



APPLICATIONS OF COLORED SORGHUM IN FOOD PRODUCTS

Sara Boswell

Texas A&M University

Cereal Quality Lab

Traditional uses of Specialty Sorghums

- In East and Southern Africa, brown (tannin) sorghums have been used for stomach ailments.
- Traditional foods made from sorghum are
 - Porridges
 - Cous Cous
 - Flat Breads
 - Cooked Whole Grain



Varieties of Sorghum

- A Wide Range of Colors and bioactive compounds are present in sorghum.
 - White
 - Red
 - Black
 - Brown (tannin)
 - Yellow



Pericarp Color

– Controlled by the R and Y genes



White

R_{yy}

rr_{yy}

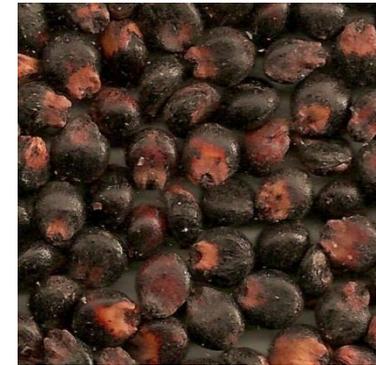


Yellow

$rr_{Y_}$



Red



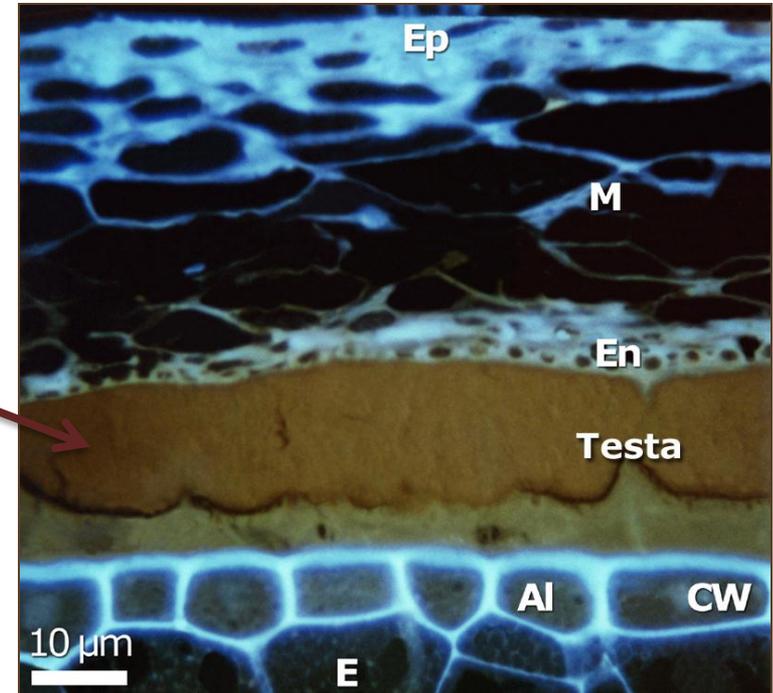
Black

$R_{Y_}$

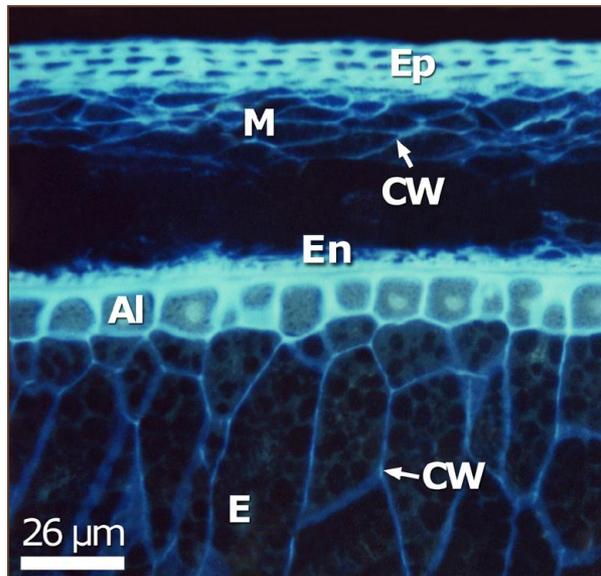
Non-Tannin vs. Tannin Sorghums



Testa



Tannin Sorghum



Non-Tannin Sorghum

(Adapted from Earp et al. 2004)

