

“Mapping organic packaging research: Environmental concern and health safety”

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ARTICLE INFO

Kseniia Bliumska-Danko, Sandra Charreire-Petit, Dongxu Qu and Tetiana Shevchenko (2022). Mapping organic packaging research: Environmental concern and health safety. *Environmental Economics*, 13(1), 155-170. doi:[10.21511/ee.13\(1\).2022.13](https://doi.org/10.21511/ee.13(1).2022.13)

DOI

[http://dx.doi.org/10.21511/ee.13\(1\).2022.13](http://dx.doi.org/10.21511/ee.13(1).2022.13)

RELEASED ON

Thursday, 01 December 2022

RECEIVED ON

Sunday, 04 September 2022

ACCEPTED ON

Tuesday, 15 November 2022

LICENSE



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JOURNAL

"Environmental Economics"

ISSN PRINT

1998-6041

ISSN ONLINE

1998-605X

PUBLISHER

LLC “Consulting Publishing Company “Business Perspectives”

FOUNDER

LLC “Consulting Publishing Company “Business Perspectives”



NUMBER OF REFERENCES

74



NUMBER OF FIGURES

5



NUMBER OF TABLES

2

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BUSINESS PERSPECTIVES



LLC "CPC "Business Perspectives"
Hryhorii Skovoroda lane, 10,
Sumy, 40022, Ukraine
www.businessperspectives.org

Received on: 4th of September, 2022

Accepted on: 15th of November, 2022

Published on: 1st of December, 2022

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**Conflict of interest statement:**

Author(s) reported no conflict of interest

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MAPPING ORGANIC PACKAGING RESEARCH: ENVIRONMENTAL CONCERN AND HEALTH SAFETY

Abstract

The adoption of biopolymer packaging materials to replace petroleum-based plastic packaging has become a global trend, which could reduce environmental impact and potential health threats. Therefore, the paper analyzes trends in organic packaging research and the prospects of its application. This study employs bibliometric methods to select relevant studies using a preset search string. The dynamics of publications, the most influential authors and articles, as well as the most productive institutions and countries on the topic for 2017–2022 were determined. To collect the data, Elsevier's database Scopus was selected. The analysis revealed five salient research themes through text mining analysis: packaging and public health; packaging and children's health safety; eco-friendly packaging and consumer behavior; food packaging and labeling; and packaging with a focus on marketing and advertising.

864 terms from 40 articles were analyzed. As a result, most selected publications focused on the impact of packaging on the environment. In addition, some publications consider it from the perspective of consumer safety. Moreover, consumers unconsciously associate organic packaging with products' safety and quality. However, the marketing and advertising of organic packaging are insufficient, as well as the application of organic packaging in children's food products.

Keywords

biodegradable material, eco-labeling, food packaging, marketing activities, public health

JEL Classification

I15, M31, Q56, Q57

INTRODUCTION

Using environmentally safe materials for packaging food products is the country's requirement for the European market. The primary motivation for moving away from packaging materials such as polyethylene (PE) is to identify ways to dispose of these substances and pollute the environment. Therefore, many countries have restrictions on the use of polyethylene packaging materials. For example, since June 1, 2008, the production and use of thin PE materials have been banned in China (Chinese State Council, 2007). In Denmark and Ireland, a tax has been introduced for food products that require PE packaging materials (Convery et al., 2007). In Austria, at the end of 2008, a ban on the use of PE packages was introduced (Van Eygen et al., 2018). In Germany, companies that are suppliers of goods in bio-packaging are exempt from waste disposal tax until 2012 (Friedrich, 2020). In 2008, a tax on PE packaging materials was introduced in Latvia, while goods in bio-packaging are exempt from such tax (Dace et al., 2013). Therefore, biopolymers as packaging materials, especially for food products, are a global trend.

Most organic packaging applications are related to environmental concerns. Companies implement biodegradable packaging because they do not want to pollute the environment. However, are manufacturers guided by the trailer “organic product-organic packaging”?

1. LITERATURE REVIEW

Synthetic and non-biodegradable petroleum-based packaging led to severe environmental deterioration (Qasim et al., 2021). Therefore, sustainable packaging is crucial for traders to react to the growth of environmentally mindful consumption (Dinh et al., 2022). Today, product packaging is essential for communicating with the consumer directly from the supermarket shelf and ensuring its proper preservation. Considering environmental pollution concerns, at the stage of creating product packaging, it is possible to reduce the cost of packaging and minimize its impact on the environment. Furthermore, due to the environmental trend, it is possible to make products more attractive to consumers who prefer ecological packaging. This packaging protects products and facilitates the transportation, sale, and storage of goods.

Kádeková et al. (2020) investigated the impact of packaging on consumer choice. They concluded that only 33% of consumers do not pay attention to packaging when purchasing products. Further, Anetoh et al. (2020) investigated the impact of packaging on buyer choice. They conclude that consumer choice almost directly depends on the product’s visual appeal.

Contrary to these statements, Šugrova et al. (2020) indicated that Generation Z pays little attention to packaging and prefers taste. However, young people still prefer socially responsible producers who use ecological packaging. Since the negative trends of climate change affect the quality of life, the importance of the economy is increasing (Pu et al., 2021). Lobachevska and Daub (2021) indicated that Ukrainian consumers prefer companies specializing in environmental friendliness and responsible food packaging. Analyzing the formation of an eco-brand, Danko and Nifatova (2022) emphasized that organic packaging is one of the factors affecting the brand’s attractiveness.

The role of packaging as a marketing tool is also explored by Lialiuk et al. (2019). They indicate

possible packaging recycling options: use of reusable packaging, disposal of packaging, appropriate materials that are subject to repeated processing, and using the packaging for another purpose. Finally, Agustini et al. (2019) review the transition to eco-packaging, recycling, and waste reduction.

Therefore, based on the available literature sources, this study aims to analyze how relevant biodegradable packaging is in the modern research environment related to the production of products, their protection and impact on human health.

