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PACKAGING SCIENCE

E' la Rassegna Scientifica Internazionale della ***Fondazione Carta Etica del Packaging.***

Pubblicazione bimestrale in cui sono presentati 7 articoli multidisciplinari, afferenti al packaging, selezionati da diverse riviste del mondo scientifico digitale.

Packaging Science attraverso le tematiche sempre attuali ed aggiornate dei suoi articoli in diverse discipline, concorre ampiamente alla promozione e all'evoluzione della corretta cultura del packaging e dei ***10 Valori della Carta Etica*** *per accompagnare il packaging verso un futuro più consapevole.*

FONDAZIONE™ CARTA ETICA del Packaging

Packaging intelligente: sviluppi attuali e futuri

L'imballaggio alimentare intelligente sviluppa ulteriormente le funzioni delle confezioni tradizionali introducendo la capacità di monitorare continuamente la qualità degli alimenti durante l'intera catena per valutare e ridurre l'insorgere delle malattie di origine alimentare e degli sprechi alimentari. A tal fine, negli ultimi anni sono stati proposti diversi sistemi di rilevamento basati su diversi indicatori di qualità degli alimenti, ma le applicazioni commerciali rimangono una sfida.

applied sciences

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Review

Intelligent Packaging for Real-Time Monitoring of Food-Quality: Current and Future Developments

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Abstract: Food packaging encompasses the topical role of preserving food, hence, extending the shelf-life, while ensuring the highest quality and safety along the production chain as well as during storage. Intelligent food packaging further develops the functions of traditional packages by introducing the capability of continuously monitoring food quality during the whole chain to assess and reduce the insurgence of food-borne disease and food waste. To this purpose, several sensing systems based on different food quality indicators have been proposed in recent years, but commercial applications remain a challenge. This review provides a critical summary of responsive systems employed in the real-time monitoring of food quality and preservation state. First, food quality indicators are briefly presented, and subsequently, their exploitation to fabricate intelligent packaging based on responsive materials is discussed. Finally, current challenges and future trends are reviewed to highlight the importance of concentrating efforts on developing new functional solutions.

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Keywords: food; intelligent packaging; food quality indicators; real-time monitoring; sensors

Citation: Dodero, A.; Escher, A.; Bertucci, S.; Castellano, M.; Lova, P.

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Pellicole per imballaggi nanocomposite antiossidanti e antimicrobiche a base di biopolimero di particelle di ZnO/CuO derivanti dall'estratto di foglie di ortica.

Le nanoparticelle di ossido metallico sintetizzati verdi (NP) hanno applicazioni prominenti nei sistemi di imballaggio antimicrobico. Focus dell'articolo la fabbricazione di pellicole nanocomposite a base di chitosano contenenti estratto di foglie di Urtica dioica - ossido di rame (CuO) e ossido di zinco (ZnO) NPs per l'estensione della shelf-life dei frutti di guava confezionati.

biomolecules

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Article

Nettle-Leaf Extract Derived ZnO/CuO Nanoparticle-Biopolymer-Based Antioxidant and Antimicrobial Nanocomposite Packaging Films and Their Impact on Extending the Post-Harvest Shelf Life of Guava Fruit

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Citation: Kalia, A.; Kaur, M.; Shami, A.; Jawandha, S.K.; Alghuthaymi, M.A.; Thakur, A.; Abd-Elsalam, K.A. Nettle-Leaf Extract Derived ZnO/CuO Nanoparticle-Biopolymer-Based Antioxidant and Antimicrobial Nanocomposite Packaging Films and Their Impact on Extending the Post-Harvest Shelf Life of Guava Fruit. *Biomolecules* **2021**, *11*, 224. https://doi.org/10.3390/biom11020224

