White Sorghum, the New Food Grain

SORGHUM HANDBOOK

All About White Sorghum
Grain sorghum is the third most important cereal crop grown in the United States and the fifth most important cereal crop grown in the world.
Origin  Sorghum (Scientific name: Sorghum Bicolor (L.) Moench) is native to the tropical areas in Africa. The oldest cultivation record dates back to B.C. 3000 in Egypt. Sorghum is produced throughout the tropical, semi-tropical and arid regions of the world. Sorghum came to the Americas via trade routes in the 1700’s.

Naming  Sorghum is called various names in different places in the world. In Western Africa, it is called great millet, kafir corn or guinea corn, which represents a connection with corn or millet. It is called jowar in India, kaolian in China and milo in Spain.
Sorghum seed consists of 3 major anatomic sections - pericarp (outer layer), endosperm (storage organ) and the germ. The pericarp that is expressed from the ovary wall is made of 3 segments - epicarp, mesocarp and endocarp. The epicarp is the outermost layer and usually covered with a thin waxy film. The thickness of the mesocarp, the middle structure, varies from the very thin cellular remnant of small amount of starch granules to 3 or 4 cellular layers containing a large amount of starch granules. Sorghum is the only food grade crop that is reported to contain starch in this anatomical section. The endosperm is a storage organ that is comprised of aleurone layer, peripheral, corneous and floury areas.

The aleurone contains proteins (protein bodies, enzymes), ash (phytin bodies) and oil (spherosomes). The germ is comprised of 2 major parts, the embryonic axis and embryonic disc. The protein of the germ contains high levels of lysine and tryptophan that are excellent in quality.

**Classification by Intended Purposes**

Sorghum is a member of the grass family and is classified in the following 4 groups by application:

1. **Grain Sorghum**
2. **Sweet Sorghum**
3. **Broom Sorghum**
4. **Grass Sorghum**

Grain sorghum is mainly used as a principal food in tropical areas and often used as raw materials for alcoholic beverages, sweets and glucose. Broom sorghum is used as a material to make brooms, while sweet sorghum is used as a material for sweetener syrup. Grass sorghum is grown for green feed and forage use.

**Places of Production**

The United States is the world's largest producer of grain sorghum followed by India, Nigeria, and Mexico. It is a leading cereal grain produced in Africa and is an important food source in India. Leading exporters are the United States, Australia and Argentina.
Sorghum is recognized to be the most important farm crop behind corn, soybeans and wheat in the U.S. It features higher resistance against dry weather and high temperatures than soybeans, wheat, corn and other crops. In the 1950’s, hybrid sorghums were developed for higher yields and it became a popular crop as yields increased dramatically. Originally the color of sorghum was purple or red and the seed coat was red. The color and the taste were regarded to be inappropriate as a food crop. To overcome the drawbacks, breeding improvements were pursued and realized, which lead to the development of white sorghum that has a white seed coat, champagne colored body and wheat colored head.
Amazing Features of White Sorghum

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**Nature-cared crop**
- It has strong resistance to harsh environments such as dry weather and high temperature in comparison with other crops. It is usually grown as a low-level chemical treatment crop with limited use of pesticides.
- It has the potential to adapt itself to the given natural environment. It can be called “Nature-cared Crop” as it requires little artificial care such as irrigation and insect removal.

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**Versatile Food Material**
- It can be added to a variety of foods as it is almost taste and scent free and naturally white in color.
- The material advantages of other added ingredients such as taste are not harmed.

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**No Gluten Content**
- Unlike wheat flour, it does not contain gluten. This makes it a suitable alternative food for people with wheat gluten allergies.

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**No Biotech Sorghum**
- It is not modified genetically and can be used for products that are labeled as non-genetically engineered products.

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**Small Amount of Tannin Content**
- This means that polyphenols (phenolic acid and flavonoid) are available.

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Componential Analysis of White Sorghum Flour and Grain

*Flour was analyzed by JOWAR FOOD in the US and Japan Food Research Laboratories.

