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Action for Education Spatial Organisation and Planning For Sustainable Food

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Sustainable Food Planning Seminar

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Giuseppina Bifulco
Italy, University of Turin, LL Madrid

Tutor: **Marian Simon**

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Circular Economy in Food Retail Alternative Packaging

The Living Lab is conceived as a space for the co-generation of applied knowledge together with **the cooperative supermarket LA OSA** and with the support of the International Center for Circular Economy (CIEC) of the Municipality of Madrid.

The main goal is to **boost mechanisms of circular economy**, to **reduce both packaging and food waste**, but also to **enhance the recovery and reuse of packaging**.

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Research aim and research questions

How to reduce food packaging in the food chain in a perspective of circularity and sustainability?

The aim of this research was to explore and analyse **possible alternative solutions for food packaging** in the food chain, at the retail level, to reduce the impact of packaging and increase the sustainability of the food chain.

Approach, Methodology

•**Objective:** To explore and assess alternative packaging solutions in the food chain, focusing on sustainability and recent developments

•**Method:** comprehensive literature review of scientifically relevant contributions

•**Search Engine:** Scopus

•**Keywords:** food, packaging, sustainability, circular economy, circular bioeconomy, biodegradable, food chain, sustainable food system

•**Research Steps:**

- **Phase 1:** study of the theoretical framework surrounding alternative packaging solutions.
- **Phase 2:** identification and analysis of 10 key papers to evaluate the state of the art and recent advancements in the field.

Theoretical Framework

Between circular economy and circular bioeconomy

How can we define the circular economy?

<< An economic system that is based on business models which replace the “end-of-life” concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations. >>

Kirchherr et al. (2017)

Theoretical Framework

Between circular economy and circular bioeconomy

And the Circular Bioeconomy?

<< The Circular Bioeconomy (CBE) is a niche within Circular Economy (CE). It focuses on utilizing biological resources from waste streams. It creates valuable products like organic fertilizers, bioenergy and alternative proteins. Additionally, CBE promotes sustainable growth through closed-loop resources cycles, reduced reliance on virgin resources and the substitution of chemical fertilizers and non-renewable resources with consequent reduction in GHG emissions.>>

Dr. Susanne Bodach, International Water Management Institute, part of the FAO webinar "Overcoming barriers to building the Circular Bioeconomy", part of the CRFS Knowledge Exchange Series in partnership with RUAF, 2024

Results

Edible or biodegradable packaging has a double function: prevent waste in packaging and increasing food storage quality.

- **Biodegradable polymers:** frequently made from renewable resources like corn starch, potatoes, or sugarcane. When disposed of, they gradually decompose into harmless components, decreasing landfill waste while effectively shielding food goods from environmental variables like moisture and oxygen.
- **Biomaterials-based recyclable and biodegradable packaging:** a viable alternative to the traditional single-use plastics that pose environmental problems. These materials are biodegradable and less dependent on fossil fuels since they are made from renewable resources like algae, cellulose, or plant-based starches. Double aim: reducing waste and the use of new resources.

Results

Edible films and coatings: in nature, edible films are free-standing structures, whereas edible coatings cling to the surface of food. Many studies proved there are several benefits to using different coating materials to preserve and improve the quality of various food products.

Table 4
Lists possible uses for innovative edible coatings [69].

Coating Materials	Food Products	Main Advantages
Yam starch	Strawberries	Reduced decay, weight loss and firmness
Gum arabic	Anna apple	Reduced decay
Almond gum	Sweet cherries	Decrease in respiration rate and ethylene production; delayed the changes in color, weight loss, firmness, titratable acidity and soluble solid concentration
Gum arabic	Strawberries	Inhibited fungal growth
Gum arabic	Tomatoes	Inhibited fungal growth
Apricot gum containing *Satureja intermedia* extract	Wild almond kernels	Lower fungal contamination, oxidative compounds content and fatty acid profile variation
Gum arabic with lemongrass and cinnamon essential oill	Banana and papaya	Antifungal effect; reduced the growth of *Colletotrichum musae* and *Colletotrichum gloeosporioides*
Potato peel waste with oregano essential oil	Salmons (Cold-smoked)	Reduced the growth of L. *Monocytogenes*
Cordia myxa gum	Artichoke bottoms	Delayed browning; overall shelf-life extension
Mucilage extract from *Opuntia ficus-Indica* cladodes	Figs	Maintained the fruit weight and firmness
Opuntia cactus polysaccharides	Kinnow mandarin	Increase shelf life with regard to its ph, acidity, aroma, color, texture and general appearance
Aloe vera Gel	Apple	Maintained the bioactive compounds; reduces weight loss and firmness
Arabic gum with *Aloe vera* and garlic extract	Guava	Shelf-life extension; higher ascorbic acid content; lower content of total sugars
Fruit and vegetable residue flour from orange, passion fruit, watermelon, lettuce, courgette, carrot, spinach, mint, taro, cucumber, and rocket	Carrots (fresh-cut)	Delayed weight loss; maintained the color
Fruit and vegetable residue flour from orange, passion fruit, watermelon, lettuce, courgette, carrot, spinach, mint, taro, cucumber and rocket with the addition of potato peel flour	Acerolas	Delayed weight loss
Almond gum exudate	Tomatoes	Delayed the changes in color, weight loss, titratable acidity, soluble solid concentration, ascorbic acid content, firmness, and decay percentage
Almond gum	Bananas (slices)	Delayed the changes in weight loss; lower browning index

Source: Mahmud et al. (2023)

Results

- **Recent trends:** growing interest in agro-food waste as a source of bio-based materials with potential use in the packaging sector.