Tannin Content

FGIS/GIPSA Class

Sorghum
No Tannins

Genetics

$b_1b_1B_2- - -$
 $B_1- b_2b_2- - -$



Tannin Sorghum
Low Tannins

$B_1- B_2- s s$



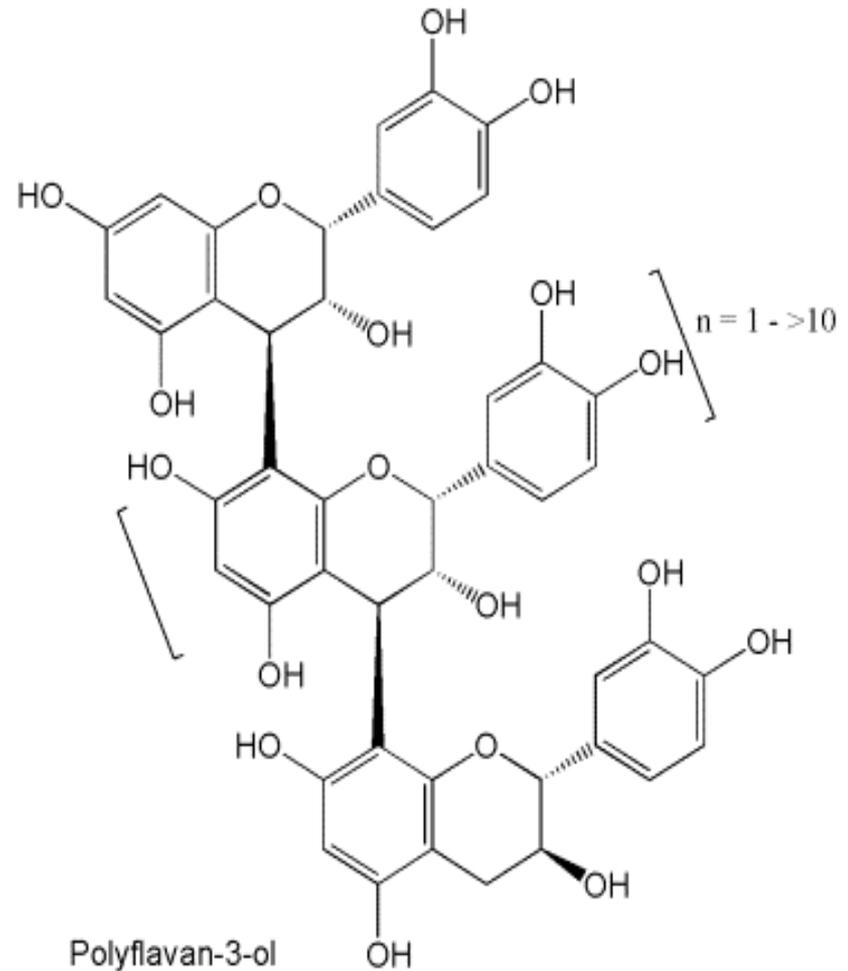
Tannin Sorghum
High Tannins

$B_1- B_2- S s$

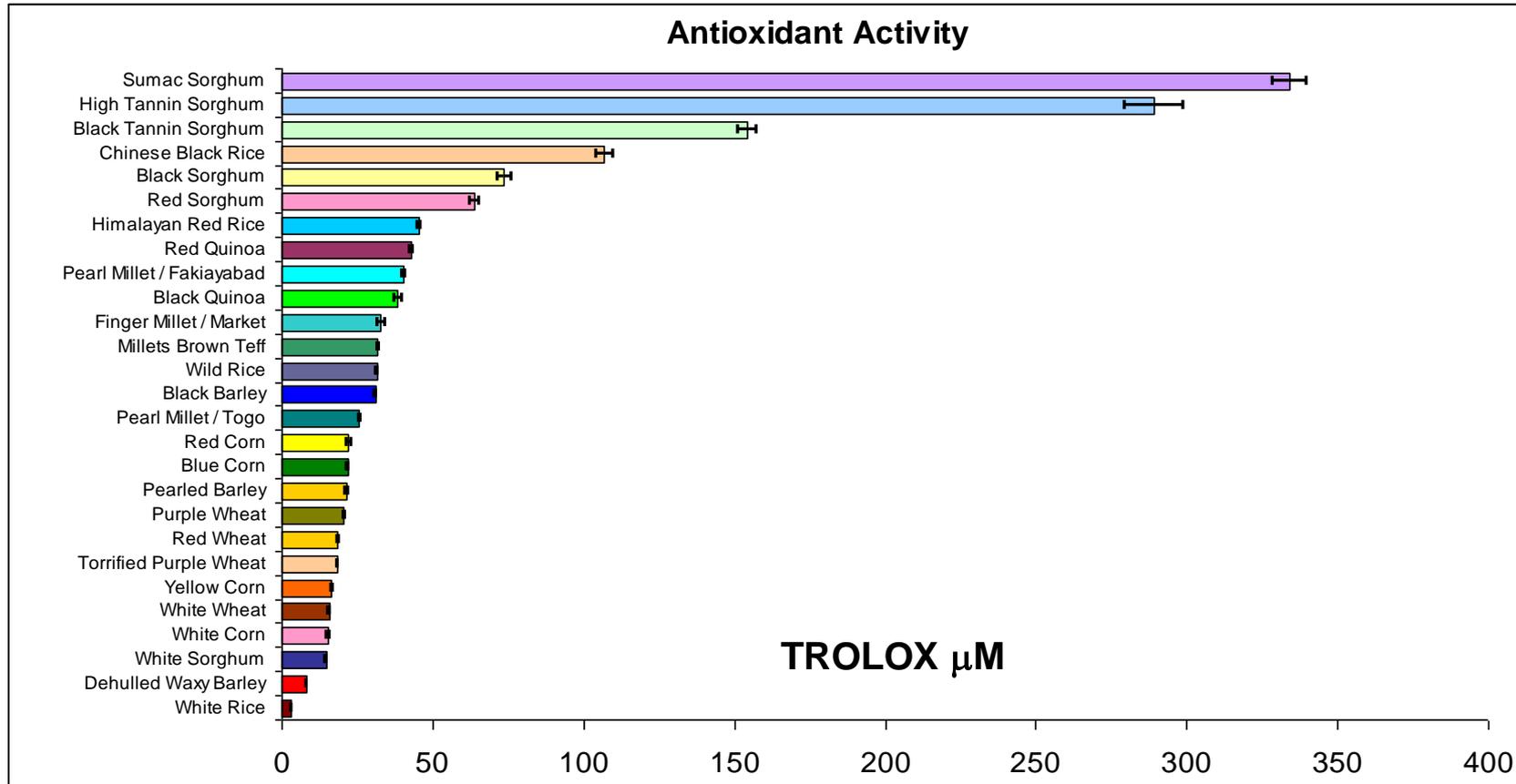


Tannin Sorghums

- Most sorghums do not contain tannins
- All sorghums contain phenol compounds
- Only brown or tannin sorghums contain condensed tannins
- Exhibit a reduced feed efficiency
- Tannins bind proteins and complexes with minerals



Antioxidant Activity Among Cereal Grains



Adapted from Guajardo-Flores
et al. 2006



Benefits of Specialty Sorghums

- Tannin sorghums are high in antioxidants which exhibit anti-cancer activity
- Sorghum is the only dietary source of 3-deoxyanthocyanins found in nature
 - Black sorghums are an excellent source
- Natural attractive dark colors that are pH stable and ideal for use in foods
- In vitro anti-breast & colon cancer activity
- Anti-inflammatory Activity

Sources: Awika et al 2004, 2009; Bralley et al 2008; Shih et al 2007; Yang et al 2009; Wu and Prior 2005.

Uses for Sorghum in Food

- White sorghum can be used in a wide variety of products.
 - Cakes
 - Breads
 - Muffins
 - Sweetbreads
 - Flatbreads
 - Tortillas
 - Noodles
 - Snack Foods

