Smart Intelligent Packaging: Understanding the Perspective of Food Producers in Georgia

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Abstract

Given the scholarly emphasis on researching intelligent packaging, this study seeks to examine food manufacturers' awareness of intelligent packaging and explore the specific features and characteristics they seek in such packaging. The paper aims to answer the following research questions by means of the qualitative interview method: (i) To what extent do smart packaging features matter to food manufacturers in Georgia? (ii) How familiar are food manufacturers in Georgia with innovative packaging solutions? The aim of this exploratory study is to gain a deeper understanding of the research phenomena and delve into various factors influencing the perspectives of food producers related to smart intelligent packaging in Georgia for the first time. Purposive sampling was applied to recruit food manufacturers. The main results show that although Georgian food producers are less aware of smart intelligent packaging, they are interested in it and determine certain smart intelligent features, traceability and monitoring attributes, and indicators that would increase their products' quality and safety. While the research is confined to a single country, the findings provide valuable insights into the attitudes of food producers towards intelligent packaging, shedding light on the market potential of smart packaging systems in Georgia. Consequently, the study contributes to the discourse on intelligent packaging in the food industry, offering diverse perspectives on its practicality in business. The research outcomes offer dual contributions to both academic knowledge and business practices. This investigation into food manufacturers' perspectives on smart intelligent packaging in Georgia is unprecedented. By examining their opinions on packaging, the study uncovers the market potential of intelligent packaging in developing economies. The insights gained from the research may assist food manufacturers in making informed decisions regarding the adoption of innovative packaging solutions, weighing the costs against the perceived benefits.

Key words

food packaging, intelligent packaging, smart packaging, marketing, sustainability, exploratory study.

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Introduction

Contemporary developments determine leading trends in the food packaging market. The modern age is marked by increasing concern for health and safety, ecology and environmental protection, an ageing society and modern technologies, which leads to changing lifestyles and growing demand for comfort and individualisation (Kita et al., 2021). By the same token, the importance of natural and organic food, produced and packed without artificial food additives, is increasingly required (Nile et al., 2020; Kalpana et al., 2019). These advancements have been reflected in the packaging industry producing environmentally friendly packaging from biodegradable materials, which at the same time are practical, simple, and contain a minimal amount of visual incentives while accentuating food safety (Han et al., 2018; Santeramo et al., 2018; Sharma & Ghoshal, 2018; Gréa et al., 2023). Consequently, the sustainable packaging concept has emerged, intertwined with smart intelligent packaging ideas. Intelligent packaging systems are used for monitoring packaged food, especially during transportation and storage (Shao et al., 2021). Smart, active, and intelligent packaging monitors packaged products and the surrounding environment to communicate product conditions in real time, and in this way help to avoid unsafe food and prevent unnecessary food waste (Yousefi et al., 2019). Thus, smart packaging communicates information about the product and improves its conditions. Smart packaging is comprised of active and intelligent packaging, which was initially introduced in Japan in the 1970s (Dainelli et al., 2008) and expanded to the American, Australian, and European markets in the 1990s, mainly for food and pharmaceutical products (Stoma & Dudziak, 2022). Since then, the packaging industry has shifted from the passive protective function to active protective capability, avoiding not only external damage but also controlling the internal deterioration of a product (Stoma & Dudziak, 2022). In addition, intelligent packaging technologies can reveal those suppliers who violate the storage conditions by, for example, turning off refrigerators at night in order to economise energy expenses (Azerdo & Correa, 2021). At this point, it should be noted that a similar practice is also observed in Georgia.

