INVESTIGATING CONSUMER PERCEPTION AND ACCEPTANCE OF BIODEGRADABLE PLASTIC PACKAGING IN THE FOOD SECTOR

Arun Kumar Budda
Research Scholar
Chemistry
Shri JJT University
Rajasthan.

Dr. Bhupesh Kumar Sharma
Professor
Chemistry
Shri JJT University
Rajasthan.

Dr. Tumati Srinivasarao
Manager
Satyadeva Pharmaceuticals Pvt Limited, Hyderabad.

ABSTRACT

This manuscript concerned customer recognition of biodegradable packaging. The authors of this study took up this issue due to its topicality and importance for enterprises and customers. The demand to develop and produce eco-friendly alternatives for food packaging is increasing. The huge negative impact that the disposal of so-called "single-use plastics" has on the environment is propelling the market to search for new solutions, and requires initiatives to drive faster responses from the scientific community, the industry, and governmental bodies for the adoption and implementation of new materials. It explored the role of these packages in marketing activities in the organic products market. Bioplastics are an alternative group of materials that are partly or entirely produced from renewable sources. Some bioplastics are biodegradable or even compostable under the right conditions. Providing correct answers on this topic did not depend on gender, health status, or place of residence, only on the age and education of respondents. The research results may have both practical and theoretical implications. The results contribute to the development of management sciences. The conclusions from the manuscript allow producers, not only in food, to design new, biodegradable packaging in accordance with the feelings and expectations of consumers.

Keywords: *biodegradable packaging, bioplastics, "single-use plastics", organic products market, education of respondents.*

INTRODUCTION

Packaging is an integral part and enabler of modern food systems. As a result, there is hardly any food item today that is not packaged at least once on its way from farm to fork. The background to this is the underlying and essential service functions that it performs. Even the most trivial function, namely containment, is what makes liquid foodstuffs, for example, manageable and transportable in the first place—a key function for our modern economy. Moreover, and most importantly, it provides protection to the food, thus, enabling high levels of food quality, safety, and security to be achieved. This is rounded off by the functions of communication (e.g., information about the product) and convenience. The food production and consumption sectors are of great importance here, as around 30 percent of global greenhouse gas emissions are related to food. In this sector, the participants see the greatest need for action in reducing packaging waste and ensuring that less food is thrown away. This contains a contrast, as one way to prevent food waste is the use of optimized packaging. In addition to maintaining quality and protection as the most elementary functions, packaging also plays an important role in storage and transport, handling of the product, and informing the consumer. Taking a closer look at plastic materials, it quickly becomes clear this material group comprises a wide range of different

materials, including polyolefins, such as polyethylene (PE), polypropylene (PP), and polyethylene terephthalate (PET), each with very different properties. Even though this consumption decreased by four percent compared to the previous year, the long-term trend shows a steady increase in packaging waste.

LITERATURE REVIEW

Leonardo Casini (2023) Plastic pollution causing the near-permanent contamination of the environment is a preeminent concern. The largest market sector for plastic resins is packaging, and the food industry plays a major role in producing plastic packaging waste. To this extent, this study aimed to investigate how food consumers relatively value the provision of different sustainable packaging alternatives, namely the unpackaged option and bioplastic packaging. Overall, our results indicate that consumer tastes are highly heterogeneous and that preference patterns change according to the behavioural approach assumed by individuals. Policymakers and marketers of food industries need to carefully consider the differences in the decision mechanism of consumers when implementing strategies to encourage pro-environmental food choices.

Marisa Bock (2023) Due to increasing environmental awareness, especially among the young German population, people are increasingly striving to buy food in the most environmentally friendly way. In this context, packaging is becoming the focus of sustainability assessment, not because of its protection against food waste but because of the increasing amount of packaging rubbish. For this purpose, an online choice experiment was conducted with a representative sample of 250 German consumers. The results show that origin is the most important factor, followed by packaging material. With the help of a latent class analysis, the respondents were divided into three segments, which differ in whether origin or material is more important in the sustainability assessment of a product.

