

2018 AOCS Annual Meeting & Expo

May 6–9 | Minneapolis Convention Center | Minneapolis, Minnesota, USA



Edible Applications Technology (EAT) Interest Area Tentative Technical Program

As of March 12, 2018

This presentation list is not final and is subject to change.

The presenter is the first author, or the author indicated with an asterisk ().*

Monday Afternoon

EAT 1: Phase Transition in Edible Applications (A Session Dedicated to David Pink)

Chairs: Gianfranco Mazzanti, Dalhousie University, Canada; and David Pink, St. Francis Xavier University, Canada

An Alternative to the Avrami Model in Fat Crystallization: A Chemical Potential Approach (CPA). Alejandro G. Marangoni, *University of Guelph, Canada*

Phase Transitions in Edible Fats and Oils. David A. Pink, *St. Francis Xavier University, Canada*

Effect of Acoustic Power Level on Cavitation Events in Oil. Silvana Martini¹, Peter Birkin², P. Martin², Jack Youngs², Tadd Truscott³, and Andrew Merritt³, ¹*Utah State University, USA*; ²*University of Southampton, United Kingdom*; ³*Utah State University, USA*

The Role of Mechanical Processing on Water Droplet Distribution in the Manufacture of Margarine. Steven Robbins, *Richardson International, Canada*

Influence of Droplet Size on Salt and pH-induced Attractive Gelation in Food-Protein Stabilized Nanoemulsions. Aakash Patel, Natalie Longmore, and Supratim Ghosh*, *University of Saskatchewan, Canada*

Impact of Margarine and Shortening on Puff Pastry Attributes. Rachel E. Mertz, Dilip Nakhasi, and Roger Daniels, *Stratas Foods, USA*

Evaluation of Stabilizer Type on Peanut Butter Physical Attributes. Don Gifford, Rachel E. Mertz, Dilip Nakhasi, and Roger Daniels, *Stratas Foods, USA*

Can Humans Detect if a Chocolate is in the α or β_v Form? Fernanda Peyronel, *Dept. of Food Science, University of Guelph, Canada*

Tuesday Morning

EAT 2: Confectionery Fats

Chairs: Farnaz Maleky, Ohio State University, USA; and Linsen Liu, IOI Loders Croklann, USA

Fat Bloom and Anti-bloom in Confectionery Application. Linsen Li and Guang (Gil) Wang*, *Loders Croklaan, USA*

Studies on the Effect of Thermal Pre-treatment on the Isothermal Crystallisation of Cocoa Butter. Marjorie Ladd Parada¹, Josélio Vieira², Peng Siong Chong², Michael Rappolt¹, and Malcolm J.W. Povey¹, ¹University of Leeds, UK; ²Nestlé Product Technology Centre, UK

Functional Properties of Fats and Emulsifiers in Candy Application. Linsen Liu, Guang (Gil) Wang, and Aliess Bedford*, *Loders Croklaan, USA*

Shea-based Shortenings. How to Overcome the Post-hardening Effect. Krish Bhaggan, Raul F. Petrut*, and Jun Ma, *IOI Loders Croklaan, The Netherlands*

Confectionary Coating and Filling Fat: A Review. Linsen Liu and Guang (Gil) Wang*, *Loders Croklaan, USA*

The Solubilization-Recrystallization-Diffusion Model to Quantify Oil Migration Kinetics in Cocoa Butter. Alejandro G. Marangoni, *University of Guelph, Canada*

Synthesis of Cocoa Butter Equivalent by Enzymatic Interesterification of Illipe Butter and Palm Mid-fraction. Adiguna Bahari and Casimir C. Akoh, *University of Georgia, USA*

Polymorphic Transition and Bloom in Cocoa Powder. Paige Palmieri and Richard W. Hartel, *University of Wisconsin-Madison, USA*

The Art and Science of Ganache. Jade McGill¹ and Richard W. Hartel*², ¹Nassau Candy, USA; ²University of Wisconsin-Madison, USA

EAT 2.1: Delivery and Dispersed Systems

Chairs: Dérick Rousseau, Ryerson University, Canada; and Christopher Gregson, Ingredient, USA

Modelling the Effect of Confectioner's Sugar on Processing Interactions in Palm Oils. Ryan West and Dérick Rousseau, *Ryerson University, Canada*

