CURRENT PERSPECTIVES ON THE DEVELOPMENT OF FOOD PACKAGING IN LOCAL AGRI-FOOD SYSTEMS: AN INTEGRATIVE REVIEW

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ABSTRACT

Objective: This study aims to consolidate a theoretical framework on the development of food packaging within the context of family farming and local agri-food systems, focusing on a critical analysis of the existing literature.

Theoretical Framework: The study addresses active and intelligent packaging, new bioactive materials, and biopolymers, focusing on food quality and safety. It also explores strategic design, environmental impact, food waste, emerging trends, consumer behavior, circular economy, and the role of packaging in territorial sustainability and local food entrepreneurship.

Method: The methodology consisted of applied, exploratory, and descriptive research, using longitudinal and cross-sectional studies. An integrative review was conducted, initially including 755 articles indexed in databases such as "Periódicos CAPES", "Web of Science", "Scopus", and "Science Direct", of which 47 texts were selected based on the "PRISMA 2020" protocol. The analysis of the selected articles was supported by the "Parsifal" tool, generative artificial intelligence solutions "SciSpace-Copilot" and "ChatGPT-4", and the "VOSviewer" software for graphical-bibliometric analyses.

Results and Discussion: The importance of technological innovations in packaging was identified, highlighting sustainable practices and the challenges to increase the competitiveness and sustainability of agri-food products.

Research Implications: The study emphasizes the need for innovations in packaging design to enhance competitiveness, as well as the importance of interdisciplinary approaches that integrate technical, environmental, and consumer aspects.

Originality/Value: It contributes to the literature by mapping technological innovations in packaging and their applications in local agri-food systems, providing insights into the integration between technology, sustainability, and food systems.

Keywords: Systematic Review, Food Packaging, Packaging Design, Local Foods, Family Farming.

PERSPECTIVAS ATUAIS NO DESENVOLVIMENTO DE EMBALAGENS PARA ALIMENTOS EM SISTEMAS AGROALIMENTARES LOCAIS: UMA REVISÃO INTEGRATIVA

RESUMO

Objetivo: Este estudo visa consolidar um quadro teórico sobre o desenvolvimento de embalagens alimentícias no contexto da agricultura familiar e sistemas agroalimentares locais, enfocando uma análise crítica da literatura existente.

Referencial Teórico: O estudo aborda embalagens ativas e inteligentes, novos materiais bioativos e biopolímeros, focando na qualidade e segurança alimentar. Explora-se também o design estratégico, impacto ambiental, desperdício de alimentos, tendências emergentes, comportamento do consumidor, economia circular, e o papel das embalagens na sustentabilidade territorial e empreendedorismo alimentar local.

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Resultados e Discussão: Identificou-se a importancia de inovações tecnológicas em embalagens, destacando-se as práticas sustentáveis e os desafios para aumentar a competitividade e sustentabilidad de los productos agroalimentarios.

Implicaciones da Pesquisa: O estudio sublinha a necessidade de inovações em design de embalagens para melhorar a competitividade, além da importancia de abordagens interdisciplinares que integrem aspectos técnicos, ambientais e do consumidor.

Originalidade/Valor: Contribui para a literatura ao mapear inovações tecnológicas en embalagens e suas aplicaciones en sistemas agroalimentares locais, proporcionando insights sobre a integração entre tecnologia, sustentabilidad e sistemas alimentares.


PERSPECTIVAS ACTUALES EN EL DESARROLLO DE ENVESAS PARA ALIMENTOS EN SISTEMAS AGROALIMENTARIOS LOCALES: UNA REVISIÓN INTEGRATIVA

RESUMEN

Objetivo: Este estudio tiene como objetivo consolidar un marco teórico sobre el desarrollo de envases alimenticios en el contexto de la agricultura familiar y sistemas agroalimentarios locales, enfocándose en un análisis crítico de la literatura existente.

Marco Teórico: El estudio aborda envases activos e inteligentes, nuevos materiales bioactivos y biopolímeros, centrándose en la calidad y seguridad alimentaria. También se explora el diseño estratégico, impacto ambiental, desperdicio de alimentos, tendencias emergentes, comportamiento del consumidor, economía circular y el papel de los envases en la sostenibilidad territorial y el emprendimiento alimentario local.


Resultados y Discusión: Se identificó la importancia de las innovaciones tecnológicas en los envases, destacando las prácticas sostenibles y los desafíos para aumentar la competitividad y sostenibilidad de los productos agroalimentarios.

