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Consumer Acceptance of Edible Food Packaging as a Sustainable

Innovation: A Study in Italy, Germany, and the Netherlands

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TABLE OF CONTENT

Introduction.....	11
Chapter 1 — Food Packaging Overview	
1.1 Background and Context.....	14
1.2 The Role of Packaging in the Agrifood System.....	15
1.3 Other Strategies to Reduce Packaging Waste.....	23
1.4 Sustainable Food Packaging.....	25
1.4.1 Definition of Sustainable Packaging.....	25
1.4.2 Types of Sustainable Food Packaging.....	25
1.4.3 Sustainable Packaging Materials.....	26
1.5 Edible Packaging as a Sustainable Innovation.....	27
1.6 Research Problem and Justification	28
1.7 Objectives and Research Question.....	29
1.8 Scope and Limitations.....	29
Chapter 2 — Food Packaging Evolution	
2.1 The Role of Packaging in the Food Industry.....	32
2.2 Food Packaging and Sustainability.....	33
2.3 Environmental Impacts of Traditional Packaging.....	35
2.4 Edible Packaging: Definition, Materials, Types, Benefits and Challenges.....	36
2.4.1 Edible Films and Edible Coatings.....	37
2.4.2 Materials Used in Edible Packaging.....	37
2.4.3 Benefits of Edible Packaging	38
2.4.4 Protein-Based Edible Packaging.....	38
2.4.5 Challenges and Limitations.....	39
2.5 Consumer Behavior Toward Sustainable Packaging	39
2.5.1 Consumer Awareness and Perceptions.....	40
2.5.2 Trust and Environmental Information.....	40

2.5.3 Attitude–Behaviour Gap.....	40
2.5.4 Willingness to Pay.....	41
2.5.5 Factors Influencing Sustainable Packaging Choices.....	41
2.5.6 Packaging Design and Product Type.....	42
2.5.7 Relevance to Edible Packaging.....	42
2.6 Life Cycle Assessment in Packaging Sustainability.....	43
2.7 Edible Packaging and the EU Market.....	44
2.8 Research Gap and Contribution of This Study.....	46

Chapter 3 — Edible Packaging Study

3.1 Research Design and Methodology.....	49
3.2 Study Area.....	50
3.3 Questionnaire Design.....	51
3.4 Data Collection.....	52
3.5 Participants and Sampling.....	53
3.6 Data Analysis.....	54
3.7 Ethical Considerations.....	55
3.8 Methodological Limitations.....	55

Chapter 4 — Results

4.1 Characteristics of the Respondents.....	58
4.2 Awareness and Previous Experience with Edible Packaging.....	59
4.3 General Attitudes Toward Edible Packaging.....	60
4.4 Perceived Benefits of Edible Packaging.....	64
4.5 Concerns and Perceived Risks of Edible Packaging.....	66
4.6 Willingness to Try and Willingness to Pay.....	70
4.7 Factors Influencing Purchase Decisions.....	73
4.8 Summary of Main Findings.....	77

Chapter 5 — Discussion

5.1 Consumer Awareness and Experience with Edible Packaging.....	80
5.2 Consumer Attitudes Toward Edible Packaging.....	81
5.3 Perceived Environmental Benefits of Edible Packaging.....	83
5.4 Consumer Concerns, Food Safety, and Trust.....	85
5.5 Willingness to Try Edible Packaging.....	87
5.6 Willingness to Pay and the Role of Price.....	89
5.7 Factors Influencing Consumer Purchase Decisions.....	91
5.8 Implications for Edible Takeaway Coffee Packaging.....	94
5.9 Limitations of the Study.....	96
5.10 Recommendations for Future Research.....	98

Chapter 6 — Conclusions

6.1 Overall Conclusions.....	100
6.2 Answers to the Research Objectives.....	101
6.3 Practical Implications.....	103
6.4 Final Remarks.....	104

References.....	106
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Appendix A — Survey Questionnaire.....	112
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ABSTRACT

The increasing use of conventional food packaging, particularly single-use plastics, has created growing environmental concerns and increased interest in more sustainable packaging alternatives. Edible food packaging represents an innovative approach because it can potentially reduce packaging waste while maintaining important packaging functions. However, its successful introduction depends not only on technical and environmental performance but also on consumer acceptance. This study investigated consumer acceptance of edible food packaging and identified the main factors that may encourage or prevent its adoption. An online questionnaire was conducted among 90 respondents from Italy, Germany, and the Netherlands. The survey examined consumer awareness and previous experience, general attitudes, perceived environmental benefits, concerns, willingness to try, willingness to pay, and factors influencing purchase decisions. The findings showed generally positive attitudes toward edible packaging. 67.8% of respondents had previously heard of edible packaging, although only 30.0% had seen or used it. Waste reduction was the most strongly perceived benefit, with 92.2% agreeing or strongly agreeing that edible packaging could help reduce packaging waste. Regarding behavioural intentions, 67.8% were willing to try edible packaging and a further 25.6% responded “Maybe”. Most respondents were also willing to pay some additional cost, although the majority preferred a price increase of no more than 5%. Food safety and hygiene were important concerns, while EU certification, clear information, attractive design, and trust were important factors influencing acceptance. Overall, the findings suggest that consumers are open to edible food packaging as a sustainable innovation, but wider acceptance depends on addressing safety and hygiene concerns, providing reliable information and certification, and maintaining an acceptable price.

RIASSUNTO

Il crescente utilizzo degli imballaggi alimentari convenzionali, in particolare della plastica monouso, ha generato crescenti preoccupazioni ambientali e un maggiore interesse verso alternative di imballaggio più sostenibili. Gli imballaggi alimentari commestibili rappresentano un approccio innovativo, poiché possono potenzialmente ridurre i rifiuti da imballaggio mantenendo al tempo stesso importanti funzioni di protezione e conservazione. Tuttavia, il successo della loro introduzione dipende non solo dalle prestazioni tecniche e ambientali, ma anche dall'accettazione da parte dei consumatori.

Questo studio ha analizzato l'accettazione degli imballaggi alimentari commestibili da parte dei consumatori e ha identificato i principali fattori che possono favorirne o ostacolarne l'adozione. È stato condotto un questionario online con 90 partecipanti provenienti da Italia, Germania e Paesi Bassi. Il questionario ha esaminato la conoscenza e l'esperienza precedente dei consumatori, gli atteggiamenti generali, i benefici ambientali percepiti, le preoccupazioni, la disponibilità a provare il prodotto, la disponibilità a pagare un prezzo più elevato e i fattori che influenzano le decisioni di acquisto.

I risultati hanno mostrato atteggiamenti generalmente positivi nei confronti degli imballaggi commestibili. Il 67,8% degli intervistati ne aveva già sentito parlare, mentre solo il 30,0% li aveva già visti o utilizzati. La riduzione dei rifiuti è risultata il beneficio maggiormente percepito: il 92,2% degli intervistati si è dichiarato d'accordo o pienamente d'accordo sul fatto che gli imballaggi commestibili possano contribuire a ridurre i rifiuti da imballaggio. Per quanto riguarda le intenzioni comportamentali, il 67,8% si è dichiarato disposto a provare gli imballaggi commestibili, mentre un ulteriore 25,6% ha risposto "Forse". La maggior parte degli intervistati si è inoltre dichiarata disponibile a sostenere un costo aggiuntivo, anche se la maggioranza preferiva un aumento di prezzo non superiore al 5%. La sicurezza alimentare e l'igiene sono emerse come importanti preoccupazioni, mentre la certificazione dell'Unione Europea, informazioni chiare, un design attraente e la fiducia sono risultati fattori importanti per favorire l'accettazione.

Nel complesso, i risultati suggeriscono che i consumatori sono aperti agli imballaggi alimentari commestibili come innovazione sostenibile, ma una loro più ampia accettazione dipende dalla capacità di affrontare le preoccupazioni relative alla sicurezza e all'igiene, fornire informazioni chiare e certificazioni affidabili e mantenere il prezzo a un livello accettabile.

LIST OF FIGURES

Figure 1. Global plastic waste generation and waste-management trends from 1950 to 2050	17
Figure 2. Annual global plastic use by sector in 2019	18
Figure 3. Global plastic production with projections, 1950–2060	19
Figure 4. Plastic waste by disposal method with projections, 2000–2060	20
Figure 5. Generation of plastic packaging waste per capita in European countries, 2023	21
Figure 6. Recycling and recovery rates of packaging waste in the EU, 2009–2020	22
Figure 7. Europe edible packaging market size and forecast, 2023–2033	46
Figure 8. General attitudes toward edible packaging: Average agreement with five statements about edible packaging	63
Figure 9. Percentage of respondents who agreed or strongly agreed with statements about edible packaging	63
Figure 10. Mean scores for the perceived benefits of edible packaging	65
Figure 11. Percentage of respondents who agreed or strongly agreed with the perceived benefits of edible packaging	66
Figure 12. Mean scores for consumer concerns about edible packaging	68
Figure 13. Consumer concerns and agreement on the importance of EU food safety approval	69
Figure 14. Respondents' willingness to try takeaway coffee served with edible packaging	71
Figure 15. Respondents' willingness to pay a higher price for products using edible packaging	72
Figure 16. Mean scores for factors influencing purchase decisions	76
Figure 17. Percentage of respondents who agreed or strongly agreed with factors influencing their purchase decision	77

LIST OF TABLES

Table 1. Structure of the questionnaire	52
Table 2. Demographic characteristics of the respondents (N = 90)	59
Table 3. Awareness and previous experience with edible packaging (N = 90)	60
Table 4. General attitudes toward edible packaging	62
Table 5. Perceived benefits of edible packaging	65
Table 6. Consumer concerns about edible packaging	68
Table 7. Willingness to try edible packaging (N = 90)	70
Table 8. Willingness to pay more for products using edible packaging	72
Table 9. Factors influencing the purchase decision	75
Table 10. Summary of the main survey findings	79

INTRODUCTION

Food packaging is an essential part of the modern food system. It protects food during transportation, storage, and distribution, helps maintain food quality and safety, and provides important information to consumers. Different materials are used for food packaging, including plastic, glass, metal, paper, and cardboard. Among these materials, plastic is widely used because it is lightweight, practical, and relatively inexpensive. However, the large amount of single-use packaging has created serious environmental concerns. Many conventional plastics are produced from fossil resources and can remain in the environment for a long time if they are not properly collected, recycled, or treated at the end of their life (Nair et al., 2023). Growing concerns about packaging waste and environmental pollution have increased the demand for more sustainable packaging solutions. Different approaches have been developed, including recyclable, reusable, bio-based, biodegradable, and compostable packaging. At the same time, packaging cannot simply be removed because it has an important role in protecting food and reducing food losses and waste. Therefore, sustainable packaging should reduce environmental impacts while still providing the necessary functions of conventional packaging, such as protection, safety, quality, and convenience. Its sustainability also depends on different stages of its life cycle, from raw material production to manufacturing, transportation, use, and end-of-life management. One alternative that has received increasing attention is edible food packaging. Edible packaging is made from food-grade materials and is designed to be safe for consumption. It can be produced in different forms, particularly as edible films and coatings, using materials such as polysaccharides, proteins, and lipids. These materials can provide protective functions and help control the transfer of moisture and oxygen. They may also contain active compounds, such as antioxidants or antimicrobial substances, which can help maintain food quality and extend shelf life. Because edible packaging can be consumed with the food or biodegrade more easily than many conventional materials, it has the potential to reduce the use and disposal of some forms of single-use packaging (Nair et al., 2023). However, the environmental potential of edible packaging does not automatically mean that consumers will accept it. Edible packaging is different from conventional packaging because consumers may directly eat a material that they normally consider as a protective layer around food. This can create concerns about food safety, hygiene, taste, texture, allergens, and the general idea of eating the package. Price, convenience, appearance, information, and trust in certification

may also affect consumer decisions. Previous studies on sustainable and edible packaging have shown that consumers can have positive attitudes toward environmentally friendly alternatives while still having concerns that influence their actual choices (Ketelsen et al., 2020; Taylor et al., 2024; Zhang et al., 2024). Therefore, understanding consumer acceptance is an important part of evaluating the future potential of edible packaging. This issue is particularly relevant in Europe, where reducing packaging waste and moving toward more sustainable and circular packaging systems have become important environmental goals. Although edible packaging may offer environmental benefits, its successful introduction into the market depends not only on technological development but also on how consumers understand and respond to it. A product may be innovative and environmentally promising, but its market potential will remain limited if consumers do not trust it or are unwilling to use it. For this reason, it is important to understand both the positive perceptions and the concerns associated with edible packaging. The main objective of this thesis is to investigate consumer acceptance of edible food packaging as a sustainable innovation in Italy, Germany, and the Netherlands. More specifically, the study has three objectives: (1) to understand consumer awareness and previous experience with edible packaging; (2) to examine consumers' willingness to try edible packaging and willingness to pay more for it; and (3) to identify the main factors that influence consumer acceptance and purchase decisions, including perceived environmental benefits, possible risks, safety, trust, and price. Based on these objectives, the main research question is:

Would the consumer accept edible food packaging as a sustainable innovation and which factors may encourage or prevent its acceptance?

To investigate this question, a quantitative consumer survey was conducted in Italy, Germany, and the Netherlands. These three countries were selected to represent different European contexts in terms of food culture, consumer habits, sustainability practices, and packaging waste-management systems. At the same time, they operate within the broader European framework related to food safety, packaging, and environmental policies. This makes them useful contexts for exploring how consumers perceive a relatively new packaging concept. The questionnaire was developed using Microsoft Forms and included questions about consumer awareness, previous experience, general attitudes, perceived environmental benefits, concerns and risks, willingness to try and pay, and

factors affecting purchase decisions. An edible takeaway coffee cup was used only as a practical example in the survey to make the concept of edible packaging easier for participants to imagine and evaluate. The thesis itself does not focus specifically on edible coffee cups; its broader focus is consumer acceptance of edible food packaging. Data were collected between May and July 2026 using convenience sampling, and 90 valid responses were included in the final analysis. The data were analyzed using descriptive statistics, including frequencies, percentages, mean scores, and graphs. This thesis is organized into six chapters. Chapter 1 provides the general background of food packaging and discusses its role in the agrifood system, packaging waste, sustainable packaging strategies, and edible packaging as a sustainable innovation. Chapter 2 reviews the existing literature on conventional and sustainable food packaging, the environmental impacts of packaging, edible packaging materials and technologies, their benefits and challenges, and consumer behavior and acceptance. Chapter 3 describes the research methodology, including the study area, questionnaire design, sampling, data collection, and data analysis. Chapter 4 presents the results of the consumer survey. Chapter 5 discusses the findings in relation to previous studies and considers the main factors influencing consumer acceptance of edible packaging. Finally, Chapter 6 presents the main conclusions, practical implications, study limitations, and recommendations for future research. Overall, this thesis examines edible food packaging mainly from a consumer and sustainability perspective. Edible packaging may provide opportunities to reduce the environmental impact of some forms of conventional packaging, but environmental benefits alone may not be enough to ensure its acceptance. Consumers also need to feel that the product is safe, hygienic, practical, trustworthy, and reasonably priced. By studying consumer perceptions in Italy, Germany, and the Netherlands, this research aims to provide a better understanding of the factors that may support or limit the future acceptance of edible food packaging as a sustainable innovation.

CHAPTER 1 — FOOD PACKAGING OVERVIEW

1.1 Background and Context

Food packaging is an essential part of food processing and acts as a connection between food producers and consumers. During transportation, storage, and handling, packaging protects food products from different hazards that could affect their quality and safety. Therefore, the quality and integrity of packaging materials are important for maintaining food quality, safety, and consumer acceptance. Packaging materials should provide suitable protection and ensure consumer safety. In addition, packaging design and labeling must follow specific standards and regulations. Traditionally, food packaging had two main functions. The first was to act as a barrier and protect the packaged product from the external environment. The second was to provide important information about the product. This information included the product composition and ingredients, the name and address of the manufacturer, preparation instructions, and manufacturing and expiry dates. However, the role of food packaging has developed over time. Today, the food industry is moving beyond these basic functions and using packaging for additional purposes, including active and smart functions (Onyeaka & Nwabor, 2022). Packaging is no longer used only for protection. It also plays an important role in marketing and consumer convenience. For example, packaging design can influence consumer decisions, while easy-to-use packaging can improve the consumer experience. Conventional packaging materials used in the food industry mainly include glass, cardboard, metal, and plastics. Among these materials, plastics are widely used in food packaging because of their useful properties and relatively low cost (Nair et al., 2023). Food packaging also provides consumers with important information about the product, such as its contents, brand, shelf life, and storage conditions. This communication helps consumers understand the product's characteristics, quality, and correct handling. Packaging can include nutritional information, product weight, brand labels, certifications, ingredients, and barcodes. This information is important for meeting legal requirements and can also support product marketing and branding. In addition, packaging may provide information about storage conditions, cooking instructions, price, and product shelf life (Wani et al., 2014). The food industry widely

uses materials such as polyethylene (PE), polypropylene (PP), and polyethylene terephthalate (PET) for food packaging. These plastics are relatively inexpensive, easy to shape, lightweight, and practical compared with materials such as glass or metal. However, conventional plastics are mainly petroleum-based and can create environmental problems, especially when they are not properly collected or recycled. Non-biodegradable packaging can remain in the environment for a long time and contribute to packaging waste and pollution (Nair et al., 2023). As concerns about the environmental effects of packaging waste have increased, there has also been growing interest in natural, high-quality, eco-friendly, and safe food-packaging solutions. At the same time, consumers still expect packaging to be convenient and functional. This creates an important challenge for the food industry, which needs to develop more sustainable packaging while maintaining food quality and safety and reducing environmental impacts. As a result, increasing attention has been given to biodegradable, edible, and other sustainable packaging materials. These alternatives may help reduce packaging waste while still providing the protection required for food products (Nair et al., 2023).

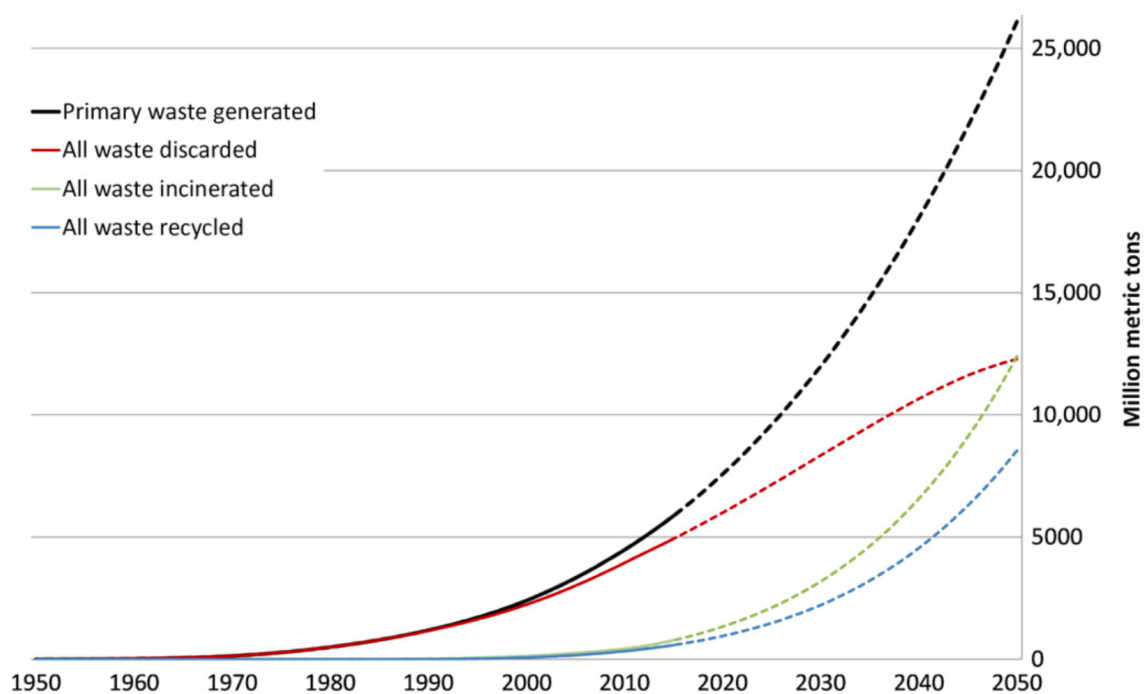
1.2 The Role of Packaging in the Agrifood System

Food deterioration can be caused by both external and internal factors. External factors include oxygen, moisture, unwanted odors and flavors, toxins, microorganisms, physical damage, and mechanical stress. Internal factors can include microorganisms that are naturally present in food. Therefore, one of the main functions of packaging is to protect food from environmental conditions, maintain the benefits of food processing, extend shelf life, and preserve the quality and safety of both fresh and processed foods. Since food products have different compositions, structures, and characteristics, they require different levels of protection throughout the supply chain. In general, packaging should protect food against physical, chemical, and biological hazards. Physical protection helps prevent mechanical damage caused by shocks, vibration, pressure, and movement during transportation and distribution. Materials such as paperboard and corrugated packaging can protect products such as fruits, eggs, and cakes from impact, crushing, and abrasion. Replacing glass bottles with lighter plastic packaging is another example of how packaging materials can reduce the risk of physical damage during transportation. Chemical protection aims to reduce changes in food caused by factors such as oxygen and light. These factors can lead to oxidation and the loss of color, vitamins, and other nutrients. Different packaging materials provide different

levels of chemical protection. For example, glass provides a strong barrier against many substances but may not protect the product from light unless it is colored or specially treated. Metal packaging also provides a strong barrier, although interactions between the food and packaging material need to be controlled. Plastic packaging materials can provide different levels of barrier protection depending on the type of plastic and its properties. Biological protection is also an important function of food packaging. Packaging helps protect food from spoilage and pathogenic microorganisms, including bacteria, yeasts, fungi, and viruses. It can also help prevent contamination and damage caused by insects and rodents. In this way, suitable packaging contributes to maintaining food safety and quality throughout storage and distribution. Another basic function of packaging is to contain food products and make their transportation and distribution easier throughout the supply chain. Without suitable packaging, food losses could increase because products would be more exposed to environmental and physical factors. Packaging is particularly necessary for liquid products, which cannot be transported or stored easily without a suitable container. It also prevents different solid products from mixing during transportation and helps reduce problems such as bruising of soft fruits, physical damage caused by friction, mixing of graded products, and contamination by airborne particles. Therefore, packaging can play an important role in reducing food losses throughout the supply chain. Industrialization and increasingly busy lifestyles have also increased the demand for convenient food products and packaging. The packaging industry has responded by introducing features such as easy-opening systems, resealable packages, microwavable packaging, oven-safe trays, and boil-in-bag products. These solutions can make food preparation and consumption easier and faster, contributing to the growing demand for packaged and convenience foods (Wani et al., 2014). In addition to protecting and containing food, packaging also provides consumers with information about the product. Text and graphics on food packages can provide information about the type, origin, composition, and nutritional content of the food, as well as information related to environmental sustainability. Packaging can also be designed to make food easier to handle, store, open, and close. For some products, packaging materials must be able to resist different cooking conditions, such as boiling, baking, or microwaving. Therefore, food-packaging materials need to be versatile and suitable for different sizes, shapes, products, and functional requirements (Cheng et al., 2022). Even though food packaging provides many important benefits, it can also create environmental problems. In particular, the high use of conventional plastic packaging contributes

to waste generation and environmental pollution. Many plastic packages, especially single-use packages, have a short period of use but can remain in the environment for a long time after disposal. For this reason, plastic packaging waste has become an important environmental concern, and the development of more sustainable packaging alternatives is receiving increasing attention (Nair et al., 2023). The increase in plastic production and consumption has also resulted in a growing amount of plastic waste. As shown in Figure 1, the amount of plastic waste generated has increased strongly over time and is expected to continue increasing in the future. The figure also shows different waste-management pathways, including discarded, incinerated, and recycled plastic waste. Although recycling and incineration are expected to increase, the overall amount of plastic waste remains an important environmental challenge.

Figure 1. Global plastic waste generation and waste-management trends from 1950 to 2050.