<table>
<thead>
<tr>
<th>Analyzed item</th>
<th>Results (100g)</th>
<th>Analysis method</th>
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<tr>
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<td>Flour</td>
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<tr>
<td>Water</td>
<td>11.6g</td>
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<tr>
<td>Protein *1)</td>
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<td>Carbohydrate *2)</td>
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<tr>
<td>Dietary fiber</td>
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<tr>
<td>Tannin (as tannin acid)</td>
<td>0.06g</td>
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*1) Nitrogen-protein conversion factor: 6.25
*2) 100 - (water + protein + fat + ash + dietary fiber + tannin) based on the Nutrition Labeling Standard (Ministry of Health and Welfare Public Notification No. 146 in 1996)
White sorghum has been developed for farming in the U.S. and increasingly cultivated. The major production areas are in Texas, Oklahoma, Kansas, Nebraska, and California.
U.S. Sorghum Production

Sorghum production estimate 2003/04

Area planted ....................9.4(mil. acres) ...............3.8(million hectares)
Area harvested .................7.8(mil. acres) ...............3.2(million hectares)
Yield ..........................52.7(bushels/acre) .............3.3(MT/hectare)
Production .....................411(million bushels) ...........10.44(million metric tons)
Exports ..........................210(million bushels) ...........5.33(million metric tons)
Total domestic use ............200(million bushels) ...........5.08(million metric tons)

Major states’ sorghum production numbers 2003

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<th>Planted (acres – thousand)</th>
<th>Production (hectares)(1000 bushels) (1000MT)</th>
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<td>California</td>
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<td>7.3 900 23</td>
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Classification of Sorghum by U.S. Authorities

In the U.S., sorghum is classified into 4 classes based on tannin content and color by the grain standards stipulated by the USDA Federal Grain Inspection Service (FGIS). While the classes can be visually identified, properties of the types are determined by tannin content.

Sorghum
Low in tannin content due to the absence of a pigmented subcoat and contains less than 98% white sorghum and not more than 3% tannin sorghum. The color of the seed coat in this class may appear, white, yellow, pink, orange, red or bronze.

Tannin Sorghum
Sorghum which is high in tannin content due to pigmented subcoat and contains not more than 10% non-tannin sorghum. The color of the seed coat is usually brown, but may also be white, yellow, pink, orange, red or bronze.

White Sorghum
Low in tannin content due to the absence of a pigmented subcoat and contains not more than 2% of other classes. The color of the seed coat is white or translucent and includes sorghum containing spots that cover 25% or less of the kernel.

Mix Sorghum
Sorghum which does not meet the requirements for any of the other classes.

Major White Sorghum Seed Varieties Sold in U.S.

The following shows the names of major sorghum seed varieties currently sold in the American market and their web page addresses:
- Fontanelle W 1000  http://www.fontanelle.com
- Sorghum Partners 828  http://www.sorghumpartners.com
- Producers 79  http://www.producershybrids.com
Rather than give up their favorite wheat-based foods like bread, cookies, cake, and pizza, gluten-free people learn to cook with gluten-free ingredients such as sorghum. Distantly related to corn, sorghum is gaining wide popularity as a wheat substitute in America. About 10-15% of Americans cannot eat wheat (and its cousins barley, rye, and spelt) because it contains gluten, an otherwise harmless protein that is toxic for certain people. This includes those with wheat allergies as well as the 2.2 million people with celiac disease, a little-known but increasingly common autoimmune condition. Celiacs must avoid gluten because it damages the lining of the small intestine, preventing absorption of nutrients in food. This can lead to diarrhea, anemia, osteoporosis, infertility, lymphoma, and other complications. The only treatment is a gluten-free diet for life. Left untreated, it can be fatal.

