

Consumer Preferences and Industry Practices in Biodegradable Packaging and Sustainable Environment

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Abstract: Biodegradable packaging is gaining traction as a sustainable alternative. This study examines consumer perceptions of biodegradable packaging and their influence on product choices and satisfaction. A survey was conducted to measure perceived quality, value, consumer preferences, industry practices, and customer satisfaction. Correlation analysis revealed positive relationships between all constructs, suggesting that consumers who perceive higher quality and value in biodegradable packaging are also more likely to prefer it, be aware of industry practices related to it, and experience higher satisfaction with products using it. Regression analyses confirmed that perceived quality has a significant positive impact on choosing products with biodegradable packaging, and perceived value has a significant positive effect on consumer preference for it. However, only perceived quality directly influences customer satisfaction in this model. These findings suggest that both perceived quality and value are important for influencing consumer behavior toward biodegradable packaging. Firms can leverage these insights by focusing on enhancing packaging quality, clearly communicating its environmental benefits and product protection aspects, and educating consumers about its advantages. Further research is recommended to explore the potentially indirect role of perceived value and the influence of pricing strategies on consumer choices.

Keywords: Biodegradable Packaging; Consumer Perception; Product Choice; Customer Satisfaction; Perceived Quality; Perceived Value; Consumer Preference; Industry Practices; Sustainable Alternative.

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1. Introduction

The global landscape of consumerism and industry practices is undergoing a profound transformation, driven by heightened awareness of environmental sustainability. Central to this shift is the critical evaluation of packaging materials, which play a

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pivotal role in modern commerce but have long been associated with significant environmental impacts [39]. Traditional packaging, particularly plastics derived from non-renewable resources, has become emblematic of environmental degradation, contributing to overflowing landfills, marine pollution, and broader ecological concerns such as climate change. Staggering statistics underscore the urgency of addressing these issues [40]. The Ocean Conservancy estimates that an estimated 8 million tons of plastic enter the oceans annually, posing severe threats to marine life and ecosystems [41]. Microplastics, which result from the breakdown of larger plastic items, further permeate the food chain, raising concerns about potential human health risks. Against this backdrop, consumer sentiment has markedly shifted, with sustainability emerging as a decisive factor influencing purchasing decisions [42].

The emergence of biodegradable packaging represents a promising response to the environmental challenges posed by traditional materials [43]. Biodegradable packaging materials derived from renewable sources like plant starches, cellulose, and biopolymers offer a pathway to mitigate environmental harm [44]. These materials decompose naturally through the action of microorganisms, reducing long-term pollution and reliance on finite fossil fuel resources [45]. Moreover, they align closely with evolving consumer preferences for eco-friendly products, reflecting a broader societal shift towards sustainable consumption patterns. Consumer preferences are pivotal in driving the demand for biodegradable packaging solutions. Research shows that consumers are becoming increasingly conscious of the environmental consequences of packaging waste, which shapes their inclination towards sustainably packaged products [46]. A 2023 Nielsen report highlighted that 92% of global consumers consider sustainability important when choosing brands, underscoring the significance of this trend in shaping market dynamics. This heightened awareness has prompted businesses across industries to reassess their packaging strategies, with a notable emphasis on adopting more sustainable alternatives [47].

Industry responses to these shifting consumer preferences have been varied and dynamic. While some companies have integrated biodegradable packaging as a cornerstone of their corporate sustainability initiatives, others grapple with challenges such as cost competitiveness, scalability of production, and ensuring compatibility with existing packaging processes [48]. Technological advancements and innovations in material science play a crucial role in overcoming these barriers, facilitating the development of biodegradable materials that not only meet environmental standards but also maintain the functional and protective qualities expected of modern packaging [49]. This paper endeavors to provide a comprehensive exploration of the biodegradable packaging landscape, focusing on both consumer preferences and industry practices [50]. By synthesizing current research, analyzing consumer behavior trends, examining regulatory frameworks, and showcasing case studies from leading businesses, this study aims to offer a nuanced understanding of the opportunities and challenges associated with biodegradable packaging [51]. Furthermore, it seeks to provide actionable insights for businesses to navigate this evolving landscape successfully, capitalize on emerging market opportunities, and contribute positively to global sustainability goals.

Recent studies underscore a significant shift in consumer preferences towards environmentally friendly packaging solutions. Moreover, insights from McKinsey & Company's report on sustainability in packaging inside the minds of US consumers reveal a notable willingness among consumers to pay a premium for sustainable packaging options. This willingness reflects a broader commitment to environmental responsibility, suggesting that consumers prioritize sustainable practices even when faced with slightly higher costs. Transparency has emerged as a crucial factor in shaping consumer purchasing decisions regarding packaging. Studies such as the preferences and attitudes of consumers towards eco-friendly packaging illustrate a growing demand for detailed information about packaging materials and disposal methods. Brands that provide transparent information about their sustainable packaging choices can build trust and foster loyalty among environmentally conscious consumers.