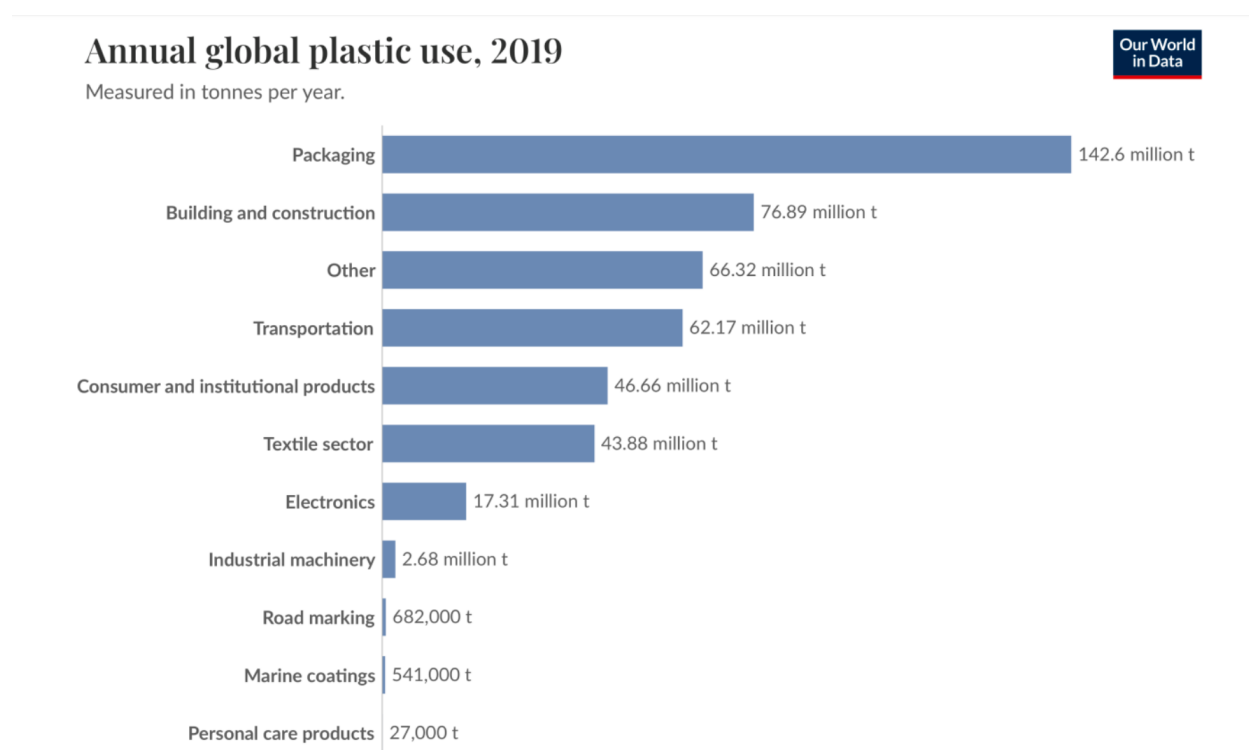


Source: Ncube et al. (2021).

Even though food packaging provides many important benefits, it can also create environmental problems. In particular, the high use of conventional plastic packaging contributes to waste generation and environmental pollution. Packaging represents an important area of global plastic consumption. As shown in Figure 2, packaging was the largest sector of global plastic use in 2019,

accounting for approximately 142.6 million tonnes. This high level of plastic use highlights the importance of reducing packaging waste and developing more sustainable packaging alternatives.

Figure 2. Annual global plastic use by sector in 2019.



Source: Our World in Data, based on OECD (2022) data.

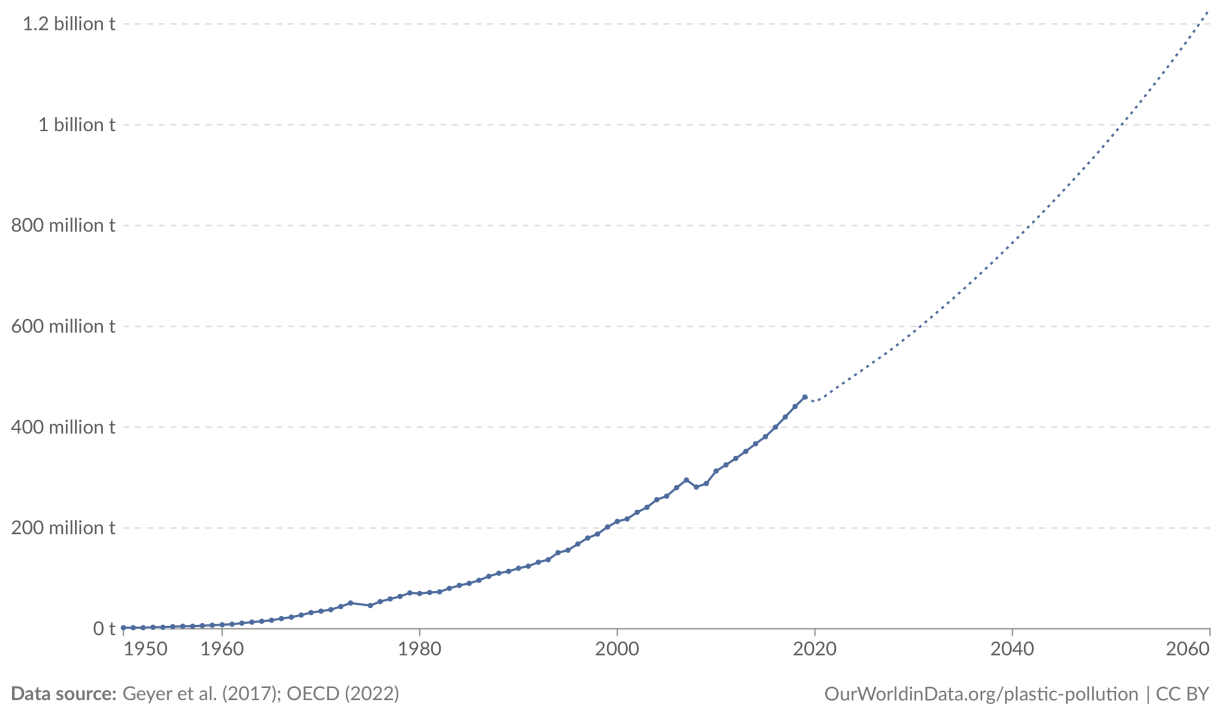
Global plastic production has increased rapidly during the last several decades. As shown in Figure 3, annual global plastic production increased from a relatively low level in 1950 to more than 400 million tonnes per year by 2020. Under the business-as-usual scenario, which assumes that current policies remain unchanged, plastic production is projected to continue increasing and could reach more than 1.2 billion tonnes per year by 2060. This trend shows that the environmental challenges related to plastic production and waste may become more serious in the future. Therefore, reducing dependence on conventional plastics and developing more sustainable materials are becoming increasingly important.

Figure 3. Global plastic production with projections, 1950–2060.

Global plastic production with projections, 1950 to 2060



Annual production of polymer resin and fibers. Projections are based on the "business-as-usual" scenario which assumes that current policies remain unchanged in the foreseeable future.



Source: Our World in Data, based on Geyer et al. (2017) and OECD (2022).

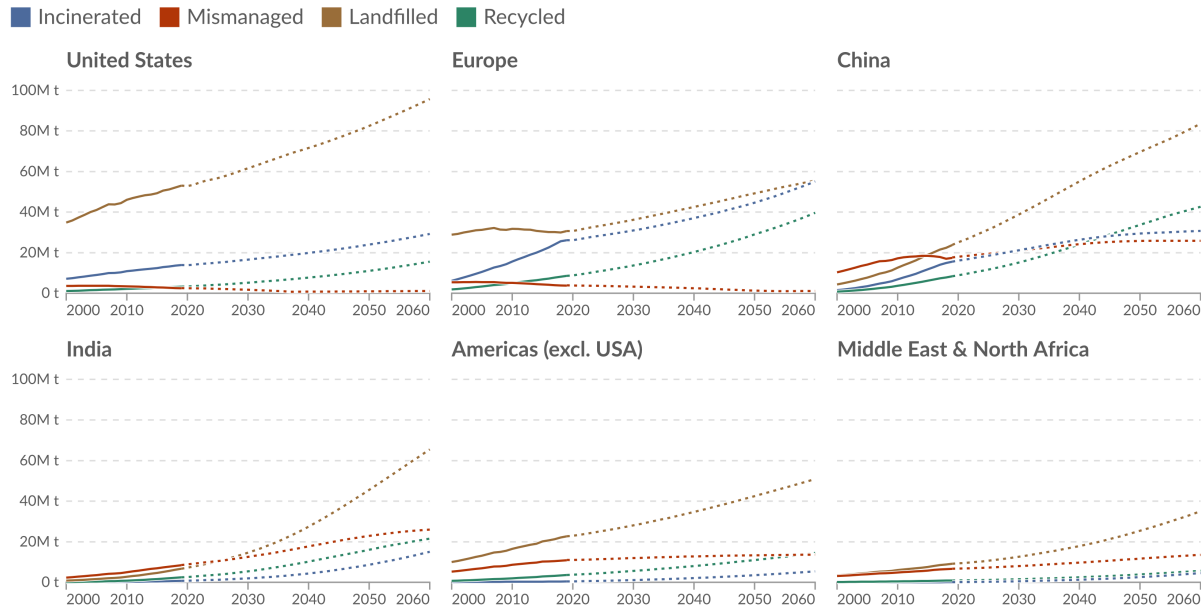
Plastic waste is managed in different ways across regions, including recycling, incineration, landfilling, and, in some cases, mismanaged disposal. As shown in Figure 4, the use of these disposal methods differs considerably between regions and is expected to change in the coming decades. In Europe, recycling and incineration are projected to increase, while landfilling is expected to remain an important disposal method in several other regions. The projections also show that the total amount of plastic waste could continue to increase in many parts of the world if current policies remain unchanged. These differences show that improving recycling systems and waste-management strategies is important, but reducing the amount of plastic waste generated is also necessary to address the environmental impacts of plastics.

Figure 4. Plastic waste by disposal method with projections, 2000–2060.

Plastic waste by disposal method with projections, 2000 to 2060

Our World
in Data

Mismanaged plastic waste includes materials burned in open pits, dumped into seas or open waters, or disposed of in unsanitary landfills and dumpsites. Projections are based on the "business-as-usual" scenario which assumes that current policies remain unchanged in the foreseeable future.



Data source: OECD (2023)

OurWorldinData.org/plastic-pollution | CC BY

Note: Regional aggregates were calculated by Our World in Data and are based on those specified by the OECD¹.

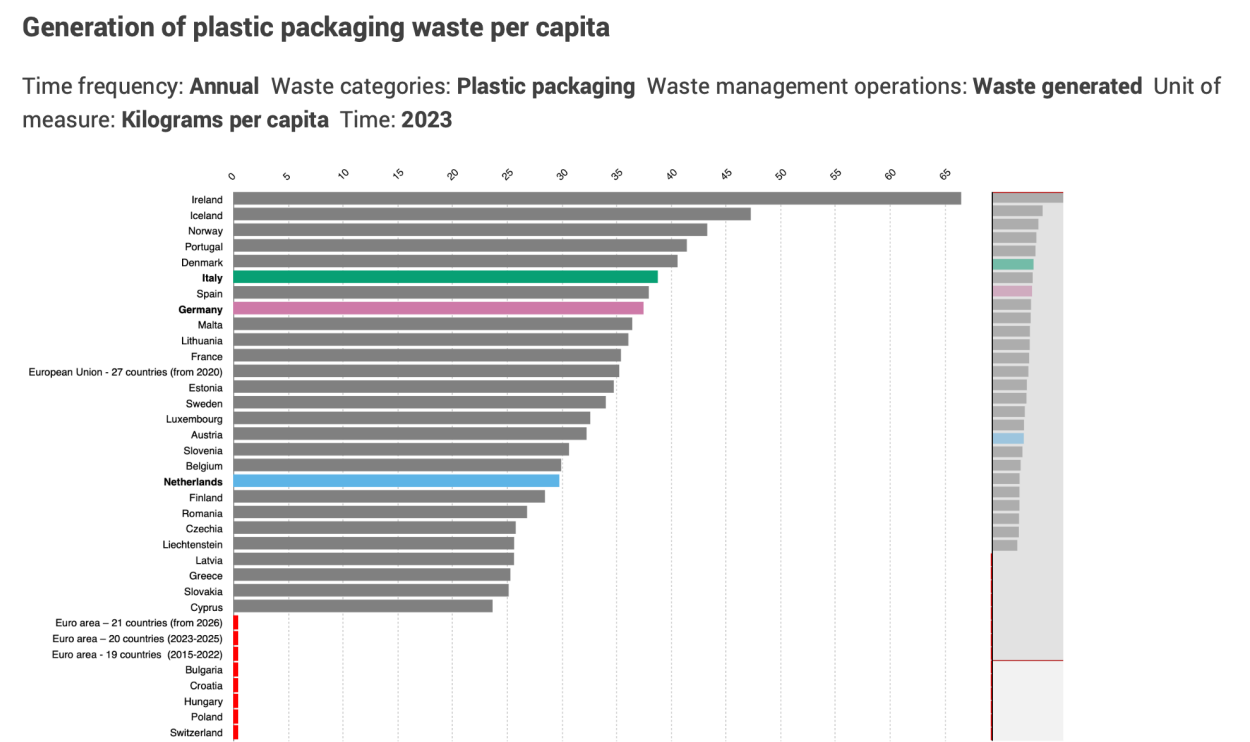
1. OECD regions The definitions of regions, as stipulated by the OECD, are:

- Other OECD America: Chile, Colombia, Costa Rica, Mexico
- OECD EU countries : Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden
- OECD Non-EU countries: Iceland, Israel, Norway, Switzerland, Turkey, United Kingdom
- OECD Oceania: Australia, New Zealand
- OECD Asia: Japan, Korea
- Latin America: Non-OECD Latin American and Caribbean countries
- Other EU: Bulgaria, Croatia, Cyprus, Malta, Romania
- Other Eurasia: Non-OECD European and Caspian countries, including Russian Federation
- Middle East & North Africa: Algeria, Bahrain, Egypt, Iraq, Islamic Rep. of Iran, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, United Arab Emirates, Syrian Arab Rep., Western Sahara, Yemen
- Other Africa: Sub-Saharan Africa
- China: People's Republic of China, Hong Kong (China)
- Other non-OECD Asia: Other non-OECD Asian and Pacific countries

Source: Our World in Data, based on OECD (2023) data.

Plastic packaging waste is also an important environmental issue in Europe. As shown in Figure 5, the amount of plastic packaging waste generated per person differs considerably among European countries. In 2023, Italy and Germany generated relatively high amounts of plastic packaging waste per capita, while the Netherlands had a lower level. However, all three countries generated considerable amounts of plastic packaging waste. Since Italy, Germany, and the Netherlands are also the countries included in the consumer survey of this study, these data provide useful background for understanding the importance of packaging waste in the selected study area. The differences between European countries also show that plastic packaging waste remains an important challenge across Europe (Eurostat, 2023).

Figure 5. Generation of plastic packaging waste per capita in European countries, 2023.

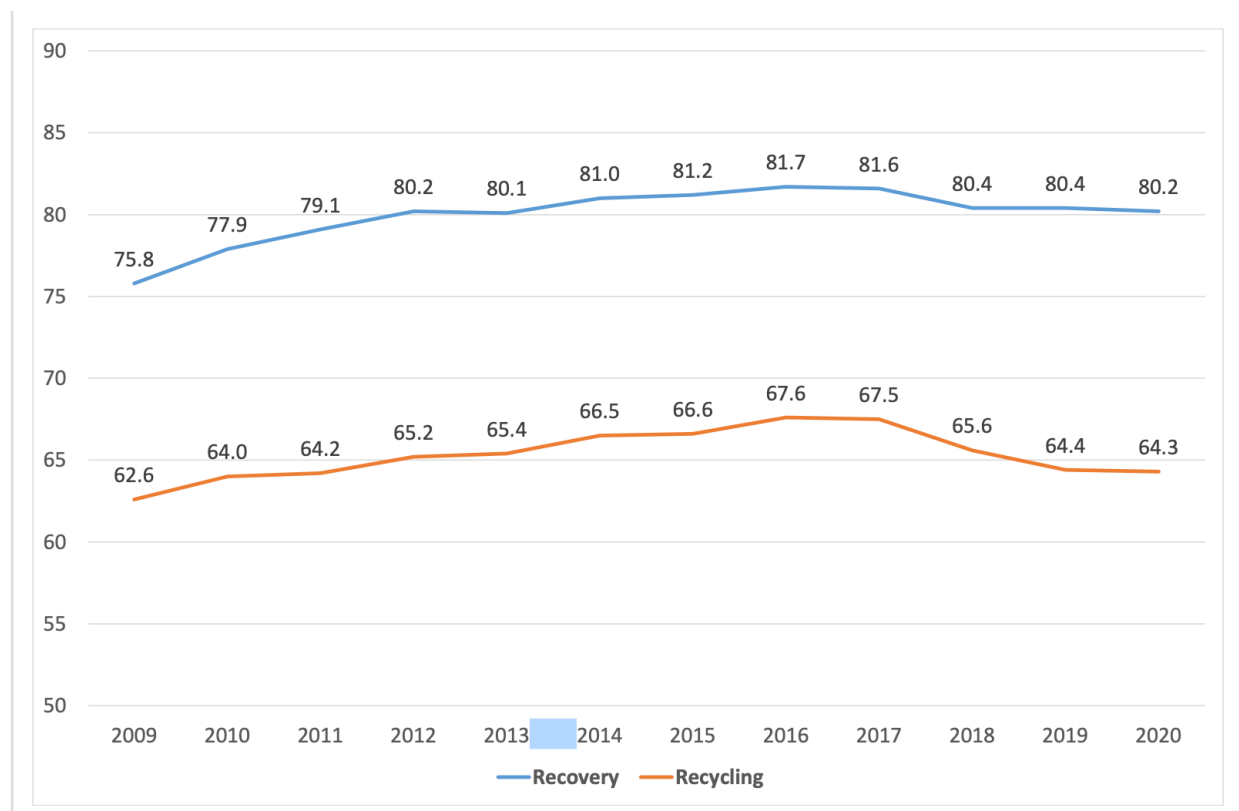


Source: Eurostat (2023).

In the European Union, the amount of packaging waste has increased considerably in recent years. Between 2009 and 2020, the total amount of packaging waste generated in the EU increased by approximately 20%, or 13 million tonnes. In 2020, around 79 million tonnes of packaging waste were generated, equal to approximately 177 kg per person, compared with 150 kg per person in

2009. However, considerable differences were observed among EU Member States. Paper and cardboard represented the largest share of packaging waste (41%), followed by plastic (19.5%), glass (19%), wood (15%), and metal (5%). Plastic packaging waste increased by 27% between 2009 and 2020, while paper and cardboard waste increased by 25% during the same period. Although the amount of packaging waste increased, progress in recycling was relatively limited. As shown in Figure 6, the recycling rate for packaging waste increased from 62.6% in 2009 to a peak of 67.6% in 2016, before decreasing to 64.3% in 2020. A similar pattern can be observed for the recovery rate, which increased from 75.8% in 2009 to 81.7% in 2016, before falling slightly to 80.2% in 2020. This suggests that although the EU has made progress in the management of packaging waste, improvements in recycling have slowed in recent years. Therefore, reducing packaging waste and developing more sustainable packaging solutions remain important challenges in the EU.

Figure 6. Recycling and recovery rates of packaging waste in the EU, 2009–2020.



Source: Eurostat (2022), as reported in Ragonnaud (2024).

1.3 Other Strategies to Reduce Packaging Waste

Before discussing edible packaging, it is important to recognize that it is only one of several approaches developed to reduce food packaging waste and improve the sustainability of food systems. The increasing amount of plastic waste, the use of non-renewable resources, growing environmental awareness, and the development of circular economy policies have increased interest in more sustainable packaging solutions. Although conventional plastic packaging still plays an important role in protecting food and extending shelf life, current research also focuses on reducing its environmental impact through better packaging design, renewable materials, new technologies, and improved waste management. These strategies aim to reduce packaging waste while also maintaining food quality and reducing food loss throughout the supply chain (Murugesan & Li, 2026; Nilsen-Nygaard et al., 2021; Oliveira et al., 2025; Operato et al., 2025). One important strategy is packaging optimization, which aims to reduce the amount of material used while maintaining the main functions of packaging, such as food protection, preservation, transportation, and convenience. This approach is closely related to eco-design, where environmental impacts are considered throughout the life cycle of a package, from raw material production to its use and final disposal. Life Cycle Assessment (LCA) can also be used to compare different packaging alternatives and identify options with lower environmental impacts while maintaining food quality and safety (Operato et al., 2025). Another important approach is the development of bio-based and biodegradable packaging materials. Unlike conventional petroleum-based plastics, bio-based materials are partly or fully produced from renewable biological resources. Examples include polylactic acid (PLA), polyhydroxyalkanoates (PHAs), and natural biopolymers such as cellulose, starch, alginate, chitosan, and proteins. Some of these materials can also be biodegradable or compostable under suitable conditions. However, they still have several limitations, including poor moisture resistance in some applications, weaker mechanical properties, higher production costs, and difficulties with large-scale production (Nilsen-Nygaard et al., 2021). Recycling, reuse, and circular packaging systems are also important strategies for reducing packaging waste. Packaging can be designed to make collection, sorting, recycling, and reuse easier. In Europe, current packaging policies increasingly support recyclable packaging, the use of recycled materials, the reduction of unnecessary packaging, and reuse and refill systems. These approaches aim to keep packaging materials in use for longer and reduce the amount of waste

generated. However, recycling alone cannot completely solve the packaging waste problem because some packaging systems, particularly complex or multi-material packages, can be difficult or expensive to recycle (Operato et al., 2025). Another strategy is the development of active and intelligent packaging technologies. Active packaging can interact with food or the environment around it through systems such as oxygen scavengers, moisture absorbers, antimicrobial agents, and antioxidants. These technologies can help delay food deterioration and extend shelf life. Intelligent packaging, in contrast, can provide information about food quality and storage conditions through technologies such as freshness indicators, RFID tags, and time-temperature indicators. More recently, artificial intelligence (AI) has also been explored in relation to smart packaging, for example to support packaging design, shelf-life prediction, material selection, and supply-chain management (Murugesan & Li, 2026). In addition to packaging innovations, advanced food-processing technologies can support the development of more sustainable food systems. Technologies such as high-pressure processing (HPP), cold plasma, ultraviolet (UV) treatment, microwave processing, and ultrasound can help improve food safety and extend shelf life. Some of these technologies can also be combined with biodegradable packaging materials to improve their functional properties. At the same time, consumer awareness, clear environmental labeling, and cooperation between manufacturers, retailers, waste-management companies, policymakers, and consumers are important for developing more circular packaging systems (Nilsen-Nygaard et al., 2021). Despite these developments, conventional petroleum-based plastics are still widely used in food packaging because of their low cost, light weight, and useful functional properties. However, concerns about fossil-resource use, plastic waste, and environmental pollution have increased interest in alternative materials. Among these alternatives, edible packaging is particularly interesting because the packaging itself can be consumed together with the food or can be made from food-grade materials. Depending on its composition and application, edible packaging may also help protect food, extend shelf life, and reduce the need for some conventional packaging materials. For these reasons, edible packaging has received increasing attention as one possible approach to more sustainable food packaging systems (Nair et al., 2023).

1.4 Sustainable Packaging

1.4.1 Definition of Sustainable Packaging

Sustainable food packaging can be defined as a packaging solution that protects food effectively while considering environmental, economic, social, and food-safety aspects throughout the whole life cycle of the food–package system. It should reduce the use of resources and environmental impacts, maintain food quality and safety, and support circular solutions such as reuse, recycling, or recovery where possible (Dörnyei et al., 2023). Sustainable packaging aims to reduce the environmental impacts associated with the production, use, and end-of-life of packaging while still meeting its main functional and economic requirements. It should provide adequate protection for the product while using materials and resources efficiently and reducing negative impacts on the environment. According to the Sustainable Packaging Coalition [SPC], 2023, sustainable packaging should consider environmental performance together with the functional and economic needs of the packaging system. Sustainable packaging should also be effective, safe, and compatible with circular systems. It should use energy and materials efficiently, support material recovery where possible, and avoid negative effects on human health and ecosystems (Australian Sustainable Packaging Alliance [ASPA], 2005). In addition, sustainability should be considered throughout the entire life cycle of packaging. This includes the responsible sourcing of materials, efficient and safe production and use, affordability, consumer needs, and suitable end-of-life options such as recycling or recovery. (The European Organisation for Packaging and the Environment [EUROPEN], n.d.).

1.4.2 Types of Sustainable Food Packaging

Different packaging approaches have been developed to reduce the environmental impacts associated with food packaging. Biodegradable packaging is made from materials that can be broken down by microorganisms under suitable environmental conditions. The rate and level of biodegradation depend on the characteristics of the material and conditions such as temperature, moisture, and the presence of microorganisms. Compostable packaging is a specific type of biodegradable packaging designed to break down under defined composting conditions. During this process, the material is converted into substances such as carbon dioxide, water, and biomass

without leaving harmful residues under the required composting conditions. However, the terms biodegradable and compostable should not automatically be considered equal to environmentally sustainable. Their environmental performance depends on several factors, including the raw materials used, production processes, disposal conditions, and the availability of suitable waste-management infrastructure. Recyclable packaging includes materials that can be collected and processed to produce new materials or products. Common examples include paper, glass, metals, and certain types of plastics. Another approach is zero-waste packaging, which focuses on preventing and reducing packaging waste through actions such as avoiding unnecessary packaging, reusing containers, and recycling materials where possible (Thapliyal et al., 2024).

1.4.3 Sustainable Packaging Materials

Different materials can contribute to more sustainable food-packaging systems depending on their production, use, and end-of-life conditions.

- Paper and cardboard are widely used because they can be recyclable and biodegradable and are relatively inexpensive and easy to print. However, coatings or additional layers may affect their recyclability and environmental performance.
- Glass can be reused and recycled and provides strong barrier properties against moisture and gases. However, its high weight and risk of breakage can create disadvantages during transportation.
- Metals, particularly aluminium and steel, provide good mechanical and barrier properties and can be recycled. However, their overall environmental performance also depends on factors such as production and recycling processes.
- Plastics are lightweight and can provide good barrier properties and protection against contamination. Some plastic types can be recycled, although their actual recycling depends on the material, package design, collection system, and available recycling infrastructure.
- Bio-based and biodegradable polymers are increasingly studied as alternatives to conventional petroleum-based plastics. They can be produced from different renewable resources, including plant biomass and microorganisms. However, bio-based materials are not necessarily biodegradable, and biodegradable materials are not necessarily bio-based.

