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Innovative principles of designing eco-friendly packaging

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Abstract. The purpose of the work was to identify innovative principles in packaging design that integrate functionality, aesthetics and environmental responsibility, contributing to the spread of a culture of sustainable consumption. The work used a systematic approach to the design of eco-friendly packaging, which is based on the integration of analytical-comparative, functional and morphological analysis methods and covers interdisciplinary research in the fields of design, ecology, materials science, marketing, consumer psychology, etc. A systematic analysis of eco-packaging has led to the development of three principles for its design: the use of biodegradable materials, multifunctionality, and the visualisation of natural aesthetics. It has been proven that the key area of innovation is the creation of packaging from biodegradable materials (paper, fabric, wood, plant raw materials, bioplastics, combined raw materials) that are capable of decomposing naturally without leaving environmentally harmful waste. The essence of the principle of multifunctionality has been substantiated, demonstrating the possibilities of eco-packaging design to form new ways of interacting with people and products (edible packaging, transformer packaging, organiser packaging, scented packaging). It has been found that the principle of visualising natural aesthetics emphasises the ecological orientation of the product and shapes the eco-conscious behaviour of the consumer through design. The principles considered ensure systematic design aimed at sustainable development of the natural environment, minimisation of negative impact on the environment, and improvement of aesthetic appeal. The results of the study outline the prospects for the implementation of innovative strategies in the practice of enterprises that seek to combine economic efficiency with care for the environment. The practical results of the research open up opportunities for creating conceptual models of eco-packaging that demonstrate a synthesis of functionality, aesthetics and environmental responsibility. This can be used in the design, educational and manufacturing activities of designers

Keywords: packaging design; eco-design; design for sustainable development; visual communications design; biodegradable materials; secondary raw materials; packaging life cycle

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INTRODUCTION

The world today is facing a bunch of global environmental issues linked to the rise in single-use packaging, the heavy use of synthetic materials, and the build-up of packaging waste. This is leading to the degradation of natural ecosystems and putting more pressure on the environment. Currently, packaging is no longer just an auxiliary element of a product, but an important factor influencing environmental safety and the sustainability of consumption practices. Consumers are becoming increasingly interested in the environmental aspects of goods.

Packaging, as an element of communication between the manufacturer and the consumer, plays a key role not only in marketing strategies, but also in cultivating a culture of responsible consumption. In the context of the global environmental crisis and ever-increasing consumer demands, environmentally friendly packaging is becoming not only a competitive advantage but also a necessity. That is why it is becoming increasingly important to find new approaches to its design, where the synthesis of aesthetic, functional, technological and environmental characteristics plays an important role. In this context, eco-packaging design takes on strategic importance as a tool for minimising negative environmental impact and integrating environmental values into everyday consumer culture. In today's world, the problem of packaging waste (Peydayesh *et al*., 2021) and the environmental challenges associated with it are becoming particularly relevant in the work of modern scientists. The need for sustainable development and the implementation of innovative approaches to packaging design necessitates a comprehensive study of this topic.

The problem of applying smart packaging technologies and using eco-materials in packaging shifts the focus to finding ways to improve environmental performance. In recent years, scientific publications have shown an increasing interest in the creation of environmentally friendly packaging materials based on biopolymers. In particular, considerable attention has been paid to the study of materials formed on the basis of fungal mycelium. Thus, R. Khan (2025) in his review study emphasizes the high potential of mycelial bioproducts as an alternative to traditional polymer materials in the context of the formation of a sustainable economy. A similar position is confirmed by the results of the experimental work of S. R. Biby *et al.* (2025), which demonstrate the possibilities of creating mycelial biocomposites from agricultural and paper waste as an ecological alternative to polystyrene foam packaging. Biopolymers obtained from seaweed are also actively studied. For instance, P. Kajla *et al.* (2024) consider the potential of algal biopolymers for the creation of environmentally friendly packaging materials of a new generation. Additionally, the possibilities of such materials are confirmed in the work of H. Dogruoglu *et al*. (2023), where the properties of biodegradable composites based on Chlorella algae and k-Carrageenan were investigated.

An analysis of scientific publications in recent years indicates the intensive development of research in the field of biopolymer materials for packaging, in particular based on plant biopolymers. Specifically, X. Dang *et al*. (2025) developed multifunctional packaging materials based on corn starch with improved antimicrobial and preservative properties. Considerable attention is also paid to composite materials made of nanocellulose. In their review, Y. Xu *et al.* (2024) emphasize the prospects of nanocellulose films for food packaging due to their barrier properties, biodegradability and the possibility of combining with other biopolymer components. The described studies demonstrate the possibilities for the transition to more sustainable solutions in packaging design.

