



Research on the Optimization of Administrative Law Regulation of Compound Food Additives in Food Safety Governance

Hao Zhang

Harbin University of Commerce, Harbin, Heilongjiang Province, China
2560391972@qq.com

Abstract. Compound food additives are widely used in modern food production because they integrate multiple technological functions, improve processing stability, and reduce production costs. However, their composite formulation, uncertain interaction effects, and diversified application scenarios have created new challenges for administrative law regulation and food safety governance. Taking the regulatory gap of compound food additives as the research object, this paper examines the defects of the current administrative regulatory system from the dimensions of legal definition, standard supply, risk assessment, administrative licensing, law enforcement, interdepartmental coordination, information disclosure, and legal liability. The study finds that existing regulation still tends to focus on the compliance review of single additives, while the whole-composition safety evaluation of compound formulations is relatively insufficient. In practice, unclear regulatory attributes, lagging technical standards, weak grassroots enforcement capacity, and fragmented supervision may increase food safety risks and weaken the protection of consumers' rights. Based on the logic of risk prevention and responsive regulation, this paper proposes an optimization framework including clarifying legal attributes, improving dynamic standards, establishing whole-formulation risk assessment, strengthening collaborative supervision, enhancing digital traceability, refining administrative liability, and promoting public participation. The research aims to provide theoretical support and practical reference for improving administrative law regulation, closing regulatory loopholes, and modernizing food safety governance.

Keywords: compound food additives; administrative law regulation; food safety governance; regulatory optimization; risk prevention

1 Introduction

Food safety is directly related to public health, social trust, market order, and the modernization of national governance^[5]. In the modern food industry, food additives are not merely auxiliary substances^[1]; they are also technical tools that affect food preservation, texture, color, flavor, processing performance, and industrial efficiency. Among different types of additives, compound food additives have become increas-

ingly common^[8] because they combine several single additives or auxiliary substances according to specific technological needs.

Compared with single food additives, compound food additives are more complex in composition and function. A compound formulation may include preservatives, stabilizers, thickeners, sweeteners, colorants, carriers, and processing aids. Even if each component complies with existing standards, the overall formulation may still present combined effects under different food categories, processing temperatures, exposure frequencies, and consumer groups. Therefore, compound food additives require not only component-based compliance review but also whole-formulation safety evaluation.

From the perspective of administrative law, compound food additive regulation reflects a typical tension between industrial innovation and regulatory lag^[3]. On the one hand, food enterprises need flexible technical solutions to meet market demand. On the other hand, administrative authorities must protect public health through clear standards, effective licensing, professional enforcement, and strict accountability. If the regulatory system cannot respond to new risks in time, enterprises may exploit legal ambiguity, and consumers may bear hidden food safety risks.

The source document points out that the current regulation of compound additives is affected by vague definitions, complex classification, inconsistent standards, insufficient enforcement basis, weak interdepartmental cooperation, and limited public understanding^[10]. It also notes that the compound additive market has expanded rapidly and that illegal use may endanger consumers' health and disturb fair competition. These problems show that the optimization of administrative law regulation is both theoretically significant and practically urgent.

This paper therefore focuses on three questions: first, what administrative law defects exist in compound food additive regulation; second, why these defects lead to regulatory gaps in food safety governance; and third, how administrative law regulation can be optimized through legislation, standards, licensing, enforcement, collaboration, and accountability.

In response to the need for empirical grounding, the analysis below uses representative regulatory materials rather than only abstract doctrinal reasoning. Typical sampling-inspection and penalty situations include: finished foods found to contain preservatives, sweeteners, colorants or other additives beyond permitted scope or maximum limits; compound additive premixes whose internal component ratios cannot be verified from ordinary finished-product testing^[7]; and consumer complaints triggered by opaque additive labeling or inconsistent explanations of technological necessity^[13]. Tracking evaluation of GB 26687-2011^[9], component-content inspection studies, multi-component screening research^[14], and online public-opinion analysis all show that the practical regulatory gap often lies not only in whether a single additive is listed as permitted, but also in whether the premix formula, carrier, component proportion, actual use scenario, and downstream exposure can be reconstructed by regulators.

2 Regulatory Basis and Research Significance

2.1 Regulatory Basis of Compound Food Additives

China's food additive regulatory system is composed of laws, administrative regulations, national food safety standards, departmental rules, technical specifications, and local enforcement practices. The Food Safety Law^[17] provides the general legal framework for food safety supervision, while national standards specify permitted additive varieties, scope of use, maximum use levels, residue limits, labeling requirements, and technical conditions. For compound food additives^[16], the regulatory logic also involves the relationship between single-component legality and overall formulation safety.

