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Nanoclays and Curcumin based food packaging material for intelligent food packaging applications

Kalpani Y. Perera
Technological University Dublin, d19129125@mytudublin.ie

Swarna Jaiswal
Technological University Dublin

Amit K. Jaiswal
Technological University Dublin

See next page for additional authors

Growth of food-borne pathogens *Listeria* and *Salmonella* and spore-forming *Paenibacillus* and *Bacillus* in commercial plant-based milk alternatives

K. Bartula, M. Begley and M. Callanan
Department of Biological Sciences, Munster Technological University, Bishopstown, Cork

An increase in vegan diet preference, lactose intolerance, calorie concern and environmental awareness has led to a rise in the popularity of plant-based alternatives to bovine milk. However, there are still gaps in understanding how known bacterial food contaminants behave in plant-based beverages. The present study is the first to compare the growth of food-pathogens *Listeria monocytogenes* and *Salmonella enterica*, food spoilage *Bacillus subtilis* and an industrial milk product isolate, spore-forming *Paenibacillus* in commercially available ultrahigh temperature processed bovine milk and plant-based milk alternatives (coconut, almond, cashew). Beverage samples were inoculated with a strain cocktail or individual strains of either *Listeria*, *Salmonella*, *Bacillus* or *Paenibacillus*, respectively (approximately 1 x 10^3CFU/mL) and stored at chilled and ambient temperatures (4^{o}C, 8^{o}C or 20^{o}C). Bacterial strains used in the study were capable of proliferating in plant-based beverages at higher rates than in bovine milk at 8^{o}C and 20^{o}C for *Listeria* and 20^{o}C for *Salmonella* and *Paenibacillus*, respectively. *Bacillus subtilis* grew equally fast in bovine milk and plant-based milk at 20^{o}C. No statistically significant difference (p>0.05) in growth rates between different types of tested beverages was observed at 4^{o}C and at 8^{o}C for *Listeria* and *Salmonella* cocktails, respectively. These data suggest that plant-based beverages may present a significant risk for listeriosis and salmonellosis and post-opening recommendations should be carefully considered.

Characterization of macroalgal bioactive compounds using chromatography-mass spectrometry techniques

O.O. Olatunji , D. Bhati, M. Hayes and D.K, Rai
Department of Food Bioscience, Teagasc Food Research Centre, Ashtown, Dublin 15

Macroalgae contain a diverse range of bioactive compounds, which have been associated with anti-inflammatory, antioxidant, anticancer, antibacterial and antiviral properties. The classes of compounds include polysaccharides, polyphenols, pigments, lipids, peptides and vitamins. Owing to the presence of a wealth of health-beneficial diverse metabolites in algal species, exploration of these compounds have gained research attention aiming towards application in nutraceuticals, pharmaceuticals and cosmetics. This study used liquid chromatography electrospray ionisation quadrupole time-of-flight ((LC-ESI-QTOF) mass spectrometry techniques to characterise compounds in acetone extract fractions from five macroalgae species [4 Ochrophyta (brown algae) and 1 Rhodophyta (red algae)]. The LC-ESI-QTOF mass spectrometry, aided by accurate mass measurement and tandem mass spectrometry, tentatively identified a number of fatty acids including eicosapentaenoic acid, arachidonic acid, and stearidonic acid. Different oligomers of phlorotannins such as fucotetraphlorethol, fucophlorethol decamer, trifuhalolhydroxycarmalol and laminarins were found in abundance in the extracts, and therefore these oligomers may be responsible for possessing the aforementioned biological activities. These results demonstrate that the studied brown and red seaweeds have potential for use in the food, pharmaceutical, and nutraceutical sectors.