Smart packaging technologies have been studied by Akbar *et al*. (2025), A. Grossman (2022), S. Hussain *et al*. (2024), who worked on biodegradable materials that replace traditional synthetic materials in the food industry. Tools for assessing the environmental impact of packaging throughout its life cycle and methods for integrating eco-design into production were the subject of research by Wang *et al*. (2024), Aguiar *et al*. (2021) created maturity models that allow companies to assess the level of integration of sustainable design principles, particularly in the field of packaging.

Eco-friendly packaging attracts the attention of researchers in the context of eco-design theory, where eco-packaging design, smart packaging technologies and eco-materials are becoming dominant. M. Blyzniuk (2022) analysed the principles and theoretical foundations of eco-design, which became the basis for understanding the concept of sustainable packaging. The relevant aspects of modern eco-packaging design are compliance with the principles of the circular economy (Goodrich, 2022), the use of biodegradable materials, and the possibility of reusing packaging to extend its life cycle (Skliarenko *et al*., 2021; Szaky, 2023; Pant *et al*., 2024). A. Khezerlou *et al*. (2025) emphasise the importance of integrating innovative technologies in packaging design to reduce the environmental footprint.

Another important aspect of contemporary eco-packaging research is visual language, in particular "green" typography, colour and graphic elements that transform packaging design into a tool for shaping brand uniqueness (Shukla *et al*., 2022; Carvalho *et al*., 2025). This shapes consumer perception, programmes eco-conscious behaviour and provides an emotional connection between the brand and the consumer (Neacşu, 2025). The outlined aspects prove the existence of a significant source base, which emphasises the relevance of the topic raised, but requires systematisation and analysis from the point of view of eco-packaging design.

Considering the analysis of contemporary scientific works, the aim of the study was to systematise innovative principles of designing environmentally

friendly packaging based on modern scientific approaches, technological capabilities and market needs. **The research tasks** were aimed at achieving the goal, in particular: 1) to analyse modern scientific concepts in the field of eco-friendly packaging; 2) to generalise and systematise the key principles of packaging design solutions; 3) justify their essence in order to assess the level of environmental friendliness of packaging materials and design solutions suitable for practical integration into production.

MATERIALS AND METHODS

The study is based on a systematic approach and is interdisciplinary in nature, which has made it possible to integrate methods from the fields of design, ecology, materials science, aesthetics, consumer psychology, marketing, etc.

The research methodology is based on a comprehensive combination of analysis of scientific sources, results of comparative analysis of design cases, and systematisation of real examples of modern eco-packaging. The research is based on scientific publications and examples of design solutions selected from international scientometric databases, including Scopus, Web of Science, Google Scholar, as well as professional platforms dedicated to design and innovation in packaging (Designboom, Dezeen, Packaging Europe). The search for sources was carried out using the keywords such as *sustainable packaging, eco-friendly packaging, biodegradable packaging, mycelium packaging, seaweed packaging, edible packaging, biopolymer packaging, circular packaging design*, as well as their Ukrainian equivalents. The search strategy involved combining these keywords with the following terms: *design principles, innovation, sustainability, consumer perception and life cycle.*

The time frame of the study covers mainly scientific works and design projects of recent years (approximately 2018–2025), which allowed the focus to be placed on current technological and design trends in the field of sustainable packaging. The analysis includes publications that examined innovative materials, new packaging life cycle models, and design solutions that combine environmental, functional, and communicative aspects. The criteria for including sources were scientific peer review of publications, the availability of empirical or experimental data on the properties of materials, and a description of practical design solutions. At the same time, sources that were purely marketing and advertising in nature, did not contain a description of materials or technologies, and duplicated already processed research results were excluded from the analysis.

