin before launch. Food Design Thinking, sensory and package testing, message testing, and pilot launches can identify product-market problems that technical development alone may miss [45].

6.4 Value-Based Pricing and Segmentation

Pricing should reflect benefits valued by different segments. Resource efficiency, controlled production, shelf life, convenience, and safety may have different value across consumers, as shown for hydroponic products [36].

Smaller trial packages, introductory offers, tiers, and bundles can reduce first-purchase risk, but discounts should support rather than replace a credible benefit-price relationship.

6.5 Layered Communication and Responsible Digital Design

Front-of-pack communication should state one primary benefit; back labels should provide essential evidence and use information; and QR codes or websites should offer optional traceability and production detail. Simple language, readable design, and appropriate information density improve usability [49].

Environmental claims should be specific and proportionate—for example, measured packaging reduction or verified origin rather than "fully sustainable." This lowers legal, reputational, and category-wide trust risks.

6.6 Distribution and Market Legitimacy

Early channels such as direct sales, specialist retailers, farmers' markets, food service, or subscriptions can support explanation and feedback. Wider expansion then requires consistent supply, retailer training, and clear category placement.

Regulatory clarity, shared terminology, interoperable traceability, and category education require collaboration among producers, retailers, researchers, certifiers, technology providers, and policymakers, especially for disruptive innovations.

The alignment between principal challenges and strategic responses is summarized in Table 5.

Table 5. Challenge–strategic response matrix

Key challenge	Strategic response	Illustrative action	Expected outcome
Limited awareness	Consumer and category education	Simple explanation, familiar comparison, short educational video	Greater comprehension and consideration
Technology neophobia or unnaturalness	Balanced benefit and risk communication	Explain purpose, safety assessment, and direct benefit without vague "natural" claims	Lower uncertainty and more balanced evaluation
Invisible benefits	Certification and verified signalling	Independent label, transparent origin, concise supporting evidence	Reduced information asymmetry
Low trust	Trust architecture	Credible partnerships, transparent procedures, consistent quality	Stronger credibility
Sensory uncertainty	Experiential marketing	Sampling, tasting, recipe, or demonstration	Trial and corrected expectations
High price	Segmentation and value-based pricing	Smaller trial size, product tier, direct benefit communication	Greater perceived value and lower first-purchase risk
Information overload	Layered information design	One front-of-pack benefit with optional QR detail	Greater clarity and usability
Greenwashing concern	Specific and verifiable claims	State the measured improvement, comparison, and verifier	Lower skepticism and reputational risk
Weak product–market fit	Consumer co-creation	Sensory testing, package testing, pilot launch	Better compatibility with consumer needs
Limited distribution	Staged channel development	Direct or specialist channels followed by mainstream expansion	Greater access and controlled scaling
Weak category legitimacy	Multistakeholder collaboration	Shared standards, public education, and regulatory dialogue	Stronger institutional acceptance

Note: Responses are complementary. One intervention may address several barriers, while one barrier may require several coordinated actions.

Source: Authors' synthesis based on [10, 15, 17, 18, 20–22, 36, 42–44, 47].

VII. Discussion

The findings support a market-translation perspective: each innovation location creates a distinct evaluation problem. Product innovation raises sensory and functional questions; production and processing innovations require invisible processes to become meaningful; packaging must balance functionality and usability; and traceability depends on information quality and institutional credibility.

The review contributes six distinctive marketing characteristics, a multilevel challenge framework, and a challenge-response matrix. Together they integrate research on information, credence attributes, trust, sensory experience, pricing, digital communication, firm capability, distribution, regulation, and culture, replacing generic recommendations with diagnostic alignment.

Together, the contributions form an analytical sequence:

Type and location of innovation → distinctive marketing requirement → multilevel challenge → strategically aligned response → market-acceptance outcome.

The integrated market-translation framework is presented in Fig. 1.