Implicaciones de la investigación: El estudio subraya la necesidad de innovaciones en el diseño de envases para mejorar la competitividad, además de la importancia de enfoques interdisciplinarios que integren aspectos técnicos, ambientales y del consumidor.

Originalidad/Valor: Contribuye a la literatura al mapear innovaciones tecnológicas en envases y sus aplicaciones en sistemas agroalimentarios locales, proporcionando perspectivas sobre la integración entre tecnología, sostenibilidad y sistemas alimentarios.

Palabras clave: Revisión Sistemática, Envase de Alimentos, Diseño de Envases, Alimentos Locales, Agricultura Familiar.
1 INTRODUCTION

Packaging plays an essential role in the safety, promotion and regulatory compliance of food products. They not only pack and protect, but also facilitate the transport, display and sale of food, ensuring that it reaches the consumer under ideal conditions (Huerta et al., 2022; Mestre et al., 2017). They are often also the consumer's first point of visual and tactile contact with the product, playing an essential role in attracting attention and in forming positive perceptions about the quality and values associated with a brand (Le Roux et al., 2017; Sánchez-Safont et al., 2018; Schiffman & Wisenblit, 2015).

In parallel, the Agri-Food Systems (SAGs) constitute a complex integration of productive chains, from the production of raw material to the management of waste, emphasizing the interdependence between their components (Batista & Araújo, 2020). Within this spectrum, Local Agri-Food Systems (Local SAGs) emerge as promising alternatives for rural development, promoting proximity and trust between producers and consumers, enhancing local production, and strengthening rural communities, while preserving traditional farming practices and contributing to food and nutrition security (McMichael, 2013; Enthoven & Van den Broeck, 2021; Kwil et al., 2020).

In contrast, conventional-global SAG models focus on large-scale production and standardization, aiming to maximize profits (Kwil et al., 2020; Valente; Ribeiro & Joele, 2023), bring substantial environmental and social impacts, with "hidden costs" of up to $12.7 trillion related to gas emissions, excessive water use, changes in land use, and health and social problems arising from inadequate diets (FAO, 2023). This highlights the urgency of promoting more sustainable agri-food systems.

Thus, Martinazzo et al. (2020), in the general context of these systems, clarify that packaging not only increases food safety and indicates the origin of products, but also serves as differentials, adding value and facilitating entry into new markets. According to Delfino (2013) and Dörnyei et al. (2023), in environments that demand compliance with stringent regulations and transparency, packaging is vital to gaining consumer confidence. In addition, they play an increasing role in reducing waste and environmental impacts, highlighting the need for more sustainable solutions (Begley et al., 2005; Herbes; Beuthner & Ramme, 2018; Testa et al.,...
This time, a previous literature review revealed a significant gap: the lack of studies focused on food packaging design in local SAGs, pointing to a theoretical and methodological deficiency in this field (Valente & Ribeiro, 2023). This focus is based on recognition of the place of production, producers and production methods (Darolt et al., 2016), exploring how these factors can distinguish and add value to products. Considering market trends and consumers' preference for local, guaranteed, safe and healthy foods, this perspective can potentially increase the income of those involved in the system (Anjos & Caldas, 2017; Souza et al., 2020; Valente; Ribeiro & Joele, 2023).

This study therefore proposes to address interdisciplinary topics "Packaging System" and "Local Agro-Food Systems" from the perspective of "Food Engineering, Science and Technology". The aim is to answer the following research questions: (1) What is the current state of the scientific literature on the development of food packaging, especially in the context of family farming and local SAGs? (2) What are the essential criteria for promoting the differentiation, valorization and sustainability of these food products?

The methodology of this study was applied and exploratory-descriptive, adopting a mixed approach. An Integrative Review (IR) of the literature was used based on the PRISMA 2020 protocol criteria, employing generative AI tools and graphical-bibliometric analysis to examine a broad set of data. The research analyzed 755 articles from the CAPES Periodicals, Web of Science, Scopus and Science Direct databases, of which 47 studies were thoroughly evaluated, identifying key terminologies, gaps and emerging trends.

The results highlighted the complexity of food packaging systems and the peculiarities of local SAGs, revealing essential aspects for their development and promoting a synergy between current technological advances and managerial practices. Thus, the contribution of this research is not limited to filling a gap in existing knowledge, but also aims to enhance the value of agri-food products, while promoting sustainable rural development.