In terms of industry practices, there has been a noticeable increase in the adoption of biodegradable packaging materials across various sectors. Reports, such as investigating consumer preferences for sustainable packaging through a different behavioral approach, highlight this trend, albeit with variations influenced by factors such as cost implications and specific product requirements. The motivations driving the industry's adoption of biodegradable packaging are multifaceted. While environmental considerations play a significant role, McKinsey & Company's findings suggest that enhancing brand image and responding to consumer demand are equally influential factors. This dual motivation underscores the strategic importance of aligning packaging strategies with evolving consumer preferences and sustainability goals.

Despite progress, the transition to biodegradable packaging faces several challenges. Cost considerations remain a barrier to widespread adoption, as highlighted in a literature review on the sustainability of bio-based and biodegradable plastics: challenges and opportunities. Additionally, technical limitations, such as the availability of composting infrastructure, pose operational challenges for companies aiming to integrate biodegradable materials into their packaging solutions. Moreover, there is a pressing need for enhanced consumer awareness and education regarding the benefits and proper disposal methods of biodegradable packaging. Addressing these challenges requires concerted efforts in research and development. Innovations aimed at reducing production costs and improving the functionality of biodegradable materials are critical. Likewise, initiatives to educate consumers about sustainable packaging choices and infrastructure investments to support composting and recycling processes are essential for the sustainable growth of biodegradable packaging solutions.

This paper investigates industry responses to these consumer preferences and the implementation of biodegradable packaging solutions across a variety of sectors. It discusses the motivations driving industry adoption of sustainable packaging, including regulatory compliance, brand reputation enhancement, and strategic responses to consumer demand. Moreover, the paper examines the challenges encountered by industries in transitioning to biodegradable packaging, such as cost considerations, technical limitations, and the imperative to educate consumers about proper disposal methods. Finally, the paper synthesizes these insights to identify future research directions and propose recommendations for businesses and policymakers. By bridging the gap between consumer preferences and industry practices, this research aims to foster a more sustainable future for the packaging industry. Ultimately, the widespread adoption of biodegradable packaging has the potential to significantly reduce waste accumulation, conserve finite resources, and mitigate the environmental impact associated with traditional packaging materials.

2. Literature Review

2.1. Perceived quality

Consumers have demonstrated a willingness to purchase eco-friendly packaging options like Ecoplas, indicating a growing market for sustainable packaging solutions [25]. Siddiqui et al. [23] have found that the high biodegradability of renewable components in biodegradable packaging makes it more sustainable than conventional plastics. Individuals with higher environmental concerns tend to perceive greater cognitive benefits associated with biodegradable and compostable packaging [15]. Perceived quality related to biodegradable packaging is a critical aspect of sustainable food packaging. When evaluating sustainable packaging options, consumers prioritize attributes such as biodegradability, disposal methods, recyclability, renewable sources, and product quality [17]. Cruz et al. [10] have shown that consumers place a strong emphasis on the end-of-life stage of packaging, particularly focusing on biodegradability. Consumers have shown a preference for biodegradable packaging over traditional options and are willing to pay a premium for products with lesser environmental impact [6].

Choudhary et al. [9] have explored innovative initiatives like edible coatings and films as alternatives to conventional packaging, highlighting the significance of fundamental characterization for specific applications such as food preservation and shelf life enhancement. Baghi et al. [2] have shown that incorporating nano/microencapsulated antimicrobial and antioxidant natural molecules into biodegradable food packaging systems can prevent food spoilage, extend shelf life, and preserve food quality. The development of smart and active biodegradable packaging materials has gained interest as a means for food manufacturers to enhance sustainability and environmental impact while maintaining product quality and safety [22]. Lignou & Oloyede [13] have linked packaging sustainability to a more positive perceived quality of food products, suggesting that sustainable packaging can impact consumer perceptions. The biodegradability of bioplastics offers advantages in controlling food waste and preventing plastic pollution, aligning with consumer preferences for environmentally friendly products [26].

Verma and Srivastava [27] have highlighted the importance of biodegradable packaging in preserving food quality and extending shelf life, showcasing its potential as a protectant for food conservation. Snoz et al. [24] have established standardized test schemes and specifications to evaluate the biodegradability of packaging materials, enabling certification based on biodegradation criteria.

2.2. Sustainable package

Sustainable packaging not only aligns with environmental goals but also influences consumer purchasing decisions, highlighting the importance of integrating sustainability into business strategies [28]. Sustainable packaging plays a critical role in reducing the environmental footprint associated with product manufacturing and distribution [12]. Innovations in sustainable packaging play a pivotal role in reducing the ecological footprint of industries, particularly in the fast-moving consumer goods sector [1]. The implementation of sustainable packaging strategies is essential for enhancing product innovation and competitiveness in the market [29]. Companies are increasingly focusing on eco-design, life cycle assessments, and sustainable materials to improve their environmental performance [30]. Furthermore, sustainable packaging practices are essential for achieving industrial sustainability goals and minimizing environmental impacts [31]. Circular economy principles closely link to the development of sustainable packaging, emphasizing the need for efficient resource utilization and waste reduction [14].