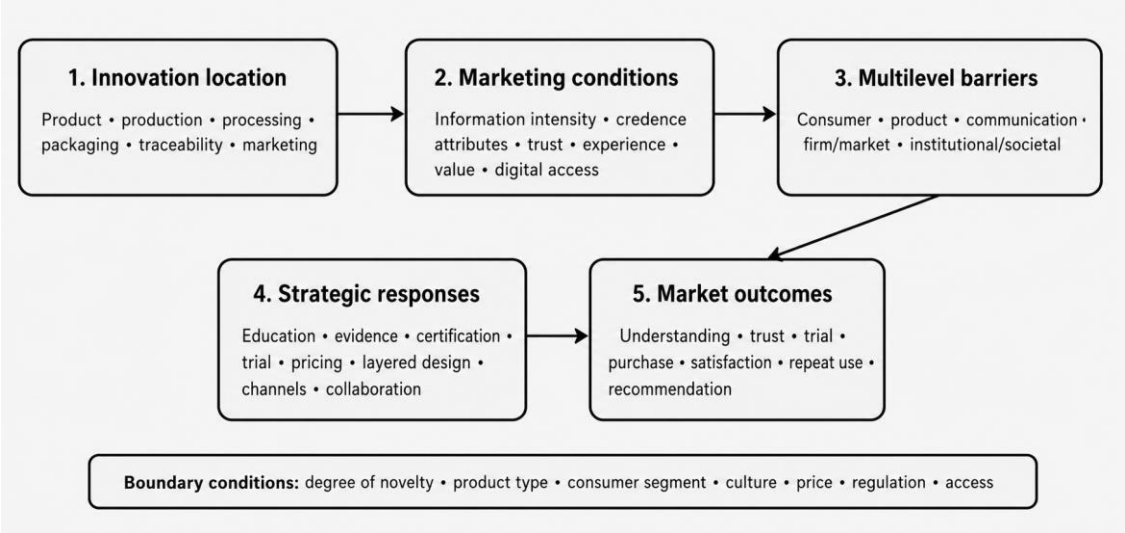

Fig. 1. Integrated market-translation framework for innovative agri-food products
Source: Authors' synthesis informed by [2, 9–26, 36].

The sequence is a diagnostic and research framework rather than a tested causal model. Acceptance is dynamic: consumers may become aware without understanding, understand without trusting, trust without trying, or try without repurchasing. Future research should therefore examine the complete response process:
Awareness and information → perceived ease of use, perceived usefulness, trust, perceived risk, and perceived quality → attitude → engagement and purchase intention → purchase decision → satisfaction → recommendation.

Technology-acceptance constructs are most relevant when consumers interact with QR codes, smart packaging, unfamiliar preparation, or new routines [21, 25, 26]. Diffusion attributes also vary by product, country, and adoption stage [2, 11, 23, 24]. For composition-only or low-disruption innovations, meal compatibility, familiarity, naturalness, and sensory fit may matter more [14]; for enabling agricultural technologies, perceived knowledge, social norms, and technology neophobia require greater attention [12, 13]. Trust, risk, quality, and sensory experience should therefore be tested as product- and context-specific boundary conditions.

Marketing should be integrated into innovation development. Technical advancement is commercially weak when consumers cannot understand value, retailers cannot position the product, or price exceeds experienced benefit. Certification, regulatory clarity, and traceability standards also shape trust and scalability.

7.1 Theoretical Integration

The framework combines information economics, signaling, innovation diffusion, and technology acceptance. Information asymmetry and the distinction among search, experience, and credence attributes explain why consumers cannot independently verify many innovation-related claims [16–18]. Signaling theory explains the role of certification, retailer endorsement, verified traceability, and institutional partnerships [19], while contemporary food-market research shows that the effectiveness of these signals depends on information quality, governance, and consumer trust [20–22]. Technology-acceptance and diffusion perspectives clarify how usefulness, ease of use, relative advantage, compatibility, and trialability shape adoption [2, 23–26]. Food-specific evidence adds sensory confirmation, naturalness, perceived quality, trust, and risk as important boundary conditions.

Taken together, these perspectives indicate that commercialization depends on translating technological novelty into recognizable consumer value. Credible third-party signals and institutional trust are especially important when benefits cannot be verified directly, whereas trial and satisfactory sensory or functional performance become more influential when product quality is evaluated through experience. The conversion of favorable attitudes into purchase and continued use is also shaped by market conditions, including price, availability, retailer support, regulatory clarity, and digital access.