Nanoclays and Curcumin based food packaging material for intelligent food packaging applications

Kalpani Y. Perera[1,2], Shubham Sharma[1,2], Amit K. Jaiswal[1,2], Swarna Jaiswal[1,2]
[1]School of Food Science and Environmental Health, Technological University Dublin; [2]Environmental Sustainability and Health Institute, Technological University Dublin

Bionanocomposite packaging eco-friendly alternatives with enhanced characteristics. This study aimed to develop a bionanocomposite intelligent packaging. Sodium alginate, gelatin, Curcumin (Cur), glycerol, and Nanoclay (NC) films were prepared. The influences of nanoclay and curcumin on the surface, optical, mechanical, chemical, barrier, and pH-indicating properties were studied. The results

showed that the lightness of films was reduced by 1.28 folds compared to NC (control) film, while the yellowness of films increased by 5.82 folds. Film transparency was reduced by 9.3 folds and a 3.46 folds increase in UV barrier properties was observed compared to NC (control) film. The highest tensile strength and elongation at break was observed was 38.63±0.93MPa and 3.89±0.69%. The hydrophobicity of films increased upto 87.36. N-H, C-O, and O-H covalent bonds are observed between biopolymers. The water vapour barrier and oxygen permeability increased by 8.95% and 93.06% respectively when compared to Curcumin (control). A colour change was observed from orange to red in alkaline conditions. The biodegradation study showed that all developed films biodegraded 100% within 1 month. The films had enhanced mechanical, barrier, and pH-indicating properties. Therefore, it can be used as a potential intelligent food packaging material to improve the quality of food products.

Pulsed electric field (PEF) assisted extraction of polyphenols from white willow (*Salix Alba*) bark

Liwen Zheng, Selene Pedrós-Garrido, Jean-Christophe Jacquier and Niamh Harbourne
School of Agriculture and Food Science, University College Dublin

White willow bark is a medicinal herb rich in polyphenolic compounds. Extraction of polyphenols is commonly done using pulverised material followed by solvent extraction. Literature showed PEF can be used prior to extraction to enhance the release of intracellular compounds. Therefore, the aim of this study was to investigate the effect of PEF as a pre-treatment for polyphenols extraction from willow bark chips and to compare its efficacy with pulverisation. Willow bark chips (1-2cm) underwent either PEF or pulverisation pre-treatment. PEF was carried out with constant pulse width of 20µs and pulsed field strength of 2 kV/cm. The number of pulses (100-400) varied to obtain a range of specific energy from 60.5 to 223.61 kJ/kg, in line with energy consumption of pulverisation. Subsequent aqueous extraction was carried out at 60°C for 30min. Total phenolic (TP) content, DPPH radical scavenging activity and ferric reducing antioxidant power (FRAP) were assessed as an index of extraction efficacy. For PEF, the TP content and antioxidant activities (DPPH and FRAP) of willow extracts increased by increasing specific energy ($p < 0.05$). In comparison with pulverisation, PEF had little effect on the TP content at same energy level (60.5 to 103 kJ/kg), but the resulting extracts had higher antioxidant activities. PEF pre-treatment could serve as an alternative to pulverisation to extract polyphenols from willow bark and can produce extracts with enhanced antioxidant activity.

Appetite-Modulating Properties of Whey Powders and Isolated Whey Proteins via Ghrelin Receptors

L. Gunning[1], N.K. Leeuwendaal[2], J.C. Jacquier[1] and H. Schellekens[2]
[1]UCD Institute of Food and Health, University College Dublin; [2]Department of Anatomy and Neuroscience, University College Cork

To counteract malnutrition which is widespread in hospital and care homes related to poor appetite, whey powders and isolated whey proteins were examined to determine their capacity to stimulate hunger via appetite receptors including the ghrelin receptor GHRS1a and glucagon-like peptide 1 (GLP-1). Simulated *in-vitro* gastrointestinal digestion was performed on commercial whey protein concentrates (WPC35, WPC80) and isolates (WPI) and, on isolated whey proteins. Calcium flux assays were used to measure the ability of whey digesta at 1mg/mL to cause receptor mediated changes in intra-cellular calcium for G-protein coupled receptors of interest (n=3). Method development to allow cell assay completion was thoroughly examined, with sample cleaning protocols implemented. High specific activation of GHRS1a was observed for all whey powders after gastric digestion ranging from 56-98% increasing in line with protein content from WPC35 to WPI. High activation of GHRS1a by three minor whey proteins lactoferrin, bovine serum albumin, and glycomacropeptide digesta was observed. Specific action of GLP-1R by 87% by *in-vitro* digests of β-lactoglobulin was also recorded. Ghrelin receptor activation by whey protein products was found to not be whey product specific, and gastric digestion increased ghrelin receptor activation. Specificity of isolated whey proteins on appetite related receptors *in-vitro* was observed and should be further explored.