Table 3
Shows some instances of food packaging products readily accessible in the market that incorporate engineered nanomaterials (ENP) [63].

Company	Brand/Product	Description
Debbie Meyer® Innovation (U.S.)	Debbie Meyer® GreenBags	Food storage bags containing nano-clay to preserve freshness and extend the shelf-life of fruits and vegetables.
Baby Dream Co. Ltd® (Korea)	Nano-silver Baby Milk Bottle	Baby milk bottle containing nanosilver for antimicrobial properties.
NanoPack Inc. ® (U.S.)	NanoSeal™ - Barrier Coating and NanoSeal™ - Bairicade XT™ Barrier Coating	Coating applied to traditional packaging films to enhance gas barrier properties, approved for indirect food contact.
Baby Dream Co. Ltd® (South Korea)	Silver-nano Noble one-touch mug cup	Mug cup with silver-nano coating.
Debbie Meyer® Innovation (U.S.)	Debbie Meyer® Bread Bags™	Bread bags containing nano-clay for bread storage.
Colormatrix® (U.S.)	PET bottles with nano-titanium nitride	PET bottles with nano-titanium nitride for barrier properties.
Miller Brewing Co® (U.S.) and Hite Brewery Co.® (South Korea)	Plastic beer bottles with nano-clay	Plastic beer bottles containing nano-clay for barrier properties.
Zeomic Co Ltd® (Japan)	Zeomic® silver zeolites packaging film	Packaging film with silver zeolites for antimicrobial properties.
Oso Fresh® (U.S.)	Fresh food containers with nanosilver	Food containers containing nanosilver particles.
A-DO Global® (South Korea)	Nano-silver food containers	Food containers with nanosilver for antimicrobial properties.
A-DO Global® (South Korea)	Nano-silver NS-315 water bottle	Water bottle with nanosilver coating.
Changmin Chemicals® (South Korea)	Nano-silver salad bowl	Salad bowl with nanosilver coating.
Sharper Image® (U.S.)	FresherLonger™ Miracle Food Storage	Food storage containers containing nanosilver.
Sharper Image® (U.S.)	FresherLonger™ Plastic Storage Bags	Plastic storage bags containing nanosilver.
BlueMoonGoods™® (U.S.)	Fresh box silver nanoparticles food storage containers	Food storage containers with silver nanoparticles.
Kinetic Go Green® (U.S.)	Smartwist food storage with nanosilver	Food storage containers with nanosilver coating.
Pabck® (U.S.)	Clear Silver Reclosable Mylar Zip Lock Bags	Aluminum foil packaging with a clear silver layer.
Honeywell® (U.S.)	Aegis® OX	Oxygen-scavenging barrier resin for PET bottle applications, containing passive nano-clay particles.
Quan Zhou Hu Zeng Nano Technology Co.	Nano-silver storage box	Storage box with nanosilver coating.

Source: Mahmud et al., 2023.

Challenges and future directions

- Balance cost effectiveness and sustainability
- Commercial scalability and cost of these materials
- Safety evaluations for consumer well-being
- Regulatory framework
- Need for consistent policies to promote and incentive practices
- Need for behavioural change through awareness and education

The role of multi-actor synergies: academia, industry and the public sector.

References

Al Mahmud, M. Z., Mobarak, M. H., & Hossain, N. (2024), Emerging trends in biomaterials for sustainable food packaging: A comprehensive review. Heliyon.

F. Versino, F. Ortega, Y. Monroy, S. Rivero, O.V. Lopez, M.A. García, (2023), Sustainable and bio-based food packaging: a review on past and current design innovations, Foods 12 (5)

J. Wr´oblewska-Krepsztul, T. Rydzkowski, G. Borowski, M. Szczypi´nski, T. Klepka, V.K. Thakur, (2018), Recent progress in biodegradable polymers and nanocomposite-based packaging materials for sustainable environment, Int. J. Polym. Anal. Char. 23 (4) 383–395.

K.J. Jem, B. Tan, (2020), The development and challenges of poly (lactic acid) and poly (glycolic acid), Advanced Industrial and Engineering Polymer Research 3 (2) 60–70.

Kocira, K. Kozłowicz, K. Panasiewicz, M. Staniak, E. Szpunar-Krok, P. Horty´nska, (2021)Polysaccharides as edible films and coatings: characteristics and influence on fruit and vegetable quality—a review, Agronomy 11 (5) 813.

M.C. Gaspar, M.E. Braga, (2023), Edible films and coatings based on agrifood residues: a new trend in the food packaging research, Curr. Opin. Food Sci. 50 101006.

N. Tammineni, G. Ünlü, S.C. Min, (2013), Development of antimicrobial potato peel waste-based edible films with oregano essential oil to inhibit Listeria monocytogenes on cold-smoked salmon, Int. J. Food Sci. Technol. 48 211–214.

N.L. Cristofoli, A.R. Lima, R.D. Tchonkouang, A.C. Quintino, M.C. Vieira, (2023), Advances in the food packaging production from agri-food waste and by-products: market trends for a sustainable development, Sustainability 15 (7) 6153.

R. Ravichandran, (2010), Nanotechnology applications in food and food processing: innovative green approaches, opportunities and uncertainties for global market, Int. J. Green Nanotechnol. Phys. Chem. 1 (2) P72–P96.

M. Amir, N. Bano, M.R. Zaheer, T. Haq, Roohi, (2022), Impact of biodegradable packaging materials on food quality: a sustainable approach, Biodegradable Materials and Their Applications (627–652. [95] M.S. Ayilara, O.S. Olanrewaju, O.O. Babalola.

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