Companies are increasingly recognizing the importance of incorporating sustainable practices throughout the packaging supply chain to meet consumer demands and industry standards [18]. Consumer awareness and acceptance of sustainable packaging practices are key drivers for industry initiatives towards sustainability [32]. Choudhary et al. [7] talk about the latest progress in smart biogenic packaging. They focus on the change from traditional to natural packaging, the properties of different biogenic packaging materials, and how technologies like nanotechnology and encapsulation are being combined to create active and smart biogenic systems, like using biosensors in food packaging. Guha Neogi et al. [16] focus on the various types of edible

packaging and provide insight into its potential applications in the food industry, as well as its contribution to a sustainable environment. Consumer concerns and awareness regarding sustainability, environmental pollution, food quality, and cost have led to an increased focus on the development of bio-friendly packaging materials. Technologically, we can develop bio-based biodegradable edible coatings and films from various natural polymers like lipids, polysaccharides, or proteins [3]. The adoption of sustainable packaging practices is essential for achieving global sustainable development goals and reducing plastic pollution [19].

Cammarelle et al. [5] investigate consumers' intentions to purchase sustainable packages as well as their willingness to pay for them, taking into account renewable packages made using organic waste feedstock from the dairy industry and plant-based materials. Efforts to promote sustainability in industries require a holistic approach that encompasses eco-conscious shipping, basic recycling practices, and the use of sustainable materials [33]. By transitioning to eco-friendly packaging materials and implementing efficient waste management systems, industries can contribute to a more sustainable future [34]. Consumer preferences and industry practices in biodegradable packaging and sustainable environments are crucial aspects of contemporary business operations. Sustainable packaging practices have gained significant attention due to their potential to reduce environmental impact and promote eco-friendly alternatives [35]. Consumers are increasingly willing to pay for products packaged with recycled materials, showcasing a growing preference for sustainable options [36]. The advantages associated with biodegradable packaging materials, such as their ecological, natural, renewable, and environmentally friendly nature, further reinforce this shift in consumer behavior [8].

Popescu et al. [20] describe the current state of existing petrochemical-based plastics, their recycling capabilities, and the newly developed biodegradable food packaging materials, highlighting the opportunities and risks for improving the sustainability of our lives. Reichert et al. [21] discussed the bio-based packaging material, including processing, an evaluation of its sustainability, and recycling options. By adopting recyclable materials and safe end-of-life disposal practices, companies can enhance operational efficiency and contribute to sustainable supply chain management [37].

Sustainable packaging design is essential for enhancing supply chain management practices and reducing environmental impacts across various industries [38]. Changes in consumer demand, industrial production trends (such as mildly preserved, fresh, tasty, and convenient food products with enhanced shelf life and controlled quality), retailing practices (such as trans-regional and transnational long-distance sales of food), and customer lifestyles (such as a fast-paced lifestyle resulting in less time spent shopping for fresh food at the market and cooking) are the main forces driving the evolution of novel and innovative packaging techniques that maintain and monitor food safety and quality, extend shelf life, and reduce the environmental burden of food packaging [11]. Sharma and Ghoshal [4] have discussed three major categories of biodegradable polymers, namely polysaccharide-based materials, protein-based materials, and lipid-based materials, and provided insights into sustainable packaging, edible films, and coatings. These innovations not only contribute to environmental protection but also enhance the overall product performance, ensuring safety for consumers and promoting the use of renewable materials.

3. Research Methodology

The applied research design in the present study is descriptive research. The sample respondents are selected from the different supermarkets. A sample of 250 respondents was met, and the questionnaires were distributed, and responses were collected. After the scrutiny, 223 valued questionnaires were finalized, and the data were entered into the SPSS 26. Data were analyzed, and the results were given below.

4. Analysis and Interpretation

The factor analysis conducted in this study assessed the reliability and validity of the measurement scales for perceived quality, perceived value, consumer preferences, industry practices, and customer satisfaction. Convergent validity was examined through factor loadings and Average Variance Extracted (AVE) (Table 1).

Table 1: Construct and measurement items

Perceived quality (AVE=0.703, CR=0.79, Cronbach alpha =0.836)	Loadings
The biodegradable packaging feels sturdy and durable.	.803
I trust that the biodegradable packaging will protect the product effectively.	.772
The design of the biodegradable packaging is appealing.	.748
The materials used in the biodegradable packaging appear to be of high quality.	.811
I believe the biodegradable packaging is environmentally friendly.	.746
Overall, I am satisfied with the perceived quality of the biodegradable packaging.	.715
Perceived value (AVE=0.641, CR=0.82, Cronbach alpha =0.812)	

