Author: Gade, Sreeja

Title: ***Consumer Perceptions Towards Sustainable Packaging Alternatives for Shredded Cheddar Cheese***

The accompanying research report is submitted to the **University of Wisconsin-Stout**, **Graduate School** in partial completion of the requirements for the

Graduate Degree/ Major: MS Food Science and Technology

Research Advisor: DeGruson L. Min, Ph.D.

Submission Term/Year: Summer 2024

Number of Pages: 67

Style Manual Used: American Psychological Association, 7th edition

☒ **I have adhered to the Graduate School Research Guide and have proofread my work.**
☒ **I understand that this research report must be officially approved by the Graduate School.**
Additionally, by signing and submitting this form, I (the author(s) or copyright owner) grant the University of Wisconsin-Stout the non-exclusive right to reproduce, translate, and/or distribute this submission (including abstract) worldwide in print and electronic format and in any medium, including but not limited to audio or video. If my research includes proprietary information, an agreement has been made between myself, the company, and the University to submit a thesis that meets course-specific learning outcomes and CAN be published. There will be no exceptions to this permission.
☒ **I attest that the research report is my original work (that any copyrightable materials have been used with the permission of the original authors), and as such, it is automatically protected by the laws, rules, and regulations of the U.S. Copyright Office.**
☒ **My research advisor has approved the content and quality of this paper.**

STUDENT:

NAME: **Sreeja Gade** **DATE:** **6/21/2024**

ADVISOR: (Committee Chair if MS Plan A or EdS Thesis or Field Project/Problem):

NAME: **Min L. DeGruson** **DATE:** **7/30/2024**

This section for MS Plan A Thesis or EdS Thesis/Field Project papers only
Committee members (other than your advisor who is listed in the section above)

1. **CMTE MEMBER'S NAME:** **DATE:**
2. **CMTE MEMBER'S NAME:** **DATE:**
3. **CMTE MEMBER'S NAME:** **DATE:**

This section to be completed by the Graduate School
This final research report has been approved by the Graduate School.
Director, Office of Graduate Studies: **DATE:**

Gade, Sreeja. ***Consumer Perceptions Towards Sustainable Packaging Alternatives for Shredded Cheddar Cheese***

Abstract

In the food industry, environmentally friendly packaging options are becoming more and more in demand. This study focuses on consumer perceptions of sustainable packaging options for the popular American dairy product, shredded cheddar cheese. The objective of the study is to create a bridge between the preferences of consumers and the practices of the industry. The research combined a large-scale online survey with descriptive questions and qualitative focus group study to understand detailed behavioral observations. They were evaluated based on physical appearance, cost, and data from lifecycle assessment of the five packaging materials: a control, a recycle-ready alternative, and varying levels of post-consumer recycled content (30%, 90%) as well as compostable Polylactic Acid (PLA) plastic.

The online survey revealed that 49% of participants preferred the compostable option, 22% the recycle-ready, 24% the 90% PCR, 5% the 30% PCR, and 3% the control. Notably, 51% of consumers would pay up to a 10% premium or less, and 39% would pay more than 10%, reflecting increased environmental awareness. While compostable packaging was most popular choice in online surveys, its perceived practicality issues, such as crinkle noise, influenced its lower ranking in focus groups. 90% PCR was second highest but due to its cloudy appearance most people chose 30%. The findings suggest that addressing both the functional and environmental aspects is crucial for increasing consumer acceptance. Future research should focus on improving the design and overall user experience of sustainable alternatives to enhance their appeal and encourage wider adoption.

Acknowledgments

The successful completion of this thesis represents the end of a rewarding journey, fueled by the unwavering support and guidance of many people. First and foremost, I recognize the profound impact of unforeseen challenges. These challenges, which were often viewed as setbacks, acted as catalysts for personal development. For this, I am deeply grateful.

Professor Min Degruson's unwavering trust and invaluable mentorship helped shape this thesis project. Her unwavering support served as a pillar of strength, instilling confidence and a sense of direction throughout the research process. My heartfelt gratitude goes to my parents, whose unwavering trust and encouragement have been the foundation of my academic journey. The successful completion of this thesis would not have been possible without their unwavering confidence in my abilities.

Special thanks go to my friend Bharadwaj Chukkala's, unwavering belief in my potential, combined with their willingness to help during difficult times, proved instrumental in maintaining concentration and perseverance. I am thankful to my friends, Sagarika Sommineni, Sasidhar Varma Pandeti, BindhuMadhav Reddy and Raja Thunga for their support and encouragement throughout the completion of this research project. The inspiration for this thesis came during an internship when a critical need in the scientific community was identified. Recognizing the potential impact of addressing this knowledge gap, I initiated this research project. I'd like to express my heartfelt appreciation to the Evelyn Van Donk Steenbock Endowed Chair grant (RS Project # CEHHHS-GM-00307-2- A-22) for providing financial assistance that enabled the completion of this research project.

This thesis represents the collective efforts and support of many, and I am sincerely thankful to everyone who played a role, no matter how big or small, in bringing this work to fruition.

Table of Contents

List of Figures

Chapter I: Introduction and Problem Statement

Environmental sustainability has become increasingly important in a number of industries, including the food packaging industry, in recent years. Customers are looking for more environmentally friendly solutions to lessen their carbon footprint as they become more aware of how packaging affects the environment (Nordin & Selke, 2010). For food producers and retailers, this shift in consumer preference toward sustainable packaging offers both opportunities and challenges. A common dairy product that is usually sold in plastic bags or containers is shredded cheddar cheese. Industry stakeholders must comprehend consumer perceptions and preferences regarding sustainable cheese packaging as consumers become more ecologically conscious in order to adjust and meet changing market demands (Martinho et al., 2015; Popović et al., 2020). The purpose of this study is to offer guidance for the creation of eco-friendly packaging options for shredded cheddar cheese that satisfy customers' needs while addressing their worries about an excessive amount of plastic waste.

Examining consumer attitudes, preferences, and perceived barriers regarding sustainable packaging options for shredded cheddar cheese is the main goal of this study. Through an investigation of the primary determinants of consumer behavior, such as convenience, environmental awareness, and packaging features, producers can create packaging solutions that strike a balance between consumer acceptance and sustainability. According to earlier research, consumers are willing to pay more for environmentally friendly packaging when it comes to liquid foods like milk and juice. This willingness is influenced by perceptions of product quality and environmental awareness. Nonetheless, research on how consumers view environmentally friendly packaging for solid dairy products, such as shredded cheese, which is usually sold in restricted packaging, is limited. One study looked at how consumers feel about biobased packaging that is recyclable and biodegradable. It discovered that consumers value end-of-life characteristics more than renewable origin. A different review brought attention to the disparity that exists between what consumers believe and the true environmental impact of various packaging materials. This suggests that more research is necessary to bring consumer perceptions into line with scientific facts.

By concentrating on consumer perceptions of sustainable packaging for shredded cheddar cheese, a dairy product that is frequently purchased, this study seeks to fill a vacuum in the literature. Industry players can create packaging solutions that satisfy changing consumer demands and advance the overarching objective of environmental sustainability in the food sector by knowing what drives consumer behavior toward sustainable cheese packaging.

Purpose of the Study

This study's main goal is to find out how consumers feel about and prefer environmentally friendly packaging options for shredded cheddar cheese. The study specifically aims to investigate potential barriers to the adoption of more sustainable packaging solutions, evaluate the relative importance of various packaging attributes, and comprehend the mindset of consumers when making purchasing decisions.

Goals of the Study

The goals of the study are listed below:

- Determine the key packaging attributes, including price, that influence consumer preferences for shredded cheddar cheese, with a focus on sustainability-related elements.
- Examine how environmental awareness and the availability of informed LCA data impact consumer behavior towards sustainable cheese packaging.

- Evaluate the alleged obstacles and difficulties that might prevent the use of sustainable packaging for cheddar cheese that has been shredded.
- Offer industry stakeholders advice and insights on how to create environmentally friendly packaging solutions that meet consumer demands and gain traction in the marketplace.

Assumptions of the Study

Customers are increasingly looking for more environmentally friendly options as they become more conscious of the environmental impact of packaging. Despite this trend, there is limited research on consumer perceptions of sustainable packaging for solid dairy products like shredded cheese. One study found that consumers value end-of-life characteristics, such as the ability to decompose and be recycled, over the renewable origin of biobased packaging (Martinho et al., 2015). Additionally, a review highlighted the disparity between consumer beliefs and the actual environmental impact of various packaging materials, suggesting the need for further research to align consumer perceptions with scientific facts (Nordin & Selke., 2010).

The assumptions of the study are as follows:

1. As consumers become more aware of how packaging affects the environment, they look for more environmentally friendly options.
2. When choosing shredded cheddar cheese, consumers consider packaging characteristics like biodegradability, recyclability, and renewable origin.
3. Consumer preferences for sustainable packaging are influenced by their knowledge of lifecycle assessment and environmental awareness.

Definition of Terms

The following terms used in this research paper. This section is designed to clarify and explain the meanings of specific words, phrases, or technical terms that may not be widely understood by audience. The purpose is to ensure that readers, especially those who may not be familiar with your field of study, can comprehend the terminology used throughout this thesis.

