FOR ADMINISTRATIVE USE

Minnesota Wheat Research and Promotion Council

Program Area Code Proposal Code

RESEARCH PROPOSAL GRANT APPLICATION

1. NAME AND ADDRESS OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE

Name: North Dakota State University
Address: Office of Sponsored Programs Administration
Dept #4050 PO Box 6050, Fargo, ND 58108-6050

2. TITLE OF PROPOSAL

Effect of Location and Genotype on Arabinoxylan Production in HRS Wheat from Minnesota

3. PRINCIPAL INVESTIGATOR(S)
Dr. Senay Simsek

PI# 2 Name: : Dr. James Anderson, U of Mi

PI# 3 Name:

4. PI #1 BUSINESS ADDRESS

North Dakota State University
Department of Plant Sciences
PO Box 6050, Dept 7670
Fargo, ND 58108-6050

5. PROPOSED PROJECT DATES (calendar years)
01/01/2011 to 12/31/2011

Note: Research Reports are Due November 15th of Each Year

6. TOTAL PROJECT COST

$ 17,750

7. PI #1 PHONE NO.

701-231-7737

8. RESEARCH OBJECTIVES: (List objectives to be accomplished by research grant)

Arabinoxylans are unique non-starch carbohydrates found in wheat grain as minor constituents. They have significant contribution to farinograph and baking water absorption since they can associate with large amounts of water. Arabinoxylans can hold up to 8-10 times their weight in water and have impact on farinograph consistency. These properties are important factors in end-use quality of wheat. **The objective of this study** is to delineate the influence of wheat genotype and growing environment on variation in arabinoxylans (water-soluble, water insoluble) and total arabinoxylan contents of flour obtained from wheat grown in Minnesota.

The proposed project will help the UMN HRS wheat breeding program to identify and develop wheat varieties that have target Arabinoxylan content. Since their production is under genetic control, the potential exists for new varieties with targeted arabinoxylan content that have better end-use functionality

Attach a 2-page detailed discussion of importance of the proposal to wheat profitability; how study complements previous research in area; procedures to be used; and competency of the research group in achieving research objectives. (Please keep the proposal concise, only 2 pages will be provided reviewers).

Signature Of Principal Investigator	**Date**	**Phone Number**
Signature Of Authorized Representative	**Title**	**Date**
Address Of Authorized Representative		**Phone Number**

Minnesota Wheat Research and Promotion Council
RESEARCH PROPOSAL GRANT APPLICATION
(2-pages maximum)

Project Title: Effect of Location and Genotype on Arabinoxylan Production in HRS Wheat from Minnesota

Importance:
Many factors have effect on the biochemical composition of wheat grain and thus largely determine its end-use quality. These influencing factors can be grouped according to whether they originate from the genetic makeup of the plant (i.e., genotype or cultivar) or from the environment (all external conditions under which the plant grows). Cultivar and environment each influence wheat composition to varying degrees.
Arabinoxylans are carbohydrates naturally found in wheat flour. They have significant impact on farinograph and baking water absorption of flours.

1) Determine the influence of genotype and environment on the WE-AX and WU-AX in Hard Red Spring wheat from Minnesota.
2) Identify how the impacts of genotype and environment affect the end-use quality of the wheat (especially water absorption) due to the variations to the structure and distribution of the arabinoxylan in wheat.

The proposed project will help the UMN HRS wheat breeding program to identify and develop wheat varieties that have target arabinoxylan content. Since AX production is under genetic control, the potential exists for new varieties with targeted AX content that have better end-use functionality.