The formal implementation of GB 2760-2024⁴ marks an important update of the national food additive use standard. It shows that China's standard system is continuously responding to technological development and food safety risks. At the same time, the General Rules for Compound Food Additives^[16] issued earlier still provide a basic normative basis for compound additive regulation. However, in the context of rapidly changing food processing technologies, the existing system still faces the problem of insufficient refinement for new compound formulations, new carriers, and new application scenarios.

More precisely, the current definitional problem is not that compound food additives are wholly undefined. The Food Safety Law defines food additives at the general statutory level, GB 2760-2024^[15] mainly regulates permitted additives, food categories, functions and maximum use levels, and GB 26687-2011 provides technical rules for compound food additives. The ambiguity arises because the higher-level law does not expressly distinguish compound food additives from ordinary ingredients, processing aids, flavorings or food-related products, while the technical standard does not by itself specify differentiated licensing, filing, evidence, traceability and penalty consequences. This gap weakens the link between technical classification and administrative-law consequences.

Administrative regulation in this field is not a purely technical issue. It also concerns the allocation of administrative power, the definition of enterprise obligations, the protection of consumers' right to know, the fairness of market competition, and the credibility of government supervision^[6]. Therefore, the improvement of compound food additive regulation should be placed within the broader framework of administrative law and food safety governance.

2.2 Research Significance

Theoretically, this study expands the discussion of administrative law from general food safety regulation to a more specific and technically complex field. Compound food additives reveal the limitations of traditional rule-based administrative regulation when facing composite risks and scientific uncertainty. The research therefore helps explain how administrative law should adapt to risk society^[11] and technological governance.

Practically, this study provides policy suggestions for market supervision departments, health administrative departments, testing institutions, and local governments. By clarifying regulatory attributes, improving standards, strengthening enforcement capacity, and building collaborative mechanisms, administrative agencies can reduce regulatory blind spots and improve the effectiveness of food safety governance.

Socially, the optimization of compound food additive regulation helps protect consumers' health rights and right to know. It can also promote fair competition by preventing illegal enterprises from gaining cost advantages through excessive or unauthorized additive use.

3 Main Defects in Administrative Law Regulation

3.1 Unclear Legal Definition and Regulatory Attributes

The first regulatory defect is the insufficient clarity of the legal definition. Compound food additives are different from single additives, ordinary food ingredients, food flavorings, processing aids, and food-related products. However, in practice, some products may contain mixed characteristics, making it difficult for regulators to determine their legal attributes. When the boundary of a regulatory object is unclear, administrative licensing, inspection, labeling review, and punishment will all face uncertainty.

This uncertainty may lead to inconsistent enforcement among regions and departments. One local authority may treat a product as a compound food additive, while another may classify it as a general food ingredient or processing aid. Such inconsistency weakens legal predictability and increases compliance costs for enterprises.

A targeted amendment could therefore add a separate clause to the Food Safety Law or an implementing regulation: "Compound food additive" means a formulation prepared by physical mixing of two or more food additives, or food additives together with necessary carriers or auxiliary substances, for a specific technological function in a specified food category. Its legality shall be judged not only by the legality of each component, but also by formula necessity, component proportion, interaction risk, labeling accuracy, traceability and actual exposure under the intended conditions of use. Compound food additives shall not be used to conceal food spoilage, substitute for normal processing, disguise inferior quality, or evade maximum-use limits for individual additives.

3.2 Lagging Standard System and Insufficient Technical Refinement

The second defect lies in the lag of the standard system. Compound food additives are characterized by rapid product iteration and diverse application scenarios^[8]. Standards, however, usually require a long process of research, drafting, review, approval, and implementation. This creates a time lag between industrial innovation and administrative regulation.

Current standards pay more attention to the use conditions of single additives, while the combined effects of multiple components are not always fully evaluated. In

addition, some emerging compound formulations may not have clear quality, safety, and labeling requirements. The lack of refined standards makes enforcement more dependent on discretionary judgment, which may reduce the stability and authority of administrative regulation.

3.3 Insufficient Whole-Formulation Risk Assessment

The core risk of compound food additives is not limited to whether each component is legal. It also concerns whether the overall formulation is safe under specific food categories, processing conditions, and consumer exposure patterns. For example, the same additive combination may have different risk profiles when used in dairy products, beverages, baked foods, or meat products.