Flavor Partitioning into Short-chain Phospholipids: Effects of Self-assembled Structure. Andrew P. Karman, Stephanie R. Dungan, Susan E. Ebeler, and Nitin Nitin, *University of California, Davis, USA*

Thermal Analysis of Cough Drops Using Microstructure Evolution Analysis. Matt Vanden Eynden¹, Roland Ramsch², Giovanni Brambilla², Pascal Bru², and Gerard Meunier², ¹Formulaction, Inc., USA; ²Formulaction, France

Milk Fat Globules, A Novel Carrier for Delivery of Vitamin D₃. Maha Alshehab¹, Mariza Gomes Reis², Li Day², and Nitin Nitin¹, ¹University of California, Davis, USA; ²AgResearch, Grasslands Research Centre, New Zealand

Enhanced Antimicrobial and Mycotoxin Inhibitory Activity of Clove Oil in Water Nanoemulsion. Jiajia Rao and Jing Wan*, *North Dakota State University, USA*

Emulsified Lipid Crystallinity Affects Early *in vitro* Lipolysis and beta-carotene Bioaccessibility. Samantha M. Hart, Xinjie Lin*, Surangi K.P.H. Thilakarathna, and Amanda Wright, *University of Guelph, Canada*

Spray Drying Flavor Encapsulation Process at 25-100°C. Charles Beetz, Daniel M. Schlipf, and Jason Z. Li, *ZoomEssence, USA*

Encapsulation of Lactase (β -galactosidase) into Novel Hydrogel Beads for the Effective Treatment of Lactose Intolerance. Zipei Zhang, Ruojie Zhang, and D. Julian McClements, *University of Massachusetts Amherst, USA*

Effect of Water Addition on Physical Properties of Emulsion Gels. Thais L.T. da Silva¹, Daniel B. Arellano¹, and Silvana Martini², ¹University of Campinas, Brazil; ²Utah State University, USA

Insect Lipids as Food Ingredients: Oil Extraction, Characterization and Perspectives as Food Ingredient. Daylan A. Tzompa-Sosa¹, Liya Yi², Hein H.J van Valenberg², Martinus A.J.S. van Boekel², and Catriona M.M. Lakemond², ¹Ghent University, Belgium; ²Wageningen University, The Netherlands

Tuesday Afternoon

EAT 3: Nano-, Micro- and Macrostructure

Chairs: Silvana Martini, Utah State University, USA; and Alejandro Marangoni, University of Guelph, Canada

Determination of Phase Transition Temperatures of Micro Crystals from Sequential Microscopic Images.

Hironori Hondoh¹, Mio Aoki², Seiya Takeguchi³, and Satoru Ueno¹, ¹Graduate School of Biosphere Science, Hiroshima University, Japan; ²Hiroshima University, Japan; ³The Nisshin OilliO Group, Ltd./Hiroshima University, Japan

Addition of Phytosterol Esters to Palm Oil Influences its 'Equilibrium' and Isothermal Crystallization Behavior.

Eva Daels, Bart Goderis, and Imogen Foubert, *Katholieke Universiteit Leuven, Belgium*

Tailoring Promotion or Retardation of Nucleation Kinetics of Fats with Emulsifiers. Katsuyoshi Saitou¹, Ken Taguchi², Rika Homma¹, Masao Shimizu¹, Koichi Yasunaga¹, Yoshihisa Katsuragi¹, Satoru Ueno³, and Kiyotaka Sato^{*4}, ¹Kao Corporation, Japan; ²Graduate School of Integrated Arts and Sciences, Hiroshima University, Japan; ³Graduate School of Biosphere Science, Hiroshima University, Japan; ⁴Hiroshima University, Japan

The Coalescence Behavior of Fat Globules in the Presence of Protein, mono/diglycerides and Polysorbate 80.

Abbey E. Thiel and Richard W. Hartel, *University of Wisconsin-Madison, USA*

Adsorption Mechanisms for Hydrophobic Food Surfactants at an Oil-Water Interface.

Jennifer A. Staton and Stephanie R. Dungan, *University of California, Davis, USA*

Stability Studies of Pickering Emulsions Based on Different Types of Oils and its Application in Chocolate.