The biodegradable packaging provides good value for its cost.	.783
I believe the benefits of using biodegradable packaging outweigh the costs.	.809
Compared to traditional packaging, I find biodegradable packaging to be a worthwhile investment.	.815
The quality of the product inside the biodegradable packaging justifies its price.	.750
I feel that purchasing products with biodegradable packaging is a wise choice for the environment.	.752
Overall, I perceive biodegradable packaging as a cost-effective option for consumers.	.781
Consumer Preferences (AVE=0.694, CR=0.83, Cronbach alpha =0.848)	
I consider the environmental impact of packaging when making purchasing decisions.	.728
I am willing to pay a slight premium for products with biodegradable packaging.	.826
I am familiar with different types of biodegradable packaging materials	.824
I am confident in my ability to dispose of biodegradable packaging properly.	.756
Clear and informative labeling on packaging is important to me when choosing products.	.840
Industry Practices (AVE=0.655, CR=0.83, Cronbach alpha =0.839)	
I believe that most companies are actively working towards using more sustainable packaging solutions.	.736
I see a growing number of products with biodegradable packaging options in stores.	.802
Companies are transparent about the materials used in their packaging and how to dispose of them.	.821
The current cost of biodegradable packaging is a major barrier to wider adoption by companies.	.795
There is enough public awareness about biodegradable packaging and its benefits.	.825
Customer satisfaction (AVE=0.763, CR=0.81, Cronbach alpha =0.857)	
I am satisfied with the overall quality of products packaged in biodegradable materials.	.849
The biodegradable packaging meets my expectations in terms of durability.	.813
I am happy with the environmental benefits provided by biodegradable packaging.	.809
Using biodegradable packaging enhances my overall experience as a consumer.	.782
I would recommend products packaged in biodegradable materials to others.	.877
Overall, I am satisfied with the performance of biodegradable packaging compared to other packaging types.	.821

Note: AVE: average variances extracted; CR: composite reliability

All factor loadings fell within the range of 0.715 to 0.877, exceeding the recommended threshold of 0.5. Similarly, AVE values ranged from 0.641 to 0.763, also surpassing the minimum standard of 0.5. These results indicate strong convergent validity, suggesting the items within each construct effectively capture the underlying concept they represent. Discriminant validity was evaluated by comparing the square root of each AVE with the correlations between the constructs. If the square root of AVE is consistently higher than the corresponding construct correlations, it suggests good discriminant validity (Table 2).

Table 2: Correlation results

S. No.		Mean	SD	1	2	3	4	5
1	Perceived quality	3.78	.831	.783				
2	Perceived value	3.93	.490	.561	.758			
3	Consumer Preferences	3.98	.545	.483	.336	.791		
4	Industry Practices	3.83	.638	.477	.319	.383	.805	
5	Customer satisfaction	4.07	.612	.496	.545	.427	.304	.772

Note: Diagonal elements are squared AVE; SD: standard deviation

The correlation analysis reveals positive relationships between all the measured constructs. Consumers who perceive higher quality and value in biodegradable packaging are also more likely to have stronger preferences for it, be aware of industry practices related to it, and experience higher satisfaction with products using such packaging. The strongest correlations exist between perceived quality and value and between customer satisfaction and all other constructs. These findings suggest that positive perceptions of quality and value, along with awareness of industry practices towards sustainable packaging, contribute to higher customer satisfaction with products using biodegradable packaging. While correlations indicate relationships, further analysis can explore the direction and strength of these influences to understand how these factors interact and influence each other (Table 3).

H1: Consumers who perceive biodegradable packaging as high quality will be more likely to choose products with it.

Table 3: Regression analysis between Consumer Preferences and Perceived quality

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.766	1	5.766	26.705	.000 ^b
	Residual	47.714	221	.216		
	Total	53.480	222			
a. Dependent Variable: COP						
b. Predictors: (Constant), PERQ						
Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.864	.108		7.996	.000
	PERQ	.161	.031	.328	5.168	.000
a. Dependent Variable: COP		R=.428; R ² = .183				

The regression analysis shows a statistically significant relationship ($F = 26.705$, $Sig. = .000$) between perceived quality (PERQ) and choosing products with biodegradable packaging (COP). While the R-squared value (0.183) suggests that perceived quality explains a moderate portion of the variance in choosing such products, it does have a positive effect. For every unit increase in perceived quality score, the predicted likelihood of choosing a product with biodegradable packaging increases by 0.161 units. This indicates that consumers who perceive higher quality in biodegradable packaging are indeed more likely to select products with it, and this relationship is statistically significant (Table 4).

H2: Consumers who perceive biodegradable packaging to offer greater value (environmental benefit + product protection) will have a stronger preference for it.

Table 4: Regression analysis between Consumer Preferences towards biodegradable packaging and Perceived quality

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	12.505	1	12.505	34.424	.000 ^b
	Residual	80.284	221	.363		
	Total	92.789	222			
a. Dependent Variable: CUSPR						
b. Predictors: (Constant), PERV						
Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.720	.259		10.485	.000
	PERV	.351	.060	.367	5.867	.000
a. Dependent Variable: CUSPR		R=.509; R ² = .259				

The regression analysis reveals a statistically significant relationship ($F = 34.424$, $Sig. = .000$) between perceived value (PERV) and consumer preference for biodegradable packaging (CUSPR). The R-squared value (0.259) indicates that perceived value explains a moderate but substantial portion of the variation in consumer preference. This means that consumers who perceive biodegradable packaging to offer greater value, combining environmental benefits and product protection, are more likely to have a stronger preference for it. For every one-unit increase in the perceived value score (PERV), the predicted consumer preference score (CUSPR) increases by 0.351 units. The standardized coefficient (Beta = .367) further emphasizes this positive and moderate effect of perceived value on consumer preference, independent of the scales used for the variables. Hence, consumers who find greater value in biodegradable packaging due to its environmental benefits and product protection tend to have a significantly stronger preference for such packaging, and this relationship is statistically significant (Table 5).