Jelena Barbir (2022) The world production of plastic exceeded 360 million tonnes in 2020 alone, a considerable amount of which is not properly disposed of. The significant pressures and damages posed by conventional plastic to human and environmental health suggest that alternatives are urgently needed. One of them is "bioplastic", which is defined as bio-based plastic that is (or not) biodegradable. The results suggest that most respondents have positive expectations regarding the future of bioplastics to replace conventional plastics fully or partially, especially for food containers, kitchenware, and boxes and bags for packaging. They also reported that the low costs and increased availability of bioplastic products on the market are likely to be the main drivers for their wide-scale adoption.

Sebastian Rhein (2022) Research regarding consumers' perception of and willingness-to-pay for alternatives to conventional plastic packaging reveals an ambiguous picture. On the other hand, there is evidence that consumers have an increasing environmental awareness and a positive willingness-to-pay for packaging alternatives. Results demonstrate that consumers are willing to pay for packaging that they perceive to be sustainable and are

not willing to pay for packaging that they perceive to be non-sustainable or about which they are uncertain. Besides, results demonstrate that consumers are largely united in their general dissatisfaction with the current packaging situation, even though they are aware of the positive characteristics of single-use plastic packaging.

Mara Strenger (2021) Food packaging maintains the food safety and ensures the quality of food throughout the supply chain. Both are achieved by the protective function of the packaging against negative ambient influences such as mechanical damage, light or water vapour. This study provides an overview of the current research of European consumer perception and how this correlates with the environmental impact of loose foodstuffs and packaged food. These perceptions are compared to the objective environmentally friendliness based on the selected assessment criteria carbon footprint, recycling rate, reuse rate and biological degradation/decomposition in Europe. The purpose of this study is to discover whether there is any link between the consumer perception and the scientific assessed environmental sustainability.

Biodegradable Food Packaging Market-Dynamics

Due to the busy lifestyle of people, food takeaway and food ordering have become a common practice worldwide which has led to an increase in demand for the biodegradable food packaging market. Food on the go is another trend which is boosting sales of the biodegradable food packaging market. Due to the outbreak of covid-19 worldwide, customers are demanding more hygienic and clean packaging which they can reuse and recycle easily, which is helping biodegradable food packaging to grow in the market. Environmental concerns like global warming and pollution are forcing individuals to give up non-biodegradable and disposable packaging. Plastics and other harmful packaging materials wastage damage the marine environment and exterminate lives of aquatic animals by either ingestion or entanglement with the wastage. BPA and Benzene found in many packaging materials also harm human health, causing issues like respiratory diseases, blood pressure and even cancer in some cases. Nowadays, consumers are aware of all the ill effects of packaging and are choosing biodegradable packaging materials over other non-sustainable packaging materials.

Protein-Based Bioplastics

Protein-based bioplastics can be derived from raw materials of both plant and animal origin. Common sources of plant origin are wheat gluten, soy, pea, corn zein, and cottonseed proteins. On the other hand, whey, casein, collagen, gelatin, and keratin are some proteins of animal origin. Because proteins consist of different types of amino acids, the strong intermolecular binding of proteins affects the functional properties of protein-based bioplastics, giving them superior characteristics in comparison with carbohydrates and lipids. Protein-based films are extremely popular, as they are abundant, inexpensive, non-ecotoxic, biodegradable, and have very good film-forming properties.

Polysaccharide-Based Bioplastics

Polysaccharides have also been proposed as a biopolymer source for bioplastics. Alginate, cellulose, pectin, and starch are

derived from plants, while glycogen and chitin are of animal origin.

