NOVEL ROASTED & FREEZE DRIED FOOD PRODUCTS DEVELOPED USING NON-GM SOYBEANS THAT CAN BE MARKETED AS SNACKS OR INCORPORATED INTO BREAKFAST CEREALS

Issue
There is abundance in production of soybeans which can be utilized in producing various food products that are either completely or mainly of soy ingredients. Recent trends in the health foods markets promote use of soy as snack foods that are good for a healthy diet for children and adults to help them regulate their appetite. Studies have shown that 20% of the daily calories consumed by young and adult Americans are from snacks. Soybeans have been shown to have several benefits due to the presence of complete protein, isoflavones and dietary fiber. There is a need to utilize the whole soybean seeds in preparing snack food products that can appeal to the American consumers.

Action
This research evaluated the quality of freeze-dried and roasted soybean products by testing their physical and -textural properties. Four non-genetically modified (non-GM) and two genetically modified (GM) varieties were compared in their physical characteristics such as color, texture (crispiness and hardness), water activity, and water absorption. The freeze-dried seeds showed significantly enhanced color and textural characteristics while maintaining crunchiness in the product along with low water activity. The roasted seeds had significantly better texture and low water activity when prepared at the optimal conditions and showed less browning. The large sized seeds showed significantly higher water absorption efficiency for both freeze dried and roasted products.

Impact
Freeze-dried/ roasted soybean snack foods are innovative and engage the whole soybean seeds in consumers’ diet. They can also be incorporated into breakfast cereals. The freeze-dried/roasted soybeans provide high quality protein, cholesterol-free low percentage of saturated fats, minerals, and vitamins. Soy snacks can serve vegans and vegetarians as a source of high quality vegetable protein. There are several health benefits from soy snacks due to the attributes including isoflavones as antioxidants, presence of vitamins and minerals, and dietary fiber. This study showed that freeze-drying maintains the visual appeal and textural qualities, while roasting provides additional flavors and color to the soybeans that would entice the consumers. This will be the first time that non-GM soybeans are being used for preparing novel food products that have potential for commercialization. The outcome of this study will result in the growth of tastier and healthier food products that are gluten, corn, dairy, egg free; non-GM; no trans-fat; no cholesterol; vegan; dietary fiber and protein snack products.

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RICE BRAN DERIVED PENTAPEPTIDE INDUCED APOPTOTIC PATHWAYS AND REDUCED CANCER PROLIFERATION IN BREAST CANCER CELL MODELS (MCF-7 AND MDA-MB-231)

Issue
Breast cancer is one of the leading causes of cancer related deaths in the United States. Preparation of small molecular therapeutics’ (like peptides) and mechanism of action in treating, preventing, and management of various diseases related to cancers have drawn the attention of science community. A pentapeptide derived from rice bran (sequence: EQRPR) from the previous study has shown anti-proliferative property on human breast cancer cells. There is no literature available on the mechanistic pathways of a pentapeptide-induced apoptosis in human breast cancer cell models that can pave way for developing specific food-based bioactives that can cause cancer cell apoptosis. Hence, molecular mechanism of the pentapeptide against breast cancer cells needs to be investigated.

Action
To investigate the molecular mechanism of the pentapeptide against breast cancer cells, the apoptotic pathways (Caspases 8 & 9) induced by the pentapeptide in breast cancer cell models (MCF-7 and MDA-MB-231) were evaluated. The levels of molecular targets (TNF-α, Bax, Bcl-2, Fas, and erbB-2 gene) were evaluated by ELISA kits to investigate the activation of caspase-induced apoptosis in pentapeptide treated human breast cancer cells. Pentapeptide induced activation of apoptosis by up regulation of Bax/Bcl-2 ratio leading to the release of cytochrome c in mitochondria-mediated pathway were studied. The assays were conducted to study the specific apoptotic pathways that are triggered by the pentapeptide which will elucidate its activity against breast cancer cells.

Impact
The pentapeptide derived from rice bran showed promising anti-proliferative activities against MCF-7 and MDA-MB-231 human breast cancer cell lines. Pentapeptide showed 80-85% cell proliferation inhibition on MCF-7 and MDA-MB-231 at a dosage of 1000μg/mL with a significantly high reduction (80%) of MCF-7 cells even at a low dosage (400μg/mL). Significant (p < 0.05) decrease in the levels of Bcl-2 and erbB-2 (gene expression) and increase in the levels of TNF-α and Bax were detected after pentapeptide treatment, leading to apoptosis. The results suggested that the rice bran pentapeptide prevents the proliferation of breast cancer cells by Caspase-dependent apoptosis pathways and modifications in cell physiology through gene-expression. Pentapeptide may potentially amplify apoptotic signals by down-regulating the expression of ErbB-2 gene. This finding can have significant impact in breast cancer therapy involving apoptosis as the physiological barrier in preventing metastasis of carcinogenic tissue. This study demonstrated an impending value for pentapeptide as an alternative and inexpensive anti-cancer therapeutic agent. There is a potential for advanced research in animal models and clinical trials using pentapeptide as an anti-cancer agent.