- Materials based on starch and other plant-derived resources can provide biodegradable alternatives for some packaging applications.
- Innovative materials such as mushroom-based packaging and materials produced from agricultural by-products, including avocado-seed waste, are also being investigated as possible alternatives to conventional packaging materials (Thapliyal et al., 2024).

1.5 Edible Packaging as a Sustainable Innovation

Edible food packaging is considered a possible sustainable alternative to some conventional packaging because it is produced from food-grade materials that are safe for human consumption. Depending on its function, edible packaging can be neutral, active, or intelligent. Active edible packaging may contain functional ingredients such as antioxidants, vitamins, or antimicrobial agents that can help extend shelf life, maintain food quality, and improve food safety. Unlike conventional packaging, edible packaging is designed so that it can be consumed together with the food or safely removed and discarded. Edible packaging is commonly produced in the form of films or coatings. Edible coatings are applied directly to the surface of food, while edible films are generally produced separately and then applied to or used around the product. These materials can provide a barrier against moisture, oxygen, microorganisms, and other external factors. They can also act as carriers for functional compounds. Common materials used to produce edible films and coatings include starch, cellulose derivatives, chitosan, gums, proteins from plant or animal sources, and lipids. The thickness and barrier properties of edible packaging depend on the material and its intended application. Edible packaging must also meet food-safety requirements before commercial use. The idea of edible packaging is not completely new. Different forms of edible coatings have been used for food preservation for centuries. Historical examples include the use of wax on fruits to reduce moisture loss and the development of protein-based films such as Yuba films in Asia. Other traditional methods included coating foods with waxes or fats to protect them during storage. These early applications show that the idea of using edible materials to protect food existed long before the development of modern plastic packaging. Interest in edible packaging decreased with the widespread availability of inexpensive conventional plastics during the twentieth century. However, growing concerns about plastic waste and increasing interest in more sustainable food-packaging systems have renewed attention to edible films and coatings. Today,

edible packaging is being studied as one possible way to reduce the use of conventional packaging materials while maintaining food quality and safety (Nair et al., 2023). An interesting possible application of edible packaging is in takeaway food and beverages, including coffee. Takeaway drinks normally require single-use packaging, which contributes to packaging waste. Conventional paper coffee cups may also contain a plastic-based lining, which can make their recycling more difficult. Therefore, alternative solutions for takeaway beverages have received increasing attention. In this study, edible coffee cups are used as a case study to explore consumer attitudes towards edible packaging. Although this type of packaging may offer an alternative to conventional single-use packaging, its practical use also depends on factors such as cost, hygiene, safety, taste, convenience, and consumer acceptance. Understanding these factors is therefore important when considering the possible future use of edible packaging.

1.6 Research Problem and Justification

Although different sustainable packaging solutions are being developed, many alternatives to conventional packaging are still not widely used in the market. Edible packaging is one possible solution, but its successful introduction depends not only on its technical properties but also on whether consumers are willing to accept and use it. Consumer acceptance can be influenced by several factors. For example, people may have concerns about hygiene, food safety, taste, price, or the practical use of edible packaging. At the same time, consumers may have positive attitudes towards these products because of their potential environmental benefits and their ability to reduce the use of conventional single-use packaging. Understanding these perceptions is important because even a technically successful packaging innovation may have limited market potential if consumers are unwilling to use it. There is therefore a need to better understand how consumers perceive edible packaging and which factors may encourage or prevent its acceptance. This is particularly relevant in the European context, where reducing packaging waste and developing more sustainable packaging systems have become important environmental goals. For these reasons, this study focuses mainly on consumer awareness, perceptions, concerns, willingness to try, and willingness to pay for edible packaging. A consumer survey conducted in Italy, Germany, and the Netherlands is used to explore these issues and to identify some of the main factors that may influence consumer acceptance of edible packaging.

1.7 Objectives and Research Questions

The main goal of this study is to evaluate edible packaging as a sustainable solution in the European market.

The objectives are:

- To understand consumer awareness of edible packaging
- To study willingness to try and willingness to pay
- To identify factors that influence consumer decisions

Research questions:

Would the consumer accept edible food packaging as a sustainable innovation and which factors may encourage or prevent its acceptance?

1.8 Scope and Limitations

This study focuses on consumer acceptance of edible food packaging in the European context, with particular attention to its potential application to takeaway coffee packaging. The consumer study was conducted through an online questionnaire distributed among respondents in Italy, Germany, and the Netherlands. The study examines consumer awareness, previous experience, perceptions, concerns, willingness to try, willingness to pay, and other factors that may influence the acceptance of edible packaging. Italy, Germany, and the Netherlands were selected because they provide different European contexts in terms of food culture, consumer behaviour, sustainability, and waste-management practices. Previous research has shown that consumer perceptions and preferences related to sustainable food packaging can differ between European countries. These differences may be connected to environmental awareness, cultural attitudes, packaging preferences, and waste-management systems. Including respondents from three different countries therefore provides an opportunity to explore both common and country-specific attitudes towards edible packaging (Norton et al., 2026). The Netherlands provides an interesting context because of its strong focus on recycling and the circular economy. The Dutch government

has established ambitious circular-economy goals, including the aim of developing a fully circular economy by 2050. Research has also shown that European countries differ in their recycling systems, collection methods, and approaches to plastic-packaging management. These characteristics make the Netherlands relevant for studying consumer attitudes towards more sustainable packaging solutions (Çevikarslan et al., 2022). Germany is another important market for packaging and plastics in Europe. The German packaging industry has increasingly focused on sustainability and circular-economy approaches, including innovation in packaging materials and design. Sustainable packaging has also become more important for consumers and companies. These developments make Germany a relevant context for investigating attitudes towards new packaging solutions (Gavazzi et al., 2022). Germany is also an important country in the European coffee sector. Research on the German coffee value chain has highlighted increasing attention to sustainability and circular-economy approaches. At the same time, further innovation is needed in areas such as packaging and the use of resources within the coffee value chain. This connection between coffee consumption, industry, and sustainability supports the inclusion of Germany in a study focusing on edible packaging for takeaway coffee (Venus et al., 2024). Italy was selected because food culture and food preservation have an important role in the Mediterranean context. The Mediterranean food system also faces challenges related to food waste, preservation, and packaging sustainability. Research in this area has highlighted the importance of considering consumer acceptance together with the technical performance of innovative food-packaging solutions (de Chiara et al., 2026). Italy is particularly relevant to the case study of takeaway coffee because coffee has an important cultural and economic role in the country. Coffee, especially espresso, is strongly connected to Italian food culture and everyday consumption habits. Research has also discussed changes in coffee-purchasing habits and the increasing use of convenient single-serve coffee systems. These characteristics make Italy an interesting context for studying consumer responses to innovative packaging solutions related to coffee (Lanfranchi et al., 2016). However, this study has several limitations. The survey sample is relatively small and was collected through an online questionnaire. Therefore, the respondents cannot be considered representative of the populations of Italy, Germany, and the Netherlands or of European consumers in general. Differences in the number and demographic characteristics of respondents from each country may also limit direct comparisons between the three countries. In addition, the study examines stated perceptions and intentions rather than actual consumer behaviour. Respondents reported whether

they would be willing to try or pay for edible packaging, but they did not make a real purchasing decision. They also did not physically test an edible coffee cup during the survey. Therefore, factors such as actual taste, texture, appearance, hygiene perception, and practical experience could influence consumer acceptance differently in a real-life situation. Finally, this research focuses mainly on the consumer perspective. It does not conduct a complete environmental Life Cycle Assessment (LCA), techno-economic assessment, or industrial feasibility analysis of edible coffee cups. Therefore, the findings should not be interpreted as evidence that edible coffee cups have lower environmental impacts than conventional coffee cups. Instead, the study provides information about how consumers perceive edible packaging and the factors that may support or limit its acceptance.

CHAPTER 2 — FOOD PACKAGING EVOLUTION

2.1 The Role of Packaging in the Food Industry

Food packaging plays an important role in protecting food, containing products safely, and providing consumers with essential information, such as ingredients, nutritional values, storage conditions, and expiry dates. Modern packaging can also support traceability, convenience, and tamper evidence, which are important for both food manufacturers and consumers. An effective packaging system should protect the product and maintain its quality and safety throughout the supply chain. One of the main functions of food packaging is protection and preservation. Packaging can slow food deterioration, extend shelf life, and help maintain the nutritional quality and safety of food products. In general, packaging protects food against three main types of external hazards: chemical, biological, and physical. Chemical protection helps reduce changes caused by factors such as oxygen, moisture, and light, which can lead to oxidation, nutrient loss, changes in color, and food deterioration. Different packaging materials provide different levels of protection. For example, glass and metal generally provide strong barrier properties, while the barrier properties of plastics depend on the type and composition of the material. Biological protection helps prevent food contamination by microorganisms, insects, rodents, and other pests. Suitable packaging can also help maintain appropriate conditions around the food and reduce exposure to factors that may accelerate spoilage. Physical protection reduces mechanical damage during transportation, storage, and handling. Materials such as paperboard and corrugated cardboard can protect food from impacts, vibration, and compression. Packaging design can also improve consumer safety through features such as tamper-evident and child-resistant closures. Overall, food packaging is essential for maintaining food quality and safety, extending shelf life, reducing physical damage, and protecting products during transportation, storage, and distribution (Marsh & Bugusu, 2007).

2.2 Food Packaging and Sustainability

The environmental impact of food packaging depends on several factors, including the type of material, production process, transportation, reuse, recycling, and end-of-life treatment. Previous studies have used Life Cycle Assessment (LCA) to compare packaging materials and evaluate impacts such as greenhouse gas emissions and resource use. This section reviews findings from the literature on the environmental performance of common food packaging materials, including plastic, glass, metal, paper and cardboard, as well as unpackaged food. The results reported in previous studies show that no single packaging material is always the most sustainable option, as its environmental performance depends on the product and the whole packaging system.

Plastic Packaging

Plastic is widely used for food packaging because it is lightweight, relatively inexpensive, and versatile. Common plastics used in food packaging include polypropylene (PP) and polyethylene terephthalate (PET), while polylactic acid (PLA) is increasingly studied as an alternative material. According to the studies reviewed by (Otto et al., 2021) the production of PP containers can generate approximately 3.94 kg CO₂ eq. per kg, compared with around 2.95 kg CO₂ eq. per kg for PET bottles and 3.05 kg CO₂ eq. per kg for PLA bottles. However, these values can vary depending on the production system, energy source, and assumptions used in the environmental assessment. Reuse can considerably improve the environmental performance of some plastic packaging systems. For example, reusable PET bottles can be used several times, and some studies have reported reductions in greenhouse gas emissions of up to 70% compared with single-use alternatives. PLA can biodegrade under suitable industrial composting conditions, which normally require controlled temperature, moisture, and microbial activity. However, its degradation can be much slower under natural environmental conditions. The recycling of plastic packaging also remains challenging because different polymers, additives, and multi-layer materials can make collection and separation difficult. Therefore, the environmental performance of plastic packaging strongly depends on appropriate collection, recycling, reuse, or end-of-life treatment.

Glass Packaging

Glass is produced mainly from raw materials such as sand, soda ash, and limestone. Its production requires high temperatures and therefore considerable energy. According to the studies reviewed in the literature, producing 1 kg of glass can generate approximately 0.898 kg CO₂ eq., while the production of an average glass bottle may generate around 0.296 kg CO₂ eq. Bottle production can therefore represent an important part of the total greenhouse gas emissions associated with bottled products. However, glass also has important advantages because it can be reused and recycled. Recycling glass generally requires less energy than producing new glass from raw materials. Reusing glass bottles can further reduce their environmental impact, especially when bottles are reused many times and transported over relatively short distances. Therefore, the environmental performance of glass packaging depends strongly on reuse rates, recycling systems, bottle weight, and transportation distances.

Metal Packaging

The main metals used in food packaging include aluminum and steel-based materials such as tinsplate. Metal packaging provides strong protection against light, gases, moisture, and physical damage. However, its production can require considerable amounts of energy and resources. According to the reviewed literature, the production of a metal can generate approximately 0.245 kg CO₂ eq., although the environmental impact varies depending on the type of metal, production process, and food product. An important advantage of metal packaging is its high recycling potential. The reviewed literature reports high recycling rates for metal packaging in Europe, although these rates differ among countries. Recycling metals can reduce the need for virgin raw materials and lower some environmental impacts associated with primary production. However, effective collection and recycling systems are necessary to achieve these benefits.

Paper and Cardboard Packaging

Paper and cardboard are widely used in food packaging and are mainly produced from wood fibers and recycled materials. They are based on renewable resources and can have relatively high recycling rates. However, their production still requires energy, water, land, and other resources, meaning that paper-based packaging is not automatically free from environmental impacts. Paper

and cardboard are among the most commonly recycled packaging materials in Europe. However, paper fibres cannot be recycled indefinitely because their quality decreases after repeated recycling. In addition, food packaging made from paper or cardboard often includes coatings or layers of plastic or aluminium to provide better resistance to moisture, oxygen, or grease. These combinations can make recycling more difficult.

Loose (Unpackaged) Food

Selling food without packaging can reduce the amount of packaging material used and has become an important part of some zero-waste approaches. However, unpackaged food does not always have a lower overall environmental impact. The environmental performance of a food product depends on several factors, including production, processing, transportation, storage, and food waste. For example, the environmental impact of producing the food itself can sometimes be much greater than that of its packaging. Packaging can help protect food and extend shelf life, which may reduce food losses. The reviewed literature reports cases in which suitable packaging significantly reduced food waste, including a reduction in beef waste from 34% to 18%. Therefore, removing packaging without considering its role in food preservation may sometimes increase the overall environmental impact if it results in greater food waste. This relationship shows an important challenge in sustainable food packaging. The goal should not simply be to use the smallest possible amount of packaging, but to find a balance between reducing packaging impacts and preventing food waste. The most sustainable solution can therefore vary depending on the food product, packaging material, transportation system, consumer behaviour, and available waste-management infrastructure (Otto et al., 2021).

2.3 Environmental Impact of Traditional Packaging

Traditional packaging materials, especially plastics, are widely used in the food industry because they are lightweight, durable, relatively inexpensive, and suitable for many different food products. However, conventional plastic packaging is mainly produced from fossil-based resources and can remain in the environment for long periods when it is not properly collected or treated. The accumulation of plastic packaging waste has therefore increased interest in alternative materials and more sustainable packaging systems (Nair et al., 2023). The growing demand for ready-to-eat

foods, takeaway products, and convenience foods has contributed to an increase in the use of food packaging and the amount of packaging waste generated. Packaging is necessary for protecting food, extending shelf life, supporting transportation, and providing product information. These functions can also help reduce food loss and waste throughout the supply chain. However, packaging can create environmental impacts during different stages of its life cycle, including raw material extraction, manufacturing, transportation, and end-of-life treatment. Previous studies have used Life Cycle Assessment (LCA) to evaluate these impacts and compare different packaging systems. Conventional materials such as polyethylene terephthalate (PET), polypropylene (PP), polyethylene (PE), polystyrene (PS), glass, aluminium, and cardboard are frequently included in these assessments. The environmental performance of each material depends on several factors, including the amount of material used, production processes, transportation, reuse, recycling, and waste-management systems. Recycling can reduce some environmental impacts, but its effectiveness depends on appropriate collection, sorting, and recycling infrastructure. Therefore, improving packaging sustainability requires a combination of waste prevention, better packaging design, effective recycling, and the development of alternative materials (Koblianska et al., 2026). Among traditional packaging materials, plastic is a major environmental concern because of its large production volume and persistence in the environment. Plastic packaging can accumulate in landfills and natural environments when it is not properly managed. Over time, larger plastic items can also break down into smaller particles, including microplastics, which can enter terrestrial and aquatic ecosystems. The environmental impacts of plastics are not limited to their disposal. Conventional plastics require fossil resources and energy during production and can generate greenhouse gas emissions throughout their life cycle. Global plastic production has increased considerably, while packaging represents one of the largest areas of plastic use. These trends have increased concerns about resource consumption, waste generation, and plastic pollution. As a result, research and industry have increasingly focused on biodegradable, bio-based, recyclable, reusable, and other alternative packaging solutions that may support the transition towards more sustainable and circular packaging systems (Hariharan et al., 2025).

2.4 Edible Packaging: Definition, Materials, Types, Benefits and Challenges

Edible packaging has received increasing attention as a possible alternative to conventional food packaging. It includes edible films and edible coatings, which are produced from food-grade

materials and are designed to be safe for consumption. Edible packaging can protect food from physical, chemical, and biological factors while helping to maintain food quality and extend shelf life. It can also reduce moisture loss and gas transfer and can carry functional compounds such as antioxidants and antimicrobial agents (Chhikara & Kumar, 2022).

2.4.1 Edible Films and Edible Coatings

Although edible films and edible coatings have similar functions, they differ mainly in the way they are produced and applied. Edible films are usually produced separately as thin layers and are later used to wrap, cover, or separate food products. In contrast, edible coatings are formed directly on the surface of food by methods such as dipping, spraying, or brushing. Both films and coatings can act as barriers between food and the surrounding environment. They can reduce the transfer of moisture, oxygen, and other gases and may help delay food deterioration. They have been applied to different products, including fruits, vegetables, meat, dairy products, and bakery products (Kumar et al., 2023).

2.4.2 Materials Used in Edible Packaging

Materials used for edible packaging can generally be divided into three main groups: polysaccharides, proteins, and lipids. Polysaccharides include materials such as starch, cellulose, pectin, alginate, chitosan, carrageenan, and agar. These materials generally have good film-forming properties and can provide useful barriers against gases. Proteins used in edible packaging include gelatin, collagen, casein, whey protein, soy protein, wheat gluten, and zein. Protein-based materials can provide good mechanical and oxygen-barrier properties and can be produced from both plant and animal sources. Lipids, including waxes, fatty acids, and vegetable oils, are particularly useful for improving water resistance and reducing moisture loss. However, no single material provides all the properties required for every food-packaging application. For this reason, different materials can be combined to produce composite edible packaging. Other substances, such as plasticizers, essential oils, plant extracts, and active compounds, can also be added to improve flexibility, barrier properties, or antimicrobial and antioxidant activity (Kumar et al., 2023).

2.4.3 Benefits of Edible Packaging

One of the main potential advantages of edible packaging is the possibility of reducing the use of some conventional single-use packaging materials. Because edible films and coatings are produced from food-grade materials and can be consumed with the food in suitable applications, they may reduce the amount of packaging that needs to be discarded. Edible packaging can also provide important functional benefits. Films and coatings can act as barriers against moisture and oxygen and can help reduce oxidation, water loss, and microbial deterioration. As a result, they may help maintain food quality and extend shelf life. Another important advantage is the possibility of developing active edible packaging. Antioxidants, antimicrobial compounds, vitamins, probiotics, flavours, and plant extracts can be incorporated into edible materials. These compounds can provide additional functions related to food preservation, safety, sensory properties, and nutritional quality (Nair et al., 2023; Otto et al., 2021).

2.4.4 Protein-Based Edible Packaging

Among the different materials used for edible packaging, proteins have received considerable research attention because of their film-forming ability and useful barrier properties. Protein-based films can be produced from animal sources, such as gelatin, casein, and whey protein, or plant sources, such as soy protein, wheat gluten, and corn zein. Protein-based films can provide good barriers against oxygen, carbon dioxide, lipids, and aroma compounds. They can also carry active substances such as antimicrobial agents and antioxidants. These characteristics have supported their application to different food products, including fruits, vegetables, meat, fish, and dairy products. However, protein-based packaging also has limitations. Many protein films have relatively poor resistance to water vapour because of their hydrophilic nature, and their mechanical and thermal properties may be weaker than those of conventional plastics. Different strategies, including combining proteins with polysaccharides or lipids and using cross-linking or reinforcement methods, have therefore been investigated to improve their performance (Milani & Tirgarian, 2020).

2.4.5 Challenges and Limitations

Despite its potential benefits, edible packaging still faces several challenges that limit its wider commercial application. One important technical limitation is that many edible materials have lower mechanical strength and poorer moisture resistance than conventional plastic packaging. This can make them unsuitable for products with high moisture levels or products requiring long storage periods. Commercialization is another challenge. Although many edible films and coatings have shown promising results in laboratory studies, large-scale industrial production remains limited. Production costs, manufacturing processes, material stability, storage conditions, and the maintenance of sensory and functional properties are important issues that still need improvement (Shit & Shah, 2014). Consumer acceptance is also an important issue. Since edible packaging may be consumed together with food, consumers may have concerns about hygiene, safety, taste, texture, appearance, and price. These factors are particularly important for the present study because the technical development of edible packaging alone does not guarantee that consumers will be willing to purchase or consume it. Recent developments in nanotechnology and active packaging may help improve some properties of edible films and coatings. For example, nanoemulsions, nanofibers, nanoparticles, and encapsulation systems have been investigated to improve mechanical and barrier properties and to control the release of active compounds. However, further research is still needed regarding safety, cost, industrial production, and consumer acceptance before these technologies can be widely applied (Trajkovska Petkoska et al., 2021).

2.5 Consumer Behavior Toward Sustainable Packaging

Consumer behavior plays an important role in the successful adoption of sustainable packaging. Although environmental awareness has increased in recent years, consumers do not make purchasing decisions based only on environmental concerns. Factors such as price, convenience, packaging performance, environmental awareness, and trust can influence whether consumers choose products with sustainable packaging. Therefore, understanding consumer attitudes and preferences is important for developing packaging solutions that are both environmentally responsible and acceptable to consumers (Jain & Hudnurkar, 2022).

2.5.1 Consumer Awareness and Perception

Consumers do not always have a complete understanding of what makes packaging sustainable. Some consumers mainly associate sustainability with visible characteristics such as recyclability, biodegradability, or the use of paper instead of plastic. However, the environmental impact of packaging also depends on other factors, including production, transportation, reuse, recycling, and end-of-life treatment. This difference between consumer perception and scientific environmental assessment can affect purchasing decisions. For example, consumers may consider glass or paper more sustainable because these materials are familiar and recyclable, although their actual environmental performance depends on the complete packaging system. This shows that consumer perceptions of sustainability are not always the same as environmental impacts identified through scientific assessment (Boz et al., 2020).

2.5.2 Trust and Environmental Information

Trust is another important factor in consumer acceptance of sustainable packaging. Consumers often depend on labels, environmental claims, symbols, and packaging design when deciding whether a product is environmentally friendly. Clear information and reliable eco-labels can therefore help consumers make more informed choices. However, misleading or unclear environmental claims can reduce consumer confidence. This problem is often associated with greenwashing, where environmental benefits are presented without sufficient evidence or in a misleading way. Consumers may become skeptical when companies use vague environmental claims, green colours, or sustainability symbols without clear explanations. Transparent information and credible environmental claims are therefore important for building consumer trust (Boz et al., 2020).

2.5.3 Attitude–Behavior Gap

Positive attitudes towards sustainable packaging do not always result in actual sustainable purchasing behavior. This difference is commonly described as the attitude–behavior gap or value–action gap. Consumers may express strong support for environmentally friendly packaging in surveys but still choose conventional products when making real purchasing decisions. Several

practical factors can explain this difference. Sustainable packaging may be more expensive, less available, or perceived as less convenient than conventional packaging. Consumers may also have concerns about product quality, safety, or packaging performance. Therefore, environmental benefits alone may not be enough to encourage consumers to change their purchasing behavior. Sustainable packaging should also meet consumer expectations regarding price, quality, convenience, and functionality (Boz et al., 2020).

2.5.4 Willingness to Pay

Willingness to pay (WTP) is an important indicator of consumer acceptance of sustainable packaging. Previous research generally suggests that some consumers are willing to pay a higher price for products with environmentally friendly packaging. However, the level of willingness to pay differs depending on the product, country, packaging type, environmental awareness, income, and individual preferences. Environmental concern, personal values, social norms, and green self-identity can increase willingness to pay. Consumers who consider environmental protection personally important may be more willing to accept an additional cost. However, concerns about hygiene, convenience, quality, or packaging performance may reduce this willingness. Studies also report different levels of acceptable price premiums. Some research reviewed in the literature reports willingness to pay premiums of around 10–20%, while other studies have found that many consumers accept only relatively small additional costs. This variation shows that willingness to pay should not be treated as a fixed value and can depend strongly on the research context and consumer group (Kozik-Kołodziej, 2026).