The empirical basis of the study involved the analysis of more than 150 samples of eco-packaging presented in scientific developments, design archives and examples of innovative products. To examine innovative approaches to environmentally friendly packaging, cases from leading brands and start-ups were selected that demonstrate different technological and design approaches to sustainable packaging. These include solutions proposed by Sway, which develops bioplastic films from seaweed (Waseem *et al.*, 2023), Ecovative Design, which creates packaging based on fungal mycelium (Laszlo *et al.*, 2013); Geyman, 2020; Vandelook *et al.*, 2021), and Proservation, which works with innovative food and biopolymer materials (Sheth, 2024). The analysis also includes design concepts and start-ups, such as Seaweed U (Designboom, 2020), Wonder Cup (Wonderfruit, 2023) and Good Edi edible packaging (Clark & Wright, 2023). The criteria for selecting cases were the innovativeness of materials, environmental efficiency, the scalability of technology, and the presence of distinctive design and communication solutions. It helped to reveal the main characteristics of eco-packaging and formulate the principles of its design, which influence the assessment of the effectiveness of innovative principles based on a set of indicators (ecological, functional, economic, visual-communicative, etc.), but due to publication size limitations, only some of these materials have been made available to the scientific community.

The analysis procedure was carried out in several consecutive stages. In the first stage, a systematic review of sources was conducted and a database of eco-packaging examples was compiled. In the second stage, a morphological analysis of packaging characteristics was carried out according to the parameters 'material – design – consumer – disposal', which made it possible to identify the interrelationships between the environmental properties of materials, the functionality of packaging, consumer experience and the possibilities for its reuse or recycling. In the third stage, a comparative analysis of innovative design solutions was carried out based on a set of indicators, including environmental (biodegradability, resource renewability, waste reduction), functional (product protection, ease of use), economic (production and logistics efficiency) and visual-communicative (design expressiveness, informativeness, ability to shape consumer environmental awareness).

The systematisation of the samples studied made it possible to classify eco-packaging according to its dominant characteristics. As a result, three main groups were identified: packaging made from biodegradable materials (30%), multifunctional packaging (50%) and visually aesthetic packaging (20%). These groups were identified based on an analysis of certain aspects of packaging structure, the most important of which are shape, material and technology, functionality, aesthetics, and level of visual communication. This approach allowed the establishment the basic principles of environmentally-oriented packaging design and evaluation of the effectiveness of innovative solutions within a comprehensive system of indicators.

However, the study has certain limitations. First, the analysis covers mainly samples presented in open scientific and professional sources, which may limit access to commercial or experimental developments

that have not yet been made public. Second, a significant part of innovative projects is at the prototype or start-up stage, so their economic efficiency and the potential for large-scale implementation require further research. Nevertheless, the analysis enables the establishment of a generalized methodological framework for defining innovative principles of environmentally friendly packaging design and to outline key areas for its further development.

RESULTS AND DISCUSSION

The principle of using biodegradable materials in packaging. Environmentally friendly packaging is a concept that involves creating packaging materials and forms that minimise harmful effects on the environment throughout the entire product life cycle, from manufacture to disposal (Wilber, 2010). Based on an analysis of eco-packaging samples, three design principles were identified that determine the principle of using biodegradable materials in packaging, the principle of packaging multifunctionality, and the principle of visualising natural aesthetics. A traditional solution in many countries is packaging made from natural materials, which harmoniously combines aesthetics and environmental friendliness. Such materials are biodegradable, do not pollute the environment, and can be reused in everyday life (Zeng & Durif, 2019). The use of biodegradable materials in packaging affects its design, functionality, visual appeal, and environmental performance. Eco-packaging has been classified according to the choice of material (Fig. 1).