H3: Customers who perceive both high quality and high value in biodegradable packaging will have higher overall satisfaction with the product.

Table 5: Regression analysis Consumer satisfaction and Perceived Quality and Perceived value

ANOVA ^a							
Model		Sum of Squares	df	Mean Square	F	Sig.	
1	Regression	17.398	2	8.699	8.383	.000 ^b	
	Residual	228.297	220	1.038			
	Total	245.695	222				
a. Dependent Variable: CUSSAT							
b. Predictors: (Constant), PERV, PERQ							
Coefficients ^a							
Model		Unstandardized Coefficients		Standardized Coefficients		t	Sig.
		B	Std. Error	Beta			
1	(Constant)	2.165	.502			4.313	.000
	PERQ	.274	.068	.261		4.020	.000
	PERV	.095	.101	.061		.938	.349
a. Dependent Variable: CUSSAT		R=.537; R ² = .288					

The analysis provides partial support for the hypothesis that both perceived quality and value influence customer satisfaction with biodegradable packaging. While the model itself is statistically significant (F = 8.383, Sig. = .000), explaining nearly 29% of the variation in customer satisfaction (R² = 0.288), perceived value (PERV) doesn't have a significant direct effect (B = 0.095, Sig. = .349) (Figure 1).

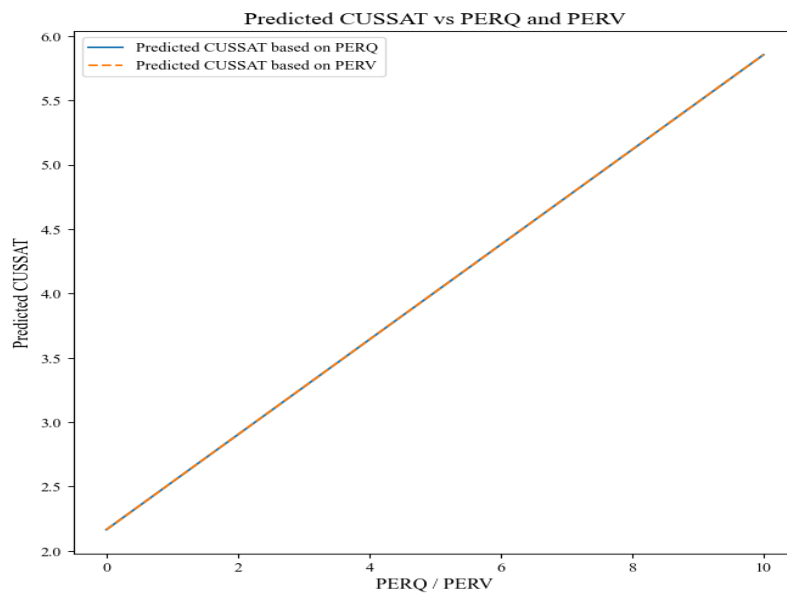


Figure 1: Predicted CUSSAT vs PERQ and PERV

However, perceived quality (PERQ) shows a positive and significant relationship with customer satisfaction (CUSSAT) (B = 0.274, Sig. = .000). This suggests that consumers who perceive the packaging as high quality are more likely to be satisfied with the product, partially supporting the hypothesis. It's possible that perceived value plays a more indirect role in satisfaction, and their relationship is statistically significant.

5. Findings

The major findings of this study on consumer perceptions of biodegradable packaging are:

Positive associations: There's a positive correlation between all the measured constructs. Consumers who perceive higher quality and value in biodegradable packaging are also more likely to prefer it, be aware of industry practices related to it, and experience higher satisfaction with products using it.

Perceived quality and choice: Perceived quality has a statistically significant and positive impact on choosing products with biodegradable packaging. Consumers with a higher perception of quality are more likely to select such products.

Perceived value and preference: Perceived value, which combines environmental benefit and product protection perceptions, has a statistically significant and positive influence on consumer preference for biodegradable packaging. Consumers who find greater value in this packaging tend to have a stronger preference for it.

Perceived quality and satisfaction: While the model showed a significant relationship between perceived quality, perceived value, and customer satisfaction, only perceived quality has a direct and statistically significant effect. Consumers who perceive higher quality in biodegradable packaging are more likely to be satisfied with the product. The role of perceived value in satisfaction may be more indirect.

5.1. Suggestions

Enhance the quality of biodegradable packaging: Invest in research and development to create high-quality biodegradable packaging that is durable, protects products effectively, and has a pleasing design. This will directly influence customer satisfaction and potentially lead to higher purchase intent.

Highlight the environmental benefits and product protection of biodegradable packaging: Clearly communicate the environmental benefits of using biodegradable packaging through marketing campaigns and packaging labels. Emphasize how it protects products as effectively as traditional packaging. This will strengthen the perceived value proposition for consumers.