Selecting Georgia as a location to analyse the topic of intelligent packaging is driven by several factors. First of all, Georgia has a significant presence of industries related to packaging, such as food and beverage manufacturing, pharmaceuticals, or logistics. Among these industries, there are companies that can be considered early adopters and other organisations that have heavily invested in exploring intelligent packaging solutions to improve efficiency, traceability, or customer engagement. Moreover, Georgia's regulatory environment is conducive to innovation in packaging technologies. Hence, understanding the regulatory landscape – considered thanks to the manufactures' perspective – can shed light on the opportunities and challenges associated with implementing intelligent packaging solutions, such as compliance with food safety standards or labelling requirements. Besides, Georgia, as a post-Soviet, developing country with a population of 3.7 million, aspires to join the European Union and has joined several trade agreements to be integrated into the global market. Therefore, the country represents an engaging environment to perform research in the field of intelligent packaging, due to the lack of studies in this regard. Moreover, the new law on the Protection of Consumer Rights in Georgia demands that manufacturers disclose exhaustive information about their products on the label. In this sense, smart intelligent packaging facilitates the fulfilment of those requirements. Although there are studies examining smart intelligent packaging, they mainly focus on customers or packaging technologies. Studies examining manufacturers, B2B customers, and suppliers are still scarce. Therefore, this research is focused on producers who are potential users of such packaging solutions. Moreover, researchers confirm the need for studies regarding innovative packaging solutions in the food industry (Stoma & Dudziak, 2022). Similarly, food producers' standpoint and acceptance of smart packaging features can be a step forward in the food packaging market. For this reason, the qualitative research fills the gap in the packaging literature by investigating food manufacturers' perspectives on intelligent packaging in Georgia. This study aims to explore the awareness of intelligent packaging among food

manufacturers and to investigate the features and characteristics of the packaging the producers are demanding.

In addition, there is limited research available on food producers' awareness of smart intelligent packaging systems and the importance of the features and attributes of such packaging for the food products they produce. Their knowledge may be related to the degree of selecting innovative packaging (Grubor et al., 2020). Food producers' attitudes toward smart intelligent packaging can influence the demand for innovative packaging solutions on the market (Young et al., 2023). It is noteworthy that certain characteristics of food products and market conditions in emerging countries can shape food producers' behaviour toward smart packaging systems and affect companies' innovation performance. Furthermore, our research focuses on the context of emerging markets, which have received less scholarly attention as most studies related to innovative packaging systems have been conducted in advanced economies, omitting the perspectives of emerging economies.

Accordingly, the research questions are formulated as follows.

RQ1: How important are the smart packaging features for food manufacturers in Georgia?

RQ2: How aware are food manufacturers in Georgia of innovative packaging solutions?

Although the scope of this research is restricted to only one country, the results still create noteworthy knowledge about the attitude of food producers toward intelligent packaging and shed light on the market potential of smart packaging systems in Georgia. Thus, the research contributes to the discussion about intelligent packaging in the food industry and illuminates its applicability to business from a variety of perspectives.

The research results contribute to both the knowledge body and business practice. Food manufacturers' viewpoints toward smart intelligent packaging studied in Georgia is the first one of this type. Since the study investigates their opinion toward packaging, it can reveal the market potential of intelligent packaging in developing economies similar to Georgia. Food manufacturers can refrain from investing in the adoption of innovative packaging solutions unless they realize the real benefits. Therefore, the research results help food manufacturers in making the decision on whether intelligent packaging is worthwhile for their products taking into consideration the costs, and if such technologies can decrease waste or increase sales from their point of view. In addition, the research sheds light on what marketing actions are needed to promote the technologies of intelligent packaging.

1. Literature review

Scholars based on their empirical studies describe various characteristics as important factors for packaging, including environmental, marketing chains, logistics functions (Firouz et al., 2021; Rundh, 2013), marketing communication, and branding functions (Ketelsen et al., 2020; Dopico-Parada et al., 2021). According to Robertson (2013), the main functions of packaging are containment, protection, convenience, and communication. Producers prefer packaging that not only protects goods during transportation, distribution, storage, and retailing from getting into contact with other products or environmental contaminants to avoid any damage to the quality but also to ensure minimal delivery costs and maximum sale revenues (Kalpana et al., 2019).

Stoma and Dudziak (2022) emphasize the motivation of producers to use lighter packaging in order to save transportation costs while maintaining its protective function. Packaging must protect food from external factors (e.g. weather) but also ensure the quality and freshness of food products inside it. For consumers, packaging must be convenient and functional in terms of its size, shape, closure and sealing along with being eco-friendly. Thus, on the one hand, packaging should satisfy producers' logistical and marketing needs while being in compliance with legislative regulations relating to marking, labelling, and food safety, and on the other hand, it should respond to customers' individual packaging requirements (Stoma & Dudziak, 2022; Chen et al., 2010). Packaging is regarded as the most essential part of the product serving as a marketing communication tool (Rundh, 2016).