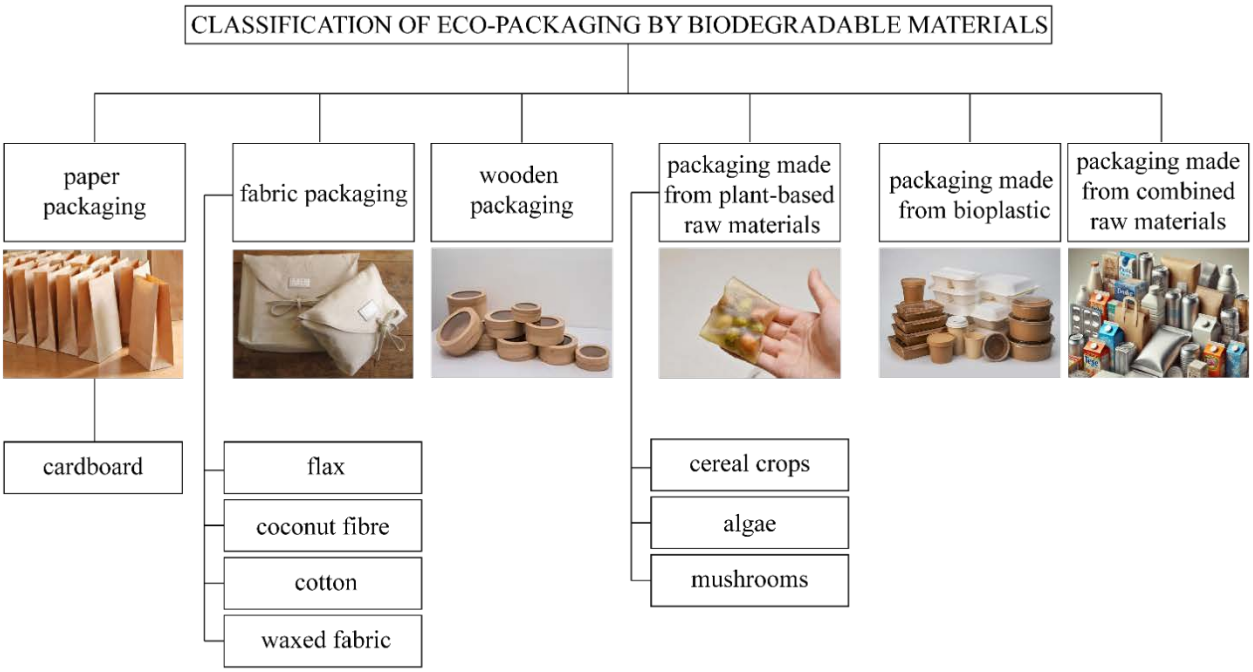


Figure 1. Types of biodegradable packaging (based on materials)
Source: created by the authors

One of the most popular eco-friendly solutions is paper packaging. It is made from renewable resources such as recycled paper or certified wood, making it an environmentally friendly choice (Skliarenko *et al.*, 2021). It is easy to recycle, decomposes quickly in natural conditions and does not harm the environment. Fabric packaging is made from natural materials such as cotton, linen or jute, coconut or hemp fibre, making it completely biodegradable. Thanks to its durability, it can be used multiple times, which significantly reduces waste. Fabric bags are an excellent alternative to disposable packaging, as they serve as a stylish accessory or a practical means of storing items. A type of fabric packaging is waxed bags, which combine naturalness and practicality thanks to a special technology of impregnating the fabric with natural wax. This process creates a thin water- and grease-resistant layer that preserves the elasticity and breathability of the material. As a result, the bags can be reused for food storage, reducing the need for disposable plastic and making everyday life more environmentally friendly. One of the most promising options for eco-friendly packaging is wood packaging, as this material is renewable, biodegradable and recyclable. Wooden packaging not only provides reliable protection for products, but also has an aesthetic appearance that emphasises the naturalness and environmental friendliness of the brand.

Plant-based packaging covers a wide range of innovative materials of natural origin. These include materials based on algae, fungal mycelium, rice husks and cereal crops. Such solutions are an alternative to traditional polymer packaging because they are biodegradable, environmentally friendly, and renewable (Jain *et al.*, 2025). Biodegradable packaging made from algae is lightweight and environmentally friendly. Polysaccharides found in algae, such as alginate and fucoidan, open up opportunities for the

creation of bioplastics, edible films and active packaging (Goodrich & Robinson, 2025). These materials have antioxidant and antimicrobial properties that help keep products fresh during storage (Marichelvam *et al*., 2025).

Sway, based in the UK, uses seaweed to create compostable packaging that replaces single-use plastic (Khalil *et al*., 2017). Their products, such as Firstwave™ Film, are transparent and suitable for replacing plastic windows in packaging. They are environmentally friendly and ideal for single use, as they leave no harmful waste behind (Fig. 2, a). This type of packaging is a promising alternative to traditional plastic materials and is widely used in the food industry and for packaging everyday goods. Biodegradable packaging made from mushroom mycelium is an environmentally friendly type of packaging made from the structure of mushroom mycelium that grows on agricultural or wood waste (Amrita & Ashok, 2025). This packaging is completely biodegradable and does not contain plastic or synthetic components, making it safe for the environment. The characteristic features of this material are its lightness, dimensional stability and ability to take various shapes during manufacture, which allows the creation of packaging of different configurations and sizes (Fig. 2, b). In addition, mycelium packaging has insulating properties that protect the product from mechanical damage, moisture, and temperature fluctuations (Hua *et al*., 2025). Cereal crops (corn, rice husks, cereal waste) are also widely used as material for biodegradable packaging. Corn starch-based bioplastics show great promise as a replacement for conventional plastic packaging (Abookleesh *et al*., 2026). Thanks to their mechanical and barrier properties, these materials are an effective choice for use in the food industry. Such packaging can be edible. Biodegradable packaging made from grain waste is an environmentally friendly type of packaging made from grain production by-products such as grain husks, bran or processing residues (Azimi *et al*., 2025; Jafarzadeh *et al*., 2025) (Fig. 2, d). Biodegradable packaging made from rice husks is an environmentally friendly type of packaging made from rice production by-products, which allows for the effective use of waste and reduces the negative impact on the environment (Amornkitbamrung *et al*., 2025) (Fig. 2, c). The main characteristics of this type of packaging are lightness, sufficient strength, resistance to deformation, and the possibility of giving it different shapes during production. The use of rice husks for packaging promotes sustainable development, reduces plastic waste and emphasises the brand's environmental responsibility and innovation.