Many other people avoid wheat due to food intolerances, where symptoms reduce our quality of life with annoying—though rarely life-threatening—headaches, rashes, nasal congestion, sinusitis, stomach aches, and fatigue. National associations such as the Gluten Intolerance Group, the Celiac Disease Foundation, and the Celiac Sparue Association recommend sorghum for the gluten-free diet. Several manufacturers use sorghum in their gluten-free products and baking mixes. Fortunately, sorghum-based ingredients are readily available at natural food markets, on the Internet, and some traditional supermarkets. This allows gluten-free consumers to incorporate sorghum into their diets using specially-formulated recipes. Manufacturing companies and home cooks value sorghum flour for its light color, neutral taste, and the pleasing texture it brings to baked goods such as cakes, cookies, breads and pizza. Whole sorghum grain—with its hearty, chewy texture—makes it the perfect gluten-free substitute for couscous, bulgur, and pearled barley in soups and side dishes.

Sorghum Replaces Wheat in Gluten-Free Diets

Sorghum is currently available in two forms: whole grain and flour. Its light color, neutral flavor, and pleasing texture have resulted in sorghum being featured in (A) gluten-free cookbooks; (B) ready-made foods such as cookies, cereal, bagels, and bars; (C) baking mixes for bread, brownies, cakes, and pancakes; (D) bread from gluten-free bakeries; (E) gluten-free beer; and (F) restaurants serving whole grain sorghum dishes.
When I was advised to stay away from wheat years ago—to get relief from chronic sinusitis—I didn’t want to give up my favorite foods like bread, pizza, and desserts. With my passion for good food and a degree in home economics, I learned to make all my favorite foods with gluten-free alternatives. Along the way—as I literally baked my way back to good health—I was delighted to discover sorghum flour. Sorghum flour’s light color and neutral flavor allow me to use it in a wide variety of dishes, ranging from delicate cakes to hearty dishes like breads and pizza. It also has a mysterious, but wonderful synergy with other flours that actually improves the overall flavor of the dish—which is particularly advantageous since we must use a combination of flours in gluten-free baking, rather than just one.

One of the things I especially missed when I gave up wheat was its texture—for example, that wholesome ‘mouth-feel’ in hearty homemade breads. Sorghum flour helps me duplicate that hearty bread with its chewy crusts. I also missed the satisfaction of chewy cooked bulgur in my favorite tabbouleh recipe or pearled barley in my homemade vegetable soup. But I find that cooked sorghum grain is a marvelous replacement, so I can replicate those dishes and everyone enjoys them—even friends and family who aren’t gluten-free. Nutritionally, sorghum contains more protein than typical wheat substitutes such as rice flour and I find that this higher protein makes better breads and rolls. I also like the fact that it is rich in anti-oxidants, which makes it a safe, delicious, and healthy choice for the gluten-free diet.”

Carol Fenster, Ph.D.

President and Founder of Savory Palate, Inc., a publishing house and information resource for people with food allergies, celiac disease, autism, and other medical conditions that require a gluten-free diet.

Dr. Fenster is the author of 5 gluten-free cookbooks, she teaches cooking classes for natural food stores, and she is an internationally recognized speaker on the gluten-free lifestyle.

She is featured on several episodes of the Health Network’s “Food for Life” and she develops gluten-free products for leading food manufacturers.

Her articles and reviews of her books have appeared in Woman’s World, Taste for Life, Vegetarian Times, Veggie Life, Better Nutrition, Energy Times, Gluten-Free Living, and Living Without magazines as well as newsletters from the Food Allergy and Anaphylaxis Network (FAAN), Gluten Intolerance Group (GIG), and Celiac Disease Foundation (CDF).

Sorghum Pilaf

1 cup uncooked sorghum grain
1 tablespoon olive oil
3 cups gluten-free chicken broth
1 teaspoon dried minced onions
1/2 teaspoon dried thyme
1/8 teaspoon ground white pepper
1/4 cup dried cranberries
1/4 cup golden raisins
2 tablespoon fresh chopped thyme leaves
Salt to taste
1/4 cup toasted almond slices
Fresh thyme or parsley sprigs for garnish