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EFFICACY OF ELECTROSTATIC SPRAYING WITH ORGANIC ACIDS IN THE DISINTEGRATION OF BIOFILM FORMED BY SALMONELLA TYPHIMURIUM AND E.COLI O157:H7 PATHOGENS IN SPINACH AND CANTALOUPE

Issue
Outbreaks from the consumption of fresh produce are a concern in the United States. The consumption of fresh produce has increased since the last 20 years because of the health trend of eating more fresh produce. Fresh produce is minimally heated or processed before consumption, which makes them a possible source of foodborne illness. The demand for preventing foodborne illness is on the increase not only from public health organizations point of view but also from an economical perspective since food recalls cause a substantial loss of money. Washing the produce is the most common protocol for disinfection in the food industry. But, pathogens like E.coli 157:H7 and Salmonella are able to survive washes by internalizing and forming a biofilm on the plant tissues. Research to disintegrate biofilms on fresh produce is scarce while some methods such as washing with chorine and irradiation have been proven ineffective. Effective multiple-hurdle technologies are needed to disintegrate biofilms and pathogen intervention.

Action
Disks from Spinach leaves and cantaloupe rinds were inoculated with E. coli O157:H7/ Salmonella Typhimurium by soaking for 24 h at 25 °C in a 24-plate that contained the culture. Disks were then washed to remove non-adherent bacteria and sprayed electrostatically with organic acids. Lactic acid and Malic acids at varying concentrations of 1.0%/2.0%/3.0/4.0 were used alone and in combination. Log reductions were determined to evaluate the best treatment that reduced the attached bacteria. Crystal violet assay and confocal microscopy were used to quantify bacterial attachment on spinach and cantaloupe. Organic acids were electrostatic sprayed to demonstrate biofilm disruption, studied using the crystal violet assay.

Impact
The significance of this research is the utilization of electrostatic spray system for delivery of inexpensive organic acids as antimicrobials. The malic and lactic acids used in this research have GRAS (generally recognized as safe) status. Electrostatic spray of natural antimicrobials diminished the bacterial number as well as disrupted the biofilms formed by major human food-borne pathogens on spinach and cantaloupe surfaces. The bacterial populations were reduced by 4.1 logs, while disruption of biofilm has significant impact in minimizing cross contaminations during packaging of spinach and cantaloupe. Furthermore, this multiple hurdle technology has demonstrated effective decontamination methods with high potential for adoption in the produce packaging industry. This will significantly promote acceptance of natural antimicrobials among consumers, while providing enhanced economic benefits to the food industry.

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**Issue**

Bioactive compounds have positive effects on human physiological health beyond their nutritional values. Proteins and peptides are important bioactive compounds which can impart several physiological functions in the body, such as anti-cancer activity. A pentapeptide derived from heat stabilized defatted rice bran (HDRB), with an amino acid sequence of Glu-Gln-Arg-Pro-Arg (EQRPR) demonstrated anti-cancer activity, but has the potential to degrade when incorporated in a food system. Fruit juices can be good vehicles to incorporate nutraceuticals and bioactive compounds; however, peptides/peptide fractions are likely to interact with other compounds in the juice matrix which affects their stability over longer storage period. To overcome this problem, the nano-encapsulation technique can be an effective method to protect the bioactive peptides/peptide fractions and prevent interactions with other components in the food matrix.

**Action**

Nanoparticles containing varying concentrations (200/400/600 μg/ml) of pentapeptide were prepared using poly(lactic-co-glycolic acid) (PLGA) to encapsulate the rice bran pentapeptide. The particle size was measured using a laser particle size analyzer. Apple juice containing pentapeptide nanoparticles was ultra-centrifuged to separate nanoparticles, and the supernatant was analyzed by high performance liquid chromatography (HPLC) to test the stability of pentapeptide. Physical properties of the apple juice were studied which included the evaluation of color, acidity (pH), and soluble solid (TSS) during storage. Microbiology tests were conducted to determine the effect of pasteurization (microbial inactivation) and growth during the storage period using the total plate count (TPC), and yeast and mold colony counts.

**Impact**

The utilization of PLGA nanoparticles in protecting and stabilizing the bioactive compounds (pentapeptide) during a three month shelf life at 4°C is a significant impact of this research. PLGA nanoparticles have proven biodegradability compatibility and approved by FDA. They are extensively used to deliver proteins and peptide while being degraded in vivo through enzymatic or non-enzymatic reactions, producing safe monomers. Nano-precipitation for preparing nano-encapsulated pentapeptide is simplified for fabrication of polymeric nanoparticles and can be potentially commercialized to maintain the stability and prevent degradation of bioactives in a food matrix during storage.

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