2. METHODOLOGY

This study employs bibliometric analysis to determine the relationships between articles, researchers, and research domains. In addition, it shows research trends and clusters, the most-cited authors and articles, and chief contributing institutions and countries. For this purpose, research design, data collection, analysis, visualization, and interpretation techniques were selected.

Elsevier’s global database Scopus was chosen for collecting data. The studies were selected based on the following search string with appropriate keywords and Boolean connectors: “*package**” and “*health**” or “*safe**” or “*eco-friendly**” and “*marketing**” (search in the title, abstract, and keywords). The search results were limited to peer-reviewed journal articles and reviews in the English language only for the period from 2017 to 2022. The analysis assessed the dynamics of publications, top 15 authors, top 10 articles, top 15 universities, and top 15 countries by subject. The cluster analysis was conducted among 864 terms. The search was conducted in July 2022, and as a result, 765 papers comprised the sample of this study.

3. RESULTS

Given the growing awareness of the need for ecological consumption and preservation of ecology,

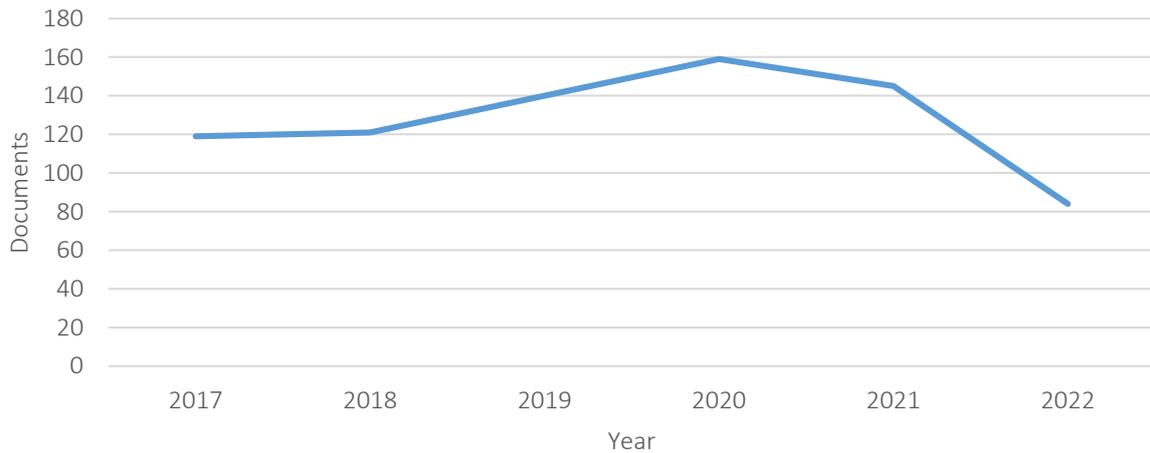


Figure 1. Dynamics of publications for the period 2017–2022

the level of research is also increasing. Analysis of the Scopus database (Figure 1) shows that during the study period from 2017 to 2021, interest in the study gradually increased, with 2020 being the most productive year. As a result, the average number of publications per year ranges from 140 articles.

of Lifestyle and Chronic Diseases (Belgium, Brussels) also published 12 articles for the period in journals included in the database. Finally, two groups of scientists with the participation of Gaston Ares from the Universidad de la Republica, Montevideo, Uruguay, and Elliott each published 11 articles from 2017 to 2022.

The most productive authors on this topic (Figure 2) are a group of American researchers from The University of North Carolina at Chapel Hill led by Lindsey Smith Taillie. This group has published 12 articles in scientific journals. The main research topic is to study the food labeling of products with the necessary information about the content. Another group of authors from the Service

The citation rate indicates the impact of respective articles on the overall research domain (Merigó et al., 2015). Table 1 presents the top 10 sources in the HCW research field, with Vanapalli et al.'s (2021) study being the most cited one (179 citations). This study investigates sterilization and sealed bags for the safe disposal of contaminated plastic products. It is concluded that this must be implemented in

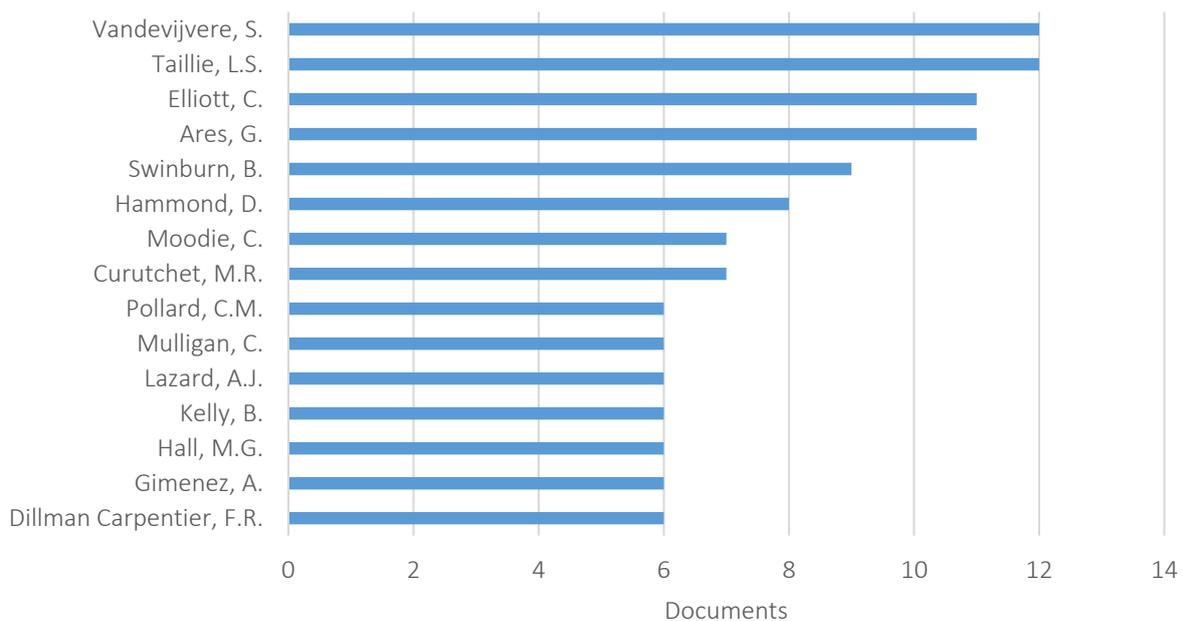


Figure 2. Top 15 most productive authors for the period 2017–2022

the nearest time to reduce transmission risks for sanitary staff. Moreover, it is vital to invest in circular technologies and improve existing facilities and their environmental viability to tackle the challenges associated with plastic waste fluxes. Considering future crises (e.g., pandemics), countries should adopt environmentally friendly production methods (bioplastics or new sustainable technologies).