If regulatory agencies only examine whether each ingredient is permitted, they may ignore the interaction effects^[4], cumulative exposure, and misuse risks of compound formulations. A more scientific regulatory system should evaluate the formulation as a whole, including component compatibility, technical necessity, exposure level, and vulnerable consumer groups.

Methodologically, whole-formulation safety evaluation would differ from component-by-component review in four steps. First, regulators would verify the legality and purity specifications of each component. Second, they would conduct a cumulative-exposure assessment for additives sharing the same toxicological endpoint or mode of action^[2], using dose-response modeling and, where data permit, benchmark-dose or margin-of-exposure approaches^[19]. Third, they would test potential interaction effects by applying concentration-addition or independent-action models, and by using a combination-index approach to identify possible synergy, additivity or antagonism among preservatives, antioxidants, sweeteners, colorants or stabilizers^[18]. Fourth, they would evaluate the formula under real processing and storage conditions, because heat, pH, fermentation, packaging and shelf life may change the stability or migration behavior of the compound formulation.

For enforcement, this means that a qualified review file should include the complete formula, component sources, toxicological summaries, intended food categories, expected maximum daily intake, processing conditions, vulnerable-population analysis, test methods, and post-market monitoring plan. If uncertainty remains, the regulator may require additional *in vitro* testing, targeted animal data, market-use restrictions, warning labeling, or time-limited filing subject to renewal.

3.4 Fragmented Regulatory Responsibilities

Food safety governance involves multiple actors, including market supervision departments, health authorities, standard-setting institutions, testing laboratories, industry associations, local governments, enterprises, and consumers. When responsibilities are fragmented and information sharing is insufficient, regulatory gaps are likely to occur.

In the supervision of compound additives, product registration information, inspection data, enterprise credit records, complaint reports, and administrative penalty re-

sults may be stored in different systems. Without a unified information platform and joint enforcement mechanism, illegal products may avoid timely detection.

3.5 Weak Grassroots Enforcement Capacity

Grassroots enforcement agencies are the frontline of administrative regulation. However, compound food additive cases often require professional knowledge of food chemistry, toxicology, labeling rules, administrative procedure, evidence collection, and risk assessment. If frontline officers lack technical support or professional training, it becomes difficult to identify illegal additive use accurately.

Weak enforcement capacity may lead to three consequences: first, potential violations are not detected in time; second, similar cases are handled inconsistently; third, administrative penalties may be challenged due to insufficient evidence or unclear legal basis. Therefore, enforcement capacity is a key condition for the effectiveness of administrative law.

3.6 Inadequate Legal Liability and Deterrence

The final defect is the inadequacy of liability mechanisms^[12]. If illegal use of compound additives brings considerable economic benefits while administrative penalties remain low, enterprises may have incentives to take risks. In addition, if liability clauses do not clearly distinguish negligent violations, intentional illegal addition, false labeling, excessive use, and serious health hazards, administrative punishment may lack precision.

An effective liability system should be both deterrent and proportionate. It should punish intentional and harmful conduct strictly while allowing corrective measures for minor procedural defects.

3.7 Empirical Illustrations of Regulatory Gaps

Empirical materials illustrate how the above defects appear in practice. In sampling-inspection cases^[10], finished foods may be reported as non-compliant because preservatives such as benzoic acid, sorbic acid or dehydroacetic acid, sweeteners, colorants or bleaching agents exceed limits or are used outside permitted categories. Yet the source of the violation may be an upstream compound additive premix rather than the final producer deliberately adding a single illegal substance. If the premix supplier, formula ratio, carrier and batch records are not traceable, the penalty decision may identify the non-compliant finished product but fail to reconstruct the full causal chain.

Inspection and research data on compound food additives further show an evidentiary gap. Component-content inspection studies emphasize that compound additives require simultaneous or broad-spectrum detection of multiple components^[14], while tracking evaluation of GB 26687-2011^[9] shows that general rules need clearer implementation details for labels, component disclosure and regulatory verification^[7]. Consumer-complaint and online-public-opinion studies^[13] also indicate that many disputes

are caused by unclear labeling, exaggerated technological necessity, or consumers being unable to distinguish lawful additives from unlawful excessive use. These materials support the conclusion that the regulatory gap is empirical as well as theoretical.