Cunhong Chen¹, Yanchao Liu², Hong Zhang³, Yanlan Bi², Qi Shen¹, Zhenbo Xu¹, and Xuebing Xu⁴, ¹Wilmar (Shanghai) Biotechnology Research & Development Center Co., Ltd, China; ²Henan University of Technology, China; ³Wilmar (Shanghai) Biotechnology Research & Development Center Co., Ltd, Denmark; ⁴Wilmar Global Research and Development Center, China

Particulate Effects in Chocolate on Fat Bloom during Storage. Jiayang Jin and Richard W. Hartel, *University of Wisconsin-Madison, USA*

Examining Aerated Peanut Butter Systems Containing Lactic Acid Esters of Monoglycerides Compared to Traditional Samples. Kaustuv Bhattacharya, Niall Young, and Henrik Kragh, *DuPont Nutrition & Biosciences ApS, Denmark*

EAT 3.1a / LOQ 3b: Manufacture and Stabilization of W/O and O/W Emulsions for Optimal Shelf-life

Chairs: Tanu Tokle, Qualitech, USA; Ann-Dorit Moltke Sørensen, Technical University of Denmark, Denmark; and Chandra Ankolekar, Kemin Industries Inc., USA

Stability and Functionality of Colloidosomes as Delivery Systems for Small Molecules. Umut Yucel, *Kansas State University, USA*

Tocopherol Regeneration by Phospholipids in Soybean Oil-in-Water Emulsion: Effect of Tocopherol Homologue and Emulsifier Type. Gautam Samdani, D. Julian McClements, and Eric A. Decker, *University of Massachusetts Amherst, USA*

Effect of Droplet Size and Interfacial Crystallization on the Rheology of Fat Crystal-stabilized Water-in-Oil Emulsions. D errick Rousseau and Ruby R. Rafanan, *Ryerson University, Canada*

Label Friendly EDTA Alternative for Oxidative Stability Improvement in Food Emulsions. Lan Ban, Yvonne Gildemaster, and Joan Randall, *Kemin Food Technologies, USA*

EAT 3.2 / H&N 3.1: Influence of Fat Composition on Metabolic Status

Chairs: Amanda Wright, University of Guelph, Canada; and Marie-Caroline Michalski, INRA, France

Introducing the Importance of Molecular and Supramolecular Lipid Structures on Metabolism and Beyond. Marie-Caroline Michalski, *INRA, France*

Is the Food Matrix an Important Factor for Lipid Bioaccessibility and their Subsequent Metabolism? Sylvie Turgeon, INAF, Laval University, Canada

Citric Acid Esters-stabilized Emulsions During *in vitro* Digestion: Effect of the Physical State of Emulsifier. Qing Guo, Nick Bellissimo, and D errick Rousseau, *Ryerson University, Canada*

Impact of Emulsion Droplet Physical State on *in vitro* Lipid Digestion. Surangi K.P.H. Thilakarathna and Amanda Wright, *University of Guelph, Canada*

Monounsaturated Fats and Stearic Acid: Summary of Impact on Human Cardiometabolic Outcomes. Dariush Mozaffarian*, *Friedman School of Nutrition & Health Policy, Tufts University, USA*

***In vitro* and *in vivo* Evidence of Dietary trans-vaccenic Acid Retroconversion to trans-palmitoleic Acid.** Etienne Guillocheau, Garcia Cyrielle, L eo Richard, Daniel Catheline, Philippe Legrand, and Vincent Rioux, *Agrocampus-Ouest, France*

Wednesday Morning

EAT 4: Lipid Gels: Application and Functionality in Edible Products

Chairs: Michael Rogers, University of Guelph, Canada; and Serpil Metin, Cargill R&D, USA

Oil Gel: Its Historic Development and Technical Hurdles to Overcome for Future Commercialization. Linsen Liu, *IOI Loders Croklann, USA*

Peptide-based low molecular weight organogelators (LMOGs): structural influence of side chain, chain length and D/L configuration on gelation behavior. Yaqi Lan and Yong Cao, *South China Agricultural University, China*

Physical Properties, Microstructure and Intermolecular forces of Soybean Oil Oleogels Structured by Different Polysaccharides. Zong Meng¹, Keyu Qi², and Yuanfa Liu³, ¹*School of Food Science and Technology, Jiangnan University, China*; ²*School of Food Science and Technology, State Key Laboratory of Food Science and Technology, Jiangnan University, China*; ³*School of Food Science and Technology, State Key Laboratory of Food Science and Technology, Jiangnan University, China*