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Abstract: Green synthesized metal oxide nanoparticles (NPs) have prominent applications in antimicrobial packaging systems. Here we have attempted for the fabrication of chitosan-based nanocomposite film containing *Urtica dioica* leaf extract derived copper oxide (CuO) and zinc oxide (ZnO) NPs for shelf-life extension of the packaged guava fruits. Electron microscopy and spectroscopy analysis of the CuO and ZnO NPs exhibited nano-scale size, spherical morphologies, and negative ζ-potential values. The NPs possessed appreciable antioxidant and antimicrobial activity (AMA) in order of CuO NPs > ZnO NPs > nettle extract. Therefore, this work establishes for the first time the successful synthesis of CuO NPs and compares its antimicrobial and antioxidant properties with ZnO NPs. On incorporation in chitosan, the polymer nanocomposite films were developed by solvent casting technique. The developed films were transparent, had low antioxidant but substantial AMA. The NP supplementation improved the film characteristics as evident from the decrease in moisture content, water holding capacity, and solubility of the films. The nanocomposite films improved the quality attributes and shelf life of guava fruits by one week on packaging and storage compared to unpackaged control fruits. Therefore, this study demonstrates the higher antimicrobial potential of the nettle leaf extract derived CuO/ZnO NPs for development of antimicrobial nanocomposite films as a promising packaging solution for enhancing the shelf life of various perishable fruits.

Keywords: anti-microbial; chitosan; guava; nanocomposite; perishable fruits; phyto-synthesis; storage shelf-life

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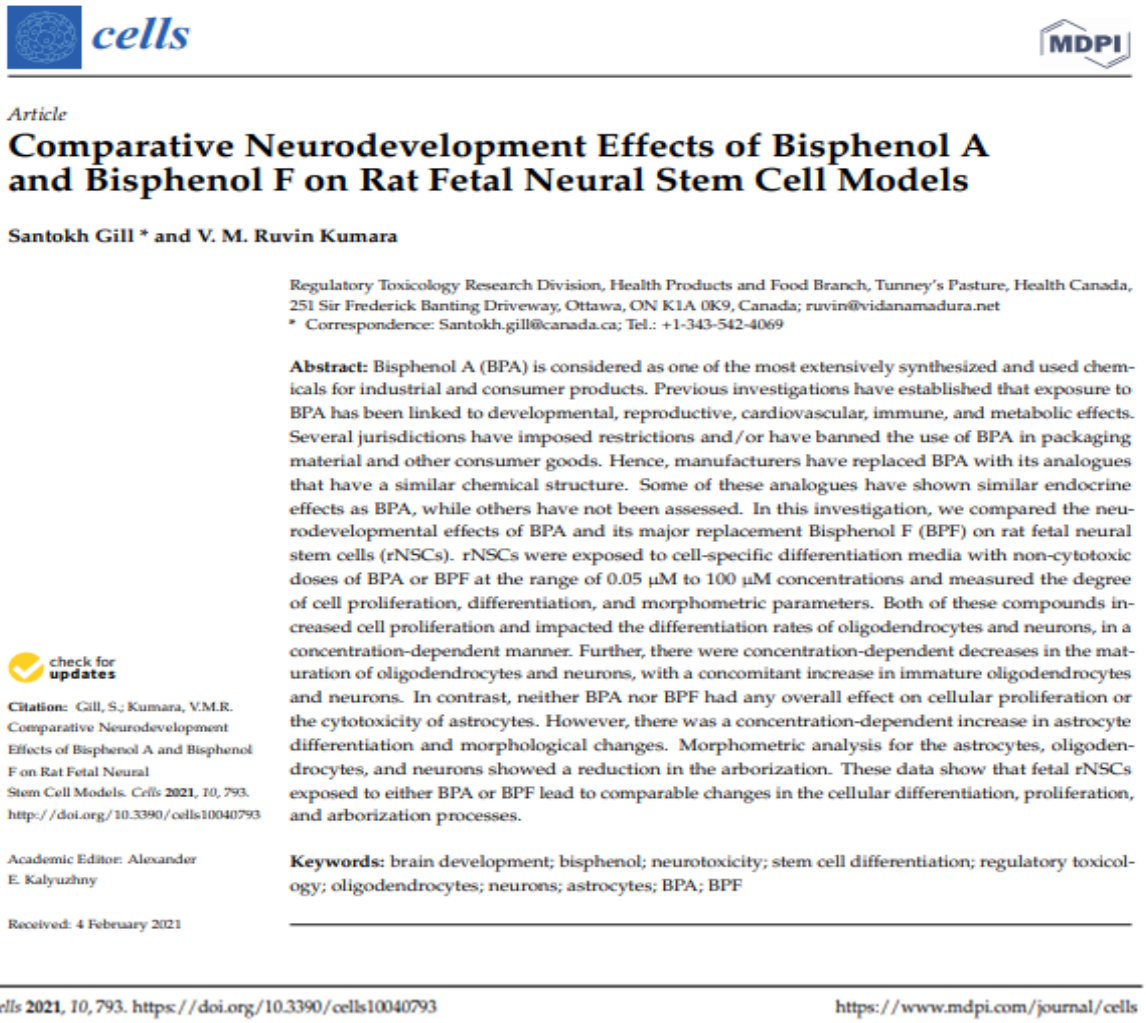
Effetti comparativi sul neurosviluppo del bisfenolo A e del bisfenolo F.