In this way, information on packaging can increase market awareness, which in turn influences food product purchase decisions (Ahmad & Juhdi, 2010). The survey conducted in Malaysia by Ahmad and Juhdi (2010) demonstrated that "the belief in the safety and health aspect of the product" impacts on purchase decision of food products.

Consumer attitudes undertake a pivotal role in purchase intention. Studies confirm the increasing demand of consumers for packaging design. Specifically, focus group participants in North Ireland declared that form, function and appearance of packaging are important and hence, companies in the food industry use packaging design as a marketing tool (Hollywood et al., 2013). Previous studies emphasize consumers' demand for convenience (Rundh, 2013), and for essential functional elements including, shape, openings and closing functions (Jinkarn & Suwannaporn, 2015). Moreover, environmental characteristics of packaging were perceived as important for consumers, which influenced their purchase decisions (Baruk & Iwanicka, 2016). In addition, design, fonts, colours, symbols, pictures, and brand communication signals, play a key role in packaging (Underwood, 2015; Spence & Van Doordn, 2022). According to the case study results used the simulation approach, smart packaging has the potential to generate considerably higher profit, especially for grocery retailers, and simultaneously reduce food waste (Kabadurmus et al., 2023).

Intelligent packaging contains indicators, sensors, and data carriers (Kabadurmus et al., 2023; Azeredo & Correa, 2021; Drago et al., 2020). Indicators are specific devices that transmit information about microbial, chemical, or biological activities that influence food quality, which can be visible through color change (Kalpana et al., 2019). External indicators are located outside while internal indicators are inside packaging (Pavelková, 2013). Indicators inform consumers about the quality of the food and measure mainly the temperature and freshness of a product inside the packaging (Azeredo & Correa, 2021). Temperature control throughout the food supply chain is essential for food quality as it indirectly notifies manufacturers about potentially spoiled food. Conversely, freshness indicators directly provide information on microbiological or chemical contamination in the products indicating that food is damaged (Kalpana et al., 2019; Mohammadian et al., 2020). Sensors facilitate the transformation of particular chemical information to electronic signals and help detect any deteriorative changes in the food (Azeredo & Correa, 2021). Data carriers in food packaging are comprised of barcodes and radiofrequency identification tags (RFID) and aim to monitor product transportation and storage through the wireless communication system connected with antennas and chips (Azeredo & Correa, 2021). They gather information on the movement of products along the distribution chain and mostly intend to trace products, prevent theft or counterfeit (Ghaani et al., 2016). However, the listed tools that are included in the intelligent packaging system are not without limitations as they represent a complex system. Therefore, the technologies are under constant improvement process to perform better, be harmless in case of interaction with food, and be useful for various types of foods (Azeredo & Correa, 2021; Drago et al., 2020). Main studies about intelligent packaging technologies are summarized in Table 1.

Table 1. Intelligent Packaging Technologies: indicators, description, source.

Indicators	Description	Source
Temperature indicators	Measure and display temperature changes of the product or its package.	Kalpana et al., 2019; Pavelková, 2013.
Critical temperature indicators	Reveal changes or worsening of foods because of fluctuations in threshold temperatures causing noticeable colour changes of the indicator.	Barska & Wyrwa, 2017; Taoukis & Labuza, 2003.
Critical temperature/time integrators (CTTIs)	Indicate a reaction above a reference critical temperature, which can be interpreted as an equivalent exposure time at that critical temperature.	Barska & Wyrwa, 2017; Taoukis & Labuza, 2003.