Natural Saponin-based Emulsion Templates for Edible Oil Structuring. Xiaquan Yang, *South China University of Technology, China*

Photoprotective Mechanism of Supramolecular Oleogels on Retinyl Palmitate. Yixing Tian and Nuria C. Acevedo*, *Iowa State University, USA*

Interaction between Different Lipid Structuring Agents in Organogels. Thais L.T. da Silva¹, Silvana Martini², and Daniel B. Arellano¹, ¹*University of Campinas, Brazil*; ²*Utah State University, USA*

Engineering Mechanical Properties of Edible Oleogels Based on Ethylcellulose and Lecithin. Mayra Aguilar-Zarate¹, Jorge F. Toro-Vazquez¹, and Alejandro G. Marangoni², ¹*Universidad Autónoma de San Luis Potosí, Mexico*; ²*University of Guelph, Canada*

Crystallization Behavior of Low Saturated, Non-hydrogenated Fat Systems Structured with Different Oleogels - Monoglycerides, Vegetable Wax and its combinations. Fernanda Davoli¹, Serpil Metin², and Paul Smith³, ¹*Cargill, USA*; ²*Cargill R&D, USA*; ³*Cargill Global Foods Research, Belgium*

Whey Protein and Vegetable Oil Interactions within Oleocolloid Matrices. Clifford Park, Rafael Jimenez-Flores, and Farnaz Maleky, *Ohio State University, USA*

Influence of Polar Compounds and Fatty Acid Composition on the Formation of Organogels. Eckhard Flöter, Maria Scharfe, and Yassin Ahmane *Technical University of Berlin, Germany*

EAT 4.1 / LOQ 4b: Food Structuring to Reduce Lipid Oxidation

Chairs: Hong-Sik Hwang, USDA, ARS, NCAUR, USA; Alex Kripps, Caldic USA, USA; and Yaqi Lan, South China Agriculture University, China

Formation of Free-flowing Fish Oil-loaded Hollow Solid Lipid Micro- and Nanospheres Using Carbon Dioxide. Junsi Yang and Ozan N. Ciftci*, *University of Nebraska-Lincoln, USA*

Natural Wax Oleogels-A Method to Prevent Oxidation of Fish Oil. Hong-Sik Hwang¹, Matthew Phaner², Jill Moser¹, and Sean Liu³, ¹*USDA, ARS, NCAUR, USA*; ²*University of Michigan-Flint, USA*; ³*USDA, ARS, USA*

Self-assembled Colloidal Complexes of Polyphenol–gelatin and their Stabilizing Effects on Emulsions. Chaoying Qiu, Yu Huang¹, Zhen Zhang², Ying Li³, and Yong Wang¹, ¹*Jinan University, China*; ²*South China University of Technology, China*; ³*Guangdong Saskatchewan Oilseed Joint Laboratory, Dept. of Food Science and Engineering, Jinan University, China*

Ability of SDS Micelles to Increase the Antioxidant Activity of α -tocopherol. Raffaella Inchingolo¹, Sezer S. Kiralan¹, Sibel Uluata¹, MariaTeresa Rodriguez Estrada², D. Julian McClements³, and Eric A. Decker⁴, ¹*University of Massachusetts, USA*; ²*University of Bologna, Italy*; ³*University of Massachusetts, Amherst, USA*; ⁴*University of Massachusetts Amherst, USA*

Impact of Reduced Oxygen Environment and Natural Antioxidants on the Oxidative Stability of Oil-in-Water Emulsions. Eric A. Decker¹, and David R. Johnson^{*2}, ¹*University of Massachusetts Amherst, USA*; ²*Kalsec Inc., USA*

Wednesday Afternoon

EAT 5 / IOP 5: Waxes and Phase Change Materials

Chairs: Nuria Acevedo, Iowa State University, USA; and Chelsey Castrodale, Clasen Quality Chocolate, USA

Multiple β Forms of Tripalmitin in Different Crystallization Pathway. Seiya Takeguchi¹, Hironori Hondoh², Hidetaka Uehara³, and Satoru Ueno², ¹The Nisshin OilliO Group, Ltd./Hiroshima University, Japan; ²Graduate School of Biosphere Science, Hiroshima University, Japan; ³The Nisshin OilliO Group, Ltd., Japan