Il bisfenolo A (BPA) è considerato una delle sostanze chimiche più ampiamente sintetizzata e utilizzata per prodotti industriali e di consumo. Precedenti indagini hanno stabilito che l'esposizione al BPA è stata collegata ad effetti dello sviluppo, riproduttivi, cardiovascolari, immunitari e metabolici. Diverse giurisdizioni hanno imposto restrizioni e/o vietato l'uso della BPA nel materiale di imballaggio e in altri beni di consumo. Quindi, i produttori hanno sostituito il BPA con i suoi analoghi che hanno una struttura chimica simile. Alcuni di questi analoghi hanno mostrato effetti endocrini simili a bpa, mentre altri non sono stati valutati. In questa indagine, abbiamo confrontato gli effetti del neurosviluppo del BPA e il suo principale bisfenolo F (BPF) sostitutivo sulle cellule staminali neurali fetali del ratto (RNSC).



cells MDPI

Article

Comparative Neurodevelopment Effects of Bisphenol A and Bisphenol F on Rat Fetal Neural Stem Cell Models

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Abstract: Bisphenol A (BPA) is considered as one of the most extensively synthesized and used chemicals for industrial and consumer products. Previous investigations have established that exposure to BPA has been linked to developmental, reproductive, cardiovascular, immune, and metabolic effects. Several jurisdictions have imposed restrictions and/or have banned the use of BPA in packaging material and other consumer goods. Hence, manufacturers have replaced BPA with its analogues that have a similar chemical structure. Some of these analogues have shown similar endocrine effects as BPA, while others have not been assessed. In this investigation, we compared the neurodevelopmental effects of BPA and its major replacement Bisphenol F (BPF) on rat fetal neural stem cells (rNSCs). rNSCs were exposed to cell-specific differentiation media with non-cytotoxic doses of BPA or BPF at the range of 0.05 µM to 100 µM concentrations and measured the degree of cell proliferation, differentiation, and morphometric parameters. Both of these compounds increased cell proliferation and impacted the differentiation rates of oligodendrocytes and neurons, in a concentration-dependent manner. Further, there were concentration-dependent decreases in the maturation of oligodendrocytes and neurons, with a concomitant increase in immature oligodendrocytes and neurons. In contrast, neither BPA nor BPF had any overall effect on cellular proliferation or the cytotoxicity of astrocytes. However, there was a concentration-dependent increase in astrocyte differentiation and morphological changes. Morphometric analysis for the astrocytes, oligodendrocytes, and neurons showed a reduction in the arborization. These data show that fetal rNSCs exposed to either BPA or BPF lead to comparable changes in the cellular differentiation, proliferation, and arborization processes.