Cellulose-Based Bioplastics: Cellulose is the most abundant biopolymer available on the planet, gaining an important role in the production of new materials. Cellulose is renewable, widely available, non-toxic, low-cost, environmentally friendly, biocompatible, biodegradable, thermally and chemically stable, and derivable. Fruit and vegetable waste is very rich in this valuable biopolymer. Cellulose esters and cellulose ethers are the main cellulose derivatives that are used in industrial applications, as the production of pure cellulose bioplastics still remains quite difficult, due to the structural complexity and difficulty in melting and dissolving it through standard processes. Mechanical properties, thermal stability, and water absorption are some properties of bioplastics that could be improved with the addition of cellulose

Biodegradable Food Packaging Market-Regional Outlook

The biodegradable food packaging market has been analyzed based on sales growth and value across different regions that include Asia Pacific, Latin, and North America, Oceania, Europe, and the Middle East and Africa. North America and Europe will dominate the biodegradable food packaging market due to the presence of an environmentally aware and high-spending population in the areas. However, due to the presence of matured markets, the growth of biodegradable food packaging in these areas is normal. Europe and the Asia Pacific hold high potential for growth in the biodegradable food packaging market. However, the Middle East and African markets are expected to observe low growth compared to other regions.

RESEARCH METHODOLOGY

This research conducted an online choice experiment to analyze and measure consumers' perception of (sustainable) packaging, comparing distinct experimental groups. The online approach was employed because it is more time efficient and reduces social biases. In this study the loose foodstuffs and selected packaging materials plastic, glass, metal and paper/cardboard were chosen considering the current trend of the substitution of plastic by traditional packaging. To reduce social desirability bias, the introduction to the choice experiment did not mention the objective of the research, i.e., understanding consumers' perceptions of (sustainable) packaging. Our sample comprised French adults who were regular consumers. Before answering the self-administrated questionnaire, the participants were assigned to one of three treatment groups. All the presented products indicated both the price and the quantity in grams. Muesli was chosen because it represents an important product category in which packaging can be improved to reflect a sustainable approach. These substitutions were established by a basic search which additionally set the assessment criteria of packaging. For the second experimental group, a reusable package was offered with information that it was a stainless-steel package and that a refundable deposit was required to purchase the product in that format. The basic search clarified that life cycle assessments (LCAs) frequently uses these criteria and consumers often use them as reference for their evaluation.

RESULTS AND DISCUSSIONS

Socio-demographic characteristics: Socio-demographic profiles by Canadian region were reflected in weighted data (Table 1). Distribution of respondents by regions shows that most reside in Ontario (38.2%), followed by Quebec (21.6%), Prairies (Alberta, Saskatchewan and Manitoba) (18.8%), British Columbia (13.5%), Atlantic Provinces (7.6%), and the North (0.03%). There were slightly more females (55.5%) than males (45.5%). Most respondents were aged 54–72 (32.7%), followed by 39–53 (24.6%) 24–38 (22.1%), 18–23 (12.1%) and 73 + (8.5%). Most respondents had attained a high school or college diploma (32.5% and 31%, respectively.

Table 1: Socio-demographic characteristics of respondents

Socio-demographics	Percent
Sex	
Male	45.5
Female	55.5
Region	
Ontario	38.2
Quebec	21.6
Prairies	18.8
British Columbia	13.5
Atlantic Provinces	7.6
North	0.03
Age (years)	
18–23	12.1
24-38	22.1
39-53	24.6
54.72	32.7
≥ 73	8.5
Education groups	
High school diploma	32.5
Undergraduate degree	16.5
College diploma	31.0
Graduate or doctorate degree	9.8
Other	10.2

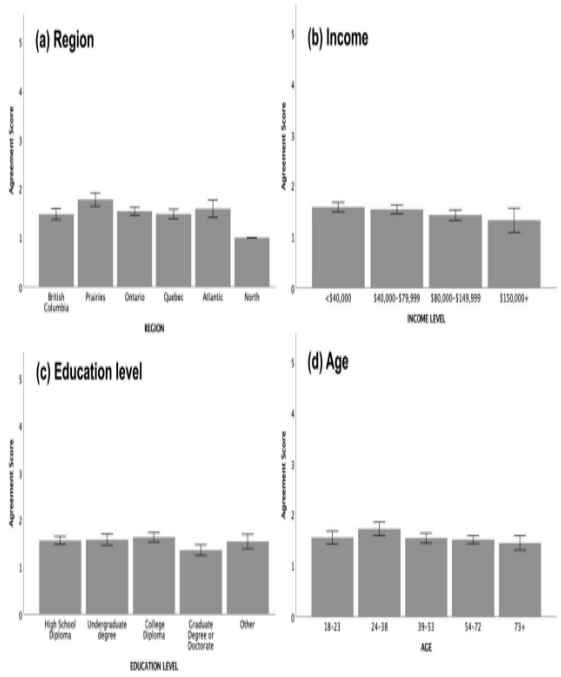
Influence on consumer change and adaptation: Many driving forces influence consumer behavior and opinions around single use plastic packaging. Moreover, the same forces influence change and adaptation. Taking into consideration the four main pillars of driving forces on consumers indicated in the conceptual framework (Graph. 1) (industry, government, personal motivation, and sustainable technologies), 91.1% of respondents believe that regulations to reduce consumption of single-use plastic food packaging should be strengthened in Canada. Older respondents were more likely to believe that regulations need to be more robust.