Indicators	Description	Source
Time-temperature indicators (TTIs)	The devices that record the temperature history of a packaged food during packaging, storage, transportation, and selling.	Taoukis & Labuza, 2003; Robertson, 2013; Brizio, 2016.
Freshness indicators	Evaluates chemical reactions by focusing on microorganisms that trigger food deterioration. A ripe sensor also indicates the ripeness of certain fruits.	Brizio, 2016; Kalpana et al., 2019.
Leak indicators	Informs if a modification due to leakage takes place inside packaging to improve shelf-life of foods. There are CO2, oxygen, and other leak indicators.	Das, et al., 2006; Brizio, 2016; Saliu & Della Pergola, 2018.
pH and colorimetric indicators	Monitor food freshness in terms of pH variations and convey information by a noticeable colour change in meat products, for example, from red to green, or from green to yellow.	Choi et al., 2017; Yoshida et al., 2014.
Sensors	**Description**	**Source**
Chemical sensors	Detect spoilage through chemical interactions as a part of smart intelligent packaging to monitor the quality of products.	Mahalik & Nambiar, 2010; Kuswandi et l.., 2011; Kalpana el.al., 2019.
Biosensors	Sense spoilage through a biological analyte and indicate alterations in foods by changing colour; also detect allergens or other pathogens ensuring food safety.	Fang et al., 2017; Mustafa & Andreescu, 2018.
Gas sensors	Detect gaseous and volatile compounds such as oxygen, carbon dioxide, and other gases to sense food spoilage in real-time.	Kalpana et al., 2019; Pereira et al., 2015; Zhai et al., 2018.
Data Carriers	**Description**	**Source**
Radio frequency identification (RFID) tags	A chip to store data applied on packaging and transmit through antennas to the reader; it is used for traceability and gathering information as well as for detecting any spoilage signs in packaged foods.	Bibi et al., 2017; Chen et al., 2008; Costa et al., 2013.
Barcodes	A machine-readable storage database for traceability of products; Information and data can be stored and read by an optical reader	Chen et al., 2008; Lin & Lin, 2013; Mahalik & Kim, 2016.

Source: developed by the authors.

2. Methodology

Since the research objective was to gather the essential information with the purpose of gaining knowledge without statistical validation (Chase & Murtha, 2019), this exploratory study employed interview methods within the framework of a qualitative research approach. Data was collected through interviews with Georgian food manufacturers following the exploratory approach design.

Applying exploratory approach to study the actors' perspective of packaging with enhanced features offers several advantages and drawbacks. First of all, this exploratory research helps in generating insights and understanding phenomena that are not well understood or defined, and it allows researchers to explore new avenues and generate hypotheses. Moreover, it helps in identifying problems or opportunities that may not be apparent initially. Besides, the exploratory research

methods facilitate a deeper understanding of complex phenomena by allowing researchers to delve into various factors influencing a situation or behaviour.

On the other hand, it is certain that the selected methods can have different drawbacks, such as (i) findings from exploratory research cannot be generalizable to the broader population or applicable in different contexts; (ii) since exploratory research involves qualitative methods such as interviews or observations, findings can be influenced by researcher bias or interpretation; (iii) the qualitative nature of exploratory research makes it challenging to replicate findings or conduct follow-up studies with the same level of depth.

Qualitative study approach is regarded as an appropriate method to explain a phenomenon with the question of "how" and profoundly examine the research questions (Yin, 2018). Through its flexible framework, this approach enables to gathering of comprehensive and descriptive information illustrating the research phenomenon (Patton, 2014). Given the research objectives, this research explores the phenomenon of innovative packaging systems for food products in Georgia. In addition, an interview method using a semi-structured interview guide was applied to examine the research questions. In-depth interview methods can collect rich information about the topic (Kvale, 2007).

Previous studies, aiming at explaining food packaging-related issues, frequently utilized interview methods within the qualitative approach (Kabadurmus et al., 2023; Afif et al., 2022; Svanes et al., 2010; Ryynänen & Rusko, 2015; Rundh, 2016).

For this study, purposive sampling was applied to recruit food manufacturers. The approach is widely used in nonprobability sampling and its size is determined by saturation (Guest et al., 2006). Interviews are terminated when no new information is provided by the respondents. According to Guest et al. (2006), essential themes appear within the first six interview sessions, and in general, saturation happens within the first twelve interviews. The eligibility criteria to choose respondents were the diverse food products produced by them or by their companies as well as their availability and willingness to participate in the study. Yin (2018) suggested selecting relevant respondents in accordance with the research aims. The interview informants were recruited through the nonprobability purposive sample technique (Patton, 2014), which allowed the researchers to attract participants who could report on the packaging issues of their food companies. Consequently, the choice of targeted food manufacturers is valid for the study objectives.

A semi-structured interview guide enabled to gather and compare relevant information (Eisenhardt & Graebner, 2007; Bernard et al., 2016). It covered four open-ended questions, which have been developed based on the literature review and previous studies in the field: (1) What are the most important factors of food packaging for you as a manufacturer or for your company? (2) How informed are you (and your company) about innovative solutions in the food packaging industry? (3) What types of innovative packaging does your company use or intend to use? (4) How important are certain features and indicators included in smart intelligent packaging for food packaging (the indicators were listed)? It should be noted that the participants were informed about the research aims and agreed to voluntarily take part in the interview sessions. Their confidentiality was ensured. Informed consent for participation in the study has been obtained from all participants.