Keywords: brain development; bisphenol; neurotoxicity; stem cell differentiation; regulatory toxicology; oligodendrocytes; neurons; astrocytes; BPA; BPF

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Le sfide della comunicazione del marketing verde per i consumatori scettici!

Comunicare efficacemente le proprietà dei prodotti ambientali ai consumatori può essere difficile. Ciò riguarda in particolare i consumatori altamente attenti all'ambiente (HEC), ma scettici, poiché questo gruppo target deve bilanciare la necessità di una conoscenza affidabile del prodotto con un'elevata sensibilità a segnali non verbali spesso ambigui sulla compatibilità ambientale di un prodotto (ad esempio, immagini ambientali).

designs

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Article

The Challenges of Green Marketing Communication: Effective Communication to Environmentally Conscious but Skeptical Consumers

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Abstract: Effectively communicating properties of environmental products to consumers can be challenging. This especially pertains to highly environmentally conscious (HEC)—yet skeptical—consumers, since this target group must balance the need for reliable product knowledge with high sensitivity to often ambiguous nonverbal cues about a product's environmental friendliness (e.g., environmental pictures). Using a group-specific (2 ×) 2 × 2 repeated-measures experimental study, we investigated the effect of communication-channel-specificity (verbal and nonverbal) to convey the environmental friendliness of products and evaluated consumers' environmental skepticism and attention during product presentation. Environmental information delivered via a verbal/text-based communication channel translates into low skepticism for both HEC and low environmental consciousness (LEC) consumers. However, nonverbal/pictorial communication proved persuasive only for LEC consumers; HEC consumers exhibited high levels of skepticism, which, in turn, decreased the products' perceived environmental friendliness. The analysis of combined verbal and nonverbal communication presented here provides a promising framework for effective green marketing communication.

Keywords: environmentally conscious consumer; environmental quality perception; nonverbal communication; verbal communication; environmental packaging communication

https://www.mdpi.com/2411-9660/4/3/25

Imballaggio Commestibile Attivo

Lo sviluppo di imballaggi commestibili attivi è in crescita. Studi di ricerca stanno capitalizzando gli sforzi sull'utilizzo di polimeri naturali che, essendo biodegradabili, non generano residui e hanno un basso impatto ambientale.

encyclopedia

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Entry

Active Edible Packaging

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Definition: Active edible packaging is a food packaging made of comestible bioproducts and active compounds that interacts with the food. The bioproducts, usually biopolymers, must be recognized as safe and with characteristics to be consumed by humans—comestible—and not toxic and capable of carrying an active compound, like anti-browning agents, colorants, flavors, nutrients, antimicrobial and/or antioxidant compounds, in order to extend the product shelf-life, reduce contamination and maintain or even enhance the nutritional value.

Keywords: edible packaging; active packaging; biopolymers; active compounds

Citation: Barbosa, C.H.; Andrade, M.A.; Vilarinho, F.; Fernando, A.L.; Silva, A.S. Active Edible Packaging. *Encyclopedia* **2021**, *1*, 360–370. https://doi.org/10.3390/

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Influenza di due materiali di imballaggio innovativi sui parametri di qualità e sull'impronta digitale aromatica degli oli extravergine di oliva

Le prestazioni di due innovativi materiali di imballaggio sono state studiate su due oli extravergine di oliva sardi (Nera di Gonnos e Bosana). In particolare, sono stati confrontati un film di plastica trasparente caricato con un blocco UV (imballaggio B) e un materiale metallizzato (imballaggio C) e con vetro marrone-ambra (imballaggio A).

foods

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Article

Influence of Two Innovative Packaging Materials on Quality Parameters and Aromatic Fingerprint of Extra-Virgin Olive Oils