2 METHODOLOGY

2.1 DELINEMANET CHARACTERIZATION AND RESEARCH STRATEGY

Applied, exploratory and descriptive research was conducted, focusing on longitudinal and cross-sectional studies to broaden the understanding of the area investigated. The integrative review was chosen, one of the 14 categories described by Grant and Booth (2009),
due to its ability to synthesize experimental and theoretical studies, providing a comprehensive and critical analysis of existing literature (Cooper, 1982; Ganong, 1987). This methodology facilitated the identification of gaps and the formulation of new models, integrating different methodological approaches flexibly and rigorously, despite the challenges related to accuracy and potential biases in the data evaluation (Hopia et al., 2016).

To circumvent these challenges and ensure a selection of literature based on relevance, robustness, rigor, transparency and replicability, data analysis and generative artificial intelligence tools were employed in specific phases of the study, aiming to optimize planning and enrich research with reliable new perspectives (Dwivedi et al., 2023; Karakose, 2023).

The integrative review was planned and executed following the four steps suggested by Whittermore and Knafl (2005), Hopia et al. (2016) and Cooper et al. (2021): (1) formulation of the search question; (2) definition of search eligibility criteria; (3) extraction and filtering of data, including quality assessment; (4) synthesis and presentation of results. In addition, elements of the "PRISMA 2020" protocol (Page et al., 2021a; 2021b) were used, which improved IR with a detailed search strategy, clear data selection and collection processes, and rigorous risk assessment of bias, ensuring a robust critical analysis of included studies and derived results.

2.2 DATA COLLECTION AND ANALYSIS DETAILS

The research questions (Q1 and Q2) were structured in line with the objectives of the study: (Q1) - How does current scientific literature characterize food packaging design, focusing on concepts, methods, gaps and trends, particularly in the context of family farming and local agri-food systems? (Q2) - What criteria are essential for the packaging design of food products from family farming in local SAGs, aiming at their differentiation, valorization and sustainability?

Systematic research was conducted in the databases CAPES Periodicals, Web of Science (covering all six databases, including Web of Science Core Collection, Derwent Innovation Index, KCI-Korean Journal Database, Preprint Citation Index, ProQuest and SciELO Citation Index), Scopus and Science Direct. Additional filters focused on quality, limiting selection to articles published in peer-reviewed journals. The research period was from 2013 to 2023 to ensure the relevance and timeliness of the studies. The research was conducted in English and Portuguese. The search string formulated was: ("Food packaging system" OR "Development of food packaging" OR "Family farming" OR "Local agri-food systems") AND
The summary of the results of the integrative review was carried out in two main phases. The first stage consisted in the elaboration of a panorama from 661 articles, followed by the detailed analysis of the 47 selected studies, using artificial intelligence tools like "Scispace Copilot" and "ChatGPT-4" for advanced data analysis. "Scispace Copilot" facilitated initial visualization and understanding of the texts, while "ChatGPT-4" was employed to categorize and hierarchize information through tokenization and semantic analysis, applying clustering techniques to group similar studies. Additionally, the software "VOSviewer" was used to perform graphical-bibliometric visualization, mapping the connections between studies and highlighting the main themes and concepts.

3 RESULTS AND DISCUSSION

3.1 OVERVIEW OF SELECTED LITERATURE IN THE INTEGRATIVE REVIEW

The results of the analyzes were synthesized using the flow chart model "PRISMA 2020" by Page et al. (2021a; 2021b), which provided an overall visual representation of the selection process and analysis of the IR studies, highlighting the steps followed and the criteria adopted (Figure 01).

Figure 01
General visual representation of the selection process and analysis of IR studies.
As food packaging technologies and practices evolve rapidly, it is imperative to keep up-to-date on emerging trends. This section offered an overview of contemporary literature, starting with an examination of the 661 pre-selected scientific papers during the integrative review. Table 01 summarizes the frequency analysis of the 2825 identified keywords, facilitating the categorization of the most recurrent terms and providing a clear overview of the main thematic trends highlighted in the literature.

Table 1
Frequency analysis of the 10 most identified keywords.