Although consumer choice determines company decisions in the market, food producers can have their own preferences, requirements and criteria for purchasing appropriate packaging for their products. Smart intelligent packaging systems offer various attributes and features for different types of food. Since food producers' choice for smart packaging can also be a crucial factor for introducing smart packaging systems into the market, this research was interested in exploring their perspectives and investigating their understanding of the benefits of smart packaging specifically for their companies and their products. Thus, this research intends to reveal whether Georgian food producers are aware of innovative solutions in packaging systems and ever considered adopting them.

A total of fifteen individuals were interviewed, for fifteen to thirty minutes. The transcripts of recorded interviews were analysed. Finally, interviews were analysed through a systematic method to

examine themes, and categories and to discover associations with the research questions (Bernard et al., 2016; MacLure, 2013). Through thematic analysis, patterns and themes are identified to capture important ideas within the data (Braun & Clarke, 2006; Terry et al., 2017). Content analysis as a descriptive approach aims at describing features, patterns and themes in the collected material and providing categorized or classified elements of the data (Neuendorf, 2017; Drisko & Maschi, 2016). For this purpose, qualitative data analysis software NVivo for Mac was used as its features are suitable for content analysis. Although NVivo cannot analyse qualitative research completely, it considerably assists researchers with the organization of data and process of analysis. In addition, Excel was used for frequency analysis, and hence, the responses were evaluated in a partially quantitative manner.

3. Research results

Interview participants were selected to consider smart packaging from various points of view. Therefore, companies that produced meat and poultry, dairy, eggs, marinade, fish and seafood, frozen food, baked goods, fruits, vegetables, grains, beans and nuts, wine, and olive and olive oil were studied. The interview participants represented small (n=6; 40%), medium (n=5; 33%), and large (n=4; 27%) companies, within the age group between 26 and 55. Three respondents possess the position of director (n=3; 20%), nine of them work as managers (n=9; 60%), and three are employees (n=3; 20%). Eight respondents have a bachelor's degree, three have – Master's degree, and one holds a doctoral degree. The research results are divided into sections to Illustrate the findings and respond to the main research questions.

The important factors of food packaging for Georgian food manufacturers. The respondents attach the greatest importance to certain factors of packaging for the food products that are produced by their companies. They mentioned that protectiveness, durability, and resistance to weather or environmental factors are essential for food packaging. Moreover, packaging should respond to their needs for profitability and weight to decrease transportation and other costs, while for consumers it should be functional and comfortable. Furthermore, the interviewees stated that packaging must maintain food quality and food freshness as well as be environmentally friendly (Table 2).

Table 2. Important factors for food packaging mentioned by Georgian food producers.

Themes	Count	Percentage
Protective	n=15	100%
Maintains food quality	n=15	100%
Maintains food freshness	n=15	100%
Functional	n=12	80%
Ecological	n=10	67%
Weight	n=7	47%
Profitable	n=6	40%
Resistant	n=6	40%
Durable	n=4	27%
Comfortable	n=4	27%

Source: Authors' own research results.

The respondents declared that some features of packaging are more important for their food companies. In this regard, they specified that the most significant feature of packaging is to ensure food safety and quality characteristics, followed by marking and labelling i.e., information on packaging. In addition, packaging compatibility with the legislation and meeting consumer requirements are of utmost importance for food manufacturers. Respondents stated that packaging enables communication about their products and hence, packaging shape, design, and capacity are significant facets. Furthermore, respondents confirm that different information about the product

should be on the packaging, which must be recognized by consumers. They also discussed the prominence of packaging closing and opening methods.

Although monitoring food conditions is essential for food manufacturers, respondents hardly refer to innovative solutions, smart functions, or new technologies related to packaging. Traceability of the food product and monitoring attribute on packaging is perceived as substantial but the interviewed food manufacturers possess less information about those features of food packaging. In addition, the respondents were asked to indicate how significant is the monitoring attribute in packaging. The majority (67%) of the respondents answered that the monitoring function of the packaging is the most important for food products.