Table 2: Consumer behavioral traits towards single-use plastic packaging

Behavior	χ^2 (ρ-Value)	Dunn's post hoc with Bonferroni correction
I am personally motivated to reduce the amount of single-use plastic food packaging because of its environmental impacts		
Age Income Education Region	4.598 (0.331) 5.059 (0.168) 8.850 (0.065) 19.989 (0.001)	Quebec (480.13) vs. Prairies (571.36) (p = 0.001) Ontario (502.77) vs. Prairies

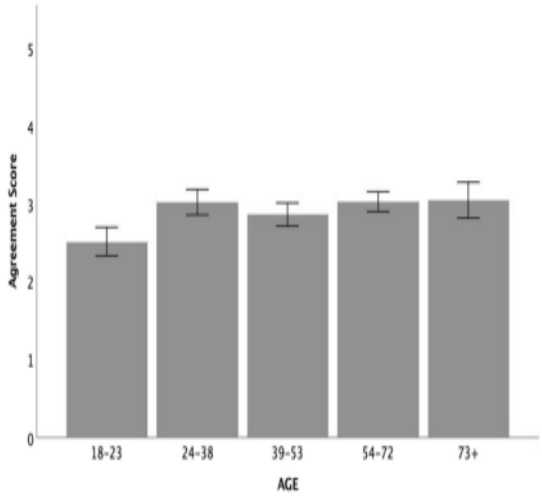
		(571.36) (p = 0.012)
I am willing to pay more for an item containing bio-degradable packaging		
Age	24.193 (0.00001)	18–23 (398.59) vs. 24–38 (524.78) (p = 0.002) 18–23 (398.59) vs. 73 + (532.19) (p = 0.012) 18–23 (398.59) vs. 54–72 (538.11) (p = 0.000)
I support a ban of all single-use plastics used for food packaging		
Region	17.553 (0.002)	British Columbia (464.62) vs. Prairies (566.86) (p = 0.001) Ontario (488.55) vs. Prairies (566.86) (p = 0.005)

Additionally, 74.3% of respondents were in favor of receiving a discount, incentive or rebate for supporting alternative plastic packaging solutions at purchase point box-length from the edge of the box in a histogram for each variable at both the upper and lower end.



Graph 1: Consumer motivation to reduce the amount of single-use plastic food packaging by region, income, education level, and age. Panels indicate region (a), income (b), education level (c), and age (d). Error bars indicate standard deviation.

Given the nature of population distribution of respondents, this was unsurprising. Rather than removing data points, outliers were left in the dataset. Data was not normally distributed, as assessed by Shapiro–Wilk's test ($p < 0.05$).



