induces anti-proliferation, apoptosis by extrinsic pathway in MCF-7 human breast cancer cells. The treated cells with limonoids inhibited proliferation and enabled significant cell death. Incubation of cells with limonoids have shown elevation in the level of the Bax protein (bcl-2 associated X protein), increased caspase activity targeting of caspase-8, and poly (ADP-ribose) polymerase (PARP) cleavage but not caspase-9. These results indicate that bioactive limonoids implicated extrinsic pathway to induce of apoptosis in MCF-7 cells.

Specified Source(s) of Funding: Federal competitive Federal Program Name, Award Number: This project is funded by the FY07-Federal Initiative Designing Foods for Health through the Vegetable and Fruit Improvement Center, Grant No. TAES 06-118409.

(251) Cytotoxicity of Lyophilized Whole Pawpaw Extract and Phenolic Rich Fraction

Hideka Kobayashi*

Kentucky State University, Frankfort, KY; hideka.kobayashi@kysu.edu

Changzheng Wang

Kentucky State University, Frankfort, KY; changzheng.wang@kysu.edu

Kirk Pomper

Kentucky State University, Frankfort, KY; kirk.pomper@kysu.edu

Pawpaw fruit, rich in phenolic and antioxidant components, has been also identified as a major source of anticancer acetogenins. The objective of the study was to investigate the cytotoxicity of lyophilized pawpaw extract and phenolic rich fraction. Two extracts used in this study include the whole extract (W) and Fraction 5 (F5), previously identified as high in phenolic content and antioxidant capacity, and brine shrimp assay was used to assess toxicity of these extracts. Pawpaw pulp was extracted with 100% acetone twice, and then lyophilized. The whole extract was reconstituted with double distilled water (DDH_2O), followed by fractionation with solvents in the order of: DDH_2O, 50% methanol, 100% methanol, 100% acetone, and 50% acetone to acquire the fifth fraction, phenolic rich F5. Extracts in 50% acetone were dispensed in each vial, and dried in the oven at 40 °C. Twenty brine shrimp larvae, taken 48 hours after initiation of hatching in 3.8% artificial brine were added to each vial, and the final volume of each vial was adjusted to 5 mL with brine at the final extract concentrations of 0.1, 0.5, 1, 1.5 and 2 mg/mL. After 24 hours, surviving larvae were counted to acquire LC_{50}. A lower toxicity of lyophilized W was observed (LC_{50} = 0.058 mg/mL), compared to fresh W (LC_{50} = 0.027 mg/mL). Moreover, LC_{50} of F5 was not determined due to low toxicity and solubility in sea salt brine. The present findings suggest partial inactivation of acetogenins during lyophilization and absence of cytotoxic acetogenins in F5.

Specified Source(s) of Funding: Federal competitive 1890 Capacity Building Grant (2007-03427) Federal Program Name, Award Number: 1890 Capacity Building Grant (2007-03427)

(252) Physiological Functions of Bitter Melon Varieties (*Momordica charantia* L.) in Relation to Polyphenolic Contents

Shahidul Islam*

University of Arkansas. Pine Bluff. AR; islams@uapb.edu

M. Jalaluddin

University of Arkansas. Pine Bluff. AR; jalaluddinm@uapb.edu

N.S. Hettiarachchy

University of Arkansas. Fayetteville, AR; hettiarachchyn@uaf.edu

Bitter melon (*Momordica charantia* L.) is a vegetable with important nutritional and medicinal qualities. Four adaptable varieties of bitter melon were tested in replicated field trials for productivity and biochemical characteristics at the University of Arkansas at Pine Bluff. The total phenolic contents of the oven-dried and freeze-dried tissues and seeds ranged from 5.39–7.75, 6.72–8.02, 6.40–8.90, and 4.67–6.69, mg/g on dry weight basis. The total phenolic content of bitter melon from 'India Green' (IG), 'India White' (IW), 'China Green' (CG) and 'China White' (CW) varieties were 4.67–6.72, 6.03–8.02, 5.39–7.81, and 6.69–8.90 mg/g dry material, respectively. The main phenolic acids in bitter melon flesh were gallic acid, gentisic acid, catechin, chlorogenic acid, and epicatechin. Bitter melon seeds had the phenolic acids, gallic acid, catechin, and epicatechin. The antioxidant activities of methanolic extracts from the bitter melon varieties IG, IW, CG, and CW ranged from 79%–85%, 79%–83%, 80%–85%, and 79%–86% inhibition, respectively. The antioxidant activities of the seed ranged 79-84% inhibition. Methanolic extracts of freeze-dried flesh and seed from IW and CG showed very high antimutagenic effects against benzo(a)pyrene with *Salmonella* TA98 (92%–100% inhibition) TA100 (79%–86% inhibition), but lower antimutagenicity activities against sodium azide that ranged from 46%–54% and 17%–32% inhibition, respectively. Along with the potential chemo-preventative activities, the popular belief of bitter melon improving glucose tolerance in Type II diabetes and lowering blood cholesterol are being investigated. However, it has not been determined if or which alkaloids, polypeptides, or combination of the chemicals, found in bitter melon, are responsible for the beneficial medicinal effect.