The awareness of smart, active, and intelligent packaging among Georgian food manufacturers. The respondents admitted that they are less informed or absolutely uninformed about the innovative solutions existing in the food packaging industry. In addition, they are not informed about smart packaging, active packaging, or intelligent packaging for food products. They know though that new packaging solutions exist, and they are aware of new technologies used in packaging. Consequently, they acknowledge their needs to learn more about innovative packaging systems to use them for their food products.

Innovative packaging types of Georgian food companies use or intend to introduce. The interviewed representatives claimed that their companies are using smart packaging (n=2; 13%), and other types of packaging (n=3; 20%), while traditional packaging is used by the rest of the respondents (n=10; 67%). To the question, of whether their companies are going to use innovative packaging, most respondents reacted negatively. As one of them explained, "We are not going to use smart, intelligent, and active packaging as we don't have information about such innovative types of food packaging and are not aware of its potential benefits for our company" (R4). Other respondents argued that "We have less knowledge about new types of packaging" (R6), and "We need to learn more about novel technologies used in food packaging" (R2).

The significance of certain indicators of smart, active, and intelligent packaging, for Georgian food manufacturers. In view of the interviewees, time-temperature indicators, freshness indicators, and pathogen indicators of food packaging are indispensable components. Besides, they connect breakage indicators, leak indicators, and colour indicators to their products and place a high value on them. As reported by the respondents, those elements can be included in the food products manufactured by their companies. In the same way, the respondents regarded carbon dioxide indicators and oxygen indicators as essential indicators that could be presented on food packaging. They corroborated the prominence of those indicators for their food products and expressed their willingness to introduce the food packaging to their companies.

Moreover, data carriers in packaging attracted the food manufacturers' attention. Although they are already familiar with QR-code and Barcode, which have been actively used in the Georgian market, Radiofrequency identification tag (RFID) is new for food packaging. With respect to sensors, the respondents reasoned that Fluorescence-based oxygen sensors and Biosensors are crucial for food packaging. However, intelligent sensors and gas sensors can be equally important for their food products.

Thus, the demand for smart intelligent packaging is outlined among Georgian food manufacturers. Against this backdrop, Georgia represents an emerging market for innovative packaging solutions.

4. Discussion

This research envisioned unfolding the awareness of smart intelligent packaging among food manufacturers in Georgia and describing the features and functions of food packaging appreciated by manufacturers.

The food manufacturers in Georgia are informed that consumers no longer choose food based only on taste, but other factors come also into play such as packaging (Hartmann, 2021; Bou-Mitri et al., 2021; Kunz et al., 2020). Packaging impacts food companies to sell products in terms of branding,

differentiation strategies, and protecting food during transportation, storage, or retailing (Shao et al., 2021; Dopico-Parada et al., 2021; Firouz et al., 2021; Kwilinski, 2023). Due to the increased competition in the market, food producers require differentiation strategies through packaging form, function, and appearance among others (Bou-Mitri et al., 2021; Young et al., 2020; Chen et al., 2020). Packaging not only plays a logistics role but can also decrease the ecological impact of companies (García-Arca et al., 2014; Kuwornu et al., 2023; Silva & Pålsson, 2022). The research results demonstrated that Georgian food manufacturers pay attention to the above-mentioned packaging components.

Yet, it is worth mentioning that manufacturers have to balance different viewpoints as operations divisions may prioritize functional and user-friendly packaging, while the marketing department focuses on packaging appearance (Afif et al., 2020). Furthermore, packaging quality can have different meanings for different people. For organizations, the packaging quality is allied with its storage capability and costs, while for marketing it relates to visual aspects to improve the performance of a product on the market (Afif et al., 2020). Quality can also include sustainability and ecological notions. In a similar vein, quality perceptions vary across product categories. For meat and fish products, food protection and extending shelf-life is the higher priority, while for the bakery, visual appearance is considerably significant for selling the product (Afif et al., 2020). The high level of customizations of packaging prompts a more complex purchase decision process in organizations, and contrariwise, the high level of packaging standardization induces a more steady and faster purchase process (Afif et al., 2020). Against this background, Georgian food manufacturers should reinvent their marketing strategies including packaging solutions.