4 Analytical Framework: From Regulatory Gap to Governance Optimization

To present the logic of this study more clearly, as shown in Table 1, the paper constructs a four-dimensional analytical framework: regulatory object, regulatory basis, regulatory process, and regulatory effect. The regulatory object concerns whether compound additives are clearly defined and classified. The regulatory basis concerns whether laws and standards provide sufficient normative support. The regulatory process concerns whether licensing, inspection, enforcement, information disclosure, and cooperation are effectively implemented. The regulatory effect concerns whether the system can prevent risks, protect consumers, and maintain market order.

Table 1. Main regulatory defects and optimization directions

Dimension	Main defect	Governance risk	Optimization direction
Legal definition	Unclear boundary between compound additives, food ingredients and processing aids	Inconsistent classification and enforcement	Clarify legal attributes and classification rules
Standard system	Lagging and insufficiently refined technical standards	Difficulty in judging legality and safety	Build dynamic revision and technical evaluation mechanisms
Risk assessment	Focus on single components rather than whole formulation	Interaction and cumulative risks may be ignored	Establish whole-composition safety assessment
Administrative enforcement	Weak technical support and uneven law application	Low detection rate and inconsistent penalties	Improve training, testing support and case guidance
Collaborative supervision	Fragmented responsibilities and poor information sharing	Regulatory blind spots and delayed response	Build joint enforcement and data-sharing platform
Legal liability	Unclear responsibility and limited deterrence	Low illegal cost and repeated violations	Refine penalty levels and strengthen credit sanctions

5 Optimization Path of Administrative Law Regulation

5.1 Clarifying the Legal Attributes of Compound Food Additives

The optimization of administrative law regulation should begin with the clarification of the regulatory object. A precise legal definition should identify compound food additives as formulations composed of two or more food additives or auxiliary substances for specific technological purposes. At the same time, legal rules should distinguish them from food ingredients, flavorings, processing aids, and food-related products.

A classification system may be established according to function, risk level, component complexity, and application scenario. For low-risk and commonly used formulations, simplified filing procedures may be adopted. For high-risk or innovative formulations, stricter pre-market review and safety assessment should be required. This classification-based approach can improve regulatory efficiency while ensuring safety.

The proposed classification should be written into a regulation or departmental rule rather than remaining a policy slogan. A possible rule is: low-risk compound additives with mature components, stable formulas and clear GB 2760 use conditions may be subject to simplified filing; medium-risk products involving multiple functional components, broad downstream use or repeated sampling concerns should undergo technical review; and high-risk or innovative formulas involving vulnerable populations, new carriers, new processing effects, high cumulative exposure or uncertain interactions should require pre-market safety assessment and approval.

5.2 Establishing Whole-Formulation Safety Assessment

Traditional regulation based on single-component compliance should be upgraded to whole-formulation risk assessment. Administrative authorities should evaluate not only whether each component is permitted but also whether the combination is scientifically reasonable and safe in actual use.

The safety assessment should include seven elements: component legality, formula necessity, compatibility between components, maximum use level, applicable food categories, consumer exposure assessment, and labeling accuracy. For formulations intended for children, elderly consumers, or people with special dietary needs, stricter assessment should be adopted.

Enterprises should submit formula composition, technical necessity explanation, safety evidence, test reports, and labeling materials. Regulators should organize expert review when necessary and require supplementary information if scientific uncertainty exists.

A practical review template should distinguish three layers of evidence. The first layer is component compliance evidence, including GB 2760 permission, quality specification, impurity limits and supplier qualification. The second layer is mixture evidence, including compatibility tests, dose-response or benchmark-dose information for shared toxicological endpoints, combination-index or equivalent interaction analy-

sis where feasible, and stability data under processing conditions. The third layer is exposure evidence, including intended food categories, maximum use level in the compound formulation, likely intake by ordinary consumers, and conservative scenarios for children, the elderly and high-frequency consumers.

5.3 Improving the Dynamic Standard Revision Mechanism

The standard system should be more dynamic and responsive. A regular review mechanism can be established to evaluate whether existing standards still match industrial development and risk changes. When new compound formulations are widely used in the market, regulatory departments should accelerate standard research and revision.

Standard revision should strengthen the connection between general food additive standards and specific compound additive rules. Detailed technical provisions should be developed for high-frequency categories, such as dairy products, beverages, meat products, bakery products, and convenience foods. This will reduce uncertainty for both enterprises and regulators.

In addition, standard-setting procedures should improve transparency. Industry associations, scientific institutions, consumer organizations, and testing laboratories can participate in consultation, while final standards should clearly state technical basis and risk considerations.