Furthermore, one may consider single-use plastic bans ineffective and transient. However, their impact on customer awareness could be detrimental to the long-term objectives of the transition to a circular economy.

Food producers face the difficult challenge of feeding the ever-growing world population. Moreover, they must adhere to strict food security laws and regulations. As a result, food and pharmaceutical companies are gradually switching to active and smart packaging techniques to extend life expectancy and simplify production processes.

The application of active and intelligent packaging has been commercially adopted by food and pharmaceutical industries as a solution for the future for extending shelf life and simplifying production

processes. These industries also facilitate distribution logistics, reduce (even eliminate) the need for preservatives, and introduce restricted food packaging. Thus, they ensure convenience, improved quality, variety and marketing characteristics, and the provision of essential information to keep consumers safe (Janjarasskul & Suppakul, 2018).

Most authors emphasize the marketing component of packaging, not paying attention to its quality characteristics. Instead, they study the information it contains and its impact on the consumer. For example, Janjarasskul and Suppakul (2018) considered the need to ensure food security in the face of the growing world population. Representatives of the food industry were among the first to respond to the need to modernize packaging. It is about the use of marketing tools, brand protection, and convenience through the use of active and intelligent packaging.

Arrúa et al. (2017), Ikonen et al. (2020), and Reyes et al. (2019) analyzed not only the packaging itself but to the need for proper labeling of goods. They analyzed the relative impact of food labeling schemes on consumer preferences. It was concluded that consumers read the information on the FOP labels and thus identify healthier foods;

Table 1. Top 10 most influential articles for the period 2017–2022

Author(s)	Title	Journal	Citation count
Vanapalli et al. (2021)	Challenges and strategies for effective plastic waste management during and post COVID-19 pandemic	Science of the Total Environment	179
Smith et al. (2019)	Food marketing influences children's attitudes, preferences and consumption: A systematic critical review	Nutrients	108
Janjarasskul and Suppakul (2018)	Active and intelligent packaging: The indication of quality and safety	Critical Reviews in Food Science and Nutrition	105
Arrúa et al. (2017)	Impact of front-of-pack nutrition information and label design on children's choice of two snack foods: Comparison of warnings and the traffic-light system	Appetite	94
Ikonen et al. (2020)	Consumer effects of front-of-package nutrition labeling: an interdisciplinary meta-analysis	Journal of the Academy of Marketing Science	91
Gardas et al. (2018)	Evaluating critical causal factors for post-harvest losses (PHL) in the fruit and vegetables supply chain in India using the DEMATEL approach	Journal of Cleaner Production	83
Sohail et al. (2018)	Recent developments in intelligent packaging for enhancing food quality and safety	Critical Reviews in Food Science and Nutrition	76
Jeevahan et al. (2020)	Scaling up difficulties and commercial aspects of edible films for food packaging: A review	Trends in Food Science and Technology	72
Correa et al. (2019)	Responses to the Chilean law of food labeling and advertising: Exploring knowledge, perceptions and behaviors of mothers of young children	International Journal of Behavioral Nutrition and Physical Activity	71
Reyes et al. (2019)	Development of the Chilean front-of-package food warning label	BMC Public Health	70

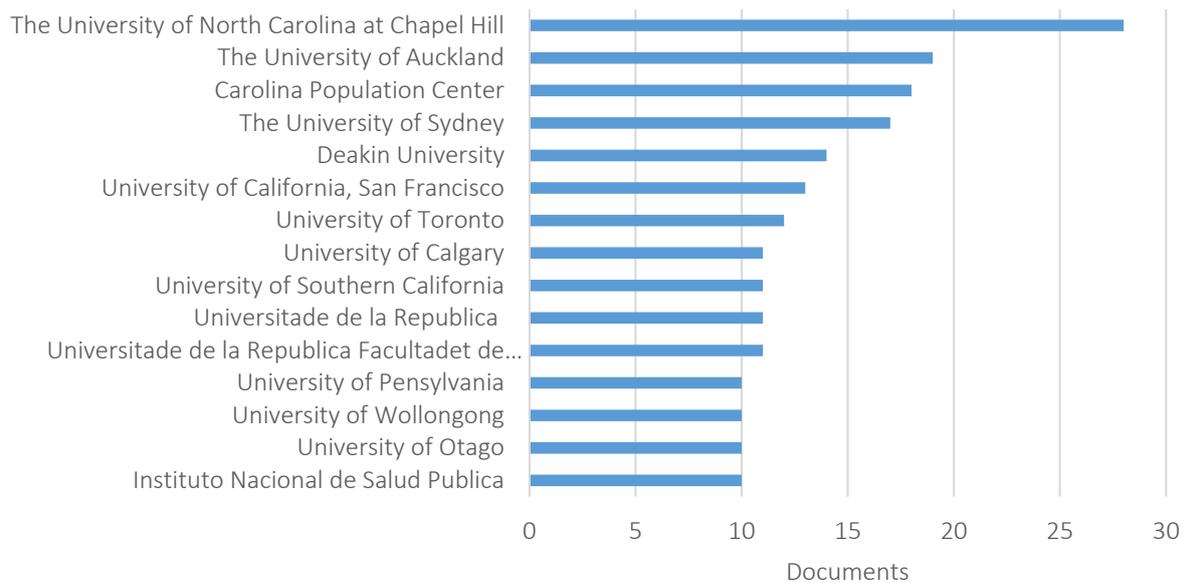


Figure 3. Top 15 most productive universities

however, their capacity to encourage consumers to make healthier food choices is reduced. Furthermore, such labels may cause a halo effect, positively influencing not only the products' virtues but also the vices, e.g., nutrient-specific labels enhance health perceptions.