<table>
<thead>
<tr>
<th>Keywords</th>
<th>Number of incidents</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food packaging</td>
<td>278</td>
<td>1.</td>
</tr>
<tr>
<td>Food products</td>
<td>84</td>
<td>2.</td>
</tr>
<tr>
<td>Food</td>
<td>74</td>
<td>3.</td>
</tr>
<tr>
<td>Packaging materials</td>
<td>67</td>
<td>4.</td>
</tr>
<tr>
<td>Biopolymers</td>
<td>53</td>
<td>5.</td>
</tr>
<tr>
<td>Food safety</td>
<td>52</td>
<td>6.</td>
</tr>
<tr>
<td>Food quality</td>
<td>51</td>
<td>7.</td>
</tr>
<tr>
<td>Sustainability</td>
<td>43</td>
<td>8.</td>
</tr>
<tr>
<td>Antimicrobial agents</td>
<td>41</td>
<td>9.</td>
</tr>
<tr>
<td>Biodegradability</td>
<td>33</td>
<td>10.</td>
</tr>
</tbody>
</table>

"Food packaging" emerged as the most frequently used term reflecting the central importance of packaging in the context of research. Other terms such as "Food products" and "Food" reiterate the focus on the food area. The terms "Biopolymers" and "Biodegradability" suggest a trend towards sustainable solutions, while "Food safety" and "Antimicrobial agents" underline the importance of food safety. In addition, "Packaging materials", "Sustainability", and "Food quality" emphasize the focus on food production, conservation and quality, as well as environmentally sustainable practices. These keywords together reflect current and future trends at the intersection of technology, sustainability and safety in the food sector. Based on these observations, interdisciplinary domains and emerging trends were outlined, thus defining the research scenario in the area, as presented in Figure 02.

Figure 02
Interdisciplinary areas and thematic trends identified in the integrative review

<table>
<thead>
<tr>
<th>Interdisciplinary Areas</th>
<th>Trends</th>
<th>Qualitative Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Packaging Technology</td>
<td>Food Conservation; Food Safety; Non-Thermal Technologies; Food Storage; Food Processing; Use of colorimetric sensors; pH indicators; Freshness labels; Active packaging; Shelf life; Smart packaging.</td>
<td>Topics highlight innovations in packaging technology to ensure food quality and safety, with emphasis on smart packaging and monitoring.</td>
</tr>
</tbody>
</table>
Materials Science | Nanomaterials in packaging; Polymers; Bioplastics; Nanocomposites; Biodegradable materials; Nanocellulose-based packaging; Alginites; Nanofibers; Packaging; Nanoscale packaging; Nanostructure; Biosensors; Nanocompounds; Nanotechnology; Nanomaterials; Nanoparticles; Microcrystalline cellulose; Biopolymer; Biodegradable films; Plant-based materials. | The emphasis is on innovations and developments in nanotechnology and sustainable materials, with a focus on packaging applications.

Sustainability and Environment | Circular economy; Life cycle assessment; Environmental impact; Biodegradability; Sustainable production; By-product reuse; Eco-packaging; Sustainability; Waste recovery; Green technologies; Sustainable industry; Ecodesign; Global warming; Renewable energy; Sustainable packaging; Biodegradable | Interdisciplinarity is evident, with a focus on sustainable practices along the productive chain and innovations in sustainability.

Economics and Management | Consumer behavior; Supply chain; Economic viability; Cost-benefit analysis; Marketing; Incentive policies; Sustainability policies; Consumer perceptions; Food systems; Agro-food industry; Agribusiness | The scope covers economic, managerial, and governance aspects that influence the adoption of innovations and technologies in the agri-food sector.

Microbiology and Food Safety | Food contamination; Antimicrobials; Bioactive; Polyphenols; Essential oils; Cytotoxicity; Microorganisms; Food-borne pathogens; Natural antimicrobials; Food quality; Toxicity; Biosafety concerns; Safety evaluation | The importance of this field for food safety is seen as undeniable, with a focus on mitigating contamination and introducing new bioactive compounds.

Information Technology | Sensors and biosensors; Traceability; Neural networks; Intelligent evaluation; Real-time monitoring | The application of information technologies is central to improving traceability, food quality and trend forecasting.

Environmental Engineering and Sustainability | Environmental impact; Waste management; Energy efficiency; Recycling and reuse | It complements the field of ‘Sustainability and Environment’, but with a more technical approach, focusing on waste management, environmental impacts and recycling practices.