Figure 2. Features of biodegradable packaging made from plant materials
Note: a – biodegradable films made from seaweed; b – biodegradable packaging made from mushroom mycelium; c – biodegradable packaging made from rice husks; d – biodegradable packaging made from grain waste
Source: Designboom (2020), M. Geyman (2020), Wonderfruit (2023), Sheth (2024)

Composted materials made from rice husks and grain waste are a new type of environmentally friendly packaging material, as they are completely biodegradable in composting conditions, turning into organic fertilisers. Composted packaging is used for food, cosmetics and household goods, and its main advantage is that it can be safely returned to the natural cycle. Thanks to its properties, bioplastic packaging completely replaces traditional plastic, which pollutes the environment (Peydayesh *et al*., 2021).

Biodegradable materials have high environmental value because they decompose quickly under the influence of natural factors. The main challenge for biodegradable packaging is its cost, which is still higher than that of traditional plastic counterparts. Composite packaging is a type of packaging made from several different materials (e.g. cardboard, aluminium, polyethylene and waste cotton (Mahmud *et al*., 2025) that are combined to achieve better protective and functional properties. Such packaging provides high strength and barrier protection for the product, but is difficult to recycle due to its multi-layer structure.

The principle of using biodegradable materials in packaging combines functionality and environmental friendliness, allowing the creation of packaging that protects the product while minimising the negative impact on the environment. The main goal of this principle is to minimise the negative impact of packaging on the ecosystem, reduce the amount of plastic and other inorganic waste, and support the concept of sustainable development. The use of materials such as algae, mushroom mycelium, and rice husks contributes to sustainable development, reduces the amount of plastic waste, and increases brand value in the eyes of conscious consumers.

The principle of multifunctionality of packaging. The integration of additional functions into packaging materials is becoming increasingly important, allowing for an expansion of the range of eco-packaging functions. The principle of multifunctionality in eco-packaging ensures that several functions can be combined simultaneously. Going beyond its standard protective role, packaging includes functions such as protection, consumption together with the product, aesthetic and visual communication, and many others.

Multifunctional packaging not only stores and transports the product, but also serves as a storage container, stand, dispenser, decorative element, or even part of a gaming or interactive experience for the consumer. The characteristic features of multifunctional packaging are convenience, versatility, and increased aesthetic value. It reduces the use of additional resources, increases the practicality of the product, and creates a positive image for the brand, focused on environmental friendliness and creative design. This approach also supports the principles of sustainable development by ensuring reuse or multiple use (Wimmer *et al*., 2004).