Gardas et al. (2018), using decision-making and evaluation of tests, claimed that the lack of proper packaging is one of the crucial factors of the critical causal factors of post-harvest losses in the supply chain of fruits and vegetables.

Sohail et al. (2018) concluded that intelligent packaging is a new technology. This type of packaging guarantees the quality and safety of food products. However, it demands high costs and complicated regulations. Therefore, policymakers must implement measures to overcome these issues and promote their application in the food industry.

Jeevahan et al. (2020) examined the prospects of edible films. Despite their advantages, they still need to be widely produced. It is important that among the reasons for the unpopularity of edible packages, the authors identify improper marketing and insufficient awareness of consumers about the benefits. In addition, cultural issues can affect the safety of food products and their perception by consumers. This study generally supports the position outlined in previous reviews (Shevchenko et al., 2022).

3.1. Geographic distribution of articles

Figure 3 shows the top institutions with the highest number of publications in the field from 2017 to 2022. The top 15 listed institutions contributed 205 documents or 27% of the total publications disseminated for the studied period. As can be seen in Figure 3, there are eight US institutions: United States of America (The University of North Carolina, Carolina Population Center, University of California, University of Southern California, and University of Pennsylvania), two Canadian (University of Toronto and University of Calgary) and one Mexican (Instituto Nacional de Salud Publica). The next group of countries is the Indian Ocean region: Australia (The University of Sydney, Deakin University, and University of Wollongong) and New Zealand (The University of Auckland and University of Otago).

The University of North Carolina in the US has the highest number of publications – 28 – becoming a leading contributor to this field. Other top institutions include The University of Auckland in New Zealand, with 18 papers, Carolina Population Center in the US, with 17 papers, and The University of Sydney and Deakin University, with 17 and 16 papers, respectively.

Regarding leading countries, researchers from the United States of America were the most pro-

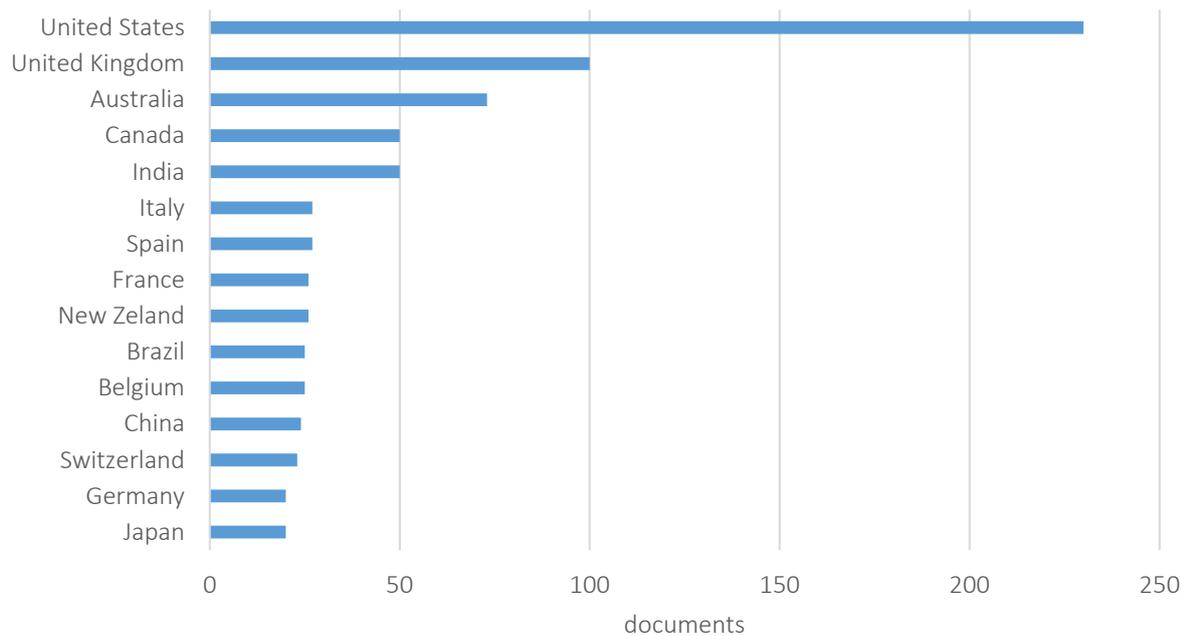


Figure 4. Top 15 most productive countries

ductive during the studied period – 230 articles, followed by Great Britain – 100, then Australia – 73. Researchers from Canada and India published 50 articles each. European countries such as Italy, Spain, France, and Belgium published an average of 25-27 articles each. New Zealand, Brazil, and China share similar indicators.

indicates the global relevance of the mentioned topic. Accordingly, there could be a growth of activity of researchers in the study of the indicative problem in the future.

3.2. Text mining analysis: Identifying salient research themes

These findings indicate that only several institutions and countries worldwide actively participate in biodegradable packaging research. However, the presence of countries from different regions

Textual analysis of the concatenation of titles and abstracts of all 40 articles showed 864 terms. According to the co-occurrence relationship algorithm, these terms were clustered, as shown in