The Effect of Processing on Hybrid Shortenings Containing Diacylglycerols. Iris Tavernier¹, Tom Rimaux², Koen Dewettinck³, and Ian T. Norton⁴, ¹Ghent University, Belgium; ²Vandemoortele R&D Centre, Belgium; ³University of Gent, Belgium; ⁴Chemical Engineering, University of Birmingham, United Kingdom

Engineering Lipid Properties Through Glycerolysis. Reed A. Nicholson and Alejandro G. Marangoni, University of Guelph, Canada

Developing Vegetable Oil Based Wax Coating Alternatives. Tong Wang and Tao Fei, Iowa State University, USA

An Emerging Natural Wax: Sorghum Wax from Bioethanol Production. Jeffrey T. Cafmeyer, Battelle, USA

Role of Rice Bran Wax on Crystallization and Rheological Properties of Oleogels from Rice Bran Oil. Khakhanang Wijarnprecha¹, Pravit Santiwattana², Sopark Sonwai³, and Dérick Rousseau⁴, ¹Department of Food Technology, Silpakorn University, Thailand; ²Thai Edible Oil Co., Ltd., Thailand; ³Silpakorn University, Thailand; ⁴Ryerson University, Canada

Phase Change Analysis of Waxes and Wax Blends by Thermal Microstructure Evolution Analysis. Matt Vanden Eynden¹, Roland Ramsch², Giovanni Brambilla², Pascal Bru², and Gerard Meunier², ¹Formulaction, Inc., USA; ²Formulaction, France

EAT 5.1 / S&D 5.1: Complex Phenomena at Interfaces

Chairs: Sam Adamy, Church & Dwight Co. Inc., USA; and Ozan Ciftci, University of Nebraska-Lincoln, USA

Complex Interfaces: Role in Foam and Emulsion Behavior of Rinse-off Cosmetics. Edward DiAntonio¹, Hani Fares¹, Martin S. Vethamuthu^{*1}, and Seher Ozkan², ¹Ashland Specialty Ingredients G.P., USA; ²Ashland Specialty Ingredients, USA

Effect of Emulsifiers on the Interfacial Tension of Fat-reduced W/O Emulsions Added with a High Behenic Stabilizer. Marisol Cordoba-Barragan¹, Jaime D. Pérez-Martínez¹, and Elena Dibildox Alvarado², ¹Lab. Biopolímeros Alimentarios, Facultad de Ciencias Químicas, Universidad Autónoma de San Luis Potosí, Mexico; ²Universidad Autónoma de San Luis Potosí, Mexico

Interaction and Synergism in Surfactant/Water Soluble Polymer Solutions in Boosting Foaming Performance in Home, Personal Care Formulations. Manilal Dahanayake¹ and Milton J. Rosen², ¹Surfactant Solution Experts LLC, USA; ²Surfactant Research Institute, USA

Preparation of Novel Food Emulsifier using Amino Acids and Partial Glycerides. Mahua Ghosh and Sriparna Chakraborty, University of Calcutta, India

Surfactant Effects on Fat Crystallization at the Oil-water Interface. Nicole Green¹, Stephen R. Euston², and Dérick Rousseau¹, ¹Ryerson University, Canada; ²Heriot-Watt University, United Kingdom

Characterizing Adsorption Kinetics and Wetting Behavior of Polyelectrolyte Complexes (PECs). Claire Dentinger and David Scheuing, Clorox, USA

Physical Modification of Faba Bean Proteins Significantly Improves Interfacial and Emulsifying Properties of O/W Emulsions. Yan Ran Tang, and Supratim Ghosh*, *University of Saskatchewan, Canada*

Crystal-melt Interfacial Energy Effects on the Surface Nucleation of Triglycerides. Alejandro G. Marangoni, *University of Guelph, Canada*

EAT-P: Edible Applications Technology Poster Session

Chair: Supratim Ghosh, University of Saskatchewan, Canada

Posters will be available for viewing from noon on Monday, May 7 through 2:00 p.m. Wednesday, May 9, 2018.