Specified Source(s) of Funding: Department, College, State and/or HATCH

(253) Effects of Plant Growth Regulators on Essential Oil Production in *Mentha spicata* L. Shoots In Vitro

David Markle*

University of Wisconsin–River Falls, River Falls, WI; david.markle@uwrf.edu

Native spearmint (*Mentha spicata* L.) shoots were cultured in vitro on media containing 12 plant growth regulator combinations: three cytokinins; N6-benzyladenine (BA), kinetin (KT), or zeatin (ZT) at pre-optimized levels (1.0, 1.0. and 2.5 mg/L respectively), without or with three concentrations (20, 30, and 40 mg/L) of 6-(3,3dimethylallylamino) purine (2iP). All media contained MS basal salts with vitamins, 2% sucrose, 10% coconut water, 1.0 mg/L thiodiazuron (TDZ), 4.0 g/L Gellan Gum, and 2 mL/L Plant Preservative Mixture" (PPM). The experimental design was a $3 \times 4 \times 2$ factorial with two native spearmint clonal selections as the other variable. Two-node leafy explants were used. The plant responses evaluated were shoot multiplication rate, fresh weight, dry weight, and yield (v/w) of (-)-carvone, the most critical essential oil obtained from spearmint. Preliminary data shows that as the concentration of 2iP is increased by 20 $mg \cdot L^{-1}$ in the media, both fresh and dry weight of the *M. spicata* decreases by 1.0 g. The shoots were harvested, weighed, and the total dry weight tissue from each treatment was distilled using continuous water circulation distillation (CWCD). Identification of component essential oils and quantification were conducted using thin layer chromatography (TLC) and high performance liquid chromatography (HPLC). The project was conceived to test the biological feasibility of advancing the Wisconsin and United States mint oil industry through the use of controlled environment production. Results indicate that in vitro spearmint culture may rival field production since with appropriate plant growth regulator manipulation adequate (-)-carvone production is possible within a competitive time span. Labor intensiveness and laboratory costs may be competitive vs. costs of land, irrigation, pesticide usage, and/or losses to pathogens and weather. This technique also lends itself to a high level of automation and broader application in production of other essential oils.

Specified Source(s) of Funding: Department, College, State and/or HATCH

(254) Allelopathic Effect of Maca

Youping Sun*

University of Maine, Orono, ME; youping.sun@umit.maine.edu

Hua Cheng

Wuhan Tobacco Group Co. Ltd, Wuhan HB, China; hbchh2008@163.com

Longjiang Yu

Huazhong University of Science and Technology, Wuhan, China; yulongjiang@hust.edu.cn

Donglin Zhang

University of Maine, Orono, ME; oleifera@163.com

Maca (*Lepidium meyenii* Walp.) is an important medicinal herb and root vegetable, which is native to the high Andes of Bolivia and Peru. Seed germination is generally inhibited when it is planted after a production cycle of maca. This may be attributed to the possible maca allelopathic property. Maca foliage residue was incubated in hot water and then placed in room temperature for 24 hours. The solution was used to screen for its effect on seed germination of common chicory (*Cichorium intybus* L.) and perennial ryegrass (*Lolium perenne* Lam.). Compared with control (distilled water), maca foliage extracts significantly inhibited seed germination common chicory and perennial ryegrass. The seed germination rate was reduced by 66.7% for common chicory and 70.2% for perennial ryegrass. A concentration of 0.8g FW·mL^{-1} or more completely inhibited its seed germination. As the concentration of maca foliage extracts increased from 0.2 and 0.6 g FW·mL^{-1}, seedling growth of common chicory reduced linearly. Shoot and root length after 14 days of treatment decreased by 58.7% and 40.7%, respectively. For perennial ryegrass, a significant, negative linear correlation between the concentration of maca foliage extracts (0.2 to 1.0 g FW·mL^{-1}) and its shoot and root growth had also been observed. Their shoot and root length decreased by 79.3% and 97.8%, respectively. Allelopathy of maca could play an important inhibitory role in the seed germination and seedlings growth of some crops in the field right after maca was harvested. Donglin Zhang is also a guest professor at the Central South University of Forestry and Technology.