Background:
The biochemical composition of wheat is influenced by many factors including the class of wheat, specific genotype, and growing location. Starch and protein characteristics, which have been extensively investigated, make up a large part of wheat flour's end-use quality. However, arabinoxylans (also known as pentosans) have effects on end use quality parameters, such as, water absorption and gluten-starch separation (Dornez et al 2008). Specific genotypes and growing location will affect the structure and functionality of arabinoxylans, resulting in changes in the wheat quality and functionality (Finnie et al 2006).
Arabinoxylans are unique carbohydrates, which are found in several cereal grains, including wheat. The source of arabinoxylans within the cereal grains is in the cell wall structure. The basic structure of the arabinoxylans is a backbone consisting of β-1, 4 linked xylose with arabinose substitution on C (O)-3 or C (O)-2, 3. In general, there are two types of arabinoxylan found in the cell wall. These are classified as either water soluble (WE-AX) or water insoluble (WU-AX). The degree of arabinose substitution, ferulic acid cross linking and the degree of xylan polymerization all affect the solubility of the arabinoxylans (Sorensen et al 2007).
The use of arabinoxylan for food and industrial applications is highly varied. Arabinoxylan may be added to various foods to add increased health benefit. Arabinoxylans are classified as dietary fiber, but have been less extensively studied than other non-starch polysaccharides such as (1,3;1,4)-β-D-glucan, guar or galactomannan. Dietary supplementation of arabinoxylans has reported to have many health benefits. These health benefits include lower cholesterol absorption, control of type-2 diabetes and increase in fermentation by gut microflora in the large intestine (Shelat et al 2010). For example, arabinoxylans are a source of fermentable carbohydrate for gut microflora. When ingested, the arabinoxylans may act as prebiotics (Vardakou et al 2008). Another use of arabinoxylan in food is in bread products. Most arabinoxylan in bread is endogenous to the wheat flour of which the bread is made. However, arabinoxylan may be added to increase nutritional value to increase the dietary fiber content (Schelat et al 2010). These characteristics, such as water solubility have an effect on the bread baking quality of the wheat flour (Biliaderis et al 1995).

Relationship To Past Projects:
This project was not funded in previous years.

Procedures:
HRS wheat samples will be provided by Dr. James Anderson. They are variety trials (see table 1) from three different locations in MN and harvested over 2-year period.
2009 AY1 quality samples are from Lamberton, Morris, and Stephen
2010 AY1 quality samples are from Crookston, Roseau, and Stephen
The wheat and flour moisture will be determined by AACC Approved Methods; 44-15, 8-01 and 46-30 (AACC 2000). Total starch content will be measured using the Megazyme assay kit according to AACC method 76-13 (AACC 2000). The monosaccharide composition of the wheat, flour and arabinoxylans fractions will be determined by gas chromatography using the alditol acetate method of derivitization (Blakeney et al 1983). The total arabinoxylan content and arabinose to xylose (A/X) ratio will be calculated by multiplying the sum of arabinose an xylose by 0.88 and dividing the arabinose by

xylose contents (Dornez et al 2008).
Overall, 42 genotypes from three locations over 2 year will be analyzed. Each sample will be analyzed at least in duplicate.

Research Group:

Primary Investigator (PI): Dr. Senay Simsek
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Co-PI: Dr. James Anderson
Department of Agronomy and Plant Genetics
University of Minnesota, St. Paul, MN
E-mail: ander319@umn.edu
Phone: 612- 625-9763

Regional Linkages To Other Research Activities:
Varieties that will be used in this study are listed in Table 1. These varieties are grown by Dr. Anderson's breeding program and traditional spring wheat quality tests are performed by USDA staff located in Fargo, ND. There is very limited research has been done on effect of cultivar and location on production of arabinoxylan content in wheat from Minnesota even though these minor constituents have significant impact on water absorption capacity of flour. Our research will complement UMN breeding program to see whether location and/or cultivar is affecting arabinoxylan production and how they are correlated to water absorptions.

Additional Sources of Funding:
PI does not have additional or matching funds to perform proposed research. However, PI has been performing similar research for the varieties grown North Dakota State University Research Extension Centers. ND portion of the research is funded by North Dakota Wheat Commission and PI has been collaborating with Dr. Mergoum.

Budget Narrative: Dr. Simsek will perform the experiments to determine arabinoxylan chemistry in HRS wheat grown in MN, which will be provided by Dr. Anderson. Funding would be used to provide chemicals, research supplies, shipping of wheat samples and salary of an hourly worker.

References:
American Association of Cereal Chemists and Approved Methods Committee. 2000. *Approved methods of the American Association of Cereal Chemists*. AACC. St. Paul, Minn.

Biliaderis,C.G., M.S.Izydorczyk, and O.Rattan. 1995. "Effect of Arabinoxylans on Bread-Making Quality of Wheat Flours." *Food Chemistry*. 53:165-171.

Blakeney,A.B., P.J.Harris, R.J.Henry, and B.A.Stone. 1983. "A Simple and Rapid Preparation of Alditol Acetates for Monosaccharide Analysis." *Carbohydrate Research*. 113:291-299.

Dornez,E., K.Gebruers, I.J.Joye, B.De Ketelaere, J.Lenartz, C.Massaux, B.Bodson, J.A.Delcour, and C.M.Courtin. 2008. "Effects of genotype, harvest year and genotype-by-harvest year interactions on arabinoxylan, endoxylanase activity and endoxylanase inhibitor levels in wheat kernels." *Journal of Cereal Science*. 47:180-189.