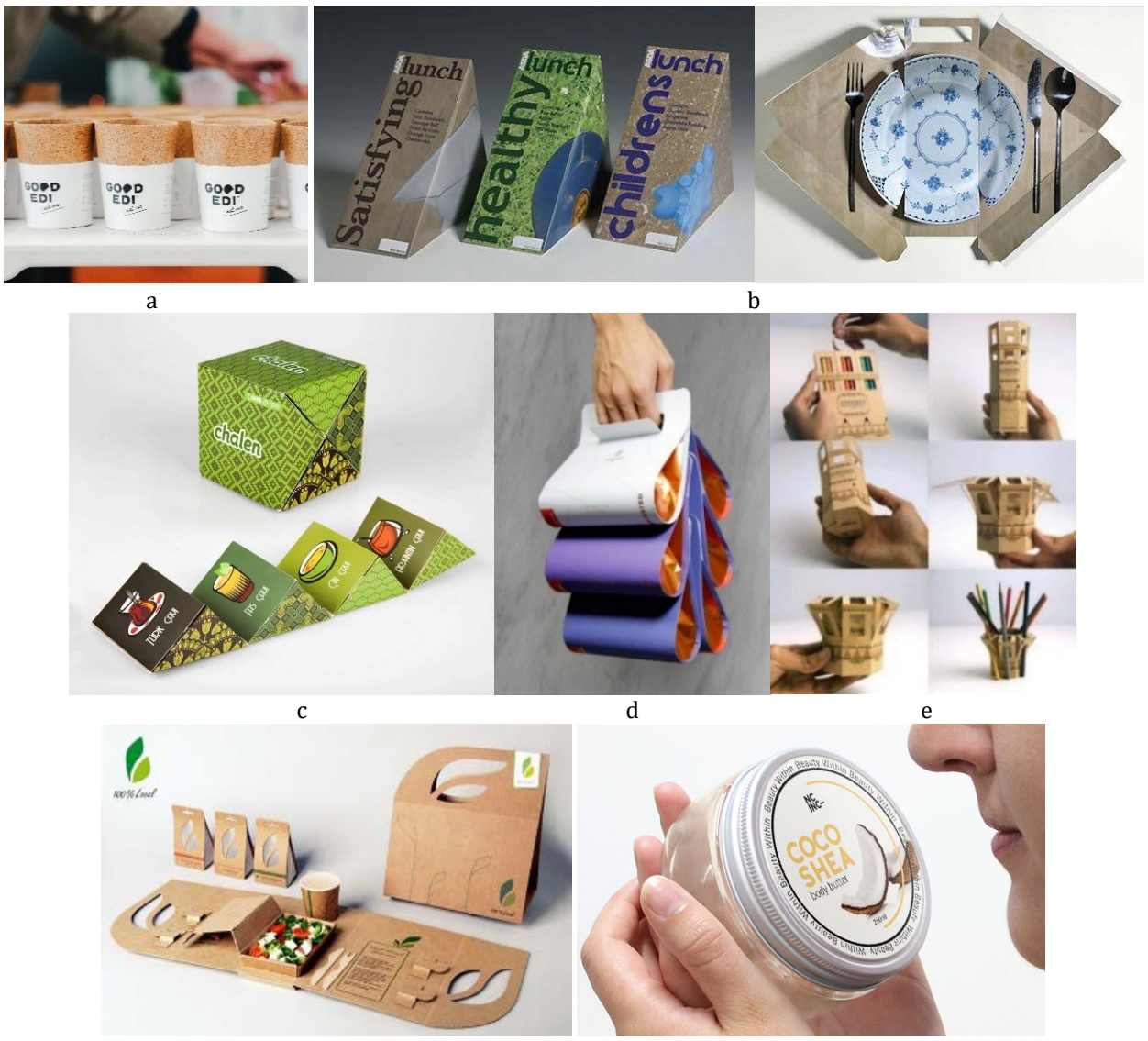
In the context of this principle, the innovative feature is the ability to consume the product together with the packaging. This function is focused on the convenience of using edible packaging (Fig. 3, a). Edible packaging is an innovative type of packaging made from natural products or food biopolymers that can be consumed together with the product or separately after use (Dang *et al*., 2025). The characteristic features of edible packaging are food safety, creativity in design and multifunctionality (Fig. 3, a). Such packaging is made from algae, gelatine, agar-agar, rice or grain flour, as well as fruit and vegetable purees. Edible packaging is essentially an integral part of the product and also serves as an additional sensory element, adding flavour and aroma.

Rethinking the aesthetic function of packaging involves creating an attractive appearance by transforming the visual design or shape, which evokes positive emotions and contributes to the creation of a holistic image of the product with transformer packaging. The concept of visual transformation provides for a change of images inside and outside the packaging, which corresponds to the characteristics of product consumption (Fig. 3, b). Such packaging can serve as a plate, cup, stand, or decorative element. This type of packaging combines aesthetic appeal with interactivity, creating an additional emotional experience for the consumer. The characteristic features of this packaging are interactivity, aesthetic value, the ability to attract attention and stimulate interest in the product. The use of such illustrations is particularly effective for children's products, premium products and gift packaging, where emotional interaction with the consumer is important.