2.5.5 Factors Influencing Sustainable Packaging Choices

Consumer decisions about sustainable packaging are influenced by a combination of environmental, psychological, social, and demographic factors. Environmental concern and environmental knowledge can increase consumers' interest in sustainable products, while price, quality, functionality, and convenience continue to play an important role in actual purchasing decisions. The Theory of Planned Behavior (TPB) is frequently used to explain these decisions. According to TPB, behavioral intention is influenced by three main factors: attitude, subjective norms, and perceived behavioral control. In the context of sustainable packaging, consumers with

positive environmental attitudes may have stronger intentions to purchase sustainably packaged products. Social influences, including the opinions of family and friends, can also affect their decisions, while perceived behavioral control is related to whether consumers believe they have the opportunity and resources to make a sustainable choice. However, environmental awareness alone does not guarantee sustainable behavior. Research has shown that consumers may value environmentally friendly packaging but still give greater importance to price or other practical product characteristics when making a purchase (Martinho et al., 2015). Environmental knowledge and trust can also strengthen purchase intentions. Consumers who understand environmental information and trust sustainability claims may feel more confident when selecting sustainable products. In contrast, misleading information can reduce trust and negatively affect purchase intention. Research also suggests that different consumer groups may be motivated by different factors. Some consumers may focus more strongly on environmental benefits, while others may be more influenced by price, information, or social factors (Petkowicz et al., 2024).

2.5.6 Packaging Design and Product Type

The design of packaging can also influence consumer perceptions before a product is purchased. Characteristics such as material, size, shape, colour, labels, and the amount of packaging used can affect how consumers evaluate the sustainability of a product. Excessive packaging may be viewed negatively because consumers can associate it with unnecessary waste. Consumer responses may also differ depending on the type of food product. Research suggests that consumers do not evaluate sustainable packaging in exactly the same way across all product categories. Therefore, packaging design should consider both environmental characteristics and the expectations consumers have for the particular food product (Seo et al., 2016).

2.5.7 Relevance to Edible Packaging

These findings are particularly important for edible packaging, where consumer acceptance may involve additional considerations beyond general environmental sustainability. Consumers may recognize the environmental benefits of reducing conventional packaging waste but may also have concerns about hygiene, food safety, taste, texture, convenience, and price. Therefore, the successful adoption of edible packaging depends not only on its technical and environmental

characteristics but also on how consumers understand and evaluate the product. Awareness, trust, perceived benefits and risks, willingness to try, and willingness to pay are therefore important factors to investigate when studying consumer acceptance of edible packaging.

2.6 Life Cycle Assessment in Packaging Sustainability

Life Cycle Assessment (LCA) is widely used in the scientific literature to evaluate the environmental impacts of packaging systems. It is a standardized method based on ISO 14040 and ISO 14044 and considers different stages of a product's life cycle, including raw material extraction, manufacturing, transportation, use, and end-of-life treatment. Depending on the scope of the study, end-of-life processes may include recycling, incineration, composting, or landfill. LCA therefore provides a useful framework for understanding the environmental impacts associated with different packaging systems (Molina-Besch et al., 2019). LCA is particularly relevant to food packaging because packaging can have both positive and negative environmental effects. Producing and disposing of packaging requires materials and energy and can generate emissions. However, packaging also protects food, extends shelf life, supports transportation, and can reduce food loss and waste. Therefore, focusing only on the environmental impact of the packaging material may provide an incomplete picture. The environmental impact of the food itself and the amount of food waste prevented by packaging should also be considered. An important limitation of some traditional packaging LCAs is that they do not fully consider packaging-related food loss and waste (FLW). Inadequate packaging may increase food spoilage, damage during transportation, or food residues remaining inside the package. Since the environmental impact of producing wasted food can sometimes be greater than that of the packaging, excluding these losses may lead to incomplete conclusions about the sustainability of a packaging system (Pauer et al., 2019). Another important issue is that LCA results can vary considerably between studies. Differences in functional units, system boundaries, geographical location, energy systems, recycling rates, databases, and end-of-life assumptions can lead to different results even when similar packaging materials are evaluated. For this reason, LCA results should always be interpreted in relation to the assumptions and methods used in each study (Bher & Auras, 2024). Studies comparing beverage packaging also show that there is no single packaging material that is environmentally superior in every situation. For example, environmental performance can change depending on the type of material, the amount of recycled content, the recycling rate, the type of beverage, and the

life-cycle stages included in the assessment. Recycled materials can reduce some environmental impacts compared with virgin materials, but the results remain dependent on the specific packaging system and assessment conditions (Brock & Williams, 2020).

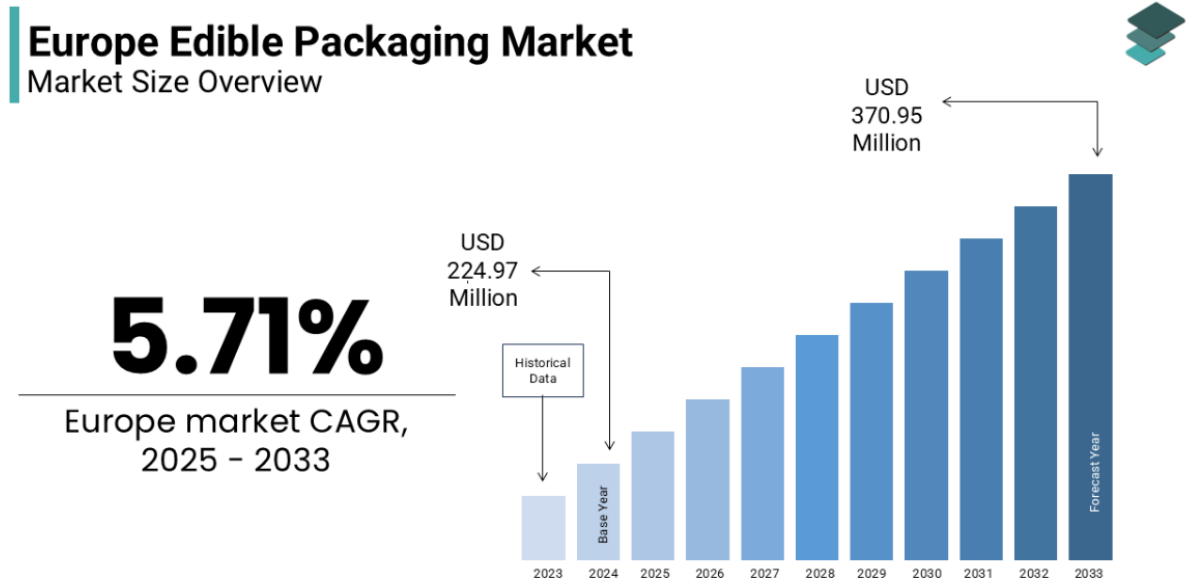
Overall, previous LCA research shows that packaging sustainability is a complex issue that cannot be evaluated only by considering whether a material is plastic, paper, glass, metal, biodegradable, or edible. The whole packaging system and its life cycle should be considered. LCA therefore provides valuable scientific evidence for understanding the environmental performance of packaging alternatives. However, the present study does not conduct an original LCA. Instead, LCA findings from previous studies are used only as background literature to provide context for the sustainability discussion.

2.7 Edible Packaging and the EU Market

Interest in sustainable packaging has increased in Europe as environmental concerns, consumer awareness, and policies related to packaging waste have become more important. Both consumers and businesses are paying greater attention to packaging materials, recyclability, waste reduction, and circular-economy principles. Regulations and consumer expectations can also encourage companies to develop packaging solutions with lower environmental impacts (Wandosell et al., 2021). Research on green packaging shows that consumer demand is an important factor in the development of more sustainable packaging solutions. However, consumer decisions are influenced not only by environmental concerns but also by factors such as price, packaging design, material type, biodegradability, and recyclability. From a business perspective, companies also need to consider costs, regulations, production requirements, supply chains, and waste management when introducing new packaging solutions (Wandosell et al., 2021). Within this wider movement towards sustainable packaging, edible packaging represents an emerging market opportunity. Commercial market reports indicate that the European edible-packaging market is expected to grow during the coming years. This development is connected to increasing interest in alternatives to conventional single-use packaging and demand for more sustainable food-packaging solutions. However, edible packaging is still an emerging technology compared with established packaging materials and systems. The food and beverage sector represents an important potential application area for edible packaging. Edible films and coatings can be used for different

food products, including fruits, vegetables, bakery products, and other foods where they may provide protective or functional properties. Different materials, including polysaccharides, proteins, and lipids, are being investigated for these applications. Their suitability depends on factors such as barrier properties, mechanical performance, food safety, production requirements, and the characteristics of the food product. Despite its potential, the wider commercialization of edible packaging in Europe faces several challenges. Technical performance, production costs, industrial scalability, food-safety requirements, and consumer acceptance can affect its market development. Consumer concerns about hygiene, safety, taste, texture, and price may be particularly important because edible packaging is different from conventional packaging that consumers normally remove and discard. These issues are particularly relevant to the present study. Takeaway coffee packaging provides a useful case for examining consumer responses to edible packaging because it combines a frequently used single-use packaging format with a product that is strongly connected to everyday consumption habits. The success of an edible coffee cup would therefore depend not only on its technical performance but also on whether consumers understand the concept, consider it safe and hygienic, are willing to try it, and are willing to pay for it. For this reason, studying consumer acceptance is important for understanding the possible future role of edible packaging in European food and beverage markets. Commercial market forecasts also indicate growing interest in edible packaging in Europe. According to Market Data Forecast, the European edible packaging market was valued at approximately USD 224.97 million in 2024 and is expected to reach around USD 370.95 million by 2033. This represents an estimated compound annual growth rate (CAGR) of 5.71% between 2025 and 2033. As shown in Figure 7, the forecast suggests a gradual increase in the market during this period. Although these figures are market forecasts rather than results from academic research, they indicate increasing commercial interest in edible packaging in Europe.

Figure 7. Europe edible packaging market size and forecast, 2023–2033.



Source: Market Data Forecast (n.d.).

2.8 Research Gap and Contribution of This Study

Edible packaging has received increasing attention as a possible alternative to conventional food packaging. However, much of the existing research has focused on the development of edible materials, their composition, mechanical and barrier properties, and their ability to maintain food quality and extend shelf life. Different materials and food-processing by-products have also been investigated as possible sources for producing edible films and coatings. Although these technical developments are important, the successful introduction of edible packaging also depends on whether consumers are willing to accept and use it (Nair et al., 2023; Petraru & Amariei, 2023). Consumer acceptance of edible packaging is still an important area for further research. Previous studies have shown that some consumers have limited knowledge or previous experience with edible packaging. This lack of familiarity can influence how consumers evaluate a new packaging concept, particularly when the packaging is intended to be eaten together with the food. In addition to environmental benefits, consumers may consider factors such as hygiene, safety, taste, appearance, convenience, and price when deciding whether they would use edible packaging. Previous consumer studies have investigated factors such as willingness to try edible packaging,

purchase intention, willingness to pay, food neophobia, perceived risks, and attitudes toward different edible-packaging applications. For example, (Taylor et al., 2024) investigated consumer perceptions and acceptance of edible packaging for different food products. Their findings demonstrate the importance of understanding consumer attitudes before edible-packaging solutions can achieve wider market acceptance. However, consumer responses can depend on the type of edible packaging and the way it is presented. (Vergura et al., 2026) further showed the importance of psychological and communication-related factors in consumer responses to edible packaging, including food neophobia, perceived risk, consumption context, and the way the benefits of edible packaging are communicated. These findings suggest that environmental benefits alone may not be sufficient to achieve consumer acceptance. Consumers also need to feel comfortable and confident about consuming the packaging. Despite these developments, evidence about consumer acceptance of edible packaging is still developing, particularly across different European consumer contexts. Many existing studies examine specific products, consumer groups, or individual countries. However, cultural habits, environmental awareness, waste-management practices, and familiarity with sustainable packaging can differ between countries. Cross-country research can therefore provide useful information about whether consumers from different European contexts respond similarly to edible-packaging concepts. The present study contributes to this area by investigating consumer responses to edible packaging in Italy, Germany, and the Netherlands. It examines consumers' awareness of edible packaging, willingness to try it, willingness to pay, perceived benefits, and concerns related to factors such as hygiene and safety. Comparing respondents from three European countries also provides an opportunity to explore whether consumer responses differ across national contexts. The study uses takeaway coffee packaging as a specific application of edible packaging. This case provides a practical context for examining how consumers respond to the idea of replacing or reducing conventional disposable packaging with an edible alternative. Rather than focusing only on the technical properties of edible materials, the study places the consumer at the centre of the analysis. Overall, the contribution of this research is to provide further evidence about the factors that may support or limit consumer acceptance of edible packaging in the European market. The results may help to identify which aspects of edible packaging are attractive to consumers and which concerns could create barriers to adoption. This information can contribute to future research and may also be

useful for food companies and packaging developers interested in introducing edible-packaging solutions.

CHAPTER 3 — EDIBLE PACKAGING STUDY

3.1 Research Design and Methodology

This study used a quantitative research design to investigate consumers' perceptions and acceptance of edible food packaging. A quantitative approach was selected because it allows information to be collected from a relatively large number of participants and provides measurable data that can be summarized and compared. The study focused on consumers' awareness of edible packaging, their perceptions of its sustainability and safety, their willingness to try or purchase edible packaging, and their willingness to pay an additional price for it. Data were collected through an online questionnaire. This method was selected because it provided a practical and efficient way to reach participants in different European countries. The questionnaire was distributed electronically, and participation was voluntary and anonymous. Respondents were able to complete the questionnaire at a convenient time, which also supported data collection from participants in different locations. The study focused on three European countries: Italy, Germany, and the Netherlands. These countries were selected to provide different European consumer contexts for examining attitudes towards sustainable and edible packaging. As discussed in Section 1.6, the three countries differ in their food cultures, sustainability contexts, waste-management systems, and consumer environments. This makes them useful cases for exploring possible similarities and differences in consumer responses to edible packaging. The questionnaire included questions about demographic characteristics, awareness and knowledge of edible packaging, perceived benefits, sustainability, safety and hygiene concerns, willingness to try, purchase-related factors, and willingness to pay. The collected data were analysed mainly using descriptive statistics, such as frequencies and percentages, to summarize consumer responses and identify general patterns in the sample. Responses from Italy, Germany, and the Netherlands were also compared descriptively where relevant. The results were then interpreted in relation to previous studies on sustainable packaging, edible packaging, and consumer acceptance.

3.2 Study Area

This study focused on three European countries: Italy, Germany, and the Netherlands. These countries were selected to represent different national contexts within the European Union while sharing a common general framework for food safety, packaging, and environmental policies. Their differences in food culture, consumer habits, sustainability practices, and packaging waste-management systems make them useful cases for examining consumer perceptions of edible food packaging. Germany was selected because it represents an important European market with a well-developed packaging waste-management and recycling system. The country applies Extended Producer Responsibility (EPR), under which producers have responsibilities related to the collection and recovery of packaging waste. Germany also has established policies supporting recycling, circular-economy principles, and more sustainable packaging practices. The Netherlands was included because of its strong focus on the circular economy and sustainable waste management. Producers and importers have responsibilities for packaging waste, while national policies encourage waste prevention, collection, recycling, and cooperation between different actors involved in packaging management. These characteristics provide a relevant context for investigating consumer attitudes towards new packaging solutions. Italy was selected as another important European food and consumer market. Like Germany and the Netherlands, Italy operates within the EU framework for packaging waste and applies Extended Producer Responsibility principles. Italy also provides a different cultural and food-consumption context, which is useful when examining consumer responses to an innovative food-packaging concept. Although these countries share European objectives related to reducing packaging waste and supporting the circular economy, the organization and implementation of packaging waste-management systems differ between countries. These differences provide useful national contexts for comparing consumer responses to edible packaging (Di Foggia & Beccarello, 2022). Overall, the selection of Italy, Germany, and the Netherlands allows this study to explore consumer acceptance of edible packaging across three different European contexts. The comparison focuses on possible patterns in awareness, perceptions, concerns, willingness to try, and willingness to pay rather than assuming that the survey sample represents the entire population of each country.

3.3 Questionnaire Design

The main research instrument used in this study was a structured online questionnaire developed using Microsoft Forms. The questionnaire was designed to investigate consumers' perceptions and acceptance of edible packaging for takeaway coffee. It examined respondents' awareness and previous experience, general attitudes, perceived benefits and concerns, willingness to try, willingness to pay, and factors influencing their purchase decisions. Before answering the main questions, participants were provided with a short explanation of edible packaging. They were asked to imagine a takeaway coffee served in an edible cup that could either be consumed or removed after drinking. Providing this explanation helped ensure that respondents had a similar understanding of the concept before answering the questions. The questionnaire consisted of 27 questions divided into seven sections. The first section collected demographic information, including gender, age, education level, and country of residence. These questions were used to describe the characteristics of the sample and support comparisons between different groups. The second section examined respondents' awareness and previous experience with edible packaging. Participants were asked whether they had heard of edible packaging before, whether they had previously seen or used it, and what type of edible packaging they had encountered. The third section focused on general attitudes toward edible packaging. Participants evaluated statements related to innovation, sustainability, added value, current sustainability trends, and their general interest in the concept. The fourth section examined perceived benefits, including the potential of edible packaging to reduce packaging waste, encourage more sustainable consumption, and improve the environmental image of food companies. The fifth section investigated concerns and perceived risks related to edible packaging. Participants were asked about hygiene, food safety, taste and texture, and possible allergens. They were also asked whether approval by European Union food safety authorities would increase their trust in edible packaging. These questions were used to identify possible barriers to consumer acceptance. The sixth section examined behavioural intentions, particularly respondents' willingness to try takeaway coffee served in edible packaging and their willingness to pay an additional price for it. The final section examined factors that could influence purchase decisions, including clear product information, certification by EU authorities, price, brand reputation, and packaging design. Most attitude and perception questions used a five-point Likert scale, ranging from 1 (Strongly disagree) to 5 (Strongly agree). This scale allowed

respondents to express different levels of agreement with each statement. The questionnaire also included multiple-choice and open-ended questions where appropriate. The complete questionnaire is provided in table 1.

Table 1. Structure of the questionnaire

Section	Purpose	Question Numbers
Demographic information	Describe the sample	Q1–Q4
Awareness and prior knowledge	Measure familiarity and previous experience	Q5–Q7
General attitudes	Evaluate overall perceptions of edible packaging	Q8–Q12
Perceived benefits	Assess environmental and functional benefits	Q13–Q15
Concerns and perceived risks	Identify barriers and trust issues	Q16–Q20
Willingness to try and pay	Measure behavioural intentions	Q21–Q22
Factors influencing purchase decisions	Identify factors affecting consumer choice	Q23–Q27

3.4 Data Collection

Data were collected through an online questionnaire developed using Microsoft Forms. The survey was conducted over a two-month period, from May to July 2026. An online survey was selected because it provided a practical and cost-effective way to collect responses from participants living in different countries. It also allowed respondents to complete the questionnaire at a convenient time and location. The questionnaire was distributed through online platforms and personal networks to reach participants living in Italy, Germany, and the Netherlands. The survey link was shared through social media platforms, including Facebook, LinkedIn, and WhatsApp, as well as other relevant online communities. A convenience sampling method was used because it allowed participants to be recruited from the selected countries within the available time and resources

(Saunders et al., 2019). Before the main data collection, a pilot study with five participants was conducted to check the clarity, relevance, and organization of the questionnaire. Participants completed the survey and provided feedback about the wording, structure, and understanding of the questions. Based on their feedback, minor changes were made to improve the clarity of some questions before the final questionnaire was distributed. Participation in the survey was voluntary and anonymous. Before completing the questionnaire, participants were informed about the purpose of the study. No directly identifying information, such as names or contact details, was collected. Participants were also free to stop completing the questionnaire at any time. At the end of the data collection period, a total of 90 responses had been received. The responses were reviewed for completeness, and all 90 responses were included in the final analysis. The data were then exported from Microsoft Forms and prepared for analysis. The analysis focused on respondents' awareness, perceptions, concerns, willingness to try, willingness to pay, and other factors related to the acceptance of edible food packaging (Saunders et al., 2019).

3.5 Participants and Sampling

The target population of this study consisted of adults aged 18 years and over living in Italy, Germany, and the Netherlands. To participate in the study, respondents were required to be at least 18 years old and to live in one of the three selected countries. Participation in the online questionnaire was voluntary. A non-probability convenience sampling method was used to recruit participants. This method was selected because it provided a practical way to reach respondents from the three countries within the available time and resources. Convenience sampling is commonly used when participants are selected based on their accessibility and willingness to participate. However, because participants are not randomly selected, the results cannot be considered representative of the entire population (Saunders et al., 2019). A total of 90 valid responses were included in the study. The sample included respondents with different demographic characteristics, including gender, age, educational level, and country of residence. These variables were used to describe the sample and to explore patterns in consumer responses across different demographic groups. The sample size was relatively modest, and the use of convenience sampling limits the possibility of generalizing the findings to the wider populations of Italy, Germany, and the Netherlands. Therefore, the results should be interpreted as findings from the survey sample

rather than representative estimates of European consumers. The main purpose of the study was to explore respondents' awareness, perceptions, concerns, willingness to try, and willingness to pay for edible food packaging. The findings can provide useful initial information and may support future studies using larger and more representative samples (Saunders et al., 2019).

3.6 Data Analysis

After data collection was completed, all responses were exported from Microsoft Forms to Microsoft Excel for analysis. The dataset was checked for completeness and consistency before the analysis began. A total of 90 responses were collected, and all were considered valid and included in the final analysis. The data were organized according to the main sections of the questionnaire, including demographic characteristics, awareness and previous experience, general attitudes, perceived benefits, concerns and perceived risks, willingness to try, willingness to pay, and factors influencing purchase decisions. The analysis was mainly based on descriptive statistics. Frequencies and percentages were calculated for demographic and multiple-choice questions, including gender, age, education level, country of residence, previous awareness of edible packaging, willingness to try, and willingness to pay. Descriptive statistics were used to provide a clear overview of the responses and identify general patterns within the sample. Similar descriptive approaches have also been used in previous studies examining consumer attitudes and purchase intentions towards sustainable packaging (Petkowicz et al., 2024). For questions measured using a five-point Likert scale, ranging from 1 (Strongly disagree) to 5 (Strongly agree), the distribution of responses was examined to understand respondents' levels of agreement with each statement. The questions were grouped according to the main themes of the study, including general attitudes, perceived benefits, sustainability, safety and hygiene concerns, trust, and factors affecting purchase decisions. Responses from Italy, Germany, and the Netherlands were also compared descriptively where relevant. These comparisons were used to observe possible similarities and differences in response patterns between the three country groups. However, no inferential statistical tests were conducted to determine whether these differences were statistically significant. The results were presented using frequencies, percentages, tables, and graphs, including bar charts and pie charts where appropriate. Presenting the results according to the main questionnaire themes made it easier to identify and communicate the main patterns in respondents' perceptions and

acceptance of edible packaging. The analysis was exploratory and descriptive and was not intended to produce estimates representative of the wider populations of Italy, Germany, the Netherlands, or Europe. More advanced statistical methods, such as factor analysis, were not applied in the present study. The analysis instead focused on providing a clear description of the responses collected from the study sample.

3.7 Ethical Considerations

Ethical considerations are important in research involving human participants, particularly when collecting information about their opinions, behaviours, and demographic characteristics. Important principles in survey research include voluntary participation, informed consent, anonymity, privacy, and responsible management of research data (Saunders et al., 2019). Participation in the present study was completely voluntary. Before starting the questionnaire, respondents were provided with information about the purpose and general topic of the research. Participants could decide whether they wanted to take part and were free to stop completing the questionnaire at any time. No financial incentive or other reward was provided for participation. Participants' privacy was protected during data collection. The questionnaire did not request directly identifying information such as names, email addresses, telephone numbers, or home addresses. Only demographic information relevant to the research was collected, including age group, gender, education level, and country of residence. The collected data were used only for academic research purposes. Responses were analysed and reported at the group level rather than presenting identifiable individual responses. Results were mainly presented through frequencies, percentages, tables, and figures. The questionnaire focused on consumers' awareness, perceptions, concerns, and behavioural intentions related to edible food packaging and did not request highly sensitive personal information. The collected data were handled responsibly, and the results were reported without intentionally changing or selectively presenting participants' responses.

3.8 Methodological Limitations

Although this study provides useful information about consumer perceptions of edible food packaging, several methodological limitations should be considered. The first limitation is the use of non-probability convenience sampling. This method provided a practical way to reach

participants through online platforms and social networks within the available time and resources. Convenience sampling has also been used in previous consumer research on sustainable packaging. For example, (Petkowicz et al., 2024) distributed an electronic questionnaire through email and social networks to investigate consumer purchase intentions toward sustainable packaging. However, convenience sampling does not give every member of the target population an equal chance of participating. Therefore, the results of the present study cannot be considered representative of all consumers in Italy, Germany, and the Netherlands. A second limitation is the sample size. The final sample consisted of 90 respondents from the three selected countries. This sample can provide useful information about general patterns in consumer responses, but it limits the possibility of making strong comparisons between countries or demographic groups. Previous studies on edible packaging have used different sample sizes. For example, (Vergura et al., 2026) included 198 Italian consumers in one of their studies, while (Taylor et al., 2024) examined consumer responses to edible packaging with a sample of 100 participants. For this reason, the findings of the present study should mainly be interpreted as an exploratory investigation of consumer perceptions rather than as representative findings for the wider population. Another limitation is related to the distribution of participants across the three countries and demographic groups. Because participants were recruited through convenience sampling, the sample may not be equally distributed between Italy, Germany, and the Netherlands or across age, gender, and education groups. As a result, differences observed between groups should be interpreted carefully and should not be assumed to represent differences between the wider populations of these countries. Another important limitation concerns participants' previous knowledge and experience with edible packaging. Edible packaging is still a relatively unfamiliar concept for many consumers, and some respondents may never have seen or used this type of packaging before. Previous research has also identified consumer understanding and familiarity as relevant issues in the acceptance of edible packaging (Taylor et al., 2024). To reduce possible misunderstanding, participants in the present study received a short explanation of edible packaging before answering the main questions. However, respondents without direct experience may still have based their answers on expectations rather than actual experience. In addition, participants did not physically use or taste an edible coffee cup during this study. Therefore, their responses represent stated perceptions and behavioural intentions rather than reactions to a real product. Factors such as actual taste, texture, appearance, durability, and the experience of consuming the packaging could

not be directly evaluated. This is important because sensory characteristics and direct product experience may influence consumer acceptance (Taylor et al., 2024). Finally, the analysis was mainly based on descriptive statistics, including frequencies, percentages, tables, and graphical presentations. This approach was useful for identifying general patterns in the responses, but it did not allow the study to test statistical relationships or determine whether observed differences between groups were statistically significant. In addition, the study cannot establish causal relationships between factors such as environmental attitudes, perceived risks, trust, and willingness to try or pay. Future research could address these limitations by using larger and more representative samples, more balanced samples across countries, additional statistical methods, and real product testing. Allowing participants to see, touch, taste, or use an edible coffee cup could provide a better understanding of how actual product experience influences consumer acceptance.