Specified Source(s) of Funding: Private (Association, Foundation, Industry) Department, College, State and/or HATCH

(255) Effect of Functional Organic Materials and Shading Structure on Root Yield and Ginsenoside Content in Korean Ginseng (*Panax ginseng* C.A. Meyer)

Chung Yeol Lee*

Pusan National Univ., Miryang, Korea; cylee@pusan.ac.kr

Hyun Ho Kim

Chungnam RES, Ginseng & Medicinal Crop Inst., Geumsan-gun Chungnam, Korea; ginlab@naver.com

Dong Joo Oh

Pusan National Univ., Miryang, Korea; dj-1228@nate.com

Son Hong Joo

Pusan National Univ., Miryang, Korea; shjoo@pusan.ac.kr

Jun Yeon Won

JoongBu Univ., Geumsan, Korea; jywon@joongbu.ac.kr

This study was conducted to investigate the optimal shading structure and functional organic materials in *Panax ginseng* C.A. Meyer. Functional organic materials (T1, T2, T3) used in this experiment were selected because they are better and more favorable compost than other organic fertilizers. T1 was humic acid (pH 5.1), which was made from organic materials (54%) and nitrogen (7.5%). The contents of T2 were green grass (40%), rice hulls expanded by heat (20%), and sawdust (20%). Content of T3 was yeast-incorporated solid microbial fertilizer, consisting of organic materials (80%), cottonseed meal, and sugar cane. Results showed that root fresh weight in ginseng grown under rain shelter was increased to about 3.0, 3.6, and 3.1 g in 3-, 4-, and 5-year-old plants, respectively. From investigating root grade of 3-, 4-, and 5-year-old ginseng, we confirmed that rain shelter was more effective than other shade materials. Root size of 3-, 4-, and 5-year-old ginseng grown under rain shelter was distributed in larger sizes than those grown under polyethylene net. Also, in the case of ginsenoside contents, the ginseng grown under shade material of rain shelter was higher than that under polyethylene net. The best compost in the conditions investigated was the functional organic materials. Fresh weight of root under the natural substance and microbial auxetic was more significant with a higher increase than in the control group. Top growth of 4-year-old-ginseng by using T1, T2, and T3 was higher than the control. It is expected that the root treated functional organic materials rather than the control would have a larger increase in total ginsenosides content. By the content of each treatment in plant, T3 was the highest in total ginsenosides content Especially, the content of Rb1, Rd and Rg1+Re in ginsenosides was higher than others. The ratio of PD and PT was increased with kinds of organic material. In addition, PD showed more considerable increase than PT. GPI ratio of treated groups are also higher than that of the control.

Specified Source(s) of Funding: Department, College, State and/or HATCH -Federal competitive Federal Program Name, Award Number: SCA 58-3607-1-118, Agricultural Research Service, USDA

(256) Human Hair as a Nutrient Source for Horticultural Crops

Valtcho Zheljazkov*

Mississippi State University, North Mississippi Res. & Ext Center Verona MS; vj40@pss.msstate.edu

Juan Silva

Mississippi State University, Mississippi State, MS; jls@ra.msstate.edu

Taejo Kim

Mississippi State University, Mississippi State, MS; tjk2@ra.msstate.edu

Thomas Horgan

Mississippi State, North Mississippi Res. & Ext. Center, Verona, MS; teh5@ra.msstate.edu

Two pot experiments were conducted to evaluate noncomposted hair by-product as a nutrient source for container-grown crops. Lettuce (*Lactuca sativa* L. 'Green leaves') and wormwood (*Artemisia annua* L. 'Artemis') were grown in a commercial growth substrate amended with 0%, 2.5%, 5%, or 10% by weight hair waste or controlled release fertilizer (CRF) or were fertigated with a complete water-soluble fertilizer (WSF). After harvest, yellow poppy (*Glaucium flavum* Grantz.) was grown in the pots and substrate that previously grew wormwood; and feverfew (*Tanacetum parthenium* L.) was grown in the pots and substrate previously containing lettuce. The 5% hair treatment and the commercial fertilizer rates were calculated to provide the same amount of N during production of lettuce and wormwood based on 50% N availability from hair. Yields in treatments containing hair or CRF or fertigated with WSF were higher than in the untreated control. The highest lettuce and wormwood yields occurred with CRF followed by WSF and 5% and 10% hair treatments. However, yield of yellow poppy was higher in the hair treatments relative to yields in inorganic fertilizer treatments or in the untreated control. Feverfew yields did not differ among fertility treatments but yields in fertility treatments were higher than those of control. Lettuce leaf moisture content was lower while soluble solids were higher in plants in the hair-waste treatments than in the WSF or CRF treatments. Total phenolics in lettuce did not differ among treatments. Total aerobic and coliforms plate counts were similar for all samples, averaging 6.0 and 1.2 log CFU/g, respectively. Results from this study suggest that noncomposted hair waste could be used as a nutrient source for container-grown plants. Hair waste should not be used as a single nutrient source for fast-growing plants because of the time needed for degradation of the hair prior to release of plant nutrients.

Specified Source(s) of Funding: Department, College, State and/or HATCH -Federal competitive USDA-ARS Specific Coop. Agreement 58-6402-4-026 with CRIS MIS-223010. Specific project: Field Establishment of Medicinal Herbs and Potential for Commercial Production"