Table 2. Salient research themes

Research theme 1: “Packaging and public health”	Research theme 2: “Packaging and children health safety”	Research theme 3: “Eco-friendly packaging and consumer behavior”	Research theme 4: “Food packaging and labeling”	Research theme 5: “Packaging with focus on marketing and advertising”
Leading terms				
Human health; chemical; dietary intake; toxicity	Unhealthy food; energy; preference; food category	Eco-design packaging; intention; behavior; food wastage	Food safety; quality system; consumption; regulation; labeling	Marketing strategy; design; visual cue; consumer attitude; health claim
Exemplary articles				
Garvey (2019)	DeCosta et al. (2017)	Jurconi et al. (2022)	Gordon and Williams (2020)	Theben et al. (2020)
Groh et al. (2019)	Hallez et al. (2020)	Nguyen et al. (2020)	Langley et al. (2021)	Elliott and Truman (2021)
Muncke et al. (2020)	Eicher-Miller et al. (2020)	Wandosell et al. (2021)	Chen et al. (2021)	McDarby et al. (2018)
Ugoeze et al. (2021)	Elliott (2019)	Polanco et al. (2021)	Pascall (2020)	Richonnet et al. (2021)
Vorst et al. (2021)	Sadeghirad et al. (2016)	Koch et al. (2022)	Soon and Wahab (2021)	Machado et al. (2019)
Wang et al. (2019)	Lavriša and Pravst (2019)	Zeng (2021)	Lee et al. (2021)	Rachel (2017)
Bansal and Kim (2015)	Jeevahan et al. (2020)	Zeng and Durif (2020)	Chia et al. (2022)	Gostin (2018)
Ezeudu et al. (2021)	Franz and Welle (2022)	Zeng et al. (2020)	Do Canto et al. (2021)	Ledin and Machin (2019)

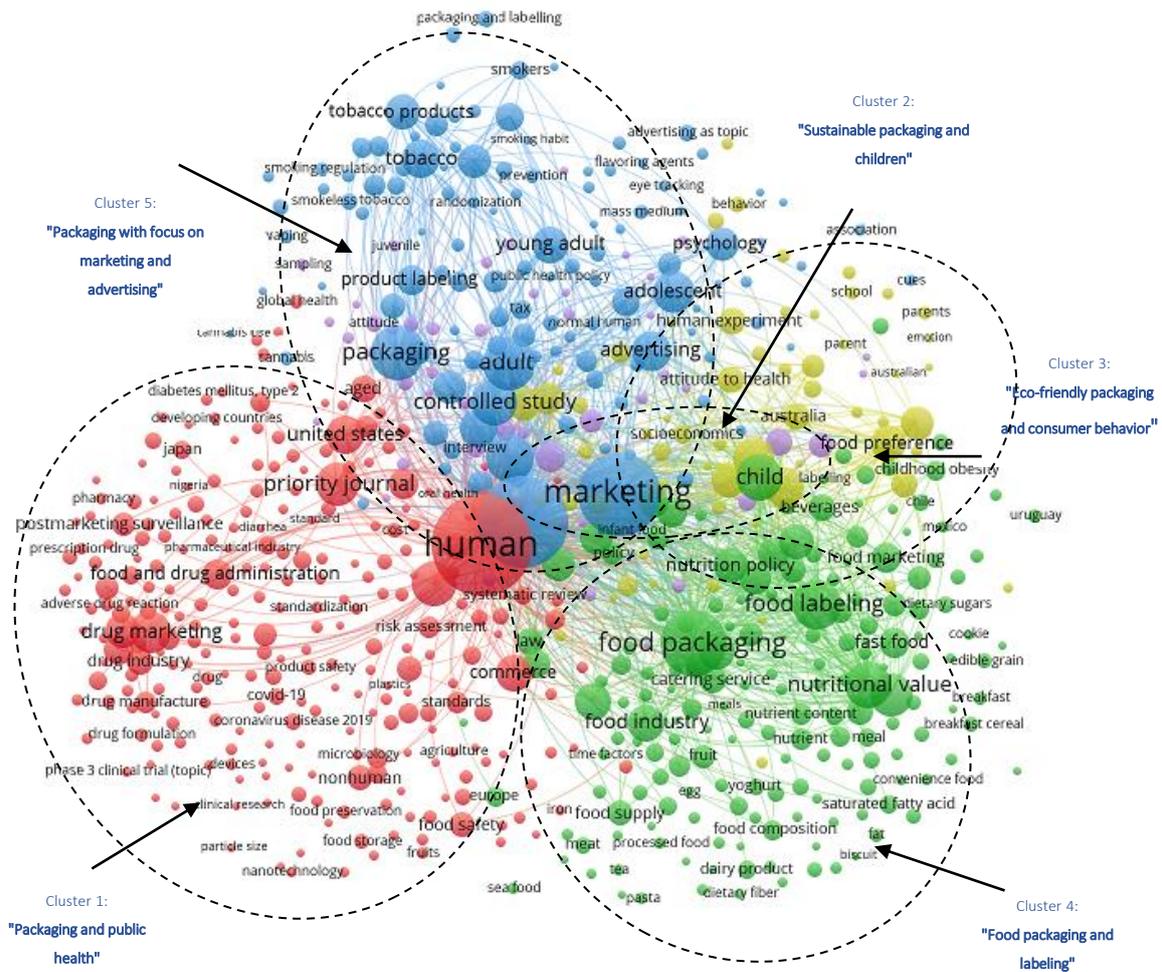


Figure 5. Main research clusters of safe packaging research

Table 2. The results revealed five main themes of the study in particular (Figure 5):

- (i) Packaging and public health;
- (ii) Packaging and children’s food safety;
- (iii) Eco-friendly packaging and consumer behavior;
- (iv) Food packaging and labeling;
- (v) Packaging with a focus on marketing and advertising.

3.2.1. Cluster 1: Packaging and public health

Chemical contamination in food, including pesticide residues, various harmful metals and non-metals, the abuse of food additives, and improper use of toxic food packaging materials, can decrease public health safety (Garvey, 2019). The contamination of food packaging materials is easy to be ignored. In 2015, 380 million metric tons of plastic were pro-

duced, with 40% used as packaging (Groh et al., 2019). It contains a variety of polymers and many additives, and other chemicals, many of which are damaging to human health. It is of high societal and economic significance because food packaging protects and conserves foods, transports them, and provides consumers with information. However, the food absorbs some chemicals from the packaging; consequently, people consume these chemicals (Muncke et al., 2020). In addition, the harnessing of single-use and improper disposal of plastic-based packages could contaminate the environment and harm the ecosystem with public health outcomes (Ugoeze et al., 2021).