Educate consumers about biodegradable packaging: Launch awareness campaigns to educate consumers about the benefits of biodegradable packaging, addressing any misconceptions they might have. Explain how it contributes to a more sustainable future. This can increase consumer preferences and potentially lead to higher demand.

Partner with environmental organizations: Collaborate with environmental organizations to endorse your products with biodegradable packaging. This can enhance consumer trust and perception of the environmental benefits.

Ensure consistent product quality: Maintain high and consistent quality standards for both the product and the biodegradable packaging. This will build trust and satisfaction among consumers.

Offer a variety of products with biodegradable packaging: Expand the range of products offered with biodegradable packaging to cater to a wider audience and increase consumer choice.

6. Conclusion

This study investigated consumer perceptions of biodegradable packaging and its influence on their choices and satisfaction. The findings reveal positive relationships between perceived quality, value, preference, industry practices, and customer satisfaction. Consumers who perceive higher quality and value in biodegradable packaging are more likely to prefer it, be aware of industry efforts, and ultimately be more satisfied with products using it. Regression analysis confirmed that perceived quality has a significant positive impact on choosing products with biodegradable packaging, and perceived value has a significant positive effect on consumer preference for it. However, only perceived quality directly influences customer satisfaction in this model. Further research is needed to explore the potentially indirect role of perceived value and other factors influencing satisfaction. Overall, the study highlights the importance of both perceived quality and value in driving consumer preferences and satisfaction with biodegradable packaging. Firms can leverage these findings by focusing on enhancing packaging quality, clearly communicating its environmental benefits and product protection, and educating consumers about its advantages. Additionally, exploring the indirect role of perceived value and the influence of pricing strategies can provide further insights to optimize product offerings and marketing strategies for success in the biodegradable packaging market.

6.1. Scope for further research

Conduct further research to understand how perceived value might indirectly influence customer satisfaction. Consider additional factors like brand image or environmental consciousness that might mediate the relationship. Explore how pricing

strategies for products with biodegradable packaging influence consumer perception and purchase decisions. This can help firms strike a balance between cost and value perception.

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References

1. A. Abatan et al., "Sustainable packaging innovations and their impact on HSE practices in the FMCG industry," *Magna Sci. Adv. Res. Rev.*, vol. 10, no. 1, pp. 379–391, 2024.
2. F. Baghi, A. Gharsallaoui, E. Dumas, S. Ghnimi, "Advancements in Biodegradable Active Films for Food Packaging: Effects of Nano/Microcapsule Incorporation" *Foods*. vol. 11, no. 5, pp. 1-46, 2022.
3. S.K. Bharti, V. Pathak, A. Arya, T. Alam, "Characterization of composite active edible film functionalized through reinforced Pimpinella anisum essential oil," *Journal of Food Processing and Preservation*, vol.46, no.1, p. e16766, 2022.
4. R. Sharma and G. Ghoshal, "Emerging trends in food packaging," *Nutr. Food Sci.*, vol. 48, no. 5, pp. 764–779, 2018.
5. A. Cammarelle, R. Viscecchia, F. Bimbo, "Intention to Purchase Milk Packaged in Biodegradable Packaging: Evidence from Italian Consumers" *Foods*. vol.10, no. 2068, pp. 2-15, 2021.
6. J.S. Carvalho, J.D.S.C. Oliverira, J.F.B.S. Jose, "Consumers' knowledge, practices, and perceptions about conventional and sustainable food packaging," *Food Science and Technology*, vol. 42, no.1, pp. 1-8, 2022.
7. V. Chaudhary, S. Punia Bangar, N. Thakur, and M. Trif, "Recent advancements in smart biogenic packaging: Reshaping the future of the food packaging industry," *Polymers (Basel)*, vol. 14, no. 4, p. 829, 2022.
8. S. Birania, S. Kumar, N. Kumar, A.K. Attkan, "Advances in development of biodegradable food packaging material from agricultural and agro-industry waste," *Journal of Food Process Engineering*, vol. 45, no. 8, pp.1-23, 2021.
9. U. Choudhary, B. Kumar Bhinchhar, V. Kumar Paswan, S. Kharkwal, S. Prakash Yadav, and P. Singh, "Utilization of Agro-industrial wastes as edible coating and films for food packaging materials," in *A Glance at Food Processing Applications*, London, England, IntechOpen, 2022.
10. R.M.S. Cruz, et al, "Bioplastics for Food Packaging: Environmental Impact, Trends, and Regulatory Aspects" *Foods*. Vol.11, no.19, p.3087, 2022.
11. J.-W. Han, L. Ruiz-Garcia, J.-P. Qian, and X.-T. Yang, "Food packaging: A comprehensive review and future trends: Food packaging: Review and future trends," *Compr. Rev. Food Sci. Food Saf.*, vol. 17, no. 4, pp. 860–877, 2018.
12. R. Kumar and A. Sharma, "Review of pet food packaging in the US market: Future direction towards innovation and sustainability," *Annu. Res. Rev. Biol.*, vol. 39, no. 6, pp. 16–30, 2024.
13. S. Lignou and O.O. Oloyede, "Consumer Acceptability and Sensory Profile of Sustainable Paper-Based Packaging" *Foods*. vol.10, no.5, p. 990, 2021.
14. W. Liu, Z. Zhu, and S. Ye, "A framework towards design for Circular Packaging (DfCP): Design knowledge, challenges, and opportunities," *Circ. Econ. Sustain.*, vol.3, no.2023, pp.2109-2125, 2023.
15. A. Lombardi, G. Califano, F. Caracciolo, T. Del Giudice, and L. Cembalo, "Eco-packaging in organic foods: rational decisions or emotional influences?," *Org. Agric.*, vol. 14, no. 2, pp. 125–142, 2024.
16. A. Guha Neogi, A. Upadhyaya, S. Manokaran, and M. Reddy, "Edible packaging: Food for thought and food for the future," *ECS Trans.*, vol. 107, no. 1, pp. 13757–13771, 2022.
17. V. Norton, C. Waters, O. O. Oloyede, and S. Lignou, "Exploring consumers' understanding and perception of sustainable food packaging in the UK," *Foods*, vol. 11, no. 21, p. 3424, 2022.
18. D. Lekesiztürk and B. S. Oflaç, "Investigating sustainable packaging practices: a framework approach," *Present Environ. Sustain. Dev.*, vol.16, no. 1, pp. 171–186, 2022.
19. M.V. Peshkam, "Eradicating Plastic Pollution Globally by 2030," *Academics International Scientific Journal*, vol.26, no.1, pp. 60-77, 2022.