Graph 2: Consumer willingness to pay a higher price for biodegradable packaging by age

Motivation scores were statistically significantly different between different regional groups, $\chi 2(4) = 17.553$, $p = 0.002$. Adjusted p-values are present in pairwise comparisons. Statistically significant differences in median ban support scores were present between British Columbia (464.62) and the Prairies (566.86) ($p = 0.005$), and Ontario (488.55) and the Prairies (566.86) ($p = 0.005$), but not between other group combinations

CONCLUSION

The testing went off without a hitch as far as the apparatus and materials were concerned. Paroprint was disappointed since the results they had hoped for from oil-based polymers did not materialise. The lack of expertise in producing biodegradable materials made it even more difficult to distinguish them from oil-based items. Could the process capabilities be enhanced? The materials shown promise as Paroprint products. The Loomans Group in Belgium tested three distinct PLA materials for use in sandwich boxes and rectangular trays. Similar process skills and qualities were seen in Cereplast, Natureworks, and Transmare. All of them might be safely handled around food because of their biodegradability. When combined with cardboard, these PLA components worked OK, but the injection moulding process quickly destroyed them. There is a little premium above polypropylene for these materials as well. Due of the unacceptable price-to-functionality ratio, Paroprint will keep doing trials until they get their desired outcomes. When it came time to wrap cardboard extrusion, Lamican Oy of Valkeakoski, Finland, tested two PLA materials: Ecoflex and BASF Ecovio. There was hardly any difference between these two materials. Because they were both biodegradable, they could be used in kitchens without worrying about contaminating food. It was difficult to employ the materials because of their low process values. Similarly, the costs exceeded PE. For Paroprint, the price-to-functionality ratio was intolerable.

REFERENCE

1. *Mara Strenger (2021), "Food packaging and sustainability – Consumer perception vs. correlated scientific facts: A review",Journal of Cleaner Production,ISSNno:0959-6526,Vol.298,Pages.126733.https://doi.org/10.1016 /j.jclepro.2021.126733*
2. *Leonardo Casini (2023), "Investigating Consumer Preferences for Sustainable Packaging Through a Different Behavioural Approach: A Random Regret Minimization Application",Environmental and Resource Economics,ISSNno: 1573-1502,Vol.86,Pages.1-27.https://doi.org/10.1007/s10640-023-00785-3*
3. *Sebastian Rhein (2022), "Consumers' sustainability-related perception of and willingness-to-pay for food packaging alternatives",Resources, Conservation and Recycling,ISSNno:1879-0658,Vol.181,Pages.106219.https://doi.org/10.10 16/j.resconrec.2022.106219*
4. *Jelena Barbir (2022), "Consumer attitudes and concerns with bioplastics use: An international study",PLoS One,ISSNno:1932-6203,Vol.17(4),doi:10.1371/ journal.pone.0266918*
5. *Marisa Bock (2023), "Consumer Perception of Food Product Packaging Materials Sustainability versus Life Cycle Assessment Results: The Case of Processed Tomatoes—A Quantitative Study in Germany",Sustainability,ISSN*

no:2071-1050,Vol.15,Pages.16370.https://doi.org/10.3390/su152316370

6. *F.Gironi (2002),"Bioplastics and Petroleum-based Plastics: Strengths and Weaknesses", Energy Sources, Part A: Recovery, Utilization and Environ-mental Effects, Vol.33, Issue: 21, Pages.1949-1959,https://doi.org/10.1080 /15567030903436830.*
7. *R.N Tharanathan (2003),"Biodegradable films and composite coatings: past, present and future",Trends in Food Science &Technology,ISSNno:0924-2244, Vol:14,No.3,Pages:71-78,https://doi.org/10.1016/S0924-2244(02)00280-7.*
8. *M. Suresh Kumar (2004),"Production of biodegradable plastics from activated sludge generated from a food processing industrial wastewater treatment plant", bio resources Technology, ISSNno:1873-2876,Vol.95,Issue,3,Pages: 327-330,https://doi.Org/ 10.1016/j.biortech.2004.02.019.*
9. *Maurizio Avella (2005),"Biodegradable Starch/Clay Nanocomposite Films for Food Packaging Applications", Food Chemistry,ISSN NO:0308-8146,Vol.93, Issue:03,Pages:548-558,DOI:10.1016/j.foodchem.2004.10.024 .*
10. *Brian P. Mooney (2009),"The second green revolution? Production of plant-based biodegradable plastics",Biochemical Journal,ISSNno:1470-8728,Vol: 418,Issue:2,https://doi.org/10.1042/BJ20081769*