To avoid the threat food packaging materials pose to human health, it is necessary to involve comprehensive information on all chemicals to characterize their risks. There are areas of certainty, such as the migration of chemicals into food

(Muncke et al., 2020). Groh et al. (2019) described chemicals associated with plastic packaging, listing 906 chemicals and 3,377 substances associated with plastic packaging. Among the 906 chemicals on the list, 63 are highly hazardous for human health, 68 are environmental hazards, 7 are persistent, bioaccumulative, and toxic, and 15 are endocrine-disrupting chemicals. It is recommended that these hazardous chemicals identified here should be evaluated in detail to determine whether they can be substituted.

Per- and polyfluoroalkyl substances (PFAS) are a group of synthetic chemicals leading to adverse health effects: reduced antibody responses to vaccination, increased cholesterol levels, low infant birth weight, and an increased risk of hypertension. Vorst et al. (2021) researched ways to detect and quantify PFAS in various foods and packaging materials and their exposure route. Considering the impact of chlorinated paraffins (CPs) on humans, Wang et al. (2019) investigated the migration of CPs from food packaging materials into food through food mimics analysis. Finally, Bansal and Kim (2015) described polycyclic aromatic hydrocarbons (PAHs) transfer, possible ways to reduce their dietary intake, and legislative aspects to control PAHs.

Sustainable packaging design and effective recycling of plastic packaging are two main approaches to address the threat posed by packaging to human health. Sustainable packaging has been considered vital for the food supply system due to its positive impact on public health and the environment. Even in developing countries focusing on production, sustainable packaging research and practice have begun to develop. According to Ezeudu et al. (2021), who researched natural leaf-type packaging materials for local food delicacies in Nigeria, there are numerous environmental and health benefits over synthetic packaging materials. Meanwhile, unhygienic practices in packaging procedures have the potential to affect public health adversely. Besides, Ugoeze et al. (2021) reviewed the status of food products packages disposal. They recommended addressing this vexing problem for relevant stakeholders, including social scientists, environmental scientists and material science experts, technologists, industrialists, and policymakers.

3.2.2. Cluster 2: Packaging and children's health safety

Due to improved living standards and developed personalized consumer demand, the consumption market of children's food products is expanding, leading to the interest in children's eating intentions and behaviors, and the ways to change them have been increasing (DeCosta et al., 2017). Packaging marketing is essential to consider the cognitive characteristics of children susceptible to visual and informational cues (Hallez et al., 2020). However, a considerable problem in children's food safety is that packaging always adds many children's preferred elements (cartoon characters and brand ambassadors/mascots) to attract children's purchases (Richonnet et al., 2021). However, some are unhealthy for children and lead to overconsumption of sodium, saturated fats, and added sugars (Eicher-Miller et al., 2020). Elliott (2019) surveyed the nutritional profile and type of marketing appeal of children's food products in supermarkets in Canada in 2009 and 2017. The results showed that nutritional quality remained poor over time, but packaging marketing strategies increased significantly, including nutritional claims and engagement of popular cartoon characters and fonts. In addition, children's beverage choices are influenced by personalized beverage bottles, which means that personalized unhealthy beverages reduce children's choice of healthy beverages (McDarby et al., 2018).

Another concern is that food packaging information shows that most foods sold to children have high amounts of fats, sugar, and salt (Machado et al., 2019). Therefore, the pervasive use of sugar in children's products is a concern. Richonnet et al. (2021) analyzed 1,155 product packages for children over three years old on the French market. They showed that 89.52% were sugar-containing foods, and 94.88% did not meet the WHO European nutrient model standards. Moreover, most such products need a better nutritional profile. A survey of supermarket goods targeted at children in Canada revealed that 88% of products would not be allowed to be sold to children according to World Health Organization (WHO) standards and were consistently high in sugar (Elliott, 2019).

Marketing strategies that promote unhealthy children's food and beverages negatively affect children's food perception, eating habits, and health (Elliott, 2019; Sadeghirad et al., 2016). As a result, there is a need to bound marketing techniques targeting children through legislation, regulations, local advertising guidelines, and voluntary actions. However, many measures must address packaging requirements and include more criteria related to the degree of packaging disposal (Richonnet et al., 2021). Considering the low nutritional quality and appealing nature of many children's products, there are growing calls for food product packaging to be included in the World Health Organization to introduce regulations on the marketing of unhealthy foods (Elliott, 2019). Public health strategies should also focus on limiting the advertising of unhealthy foods (Lavriša & Pravst, 2019). In practice, packaging that appeals to children should be encouraged to increase children's choice of healthy food, such as personalized packaging to encourage children to choose healthy drinks (McDarby et al., 2018). In addition, children's food packaging materials can be improved to perfect children's food safety, such as edible packaging materials to replace potentially hazardous materials (Jeevahan et al., 2020). Moreover, companies may use safe and durable recyclable packaging to eliminate the health risks of traditional packaging while reducing production costs (Franz & Welle, 2022).

3.2.3. Cluster 3: Eco-friendly packaging and consumer behavior

Sustainable development aims to address society's challenges regarding climate action, the environment, resource efficiency, and raw materials, which have become constant concerns for producers, traders, consumers, and regulators (Jurconi et al., 2022). Notably, the environmental consequences of plastic are a rising concern, which affects consumer intention to purchase and, thus, their selection of green brands (Nguyen et al., 2020). In this sense, promoting green packaging is essential, as it uses sustainable materials and designs (Wandosell et al., 2021). It is necessary to put more effort into implementing eco-friendly packaging due to the package's significant functions that need to be considered (Polanco et al., 2021). Therefore, it is vital to study the consumer perception of environmental packaging, motivation to prefer it, and consumer behaviors.

In terms of consumers' cognition of environmental packaging, according to Polanco et al. (2021), sustainable packaging includes several crucial elements, including design, material, and production process. Nguyen et al. (2020) explored the impact of eco-friendly packaging on consumer purchase behaviors in Vietnam. Based on the results, three key dimensions were identified, including packaging material (biodegradability and recyclability), manufacturing technology (production process, energy consumption, and materials used), and market appeal (attractive graphic design and reasonable price). However, consumer understanding of the elements of eco-friendly packaging, especially the manufacturing technology, seems to be limited even though they prefer an eco-friendlier manufacturing process.