7.2 Managerial Implications

The market-translation framework offers managers a practical diagnostic sequence. First, identify where novelty is located—in the product, production process, processing technology, packaging, traceability system, or marketing model. Second, determine whether the dominant barrier concerns comprehension, credibility, sensory performance, value, access, or institutional legitimacy. Third, select a response that directly addresses that barrier and coordinate it with product

quality, pricing, and channel availability. This sequence reduces the risk of relying on generic education campaigns when the underlying problem is weak product performance, high price, or limited distribution.

For agri-food SMEs, the most feasible launch strategy is to communicate one primary consumer benefit, support it with proportionate evidence, reduce trial risk through sampling or smaller formats, and scale through staged channels. Managers should also define how the innovation will create and capture value, which partners or retailers will confer legitimacy, and which operating capabilities are required to maintain quality and supply. Retailers can strengthen adoption through clear category placement and staff guidance, while policymakers and certifiers can improve legitimacy through consistent terminology, understandable standards, and interoperable traceability requirements. These actions connect innovation management with marketing execution and market-system development.

7.3 Limitations and Boundary Conditions

The review is structured and integrative rather than exhaustive. The heterogeneous corpus includes previous reviews and conceptual studies, limiting effect-size comparison and potentially representing some primary studies indirectly more than once. Publisher-platform searching may also be less comprehensive than database-led systematic searching, and the fit-for-synthesis appraisal is not a substitute for design-specific risk-of-bias assessment. The proposed framework therefore requires empirical validation across products, cultures, price levels, institutional environments, and market settings.

VIII. Future Research Directions

Future research should test the path from awareness to post-purchase behavior through longitudinal studies, field experiments, retailer data, and real-choice designs. These methods can determine whether stated acceptance leads to trial, purchase, satisfaction, repeat purchase, and recommendation [2, 8]. Cross-country evidence and traceability meta-analysis also indicate a need to test institutional context, risk level, technology type, and trust-transfer mechanisms as moderators [11, 15].

Studies could test whether information affects attitude through usefulness, quality, trust, and risk; whether engagement converts attitude into purchase intention; and whether satisfaction links purchase experience to recommendation. Product type and novelty should be examined as moderators because mechanisms differ across smart packaging, cultivated products, and upcycled foods.

Cross-cultural studies should examine how purchasing power, institutional trust, food traditions, regulatory confidence, and digital access alter the importance of sustainability, safety, naturalness, and price, using measurement-equivalence tests rather than mean comparisons alone.

Experiments should compare benefit explanations, certification, tasting, QR information, environmental framing, and price formats to identify which response works for each barrier, product, segment, and adoption stage.

IX. Conclusion

Innovative agri-food products may improve safety, quality, transparency, convenience, resource efficiency, and sustainability, but technical novelty alone does not create a market. Consumers must evaluate unfamiliar technologies, invisible benefits, sensory uncertainty, difficult-to-verify claims, and often higher prices, while firms must align capabilities, business models, channels, and legitimacy with the proposed value.

The review contributes a classification of innovation locations, six distinctive marketing characteristics, a multilevel challenge framework, a challenge-response matrix, and an integrated market-translation framework. Its principal advantage is diagnostic alignment: it helps managers distinguish whether weak commercialization originates in comprehension, credibility, experience, value, access, organizational capability, or institutional legitimacy, and then select a response that addresses the actual barrier.

The framework can support agri-food firms, retailers, certifiers, researchers, and policymakers in product development, market entry, communication, channel design, and category-building decisions. Market success ultimately depends on making innovation understandable, credible, satisfactory in use, conveniently accessible, and worth its monetary and behavioral cost. Because the review is integrative rather than exhaustive and the framework has not yet been tested as a causal model, its applicability should be validated empirically across technologies, consumer segments, cultures, and market systems.

Declarations

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Appendix A. Source-Level Evidence Matrix

Table A1 identifies the 41 analytical journal studies included in the substantive synthesis. Foundational theoretical and review-methodology works and institutional documents are listed in the References but are not repeated in this matrix.