Influence of Dairy Emulsifier Type and Droplet Size on Gastrointestinal Fate of Corn Oil Emulsion: In vitro Digestion. Li Liang¹, Xingguo Wang², Qingzhe Jin², and D. Julian McClements³, ¹*State Key Laboratory of Food Science and Technology, School of Food Science and Technology, Jiangnan University, China;* ²*Jiangnan University, China;* ³*University of Massachusetts Amherst, USA*

X-ray Study on Melt Crystallization Kinetics of Triacylglyceride Molecular Compound System. Ken Taguchi¹, Ryuichi Ikoma², Akihiko Toda², Hironori Hondoh³, Satoru Ueno³, and Kiyotaka Sato², ¹*Graduate School of Integrated Arts and Sciences, Hiroshima University, Japan;* ²*Hiroshima University, Japan;* ³*Graduate School of Biosphere Science, Hiroshima University, Japan*

Cocoa Butter Substitute Produced by Enzymatic Inter-esterification of Binary Blends Containing Irvingia gabonensis Seed Fat. Sabine Danthine¹, Juste Yamoneka Wasso¹, Paul Malumba¹, Georges Lognay², and Christophe Blecker², ¹*University of Liège, Belgium;* ²*University of Liège, Belize*

Electrostatic Deposition of Chitosan on Lecithin Stabilized Emulsion Inhibits Mycotoxin Production in *Fusarium graminearum*. Dianhui Wu¹, Jiajia Rao¹, and Jian Lu², ¹*North Dakota State University, USA;* ²*School of Biotechnology, Jiangnan University, China*

Extraction of Carotenoids and Antioxidant Compounds from Guava Processing Waste. Renan S. Lima¹, Itaciara L. Nunes, Sandra Regina S. Ferreira², and Jane Mara Block*³, ¹*Federal University of Santa Catarina, Brazil;* ²*Federal University of Santa Catarina;* ³*UFSC, Brazil*

Filler-matrix Interactions to Control Texture of Oil-continuous Systems. Auke de Vries and Dérick Rousseau, *Ryerson University, Canada*

Structural and Mechanical Properties of Palm Oil in the Presence of Air and Sugar. Dérick Rousseau and Hardeep Devgan*, *Ryerson University, Canada*

Fat-sugar Interactions Measured by Force Spectroscopy. Dérick Rousseau, and Nicole Green*, *Ryerson University, Canada*

Profile of Volatile Compounds of Dark Chocolate Formulated with Cocoa Butter Equivalent. Cristiano S. Souza¹, and Jane Mara Block*², ¹*UFSC, Brazil;* ²*UFSC, Brazil*

Tailoring Crystalline Structure using High Intensity Ultrasound to Reduce Oil Migration. Silvana Martini¹, Zachary Cooper¹, Juhee Lee¹, and Véronique Gibon², ¹*Utah State University, USA;* ²*Desmet Ballestra Group, Belgium*

Sonocrystallization of a Tristearin-free Fat. Jeta V. Kadamne¹, Maria A. Moore², Casimir C. Akoh², and Silvana Martini*¹, ¹*Utah State University, USA*; ²*University of Georgia, USA*

Lipid Composition and Antioxidant Property of Sea Buckthorn Oils Extracted by Supercritical and Subcritical Technologies. Li Zheng¹, Longkai Shi¹, Zhao Chenwei², Qingzhe Jin¹, and Xingguo Wang¹, ¹*Jiangnan University, China*; ²*State Key Laboratory of Food Science and Technology, School of Food Science and Technology, Jiangnan University, China*

Chemical Characterization and Antioxidant Capacity of Sesame Oils Extracted by Supercritical, Subcritical and Conventional Techniques. Longkai Shi, Li Zheng, Ruijie Liu, Ming Chang, Qingzhe Jin, and Xingguo Wang, *Jiangnan University, China*

Control of Protein Digestion under Simulated Gastrointestinal Conditions using Biopolymer Microgels. Ruojie Zhang, Zipei Zhang, and D. Julian McClements, *University of Massachusetts Amherst, USA*

Physicochemical, Functional and Sensory Properties of Margarine Supplemented with Bush Mango Kernel and Njangsa Seed Oils. Anh T.L Nguyen¹, Peace C. Asuzu², Benjamain M. Bougouneau³, Samuel A. Besong⁴, and Alberta N.A. Aryee*¹, ¹*Delaware State University, USA*; ²*College of Agriculture & Related Sciences, Delaware State University, USA*; ³*Dept. of Human Ecology, Delaware State University, USA*; ⁴*Dept. of Human Ecology, College of Agricultural Sciences, Delaware State University, USA*