20. P. Popescu, E.E. Popa, A. Mitelut, M.E. Popa, "Development of Recyclable and Biodegradable Food Packaging Materials - Opportunities and Risks" *Current Trends in Natural Sciences*. vol.9, no.17, pp.142-146, 2020.
21. C. L. Reichert et al., "Bio-based packaging: Materials, modifications, industrial applications, and sustainability," *Polymers (Basel)*, vol. 12, no. 7, p. 1558, 2020.
22. M. A. Sani, M. Azizi-Lalabadi, M. Tavassoli, K. Mohammadi, and D. J. McClements, "Recent advances in the development of smart and active biodegradable packaging materials," *Nanomaterials (Basel)*, vol. 11, no. 5, p. 1331, 2021.
23. S. A. Siddiqui, A. Sundarsingh, N. A. Bahmid, N. Nirmal, J. F. M. Denayer, and K. Karimi, "A critical review on biodegradable food packaging for meat: Materials, sustainability, regulations, and perspectives in the EU," *Compr. Rev. Food Sci. Food Saf.*, vol. 22, no. 5, pp. 4147–4185, 2023.
24. S.V. Snoz, et al., "Methodical approaches to assessment of the capability of biochemical decomposition of polymeric materials and their wastes" *One Health and Nutrition Problems of Ukraine*. vol. 53, no.2, pp.80-87, 2020.
25. A. Sabarirajan, L. T. Reddi, S. Rangineni, R. Regin, S. S. Rajest, and P. Paramasivan, "Leveraging MIS technologies for preserving India's cultural heritage on digitization, accessibility, and sustainability," in *Advances in Business Information Systems and Analytics*, IGI Global, USA, pp. 122–135, 2023.
26. B. Verma and A. Srivastava, "Dimensions of Globalisation and Economic Growth of India: Exploring Causal Linkages," *International Journal of Economic Policy in Emerging Economies*, vol. 15, no. 2-4, pp. 197-213, 2022.
27. B. Verma and D. A. Srivastava, "A Comparative Analysis of Effect of Different Measures of Globalization on Economic Development," *International Journal of Development and Conflict*, vol. 10, no.3, pp. 246-264, 2020.
28. B. Verma, A. Srivastava, R. Mehta, Meenakshi, and J. Chandel, "FDI-linked Spillovers and the Indian Economic Growth: The Role of Country's Absorptive Capacity," *2022 IEEE Delhi Section Conference (DELCON)*, New Delhi, India, pp. 1-6, 2022.
29. D. A. A. Al-Maaitah, T. A. M. Al-Maaitah, and O. H. M. Alkharabsheh, "The impact of job satisfaction on the employees turnover intention at public universities (Northern Border University)," *International Journal of Advanced and Applied Sciences*, vol. 8, no. 5, pp. 53–58, 2021.
30. D. Lavanya, S. Rangineni, L. T. Reddi, R. Regin, S. S. Rajest, and P. Paramasivan, "Synergizing efficiency and customer delight on empowering business with enterprise applications," in *Advances in Business Information Systems and Analytics*, IGI Global, USA, pp. 149–163, 2023.
31. F. M. Masad, T. A. Al-Maaitah, D. A. Al-Maaitah, E. F. Qawasmeh, and N. A. Qatawneh, "Harnessing artificial intelligence for human resources management: Tools, advantages, and risks in the energy sector," in *E3S Web of Conferences*, vol. 541, France, 2024.
32. I. Mert, "Assessment of accounting evaluation practices, a research-based review of Turkey and Romania," *Contributions to Finance and Accounting*, Springer Cham, Switzerland, 2022.
33. I. Muda, M. S. Almahairah, R. Jaiswal, U. K. Kanike, M. W. Arshad, and S. Bhattacharya, "Role of AI in Decision Making and Its Socio-Psycho Impact on Jobs, Project Management and Business of Employees," *Journal for ReAttach Therapy and Developmental Diversities*, vol. 6, no. 5s, pp. 517–523, 2023.
34. M. Lishmah Dominic, P. S. Venkateswaran, L. T. Reddi, S. Rangineni, R. Regin, and S. S. Rajest, "The synergy of management information systems and predictive analytics for marketing," in *Advances in Business Information Systems and Analytics*, IGI Global, USA, pp. 49–63, 2023.
35. M. M. Abbassy and A. Abo-Alnadr, "Rule-based emotion AI in Arabic Customer Review," *International Journal of Advanced Computer Science and Applications*, vol. 10, no. 9, p.12, 2019.
36. M. M. Abbassy, "Opinion mining for Arabic customer feedback using machine learning," *Journal of Advanced Research in Dynamical and Control Systems*, vol. 12, no. s3, pp. 209–217, 2020.
37. M. M. Al-Ajlouni, D. A. Al-Maaitah, and T. A. Al-Maaitah, "Managing Supply Chains Using Business Intelligence," *Kurdish Studies*, vol. 12, no. 2, pp. 5328–5337, 2024.
38. M. M. and S. Mesbah, "Effective e-government and citizens adoption in Egypt," *International Journal of Computer Applications*, vol. 133, no. 7, pp. 7–13, 2016.
39. N. Alrawashdeh, A. A. Alsmadi, M. Alsaaidh, D. A. Maaitah, M. Al-Okaily, and A. Al-Okaily, "Embracing cryptocurrency in the financial landscape: An empirical study," in *Studies in Systems, Decision and Control*, Cham: Springer Nature Switzerland, pp. 721–733, 2024.
40. N. Geethanjali, K. M. Ashifa, A. Raina, J. Patil, R. Byloppilly, and S. S. Rajest, "Application of strategic human resource management models for organizational performance," in *Advances in Business Information Systems and Analytics*, IGI Global, USA, pp. 1–19, 2023.
41. P. S. Venkateswaran, M. L. Dominic, S. Agarwal, H. Oberai, I. Anand, and S. S. Rajest, "The role of artificial intelligence (AI) in enhancing marketing and customer loyalty," in *Advances in Business Information Systems and Analytics*, IGI Global, USA, pp. 32–47, 2023.
42. S. Derindere Köseoğlu, W. M. Ead, and M. M. Abbassy, "Basics of Financial Data Analytics," *Financial Data Analytics*, Springer Cham, Switzerland, pp. 23–57, 2022.

