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Research Kernels

Our Latest Research Results - April 2012

Rheology, Microstructure and Baking Characteristics of Frozen Dough Containing *Rhizopus chinensis* Lipase and Transglutaminase

Authors: Z. Li, W. Huang, J.G. Liu, M. Tilley, O.K. Chung
Submitted to: Cereal Chemistry
The frozen dough market has grown in recent years due to consumer demand for convenient, high-quality baked products. Frozen dough is thawed, proofed, and baked to serve to customers as oven-fresh bread and offers a number of advantages compared to the conventional method. However, a major shortcoming of frozen dough is that its bread-making quality deteriorates substantially as time in frozen storage increases. Additives such as enzymes are used in bakeries to facilitate processing, to compensate for variations in raw materials, to guarantee constant quality, to preserve freshness and food properties and to modify dough behavior during freezing. Transglutaminase (TG) catalyzes protein cross-linking may improve dough elasticity and crumb strength. Lipase generates glycerol that has been shown to increase freeze tolerance of yeast cells. Lipase made via conventional methods has been associated with very high production costs that it made it impractical to implement into the mainstream baking industry. Lipase from *Rhizopus chinensis* (RCL) could reduce production costs and make the use of lipase a possibility for the baking industry. The objectives of this study were to investigate the abilities of RCL and TG to improve frozen dough systems. Frozen storage had a negative effect on the viscoelastic properties of the doughs however TG increased the viscoelasticity of dough by protein cross-linking resulting in stronger and more resilient gluten than the control dough after 35 days of frozen storage. RCL and TG improved the water-holding capacity of dough during frozen storage thereby decreasing the amount of freezable water. RCL and TG could significantly increase available glycerol content of dough and sustain a high glycerol content after 35 days of freezing when followed by proofing. Bread from RCL and TG had a more open network and uniform crumb structure, which resulted in bigger specific volume. Sensory evaluation found that this combination also yielded a product with higher sensory scores for test breads.
Contact Michael Tilley, telephone 785-776-2759, email Michael.Tilley@ars.usda.gov

Residual Efficacy of Methoprene for Control of *Tribolium castaneum* (Coleoptera: Tenebrionidae) Larvae at Different Temperatures on Varnished Wood, Concrete, and Wheat

Authors: L.K.W. Wijayaratne, P.G. Fields, F.H. Arthur
Submitted to: Journal of Economic Entomology
The insecticide methoprene is an insect growth regulator that affects molting and development of immature insects. It has been evaluated as an aerosol insecticide but it has not been sufficiently examined as a residual surface treatment. We conducted studies by spraying concrete and wood surfaces with methoprene and holding these surfaces at different temperatures, with or without flour, for up to 24 weeks. We then added flour to the bare surfaces or removed the aged flour and added new flour, and then added larvae of the red flour beetle to determine adult emergence.Methoprene applied to wood gave excellent residual control of the red flour beetle, but, on concrete, residual control declined with time and the presence of flour on concrete during aging reduced the effectiveness of the insecticide. Persons responsible for insect pest control can utilize these results to integrate methoprene into their management programs for the red flour beetle.
Contact Frank Arthur, telephone 785-776-2783, email Frank.Arthur@ars.usda.gov

Genomic and Proteomic Analyses of the Mode of Action of the Insect Growth Regulator Diflubenzuron in *Tribolium castaneum*

Authors: H. Merzendorfer, H.S. Kim, S.S. Chaudhari, M. Kumari, C.A. Specht, S. Butcher, S.J. Brown, R. Manak, R.W. Beeman, K.J. Kramer
Submitted to: Insect Biochemistry and Molecular Biology
The insect exoskeleton (cuticle) has many unique functions vital for insect survival, and is therefore an attractive target for new biopesticide design. One of the older pesticides, diflubenzuron, has already been shown to disrupt insect cuticle, but exactly how this occurs has never been demonstrated. We used modern genomic techniques to assess the effects of diflubenzuron toxicity on gene expression for 11,000 of the 16,000 total genes in the red flour beetle genome. Interestingly, genes for metabolism of chitin (a component of insect cuticle) were

not affected, but cuticle proteins did show abnormal expression. Genes for diflubenzuron detoxification showed increased activity. This work demonstrates the complexity of diflubenzuron's mechanism of toxicity, which could explain why this mechanism has remained elusive for decades. Modern genomic technology should enable this mystery to be solved, opening the door for better design of biopesticides that target the insect cuticle.
Contact Richard Beeman, telephone 785-776-2710, email Richard.Beeman@ars.usda.gov