Sustainable Packaging

Sustainability in the context of packaging is the capacity of packaging systems to satisfy the demands of society today without jeopardizing the ability of future generations to satisfy their own needs. It emphasizes the use of renewable resources, waste reduction, and minimal environmental impact throughout the packaging lifecycle. It encompasses environmental, economic, and social dimensions (Shahid et al., 2022).

Recycle Ready Packaging

Packaging that is ready to be recycled is made expressly to fit into the recycling system already in place. In order to maximize recyclability and reduce contamination during the recycling process, it complies with stringent material composition and design guidelines (Geyer et al., 2017).

Post-Consumer Recycled Plastic

Consumer-used plastic products are the source of post-consumer recycled (PCR) plastic, which is then gathered for recycling. According to Ghisellini et al. (2018), it is a useful resource for creating new plastic products, lowering the need for virgin materials, and keeping waste out of landfills.

Compostable PLA Polylactic acid Plastic

A biodegradable thermoplastic made from renewable resources like sugarcane or corn starch is called polylactic acid (PLA). Because of its ability to break down in particular environmental conditions, it presents a viable substitute for conventional plastics derived from petroleum (Karamanlioglu et al., 2017).

The Life Cycle Assessment

A system's or product's environmental effects are assessed over the course of its whole life cycle, from the extraction of raw materials to the management of its end of life, using life cycle assessment (LCA), a thorough assessment methodology. It considers variables like waste production, water use, energy consumption, and greenhouse gas emissions (International Organization for Standardization, 2006).

Fossil Fuel Consumption (in Oil-Equivalent Barrels)

The amount of energy used in a product or process lifecycle that comes from fossil fuel sources is measured in barrels of oil equivalent, or BOE. Comparisons between various energy carriers are made easier by this standardized unit (U.S. Energy Information Administration, n.d.).

Global Warming Potential

A gas's potential to trap heat in relation to carbon dioxide over a given period of time is measured by its global warming potential (GWP). To make comparing the environmental effects of various packaging materials and systems easier, the study's GWP is expressed in gallons of gasoline equivalent (U.S. Environmental Protection Agency, n.d.).

Water Usage (in Gallons)

Water consumption measures the total amount of water used over the course of a product's life. It evaluates the environmental effects of water scarcity in gallons of water (Swedenborg, 2024).

Limitations of the Study

The study focuses on five consumer-facing sustainable packaging options for shredded cheese: Control, Recycle Ready, 30%, 90% PCR and compostable PLA. Out of the available options, the majority of respondents to the online survey selected Compostable PLA as their most preferred shredded cheese packaging and Recycle Ready as their least preferred option**.** In contrast, respondents to the focus group survey expressed dissatisfaction with the 90% PCR and Compostable 's appearance, including its transparency, color, and crinkly sound.

Consumer opinions about other cheese products or food categories are not included in this study since it is restricted to the shredded cheddar cheese category. Furthermore, the majority of the data's participants were US consumers, so its conclusions might not apply as broadly to other or nations with disparate socioeconomic and cultural backgrounds. Even with its sizeable sample size, it might not fully represent the range of consumer preferences; therefore, larger and more representative samples should be used in future research. Finally, the study concentrates on self-reported behaviors and stated preferences, which might not always match up with actual purchases made in actual retail settings.

IRB-Approved Methodology

The goal of this study is to evaluate the viability of sustainable packaging for shredded cheddar cheese from the standpoint of the consumer, with a focus on values, influencing factors, and feedback from tangible prototypes. The research starts with creating physical prototypes of several sustainable packaging choices for shredded cheddar cheese. These prototypes will be built to demonstrate several sustainable packaging materials. During prototype development, certain aspects such as material, design, and labeling will be examined. Packaging undergraduate students will assist to create physical prototypes with different material options.

The life cycle analysis of different sustainable options will be conducted through software EcoImpact-COMPASS. The pictures of physical prototypes and environmental indicators of different sustainable options from EcoImpact-COMPASS will be used in the survey. A broad group of consumers will be chosen to take part in the online survey. Participants will be picked from various demographics to guarantee a diverse representation of consumer perspectives. To analyze customer attitudes and beliefs about sustainable packaging and collect thorough insights with the use descriptive analysis. The survey questions will center on sustainability values, environmental awareness, and the impact of packaging on purchasing decisions. The online survey will be circulated by the end of February and will be run for a defined period of time in order to collect data. Smaller group of participants will be shown physical prototypes of sustainable packaging.

Consumers will be able to view, touch, and evaluate several packaging solutions when the prototypes are shown. Consumer input on these prototypes will be gathered to gain a thorough understanding. A smaller group of attendees will interact with the physical prototypes.

These people will interact with the prototypes and provide input on the tactile sensation, aesthetics, and general appeal. Discussions and observations will be used to collect behavioral insights. The large-scale online survey data, including sustainability values and preferences, will be examined statistically. Qualitative insights collected from customer input will be organized and classified. The quantitative and qualitative findings will be analyzed and cross-referenced to provide a complete picture of customer attitudes. This scientific framework describes a structured methodology for investigating customers' attitudes toward sustainable packaging for shredded cheddar cheese. The study intends to connect consumer ideals with industrial sustainability practices by using a combination of large-scale surveys, tangible prototypes, and behavioral insights. This study adds to the expanding body of knowledge on sustainable packaging and provides practical advice to industry stakeholders.

Chapter II: Literature Review

Consumer perceptions of environmentally friendly packaging for drinks like milk and juice have been investigated in the past (Popović et al., 2020). The results indicate that, due to factors like perceived product quality and environmental awareness, consumers are willing to pay more for environmentally friendly packaging (Popović et al., 2020). Customers should consider sustainable packaging features like renewable origin, biodegradability, and recycling when choosing shredded cheddar cheese.

Overview of the Market

From 2021 to 2026, the global cheese market is projected to expand at a 3.5% compound annual growth rate, reaching a valuation of $165.8 billion. With a sizeable portion of the market, cheddar cheese is one of the most popular types of cheese. One of the most important trends in the food and beverage sector is the rising demand from consumers for environmentally friendly and sustainable packaging. Manufacturers are facing pressure to create packaging solutions that are more environmentally friendly, minimize their negative effects, and satisfy consumer demands for convenience, style, and functionality (Bogue et al., 1999; Herbes et al., 2020).

Additionally, research indicates that a sizable segment of European customers concur that businesses ought to do more to reduce plastic waste and increase recycling (Magnier & Schoormans, 2015). This implies that consumer preferences for environmentally friendly packaging might also have a significant impact on the cheese market.

Prospect of Potential for Sustainable Packaging in the Market for Cheddar Cheese

The market for cheddar cheese offers an intriguing chance to apply eco-friendly packaging techniques. Cheese is a solid food item that is usually packaged in bags, trays, or plastic films, all of which can have an adverse effect on the environment. In order to address consumer concerns and improve the overall sustainability of the cheese industry, more sustainable packaging options, such as those made of recycled, renewable, or biodegradable materials, should be adopted (Gray & Guthrie, 1990).

Businesses have been making investments in the creation of creative, environmentally friendly cheese and other food product packaging solutions over the years. For instance, a study on sustainable cheese packaging using patents and scientific publications revealed that certain companies have started using packaging composed of recycled materials, plant-based biopolymers, and other environmentally friendly materials to meet the rising demand from customers for sustainable products (Melo and Oliviera, 2019). The market for cheddar cheese may see a rise in the use of sustainable packaging options that suit consumer preferences and support an environmentally conscious business sector as sustainability awareness and expectations among consumers continue to rise. (Bogue et al., 1999; Guthrie & Gray, 1990; Popović et al., 2020; White, 2000)

The current research paper on the prospects of sustainable packaging in the cheddar cheese market can benefit from the insights gained from Spreafico and Russo's (2021)"*A Sustainable Cheese Packaging Survey Involving Scientific Papers and Patents*". The paper offers a thorough summary of the initiatives taken by industry and academia to improve the sustainability of cheese packaging. It identifies different eco-design techniques, materials, and cheese varieties taken into consideration in sustainable packaging solutions by analyzing a sizable number of scientific publications and patents. The study outlines a number of eco-strategies used to increase the sustainability of cheese packaging, including the use of biodegradable materials and active, vacuum, or modified atmosphere packaging to extend cheese shelf life. Furthermore, the analysis shows that the use of bioplastics derived from plants, as opposed to synthetic plastics, is becoming more popular for environmentally friendly cheese packaging. The paper also discusses the unique needs of various cheeses, such as the soft cheeses' quick perishability, and looks at how packaging can effectively meet these needs. The paper also explores the disparities in the approaches to sustainable packaging taken by industry and academia. Industry places more emphasis on solutions that provide immediate environmental benefits, like biodegradability, while academia concentrates on experimental fronts like active packaging. Additionally, the study makes predictions about future developments in cheese packaging, pointing to a move toward active and intelligent packaging solutions, such as the creation of intelligent packaging to support the expanding interest in improving packaging sustainability.

All things considered, the information gathered from the **"***a Sustainable Cheese Packaging Survey Involving Scientific Papers and Patents***"** can serve as a strong basis for comprehending both the present situation of sustainable packaging in the cheddar cheese industry and the prospects for future developments in this field (Boz et al., 2019; Kozik, 2020). There is, however, little research on how consumers feel about sustainable packaging for solid dairy products like shredded cheese. Consumers prioritize end-of-life attributes over renewable origin, according to a study that looked at consumer attitudes toward biobased packaging, including biodegradability and recyclability (Herbes et al., 2018). A different review brought attention to the disparity that exists between what consumers believe and the true environmental impact of various packaging materials. This suggests that more research is necessary to bring consumer perceptions into line with scientific facts (Otto et al., 2021).