1. Rinse sorghum grains with water; drain thoroughly.
2. In a heavy, medium-size saucepan over medium-low heat, combine sorghum grains and olive oil. Stirring constantly, gently toast grains in oil for 2-3 minutes or until they are slightly browned.
3. Add chicken broth, onions, thyme, and white pepper and bring to boil. Reduce heat, cover, and simmer 30-40 minutes or until liquid is absorbed and grains are tender.
4. Remove from heat and drain, if necessary. Stir in cranberries, raisins, fresh thyme, and salt to taste (depending on the saltiness of the chicken broth). Cover and let stand for 5 minutes. Transfer to large, 12-inch plate or platter. Sprinkle with toasted almond slices. Garnish with fresh thyme or parsley sprigs. Serve hot. Makes 3 cups. Serves 6 (1/2 cup servings).

Cooked sorghum grain is especially versatile. It can be used in place of couscous, bulgur, or pearled barley. In this pilaf recipe, it makes a delicious side dish to accompany chicken or fish. Nuts and dried fruits provide color and texture and a pleasingly sweet contrast to the savory seasonings.
Tabbouleh is a traditional Middle Eastern salad that is becoming increasingly popular on American menus. It is typically made with bulgur wheat and served cold or at room temperature. With its wholesome chewiness, sorghum makes a fabulous substitute for bulgur wheat in this dish.

Everyone loves pizza! Sorghum flour is the perfect choice for this all-American favorite because it makes a pleasingly crisp crust. You can use sausage or your favorite vegetables in place of the pepperoni, but the pizza works best with the hearty sauce featured here because it is thicker and richer than most pizza sauces.
Sorghum Tabbouleh

1 cup uncooked sorghum grain, rinsed
3 cups water
3/4 teaspoon salt, divided
1/4 cup lemon juice
2 tablespoons olive oil
1/8 teaspoon white pepper
1 cucumber, seeded and chopped
2 green onions, cut diagonally in 1/4 inch pieces
1 large red bell pepper, diced
1/2 cup each chopped fresh parsley, cilantro, and mint
1/4 cup pine nuts, toasted
1/4 cup crumbled feta cheese
Sprigs of fresh cilantro or mint for garnish

1. Place rinsed sorghum grain, water, and 1/2 teaspoon of the salt in large, heavy pan over high heat.
2. Bring to boil. Cover and reduce heat to low, simmering for 30-40 minutes or until liquid is absorbed and grains are tender. Drain thoroughly in strainer, transfer to large bowl.
3. Combine lemon juice, olive oil, remaining 1/4 teaspoon salt, and white pepper in screw-top jar. Shake vigorously to blend. Toss thoroughly with hot cooked sorghum.
4. Add cucumber, onions, bell pepper, and parsley, cilantro, and mint. Toss well. Refrigerate 4 hours. Let stand for 20 minutes before serving. Sprinkle with toasted pine nuts and crumbled feta cheese. Garnish with fresh cilantro or mint. Makes about 4 cups Serves 8

Chocolate Chip Cookies

3/4 cup sorghum flour
1/2 cup tapioca flour
1/2 cup potato starch
1 teaspoon xanthan gum
1/2 teaspoon baking soda
1/4 teaspoon salt
1 cup brown sugar, packed
1/3 cup granulated sugar
2 teaspoons vanilla extract
1 extra large egg
1 cup gluten-free chocolate chips
1/4 cup chopped nuts

2. In large mixing bowl, beat margarine with brown sugar, granulated sugar, vanilla extract, and egg until fluffy. Scrape down sides of bowl and blend until dough forms ball. Dough will be stiff.
3. Drop 12 tablespoonfuls of dough on baking sheet at least 2 inches apart. Bake 10-12 minutes on center rack of oven or until lightly browned. Remove from oven. Spread pizza crust with pizza sauce and toppings. Bake another 20-25 minutes or until toppings and crust are nicely browned. Makes a 12-inch pizza. Serves 6 (1 slice each)

Who can resist warm chocolate chip cookies, fresh from the oven! Sorghum flour lends an appealing crunch to these old-fashioned delights. They freeze well and make wonderful treats for lunch boxes, school parties, after-dinner dessert, or a delicious after-school snack with a cold glass of milk.
Sorghum’s light color and delicate, neutral flavor make it the perfect choice for a basic yellow cake. Use this recipe in a multitude of ways such as a layer cake, a sheet cake, cupcakes, or—as pictured here—baked in individual heart-shaped cakes and lightly dusted with powdered sugar.

