Center for Grain and Animal Health Research

Research Kernels

Our Latest Research Results • January 2010

GMPRC is now CGAHR

At the end of 2009, the Grain Marketing and Production Research Center became the Center for Grain and Animal Health Research. This change was prompted by the relocation of the Arthropod-Borne Animal Disease Research Unit (ABADRU) from Laramie, WY to Manhattan, KS. ABADRU staff and programs will be moving to Manhattan during the coming year. Look for a new logo reflecting our new name in the next few months.

Partial Removal of Lipids Improves the Functionality of Zein in Viscoelastic Zein-starch Dough

Authors: T.J. Schober, R.A. Moreau, S. Bean, D.L. Boyle

Submitted to: Journal of Cereal Science

Celiac disease is a condition, in which the human immune system erroneously attacks the intestine when gluten is ingested, causing, amongst many other symptoms, severe diarrhea and malabsorption. Its occurrence has been largely underestimated in the United States and world-wide, and recent studies suggest that 2-3 million Americans are affected. All gluten containing cereals have to be avoided by celiac patients, including wheat, rye, barley and ancient relatives of wheat like spelt wheat, emmer, and einkorn. Bread for these people has to be made from gluten-free grains like corn (maize), rice, sorghum, or isolated starches, and is frequently of poor quality when compared to wheat bread. The present study describes an important step in improving gluten-free bread. Using corn proteins (zein), a wheat-like dough can be produced. In the present study, we found that an additional defatting step helps in making zein dough much more similar to wheat dough, and in producing hearth-type rolls that closely resemble wheat rolls. The results of the present study might help in supplying celiacs with better bread.

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Effects of Transglutaminase on the Rheological and Mixolab Thermo-mechanical Characteristics of Oat Dough

Authors: F. Wang, J. Wan, W. Huang, M. Tilley

Submitted to: Food Chemistry

The bread bakery industry is increasingly using frozen dough, which is preferred for manufacturing and standardization of product quality. The phase change of water and the recrystallization of ice during frozen storage of dough are important parameters that determine the quality of bread products. Water also plays a critical role in staling of bread made from frozen dough due to the formation of ice crystals. Glycerol application to frozen dough has been demonstrated to improve the anti-freezing property of yeast, similarly, ice-structuring protein (ISP) improved the specific volume and softened the bread crumb of frozen dough bread. However, the effects of cryo-protectors such as glycerol and ISP on water mobility in frozen dough and bread are not well known. Nuclear magnetic resonance (NMR) is one of the most powerful techniques for determining changes in water mobility and molecular interactions. The changes of water state in frozen doughs were studied by NMR. It was found that several NMR parameters correlated with the firming process in bread crumb. Water mobility in frozen dough and bread during storage, and the influence of glycerol, ISP, and their combined use on the physico-chemical properties of frozen dough and the staling process of bread were investigated. In general, glycerol has a greater ability to associate with water in a dough system. ISP also can reduce the water mobility of frozen dough. NMR relaxation parameters of frozen dough could be used as a powerful tool to inspect and guide frozen dough production.

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Wheat-Rye Recombinants T2BS.2BL-2RL Conferring Resistance to Hessian Fly (H21)

Authors: J.C. Cainong, M.-S. Chen, J. Johnson, B. Friebe, B.S. Gill, A.J. Lukaszewski, L.E. Zavatsky

Submitted to: Crop Science

The use of resistance genes in wheat is the most effective and cost efficient means to control Hessian fly (*Mayetiola destructor*), a serious pest of wheat. H21 is one of the resistance genes that are still highly effective to Hessian fly populations in the fields. However, the usefulness of H21 in wheat breeding is limited due to unfavorable agronomic traits associated with the rye chromosomal arm that contains H21. This research has shortened the rye chromosomal arm to the distal ~20% region that still confers Hessian fly resistance in wheat *lines*. Wheat lines containing the shortened rye chromosomal fragment should be more useful in wheat improvement.

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Differential Accumulation of Phytohormones in Wheat Seedlings Attacked by Avirulent and Virulent Hessian Fly (Diptera: Cecidomyiidae) Larvae

Authors: L. Zhu, X. Liu, M.-S. Chen
Submitted to: Journal of Economic Entomology

Host plant resistance is the most effective and cost efficient means to control Hessian fly (Mayetiola destructor), a serious pest of wheat. However, the rapid development of new biotypes has made resistance in host plants short-lived, lasting for only 6-8 years for a specific resistance gene. A better understanding of plant resistance mechanisms is needed to develop more durable resistant wheat. This research investigated changes in concentrations of plant hormones in plants attacked by virulent and avirulent Hessian fly larvae. We found that salicylic acid (SA) and 12-oxo-phytodienoic acid (OPDA) were increased in plants attacked by avirulent larvae, indicating that these two hormones may play an important role in wheat resistance to Hessian fly. On the other hand, the plant hormone auxin increased dramatically in plants attacked by virulent larvae, suggesting that Hessian fly larvae may manipulate host plants to their advantage via auxin. This research provided a foundation for future research that will lead to a better understanding of the roles of plant hormones in wheat-Hessian fly interactions, and may eventually lead to practical applications.

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Mechanical Properties of Elytra from *Tribolium castaneum* Wild-Type and Body Color Mutant Strains

Authors: J. Lomakin, Y. Arakane, K.J. Kramer, R.W. Beeman, M.R. Kanost, S.H. Gehrke
Submitted to: Insect Biochemistry and Molecular Biology

The exoskeleton forms a protective outer covering of insects and is a potential model for next-generation plastics that would have increased biodegradability and environmental safety. We quantified the physical properties of the developing adult cuticle. We used cuticle pigmentation mutants to determine the effect of cuticle color on brittleness, elasticity, and strength of cuticle of beetle wing covers. Results show that increased pigmentation is associated with reduced cross-linking and greater viscosity, without loss of stiffness. Studies such as these will lead to better understanding of insect growth and development, better strategies for disrupting the insect exoskeleton for pest control, and new ideas for the design of next-generation biodegradable plastics based on insect “skin”.

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Long-Term Monitoring of *Tribolium castaneum* Populations in Two Flour Mills: Rebound after Fumigation

Authors: J.F. Campbell, M.D. Toews, F.H. Arthur, R.T. Arbogast
Submitted to: Journal of Economic Entomology

Methyl bromide fumigations of food processing plants to manage stored-product insect populations have been a major component of pest management programs. Limited information is available on effectiveness of these treatments and this has hampered the phase out of this fumigant under the Montreal Protocol and adoption of alternative treatments. Here, rebound in red flour beetle (*Tribolium castaneum*) pheromone trap captures after fumigation was evaluated for 21 fumigations in two wheat mills. Evaluation of the time it took for beetle captures to increase to different thresholds indicated that both time of year fumigation was performed and integrated pest management practices performed within the mill after fumigation both significantly impacted rebound time. Changes in trap captures from one monitoring period to the next were greater above the threshold of 2.5 beetles per trap per 2 week period, suggesting that this threshold might be useful as a management target to reduce risk. These findings provide baseline information on methyl bromide efficacy, but also illustrate how population growth can be manipulated to reduce the need to fumigate.

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