CHAPTER 4 — RESULTS

This chapter presents the results of the consumer survey on edible packaging for takeaway coffee. A total of 90 valid responses were included in the analysis. The results are presented according to the main sections of the questionnaire, including respondents' demographic characteristics, awareness and previous experience with edible packaging, general attitudes, perceived benefits and concerns, willingness to try and pay, and factors influencing purchase decisions.

4.1 Characteristics of the Respondents

A total of 90 respondents participated in the study. The demographic characteristics examined were gender, age, education level, and country of residence. Table 2 provides an overview of the demographic profile of the sample. Regarding gender, 61 respondents (67.8%) were women and 29 (32.2%) were men. Women therefore represented approximately two-thirds of the total sample. The largest age group was 25–34 years, with 43 respondents (47.8%), followed by the 35–44 years group with 28 respondents (31.1%). A further 16 respondents (17.8%) were aged 18–24, while 3 respondents (3.3%) were aged 45 years or above. Overall, most respondents were between 25 and 44 years old. The sample also had a relatively high level of education. 58 respondents (64.4%) held a master's degree, while 23 (25.6%) held a bachelor's degree. In addition, 5 respondents (5.6%) had a doctorate and 4 (4.4%) had completed high school. Overall, most respondents had university-level education. Participants were living in all three countries included in the study. Italy had the largest number of respondents, with 41 participants (45.6%), followed by the Netherlands with 27 (30.0%) and Germany with 22 (24.4%). The sample was therefore not equally distributed across the three countries. Overall, the demographic results show that the sample was mainly composed of women, adults aged between 25 and 44 years, and respondents with university-level education. Italian respondents formed the largest country group. These characteristics should be considered when interpreting the following results, as the sample does not represent the general populations of Italy, Germany, and the Netherlands.

Table 2. Demographic characteristics of the respondents (N = 90)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Women	61	67.8
	Men	29	32.2
Age	18–24	16	17.8
	25–34	43	47.8
	35–44	28	31.1
	45+	3	3.3
Education	High school	4	4.4
	Bachelor's degree	23	25.6
	Master's degree	58	64.4
	Doctorate	5	5.6
Country	Italy	41	45.6
	The Netherlands	27	30.0
	Germany	22	24.4

4.2 Awareness and Previous Experience with Edible Packaging

The survey examined respondents' awareness and previous experience with edible packaging before asking about their attitudes and acceptance of the concept. Table 3 presents the results for these questions. The results show that 61 respondents (67.8%) heard of edible food packaging before participating in the survey, while 29 respondents (32.2%) had not. Therefore, approximately two-thirds of the sample had some previous awareness of the concept. However, this question measured general awareness and did not assess the respondents' level of knowledge. Direct experience with edible packaging was less common. Only 27 respondents (30.0%) reported that they had previously seen or used edible packaging, while 52 respondents (57.8%) had not. A further 11 respondents (12.2%) were not sure whether they had previously seen or used this type of packaging.

Table 3. Awareness and previous experience with edible packaging (N = 90)

Question	Response	Frequency (n)	Percentage (%)
Heard of edible food packaging before	Yes	61	67.8
	No	29	32.2
Seen or used edible packaging before	Yes	27	30.0
	No	52	57.8
	Not sure	11	12.2

A comparison of the two questions shows a clear difference between general awareness and direct experience. While 67.8% of respondents heard of edible packaging, only 30.0% reported that they had previously seen or used it. This represents a difference of 37.8 percentage points, indicating that awareness of edible packaging was considerably higher than direct experience within the study sample. Respondents who reported previous experience mentioned different examples of edible packaging, including waffle or ice-cream cups, chocolate cups and spoons, edible bowls, rice paper, seaweed-based packaging, and other edible containers. These responses show that participants encountered edible packaging in different forms. Overall, the results indicate that edible packaging is relatively familiar as a concept among the respondents, but direct experience is less common. This distinction is important for the following sections, which examine respondents' attitudes, perceived benefits and concerns, willingness to try, and willingness to pay for edible packaging.

4.3 General Attitudes Toward Edible Packaging

The next section of the questionnaire examined respondents' general attitudes toward edible packaging. Five statements were presented to understand whether participants considered edible packaging innovative, sustainable, valuable for food products, connected with current sustainability trends, and personally interesting. The statements were measured using a five-point Likert scale, where 1 = Strongly disagree and 5 = Strongly agree. Overall, the results show that respondents had a generally positive attitude toward edible packaging. The strongest positive response was related to the potential of edible packaging to provide a sustainable and biodegradable alternative to conventional plastic packaging. This statement received the highest

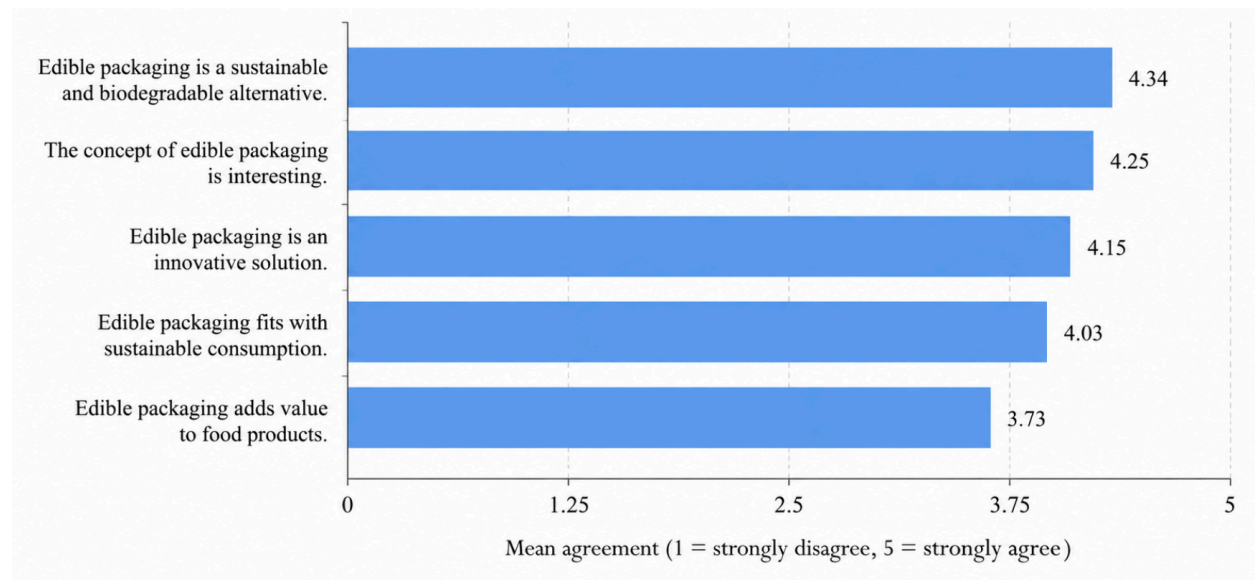
mean score in this section, at 4.34 out of 5. Around 83% of respondents agreed or strongly agreed with the statement. This result shows that most participants viewed edible packaging positively from an environmental point of view and believed that it could provide an alternative to conventional plastic packaging. Respondents also considered edible packaging to be an innovative packaging solution. This statement received a mean score of approximately 4.15, and around 76% of participants agreed or strongly agreed. Only a small number of respondents disagreed with the statement. This suggests that edible packaging was generally viewed as a new and interesting development in food packaging rather than as a traditional packaging option. A similarly positive result was found for respondents' personal interest in edible packaging. The statement "I find the concept of edible packaging interesting" received a mean score of approximately 4.25, with around 84% of respondents selecting Agree or Strongly agree. This was one of the highest levels of agreement in this section. The result is important because it shows that respondents were not only positive about the possible environmental benefits of edible packaging, but were also personally interested in the concept. Participants were also asked whether using edible packaging fits with current sustainability trends. The mean score for this statement was approximately 4.02, and around 73% of respondents agreed or strongly agreed. Most responses were therefore on the positive side of the scale. This indicates that respondents generally connected edible packaging with the wider movement toward more sustainable products and packaging solutions. The statement concerning the possibility of edible packaging adding value to food products, for example through nutrients, flavours, or functional benefits, received a lower score compared with the other statements. Its mean score was approximately 3.73, with around 64% of respondents agreeing or strongly agreeing. Although the overall response was still positive, participants appeared to be less certain about the additional functional benefits of edible packaging than about its sustainability and innovative character. A higher proportion of neutral and disagree responses was also observed for this statement.

Table 4. General Attitudes Toward Edible Packaging

Statement	Mean score (1–5)	Agree/Strongly Agree (%)
Edible packaging is an innovative packaging solution	4.15	76.4
Edible packaging could be a sustainable and biodegradable alternative to conventional plastic packaging	4.34	83.1
Edible packaging could add value to food products	3.73	64.0
Using edible packaging fits with current sustainability trends	4.02	73.0
I find the concept of edible packaging interesting	4.25	84.3

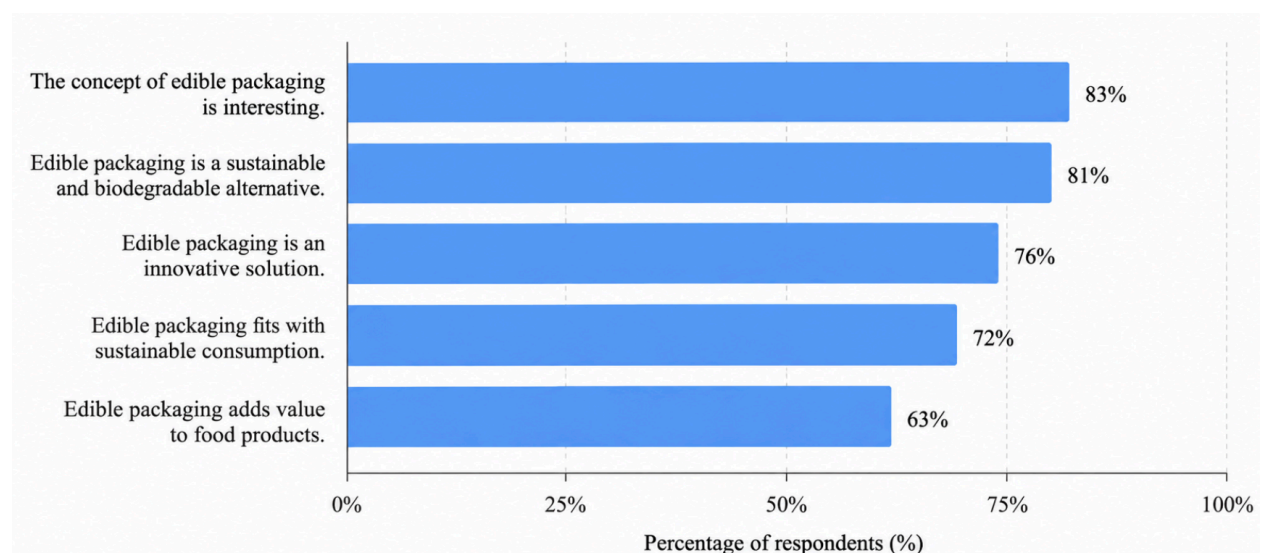
The comparison of the mean scores shows that the respondents were particularly positive about the sustainability of edible packaging and found the concept interesting. In contrast, the idea that edible packaging could provide additional value such as nutritional, flavour, or functional benefits received the lowest level of agreement. This may indicate that respondents had a clearer understanding of edible packaging as an environmental solution than of its possible additional functions.

Figure 8. General attitudes toward edible packaging: Average agreement with five statements about edible packaging.



Looking more closely at the response distribution also helps to understand these findings. For the statement about edible packaging being a sustainable alternative to plastic, most participants selected the two highest points of the scale. A similar pattern appeared for interest in the concept. In contrast, responses to the statement about adding value to food products were more spread across the scale, showing greater uncertainty among participants.

Figure 9. Percentage of respondents who agreed or strongly agreed with statements about edible packaging



Analysed dataset: N = 90.

Overall, the results of this section show a positive general attitude toward edible packaging. All five statements received mean scores above the neutral midpoint of 3. The strongest responses were connected with sustainability and personal interest, while the possibility of additional functional value received a more moderate response. These results provide a useful basis for the next section, which examines respondents' perceptions of the specific environmental and sustainability benefits of edible packaging.

4.4 Perceived Benefits of Edible Packaging

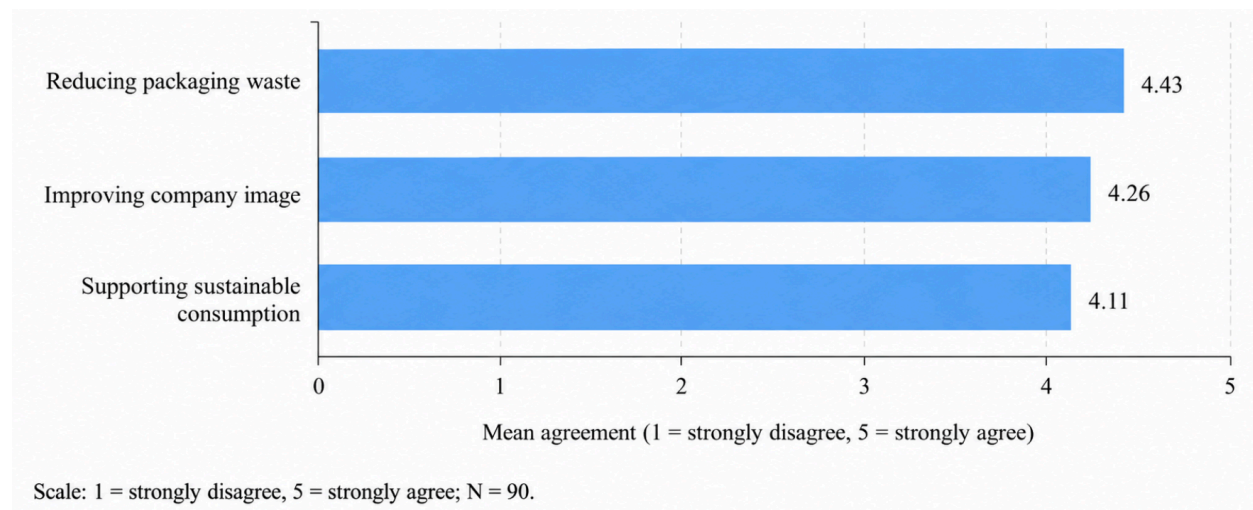
The next part of the survey examined how respondents viewed the possible benefits of edible packaging. This section focused mainly on three aspects: reducing packaging waste, supporting more sustainable consumption, and improving the environmental image of food companies. Respondents evaluated each statement using a five-point Likert scale, from 1 = Strongly disagree to 5 = Strongly agree. Overall, the responses were positive, showing that most respondents recognized possible environmental benefits of edible packaging. The strongest result was related to reducing packaging waste. The statement “Edible packaging could help reduce packaging waste” received a mean score of 4.43 out of 5, which was the highest score among the three statements in this section. In addition, 92.2% of respondents agreed or strongly agreed with this statement. This shows that waste reduction was one of the clearest benefits of edible packaging from the respondents' point of view. The second benefit was related to more sustainable consumption. The statement that edible packaging could contribute to more sustainable consumption received a mean score of 4.11. Around 77.8% of respondents agreed or strongly agreed with this idea. This result suggests that most respondents believed edible packaging could have a role in encouraging more sustainable consumption choices. However, the level of agreement was slightly lower than for packaging waste reduction. Respondents were also positive about the possible effect of edible packaging on the environmental image of food companies. This statement received a mean score of 4.26, and 80.0% of respondents agreed or strongly agreed. This indicates that many respondents believed that companies using edible packaging could be seen as more environmentally responsible. Therefore, the use of this type of packaging may be viewed not only as a way to reduce waste but also as a way for companies to show their environmental commitment.

Table 5. Perceived Benefits of Edible Packaging

Statement	Mean score (1–5)	Agree/Strongly Agree (%)
Edible packaging could help reduce packaging waste	4.43	92.2
Edible packaging could contribute to more sustainable consumption	4.11	77.8
Edible packaging could improve the environmental image of food companies	4.26	80.0

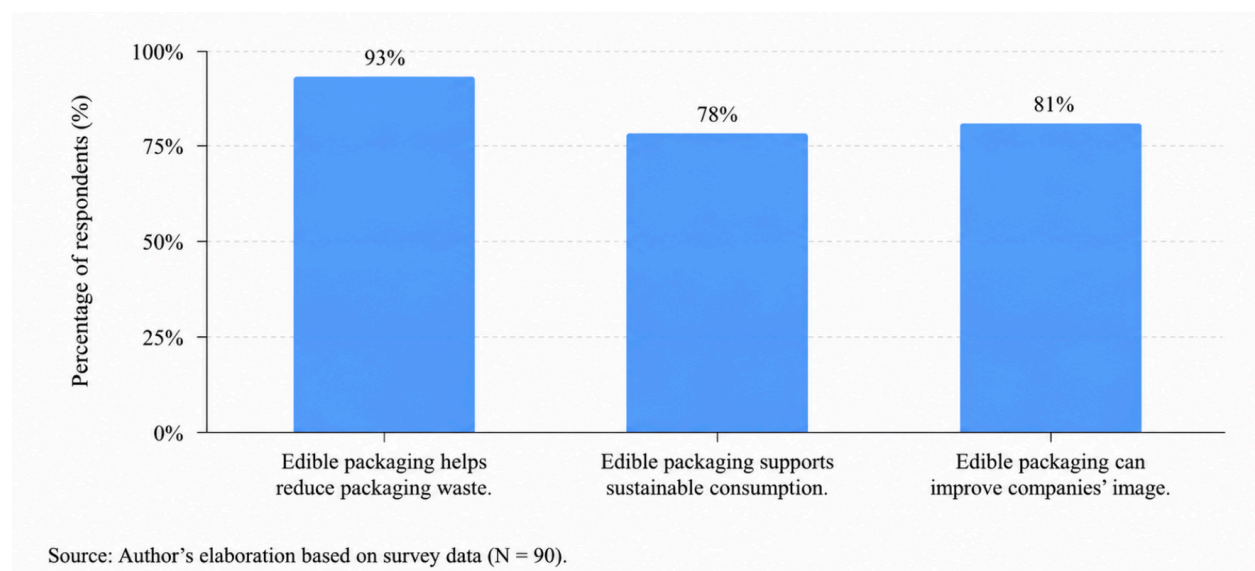
A comparison of the three statements shows that all of them received mean scores above 4 out of 5. However, reducing packaging waste clearly received the strongest response. This is particularly relevant to the present study because one of the main reasons for considering edible packaging for takeaway coffee is the possibility of reducing the amount of packaging that becomes waste after a single use.

Figure 10. Mean scores for the perceived benefits of edible packaging



The percentage of positive responses also shows a similar pattern. More than nine out of ten respondents agreed to some degree that edible packaging could reduce packaging waste. Positive responses were also high for improving the environmental image of companies and supporting sustainable consumption, although they were lower than for waste reduction.

Figure 11. Percentage of respondents who agreed or strongly agreed with the perceived benefits of edible packaging



Overall, the findings show that respondents had a strongly positive perception of the potential benefits of edible packaging. Waste reduction appeared to be the most important and widely recognized benefit, while sustainable consumption and the environmental image of companies were also evaluated positively. However, positive perceptions of environmental benefits do not necessarily mean that consumers have no concerns about using or eating this type of packaging. For this reason, the next section examines respondents' concerns about hygiene, food safety, taste and texture, and possible allergens.

4.5 Concerns and Perceived Risks of Edible Packaging

Although respondents generally had positive attitudes toward edible packaging and its environmental benefits, the survey also shows that they had several concerns about using this type

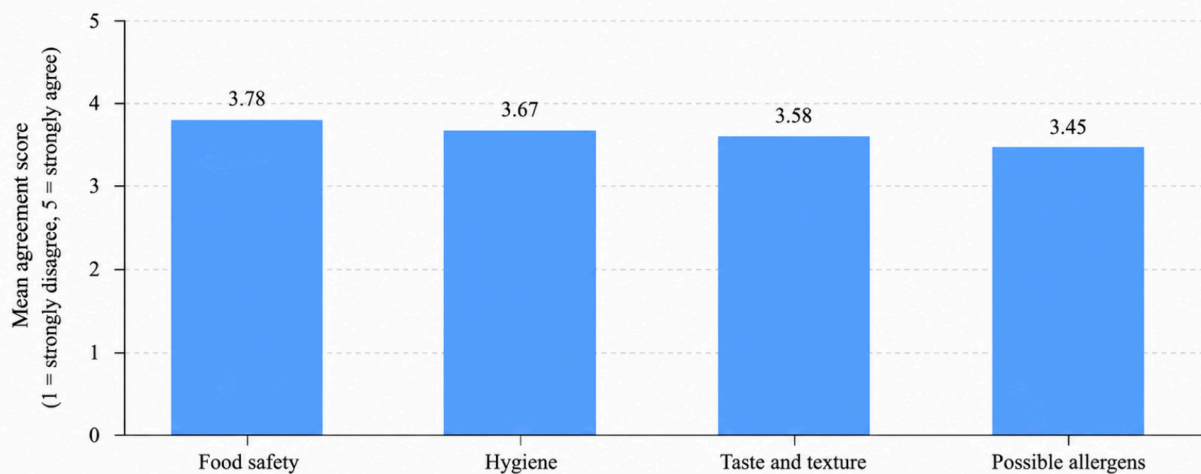
of packaging. This section examined four main issues: hygiene, food safety, taste and texture, and possible allergens. Respondents evaluated these statements using a five-point Likert scale, where 1 = Strongly disagree and 5 = Strongly agree. The results show that concerns were present for all four aspects, although their importance was different. Among the four concerns, food safety received the highest mean score. The statement “I am concerned about the food safety of edible packaging” had a mean score of 3.83 out of 5, and 63.3% of respondents agreed or strongly agreed with it. This shows that food safety was an important issue for many respondents. Since edible packaging is designed to be consumed together with or after the food, consumers may pay more attention to its safety compared with packaging that is simply thrown away after use. Hygiene was another important concern. The mean score for hygiene was 3.69, and 56.7% of respondents agreed or strongly agreed that they were concerned about this issue. This result is especially relevant for edible packaging because the outside part of the package may be touched during transportation, storage, sale, or consumption. For a product such as an edible coffee cup, consumers may therefore think about how the package is handled before deciding whether they are comfortable eating it. Concerns about taste and texture were also reported by the respondents. This statement received a mean score of 3.62, while 56.7% agreed or strongly agreed. This suggests that the sensory characteristics of edible packaging may be important for consumer acceptance. Even if consumers believe that edible packaging is environmentally beneficial, they may still be uncertain about whether the material will have a pleasant taste or texture when consumed. The fourth issue was related to possible allergens. This concern received the lowest mean score among the four factors, at 3.50, although 50.0% of respondents still agreed or strongly agreed that allergens were a concern. Therefore, possible allergens were less important than food safety or hygiene in this dataset, but they were still relevant for a considerable number of respondents. Clear information about ingredients may therefore be important when edible packaging is introduced to consumers.

Table 6. Consumer Concerns About Edible Packaging

Concern	Mean score (1–5)	Agree/Strongly Agree (%)
Food safety	3.83	63.3
Hygiene	3.69	56.7
Taste and texture	3.62	56.7
Possible allergens	3.50	50.0

The comparison between the four concerns shows that none of them received a mean score below the neutral point of 3. However, food safety was the strongest concern, followed by hygiene and taste or texture. Possible allergens received the lowest score, although half of the respondents still expressed concern. These findings show that environmental benefits alone may not be enough to create consumer acceptance. Practical issues connected with eating the packaging also need to be considered.