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Abstract: The performance of two innovative packaging materials was investigated on two Sardinian extra-virgin olive oils (Nera di Gonnos and Bosana). In particular, a transparent plastic film loaded with a UV-blocker (packaging B) and a metallized material (packaging C) were compared each other and to brown-amber glass (packaging A). During accelerated shelf-life tests at 40 and 60 °C, the evolution of quality parameters (i.e., acidity, peroxide value, K_{270}, and phenolic content) was monitored, together with the aromatic fingerprint evaluated by electronic nose. Packaging B resulted in the best-performing material in protecting oil from oxidation, due to its lower oxygen transmission rate (0.1 ± 0.02 cm^3/m^2 24 h) compared to packaging C (0.23 ± 0.04 cm^3/m^2 24 h). At the end of storage, phenolic reduction was on average 25% for packaging B and 58% for packaging C, and the aromatic fingerprint was better preserved in packaging B. In addition, other factors such as the sanitary status of the olives at harvesting and the storage temperature were demonstrated to have a significant role in the shelf life of packaged extra-virgin olive oil.

Keywords: electronic nose; accelerated shelf-life tests; transparent plastic material; metallized material; brown-amber glass; oxidation; stability; packaging; olive oil quality

Citation: Farris, S.; Buratti, S.; Benedetti, S.; Rovera, C.; Casiraghi, E.; Alamprese, C. Influence of Two Innovative Packaging Materials on Quality Parameters and Aromatic Fingerprint of Extra-Virgin Olive Oils. *Foods* **2021**, *10*, 929. https://doi.org/10.3390/

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Multifunzionalità termomeccanica nei compositi di nanotubi di nitruro di boro (BNNT)e polistirene stampati in 3D

In questo lavoro, i compositi di nanotubi di polistirene (PS) e nitruri di boro (BNNT) sono stati fabbricati, preparati e caratterizzati utilizzando processi di miscelazione diretta e sonicazione modificati.I compositi polimerici sono stati estrusi in filamenti (BNNT al 10% in peso) per la stampa 3D, utilizzando la tecnica di modellazione a deposizione fusa (FDM) per fabbricare parti meccaniche e applicazioni termiche

Journal of *Composites Science*

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Article

Thermomechanical Multifunctionality in 3D-Printed Polystyrene-Boron Nitride Nanotubes (BNNT) Composites

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Abstract: In this work, polystyrene (PS) and boron nitrides nanotubes (BNNT) composites were fabricated, prepared, and characterized using modified direct mixing and sonication processes. The polymer composites were extruded into filaments (BNNTs at 10 wt. %) for 3D printing, utilizing the fused deposition modeling (FDM) technique to fabricate parts for mechanical and thermal applications. Using a direct mixing process, we found that the thermal conductivity and the mechanical strength of the PS-BNNT composite were respectively four times and two times higher compared to the sonication method. The thermal stability and glass transition temperatures were positively affected. A 2D microstructural mechanical entanglement model captured the exact geometry of the nanotubes using the MultiMechanics software, and the performance of the additive manufactured (AM) PS-BNNT composites part for thermomechanical application was simulated in COMSOL. The modified direct mixing process for PS-BNNT, which affects morphology, proved to be effective in achieving better interfacial bonding, indicating that BNNTs are promising fillers for improving thermal and mechanical properties, and are applicable for thermal management and electronic packaging.

Keywords: additive manufacturing; fused deposition modeling technique; polymer-matrix composite; boron nitride nanotubes; sonication; direct mixing; thermal properties; mechanical properties

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Citation: Akintola, T.M.; Tran, P.; Downes Sweat, R.; Dickens, T. Thermomechanical Multifunctionality in 3D-Printed Polystyrene-Boron Nitride Nanotubes (BNNT) Composites. *J. Compos. Sci.* **2021**, *5*, 61. https://doi.org/10.3390/jcs5020061

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