Definition of Sustainability

Environmental, economic, and social aspects are all included in the broad concept of sustainability (Boz et al., 2020). According to Accorsi et al. (2014), sustainability in the food industry refers to the prudent use of natural resources, the reduction of waste and emissions, and the creation of long-term value for all parties involved, including consumers. As it attempts to lessen the environmental impact of food packaging throughout its life cycle, from production to disposal or recycling, sustainable packaging is a crucial part of sustainable food systems (Guillard et al., 2018). Packaging that is created, manufactured, shipped, and disposed of in a way that reduces its environmental impact is referred to as sustainable packaging.

Types of Sustainable Packaging

Lifecycle assessment and material composition determine the types of packaging that are considered sustainable.

Recycle Ready

One important category of environmentally friendly packaging that is made to be readily recycled is recycle ready packaging. The materials used to make this packaging can be effectively processed and recovered through well-established recycling initiatives. Common recyclable materials like paper, cardboard, some plastics, and metals that are widely accepted by municipal recycling facilities are often used in recycle ready packaging. By using these materials, packaging can be effectively gathered, sorted, and recycled into new goods, reducing waste and protecting natural resources. Recycle-ready packaging options give customers an eco-friendly packaging choice that satisfies rising environmental impact concerns and circular economy ideas. Food manufacturers, especially those in the shredded cheddar cheese industry, can improve the sustainability of their packaging and satisfy consumer demands for more environmentally friendly options by implementing recycle ready packaging.

Post-Consumer Recycled Plastic

One important kind of sustainable packaging material that is receiving more attention is post-consumer recycled plastic. These plastics are gathered from commercial and residential waste streams, cleaned, sorted, and then processed again to create new plastic products and resins. Manufacturers can drastically reduce their dependency on virgin plastic made from fossil fuels, resulting in lower greenhouse gas emissions and a smaller environmental footprint, by incorporating post-consumer recycled plastic content into packaging.

Based on the amount of recycled material, there are two primary categories of PCR (post-consumer recycled) plastics: 30% PCR and 90% PCR. The percentage denotes the proportion of post-consumer recycled material that is mixed with virgin plastic to make the plastic resin. Manufacturers are able to strike a balance between other packaging requirements and sustainability considerations thanks to these various PCR content levels. For consumer-packaged goods, food grade PCR plastics are especially desirable because they allow manufacturers to meet sustainability targets while upholding food safety and quality regulations.

There are various advantages to using recycled plastic from post-consumer waste in packaging. By extending the useful life of materials, it diverts plastic waste from landfills and incineration, promoting a more circular economy. Furthermore, compared to the production of virgin plastic, the reprocessing of post-consumer plastics usually uses less energy and produces fewer emissions. Because of this, post-consumer recycled plastics are a more environmentally friendly substitute that meets the growing demand from consumers for packaging options that don't harm the environment.

There is a growing trend in many industries, including the food and beverage industry, to increase the amount of recycled material in packaging. Higher recycled plastic targets are being pushed for by voluntary initiatives and regulatory bodies in an effort to accelerate the shift to a more circular plastics economy. In order to improve the environmental profile of their packaging, food producers—including those in the shredded cheddar cheese market—will probably find it more and more necessary to incorporate post-consumer recycled plastics as consumer awareness and demand for sustainable packaging grow.

Compostable- Polylactic Acid Plastic

PLA is a compostable and biodegradable bioplastic that is made from renewable resources, usually starch-based feedstocks like corn. In comparison to conventional plastics derived from petroleum, the production of PLA uses less energy and produces fewer greenhouse gas emissions. According to Huang et al. (2019) and Singh et al. (2020), PLA has a unique biodegradability profile and is a promising substitute for sustainable food packaging because it can decompose into natural compounds like carbon dioxide and water.

Films, coatings, and rigid containers are just a few of the packaging formats that can be made with PLA. Because PLA decomposes naturally, it can be used to create food packaging that is actually compostable. This means that waste won't end up in landfills or incinerators when it is disposed of through commercial or municipal composting programs. Packaging made of PLA for cheese has a number of benefits. Because PLA and conventional plastic feel and look alike, customers can switch to it easily. Furthermore, by lessening the environmental impact at the end of its life cycle, the biodegradable qualities of Compostable PLA can improve the sustainability profile of cheese packaging (Muller et al., 2017; Rodríguez-Núñez et al., 2018).

Lifecycle Assessment (LCA) in Sustainability

It's critical to consider every stage of the packaging system's lifecycle, from the extraction of raw materials to the recycling or disposal of the system at the end of its useful life, in order to fully evaluate the sustainability of cheese packaging. Examining the environmental effects of a product at every stage of its life, including resource extraction, manufacturing, transportation, use, disposal, and recycling, is known as lifecycle assessment (Arrieta et al., 2016).

Food producers can find opportunities to enhance the environmental performance of their cheese packaging by carrying out a thorough lifecycle assessment. This could entail optimizing end-of-life management, manufacturing procedures, logistics, and material selection. Informed decision-making that balances customer preferences, legal requirements, and general environmental considerations can be made possible by using lifecycle assessment, which can offer insightful information about the advantages and disadvantages of various packaging materials and designs (Awasthi et al., 2022).

Consumer preference for all sustainable packaging options decreased as a result of the release of LCA data, with the compostable option experiencing the largest decline. Higher PCR content options remained relatively popular, despite a general decline in preference for sustainable packaging. This suggests that there may be a trade-off between environmental impact and material composition. When consumers are presented with Life Cycle Assessment (LCA) data that highlights the potential environmental impacts of composting, they are more likely to prioritize recyclability and recycled content over biodegradability. This is evident from the significant decline in preference for the compostable option. These results highlight how crucial it is to give customers clear and precise information regarding the environmental effects of various packaging options so that they can make well-informed decisions.

Chapter III: Methodology

This study used an online survey with descriptive analysis questions to collect detailed information on consumer attitudes and beliefs about sustainable packaging. (Klaiman et al., 2017; Oloyede & Lignou, 2021; Speight et al., 2019). A large-scale online survey of over 228 consumers was conducted and focus groups with 10 participants provided detailed insights into consumer perceptions of current cheese packaging and expectations for sustainable alternatives (Oloyede & Lignou, 2021). This survey collected information on demographics, interest in sustainable purchasing, and preferences for sustainable packaging options for shredded cheddar cheese, such as recycle-ready, 30% PCR, 90% PCR, and Compostable PLA. It also looked at consumers' willingness to pay a premium for sustainable packaging, as well as the impact of environmental factors like fossil fuel use, global warming potential, and water consumption on their packaging choices.

Data Collection Procedures

This paper also used consumer-based preference methods such as online-group survey and focus group survey (Krueger & Casey, 2014) to gain a better understanding of consumer choice patterns and opinions in order to identify the most appropriate sustainable packaging options for shredded cheddar cheese. The combination of quantitative and qualitative techniques helps in a comprehensive assessment of consumer preferences, which provides the information about development of sustainable packaging solutions that addresses the target market's needs and concerns.

First, the University of Wisconsin-Stout faculty and students were given access to an online survey. Campus-wide email lists, social media platforms, Online recruiting and promotional posters were used to encourage participation. Second, the University of Wisconsin

Stout Psychology Department's participant pool was used to identify about 1000 of the people who received emails.

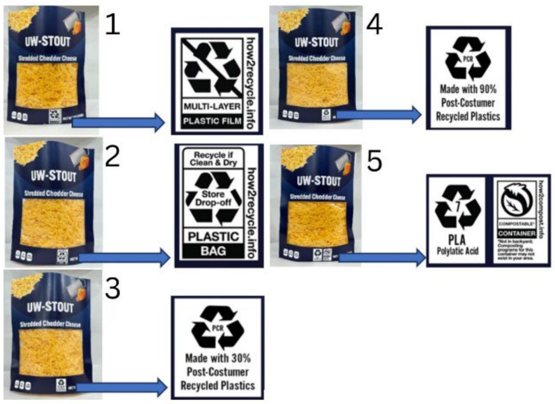
The purpose of the online survey created in Qualtrics software was to gather information on packaging preferences, environmental purchasing behavior, and demographics. Photographs of real prototypes created in conjunction with the Packaging Department and graphics showcased the packaging information along with the end-of-life or disposal guidance were given using “How2Recyle label” were shown to the participants (see Figure 1). A set of questions was employed to determine which sustainable shredded cheese packaging attributes were most highly valued. The researchers were able to quantify the trade-offs that customers were willing to make and determine the relative importance of each attribute. In order to better understand customer justifications and investigate their preferences in a group context, focus groups were held. Based on their involvement in the online survey and their interest in sustainability, participants were invited. Expert moderators led the conversations, which centered on finding out what people thought about the packaging prototypes.

Online-Survey

For the Online survey, approval was obtained from the Institutional Review Board, as detailed in Appendix A and Appendix B. The survey questions are listed in Appendix C. The survey instrument was designed to collect data on a variety of topics, including demographics, environmental purchasing behavior, and packaging preferences. questions were used to identify the most valued characteristics in sustainable shredded cheese packaging allowed the researchers to estimate the relative importance of each attribute and quantify the trade-offs consumers were willing to make (Louviere et al., 2000). Images of physical prototypes were shown for consumers in the online survey as shown in Figure 1.