Figure 12. Mean scores for consumer concerns about edible packaging

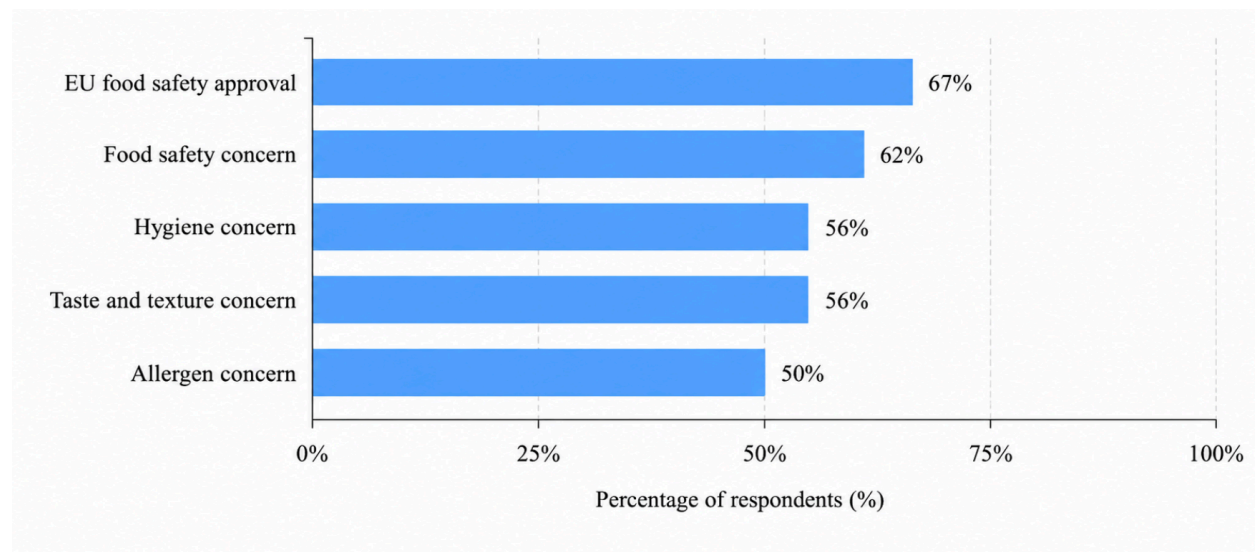


Scale: 1 = strongly disagree, 5 = strongly agree; N = 90.

The questionnaire also examined the role of EU food safety approval in consumer trust. Respondents were asked whether they would trust edible packaging only if it was approved by EU

food safety authorities. This statement received a mean score of 3.88, and 67.8% of respondents agreed or strongly agreed. This was higher than the percentage recorded for any individual concern. The result suggests that official approval could be an important factor in making consumers feel more confident about edible packaging.

Figure 13. Consumer concerns and agreement on the importance of EU food safety approval



Overall, the findings show an interesting situation. Respondents were positive about edible packaging in the previous sections, particularly about its potential to reduce packaging waste, but they also had concerns about actually consuming the packaging. Food safety and hygiene appeared to be especially important, while taste, texture, and allergens also influenced respondents' perceptions. At the same time, the results suggest that approval from EU food safety authorities could help increase trust. The next section examines whether these concerns prevented respondents from being willing to try edible packaging and pay an additional price for it.

4.6 Willingness to Try and Willingness to Pay

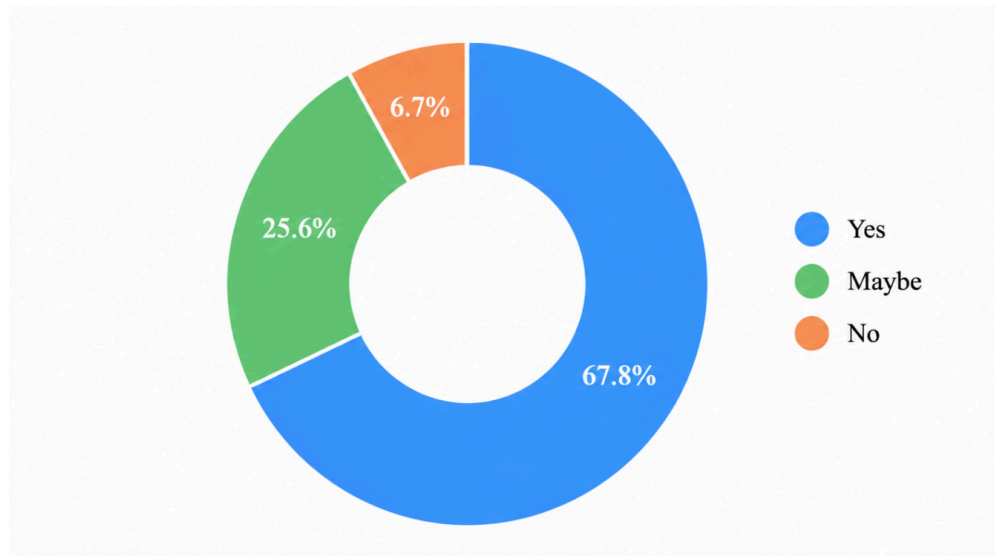
After examining respondents' attitudes, perceived benefits, and concerns, the survey investigated whether consumers would be willing to try edible packaging in a real food situation. In this study, respondents were specifically asked whether they would be willing to try a takeaway coffee served with edible packaging. This question is important because having a positive opinion about sustainable packaging does not always mean that consumers are ready to use or consume the product. The results showed a generally positive willingness to try edible packaging. Out of the 90 responses, 61 respondents (67.8%) answered "Yes", showing that more than two-thirds of the sample were willing to try a takeaway coffee served with edible packaging. Another 23 respondents (25.6%) answered "Maybe", while only 6 respondents (6.7%) answered "No". Therefore, direct rejection of the idea was relatively low.

Table 7. Willingness to Try Edible Packaging (N = 90)

Response	Frequency (n)	Percentage (%)
Yes	61	67.8
Maybe	23	25.6
No	6	6.7
Total	90	100.0

The results become more interesting when the "Yes" and "Maybe" responses are considered together. In total, 84 out of 90 respondents (93.3%) were either willing or potentially willing to try the product. Only 6.7% clearly rejected the idea. This suggests a high level of interest in trying edible packaging among the respondents, even though the previous section showed concerns about food safety, hygiene, taste, and allergens.

Figure 14. Respondents' willingness to try takeaway coffee served with edible packaging



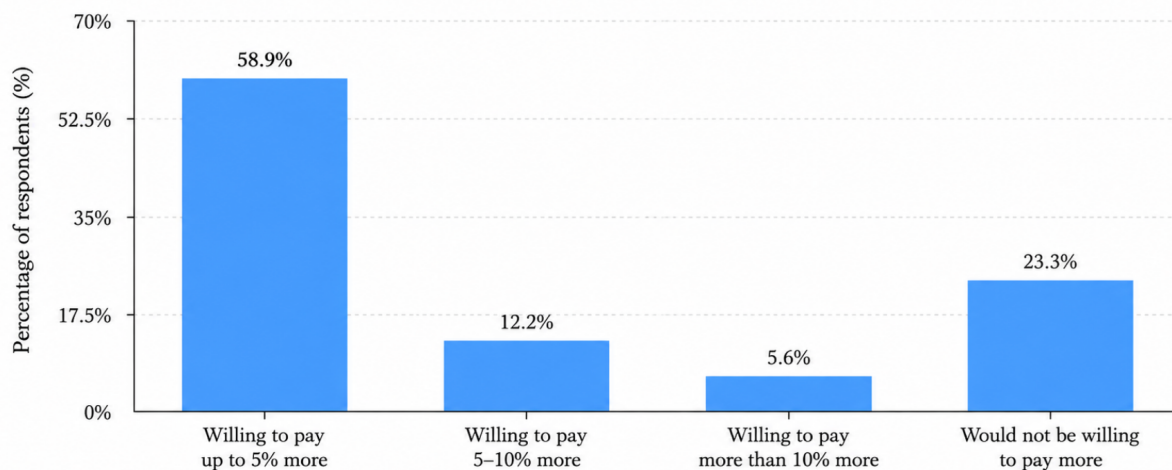
The survey also examined whether respondents would be willing to pay a higher price for a product using edible packaging. The results show a more careful response compared with willingness to try. The largest group, 53 respondents (58.9%), reported that they would be willing to pay up to 5% more. Another 12 respondents (13.3%) were willing to pay between 5% and 10% more, while only 4 respondents (4.4%) were willing to pay more than 10%. In contrast, 21 respondents (23.3%) reported that they would not be willing to pay an additional price.

Table 8. Willingness to Pay More for Products Using Edible Packaging

Willingness to pay	Frequency (n)	Percentage (%)
Yes, up to 5% more	53	58.9
Yes, 5–10% more	12	13.3
Yes, more than 10%	4	4.4
No, I would not pay more	21	23.3
Total	90	100.0

Overall, 69 respondents (76.7%) were willing to pay at least some additional amount for a product using edible packaging. However, most of these respondents preferred only a small increase in price. The percentage decreased clearly as the additional price increased. This suggests that although consumers may value edible packaging, price could still be an important factor in their final purchase decision.

Figure 15. Respondents' willingness to pay a higher price for products using edible packaging



A comparison between the two questions shows an important pattern. While 67.8% clearly stated that they would try edible packaging, willingness to pay a large additional price was much lower. Only 17.7% were willing to pay more than 5% extra. This means that interest in trying the product does not necessarily mean that consumers are willing to accept a high price premium. For many respondents, edible packaging may be attractive as a sustainable innovation, but the additional cost still appears to matter. Another interesting point is that the high willingness to try was observed even though respondents reported several concerns in the previous section. This means that concerns about hygiene, food safety, taste, texture, and allergens did not lead to a high level of rejection in this dataset. However, the present descriptive analysis cannot determine whether these concerns directly affected willingness to try or willingness to pay. Further statistical analysis would be needed to test such relationships. Overall, the findings show a positive consumer interest in trying edible packaging, together with a more cautious attitude toward paying extra for it. Most respondents were open to trying the concept, and many were also willing to accept a small increase in price. However, willingness decreased when the price premium became higher. The next section examines other factors that may influence the purchase decision, including clear product information, EU certification, price, brand reputation, and packaging design.

4.7 Factors Influencing Purchase Decisions

The final part of the survey examined the factors that could influence consumers when deciding whether to choose a product with edible packaging. Respondents were asked about five factors: clear labeling and information, EU certification or approval, price, brand reputation, and packaging design. These statements were measured using a five-point Likert scale, where 1 = Strongly disagree and 5 = Strongly agree. Overall, the results show that all five factors had some importance for the respondents, although some factors received stronger responses than others. One of the most important factors was certification or approval by EU authorities. This statement received the highest mean score in this section, at 4.32 out of 5. In addition, 84.4% of respondents agreed or strongly agreed that EU certification or approval would increase their trust in edible packaging. This result shows that official approval was an important issue for many respondents. It also supports the findings from the previous section on perceived risks, where food safety was one of the main concerns. Clear labeling and product information was another important factor. This

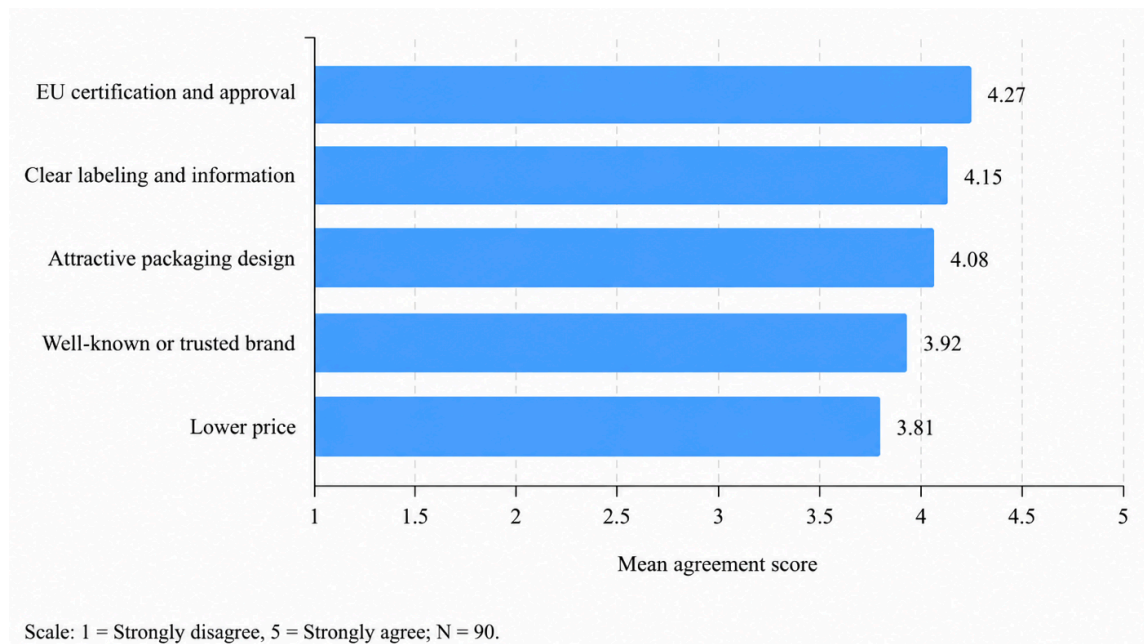
statement received a mean score of 4.21, and 83.3% of respondents agreed or strongly agreed that clear information would increase their willingness to purchase edible packaging. Since edible packaging may be unfamiliar to some consumers, information about ingredients, how the packaging should be used, and whether it is safe to eat may help consumers understand the product better. However, the survey only measured the importance of clear information in general and did not test which specific type of information consumers preferred. Packaging appearance was also important to the respondents. The statement about attractive packaging design received a mean score of 4.19. In addition, 88.9% of respondents agreed or strongly agreed that attractive design would influence their decision. This was the highest percentage of positive responses among the five factors, although EU certification had a slightly higher mean score. This finding suggests that the visual appearance of edible packaging may also be important when consumers make a purchase decision. The role of a well-known or trusted brand was also examined. This factor received a mean score of 4.04, while 75.6% of respondents agreed or strongly agreed that a trusted brand would influence their decision. This shows that the company or brand offering the product may affect consumer confidence. For a relatively new packaging solution, consumers may feel more comfortable trying a product when it is offered by a company they already know or trust. Price also influenced the respondents, although it received the lowest mean score among the five factors. The statement that a lower price would increase the likelihood of choosing edible packaging received a mean score of 3.92, with 63.3% of respondents agreeing or strongly agreeing. Although this was still a positive result, price appeared to be less important than certification, clear information, design, and brand reputation in this group of questions. At the same time, the willingness-to-pay results in Section 4.6 showed that most respondents who were willing to pay more preferred an increase of no more than 5%. Therefore, price remains an important practical issue when considering consumer acceptance.

Table 9. Factors Influencing the Purchase Decision

Factor	Mean score (1–5)	Agree/Strongly Agree (%)
Clear labeling and information	4.21	83.3
EU certification or approval	4.32	84.4
Lower price	3.92	63.3
Well-known or trusted brand	4.04	75.6
Attractive packaging design	4.19	88.9

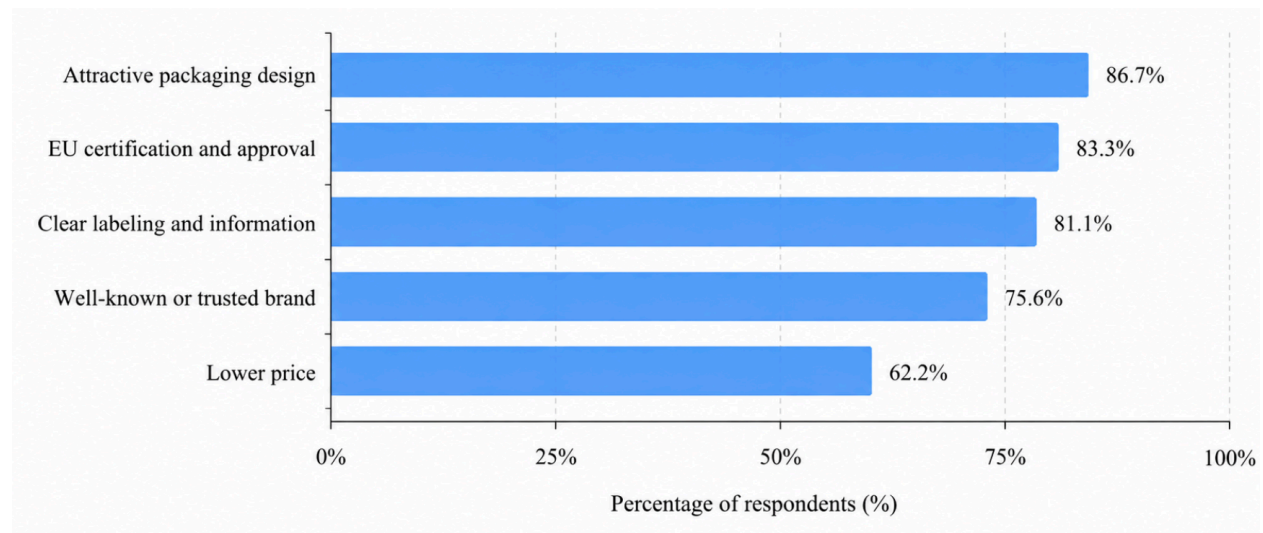
When the mean scores are compared, EU certification or approval received the highest score, followed by clear labeling and information and attractive packaging design. All five factors received mean scores close to or above 4.0. This shows that respondents considered several different aspects when thinking about edible packaging rather than focusing only on environmental sustainability.

Figure 16. Mean scores for factors influencing purchase decisions.



Looking at the percentage of positive responses gives a slightly different picture. Attractive packaging design had the highest percentage of agreement (88.9%), followed by EU certification (84.4%) and clear labeling (83.3%). Brand reputation and lower price received lower levels of agreement, although the majority of respondents still considered them important.

Figure 17. Percentage of respondents who agreed or strongly agreed with factors influencing their purchase decision.



Overall, the findings suggest that consumer decisions about edible packaging may depend on a combination of trust, information, appearance, brand, and price. EU certification and clear labeling were particularly important, which may be connected with the safety and hygiene concerns identified earlier in the survey. Attractive design was also valued by a large number of respondents. At the same time, the results indicate that environmental benefits alone may not be the only consideration when consumers decide whether to purchase a product with edible packaging.

4.8 Summary of Main Findings

This chapter presented the main results from the 90 responses included in the analysis. Overall, the findings show that respondents had a generally positive view of edible packaging, especially in relation to its environmental benefits and its potential to reduce packaging waste. At the same time, several concerns were identified, particularly regarding food safety, hygiene, taste and texture, and possible allergens. These findings show that consumer acceptance of edible packaging includes both positive attitudes and practical concerns. The demographic results showed that the sample was mainly composed of women and respondents between 25 and 44 years old. Most respondents had a university education, with master's degree holders representing the largest educational group. Participants were living in Italy, Germany, and the Netherlands, with Italy having the largest share of respondents. These characteristics should be considered when

interpreting the results because the sample does not equally represent all demographic groups or the populations of the three countries. Awareness of edible packaging was relatively high. Around 67.8% of respondents had heard about edible packaging before, but only 30.0% had previously seen or used it. This difference shows that knowledge of edible packaging was much higher than actual experience with these products. Therefore, many respondents formed their opinions about edible packaging without having directly used it. The results concerning general attitudes were mainly positive. Respondents particularly agreed that edible packaging could be a sustainable and biodegradable alternative to conventional plastic packaging, which received a mean score of 4.34 out of 5. They also showed a high level of personal interest in the concept. In addition, the strongest perceived benefit was the possibility of reducing packaging waste, with a mean score of 4.43 and 92.2% of respondents agreeing or strongly agreeing. This was one of the clearest findings of the survey. However, respondents also expressed concerns about edible packaging. Food safety was the strongest concern, with a mean score of 3.83, followed by hygiene, taste and texture, and possible allergens. The results also showed the importance of official approval. More than two-thirds of respondents agreed or strongly agreed that they would trust edible packaging only if it was approved by EU food safety authorities. This suggests that trust and safety may be important issues when edible packaging is introduced to consumers. Despite these concerns, willingness to try edible packaging was high. 67.8% of respondents said that they would be willing to try takeaway coffee served with edible packaging, while another 25.6% answered “Maybe.” Only 6.7% clearly stated that they would not try it. Therefore, 93.3% of respondents were either willing or potentially willing to try the product. This shows a high level of interest in experiencing the concept. The results for willingness to pay were more cautious. Although 76.7% of respondents were willing to pay some additional amount, most preferred only a small increase in price. In particular, 58.9% were willing to pay up to 5% more, while much smaller percentages accepted price increases above 5%. This shows that consumers may be interested in edible packaging but may not be willing to pay a large premium for it. Finally, several factors were found to be important for purchase decisions. EU certification or approval had the highest mean score (4.32), while attractive packaging design had the highest percentage of respondents selecting Agree or Strongly agree (88.9%). Clear labeling and information, a trusted brand, and price were also considered important. The results therefore suggest that consumer acceptance may depend not only on

environmental benefits but also on trust, safety information, product appearance, brand reputation, and an acceptable price.

Table 10 Summary of the Main Survey Findings

Area	Main finding
Awareness	67.8% heard of edible packaging
Previous experience	30.0% saw or used edible packaging
Sustainability perception	Mean = 4.34/5
Waste reduction	Mean = 4.43/5; 92.2% positive agreement
Main concern	Food safety (Mean = 3.83/5)
Willingness to try	67.8% Yes; 25.6% Maybe
Willingness to pay	58.9% would pay up to 5% more
EU certification	Mean = 4.32/5
Packaging design	88.9% agreed/strongly agreed it would influence their decision

Taken together, the findings present a clear overall pattern. Respondents were interested in edible packaging and strongly recognized its possible environmental benefits, particularly waste reduction. However, their acceptance was also connected with practical issues such as safety, hygiene, certification, information, and price. These results provide the basis for Chapter 5 – Discussion, where the findings can be compared with previous studies on edible and sustainable packaging and discussed in relation to the research questions of this thesis.

CHAPTER 5 – DISCUSSION

5.1 Consumer Awareness and Experience with Edible Packaging

The results of the present study show a clear difference between awareness and direct experience with edible packaging. Among the 90 respondents, 67.8% had heard of edible packaging before, while only 30.0% had previously seen or used it. This difference suggests that edible packaging is relatively well known as a concept within the study sample, but direct experience with these products much less common. Previous research has also highlighted the importance of consumer familiarity with edible packaging. (Taylor et al., 2024) explained that edible packaging is an emerging approach that may help reduce the use of single-use packaging, while consumer knowledge and acceptance are still important issues for its adoption. In their study, consumers evaluated three edible packaging applications: an edible muffin liner, a fruit leather wrap, and an edible sachet for a powdered drink. Consumers generally responded positively after experiencing these products. This suggests that direct experience may help consumers better understand edible packaging and develop clearer opinions about its use. The difference between awareness and experience found in the present study may partly be related to the novelty and limited availability of edible packaging products. Consumers may hear about innovative packaging solutions before they have an opportunity to see or use them in everyday life. Consumer openness to innovation may also be important. (Zhang et al., 2024) found that consumer innovativeness was related to more positive perceptions and acceptance of edible food packaging. This suggests that consumers who are more interested in trying new products may respond more positively to unfamiliar packaging concepts. Direct experience may be especially important for edible packaging because consumers are not only expected to use the packaging but may also consume it together with or after the food or drink. (Taylor et al., 2024) reported positive purchase intentions of approximately 64–68%, depending on the edible packaging application tested. Their findings also highlight the importance of the sensory experience of edible packaging. Characteristics such as taste, texture, and the overall experience of consuming the package may influence consumer responses. In the present study, most respondents had not directly experienced edible packaging. Their answers may therefore have been based more on their expectations and understanding of the concept than on

actual consumption experience. The way edible packaging is used may also influence acceptance. (Vergura et al., 2026) examined consumer responses to different forms of edible packaging and found differences between ready-to-eat and cook-before-eating applications. The cook-before-eating option received a more positive evaluation. The authors also found that consumers with higher levels of food neophobia, or hesitation towards unfamiliar foods, perceived greater risks and showed lower willingness to consume edible packaging. These findings indicate that familiarity, perceived risk, and the way the packaging is consumed can influence consumer acceptance. These findings are relevant to the present study because it focuses on edible packaging for takeaway coffee. An edible coffee cup is directly handled by the consumer and may also be eaten after drinking the coffee. For consumers who have never experienced this type of product, the concept may be interesting but may also create uncertainty about characteristics such as taste, texture, hygiene, safety, and convenience. The findings of (Taylor et al., 2024) and (Vergura et al., 2026) suggest that direct experience with edible packaging could help consumers form more informed opinions about these characteristics. Overall, the difference between 67.8% awareness and 30.0% previous experience is one of the main findings of this section. It shows that awareness was considerably higher than practical experience among the respondents. This result supports the importance of considering consumer familiarity and product experience when evaluating the acceptance of edible packaging. Providing clear information and opportunities to see or try edible packaging may help consumers better understand this type of packaging and make more informed decisions about whether they would use it.