Table A1. Analytical evidence base and role in the synthesis

Reference	Evidence type	Innovation/context	Role in synthesis
[1]	Literature review	Agro-food innovation	Innovation scope and sustainability, smartness, and health dimensions
[2]	Systematic review	New production technologies	Acceptance determinants and diffusion attributes
[3]	Review	Consumer and food-product innovation	Consumer involvement in product development
[5]	Review	Novel foods	Behavioral barriers and adoption drivers
[6]	Systematic review	Novel food adoption in the EU	Acceptance determinants and resilient food systems
[7]	Systematic review	Novel foods	Heuristics, biases, emotions, and information framing
[8]	Systematic review	Novel foods and beverages	Acceptance literature and future research agenda
[9]	Systematic review	Alternative proteins	Cross-category acceptance determinants
[10]	Critical review	Food-system trust	Trust architecture and institutional credibility
[11]	Cross-country survey	Gene editing, cellular agriculture, and controlled-environment agriculture	Country, demographic, safety, advocacy, and policy-support differences
[12]	Empirical survey	Enabling agricultural technologies	Knowledge, social norms, neophobia, and sustainable transition
[13]	Representative online survey	Upcycling, biostimulants, and artificial intelligence	Technology-specific acceptance and psychological involvement
[14]	Representative survey/SEM	Legume-enriched familiar foods	Familiarity, multidimensional food choice, and low-disruption innovation
[15]	Meta-analysis	Blockchain food supply chains	Trust transfer, risk context, and purchase intention
[17]	Conceptual framework	Food credence attributes	Stakeholders, motives, and information asymmetry
[20]	Empirical consumer-preference study	Blockchain and credence attributes	Signaling, preferences, and traceability value
[21]	Systematic review	Food traceability	Consumer perspectives, trust, and research agenda
[22]	Systematic review	Blockchain-tracked food	Trust, risk, usefulness, and willingness to pay
[24]	Comparative empirical study	Alternative proteins	Innovation attributes, trust, and purchase intention
[26]	Survey/SEM study	Blockchain traceability for organic food	Usefulness, ease of use, trust, and adoption intention
[33]	Empirical purchase-intention study	Upcycled food	Waste associations, circular value, and purchase intention
[34]	Scoping review	Upcycled foods	Acceptance mechanisms and waste-related associations
[35]	Empirical profiling study	Insect-based protein	Readiness, neophobia, and segment differences
[36]	Empirical willingness-to-pay study	Hydroponic tomatoes	Familiarity, quality, sustainability, safety, and value
[37]	Conjoint empirical study	Emerging processing technologies	Terminology, perceived benefit, and risk
[38]	Consumer study	Organic food-processing technologies	Processing terminology, risk, and naturalness

Reference	Evidence type	Innovation/context	Role in synthesis
[39]	Cross-cultural empirical study	Non-thermal processing technologies	Risk perceptions, terminology, and cultural variation
[40]	Extensive review	Smart packaging	Packaging innovation scope and technical-consumer interface
[41]	Quantitative survey	Smart food packaging in China	Usefulness, familiarity, and acceptance
[42]	Empirical acceptance study	Nanotechnology food and packaging	Affect and trust
[43]	Systematic review	Smart packaging	Consumer awareness, benefits, and barriers
[44]	Empirical evaluation	QR codes on food products	Information access, evaluation, and digital communication
[45]	Conceptual marketing article	Food Design Thinking	Co-creation and consumer-centered innovation development
[46]	Systematic review	Food-industry greenwashing	Claim specificity, verification, and skepticism
[47]	Conceptual/empirical article	Organic certification	Credence, motivation, trust, and certification
[48]	Experimental study	Suboptimal produce	Visual evaluation, tasting, and experiential correction
[49]	Consumer-oriented design study	Food traceability labels	Layered information and label-design principles
[50]	Systematic review	Agri-food SMEs and scaling	Firm capability, scaling, logistics, and market constraints
[51]	Systematic review	Short food supply chains	Trust, proximity, convenience, and channel conditions
[52]	Scoping review	Digitalization and traceability	Interoperability, governance, regulation, and institutional barriers
[53]	Advertising experiment	Organic food and green empowerment	Sustainability framing and purchase intention

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