Finnie,S.M., A.D.Bettge, and C.F.Morris. 2006. "Influence of cultivar and environment on water-soluble and water-insoluble arabinoxylans in soft wheat." *Cereal Chemistry*. 83:617-623.

Shelat,K.J., F.Vilaplana, T.M.Nicholson, K.H.Wong, M.J.Gidley, and R.G.Gilbert. 2010. "Diffusion and viscosity in arabinoxylan solutions: Implications for nutrition." *Carbohydrate Polymers*. 82:46-53.

Sorensen,H.R., S.Pedersen, and A.S.Meyer. 2007. "Characterization of solubilized arabinoxylo-oligosaccharides by MALDI-TOF MS analysis to unravel and direct enzyme catalyzed hydrolysis of insoluble wheat arabinoxylan." *Enzyme and Microbial Technology*. 41:103-110.

Vardakou,M., C.N.Palop, P.Christakopoulos, C.B.Faulds, M.A.Gasson, and A.Narbad. 2008. "Evaluation of the prebiotic properties of wheat arabinoxylan fractions and induction of hydrolase activity in gut microflora." *International Journal of Food Microbiology*. 123:166-170.

Table 1. List of the genotypes that will be analyzed in this study.

1	Ada		MCIA
2	Albany		Trigen
3	Barlow		NDSU
4	Bigg Red		Westbred
5	Blade		Westbred
6	Breaker		Westbred
7	Brennan		AgriPro
8	Brick		SDSU
9	Briggs		SDSU
10	Brogan	Granite/Briggs	Westbred
11	Cromwell		Thunder Seed
12	Faller		NDSU
13	Freyr		AgriPro
14	Glenn		NDSU
15	Granger		SDSU
16	Hat Trick		Trigen
17	Howard		NDSU
18	Jenna		AgriPro
19	Kelby		AgriPro
20	Knudson		AgriPro
21	Kuntz		AgriPro
22	Marshall		2008 L-2 Increase
23	MN02072-7	MN97695/MN97518	2008 L-2 Increase
24	MN03169-2-062	PARSHALL-1/MN97803-10	2008 F-1 Purification
25	MN03196	Alsen-1//Parshall/MN97665	2008 F-1 Purification
26	MN05141-2	MN99017-6/MN97803-10	2008 F-1 Purification
27	MN05214-3	MN95229-40//RL4970-4/MN95229-40	2008 L-2 Increase
28	MN06018	MN97695-4/ALSEN-1	2008 L-2 Increase
29	MN06028	MN97695-4/MN95229-40	2008 L-2 Increase
30	MN06044	Norm-5/PI350768	2008 L-2 Increase
31	MN06075	MN99017-6/MN97695-LrW	2009 New Zealand rows 1018-1037
32	MN06197	MN99192-10/N97-0100//Alsen-1	2009 New Zealand rows 1224-1243
33	MN06198	MN99192-10/N97-0100//Alsen-1	2008 L-2 Increase
34	Oklee		MCIA
35	RB07		MCIA
36	Sabin	MN98389/MN97518	MCIA
37	Samson		Westbred
38	SD3948		2008 AY1
39	Steele-ND		NDSU
40	Tom		MN
41	Traverse		SDSU
42	Vantage		Westbred

Minnesota Wheat Research and Promotion Council

RESEARCH PROPOSAL BUDGET

ORGANIZATION AND ADDRESS

Name: North Dakota State University
Address: Office of Sponsored Programs Administration
Dept #4050 PO Box 6050
Fargo, ND 58108-6050

Principal Investigator(s) / Project Directors(s)	Funds Requested For Year 1 (2011)	Year 2 (2012)	Year 3 (2013)
A. Salaries and Wages		$	$
1. Co-principal Investigator(s)			
2. Senior Associates			
3. Research Associates - Post Doctorate			
4. Other Professionals			
5. Graduate Students			
6. Prebaccalaureate Students	5,000		
7. Secretarial - Clerical			
8. Technical, Shop and Other			
B. Fringe Benefits @ 15%	750		
C. Nonexpendable Equipment (Planting and harvesting equipment use)			
D. Materials and Supplies	12,000		
E. Travel			
F. Publication Costs			
G. Computer Costs			
H. All Other Direct Costs (Attach supporting data) - Purchase of Service -			
I. TOTAL AMOUNT OF THIS REQUEST (per year)	**$ 17,750**	**$**	**$**