**Basic Yellow Cake**

This bread can be ready in one hour because it goes directly into a cold oven without any rising time. This procedure accentuates sorghum’s naturally dry texture, producing a loaf with an artisan-like crisp crust. If this cold oven method doesn’t work for you, place the dough in a French bread pan, let it rise to the top of the pan, and bake in a preheated oven at 425°F until nicely browned—about 25-30 minutes.
**Basic Yellow Cake**

- 1/3 cup margarine, room temperature
- 1 cup sugar
- 2 large eggs
- 1 tablespoon grated lemon peel
- 1 cup sorghum flour
- 1/3 cup potato starch
- 2 tablespoons tapioca flour
- 1 teaspoon xanthan gum
- 1/4 teaspoon baking powder
- 1/4 teaspoon baking soda
- 1/4 teaspoon salt
- 3/4 cup buttermilk
- 1 teaspoon vanilla extract

1. Preheat oven to 325˚F (160ºC). Generously grease 9-inch nonstick round cake pan (lined with waxed paper), or two 5 x 3-inch pans, or a 12-cupcake pan, or a 6-cup individual cake pan (such as the hearts used here). Set aside.

2. Using electric mixer and large mixer bowl, cream margarine, sugar, and eggs on medium speed until thoroughly blended. Add lemon peel.

3. In medium bowl, combine flours, xanthan gum, baking powder, baking soda, and salt. In a measuring cup, combine buttermilk and vanilla. On low speed, beat dry ingredients into egg mixture, alternating with buttermilk, beginning and ending with dry ingredients. Mix just until combined. Spoon batter into pan(s).

4. Bake 9-inch round pan for 35-40 minutes; 5 x 3-inch loaf pans for 35-45 minutes, 12 cupcakes for 20-25 minutes, 11 x 7-inch pan for 25-30 minutes, or 6-cup individual mini-cake pan for 20-25 minutes or until top of cake is golden brown and toothpick inserted into center comes out clean. Cool cake in pan for 5 minutes, then remove from pan and cool on wire rack. Serves 12.

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**Quick and Easy French Bread**

- 2 tablespoons dry yeast
- 1 1/4 cups warm water (110°F, 40°C)
- 1 tablespoon sugar
- 1 1/2 cups potato starch
- 1 tablespoon tapioca flour
- 1/3 cup sorghum flour
- 1/2 cup tapioca flour
- 1/4 cup dry milk powder (not Carnation)
- 1 teaspoon guar gum
- 1 teaspoon xanthan gum
- 1 1/2 teaspoons salt
- 1 tablespoon butter, room temperature
- 1 tablespoon vanilla extract
- 2 large eggs, divided
- 1 teaspoon vinegar

1. Dissolve sugar and yeast in warm water. Set aside to foam for 5 minutes.

2. Grease nonstick two-loaf French bread pan or line with parchment paper.

3. In bowl of heavy-duty stand mixer, combine flours, dry milk powder, guar gum, xanthan gum, and salt.

4. Add yeast mixture to flour mixture. Still on low speed, blend in butter, 3 of the egg whites, and vinegar. Beat on high speed for 1 minute. Dough will be somewhat soft.

5. Spoon dough equally into the two indentations of French loaf pan. Brush with 4th egg white which has been thoroughly beaten to foam.

6. Place immediately on middle rack of cold oven. Set temperature to 425ºF (220ºC) and bake approximately 30-35 minutes, or until bread is nicely browned. Cover with foil if bread browns too quickly.

7. Remove bread from pans; cool completely on wire rack before slicing with electric knife or serrated knife. Makes 2 loaves. Serves 20 (1-inch slices).