Induction of Reproductive Diapause in *Habrobracon hebetor* (Hymenoptera: Braconidae) When Reared at Different Photoperiods at Low Temperatures

Authors: H. Chen, H. Zhang, K.Y. Zhu, J.E. Throne
Submitted to: Environmental Entomology
The Indianmeal moth is a major pest of stored grain and processed commodities. There is a small wasp that does not sting humans but naturally parasitizes the Indianmeal moth, and releasing these parasitic wasps would be an environmentally friendly way to control the Indianmeal moth. But, there is currently no way to store these wasps for when they are needed for controlling the Indianmeal moth. We hypothesized that adult wasps that were in reproductive diapause (a resting stage where they don't produce offspring) could be stored at cool temperatures until they were needed. We conducted studies to determine the environmental conditions that might induce reproductive diapause in these wasps, and found that the wasps appear to enter reproductive diapause when they are reared at a cool temperature and short daylength (68°F and 10 hours of light). Further tests need to be conducted to determine whether these wasps that appear to be in reproductive diapause can be stored at cool temperatures without reducing their performance. Being able to store these parasitic wasps in a refrigerator will enable mass production of the wasps for release for pest management.
Contact James Throne, telephone 785-776-2796, email James.Throne@ars.usda.gov

The Longitudinal Mixed Linear Model: An Information-Rich Statistical Technique for Analyzing Disease Resistance Data

Authors: Y. Veturi, K. Kump, E. Walsh, O. Ott, J.A. Poland, J. Kolkman, R. Nelson, K.P.J. Balint, J.B. Holland, R. Wisser
Submitted to: Phytopathology
A parameter called Area Under the Disease Progress Curve (AUDPC) is often used to quantify host resistance in crop plants using repeated measurements of disease levels during the season. One limitation of this method is that changes in resistance rankings during the season are not accounted for by AUDPC. A new method of analysis was developed by incorporating advanced statistical models called longitudinal mixed linear models. The new method of analysis offers a more sensitive way of detecting effects that vary over the season such as adult plant resistance or temperature-sensitive resistance. This will help researchers more precisely characterize disease resistance in crop cultivars and identify genes that condition that resistance.
Contact Jesse Poland, telephone 785-532-2709, email Jesse.Poland@ars.usda.gov

Inheritance and Genetic Mapping of Russian Wheat Aphid Resistance in Iranian Wheat Landrace Accession PI 626580

Authors: V.A. Valdez, P.F. Byrne, N.L.V. Lapitan, F.B. Peairs, A. Bernardo, G. Bai, S.D. Haley
Submitted to: Crop Science
Russian wheat aphid (RWA) is an insect pest that can cause significant damage in wheat and has had a major economic impact on winter wheat production in the western United States. Using resistant cultivars remains the most effective method for RWA control. Iranian wheat landrace accession PI 626580 has been identified to have a high level of resistance to RWA biotypes 1 (RWA1) and 2 (RWA2). In this study, we evaluated a RWA2 resistance segregation population derived from cross PI 626580 and 'Yuma' (a susceptible wheat cultivar). Genetic analysis of the segregation data suggested a single dominant gene, designated as Dn626580, controls the resistance. Three markers were linked to Dn626580 on the short arm of chromosome 7D. Dn626580 is a new resistance gene found in PI 626580 and could be used to develop cultivars with effective RWA resistance.
Contact Guihua Bai, telephone 785-532-1124, email Guihua.Bai@ars.usda.gov

USDA-ARS Center for Grain and Animal Health Research

1515 College Avenue
Manhattan, KS 66502

800-627-0388
ars.usda.gov/npa/cgahr