Figure 1

Physical Prototypes Used in Online Survey



Note. Ascending Order of Control, Recycle Ready, 30% PCR, 90% PCR and Compostable-PLA Plastics.

Focus-Group Study

In addition to the online survey, detailed focus group discussions were held with ten people in-person. For this Focus-group study, approval was obtained from the Institutional Review Board, as detailed in Appendix A and Appendix B. Participants were selected based on their stated interest in sustainable purchasing. The focus groups provided an opportunity for in-depth qualitative research into consumer perceptions and preferences. During the discussions, participants were shown physical prototypes of several sustainable packaging options for shredded cheddar cheese (control, recycle-ready, 30% PCR, 90% PCR, Compostable-PLA) as shown in Figure 2.

Figure 2

Physical Packaging Prototypes Used for Focus Group Survey

This tangible element allowed participants to compare the visual aesthetics, functionality, and perceived user experience of each packaging type.

A semi-structured interview protocol was used to guide the discussions and elicit insights into the following topics:

- Initial Impressions and Preferences: The participants' initial reactions and preferences for the appearance and feel of each sustainable packaging option were investigated.
- Attitudes Towards Sustainability: The discussions focused on participants' overall attitudes toward sustainable packaging, including the perceived importance of environmental considerations in purchasing decisions. Participants were asked to discuss the perceived benefits and drawbacks of each sustainable packaging option. This included considerations for environmental impact, user convenience (e.g., ease

of opening and resealability), and concerns about potential safety risks associated with recycled materials.

- Trade-offs and Willingness to Pay: The focus groups investigated the trade-offs that participants were willing to make in exchange for more sustainable packaging.

Life-Cycle Assessment

To improve the impact of the research, this study included detailed LCA data presented with Eco-Impact COMPASS software as shown in Table 1. The LCA objectively assessed the environmental impact of the various sustainable packaging options being considered, including factors such as carbon footprint, energy consumption, fossil fuel consumption, and water consumption. By incorporating this extensive LCA data, the study was able to analyze if this data changes their preference. The data in Table 1 shows the of the environmental performance of various sustainable packaging options.

Table 1

Lifecycle Analysis Data of the Different Packaging Materials

	Fossil fuel use (Barrels of oil)	GWP-Global warming potential (Gallons of gas)	Water consumption (Gallons of water)
Control	511.84	14,271.87	15,366,930
Recycle ready	501.47 (-2.03%)	13,170.09 (-7.72%)	13,204,479.39 (-14.07%)
30% PCR	401.82 (-21.49)	12,426.13 (-12.93%)	11,017,914.34 (-28.30%)
90% PCR	192.93 (-62.31%)	8,989.05 (-37.01%)	4,763,537.25 (-69.00%)
PLA	272.40 (-46.78%)	26,257.37 (+83.97%)	41,443,138.74 (+169.69)

Note. Sourced from the Lifecycle Analysis through Eco-Impact COMPASS software.

Chapter IV: Results

This section presents the findings of a study that investigated consumer preferences and behaviors regarding sustainable packaging for shredded cheddar cheese. These discussions looked into the reasons behind consumer preferences and provided a foundation for a more nuanced understanding of the decision-making process. A thorough understanding of consumer attitudes and actions toward sustainable packaging for shredded cheddar cheese is offered by the combined analysis of the quantitative and qualitative data. The key findings will be presented in this section, along with themes related to sustainability interest and demographics, the value and preferences of sustainable packaging, the discrepancy between disposal behavior and preference, consumer priorities as indicated by open-ended responses, and insights from the focus group discussions. The study intends to further our understanding of consumer preferences in the context of sustainable packaging within the cheese industry by analyzing these findings. The development of packaging solutions that meet consumer needs and purchase behaviors while also being environmentally responsible can be influenced by this knowledge.

Interest in Sustainability and Demographics

Young adults made up the majority of survey respondents (*n* = 152, 67.86%), with the 18–25 age range making up the largest demographic. The majority of participants were women (*n* = 135, 60.27%); however, specific location information was not collected. The age and gender distribution indicate a geographically diverse sample despite the absence of location information, which increases the generalizability of the findings. Positively, the survey indicated a significant preference for sustainability. A significant proportion of participants (*n* = 155, 70%) indicated that they would like to make purchases that are environmentally friendly. This is consistent with current market trends that show rising customer demand for environmentally friendly goods.

There has been a noticeable shift towards environmental responsibility as only a small minority (*n* = 14, 6%) or uninterested (*n* = 54, 24%) in sustainable practices remained.

Importance and Preferences for Sustainable Packaging

The survey specifically examined how consumers choose cheese based on how sustainable the packaging is. Even though it might not be everyone's top priority, a sizable portion of participants (*n* = 228) regarded environmental friendliness as very important or important. This research points to a possible market for environmentally friendly packaging options in the shredded cheddar cheese industry. Various sustainable packaging options were presented to participants in order to gauge specific preferences. Packaging with high (90%) and moderate (30%) PCR, packaging marked as "Recycle Ready," and Compostable-PLA substitutes that degrade naturally were among these options. The findings showed a definite preference for solutions thought to be more ecologically friendly.

A fascinating discovery was made possible by the release of lifecycle analysis data: although consumers' preference for all sustainable packaging options declined, they continued to favor packaging with a higher PCR content, indicating that they place a higher value on recycled content than biodegradability. (see Table 2.) The study also used ideal situation to understand what consumers chose with the data for Compostable and Recycle Ready packaging options. The ideal situation presented in the research is a scenario where both Recycle Ready and PLA (compostable) pouches have significantly higher disposal rates. Specifically, the researchers envision a scenario where: Recycle Ready pouches are disposed of properly 55% of the time, compared to the current 13%. PLA (compostable) pouches are disposed of properly 80% of the time, compared to the current rate.

This method analyses the factors that influence consumer behavior regarding proper disposal of sustainable packaging. By comparing the hypothetical scenario with the current situation, they aim to identify the potential impact of increased awareness and improved infrastructure on disposal rates. This information can be used to inform strategies for promoting sustainable packaging practices and reducing environmental impact. Despite the potential environmental benefits of proper disposal, 112 (59%) of respondents indicated a willingness to dispose of Recycle Ready pouches correctly. PLA (Compostable) Pouches: A significantly higher proportion of respondents 100 (53%) expressed a willingness to properly dispose of Compostable PLA pouches, indicating a greater awareness of their environmental benefits. However, 64 (34%) of respondents in the Compostable plastic Ideal situation were unsure about the proper disposal methods, highlighting the need for improved education and infrastructure.

Table 2

Impact of LCA Data on Consumer Preferences Over Control Packaging

	Before LCA data *n*=228 (%)	After LCA data *n*=228 (%)	Ideal condition
Recycle ready	171 (90)	155 (82.89)	112 (59) chose Yes
30% PCR	188 (95)	148 (80)	_
90% PCR	183 (94)	156 (83)	_
Compostable PLA	170 (86)	109 (58)	100 (53) chose Yes

The Inconsistency Between Disposal Behavior and Preference

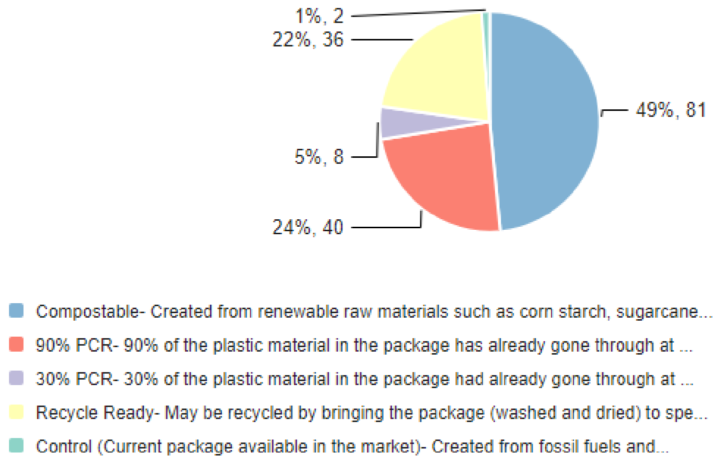
Concerning discrepancies were found in the survey between consumers' preferences for recyclable packaging and actual disposal methods. Only 13% of recyclable pouches are currently disposed of correctly (U.S. Plastics Pact, n.d.). This demonstrates how there is a big gap between expressed preferences and real behavior. Still, a bright spot appeared. In the LCA questions majority of consumers more than 50% of participants said that possible environmental advantages would spur them to dispose of packaging properly. This implies that consumers might not be aware of or confused about the right ways to dispose of sustainable packaging options. Interventions in education designed to close this gap could greatly increase the adoption of responsible disposal practices.

Ranking options and Open-Ended Responses

Consumers want assurances regarding the safety and ethical source of recycled materials. By giving consumers clear information about the source and processing of recycled content, manufacturers can allay these worries. Preferences for packaging are influenced by consumer habits, such as composting at home. In the end, the Compostable packaging option proved to be the most well-rounded choice as shown in Figure 3, satisfying consumer expectations regarding environmental impact but PCR took lead at appearance. The study found that, when compared to the results of the focus groups and online survey, post-consumer recycled content was the midpoint preference, highlighting the significance of employing both Qualitative and Quantitative methods to capture nuanced consumer insights.