Poças et al. (2010) describe packaging function as "protection and containment, preservation, information, convenience and service". The study results show that, for Georgian food manufacturers, packaging enables clean and safe distribution of products from their companies to end users. In this connection, intelligent technologies enable traceability and control of products enhancing the basic functions of packages. This makes packaging not only an effective communication tool in terms of providing relevant information about the history of a product's journey from the production process to the selling point to consumers' refrigerators, but also presents an attractive tool to distinguish a food product from competitors. However, consumers can be concerned about food safety due to packaging as they are afraid that chemical compounds or harmful substances might migrate from the package into foods (Shao et al. 2021; Cheng et al., 2022; Schmid & Welle, 2020; Poças et al., 2010).

The interviewed producers did not accentuate the costs of using smart packaging systems for their food products, though noted the profitability goals of a company, based on which the decision on packaging is made. The main disadvantage and barrier of smart packaging is the high cost of intelligent materials, indicators, sensors, and data carriers, which prevents its commercialization and effective introduction on the market. Therefore, food companies should evaluate the adoption of innovative packaging solutions in terms of the costs against benefits.

It is noteworthy that organizations are influenced by stakeholders when deciding on a certain packaging type. Packaging solutions can depend on companies' size, revenues, board members, management, strategy, or product characteristics. Intelligent packaging might not be suitable for every product and company. External factors such as laws, regulations, or market requirements need to be considered as well. Technological advancement and competition also impose packaging solutions (Afif et al., 2020).

In addition to digitalization trends, sustainability tendencies should also be considered. Intelligent packaging contributes to attaining sustainable goals while reducing waste and satisfying consumer demands (Palazzo et al., 2023). It can respond to stakeholders' environmental concerns by communicating information about a product through innovative packaging technologies (Popescu et al., 2023).

Correspondingly, innovations are core drivers in attracting consumers' attention. For this reason, food producers need to bear in mind changes in consumer preferences and follow trends in the market (Figiel & Kufel, 2016; Gigauri et al., 2024). For product innovation companies need internal resources such as technological competences and favourable external factors such as the appropriate environment including technological opportunities and industry context (Rammer & Schubert, 2018; Oh et al., 2022) as well as regional resources or country cultures (Rodríguez-Gulías et al., 2021). Smart intelligent packaging systems can be considered as marketing innovation that is able to generate demand by raising awareness, educating consumers, and creating the grounds for product differentiation (Kahn, 2018; Gigauri et al., 2024), which in turn improves companies' positions in the market and brings a competitive advantage. Thus, companies can meet consumer expectations for food safety and quality and achieve a differentiation strategy in the market through innovative packaging systems.

Georgian food manufacturers require up-to-date information about the benefits intelligent packaging can provide. This finding is consistent with prior studies confirming that companies tend to embrace innovative packaging if it brings value to their stakeholders (Zeng, 2022; Ferrara et al., 2020; Świda et al., 2018). In this context, heightening awareness about smart intelligent functions and the advantages of intelligent packaging among stakeholders can influence their acceptance.

Furthermore, based on the value co-creation in the service dominant logic theory, food manufacturers and consumers can collaborate through intelligent packaging. Co-creative value can be delivered through enhancing the experience offered by innovative packaging systems. In this sense, manufacturers should define value-creation sources of smart packaging, which are desired by consumers and perceived as a substantial component of food packaging. Thus, consumer loyalty and satisfaction will increase.

Conclusions

This research contributes to theory and practice by exploring smart packaging systems from food manufacturers' standpoints and by revealing the market potential of innovative packaging solutions in Georgia - a developing country. It evaluates new packaging solutions from food manufacturers' point of view and identifies the need for recognizing beneficial facets of intelligent packaging for the marketing strategy. The future of food packaging depends on intelligent systems of packages that go beyond protecting or maintaining a product inside. Intelligent packaging involves communication tools that address product marketing issues by embedding data carriers aiming at tracing commodities.

The results add knowledge to the literature on marketing by studying intelligent food packaging and examining its features and indicators that are demanded by food manufacturers.

Thus, the research findings will be beneficial to academics and practitioners. The study results will allow scholars and researchers to further explore the market potential of intelligent packaging solutions from the perspective of food manufacturers in different economies. In addition, research evidence will be of interest to policymakers introducing laws and regulations with the purpose of providing a supportive environment for innovations, leading-edge technologies, and enable sustainable economic development.