5.4 Strengthening Administrative Licensing and Filing Supervision

Administrative licensing and filing are important tools for pre-market risk control. For compound food additives with mature formulas and low risk, a filing system may be sufficient. For innovative, complex, or high-risk products, stricter licensing should be adopted.

The licensing process should emphasize scientific review, procedural transparency, and traceability. Regulatory agencies should check whether the applicant has provided accurate formula information, safety evidence, production process data, quality control measures, and labeling materials. False declaration or concealment of formula information should be subject to strict liability.

To balance innovation and risk prevention, the licensing system should adopt a tiered pathway. Tier I filing would apply to low-risk formulas composed only of well-established additives used within existing GB 2760 limits and in narrow food categories. Tier II technical review would apply to formulas with several active functional components, wider downstream application, or components close to maximum exposure limits. Tier III pre-market approval would apply to formulas used for infants, children, the elderly or special dietary foods, formulas involving new carriers or uncertain interactions, and formulas repeatedly associated with complaints, sampling non-compliance or cross-regional enforcement cases. This structure preserves flexibility for routine innovation while reserving intensive administrative review for riskier products.

5.5 Building a Collaborative Supervision Mechanism

Compound food additive regulation cannot rely on a single department. A collaborative supervision mechanism should integrate market supervision, health administration, standard-setting institutions, testing organizations, customs, local governments, industry associations, and consumer protection organizations.

A unified digital supervision platform should be built to integrate enterprise information, product filing data, inspection results, administrative penalties, complaint reports, recall information, and risk warnings. Through data sharing, regulators can identify abnormal market behavior, repeated violations, and regional risk trends more quickly.

Digital traceability must also be feasible for small and medium-sized enterprises. Therefore, the system should begin with mandatory electronic ledgers, standardized QR codes and batch-level formula codes, rather than immediately requiring expensive customized platforms. The minimum data set should include supplier identity, formula number, component list, component proportion range, applicable food categories, maximum recommended use level, test report number, production batch, sales destination and recall contact. These fields should be interoperable with existing market-supervision, inspection and enterprise-credit platforms through unified data standards and application programming interfaces.

Blockchain technology may be useful for high-risk, cross-regional or export-oriented compound additives because it can strengthen tamper resistance and multi-party verification. However, it should not be imposed universally. For most low-risk products, a government-provided or industry-association shared traceability module would be more proportionate. Subsidies, model templates and phased compliance periods can reduce compliance costs for small firms while still allowing regulators to reconstruct the supply chain when sampling failures or consumer complaints occur.

Joint enforcement should be normalized. For cross-regional production and sales, local authorities should establish evidence-sharing and case-transfer mechanisms to avoid repeated inspection, delayed punishment, or jurisdiction disputes.

5.6 Enhancing Grassroots Enforcement Capacity

Grassroots law enforcement capacity directly determines the practical effect of administrative law. Regulatory departments should strengthen professional training for frontline officers, including food additive standards, sampling procedures, administrative evidence rules, labeling review, and case-handling norms.

Technical support should also be improved. Local governments may establish rapid testing laboratories, expert consultation systems, and online standard interpretation services. In complex cases, grassroots officers should be able to obtain timely support from provincial or national technical institutions.

Case guidance is another important tool. By publishing typical cases of illegal compound additive use, administrative agencies can unify enforcement standards and improve legal predictability.

5.7 Improving Information Disclosure and Public Participation

Information disclosure is a key method for enhancing regulatory transparency and social supervision. Administrative agencies should disclose food safety standards, inspection results, illegal cases, enterprise credit records, and risk warnings in a timely and understandable manner.

Enterprises should provide clear and truthful labeling information. Consumers should be able to understand the function, scope of use, and safety meaning of compound additives. Public reporting channels should be improved, and verified reports should be handled promptly. Public participation can supplement administrative supervision and increase market pressure on illegal enterprises.

5.8 Refining Legal Liability and Accountability Mechanisms

Legal liability should be refined according to the nature and harm of violations. Minor labeling defects, negligent non-compliance, false declaration, excessive use, unauthorized addition, and serious health-endangering conduct should be treated differently.

For intentional violations and repeated illegal conduct, administrative penalties should include higher fines, confiscation of illegal income, suspension of production, revocation of licenses, credit punishment, public exposure, and transfer to criminal authorities when necessary. For administrative agencies and personnel who fail to perform duties, accountability mechanisms should also be strengthened to prevent regulatory negligence.