As for the consumer motivation to prefer environmental packaging, Koch et al. (2022) analyzed why customers choose eco-friendly packaging in online retail, collecting data from 1,491 German consumers. It was revealed that consumers are more likely to adopt eco-friendly packaging if they have gain and normative motives, while hedonistic motives are less influential. Furthermore, Jurconi et al. (2022) surveyed 280 respondents to identify their perceptions of sustainable food packaging. It was found that 81% of respondents identified a more pollutant-free environment as the primary benefit of using sustainable packaging, which is essential to establishing ecologically and sustainably managed food systems.

Regarding consumer behaviors, consumers will be concerned with packaging materials disposal issues when they purchase the supplies (Nguyen et al., 2020). However, price is a barrier to people's purchase behavior. In the wine industry of developed countries, customers generally prefer wine produced using sustainable practices, even if they still need to fully understand these practices (Polanco et al., 2021). A study of sustainable consumption intentions in Indonesia found that consumers incur inconveniences when buying sustainable food products (such as paying a premium for sustainable products) but prefer recycled packaging materials at standardized prices (Pascall, 2020).

In addition, eco-friendly packaging can decrease food waste. Zeng (2021) evaluated the relation-

ship between eco-design, packaging, and food waste from a consumer perspective. It was found that the health consciousness and environmental awareness of consumers with perceived risks regarding eco-design packaging affect food waste decisions.

Zeng and Durif (2020) concluded that consumers' perceptions of eco-design packaging could affect food waste avoidance intentions. They proposed a conceptual model describing the role of eco-design packaging in customer intentions to decrease food waste. Chen et al. (2021) found that consumers are not aware of how packaging can decrease food waste. Reducing packaging, especially plastic, is always considered more significant than reducing food waste since most packaging will inevitably be plastic.

Eco-friendly packaging is a requirement of sustainable development and the need of consumers. According to Nguyen et al. (2020), an eco-friendly packaging strategy initiated by consumers could be applied to sustainable packaging strategies. Koch et al. (2022) identified the framework that determines whether online retailers intend to choose environmentally friendly packaging. As part of introducing eco-friendly packaging, online retailers must consider functional requirements to meet consumer demands. Wandosell et al. (2021) examined the impact of eco-packaging from both the producer and customer perspectives. They considered costs, design, materials, marketing strategies, corporate social responsibility, and how green packaging impacts waste management, the circular economy, logistics, and supply chains. Finally, Zeng et al. (2021) reported three approaches to increase eco-packaging benefits, including a connection between new technologies and consumer vulnerability, sustainability, and public health.

3.2.4. Cluster 4: Food packaging and labeling

Focusing on packaging and labeling is significant because they are crucial for commodity exports and flowing to consumers. Generally, packaging is considered to have a negative impact on the environment because once the product is consumed, the packaging is leftover and needs to be disposed of properly (either put back in the bins or recycled) (Langley et al., 2021). In fact, packaging and

labeling have many vital functions that cannot be replaced. Gordon and Williams (2020) discussed the reasons why food packaging is used, including protection from the environment. It was shown that packaging protects the food from contamination and the transfer of gas (such as oxygen and moisture). In addition, it contains necessary information and offers. Muncke et al. (2020) argued that food packaging is essential as it preserves and protects food, makes it transportable, offers relevant information, as well as involves marketing issues. Besides, packaging could reduce food waste by prolonging its shelf life and reducing the overall environmental impact (Chen et al., 2021). Labeling functions include product description, health issues, nutrition issues, and food quality compliance certification (Langley et al., 2021). For example, the ingredient description is related to health and nutrition issues. Moreover, labeling also reduces food waste by prompting consumers to better manage their food through information such as expiration dates (Chen et al., 2021).

Due to the functions of packaging and labels in the circulation and usage of goods, there is increasing discussion about their importance and applicability, especially in packaging and labeling primary food categories. Packaging considerations include the container closure integrity and assessment, legal aspects for packaging recycling, its re-use or disposal, its effect on extending shelf life, and packaging design and innovation. In contrast, labeling considerations include labeling basics, nutrition and allergen labeling (Langley et al., 2021). The eco-labeling for recycled packaging is also a significant issue, enhancing consumers' sustainable consumption intentions (Chen et al., 2021). Pascall (2020) explored the basics of packaging, including the new options of packaging, aspects of product integrity, and container closure assessment. In addition, the study analyzed hazard and risk analysis and critical control. Further, the relevance and specific needs of packaging and labeling in numerous countries and markets are detailed (Langley et al., 2021; Soon & Wahab, 2021).

The design level of packaging and labeling determines consumers' different choices and behavior patterns. Langley et al. (2021) highlighted that good packaging design will reduce waste, bad packaging design will increase food waste, and

ugly packaging will increase food waste and contribute to a broader food degradation environment. Chen et al. (2021) explored the attributes of consumer intention and willingness toward sustainable consumption. The results revealed that the model's central improvement axis is the eco-labeled packaging certification. Conversely, labeling errors could affect consumer health, including undeclared allergens or ingredients, incorrect shelf life, and incorrect or missing storage instructions (Lee et al., 2021).

Furthermore, with the popularization of online shopping, labels in online retail may contain some inconsistencies, which can be a barrier to enabling consumers to make informed purchasing decisions (Chia et al., 2022). Therefore, it is necessary to establish food regulations for online grocery shopping to enforce and standardize the availability and presentation of product data. However, the biopolymers that indicate the edibility of food, which the starch/polyaniline biopolymer film, could be used as an alternative solution to the problems that packaging causes various environmental impacts and food insecurity due to food spoilage and misunderstanding of labeling (Do Canto et al., 2021).