Figure 3

Online Survey Result Showing Final Selected Package by Consumers



Note. Sourced from the online survey results from Qualtrics software.

Open-ended questions were also included in the survey to better understand consumer priorities and concerns about sustainable packaging for cheddar cheese shreds. A thematic analysis of these answers provided several important insights: Consumers addressed how crucial it is to have user-friendly composting or recycling procedures. Appropriate disposal may be discouraged by complicated recycling procedures. This emphasizes the need for packaging options that are easily recyclable or compostable and fit in with daily routines. Convenience is a key factor in shaping consumer behavior, so complexity shouldn't have to be sacrificed for sustainable packaging.

Consumers expressed concerns about the inconvenience of recycling flexible pouches like Recycle Ready, often citing a lack of accessible recycling facilities or the need for additional sorting. This highlights the importance of improving infrastructure and education to promote proper disposal. While compostable options were initially favored, concerns about their practicality and disposal methods emerged. Consumers expressed a desire for easier home composting options and questioned the long-term environmental benefits of certain compostable materials.

Recycled content, particularly PCR, was valued for its environmental impact and perceived safety. However, consumers remained cautious about the potential risks associated with recycled materials, emphasizing the need for transparency and quality assurance. Overall, consumers prioritize convenience and perceived environmental benefits. While compostable options offer potential advantages, practical considerations and infrastructure limitations may hinder their adoption.

The Key is Education on recycling procedures and the qualities of different packaging materials (i.e., composability, recyclability) was a recurrent theme. In order to enable customers to make sustainable decisions, manufacturers, retailers, and recycling programs can all launch educational campaigns. It's also crucial to have labels that are clear and convey information about the material's properties and disposal guidelines. Customers have voiced worries regarding the origin and safety of recycled materials used in packaging. Enhancing transparency with regards to the recycling procedure and material composition is essential to foster confidence and promote broader adoption of environmentally friendly packaging options.

Analysis of Focus Groups

The present section explores the qualitative insights from the study, which involved two focus group discussions. The five-person focus groups were designed to provide more in-depth information than the numerical data obtained from the online survey. The focus group discussions offered a useful forum for investigating the reasoning and mental models underlying consumer preferences for environmentally friendly packaging. Based on these discussions, we identified several key themes. One significant finding was the preference for 30% post-consumer recycled content as the most favored sustainable packaging feature which was least chosen in the online survey. This study presents a thematic analysis of the most important lessons learned from these focus group discussions:

Appearance of Packaging and How it Influences the Selection

It became evident from both focus groups that recyclable content options were preferred. While consumers generally value clear packaging to assess product quality, environmental concerns can outweigh aesthetic preferences. Some participants expressed a willingness to sacrifice transparency for more sustainable options. Recycled content, particularly 90% PCR, was most favored despite its opacity. Some suggested to remove the window which shows in the packaging and add more visual information about the sustainability on the package. This suggests a focus on environmental impact over visual appeal. However, the crinkle noise associated with compostable packaging raised concerns about its practicality and sensory appeal.

Consumers didn’t demonstrate a willingness to make efforts for proper disposal of sustainable packaging, because of the challenges such as cleaning and finding appropriate recycling facilities.

Adoption is Promoted and Trust is Built by Transparency

One important theme that emerged was transparency regarding the materials used in packaging. There was a clear desire for information among participants, even though some said they would be willing to accept like translucent or opaque material in appearance for packaging but that had clear information on sustainability credentials. This emphasizes how crucial it is to have labels that are clear and express the kind and proportion of recycled content that is used. Transparent information about the recycling process and sourcing practices can also help allay concerns about the safety and provenance of recycled materials. Fostering broader adoption of sustainable packaging solutions requires establishing trust via openness.

When it Comes to recycling, convenience Dominates

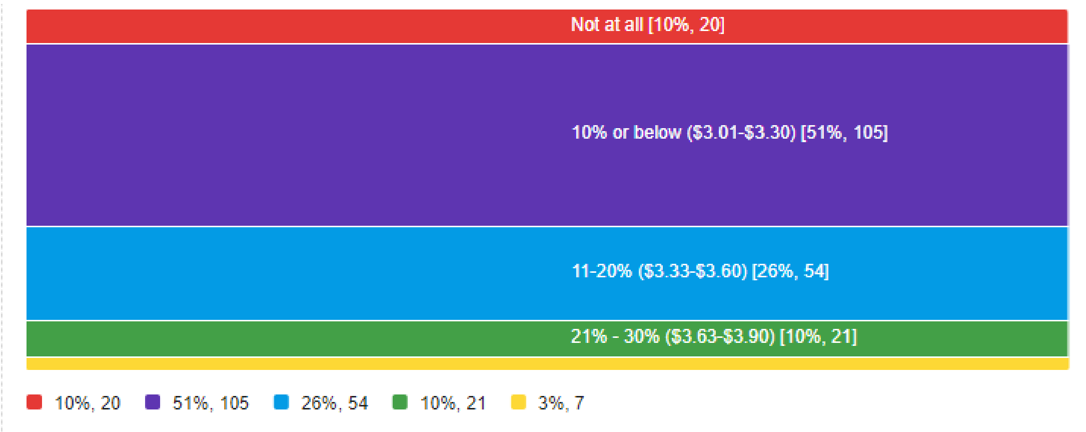
Convenient recycling practices are important, as the discussions highlighted. Both groups' participants indicated a strong dislike for intricate recycling procedures like cleaning the pouches and need to drive to the store drop-off locations, emphasizing the possible barrier they provide to appropriate disposal. This highlights the requirement for packaging that is simple to recycle and fits in well with current recycling practices. Manufacturers can accomplish this by creating packaging that complies with regional recycling regulations and prominently displays instructions for proper disposal on the package. Convenient recycling practices are important, as the discussions highlighted. This indicates a growing recognition of the possible expense of going green. Manufacturers can encourage consumers to close the gap between their environmental values and purchase decisions by stressing the long-term environmental benefits of sustainable packaging and possibly drawing attention to the ethical sourcing practices behind it.

Price Sensitivity and a Slight Willingness to Pay More

In both focus groups, price continued to be a significant factor influencing consumer decisions. The willingness of a sizable portion of participants to pay a small premium for sustainable packaging, however, was a noteworthy finding. A huge number of participants (n = 180) indicated a willingness to pay 10% or more for sustainable packaging, even though cost is clearly a factor as shown in Figure 4. Additionally, the study discovered that a large segment of consumers is willing to pay more for packaging that is more environmentally friendly for shredded cheddar cheese, with 105, 51% saying they would be willing to pay up to 10% more and 54, 26% saying they would be willing to pay between 11% and 20% more. This implies that even at a marginally higher cost, consumers are beginning to accept more environmentally friendly packaging.

Figure 4

Online Survey Results Showing Peoples Willingness to Pay More



Note. Sourced from the online survey results from Qualtrics software.

The growing impact of sustainability on purchasing decisions was confirmed by the focus groups. Price remained a major consideration, but participants in both groups indicated that sustainability would play a role in their decisions. This emphasizes the necessity of a multifaceted strategy that takes into account both economic and environmental issues. Manufacturers may create a situation where consumers and the environment benefit from their sustainable packaging solutions by coming up with affordable, aesthetically pleasing, and clearly labeled options.

Resolving Safety and Efficiency Issues

Additionally, specific concerns about particular sustainable packaging options were revealed by the focus groups. The participants conveyed a lack of confidence in the safety and cleanliness of recycled content, as well as a limited understanding of the recyclability of different materials and potential safety issues with Compostable-PLA. These issues call for focused educational efforts. Manufacturers and trade associations can work together, with clear labeling, informational campaigns, and other means, to educate consumers about the safety and effectiveness of sustainable materials.

The Influence of Attractive Design and Clearly Labeled Items

For PCR packaging, for instance, the clear window option was found to be aesthetically pleasing. Packaging can be made that appeals to consumers on an aesthetic and functional level by manufacturers by combining visually appealing elements with clear sustainability messaging. Labeling that made a clear distinction between sustainable packaging options and conventional solutions was well received by both focus groups. Although most participants said they didn't read labels carefully, it was appreciated that disposal instructions were clear and concise. This emphasizes how crucial it is to have user-friendly labeling that conveys important information clearly. The focus groups also emphasized how design aesthetics affect consumers' decisions to buy.

The Key to Wider Adoption Is Education

The emphasis of the focus group talks was on the importance of raising awareness of environmentally friendly packaging materials and their effects. The need for information that goes beyond simple symbols for recyclability was voiced by the participants. Manufacturers, retailers, and recycling programs can all take significant steps to educate consumers so they can make responsible and informed decisions about sustainable packaging. Stakeholders can promote responsible consumer behavior and hasten the broader adoption of sustainable practices within the cheese packaging industry by making information about the environmental advantages of sustainable packaging options easily understandable and accessible.

When it comes to sustainable packaging for shredded cheddar cheese, the focus group discussions shed light on the intricate interactions that exist between consumer preferences, environmental consciousness, and economic considerations. The results emphasize how crucial it is to find a balance between affordability, practicality, openness, and environmental advantages.