43. S. Kolachina, S. Sumanth, V. R. C. Godavarthi, P. K. Rayapudi, S. S. Rajest, and N. A. Jalil, "The role of talent management to accomplish its principal purpose in human resource management," in *Advances in Business Information Systems and Analytics*, IGI Global, USA, pp. 274–292, 2023.
44. S. Singh, S. S. Rajest, S. Hadoussa, A. J. Obaid, and R. Regim, Eds., "Data-driven decision making for long-term business success," *Advances in Business Information Systems and Analytics*. IGI Global, USA, 2023.
45. S. Singh, S. S. Rajest, S. Hadoussa, and A. J. Obaid, "Data-Driven Intelligent Business Sustainability," in *Advances in Business Information Systems and Analytics*, IGI Global, USA, 2023.
46. T. A. Al-Maaitah et al., "Strategies for success: A theoretical model for implementing business intelligence systems to enhance organizational performance," *Int. J. Adv. Appl. Sci.*, vol. 11, no. 1, pp. 55–61, 2024.
47. T. Maaitah, "The role of business intelligence tools in the decision making process and performance," *Journal of intelligence studies in business*, vol. 13, no. 1, pp. 43–52, 2023.
48. T. T. Y. Alabdullah and A. J. M. AL-Qallaf, "The impact of ethical leadership on firm performance in Bahrain: Organizational culture as a mediator," *Cashflow: Current Advanced Research on Sharia Finance and Economic Worldwide*, vol. 2, no. 4, pp. 482–498, 2023.
49. T. T. Y. Alabdullah and H. Q. Naseer, "Corporate governance strategic performance as a significant strategic management to promoting profitability: A study in UAE," *Journal of Humanities Social Sciences and Business*, vol. 2, no. 4, pp. 620–635, 2023.
50. U. K. Kanike, "An empirical study on the influence of ICT-based tools on team effectiveness in virtual software teams operating remotely during the COVID-19 lockdown," Georgia State University, USA, 2023.
51. W. M. Ead and M. M. Abbassy, "A general cyber hygiene approach for financial analytical environment," *Financial Data Analytics*, Springer Cham, Switzerland, pp. 369–384, 2022.