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**All-American Blueberry Muffins**

- 1 1/4 cups sorghum flour
- 3/4 cup potato starch
- 1/3 cup tapioca flour
- 3/4 cup sugar
- 1 tablespoon baking powder
- 1 1/2 teaspoons xanthan gum
- 1 teaspoon salt
- 1 1/4 cups milk
- 1/3 cup butter or margarine (room temperature)
- 2 large eggs
- 1 teaspoon vanilla extract
- 2 teaspoons grated lemon peel
- 1 teaspoon vinegar

1. Preheat oven to 400ºF (200ºC). Generously grease 12-cup nonstick standard-size muffin pan or use paper liners.

2. Blend together flour, sugar, baking powder, xanthan gum, and salt in large mixer bowl with electric mixer. Add milk, butter, eggs, vanilla extract, and lemon peel and blend on medium until ingredients are thoroughly moistened. Gently stir in blueberries. Spoon dough evenly into muffin pan. Sprinkle each muffin with 1/2 teaspoon sugar.

3. Bake 25 minutes or until muffins are lightly browned. Remove from oven. Cool muffins in pan 10 minutes. Gently remove from pan and place on wire rack to cool for another 10 minutes. Serve warm. Makes 12.

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**All-American Blueberry Muffins**

- 2 tablespoons dry yeast
- 1 1/4 cups warm water (110°F, 40°C)
- 1 tablespoon sugar
- 1 1/2 cups potato starch
- 1 cup sorghum flour
- 1/2 cup tapioca flour
- 1/4 cup dry milk powder (not Carnation)
- 1 teaspoon guar gum
- 1 teaspoon xanthan gum
- 1 1/2 teaspoons salt
- 1 tablespoon butter, room temperature
- 1 tablespoon vanilla extract
- 2 teaspoons grated lemon peel
- 1 1/4 cups blueberries

1. Preheat oven to 325°F (160°C). Generously grease 9-inch nonstick round cake pan (lined with waxed paper), or two 5 x 3-inch pans, or a 12-cupcake pan, or a 6-cup individual cake pan (such as the hearts used here). Set aside.

2. Using electric mixer and large mixer bowl, cream margarine, sugar, and eggs on medium speed until thoroughly blended. Add lemon peel.

3. In medium bowl, combine flours, xanthan gum, baking powder, baking soda, and salt. In a measuring cup, combine buttermilk and vanilla. On low speed, beat dry ingredients into egg mixture, alternating with buttermilk, beginning and ending with dry ingredients. Mix just until combined. Spoon batter into pan(s).

4. Bake 9-inch round pan for 35-40 minutes; 5 x 3-inch loaf pans for 35-45 minutes, 12 cupcakes for 20-25 minutes, 11 x 7-inch pan for 25-30 minutes, or 6-cup individual mini-cake pan for 20-25 minutes or until top of cake is golden brown and toothpick inserted into center comes out clean. Cool cake in pan for 5 minutes, then remove from pan and cool on wire rack. Serves 12.
Locations and E-mail address: White Sorghum Exporters in U.S.

**American Sunny Foods, Inc.**
Name: Shojiro Kaneyama, President
Address: 2404 Stagecoach Road
Stockton, CA 95215 U.S.A.
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Fax: 209-943-7831
E-mail: ASunnyFood@aol.com

**Agrex Inc.**
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Nobu Nagase, Export Manager
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Overland Park, KS 66213
Phone: 913-851-6335
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E-mail: lichteig@classicnet.net

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**U.S. Grains Council**
The U.S. Grains Council develops export markets for U.S. barley, corn, sorghum and related products. The U.S. Grains Council believes exports are vital to global economic development and to U.S. agriculture's profitability. Founded in 1960, the U.S. Grains Council is a private, non-profit corporation with 10 international offices and programs in more than 80 countries. Its unique membership includes producer organizations and agribusinesses with a common interest in developing export markets. Membership funds trigger matching market development funds from the U.S. Department of Agriculture and support from cooperating groups in foreign countries to produce an annual development program for U.S. grains.

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