Chapter V: Discussion, Conclusions and Recommendations

The market for shredded cheddar cheese is facing both opportunities and challenges as consumers' attitudes toward sustainability change. This study explores this changing environment using a mixed-methods approach that includes focus groups and online surveys. The results show promise, with a sizable percentage of participants indicating a willingness to pay a small premium for environmentally friendly packaging and valuing it. The option with the highest percentage of post-consumer recycled content received the most votes, making recycled content the clear winner. Compostable PLA substitutes that are biodegradable also showed promise. Wider adoption is not without its challenges, though. Customers continue to place a high value on price, which emphasizes the need for affordable solutions. A deeper understanding of the decision-making process was revealed by focus group discussions, wherein striking a balance between affordability and environmental benefits emerged as a key theme. In order to solve this, manufacturers should investigate cutting-edge production techniques and packaging materials that save costs without sacrificing sustainability. Transparency is also very important. Customers said they wanted labels that made it obvious what kind and how much recycled content was used. Transparent information about the recycling process and sourcing practices is necessary to allay concerns about the safety and provenance of recycled materials. Fostering broader adoption requires establishing trust via openness.

Discussion

The study underscores how crucial convenience is and data from focus groups and online surveys both emphasized the importance of simple recycling procedures. Complicated recycling procedures discourage appropriate disposal. Manufacturers can solve this by creating packaging that complies with regional recycling regulations and prominently displays instructions for proper disposal on the package. The likelihood of consumers adopting sustainable options is higher when they can be easily incorporated into their current recycling practices. Although consumers are still primarily influenced by price, a significant proportion of participants indicated that they would be willing to pay a small extra for environmentally friendly packaging. This indicates a growing recognition of the possible expense of going green. Producers can motivate buyers to close the gap between their ethical and environmental standards and their purchasing decisions. By highlighting the sustainable packaging's long-term environmental benefits and possibly even its ethical sourcing practices, manufacturers can encourage consumers to close the gap between their environmental values and purchase decisions.

Particular issues with a few eco-friendly packaging choices were also made public. Participants indicated a lack of confidence in the safety and cleanliness of recycled content, as well as a limited understanding of the recyclability of different materials and potential safety concerns with Compostable PLA. In order to allay consumer fears and provide factual information regarding the safety and effectiveness of sustainable materials, manufacturers, trade associations, and waste management programs should launch focused education campaigns. As the focus groups made clear, aesthetics also matter because design aesthetics affect consumers' decisions to buy.

Although most participants said they didn't read labels carefully, it was appreciated that disposal instructions were clear and concise. For PCR packaging, for instance, the clear window option was compromised for consumers as it has translucent view. Packaging can be made that appeals to consumers on an aesthetic and functional level by manufacturers by combining visually appealing elements with clear sustainability messaging. Even though price is still a major factor, focus groups revealed that sustainability is becoming more and more important in consumer decisions. This emphasizes the necessity of a multifaceted strategy that considers both economic and environmental issues. Manufacturers may create a situation where consumers and the environment benefit from their sustainable packaging solutions by coming up with affordable, aesthetically pleasing, and clearly labeled options. Lastly, a recurrent theme was the need for greater education on environmentally friendly packaging materials and their effects. Manufacturers, retailers, and waste management programs can empower consumers to make responsible and informed decisions about sustainable packaging through educational initiatives.

Conclusions and Recommendations

The market for shredded cheddar cheese is experiencing both opportunities and challenges as consumer attitudes towards sustainability evolve. Despite the enthusiasm for sustainable options, the consistent emphasis on affordability underscores the need for cost-effective solutions. Insights from the focus group discussions highlight the ongoing struggle to balance economic and environmental priorities, suggesting that price remains a crucial factor in consumer purchasing decisions.

Conclusions

Our in-depth examination of consumers' perceptions of environmentally friendly packaging for shredded cheddar cheese shows that there are plenty of opportunities for the sector to adapt to changing consumer needs and environmental objectives. While Compostable PLA was the most popular choice in the online survey, participants in the focus groups expressed less enthusiasm for it because of worries about its crinkle sound, safety and biodegradability. On the other hand, due to their familiarity and apparent environmental advantages, post-consumed recycled plastic options received more favorable responses. These results emphasize how crucial it is to strike a balance between sustainability claims and openness, knowledge, and consumer behavior. Instead of pressuring customers about recyclable packaging, manufacturers ought to concentrate on making eco-friendly packaging easily available and convenient in retail spaces. To conclude we can say that participants' preferred option was post-consumer recycled plastics physical appearance and compostable plastic ways of disposal overall, showing a good ratio of affordability to sustainability.

Recommendations

To navigate the challenges highlighted by this study, manufacturers should prioritize the development of packaging solutions that balance cost-effectiveness with sustainability. Innovating in production techniques and materials that reduce expenses without sacrificing environmental integrity is crucial. Additionally, increasing transparency about the sourcing and recycling processes is essential. Clear labeling that informs consumers about the type and amount of recycled content in packaging can help alleviate concerns about safety and provenance, thereby building trust. Making eco-friendly packaging options more accessible and convenient in retail spaces will also encourage broader consumer adoption. By implementing these strategies, manufacturers can better meet consumer expectations and contribute to environmental sustainability. Implementing these recommendations can lead to the development of packaging solutions that not only meet consumer expectations but also contribute positively to environmental sustainability.

References

Accorsi, R., Cascini, A., Cholette, S., Manzini, R., & Mora, C. (2014, June). Economic and environmental assessment of reusable plastic containers: A food catering supply chain case study. *International Journal of Production Economics*, *152*, 88-101. https://doi.org/10.1016/j.ijpe.2013.12.014

Arrieta, M. P., Fortunati, E., Burgos, N., Peltzer, M. A., López, J., & Peponi, L. (2016). Nanocellulose-based polymeric blends for food packaging applications. In D. Puglia, E. Fortunati, & J. M. Kenny (Eds.), *Multifunctional polymeric nanocomposites based on cellulosic reinforcements* (pp. 205–252). William Andrew Publishing. https://doi.org/10.1016/B978-0-323-44248-0.00007-9

Awasthi, S. K., Kumar, M., Kumar, V., Sarsaiya, S., Anerao, P., Ghosh, P., Singh, L., Liu, H., Zhang, Z., & Awasthi, M. K. (2022, August). A comprehensive review on recent advancements in biodegradation and sustainable management of biopolymers. *Environmental Pollution*, *307*, 119600. https://doi.org/10.1016/j.envpol.2022.119600

Bogue, J. C., Delahunty, C. M., Henry, M. K., & Murray, J. M. (1999). Market-oriented methodologies to optimise consumer acceptability of Cheddar-type cheeses. *British Food Journal*, *101*(4), 301-317. https://doi.org/10.1108/EUM0000000004561

Boz, Z., Korhonen, V., & Sand, C. K. (2020) Consumer considerations for the implementation of sustainable packaging: A review. *Sustainability*, *12*(6), 2192. https://doi.org/10.3390/su12062192

Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. *Science Advances*, *3*(7), e1700782–e1700782. https://doi.org/10.1126/sciadv.1700782

Gray, V., & Guthrie, J. (1990, August 1). Ethical issues of environmentally friendly packaging. *International Journal of Physical Distribution & Logistics Management*, *20*(8), 31-36. https://doi.org/10.1108/09600039010138965

Guillard, V., Gaucel, S., Fornaciari, C., Angellier-Coussy, H., Buche, P., & Gontard, N. (2018). The next generation of sustainable food packaging to preserve our environment in a circular economy context. *Frontiers in Nutrition*, *5*, 121. https://doi:10.3389/fnut.2018.00121

Herbes, C., Beuthner, C., & Ramme, I. (2020). How green is your packaging—A comparative international study of cues consumers use to recognize environmentally friendly packaging. *International Journal of Consumer Studies*, *44*(3), 258-271. https://doi.org/10.1111/ijcs.12560

Huang, T., Qian, Y., Wei, J., & Zhou, C. (2019). Polymeric antimicrobial food packaging and its applications. *Polymers*, *11*(3), 560. https://doi.org/10.3390/polym11030560

International Organization for Standardization. (2006). ISO 14040:2006: Environmental management — Life cycle assessment — Principles and framework. https://www.iso.org/standard/37456.html

Klaiman, K., Ortega, D. L., & Garnache, C. (2017). Perceived barriers to food packaging recycling: Evidence from a choice experiment of US consumers. *Food Control*, *73*, 291–299. https://doi.org/10.1016/j.foodcont.2016.08.017

Kozik, N. (2020, January 10). *Sustainable packaging as a tool for global sustainable development* [Conference Session]. SHS Web of Conferences, EDP Sciences, *74*, 04012. https://doi.org/10.1051/shsconf/20207404012

Krueger, R. A., & Casey, M. A. (2014). *Focus groups. A practical guide for applied research* (5th ed.). Sage Publications.