Public Health and Nutrition | Impact of COVID-19 on food safety; Nutritional value; Biosecurity strategies for food; Diets and health; Impact of food additives; Processed foods; Functional foods; Organic foods | It focuses on the intersection between public health and nutrition, highlighting the influence of the COVID-19 pandemic and the importance of safe and nutritious food.

Public Policies and Social-Territorial Development | Family farming; Public procurement policies; Culinary tourism; Cultural heritage; Food security in developing regions; Social inequality; Food education; Self-consumption production; Consumer perceptions | It addresses political and social dimensions, including public policy, social development and food security strategies.

This compilation reinforces the complexity and diversity of current literature, which addresses topics ranging from technological advances in packaging and nanotechnology to aspects related to public health and policy. This shows that the research of food packaging stands out for its interdisciplinarity, encompassing very diverse fields. The relevance of this approach is corroborated by the co-occurrence analysis performed with the "VOSViewer" tool,
playing a key role in understanding the interrelations between the different terms and emerging themes in the literature.

43 terms distributed in four main clusters have been identified: *food packaging application*, sustainability (*sustainability*), agricultural production and consumption and waste. Figure 03 illustrates these associations, with the frequency of each term represented by the size of each node and the thickness of the lines and the proximity of the terms indicating the degree of correlation between them, demonstrating stronger or weaker associations between the themes.

**Figure 03**

*Segmentation analysis present in review searches*

The analysis of the clusters reveals the segmentation present in the researches. For example, while one cluster highlights technical terms, emphasizing recent technologies and innovations in materials, another focuses on productive, legal, and consumer perceptions. One notable point is the lack of significant overlap and the gap between the clusters ‘Food packaging application’ and ‘Agricultural production and consumption’. This perception suggests that although there are significant innovations in packaging functionalities, there is a gap in the literature regarding the integration of these innovations into the agricultural context (Figure 04).
In time, this overview of IR provides a comprehensive understanding of current trends in research in the area. The diversity and depth of the literature highlight the imperative of interdisciplinary approaches to overcome emerging challenges in the field, as well as the insights coming from it provide the foundation to direct future studies and practical actions in this field of knowledge.

In addition, the correlation analysis highlights the need for more integrated research into food packaging and family farming/agri-food systems, encouraging the combination and connection of technical perspectives with those of the consumer, environment and the wider context.

3.2 DETAILED ANALYSIS OF THE SELECTED ARTICLES: DISCOVERIES, APPROACHES AND IMPLICATIONS

Next, the results are put to the test by way of a critical synthesis of the selected articles. The statistics related to the extracted and selected texts, per year of publication, can be appreciated in Figure 05.
Figure 05

*Number of publications selected for this IR, covering the period 2013 to 2023*

Therefore, Figure 06 presents the synthesis of 47 articles analyzed, coming from 36 different periodicals, ordered in alphabetical order of their titles. Among the topics covered, the diversity and interdisciplinarity of the field is again highlighted, highlighting several areas of interest and key trends.

Figure 06

*State of the art with main themes identified in the literature*

<table>
<thead>
<tr>
<th>Interdisciplinary areas</th>
<th>Summary of the thematic classification</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food engineering, science and technology</td>
<td>Food quality and safety</td>
<td>Gavriil <em>et al.</em> (2018); Sofi <em>et al.</em> (2018); Al-Tayyar <em>et al.</em> (2020); Ahmed <em>et al.</em> (2022); Wahbeh <em>et al.</em> (2022).</td>
</tr>
<tr>
<td></td>
<td>Packaging based on new bioactive materials, biopolymers and nanotechnologies</td>
<td>Janjarasskul and Suppakul (2018); Mei and Wang (2020); Perera <em>et al.</em> (2022); Alp-Erbay (2022); Zhang <em>et al.</em> (2022) Zhou <em>et al.</em> (2023).</td>
</tr>
<tr>
<td></td>
<td>Active and intelligent packaging</td>
<td>Mustafa and Andreescu (2018); Drago <em>et al.</em> (2020); Dodero <em>et al.</em> (2021); Azeredo and Correa (2021); Rodrigues <em>et al.</em> (2021) Singh <em>et al.</em> (2021); Osmólska <em>et al.</em> (2022); Dirpan <em>et al.</em> (2023); Poli <em>et al.</em> (2023); Alves <em>et al.</em> (2023).</td>
</tr>
<tr>
<td></td>
<td>Strategic design of food packaging</td>
<td>Huerta <em>et al.</em> (2022).</td>
</tr>
<tr>
<td>Sustainability and the environment</td>
<td>Environmental impact, food waste and sustainable packaging</td>
<td>Han <em>et al.</em> (2018) Jiang <em>et al.</em> (2021); Chauhan <em>et al.</em> (2021); Korte <em>et al.</em> (2021); Mendes and Pedersen (2021); Kan and Miller (2022); Dörnyei <em>et al.</em> (2023); Jagoda <em>et al.</em> (2023).</td>
</tr>
</tbody>
</table>
According to Figure 06, the predominant technological innovations include antimicrobial, active, intelligent and bionanocomposite packaging, notable for its role in preserving and improving food quality and ensuring food safety. Technologies such as nanotechnology and biosensors have been highlighted as essential advances, improving the functionality of packaging and reducing waste, highlighting the complexity and potential for innovation in the sector.