Moreover, this research responds to the scholar's request for more studies related to the role of food packaging within a marketing strategy to create value (Rundh, 2016; Dopico-Parada et al., 2021). Marketers can develop a product concept together with an intelligent packaging design that will lead to value creation and that will propose differentiation resulting in a competitive advantage.

The limitation of this study stems from the qualitative research method and hence, the findings may lack generalizability. Actually, qualitative interview methods are widely used in marketing and management research, but they also have certain limitations. First of all, the selected participants represent a specific organization, industry, and context, making it challenging to generalize findings

to a broader population. Secondly, interviewees may have provided socially desirable responses or withhold sensitive information during interviews, leading to biased or incomplete data. This bias can distort the accuracy of findings and compromise the validity of the study. Thirdly, the interviewer's characteristics, such as demeanor, tone, or questioning style, can influence respondents' answers and perceptions. Interviewer bias may inadvertently steer the conversation or lead to misinterpretation of responses.

The small sample size is another limitation. Notwithstanding these drawbacks, the study generates fresh insights and paves the way for further research given the importance of the topic. Future longitudinal research using follow-up interviews might explore the adoption of smart intelligent packaging in food manufacturers. Similarly, future large-scale quantitative research covering the supply chain members should explore barriers to the commercialization of smart intelligent packaging systems including technological and organizational obstacles as well as investigate technological readiness, expertise, investments, or other resources required to manufacture innovative packaging in the country. In order to illustrate the market potential of smart packaging systems, future quantitative surveys will investigate consumers' attitudes, preferences and perceptions in this regard, based on this research. In addition, further studies can investigate the factors influencing the buying decision of product packaging in different countries and economies. Finally, surveying packaging producers can elucidate challenges and opportunities that producers of smart, active, and intelligent packaging encounter in diverse country contexts.

Although the research is conducted in one country context, the implications can be extended to other contexts as well. Food producers' perspectives make a significant contribution when developing and marketing smart intelligent packaging for food products. In today's globalized world, the intelligent packaging features that food manufacturers demand for their products may be typical for companies in many countries. Furthermore, the global supply chain and competitive landscape imply that the research results from one country (i.e., Georgia) are transferable to another country setting. In addition, the need to raise awareness of smart, active, and intelligent packaging among food manufacturers in developing countries will lead to the adoption of innovative packaging solutions and hence, derive substantial benefit from it.

It should be pointed out that the specific country's context — its industry, regulations, technological infrastructure, and consumer behaviour plays a significant role. Consumer acceptance and demand create the market potential for smart intelligent packaging. Besides, legislative regulations related to packaging, labelling, and product safety, as well as health and safety regulations, environmental standards, and food industry-specific requirements can be met through smart intelligent packaging. Moreover, the technological landscape in the country is another factor companies may consider when adopting smart intelligent packaging. For instance, if smart packaging improves logistics efficiency, it can be particularly beneficial in countries with large geographical areas or complex supply chains.

Thus, the research investigated the types of packaging Georgian food companies intend to use and revealed the preferred indicators of intelligent packaging. The research results found the need to raise awareness of smart packaging systems among food manufacturers in Georgia to understand the benefits of innovative packaging solutions for their products and brands. The findings highlight that food producers are less informed about the concept of smart intelligent packaging; however, they recognize the benefits of some features and indicators for their food products. In this sense, monitoring and traceability attributes are emphasized. In addition, time-temperature, freshness, pathogen, oxygen, carbon dioxide, breakage, leak, and color indicators are remarked to be important; however, food producers acknowledge that more information about these and other indicators need to be obtained by their food companies in order to decide on smart packaging with specific features. Although the food producers are not ready yet for innovative packaging systems, the changes may

occur in conjunction with accelerated digitalization and sustainability trends as well as along with the consumers' demand and producers' understanding of its advantages.

Packaging as a marketing communication channel is widely recognized as it connects producers to customers by providing information such as brand name and manufacturing details, nutritional value, guidance about the usage or storage, expiration date, and so on (Kalpana et al., 2019; Gigauri & Palazzo, 2023). In this regard, intelligent packaging tools transfer information to consumers and manufacturers about the product through its ability to detect and record the changes outside and inside of foods (Fernandez et al., 2023). Moreover, perishable foods need extended shelf-life to sell under the circumstances of growing competition.

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