Project Title: Effect of Post-Consumer Recycled (PCR) or Bioplastic Plastic on Heavy Metal and Low Molecular Weight Migration to, and Nutritive Value Loss from, Fresh-Cut Lettuces and Bottled Juices During Retail Distribution and Display

Abstract: Food packaging is considered an indirect food additive according to the Code of Federal Regulations; therefore, risk assessment requires an understanding of packaging-component toxicities and predicted levels of human exposure. Although the initial composition of the packaging may be known, the final composition can vary depending on physical and chemical degradation during the packaging's lifecycle prior to consumption of the product; this leads to recycling feedstocks with large variations in composition. Many state agencies and environmental advocacy groups encourage the use of recycled materials for packaging food products. Recent studies suggest a potential for migration of low-molecular weight compounds and heavy metals due to contamination from the recycling and recovery process. Studies also suggest the potential link of exposure to heavy metals and compounds to incidence of low birth weight, neurological disorders and autism spectrum disorder. To date, there is little state or federal oversight of the use of recycled materials for direct contact surfaces, and monitoring is done using antiquated methods. Recent studies also suggest an effect of display case lighting and packaging on nutritive loss from foods. Recycled plastics and bioplastics may decrease nutritive value loss due to their greater haze, opacity and overall filtering of light than traditional, clear virgin plastics. Changes in surface characteristics of recycled and bioplastics can have large impacts on the chemical migration, heavy metal contamination and microbial safety of these plastics. This research provides much needed insight into the impact of widespread adoption of new and sustainable food contact materials.

Goal: To define, track and educate packaging manufacturers, retailers and consumers on the overall safety, effects on nutritive value and cost of recycled and bioplastic food packaging materials when used in direct contact with food.

Objectives:
1. Evaluate levels of heavy metals and contaminates in recycled and bioplastics and potential human exposure and associated neurological disorders.
2. Evaluate the overall food safety of fresh-cut lettuces and bottled juice beverages utilizing packaging with post-consumer recycled diverted from the waste stream or bioplastic content
3. Evaluate the nutritive loss of fresh-cut lettuces and bottled juice beverages during distribution and retail display utilizing packaging containing various amounts of recycled, virgin and bioplastic content.
4. Evaluate food surface contact changes and biofilm attachment on recycled plastics and bioplastics.
5. Evaluate the consumer and manufacturer cost of packaging that contains various amounts of recycled, virgin and bioplastic content.

Approach: Recycled and bioplastics will be gathered from major national manufacturers or manufactured in a university lab and tested for the potential for migration per Title 21, Chapter 1, Subchapter B, Part 177 of the Code of Federal Regulations (CFR) and solvent reflux with characterization using Gas Chromatography-Mass Spectroscopy (GC-MS). Additionally, the plastics will be solubilized and tested for total heavy metal content (chromium, cadmium, nickel

and lead) using an inductively-couple plasma spectrophotometer. Changes in nutritive value will be correlated to the clarity and permeation characteristics of the plastics. Nutritive changes will be assessed as decreases in Vitamin C, β-carotene and chlorophyll during retail distribution and up to 12 days display at retail outlets. An economic analysis will be performed comparing the costs to both consumers and manufacturers of incorporating recycled plastic into packaging.

Expected Outcomes: Potential migrants, including the potential for heavy metals to move onto and into food, will be identified. The impact of display and ambient lighting, and the ability of recycled plastics or bioplastics to reduce the impact, will be elucidated. The true costs associated with recycling will be calculated.

Potential Impact: Packaged foods will be safer, more nutritious using recycled or bioplastic materials.

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