Formal transformation of packaging is carried out by modifying the shape through rotation, bending, tearing, folding/unfolding, etc. of individual parts or modules (Fig. 3, c-e). This allows the consumer to reuse the packaging after its main function has been fulfilled. Modularity in eco-friendly packaging involves creating structures from separate interchangeable elements that can be combined, transformed or separated depending on consumer and logistics needs. This approach ensures versatility and functionality: one package can be used for transport, storage or product separation. Modularity increases ease of use, optimises space during transport, reduces material costs and creates a modern, innovative look for packaging, giving it a universal appeal.

Packaging as an organiser simultaneously performs the functions of protecting the product, facilitating its transportation and presenting it to the consumer (Fig. 3, f). It has a specific shape, size, material and design features that determine its practical properties and aesthetic appeal. The choice of various materials, including paper, cardboard, plastic, biopolymers, or combined structures, depends on the product's purpose and preservation requirements.

The desire to enhance the sensory experience of consumers has led to the emergence of scented packaging with freshness or fragrance indicators (Fig. 3, g). They have become widespread for packaging food products, cosmetics, household goods and gift sets, where the aroma emphasises the quality and character of the product, creating a unique brand experience. A distinctive feature of scented packaging is the presence of aroma capsules, microencapsulated essential oils or special layers that release a pleasant scent (StickerYou, 2018) enhancing the impression of the product and forming an emotional connection with the consumer (Yang & Zhao, 2019).



a b c d e f g

Figure 3. Features of multifunctional packaging

Note: a – edible packaging made from food ingredients; b – transformer packaging (visual transformation); c-e – transformer packaging (formal transformation); f – organiser packaging with additional elements for convenient use of the product; g – scented packaging

Source: A. Clark & K. Wright (2023), J. Nėjė (n.d.), Packaging of the World (2019), Packaging of the World (2015), B. Mittal (2025), F. Remonato (2014), StickerYou (2018)

a b

Figure 4. Graphic concepts of eco-packaging

Note: a – "green" packaging colours; b – integration of natural textures

Source: Charlie Stopford Design (n.d.), Vandelook *et al.* (2021)

Thus, the principle of multifunctionality allows packaging to perform not only its basic protective function, but also increasing consumer convenience, material savings and the aesthetic value of the product. This approach shapes a positive brand image, creates an emotional connection with the consumer and supports the concept of sustainable consumption.

The principle of visualising natural aesthetics. The visual component of packaging is a key tool for communication between the brand and the consumer, because it is the appearance that primarily forms an emotional impression, distinguishes the product from its competitors and enhances its environmental value (Liu *et al*., 2025). In this context, an important principle of environmentally friendly packaging is the principle of visualising natural aesthetics. Yang & Zhao (2019) analyse how people evaluate "green" packaging elements (materials and visual cues) and how this affects brand trust. Adding natural textures, shapes and colours makes packaging emotionally appealing to consumers (Mitterer-Daltoé, 2024).

This principle is implemented through the use of "green" packaging colours that are close to natural colours (Qiu *et al*., 2023). The packaging design uses shades that contain natural materials, plants, earth, water or other elements of the environment (Fig. 4, a). This design approach emphasises the environmental friendliness of the product, creates a sense of naturalness and organicity, and promotes consumer confidence. The characteristic features of packaging with "green" colours are a calm and harmonious colour scheme and associations with nature, which support the image of an environmentally responsible brand (Skliarenko *et al*., 2022). The integration of natural textures (coconut, fabric, wood, etc.) into the packaging design emphasises natural aesthetics and is defined by minimalist design (Fig. 4, b). Materials made from plant fibres or mycelium simultaneously perform a technical role and serve as a visual code for eco-friendly packaging.

Thus, eco-packaging is not only a material object, but also a visual and communicative carrier of the idea of sustainable development. It forms associations in the consumer's mind with responsibility, trust and an ethical attitude towards nature. The design of eco-packaging is becoming systematic and lies at the intersection of ecology, technology and visual culture.

The analysed principles of eco-packaging design form a systematic approach to design activities, based on the interaction of environmental, functional and aesthetic aspects and focused on sustainable development. The use of biodegradable and recycled materials reduces the negative impact of packaging on the natural environment throughout the product life cycle (Amrita & Ashok, 2025). The systematic nature of the design process is enhanced by expanding the range of functions of eco-packaging, which allows us to talk about its transformation from a traditional container to an active element of multisensory communication with the user. Edible, scented packaging and transformable eco-packaging reduce waste, increase the consumer value of the product and demonstrate the ability of design to adapt to different consumption contexts. The integration of environmental values in the visual language of design forms an emotional connection between a person and a product. The use of natural textures, minimalist forms, and natural colours contributes to the development of environmentally conscious consumer behaviour.