Louviere, J. J., Hensher, D. A., & Swait, J. D. (2010, July). *Stated choice methods: Analysis and applications* (1st ed.). Cambridge University Press. https://doi.org/10.1017/CBO9780511753831

Magnier, L., & Schoormans, J. (2015, December). Consumer reactions to sustainable packaging: The interplay of visual appearance, verbal claim and environmental concern. *Journal of Environmental Psychology*, *44*, 53-62. https://doi.org/10.1016/j.jenvp.2015.09.005

Martinho, G., Pires, A., Portela, G., & Fonseca, M. (2015, October 1). Factors affecting consumers' choices concerning sustainable packaging during product purchase and recycling. *Resources, Conservation and Recycling*, *103*, 58-68. https://doi.org/10.1016/j.resconrec.2015.07.012

Muller, J., González-Martínez, C., & Chiralt, A. (2017) Combination of poly(lactic) acid and starch for biodegradable food packaging. *Materials*, *10*(8), 952. https://doi.org/10.3390/ma10080952

Nordin, N., & Selke, S. (2010, October). Social aspect of sustainable packaging. *Packaging Technology and Science*, *23*(6), 317-326. https://doi.org/10.1002/pts.899

Oloyede, O. O., & Lignou, S. (2021, May 10). Sustainable paper-based packaging: a consumer's perspective. *Foods*, *10*(5), 1035. https://doi.org/10.3390/foods10051035

Otto, S., Strenger, M., Maier-Nöth, A., & Schmid, M. (2021, May 20). Food packaging and sustainability – Consumer perception vs. correlated scientific facts: A review. *Journal of Cleaner Production*, *298*, 126733. https://doi.org/10.1016/j.jclepro.2021.126733

Popović, I., Bossink, B. A. G., Sijde, P. C. V. D., & Fong, C. Y. M. (2020, April 2). Why are consumers willing to pay more for liquid foods in environmentally friendly packaging? A dual attitudes perspective. *Sustainability, 12*(7), 2812-2812. https://doi.org/10.3390/su12072812

Rodríguez-Núñez, J. R., Madera-Santana, T. J., Burrola-Núñez, H. & Martínez-Encinas, E. G. (2018). Composite materials based on PLA and its applications in food packaging. In G. Cirillo, M. A. Kozlowski, & U. G. Spizzirri, (Eds.), *Composites materials for food packaging* (pp. 355-399). Scrivener Publishing LLC. https://doi.org/10.1002/9781119160243.ch12

Singh, A. A., Sharma, S., Srivastava, M., & Majumdar, A. (2020, June 15). Modulating the properties of polylactic acid for packaging applications using biobased plasticizers and naturally obtained fillers. *International Journal of Biological Macromolecules, 153*, 1165-1175. https://doi.org/10.1016/j.ijbiomac.2019.10.246

Speight, K. C., Schiano, A. N., Harwood, W. S., & Drake, M. A. (2019, August). Consumer insights on prepackaged cheddar cheese shreds using focus groups, conjoint analysis, and qualitative multivariate analysis. *Journal of Dairy Science*, *102*(8), 6971-6986. https://doi.org/10.3168/jds.2018-16209

Spreafico, C., & Russo, D. (2021, April 15). A sustainable cheese packaging survey involving scientific papers and patents. *Journal of Cleaner Production, 293*, 126196. https://doi.org/10.1016/j.jclepro.2021.126196

Swedenborg, E. L. (2024, March 20). *The inequity of water: While scarcity is felt locally, its causes are increasingly global*. World Resources Institute. https://www.wri.org/insights/inequity-water-scarcity-causes

U.S. Energy Information Administration. (n.d.). *Petroleum and other liquids*. https://www.eia.gov/petroleum/data.php

U.S. Environmental Protection Agency. (n.d.). *Climate change indicators in the United States.* https://www.epa.gov/climate-indicators

U.S. Plastics Pact. (n.d.). *U.S. pact baseline report*. https://usplasticspact.org/baseline/

White, N. (2000). Consumer requirements for milk and milk products - Current and future trends. *BSAP Occasional Publication*, 25, 1-17. https://doi.org/10.1017/S1463981500040620

Appendix A

IRB Approval Letter

INSTITUTIONAL REVIEW BOARD

Office of Research
and Sponsored
ProgramsRobert S.
Swanson Learning
Center #201 715-
232-4042
irb@uwstout.edu

Date: March 22, 2024

PI: Sreeja Gade

Department: ENGINEERING & TECHNOLOGY, GRADUATE STUDENT

Re: Initial - IRB-FY2024-218

Consumer perceptions towards sustainable packaging alternatives for Shredded cheddar cheese.

Dear Sreeja Gade,

In accordance with Federal regulations, your project, ***Consumer perceptions towards sustainable packaging alternatives for Shredded cheddar cheese***., was reviewed by a member of the University of Wisconsin - StoutInstitutional Review Board and was determined to be **Exempt** from full review under the below Categories in accordance with Federal Policy for the Protection of Human Subjects (45 CFR 46).

Category: Category 2.(ii). Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview

procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met:
Any disclosure of the human subjects' responses outside the research would not reasonably place the subjects atrisk of criminal or civil liability or be damaging to the subjects' financial standing, employability, educational advancement, or reputation; or

You project is hereby approved and deemed exempt from further IRB review for 5 years from March 22, 2024. If a renewal of this approval is needed, it is to be submitted at least 10 working days prior to the expiration date.

Responsibilities for Principal Investigators of UW-Stout IRB-approved research:

1. No subjects may be involved in any study procedure prior to the IRB approval date or after the expiration date.
2. All unanticipated or serious adverse events must be reported to the IRB.
3. All protocol modifications must be approved prior to implementation unless they are intended to reduce risk.
4. All protocol deviations must be reported to the IRB.
5. All recruitment materials and methods must be approved by the IRB prior to being used.
6. Research which involves financial compensation to participants must follow appropriate UW-Stout payment procedures.
7. Consent forms must adhere to UW-Stout IRB standards and indicate that the research has been approved bythe UW-Stout IRB as required by federal regulations (see UW-Stout IRB consent form templates for more details).
8. Researchers conducting human subjects' research under an approved exempt category are still ethicallybound to follow the basic ethical principles of the Belmont Report, as reflected in the practice of obtaining informed consent from participants and adherence to IRB approved methods.
9. Any modifications to the approved study must be submitted for review through Cayuse IRB. All approvalletters and study documents are located within the Study Details in Cayuse IRB.

Thank you for your cooperation with the IRB and best wishes with your project. If you have questions, please contact the IRB office at irb@uwstout.edu or by phone 715-232-4042, and your question will be directed to the appropriate person.

Sincerely,

Michael Mensink, Ph.D.; IRB Chair

University of Wisconsin-Stout Institutional Review Board

Appendix B

IRB Consent Form

Informed Consent for Research Participation

Study Title:	Consumer perceptions towards sustainable packaging alternatives for Shredded cheddar cheese.

Researcher Names	Department	Contact Information
Sreeja Gade	Kinesiology, Health, Food and Nutritional Sciences	gades8627@my.uwstout.edu

Faculty Advisor	Department	Contact Information
Min Degruson	Engineering & Technology Department	degrusonm@uwstout.edu

Overview of the Research Study

Participation invitation:	You are invited to participate in the research study described below. Your participation is entirely voluntary, and you may stop your participation or withdraw from the study at any time and for any reason. If you choose to not participate or to stop your participation, there will be no negative consequences to you. Your decision to participate or not in this study will not

	change your relationship with the researchers or the University of Wisconsin-Stout.
Who can participate in this study:	General Public and Students who buy more cheese.
Study description:	Consumers' perspectives are critical in the creation of sustainable food packaging, notably in the United States. However, there is a noteworthy lack of study on consumer views and acceptance of sustainable packaging solutions, particularly for cheddar cheese, a top-selling commodity in the United States. Our study focuses on shredded cheddar cheese, and we provide consumers with tangible prototypes of various sustainable packaging choices to assess their desire to switch to more environmentally friendly options. We hope to lead industry players in the adoption of sustainable packaging practices by evaluating customer opinions, thus linking commercial objectives with environmental responsibility. Our thorough study includes a large-scale survey with descriptive analysis, as well as a smaller, hands-on group for in-depth behavioral insights. This integrated approach ensures an in-depth evaluation of customer perceptions and desires for sustainable packaging.

What you will be asked to do:	The questions will include general questions related to sustainable packaging options they are provided with and to look at those options and answer questions like: General information, their thoughts on sustainable packaging, their willingness to pay if they are expensive, life cycle information of the packaging material, Educating them about the packaging options provided and knowing their thoughts. Lastly ending it with open comments for feedback.
Time commitment:	Less than 10 Minutes.
Participation risks:	I believe that this research survey will not cause you any discomfort or other risk beyond what you would normally experience in your daily life.
What will be done to minimize your participation risks:	The survey is completed data protected and includes no personal information of the participation except their perceptions on what they think about the given options.
Participation benefits:	No tangible benefits to participants for participating in the study.