Sustainability and food security have emerged as central themes, with a particular focus on biodegradable and recyclable packaging, highlighting the importance of sustainable practices aligned with circular economy principles. In this context, smart and active packaging has been recognized as differentiators in the food supply chain, underlining the need to use renewable resources and balance sustainability with practical functionality, promoting an integrated and holistic approach that considers environmental, social and economic impacts in creating responsible packaging solutions.

The studies also addressed the impacts of the COVID-19 pandemic on agriculture and food security, especially in developing countries, and consumption trends related to sustainable and biodiversity-friendly products. Regulatory and operational aspects, such as food safety legislation, food loss and waste in the supply chains, and chemical safety in recycling, were also examined. Packaging design and strategies have been analyzed, proposing new approaches to sustainable packaging design that integrate traditional practices and technological innovations, adapted to the specificities of local agro-food systems.

In addition, Figure 06 presents a network diagram that highlights the correlations between the main terms and themes of the studies included in the integrative review, illustrating the interactions and relationships between the concepts in the context of the researches analyzed.
Figure 07

*Representation of the segmentation of the studies selected for the RI portfolio*

Figure 06 provides a visual representation of the most frequent terms in research correlation analysis, highlighting new clustering and association between the main topics: "Food packaging", "Food systems", "Food production", "Food product (food product)" and "Food legislation and food security". In this detailing, "food systems" appear centrally in the correlations, with a notable distinction and separation between studies focused on production, legislation and food safety and those centered on food packaging and their implications.

In short, the observation of the above table highlights the presence of several disciplinary fields, again highlighting the complexity and extent of the associated challenges and progress in several areas of knowledge. Next, each of these topics will be addressed objectively, allowing a discussion of the relevant contributions to the findings, approaches, and implications for the goals of this research.

4 FINAL CONSIDERATIONS

This study critically analyzed the development of food packaging in local agri-food systems, highlighting the importance of a solid theoretical basis for addressing this topic. The results elucidated the complexity of packaging systems and the particularities of SAGs, highlighting the synergies between technological advances and management practices that drive sustainable rural development.

The integrative review highlighted the importance of an interdisciplinary approach, integrating knowledge of food engineering, packaging design, sustainability and economics. The emphasis on innovative materials and critical issues such as sensoriality, identity and ethics in food consumption reinforces the need for such integration. In addition, innovation in the
development of active and intelligent packaging, and the use of nanotechnology to create new and biodegradable materials, are essential to improve food conservation, reduce waste and minimize environmental impacts, highlighting the relevance of this study in a society that increasingly values quality and food awareness.

The analysis further emphasized the challenges and opportunities of local SAGs, such as maintaining food quality and safety and meeting the demands for sustainable and authentic products. The critical review stressed the importance of understanding these systems within a comprehensive supply chain, ranging from raw material origin to post-consumption, emphasizing food security and quality control at each stage, as well as sustainable practices throughout the production and consumption cycle.

The results of the research confirmed the hypotheses raised and achieved the proposed objectives, providing significant theoretical contributions to this field of knowledge. For future studies, it is suggested to develop new systematic studies for the design of food packaging, adapted to the needs of family farming and these SAGs, focusing on the sustainability, functionality and valorization of local products, as well as assessing the socio-economic and environmental impacts of the proposed innovations.

In short, it is understood that this research establishes a solid basis for the development and critical evaluation of food packaging in SAG contexts, a promising field that requires a holistic and innovative approach, vital to promote the sustainability and valorization of agri-food products, thus strengthening local systems. Desire is an invitation to new advances in these fields of knowledge.

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