5.2 Consumer Attitudes Toward Edible Packaging

The results of the present study show that respondents generally have a positive attitude toward edible packaging. All five statements used to measure general attitudes received mean scores above the neutral midpoint of 3. The highest mean score was found for the statement that edible packaging could be a sustainable and biodegradable alternative to conventional plastic packaging ($M = 4.34$). Respondents also showed a high level of interest in the concept ($M = 4.25$). These results suggest that edible packaging was viewed positively within the study sample, particularly in relation to sustainability. This finding is consistent with (Taylor et al., 2024), who examined consumer responses to three different edible packaging applications. Their study found that 77% of participants agreed or strongly agreed that edible packaging could provide an environmentally

sustainable solution to single-use plastic packaging. A similar but slightly higher level of agreement was found in the present study, where 83.3% of respondents agreed or strongly agreed that edible packaging could be a sustainable and biodegradable alternative to conventional plastic packaging. Together, these findings show that sustainability is an important positive characteristic associated with edible packaging. Respondents also considered edible packaging to be an innovative solution ($M = 4.15$). This result can be considered in relation to the findings of (Zhang et al., 2024), who examined the role of consumer innovativeness in the acceptance of edible food packaging. Their study showed that consumers who were more open to innovative products tended to have more positive perceptions of edible packaging. Although consumer innovativeness was not directly measured in the present study, the high scores for both innovation and interest suggest that respondents were generally open to the concept. However, this comparison should be interpreted carefully because the present study did not directly test the relationship between innovativeness and attitudes. Not all aspects of edible packaging received the same level of agreement. The statement that edible packaging could add value to food products, for example through nutritional, flavour, or other functional benefits, received the lowest mean score among the five statements ($M = 3.73$). Although this score was still above the neutral midpoint, respondents appeared less positive about these additional benefits than about sustainability and innovation. One possible explanation is that the environmental purpose of edible packaging may be easier to understand than its nutritional or functional possibilities. This may also be connected to the limited direct experience found in Section 5.1, where only 30.0% of respondents reported having previously seen or used edible packaging. The findings of (Taylor et al., 2024) also show that consumers consider several characteristics when evaluating edible packaging. In their study, safety was an important factor, together with taste and sustainability. This suggests that positive environmental attitudes alone may not be enough to achieve consumer acceptance. Consumers may also consider the practical and sensory characteristics of the packaging before deciding whether they are willing to use or consume it. This point is particularly relevant to edible takeaway coffee packaging. The high mean scores for sustainability and interest suggest that respondents are generally open to the basic concept. However, positive attitudes do not necessarily lead directly to purchase or consumption. Factors such as safety, hygiene, taste, price, convenience, and trust may influence whether a positive attitude develops into actual willingness to try or purchase the product. Overall, the results are generally consistent with previous research showing positive consumer

attitudes toward edible packaging. Respondents in the present study mainly viewed edible packaging as sustainable, innovative, and interesting, while they were less certain about its additional functional value. The findings of (Taylor et al., 2024) and (Zhang et al., 2024) provide useful support for understanding these results, particularly regarding sustainability and openness to innovation. However, other factors must also be considered when evaluating consumer acceptance. The following section therefore discusses respondents' perceptions of the environmental and sustainability benefits of edible packaging.

5.3 Perceived Environmental Benefits of Edible Packaging

The results of the present study show that respondents have a very positive perception of the environmental benefits of edible packaging. Among the three environmental benefits examined, reducing packaging waste received the highest mean score ($M = 4.43$). In addition, 92.2% of respondents agreed or strongly agreed that edible packaging could help reduce packaging waste. This was one of the strongest findings of the survey and suggests that waste reduction was an important benefit associated with edible packaging among the respondents. This finding is consistent with (Taylor et al., 2024), who described edible packaging as an emerging approach that could help reduce waste from single-use packaging. In their consumer study, 77% of participants agreed or strongly agreed that edible packaging could provide an environmentally sustainable alternative to single-use plastic packaging. The percentage found in the present study was higher, although the two studies used different samples and edible packaging applications. Therefore, the percentages should not be treated as a direct statistical comparison. Nevertheless, both studies show strong positive perceptions of the environmental potential of edible packaging. Similar findings were reported by (Zhang et al., 2024), who examined factors influencing consumer acceptance of edible food packaging. Their study showed that positive perceptions of edible packaging were important for consumer attitudes and behavioural intentions. They also found that consumer innovativeness could contribute to more positive responses toward this type of packaging. Although innovativeness was not directly measured in the present study, respondents showed positive attitudes toward both the environmental and innovative characteristics of edible packaging. The results can also be considered in relation to sustainable food packaging more generally. (Ketelsen et al., 2020) reviewed 46 studies on consumer responses to environmentally friendly food packaging. Their review showed that environmental considerations can play an

important role in consumer responses to sustainable packaging. However, they also identified barriers that can affect consumer decisions. This is important because positive perceptions of environmental benefits do not necessarily result in actual purchasing behaviour. Another important result was related to sustainable consumption. The statement that edible packaging could contribute to more sustainable consumption received a mean score of 4.11, with 77.8% of respondents agreeing or strongly agreeing. This indicates that many respondents associated edible packaging not only with reducing packaging waste but also with more sustainable consumption choices. This result can be considered alongside broader research on sustainable food packaging. (Jaiswal et al., 2025) discussed the role of environmental concern in consumer responses to sustainable food packaging, while also highlighting other factors that may influence consumer decisions, such as price, perceived value, trust, packaging performance, and sustainability information. Therefore, positive environmental perceptions are important, but they are only one part of the consumer decision-making process. The third environmental benefit examined was the possible improvement of the environmental image of food companies. This statement received a mean score of 4.26, and 80.0% of respondents agreed or strongly agreed that using edible packaging could improve a company's environmental image. This suggests that the type of packaging used by a company may influence how consumers perceive its environmental responsibility. Communication may also be important when introducing new sustainable packaging. (Selvaggi et al., 2026) examined consumer responses to an innovative biodegradable food-packaging material and highlighted the importance of environmental information, product appearance, and consumers' environmental attitudes. This is relevant to edible packaging because consumers need clear information to understand the purpose and possible environmental benefits of an unfamiliar packaging solution. These findings are particularly relevant to takeaway coffee packaging, which is normally used for a short period before disposal. An edible package could therefore present waste reduction in a direct and understandable way to consumers. The high level of agreement with the waste-reduction statement in the present study suggests that this could be an important benefit when communicating edible packaging for takeaway coffee. However, it is important to distinguish between perceived environmental benefits and actual environmental performance. The present study examined consumers' perceptions of edible packaging and did not conduct a Life Cycle Assessment (LCA) or another environmental assessment comparing edible coffee packaging with conventional alternatives. Therefore, the results cannot demonstrate that

edible packaging has a lower environmental impact. Its actual environmental performance would depend on factors such as raw materials, production processes, energy use, transportation, storage, and end of life conditions. The findings of this study should therefore be interpreted as evidence of consumer perceptions of sustainability, rather than evidence of the actual environmental superiority of edible packaging. Overall, waste reduction was the most strongly perceived environmental benefit, followed by improvement of companies' environmental image and contribution to sustainable consumption. These findings are generally consistent with previous research showing positive consumer perceptions of edible and environmentally friendly packaging. However, environmental benefits alone may not be enough to ensure consumer acceptance. Other factors, including safety, hygiene, trust, price, sensory characteristics, and product performance, may also influence consumer decisions. The following section therefore discusses consumer concerns, food safety, and trust.

5.4 Consumer Concerns, Food Safety, and Trust

Although respondents generally had positive attitudes toward edible packaging, the results also showed several important concerns. Food safety was the strongest concern ($M = 3.83$), with 63.3% of respondents agreeing or strongly agreeing that they were concerned about this issue. Hygiene was also important ($M = 3.69$), followed by taste and texture ($M = 3.62$) and possible allergens ($M = 3.50$). These findings show that positive environmental perceptions can exist together with concerns about consuming the packaging. Food safety may be particularly important for edible packaging because the packaging itself can become part of the food that is consumed. A similar result was reported by (Taylor et al., 2024), who found that safety was the most important factor considered by participants when evaluating edible packaging, followed by taste and sustainability. This is consistent with the present study, where food safety received the highest concern score. Safety is not only a matter of consumer perception but also an important technical and regulatory issue. (Bongarde et al., 2025) identified possible risks related to edible packaging, including microbial contamination, chemical migration, and allergenicity. They also highlighted the importance of safety standards, appropriate labelling, and regulatory systems. These issues show that food safety needs to be considered throughout the development and commercialization of edible packaging. Hygiene was another important concern, with 56.7% of respondents agreeing or strongly agreeing that they were concerned about it. This issue may be especially relevant for

edible packaging that is directly touched before consumption. In the case of an edible takeaway coffee cup, the outside surface may be handled during production, transportation, storage, preparation, serving, and consumption. Consumers may therefore be concerned about whether the surface remains clean and suitable to eat. Uncertainty about edible packaging may also be related to its unfamiliarity. (Vergura et al., 2026) found that food neophobia, or hesitation toward unfamiliar foods, increased perceived risk and reduced willingness to consume edible packaging. Their study also showed that the way edible packaging is consumed can influence consumer responses, with cook-before-eating packaging receiving a more positive evaluation than ready-to-eat packaging. This suggests that consumers may feel more uncertain when they are expected to directly consume something that they clearly recognize as packaging. This point is particularly relevant to an edible coffee cup because the cup remains clearly visible as a separate package. (Aldred Cheek & Wansink, 2017) found that consumer responses to edible packaging could depend on how closely the packaging was integrated with the food. Their findings suggest that edible packaging presented separately from the main food may face greater acceptance barriers than packaging that is more closely integrated with the product. This could represent an important challenge for edible cups. Sensory characteristics were also relevant in the present study, as 56.7% of respondents expressed concern about taste and texture. Unlike conventional packaging, edible packaging becomes part of the consumption experience. Therefore, characteristics such as taste, texture, smell, and appearance may influence whether consumers are willing to eat it. This is also consistent with (Taylor et al., 2024), whose findings showed that sensory characteristics were relevant to consumer evaluations of edible packaging. Possible allergens received the lowest concern score among the four factors ($M = 3.50$), although 50.0% of respondents still agreed or strongly agreed that allergens were a concern. This remains important because edible packaging can be produced from different food-based ingredients. (Bongarde et al., 2025) also identified allergenicity as a possible safety issue. Clear information about ingredients and allergens would therefore be important when introducing edible packaging to consumers. The importance of information is also supported by broader research on sustainable packaging. (Ketelsen et al., 2020) found that consumers may be aware of environmental problems related to packaging while still having limited knowledge about specific environmentally friendly packaging solutions. This issue may be even more important for edible packaging because consumers need information not only about its environmental purpose but also about its ingredients, safety, and correct use. An

important finding of the present study is therefore the role of EU food-safety approval. 67.8% of respondents agreed or strongly agreed that they would trust edible packaging only if it was approved by EU food-safety authorities, with a mean score of 3.88. This indicates that official approval was an important source of trust for many respondents. Recognized food-safety approval may help consumers feel more confident about an unfamiliar edible packaging product. The combination of positive attitudes and concerns found in this study can also be considered in relation to (Zhang et al., 2024) Their research discussed attitudinal ambivalence, where consumers can have both positive and negative evaluations of edible packaging. This is relevant to the present findings: respondents strongly recognized the sustainability benefits of edible packaging while also expressing concerns about food safety, hygiene, taste and texture, and allergens. Therefore, a positive environmental image does not necessarily remove uncertainty about consuming the product. For takeaway coffee packaging, these findings have practical importance. An edible coffee cup may attract consumers because of its environmental benefits, but consumers also need to believe that it is safe, hygienic, pleasant to consume, and clearly labelled. Information about ingredients, allergens, handling conditions, and food-safety approval could therefore be important when introducing such a product. Overall, food safety and hygiene appear to be important potential barriers to consumer acceptance of edible packaging in the present sample. Previous studies support the importance of safety, sensory quality, perceived risk, food neophobia, allergens, and familiarity. At the same time, the importance given to EU food-safety approval suggests that clear information and trustworthy certification may help address some consumer concerns. These factors should therefore be considered together with environmental benefits when evaluating the potential acceptance of edible packaging for takeaway coffee.

5.5 Willingness to Try Edible Packaging

One of the main findings of the present study was the high willingness to try edible packaging. When respondents were asked whether they would try a takeaway coffee served with edible packaging, 67.8% answered “Yes,” 25.6% answered “Maybe,” and only 6.7% answered “No.” These results show that most respondents were willing to consider trying the product, while only a small proportion clearly rejected the idea. The relatively large “Maybe” group also indicates that some respondents were interested but still uncertain. These findings can be compared with (Taylor et al., 2024), who examined consumer responses to three edible packaging applications: an edible

muffin liner, a fruit-leather wrap, and an edible sachet for a powdered drink. Their study reported positive purchase intentions of approximately 64–68%, depending on the type of edible packaging. Although these percentages are similar to the 67.8% willingness to try found in the present study, the results should not be directly compared because the two studies measured different outcomes. Taylor et al. allowed participants to experience actual edible packaging products, while the present study measured stated willingness to try an imagined edible takeaway coffee package. This difference is particularly important because only 30.0% of respondents in the present study had previously seen or used edible packaging. Nevertheless, more than twice this percentage said that they would be willing to try an edible coffee package. This suggests that previous experience was not necessary for respondents to express initial interest. However, because the product was not physically tested in the present study, willingness to try may change when consumers experience characteristics such as taste, texture, appearance, and handling. Consumer openness to new products may also be relevant. (Zhang et al., 2024) found that consumer innovativeness was associated with more positive perceptions of edible food packaging. Their research also discussed attitudinal ambivalence, where consumers may have both positive and negative feelings about edible packaging at the same time. This is relevant to the present findings because respondents showed strong positive perceptions of sustainability while also expressing concerns about food safety, hygiene, taste and texture, and allergens. Therefore, being interested in trying edible packaging does not necessarily mean that consumers have no concerns about the product. The findings of (Vergura et al., 2026) also show that willingness to consume edible packaging can depend on individual characteristics and the way the packaging is used. They found that consumers with higher levels of food neophobia, or hesitation toward unfamiliar foods, perceived greater risks and showed lower willingness to consume edible packaging. They also found differences between ready-to-eat and cook-before-eating edible packaging. This is relevant to an edible takeaway coffee cup, which is clearly visible as packaging and requires the consumer to make a conscious decision about whether to eat it. The wider literature on sustainable packaging also suggests that positive intentions do not always lead to actual consumer behaviour. (Ketelsen et al., 2020) found that consumers generally showed positive attitudes toward environmentally friendly packaging, but factors such as product characteristics and price could influence their actual choices. This distinction is important when interpreting the present results. Saying that a respondent would try an edible coffee cup in an online questionnaire does not necessarily mean that the same person

would choose it in a real café when faced with an actual price, product appearance, taste, and alternative packaging options. The 25.6% of respondents who answered “Maybe” are also important. These respondents did not reject edible packaging, but they did not express a clear willingness to try it either. Their uncertainty could potentially be related to factors such as safety, hygiene, taste, price, information, or unfamiliarity. However, the descriptive analysis used in this study cannot determine which factors influenced individual respondents to select “Maybe.” Therefore, these possible explanations should be interpreted carefully. Communication may also influence consumer acceptance. (Vergura et al., 2026) showed that the way edible packaging and its benefits are communicated can affect consumer evaluations. For an edible coffee package, clear information about what it is made from, how it can be consumed, its safety, and its environmental purpose may help consumers better understand an unfamiliar product and make a more informed decision. Overall, the results show a high level of stated willingness and openness toward trying edible packaging within the study sample. While 67.8% clearly stated that they would try the product, another 25.6% remained open but uncertain, and only 6.7% rejected the idea. These findings are generally consistent with previous research showing positive consumer interest in edible packaging. However, willingness to try should not be interpreted as evidence of actual market acceptance. Factors such as food neophobia, perceived risk, sensory quality, familiarity, communication, and price may influence real consumer behaviour. The next section therefore examines whether respondents were willing to pay more for edible packaging.

5.6 Willingness to Pay and the Role of Price

The results of the present study show that many respondents are open to paying more for edible packaging, but most preferred only a small increase in price. Among the 90 respondents, 58.9% were willing to pay up to 5% more for a takeaway coffee with edible packaging. Overall, 76.7% were willing to pay at least some additional amount, while the remaining respondents were not willing to pay more. These results suggest that there is some willingness to accept a price premium, but the size of this premium is important. A willingness to pay more for edible packaging was also reported by (Taylor et al., 2024). In their study, participants experienced three different edible packaging products before reporting their willingness to pay. For example, 60% were willing to pay at least 15% more for a muffin with an edible liner. This supports the general finding of the present study that some consumers are willing to pay a premium for edible packaging. However,

the acceptable premium was different between the two studies. In the present research, most respondents preferred an increase of no more than 5%, while participants in (Taylor et al., 2024) showed greater willingness to accept higher premiums. One possible explanation is the difference in research design. Participants in (Taylor et al., 2024) experienced actual edible packaging products, while respondents in the present study evaluated the idea of edible takeaway coffee packaging through an online questionnaire. Most respondents in the present study also had no previous direct experience with edible packaging. Product experience may therefore influence perceived value and willingness to pay, although this relationship was not directly tested in the present study. The importance of price is also supported by broader research on sustainable food packaging. (Jaiswal et al., 2025) discussed several factors that may influence willingness to pay for sustainable packaging, including price sensitivity, perceived value, packaging performance, trust, and sustainability information. This shows that consumers may support sustainable packaging but become more careful when choosing between products with different prices. This point is particularly relevant when comparing the environmental attitudes and willingness to pay found in the present study. While 92.2% of respondents agreed or strongly agreed that edible packaging could reduce packaging waste, most respondents were willing to accept only a relatively small additional cost. Therefore, strong support for the environmental benefits of edible packaging did not correspond to a willingness to pay a large premium. For commercial applications, this suggests that price could remain an important consideration even among consumers with positive environmental attitudes. The findings can also be considered in relation to (Selvaggi et al., 2026), who investigated willingness to pay for an innovative biodegradable food-packaging material using an experimental approach. Their study highlighted the importance of environmental information, product appearance, and consumer attitudes in the evaluation of sustainable packaging. This suggests that consumers' willingness to pay may depend not only on price itself but also on how the benefits and characteristics of an innovative packaging material are presented. This is relevant to edible takeaway coffee packaging, as consumers may need to understand why an edible cup costs more than a conventional one. Clear information about its ingredients, safety, use, and environmental purpose could help consumers understand the reason for an additional cost. However, communication alone may not be enough if consumers consider the price difference too high. The findings of (Zhang et al., 2024) also show that positive attitudes toward edible packaging do not necessarily lead directly to behavioural intentions. Consumers may have both positive and

negative feelings about the same product. In the context of the present study, a consumer may appreciate the environmental benefits of an edible coffee cup but still be unwilling to purchase it if the additional price is considered too high or if concerns about safety, hygiene, or sensory quality remain. The type of product should also be considered. Takeaway coffee is generally a relatively low-cost and frequently purchased product, so even a small price increase may be noticeable to regular consumers. In the present sample, 58.9% selected a premium of up to 5%, making this the most commonly accepted price increase. However, this result should not be interpreted as an ideal market price because the study measured stated willingness to pay rather than actual purchasing behaviour. This distinction is important because consumers may report willingness to pay more for a sustainable product in a questionnaire but make a different decision in a real purchasing situation. Future research could therefore test edible coffee packaging in cafés or experimental purchasing situations to examine whether consumers are actually willing to pay the additional amount they report. Overall, the results show that many respondents were willing to accept some additional cost for edible packaging, but there was a strong preference for a relatively small premium. This suggests that price may be an important factor in the market acceptance of edible takeaway coffee packaging. Previous research also indicates that willingness to pay can be influenced by product experience, perceived value, information, trust, and price sensitivity. Therefore, keeping the additional cost reasonable while clearly communicating the benefits of the product may be important for its potential market introduction.

5.7 Factors Influencing Consumer Purchase Decisions

The results of the present study show that several factors may influence consumers' decisions regarding edible packaging. The survey examined EU certification or approval, clear labeling and information, packaging design, brand reputation, and price. All five factors received mean scores above the neutral midpoint. EU certification or approval received the highest mean score (4.32 out of 5), followed by clear labeling and information (4.21), attractive packaging design (4.19), a trusted or well-known brand (4.04), and lower price (3.92). These findings suggest that respondents considered a combination of safety, information, product appearance, trust, and economic factors when evaluating edible packaging. One of the strongest findings was the importance of official certification or approval. In the present study, 84.4% of respondents agreed

or strongly agreed that EU certification or approval would increase their trust in edible packaging. This finding is particularly relevant because edible packaging differs from conventional packaging in that it may also be consumed as part of the food. Consumers may therefore require reassurance that the material is safe for consumption. (Bongarde et al., 2025) similarly highlighted the importance of regulatory standards for edible packaging and discussed potential risks including microbial contamination, chemical migration, and allergens. Trust and certification are also relevant in the broader context of sustainable packaging. (Jaiswal et al., 2025) reported that trust in third-party certification and clear sustainability claims can contribute to perceived value and purchase intention, while unclear claims and concerns about greenwashing can reduce consumer trust. For edible packaging, reliable certification may therefore be particularly important because consumers need confidence in both the environmental claims and the safety of the product. Clear labeling and product information were also highly rated. This factor received a mean score of 4.21, and 83.3% of respondents agreed or strongly agreed that clear information would increase their willingness to purchase edible packaging. For an edible product, relevant information could include ingredients, allergens, storage conditions, consumption instructions, and safety information. This may be particularly important for consumers who have little previous experience with edible packaging, as clear information could help them understand both its function as packaging and its characteristics as an edible product. Another important finding concerned packaging design. Although certification received the highest mean score, attractive packaging design received the highest proportion of positive responses, with 88.9% agreeing or strongly agreeing that it would influence their decision. This finding suggests that environmental and safety characteristics are not the only considerations when consumers evaluate edible packaging. Design may be especially important for an edible takeaway coffee cup, because the consumer would see, touch, drink from, and potentially eat the package. Therefore, its appearance and sensory characteristics could contribute to the overall consumption experience. This interpretation is consistent with (Taylor et al., 2024), whose sensory study found generally positive responses to edible packaging products and positive purchase intentions among approximately 64–68% of participants. Their findings indicate that sensory acceptance is an important aspect of consumer evaluation of edible packaging. A trusted or well-known brand was also considered important, receiving a mean score of 4.04, while 75.6% of respondents agreed or strongly agreed that brand reputation would influence their decision. A familiar brand may provide additional reassurance

when consumers encounter an unfamiliar product. However, because the present survey did not examine specific brands or actual purchasing behaviour, the results only indicate the importance respondents reported giving to brand reputation. Interestingly, price received the lowest mean score of the five factors (3.92), although it still remained relevant. 63.3% of respondents agreed or strongly agreed that a lower price would increase their likelihood of choosing edible packaging. This finding should be considered together with Section 5.6, where most respondents who were willing to pay a premium preferred only a relatively small increase. Therefore, price may not be the most important factor when consumers evaluate edible packaging conceptually, but it could still become important in an actual purchasing situation. This interpretation is consistent with (Jaiswal et al., 2025), who identified price sensitivity, perceived value, packaging functionality, trust in environmental claims, and consumer characteristics as factors that can influence willingness to pay for sustainable packaging. Their findings indicate that positive environmental attitudes do not necessarily remove consumers' sensitivity to price. Taken together, the findings suggest that environmental sustainability alone may not be sufficient to encourage the acceptance of edible packaging. Consumers may appreciate its environmental benefits while still considering safety, information, appearance, brand reputation, and price when deciding whether they would choose the product. For the specific case of edible takeaway coffee packaging, these results suggest that several elements may need to work together. Official safety approval could provide reassurance, while clear labeling could explain ingredients, allergens, consumption instructions, and environmental benefits. Attractive design could improve the product experience, while a trusted brand and a reasonable price could further support consumer acceptance. Overall, the results indicate that respondents' acceptance of edible packaging was associated with a combination of trust, information, design, brand reputation, and price. Certification and labeling were particularly important, which is consistent with the safety and hygiene concerns identified earlier in the study. At the same time, the strong response to attractive design shows that the appearance and experience of the product may also be important. Therefore, the findings suggest that edible packaging should not only communicate sustainability but should also be safe, clearly explained, attractive, trustworthy, and reasonably priced.