Confidentiality and Data Protection

Who will have access to your data:	Myself (Researcher and Thesis advisor)
Data protection and future use:	

Protection of Human Research Subjects

<table>
<tr>
<td>If you have questions about this study, please contact:</td>
<td>
<table>
<tr><td>Sreeja Gade</td><td>Kinesiology, Health, Food and Nutritional Sciences</td><td>gades8627@my.uwstout.edu</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>
<table>
<tr><th>Faculty Advisor</th><th>Department</th><th>Contact Information</th></tr>
<tr><td>Min Degruson</td><td>Engineering & Technology Department</td><td>degrusonm@uwstout.edu</td></tr>
</table>
</td>
</tr>
<tr>
<td>If you have concerns about this study or your rights as a participant, please contact:</td>
<td>Institutional Review Board Chair
University of Wisconsin-Stout
Robert S. Swanson Learning Center #207
715-232-4042
irb@uwstout.edu</td>
</tr>
<tr>
<td>Your right to withdraw:</td>
<td>Your participation in this study is entirely voluntary. You may choose not to participate or to stop the study or survey without any adverse consequences to you. However, should you choose to participate and later wish to withdraw from the study, there may be no way to identify your data after it has been submitted. If you are participating in an anonymous</td>
</tr>
</table>

	survey, once you submit your responses, the data cannot be linked to you and cannot be withdrawn.
UW-Stout IRB approval statement:	This study has been reviewed and approved by the University of Wisconsin-Stout's Institutional Review Board (IRB). The IRB has determined that this study meets the ethical obligations for human subjects research as required by federal law and UW-Stout policies.

Consent Statement

I agree to participate in this study and understand that I may stop my participation or withdraw my consent at any time during active participation.

Printed name of participant

Signature of participant **Date**

Appendix C

Online Survey Questionnaire

We are asking for your help and cooperation in a research project investigating "Consumer perceptions towards sustainable packaging alternatives for Shredded cheddar cheese ". Consumers' perspectives are critical in the creation of sustainable food packaging, notably in the United States. However, there is a noteworthy lack of study on consumer views and acceptance of sustainable packaging solutions. Our study focuses on shredded cheddar cheese, and its available sustainable packaging solutions in the market. The research aims to assess consumers' desire to switch to more environmentally friendly options by providing various sustainable packaging choices. We hope to lead industry players in the adoption of sustainable packaging practices by evaluating customer opinions, thus linking commercial objectives with environmental responsibility. The survey is anonymous, and data will be kept confidential. This survey is voluntary. To ensure anonymity, do not identify yourself when answering any open-ended questions. By submitting the survey, you are providing consent. **The survey has 20 questions and takes approximately 8-10 minutes to complete.**

Q1. What is your age?

1. Under 18
2. 18-25 years
3. 26-41 years
4. 42-57 years
5. 58 and older

Note: I am willing to participate in this survey at my own volition, and **I confirm that I am 18 years of age or older.**

☐I confirm

Q2. What is your gender?

1. Woman
2. Man
3. Nonbinary
4. Other
5. Prefer not to say

Q3. Do you currently live in the United States?

1. Yes
2. No

Q4. How important is sustainability in your life?

1. Not important
2. Somewhat important
3. Very important

Q5. Are you interested in making an impact on sustainability through your purchasing decisions?

1. Yes
2. No
3. Maybe

Q6. How important is environmentally friendly packaging to you when purchasing shredded cheddar cheese?

1. Extremely important
2. Very important
3. Somewhat important

4. A little important
5. Not at all important

Q7. How likely are you to purchase shredded cheddar cheese if it is packaged in a sustainable option?

1. Very likely
2. Likely
3. Neutral
4. Unlikely
5. Very unlikely

Sustainable packaging uses eco-friendly materials and design to minimize environmental impact. It aims to reduce waste, energy use, and greenhouse gas emissions. By using renewable resources and recyclable materials, it helps lessen the environmental footprint of packaging.

Q8. If you were to encounter these two packages on a store shelf, which one would you select?

Q9. If you were to encounter these two packages on a store shelf, which one would you select?

Q10. If you were to encounter these two packages on a store shelf, which one would you select?

Q11. If you were to encounter these two packages on a store shelf, which one would you select?

Q12. How much does the cost of sustainable packaging influence your decision to purchase cheese?

1. Not at all
2. Slightly
3. Moderately
4. Very much

Q13. Would you be willing to pay a slightly higher price for shredded cheddar cheese if it was packaged in a more sustainable option?

1. Yes
2. Maybe
3. No

Q14. By choosing a more sustainable option, there may be a price increase. To what extent are you willing to pay for it? A bag of shredded cheddar cheese 8 oz is about $3 with tax.

1. Not at all
2. 10% or below ($3.01-$3.30)
3. 11-20% ($3.33-$3.60)
4. 21% - 30% ($3.63-$3.90)
5. More than 30% (more than $3.90)

We conducted the Life Cycle Assessment (LCA) to assess the environmental impact of each packaging material. Please note that when we conduct LCA we used the current recycle rate and compost rate in United States. This Life Cycle Assessment was conducted with an estimated annual volume of 6,300,000 pouches.

Q15. Several factors will be impacted by implementing an alternative sustainable packaging solution. These factors include, but are not limited to, fossil fuel use, global warming potential and water consumption. Based on the annual data provided, which packaging solution would you prefer?

	Fossil Fuel Use Barrels of Oil	GWP (Global Warming Potential) Gallons of Gas	Water Consumption Gallons of Water
Control	511.84	14,271.87	15,366,930
Recycle Ready	501.47 (-2.03%)	13,170.09 (-7.72%)	13,204,479.39 (-14.07%)

1. Control (Current package available in the market)
2. Recycle Ready

Q16. Several factors will be impacted by implementing an alternative sustainable packaging solution. These factors include, but are not limited to, fossil fuel use, global warming potential and water consumption. Based on the annual data provided, which packaging solution would you prefer?

	Fossil Fuel Use Barrels of Oil	GWP (Global Warming Potential) Gallons of Gas	Water Consumption Gallons of Water
Control	511.84	14,271.87	15,366,930
30% PCR (Post Consumer Recycled) Content	401.82 (-21.49)	12,426.13 (-12.93%)	11,017,914.34 (-28.30%)

1. Control (Current package available in the market)
2. 30% PCR

Q17. Several factors will be impacted by implementing an alternative sustainable packaging solution. These factors include, but are not limited to, fossil fuel use, global warming potential and water consumption. Based on the annual data provided, which packaging solution would you prefer?

	Fossil Fuel Use Barrels of Oil	GWP (Global Warming Potential) Gallons of Gas	Water Consumption Gallons of Water
Control	511.84	14,271.87	15,366,930
90% PCR (Post Consumer Recycled) Content	192.93 (-62.31%)	8,989.05 (-37.01%)	4,763,537.25 (-69.00%)

1. Control (Current package available in the market)
2. 90% PCR

Q18. Several factors will be impacted by implementing an alternative sustainable packaging solution. These factors include, but are not limited to, fossil fuel use, global warming potential and water consumption. Based on the annual data provided, which packaging solution would you prefer?

	Fossil Fuel Use Barrels of Oil	GWP (Global Warming Potential) Gallons of Gas	Water Consumption Gallons of Water
Control	511.84	14,271.87	15,366,930
PLA (Compostable packaging solution)	272.40 (-46.78%)	26,257.37 (+83.97%)	41,443,138.74 (+169.69)

1. Control (Current package available in the market)
2. PLA- Compostable Packaging

Q19. Currently, Recycle Ready pouches are disposed of properly 13% of the time. In ideal circumstances, we could increase this disposal rate to 55%. By doing so, changes are seen in the environmental impact of the material. Based on the data below, would this promote you to dispose of the product properly knowing the potential benefit?

	Fossil Fuel Use Barrels of Oil	GWP (Global Warming Potential) Gallons of Gas	Water Consumption Gallons of Water
Control	511.84	14,271.87	15,366,930
Recycle Ready	501.47 (-2.03%)	13,170.09 (-7.72%)	13,204,479.39 (-14.07%)
Recycle Ready Ideal	500.80 (-2.16%)	12,921.94 (-9.46%)	13,161,502.03 (-14.35%)

1. Yes
2. No
3. Maybe

Q20. Currently, PLA (compostable) pouches are not disposed of properly. In ideal circumstances, we could increase this composting rate to 80%. By doing so, changes are seen in the environmental impact of the material. Based on the data below, would this promote you to dispose of the product properly knowing the potential benefit?

	Fossil Fuel Use Barrels of Oil	GWP (Global Warming Potential) Gallons of Gas	Water Consumption Gallons of Water
Control	511.84	14,271.87	15,366,930
PLA (Compostable packaging solution)	272.40 (-46.78%)	26,257.37 (+83.97%)	41,443,138.74 (+169.69)
PLA (Compostable packaging solution) Ideal	273.00 (-46.67%)	15,207.58 (+6.56%)	41,339,745.46 (+169.02%)

1. Yes
2. No
3. Maybe

Q21. Which among the above packaging materials would you choose for shredded cheddar cheese?

1. Control (Current package available in the market)- Created from fossil fuels and must be disposed of in the trash after use.

2. Recycle Ready- May be recycled by bringing the package (washed and dried) to specific drop- off locations. These locations are usually located in supermarkets such as Wal-Mart and Target.
3. 30% PCR- 30% of the plastic material in the package had already gone through at least one life cycle and is recycled content. This structure cannot be recycled after use.
4. 90% PCR- 90% of the plastic material in the package has already gone through at least one life cycle and is recycled content. This structure cannot be recycled after use.
5. PLA- Created from renewable raw materials such as corn starch, sugarcane, etc. Because of this, the material should be recycled or composted after use.

Q21. Why?

Also, this is the last question of the survey!

Q22. What specific improvements or features could enhance your perception of sustainable cheese packaging?

Click submit to complete the Survey.

☐SUBMIT

End of Survey.

We thank you for your time spent taking this survey.

Your response has been recorded.