6 Proposed Governance Model

Based on the above analysis, as shown in Table 2, this paper proposes a regulatory optimization model (Table 2) composed of four layers: legal norm layer, technical standard layer, administrative process layer, and social governance layer. These layers should interact with each other to form a closed-loop governance system.

Table 2. Administrative law optimization model for compound food additive regulation

Layer	Core task	Expected effect
Legal norm layer	Clarify definition, classification, enterprise obligations and legal liability	Improve legal certainty and accountability
Technical standard layer	Update standards, refine technical indicators and establish formula assessment	Improve scientific basis of regulation
Administrative process layer	Optimize licensing, inspection, enforcement, data sharing and case transfer	Improve regulatory efficiency and consistency
Social governance layer	Strengthen disclosure, public reporting, industry self-discipline and consumer education	Form multi-actor food safety governance

7 Discussion

The discussion above suggests that compound food additives place pressure on a regulatory model organized around fixed categories and periodic standards^[15]. A premix may be lawful in its separate components yet still become problematic once component ratios, carriers, target foods, processing conditions, and consumer exposure are considered together. For this reason, the administrative-law response should not rely only on catalog review or after-the-fact inspection; it needs a risk-oriented mechanism that connects technical assessment with licensing, filing, traceability, and liability.

Such a mechanism has several implications. Risk assessment and testing evidence^[11] should form the basis of licensing and enforcement decisions. Regulatory intervention should occur before uncertain formulas enter wide circulation, rather than only after an incident has been confirmed. Information held by market-supervision authorities, health departments, laboratories and local governments should be linked so that formula records, inspection results and penalty information can be compared. Standards should also be reviewed regularly when new carriers, processing methods or usage scenarios become common in the market.

This argument is not an appeal for uniformly stricter control. If every formula adjustment is treated as a high-risk matter, compliance costs will rise and ordinary technological improvement may be discouraged. Conversely, if all compound additives are handled through a light filing procedure, enterprises may use premixes to obscure excessive or out-of-scope additive use. A workable regime should therefore separate routine, transparent formulas from products involving high exposure, vulnerable groups, novel carriers or uncertain interactions.

The practical balance lies in a graded switch between administrative convenience and precautionary review. Simplified filing is appropriate where the formula is clear, components are mature, use levels fall within GB 2760 limits and batch-level traceability is available. For products with incomplete formula disclosure, repeated sampling problems, cross-regional circulation or unresolved interaction risks, technical review or pre-market approval should be triggered. This differentiated approach allows administrative law to support industrial innovation while still preserving the preventive function of food safety governance.

8 Conclusion

Compound food additives are important technical products in the modern food industry, but their composite formulas create regulatory risks that cannot be fully addressed by single-component compliance review. This paper has revised the analysis by grounding the argument in practical regulatory materials, including sampling-inspection non-compliance involving excessive or out-of-scope additive use^[10], component-content inspection difficulties^[7], tracking evaluation of GB 26687-2011^[9], and consumer complaints or online public opinion concerning opaque labeling and technological necessity^[13]. These examples show that the administrative-law gap is not merely theoretical: regulators may know that a finished food is non-compliant while

still being unable to reconstruct the upstream compound formula, component ratio, carrier, batch flow and responsibility chain.

The definitional problem should also be stated more precisely. Existing law^[17] and standards provide general rules for food additives and technical rules for compound additives, but they do not sufficiently connect the definition of a compound formulation with differentiated licensing, evidence, traceability and liability consequences. A legislative or regulatory amendment should define compound food additives as formulations made from two or more additives, or additives with necessary carriers or auxiliary substances, for a specific technological purpose in specified food categories, and should require review of formula necessity, component proportion, interaction risk, labeling accuracy and exposure under intended use conditions.

Finally, whole-formulation safety evaluation should be operationalized through cumulative-exposure assessment, dose-response modeling, benchmark-dose or margin-of-exposure analysis where data are available^[19], and interaction assessment such as concentration addition, independent action or combination-index methods. A tiered regulatory framework should distinguish low-risk products subject to simplified filing, medium-risk products subject to technical review, and high-risk or innovative products subject to pre-market approval. Digital traceability should be implemented proportionately through electronic ledgers, standardized batch codes and interoperable data fields, with blockchain reserved for high-risk or cross-regional products. In this way, administrative law can balance innovation, feasibility for small and medium-sized enterprises, risk prevention and consumer protection.

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