5.8 Implications for Edible Takeaway Coffee Packaging

The findings of the present study provide useful insights into the potential introduction of edible packaging for takeaway coffee. Overall, respondents show positive attitudes toward the concept, particularly because of its perceived environmental benefits. However, the results also demonstrate that consumer acceptance is influenced by several factors beyond sustainability, including food safety, hygiene, sensory quality, certification, information, design, brand reputation, and price. Therefore, the successful introduction of an edible coffee package would require these different consumer expectations to be considered together. One of the strongest opportunities identified in this research is waste reduction. A total of 92.2% of respondents agreed or strongly agreed that edible packaging could help reduce packaging waste. This benefit is particularly relevant to takeaway coffee because the packaging is normally used for only a short period before disposal. An edible alternative could therefore be perceived as a direct way of reducing single-use packaging waste. Similar positive environmental perceptions were reported by (Taylor et al., 2024), where 77% of participants agreed or strongly agreed that edible packaging could provide an environmentally sustainable alternative to single-use plastic packaging. Nevertheless, positive environmental perceptions alone may not be sufficient for market acceptance. Previous research on environmentally friendly packaging has shown that consumers may support sustainable alternatives while still considering other characteristics such as functionality, quality, safety, and price (Ketelsen et al., 2020). This pattern is also visible in the present study, where strong perceptions of environmental benefits existed alongside concerns about food safety, hygiene, taste, texture, and allergens. For edible takeaway coffee packaging, food safety and hygiene appear to be particularly important challenges. Food safety was the strongest concern in the survey, with a mean score of 3.83 out of 5. This is consistent with (Taylor et al., 2024), who found that safety was the most important factor affecting consumers' purchase intentions for edible packaging, followed by taste and sustainability. Hygiene may be especially important for an edible coffee cup because its external surface could be handled during production, transportation, storage, preparation, serving, and consumption. Producers would therefore need to protect the edible surface from contamination while avoiding the creation of unnecessary additional packaging. The sensory and functional performance of the package is another important consideration. Because consumers may eat the cup after drinking the coffee, taste, smell, texture, and appearance become

part of the overall consumption experience. At the same time, an edible coffee cup must perform its basic packaging function by maintaining its structure while containing a hot liquid without negatively affecting the coffee or becoming uncomfortable to handle. These technical characteristics were not tested in the present study, and therefore consumer responses to an actual edible coffee cup may differ from the stated intentions measured through the questionnaire. Future research involving physical product testing would be useful for examining these issues. The results also emphasize the importance of information and trust. In the present study, 83.3% of respondents agreed or strongly agreed that clear labeling and information would influence their decision, while 84.4% reported that EU certification or approval would increase their trust. For an edible coffee package, consumers may need clear information about ingredients, allergens, storage, safety, and how the package should be consumed. Official certification or approval could provide additional reassurance, particularly because the product functions both as packaging and as something intended for consumption. Design also appears to be important. Attractive packaging design received the highest proportion of positive responses among the purchase factors, with 88.9% of respondents agreeing or strongly agreeing that it would influence their decision. This suggests that an edible coffee cup should not only communicate sustainability and safety but also look attractive and appropriate for consumption. An unfamiliar appearance or texture could potentially create hesitation, particularly among consumers who have never previously used edible packaging. Price represents another practical consideration. Although most respondents were willing to pay some additional amount for edible packaging, the largest group preferred a premium of only up to 5%. This indicates that consumers may recognize additional value in an edible package while remaining sensitive to its cost. Consequently, maintaining a relatively small price difference compared with conventional takeaway coffee packaging could be important for encouraging initial adoption. Taken together, these findings suggest that the potential of edible takeaway coffee packaging depends on achieving a balance between environmental benefits and practical consumer expectations. Waste reduction represents the clearest perceived advantage, while food safety, hygiene, sensory characteristics, information, certification, design, and price represent important considerations for consumer acceptance. The results therefore suggest that an edible coffee package should not be developed or marketed solely as an environmentally friendly alternative. It should also provide a product experience that consumers perceive as safe, hygienic, understandable, attractive, enjoyable, trustworthy, and reasonably priced.

5.9 Limitations of the Study

Although the present study provides useful information about consumer perceptions of edible packaging, several limitations should be considered when interpreting the findings. These limitations are mainly related to the sample size and sampling method, geographical coverage, online survey design, absence of real product experience, use of stated intentions, and descriptive nature of the analysis. The first limitation concerns the sample size and sampling method. The study included 90 valid responses from Italy, Germany, and the Netherlands. Although this sample is sufficient for an exploratory descriptive analysis, it is relatively small for making conclusions about consumers in these three countries or Europe more generally. Previous studies on edible packaging have used different sample sizes; for example, (Taylor et al., 2024) included 100 participants, while (Zhang et al., 2024) examined 436 consumers. Therefore, the findings of the present study should be understood as representing the respondents included in this research rather than the wider European population. In addition, the use of convenience sampling and voluntary participation may have created self-selection bias. People who were already interested in sustainability, food packaging, or environmental issues may have been more willing to participate in the questionnaire. As discussed by (Bethlehem, 2010), self-selection can be an important limitation of online surveys because participants decide for themselves whether to take part. Therefore, the high level of positive environmental attitudes observed in this study may partly reflect the characteristics of the sample. Another limitation is the geographical scope. The study included respondents from only Italy, Germany, and the Netherlands. Although these countries provide different European contexts, the findings cannot represent consumers across the whole European Union. Consumer attitudes toward sustainable packaging may vary according to cultural, economic, social, and environmental conditions. Future studies involving more European countries and larger national samples could provide a broader understanding of consumer acceptance of edible packaging. An important limitation is that respondents evaluated the concept of edible takeaway coffee packaging rather than a real product. The questionnaire was conducted online, and participants did not physically see, touch, taste, or use an edible coffee cup. Therefore, their answers mainly represent expectations and perceptions. (Taylor et al., 2024), in contrast, allowed participants to experience different edible packaging products before evaluating them, showing the importance of sensory experience in consumer acceptance. This limitation is

particularly relevant for an edible coffee cup because characteristics such as taste, texture, smell, appearance, strength, temperature resistance, and comfort while drinking may influence consumer acceptance. A respondent who likes the idea of an edible cup in an online questionnaire may react differently after actually drinking from and eating one. Future research should therefore include real product testing and sensory evaluation. The study also measures stated intentions rather than actual behaviour. Respondents reported whether they would try edible packaging and how much more they would be willing to pay. However, these answers do not necessarily show what they would do in a real café when faced with actual products and prices. (Ketelsen et al., 2020) also identified limited evidence from real purchasing situations in research on environmentally friendly packaging. Similarly, (Selvaggi et al., 2026) demonstrated the value of experimental approaches when examining consumers' willingness to pay for innovative sustainable packaging. Another limitation is that the research did not examine the technical performance of an edible coffee cup. For example, the study did not test whether a specific edible cup could safely contain hot coffee, maintain its structure for a suitable period, provide adequate thermal protection, or remain hygienic during transportation and serving. Therefore, the positive consumer responses found in this research should not be interpreted as evidence that a particular edible coffee cup is technically ready for commercial use. The environmental findings should also be interpreted carefully. Respondents strongly believed that edible packaging could reduce packaging waste, but this study did not conduct a Life Cycle Assessment (LCA). Consequently, it cannot demonstrate that an edible coffee cup has a lower overall environmental impact than a conventional takeaway cup. Environmental performance would depend on factors such as raw materials, production, energy consumption, transportation, storage, and end-of-life conditions. Therefore, the environmental findings in this study represent consumer perceptions of sustainability rather than measured environmental performance. Finally, the analysis was based mainly on descriptive statistics. This approach was appropriate for describing the responses of the 90 participants but does not allow strong conclusions about relationships between variables. For example, the study cannot determine whether differences in age, gender, education, country, or previous experience significantly affected willingness to try or willingness to pay. Future research with larger samples could apply inferential statistical methods to investigate these relationships in greater detail. Overall, the findings should be interpreted as an exploratory picture of consumer perceptions and intentions toward edible takeaway coffee packaging rather than as representative evidence of European

consumer behaviour. Future studies could strengthen these findings by using larger and more representative samples, real edible coffee cups, sensory testing, actual purchasing experiments, broader cross-country comparisons, and environmental assessment.

5.10 Recommendations for Future Research

Based on the findings and limitations of the present study, several directions can be suggested for future research. Although respondents generally showed positive attitudes toward edible packaging and recognized its potential environmental benefits, concerns related to food safety, hygiene, sensory characteristics, and price remained important. Future research should therefore move beyond examining perceptions of the concept and investigate consumer responses to real edible packaging products and actual purchasing situations. First, future studies should use larger and more representative samples. The present study included 90 respondents from Italy, Germany, and the Netherlands, which was appropriate for an exploratory analysis but limits the generalizability of the findings. Including more participants and additional European countries would allow more reliable comparisons between countries and demographic groups. Larger samples would also make it possible to use inferential statistical methods to investigate whether factors such as age, gender, education, country, previous experience, or environmental attitudes significantly influence willingness to try and willingness to pay. Another important direction is real product and sensory testing. Participants in the present study evaluated the concept of an edible takeaway coffee package without physically using or tasting one. Future studies could provide participants with an actual edible coffee cup and evaluate characteristics such as taste, texture, smell, appearance, overall acceptability, and willingness to consume the cup after drinking the coffee. Previous research suggests that direct experience and familiarity can influence consumer acceptance of edible packaging (Taylor et al., 2024; Vergura et al., 2026). Future research should also investigate the food safety, hygiene, and technical performance of edible coffee packaging. Studies could examine microbial safety, allergens, shelf life, storage conditions, heat and moisture resistance, structural stability, and the ability of the cup to safely contain a hot beverage. These characteristics are particularly important because positive consumer perceptions alone do not demonstrate that an edible coffee cup is technically suitable for commercial use. Another important area is actual consumer behaviour and willingness to pay. The present study measured stated

intentions, which may differ from real purchasing decisions. Future experiments could therefore introduce edible coffee cups in cafés, university cafeterias, or controlled purchasing environments and examine whether consumers actually choose the edible option when faced with real prices and alternatives. Experimental approaches could also provide more reliable estimates of the price premium consumers are willing to accept. The role of information, labeling, and certification should also receive further attention. Since food safety and trust were important issues in the present study, future research could compare different communication strategies, including EU food-safety certification, ingredient and allergen information, environmental claims, and instructions explaining how the edible package should be consumed. Such research could help identify which information is most effective in reducing uncertainty and increasing consumer trust. Future studies could also conduct a Life Cycle Assessment (LCA) to compare the actual environmental performance of edible coffee packaging with conventional takeaway cups. The present study examined consumers' perceptions of environmental benefits rather than measuring environmental impacts. An LCA considering raw materials, manufacturing, transportation, use, and end-of-life conditions could therefore determine whether the perceived sustainability advantages are supported by environmental performance. Finally, long-term consumer acceptance should be investigated. Consumers may initially be interested in edible packaging because of its novelty, but initial willingness to try does not necessarily indicate repeated use. Longitudinal or repeated-use studies could therefore examine whether consumers continue to choose edible packaging after becoming familiar with the product. Overall, future research should focus on real products, real consumption experiences, and real purchasing behaviour. Combining larger and more diverse samples with sensory testing, safety and technical evaluation, behavioural experiments, and environmental assessment would provide stronger evidence about the potential of edible takeaway coffee packaging in the European market.

CHAPTER 6 – CONCLUSION

6.1 Overall Conclusion

Food packaging plays an important role in protecting food and supporting its transportation and consumption. However, the large amount of waste produced by single-use packaging has increased the need for more sustainable alternatives. Edible packaging is one possible solution because it can be consumed instead of being discarded. Previous research has also suggested that edible packaging may help reduce waste from conventional packaging systems (Zhang et al., 2024). The main purpose of this thesis is to investigate consumer acceptance of edible food packaging as a sustainable innovation, with particular attention to takeaway coffee. The study examined consumers' awareness, environmental perceptions, concerns, willingness to try, willingness to pay, and factors influencing purchase decisions. The analysis was based on 90 respondents from Italy, Germany, and the Netherlands. The results showed a generally positive attitude toward edible packaging. One of the strongest findings was that 92.2% of respondents agreed or strongly agreed that edible packaging could reduce packaging waste. This suggests that waste reduction is one of the main benefits consumers associate with this type of packaging. This result is consistent with (Taylor et al., 2024) who found that consumers generally considered edible packaging a sustainable alternative to single-use packaging. However, environmental benefits alone were not enough to guarantee consumer acceptance. Respondents also expressed concerns about food safety, hygiene, taste and texture, and possible allergens. Previous research has similarly shown that uncertainty and perceived risk can affect the acceptance of edible packaging. (Vergura et al., 2026) for example, found that food neophobia can increase perceived risk and reduce willingness to consume edible packaging. Despite these concerns, respondents showed strong interest in trying the product. 67.8% said they would try takeaway coffee with edible packaging, while 25.6% answered “Maybe.” This suggests that consumers may be open to edible packaging even when they have limited previous experience with it. (Zhang et al., 2024) also found that positive attitudes and consumer innovativeness can support purchase intentions toward edible food packaging. Price was another important factor. Although 76.7% were willing to pay some additional amount, 58.9% preferred to pay no more than 5% extra. Therefore, consumers may recognize the added value of

edible packaging, but a large price increase could reduce its acceptance. Trust and information were also important: EU certification or approval received a mean score of 4.32 out of 5, while clear labeling and information received 4.21. This indicates that consumers need reliable information about ingredients, allergens, safety, and how the packaging should be consumed. The study has some limitations. The sample included only 90 respondents, so the findings cannot represent all consumers in the three countries or in Europe. In addition, the study measured stated perceptions and intentions rather than actual behaviour. Participants did not use or taste a real edible coffee cup, so characteristics such as taste, texture, strength, and heat resistance could not be evaluated. Future studies should therefore use larger samples and test real edible coffee packaging. (Taylor et al., 2024) also showed the importance of direct product experience when studying consumer acceptance. Future research could also use an LCA to determine whether edible coffee packaging actually has a lower overall environmental impact than conventional alternatives. Overall, this study suggests that edible packaging has promising potential for takeaway coffee, particularly because consumers recognize its possible role in reducing packaging waste and show a high willingness to try it. However, successful adoption will depend on more than sustainability alone. Edible packaging should also be safe, hygienic, functional, attractive, clearly explained, and reasonably priced. Therefore, finding a balance between environmental benefits and consumer expectations will be important for its future use in sustainable food-packaging systems.

6.2 Answers to the Research Objectives

The findings show that consumers are generally willing to accept edible food packaging, mainly because of its environmental benefits. Acceptance is encouraged by safety certification, clear information, trust, and attractive design, but may be reduced by concerns about safety, hygiene, taste, allergens, and higher prices. The main aim of this study was to understand consumer acceptance of edible food packaging as a sustainable innovation. In relation to the research question, the findings indicate that consumers are generally willing to accept edible food packaging, but their acceptance depends on several factors, particularly perceived environmental benefits, safety, hygiene, taste and texture, trust, information, and price. The first objective was to understand consumer awareness of edible packaging. The results showed that awareness was higher than direct experience. While 67.8% of respondents had previously heard about edible packaging, only 30% reported that they had seen or used it. This suggests that edible packaging is

already known to many consumers, but practical experience with this type of packaging remains limited. However the low level of previous experience did not prevent respondents from showing positive attitudes toward the concept. This is consistent with (Taylor et al.,2024), who found that consumers could respond positively to edible packaging despite having limited previous experience with it. The second objective was to study consumers' willingness to try edible packaging and their willingness to pay for it. The findings showed a high level of willingness to try, with 67.8% of respondents answering "yes" and a further 25.6% answering "maybe." Only 6.7% stated that they would not try it. Willingness to pay was more moderate. Overall, 76.7% of respondents were willing to pay some additional amount for edible packaging, although most preferred only a small price increase, with 58.9% willing to pay up to 5% more. These findings suggest that consumers are open to trying edible packaging, but price remains important when this interest is translated into a purchasing decision. The third objective was to identify the factors that influence consumer decisions regarding edible packaging. Environmental benefits were among the strongest positive factors. In particular, 92.2% of respondents agreed or strongly agreed that edible packaging could reduce packaging waste. This supports previous research showing that sustainability and waste reduction can contribute positively to consumer acceptance of edible packaging (Taylor et al., 2024; Zhang et al., 2024). However, the results also identified important barriers. Food safety was the strongest concern, followed by hygiene, taste and texture, and possible allergens. (Taylor et al.,2024) similarly identified safety and sensory characteristics as important factors influencing consumer responses to edible packaging. At the same time, EU certification and approval, clear labeling and information, attractive packaging design, a trusted brand, and price were important factors that could influence acceptance. Therefore, the results indicate that environmental benefits alone are not sufficient to ensure consumer acceptance. Consumers also need confidence that edible packaging is safe, hygienic, clearly explained, trustworthy, pleasant to consume, and reasonably priced. Overall, the three research objectives were achieved. The findings show that consumers have relatively high awareness but limited direct experience with edible packaging, demonstrate a strong willingness to try it but greater sensitivity when additional payment is required, and base their acceptance on a combination of environmental, safety, sensory, informational, trust, and economic factors. The study also examined willingness to try edible packaging. The results showed that 67.8% answered "Yes" and 25.6% answered "Maybe" when asked if they would try takeaway coffee with edible packaging. This shows a high

level of initial interest. (Taylor et al., 2024) also reported positive purchase intentions for different edible packaging products. However, (Vergura et al., 2026) found that food neophobia and perceived risk can reduce willingness to consume edible packaging. Regarding willingness to pay, 76.7% of respondents were willing to pay some extra amount, but 58.9% preferred to pay no more than 5% extra. (Taylor et al., 2024) found higher willingness to pay after participants tried real edible products. This difference suggests that direct experience with the product may influence how much consumers are willing to pay. The study also identified important purchase factors. EU certification or approval received the highest mean score (4.32/5), followed by clear labeling and information (4.21), attractive design (4.19), trusted brand (4.04), and lower price (3.92). This shows that consumers want edible packaging to be not only sustainable but also safe, clear, attractive, trustworthy, and affordable. (Vergura et al., 2026) also showed that communication can influence consumers' evaluation of edible packaging. Overall, the research shows positive but conditional acceptance of edible packaging for takeaway coffee. Consumers recognize its environmental benefits and are generally willing to try it. However, environmental sustainability alone is not enough. For wider acceptance, edible coffee packaging should be safe, hygienic, practical, enjoyable, clearly explained, and reasonably priced.

6.3 Practical Implications

The findings of this study provide useful information for companies that may want to introduce edible packaging for takeaway coffee. The results show that consumers are interested in this idea, but companies should consider not only environmental benefits but also safety, hygiene, information, taste, design, trust, and price. One important advantage is waste reduction. In this study, 92.2% of respondents agreed or strongly agreed that edible packaging could reduce packaging waste. (Taylor et al., 2024) also found strong consumer support for edible packaging as a sustainable alternative to single-use plastic. (Zhang et al., 2024) similarly described edible packaging as a possible solution for reducing packaging waste. However, sustainability alone is not enough. Food safety and hygiene are especially important because consumers may eat the packaging. (Taylor et al., 2024) also found that safety was the most important factor affecting purchase intention. For edible coffee cups, companies should therefore make sure that the product is protected from contamination during production, transport, storage, and serving. Clear

information and certification are also important. Clear labeling received a mean score of 4.21 out of 5, while EU certification or approval received the highest score of 4.32. Consumers should receive simple information about ingredients, allergens, how to eat the packaging, and its safety. (Ketelsen et al., 2020) also showed that limited consumer knowledge can be a barrier to the acceptance of environmentally friendly packaging. Taste, texture, appearance, and design should also be considered because the packaging becomes part of the eating experience. (Taylor et al., 2024) showed that consumers evaluated edible packaging based on sensory characteristics such as appearance, flavour, and texture. Therefore, an edible coffee cup should be both functional and enjoyable to consume. Finally, price should remain reasonable. Although 76.7% of respondents were willing to pay something extra, 58.9% preferred to pay no more than 5% more. This suggests that a large price increase could reduce consumer acceptance. (Ketelsen et al., 2020) also identified price as an important factor in sustainable packaging decisions. Overall, companies should find a balance between sustainability and consumer experience. Edible coffee packaging should reduce waste, but it should also be safe, hygienic, attractive, functional, clearly explained, and affordable. These factors could help edible packaging become a practical option for everyday takeaway coffee.

6.4 Final Remarks

Edible food packaging is a promising solution for reducing packaging waste. Instead of becoming waste directly after use, the package can be partly or completely consumed. However, the results of this study show that environmental benefits alone are not enough. Consumers also need to trust the product, feel that it is safe and hygienic, enjoy using it, and consider its price reasonable. The results showed a generally positive attitude toward edible packaging. Most respondents believed that it could reduce packaging waste, and many were willing or potentially willing to try takeaway coffee with edible packaging. However, positive opinions in a survey do not necessarily mean that consumers will choose the product in real life. (Selvaggi et al., 2026) found that appearance, practical characteristics, environmental information, and product experience can influence consumers' willingness to pay for sustainable packaging. Consumer concerns are also important. For an edible coffee cup, consumers would need to hold, drink from, and possibly eat the package. Therefore, taste, texture, appearance, hygiene, and safety can strongly influence acceptance. (Vergura et al., 2026) found that food neophobia and perceived risk can reduce willingness to

consume edible packaging. Similarly, (Aldred Cheek & Wansink, 2017) showed that acceptance can depend on how edible packaging is connected with the food, suggesting that separate products such as edible cups may face greater barriers. The findings of this study also highlight the importance of trust and clear information. Respondents gave high importance to EU certification or approval and clear labeling. Information about ingredients, allergens, safety, storage, and how the package should be consumed could therefore help consumers feel more confident about edible packaging. Another important point is that consumers' perception of sustainability should not be confused with the actual environmental performance of the product. The environmental impact of an edible coffee cup depends on factors such as ingredients, production, energy use, transportation, and storage. Therefore, future studies could use Life Cycle Assessment (LCA) to compare edible coffee cups with conventional packaging. Future research should also include real product testing. Participants in this study did not actually use or taste an edible coffee cup. Testing the product in cafés, universities, or other foodservice settings could provide better information about consumer reactions, sensory quality, hygiene, willingness to pay, and repeated use. Overall, this study suggests that edible takeaway coffee packaging has potential, but its success depends on more than sustainability. Safety, hygiene, sensory quality, information, certification, functionality, and price should all be considered. Edible packaging can therefore be understood not only as a new packaging material but also as a new consumer experience. If environmental sustainability, technical performance, food safety, and consumer acceptance can be successfully combined, edible packaging may become a useful alternative for reducing some forms of single-use packaging waste.

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APPENDIX A — SURVEY QUESTIONNAIRE

Consumer Perception of Edible Packaging for Takeaway Coffee

The following questionnaire was used for data collection in this study. The survey was conducted online and was designed to investigate consumer awareness, attitudes, perceived benefits and risks, willingness to try and pay, and factors influencing the acceptance of edible food packaging. The questionnaire consisted of 27 questions divided into seven sections.

The introductory information presented to participants was as follows:

This survey is part of a master's thesis and takes approximately 5–7 minutes.

In this survey, edible packaging refers to food-grade materials used in contact with beverages. Please consider a takeaway coffee served in an edible cup that can be consumed together with the beverage or removed before/after consumption.

A.1 About You

Participants were informed that their information was confidential, would be used only for academic purposes, and would not be shared externally.

Q1. What is your gender?

- Woman
- Man
- Prefer not to say

Q2. How old are you?

- 18–24

- 25–34
- 35–44
- 45–54
- 55–64
- 65+

Q3. Highest level of education completed.

- High school
- Bachelor's degree
- Master's degree
- Doctorate
- Other

Q4. Where do you live?

- Italy
- Germany
- The Netherlands

A.2 Awareness and Prior Knowledge

Q5. Have you heard of edible food packaging before?

- Yes
- No

Q6. Have you ever seen or used edible packaging (e.g., edible cups)?

- Yes
- No
- I'm not sure

Q7. If yes, in which form?

Open-ended response

A.3 General Attitudes toward Edible Packaging

For Questions 8–12, participants indicated their level of agreement using a five-point Likert scale:

1 = Strongly disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly agree

Q8. Edible packaging is an innovative packaging solution.

1 2 3 4 5

Q9. Edible packaging could be a sustainable and biodegradable alternative to conventional plastic packaging.

1 2 3 4 5

Q10. Edible packaging could add value to food products (e.g., nutrients, flavors, functional benefits).

1 2 3 4 5

Q11. Using edible packaging fits with current sustainability trends.

1 2 3 4 5

Q12. I find the concept of edible packaging interesting.

1 2 3 4 5

A.4 Perceived Benefits

For Questions 13–15, the same five-point Likert scale was used:

1 = Strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly agree

Q13. Edible packaging could help reduce packaging waste.

1 2 3 4 5

Q14. Edible packaging could contribute to more sustainable consumption.

1 2 3 4 5

Q15. Edible packaging could improve the environmental image of food companies.

1 2 3 4 5

A.5 Concerns and Perceived Risks

For Questions 16–20, participants indicated their level of agreement using the same five-point Likert scale:

1 = Strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly agree

Q16. I am concerned about the hygiene of edible packaging.

1 2 3 4 5

Q17. I am concerned about the food safety of edible packaging.

1 2 3 4 5

Q18. I am concerned about the taste or texture of edible packaging.

1 2 3 4 5

Q19. I am concerned about possible allergens in edible packaging.

1 2 3 4 5

Q20. I would trust edible packaging only if it is approved by EU food safety authorities.

1 2 3 4 5

A.6 Willingness to Try and Willingness to Pay

Q21. Would you be willing to try a takeaway coffee served with edible packaging?

- Yes
- No
- Maybe

Q22. Would you be willing to pay more for a product using edible packaging?

- No, I would not pay more
- Yes, up to 5% more
- Yes, 5–10% more
- Yes, more than 10%

A.7 Factors Influencing Purchase Decision

For Questions 23–27, participants indicated their level of agreement using the five-point Likert scale:

1 = Strongly disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly agree

Q23. Clear labeling and information would increase my willingness to purchase edible packaging.

1 2 3 4 5

Q24. Certification or approval by EU authorities would increase my trust.

1 2 3 4 5

Q25. A lower price would increase my likelihood of choosing edible packaging.

1 2 3 4 5

Q26. A well-known or trusted brand would influence my decision.

1 2 3 4 5

Q27. Attractive packaging design would influence my decision.

1 2 3 4 5