3.2.5. Cluster 5: Packaging with a focus on marketing and advertising

Packaging design is essential in consumers' search for healthy food (Theben et al., 2020). Meanwhile, packaging is a powerful, persuasive technology for product manufacturers to promote consumer buying behavior (Elliott & Truman, 2021). Therefore, packaging design focusing on marketing and advertising is of great significance to manufacturers and consumers. For example, McDarby et al. (2018) identified that the design of personalized drink bottles could affect children's drink choices. According to Richonnet et al. (2021), children and their desire to consume specific products are highly influenced by various marketing tools, such as cartoon characters and brand mascots. In terms of graphic design, consumers will be attracted by visually attractive packaging, such as color images, and are unsatisfied with the poor appearance of the packaging (Nguyen et al., 2020). Theben et al. (2020) examined the effects of packaging color, health claims, and palatability claims on consum-

er attitudes toward products and their purchase intentions using a 2x2 between-subjects experimental design. The results confirmed that consumer attitudes toward products do have a significant impact on purchase intention. Nevertheless, it has not been proven that health cues on food packaging, such as color and advertising, impact consumer attitudes toward products.

Given the diversity and inconsistency of packaging designs, it is necessary to monitor and regulate food packaging to limit unhealthy food marketing and advertising, especially for children. Elliott and Truman (2021) examined studies on persuasive techniques of packaging and proposed a model to monitor packaging capacity in retail environments. Machado et al. (2019) analyzed products in a Brazilian supermarket chain. They found that policymakers should revise the requirements for food labeling due to the effect marketing tools have on children's choices (i.e., consumption of low-quality food). Relevant research conducted in Canada also confirmed that inappropriate marketing of unhealthy food for children needs to be modified or even banned (Elliott, 2019; Rachel, 2017). Similarly, Gostin (2018) concluded that there is a need for food regulations to successfully limit the prevalence of obesity in the US by reducing the consumption of sugary drinks, such as labeling and marketing restrictions.

In recent years, more food products have been marketed through buzzwords such as "organic," "local," "recyclable," and "fairtrade," reflecting the trends in marketing and advertising in product design (Ledin & Machin, 2019). Among them, the green marketing strategies of sustainable packaging (Polanco et al., 2021), eco-friendly packaging (Nguyen et al., 2020), and green packaging (Wandosell et al., 2021) are highly preferred, including the design and use of green packaging materials and green packaging-related companies. Promotion of social responsibility (Jurconi et al., 2022). When sustainability initiatives are on the rise, such marketing content enables consumers to increase their recognition of products by learning about the company's sustainable practices while generating a sense of engagement in achieving sustainability goals during consumption. According to Pascall (2020), recycled packaging is the most significant aspect of consumers' consumption in-

tention. Of course, there are concerns that marketing and advertising involving socio-political issues will influence consumers' definitions of environmental issues and behavior (Ledin & Machin, 2019). These marketing and advertising stances may become barriers to socially sustainable actions if they are misaligned.

4. DISCUSSION

This study adopted a hybrid analysis method to describe the evolution and status of organic packaging research. Moreover, it explored possible future research trends in this field. The research results confirmed that packaging materials, such as PE, PFAS, and PAHs, commonly used in the past, have significant defects in reducing environmental impact and promising product safety. As an alternative, organic packaging/sustainable packaging/eco-friendly packaging has advanced application in the food supply chain compared with traditional plastic packaging, consistent with the literature review results on metal-organic frameworks packaging (Sharanyakanth & Radhakrishnan, 2020; Sultana et al., 2022). As for the promotion of organic packaging, various stakeholders have different intentions and behaviors due to their different positions. The government's position is evident in increasingly restrictive regulations on plastic packaging and incentives for organic packaging applications, such as tax exemptions (Trubetskaya et al., 2022). Consumers always prefer biodegradable packaging, as they unconsciously wrap organic packaging with environmental consequences, product quality, and health safety (Ketelsen et al., 2020; Boz et al., 2020). However, it is undeniable that the

convenience of using disposable packaging at will and the high price of degradable packaging are still dominant factors hindering consumers from choosing sustainable packaging (Popovic et al., 2019). Companies are willing to choose biodegradable packaging because of the pressure from the government and consumers and its social responsibility (Van Velzen, 2020).

In contrast, manufacturers' intentions and behaviors for organic packaging applications are more complex because they are directly faced with the challenges of material and technology innovation and the instability of market demand in the production process (Rauch et al., 2022). This has led to the current reality that the government mainly follows the 3Rs principles of circular economy in terms of plastic packaging management, putting reduction in the first place, followed by re-use and recycling. In contrast, promoting organic packaging that is more environmentally friendly and healthy is still a phase of support and encouragement.

These findings highlight existing gaps and challenges in organic packaging and provide potential avenues for further research into packaging applications and food packaging safety management. In the future, the application of organic packaging from the perspective of consumer safety needs to be further strengthened. In particular, the application of healthy and harmless organic packaging in children's food needs further attention because the issue of children's health and safety has become an increasing concern. In addition, the behavior of stakeholders, especially packaging manufacturers, and related influencing factors need to be further explored to accelerate the promotion of organic packaging.

CONCLUSION

This study conducted a retrospective analysis of existing developments and identified existing trends in organic packaging research. The study was conducted by analyzing articles in Scopus from 2017 to 2022. After a detailed literature review, the study contributes new knowledge to the use of organic food packaging. Therefore, it was established that despite the significant level of research on the specified subject, only some publications consider organic packaging from the point of view of consumer safety. The main emphasis in most publications is on the role of packaging in environmental pollution. The segment of application of organic packaging in marketing activities and related advertising needs to be further sufficiently developed.

However, this paper has several limitations that can be addressed in future research. First, non-English language studies were not included in the sample, even though they may add more value to the findings and insights provided. Second, the Scopus database was the only database assessed, resulting in the absence of some relevant studies in the field.

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ACKNOWLEDGMENT

The study was conducted within the framework of the ERASMUS+ Jean Monnet Project “Production and dissemination of circular economy ideas in accordance with the EU Action Plan.” Furthermore, Kseniia Bliumska-Danko gratefully acknowledges financial support from the Government of France within the framework of the PAUSE program (National Program of Urgent Assistance and Reception of Scientists).

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