Through the synthesis of the three design principles, packaging is considered not as a separate design object, but as part of an eco-sociocultural system. Designers combine the principles of sustainable development with design thinking methods, product life cycle analysis and an interdisciplinary approach during the design process. This allows to take into account the interconnections between material, production technology, features of use, visual and communication characteristics, and consumer behaviour. In this context, the aesthetics of eco-packaging is considered as a strategic tool for environmental communication and the transmission of sustainable development principles.

CONCLUSIONS

The study analysed the main innovative principles of eco-friendly packaging design: the use of biodegradable materials, multifunctionality, and the visualisation of natural aesthetics. These principles integrate functionality, aesthetic appeal, and sustainability requirements, which are important in modern packaging design. It has been proven that the use of biodegradable materials is an effective means of reducing the negative impact of packaging on the environment. Materials (paper, fabric, wood, plant raw materials, bioplastics, combined raw materials) allow the creation of packaging that is both durable and safe for nature, in line with the principles of sustainable development.

The essence of the principle of multifunctionality has been defined, which consists in the formation of new ways of interaction between packaging, the product and the consumer. Edible packaging, transformer packaging with visual and formal transformation capabilities, organiser packaging and aromatic packaging have been identified as contributing to the formation of a conscious and responsible culture of consumption. The essence of the principle of visualising natural aesthetics, which influences the perception of the product and corrects consumer behaviour, is substantiated. Colours close to natural colours and tactile textural elements of packaging create associations with the naturalness and safety of the product, as well as form an unforgettable sensory experience.

Integrating these principles allows for combining aesthetics and practicality in packaging design, emphasising the environmental focus of the product and encouraging consumers to make conscious choices. Manufacturers who implement innovative packaging

solutions reduce their negative impact on the environment in accordance with international environmental standards, create a positive brand image, and promote a culture of responsible consumption. Environmentally friendly packaging not only protects the product, but also shapes a conscious attitude towards resources and the environment, which is a key direction in modern design for sustainable development.

The value of the study is in the possibility of practical implementation of the research results in the field of designers' project activities, in educational, production and communication practice in order to promote environmentally responsible behaviour. The research results can be used as a methodological basis for the development of conceptual models of eco-packaging system design, as well as for the formation of strategies for the sustainable development of production and commercial structures.

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CONFLICT OF INTEREST

None.

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Інноваційні принципи проєктування екологічно безпечного паковання

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Анотація. Метою роботи було визначення інноваційних принципів дизайну упаковки, що поєднують функціональність, естетику та екологічну відповідальність, сприяючи поширенню культури сталого споживання. У роботі застосовано системний підхід до проєктування екологічної упаковки, що

ґрунтується на інтеграції методів аналітико-порівняльного, функціонального та морфологічного аналізу й охоплює міждисциплінарні дослідження у сферах дизайну, екології, матеріалознавства, маркетингу, психології споживання тощо. Системний аналіз екоупаковки дозволив сформулювати три принципи її проєктування: використання біорозкладних матеріалів, багатофункціональність та візуалізація природної естетики. Доведено, що ключовим напрямом інновацій є створення упаковки з біорозкладних матеріалів (папір, тканина, деревина, рослинна сировина, біопластик, комбіновані матеріали), здатних до природного розкладання без утворення шкідливих для довкілля відходів. Обґрунтовано сутність принципу багатофункціональності, продемонстровано можливості дизайну екоупаковки формувати нові способи взаємодії з людьми та продуктами (їстівна упаковка, упаковка-трансформер, упаковка-органайзер, ароматизована упаковка). Встановлено, що принцип візуалізації природної естетики підкреслює екологічну спрямованість продукту та формує екосвідому поведінку споживача засобами дизайну. Розглянуті принципи забезпечують системне проєктування, спрямоване на сталий розвиток природного середовища, мінімізацію негативного впливу на довкілля та підвищення естетичної привабливості. Результати дослідження окреслюють перспективи впровадження інноваційних стратегій у діяльність підприємств, що прагнуть поєднати економічну ефективність із турботою про довкілля. Практичні результати дослідження відкривають можливості для створення концептуальних моделей екоупаковки, що демонструють синтез функціональності, естетики та екологічної відповідальності.

Ключові слова: дизайн упаковки; екодизайн; дизайн для сталого розвитку; дизайн візуальних комунікацій; біорозкладні матеріали; вторинна сировина; життєвий цикл упаковки