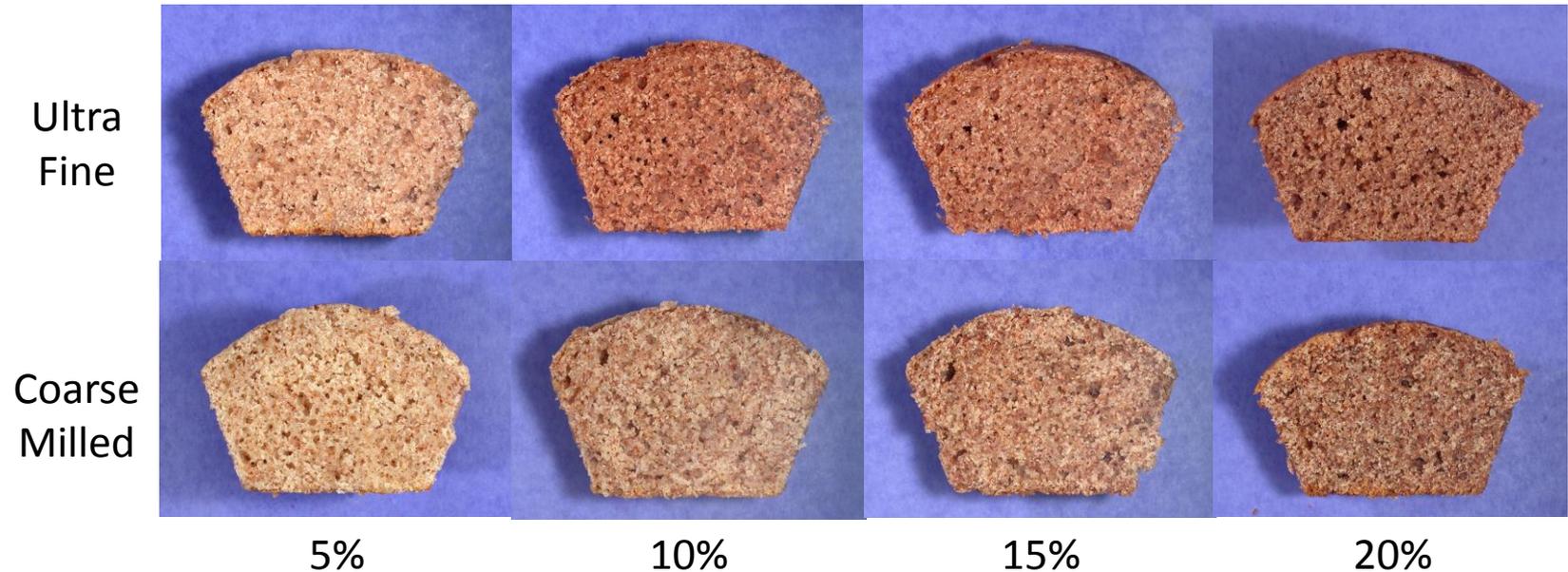


Sorghum for Bakery Products

- There are 3 primary types of milled sorghum that can be for baked goods.
 - Whole Grain Flour
 - Finely Milled
 - Coarse
 - Bran
 - Decorticated Flour
- Milling particle size and shape is a critical factor to baking characteristics.



Bran Particle Size Effects on Muffins



- Color significantly darkened with bran addition ($P < 0.05$), larger milled particles created a significantly lighter crumb color ($P < 0.05$).
- 20% addition of larger milled bran resulted in a significant reduction of specific volume ($P < 0.05$).

White Sorghum in Bread

- White sorghum flour should be used in combination with starches like tapioca or potato starch.
- If you are wanting to create a gluten free bread using sorghum a hydrocolloid such as guar gum or xanthan gum will be needed to replace the functional properties of glutenin and gliadin in dough.



White Sorghum in Wheat Free Bread

Whole grain white sorghum can be used up to 80% of the flour blend of gluten free sandwich breads, however at higher levels of substitution specific volume will be lower and crumb air cells will be smaller.



White Sorghum in Wheat Free Bread



20% White Sorghum
Flour

30% White Sorghum
Flour

40% White Sorghum
Flour



Black Sorghum Bran in Wheat Free Bread



5% Black Bran



10% Black Bran



15% Black Bran



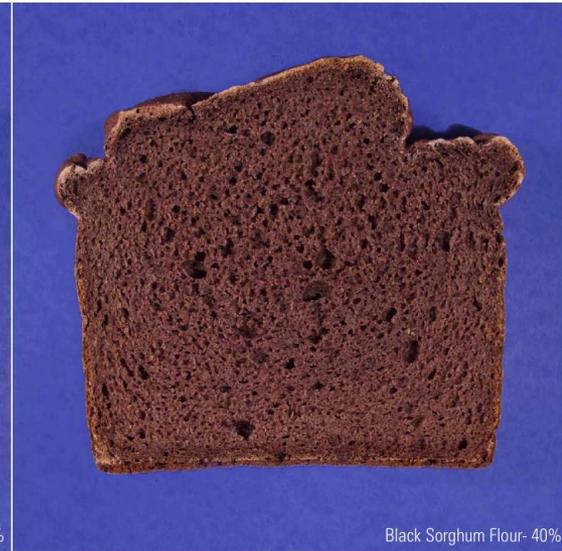
Black Sorghum Flour in Wheat Free Bread



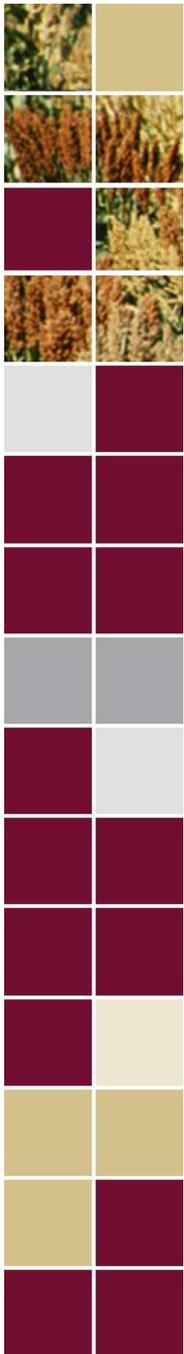
20% Black Sorghum
Flour



30% Black Sorghum
Flour



40% Black Sorghum
Flour



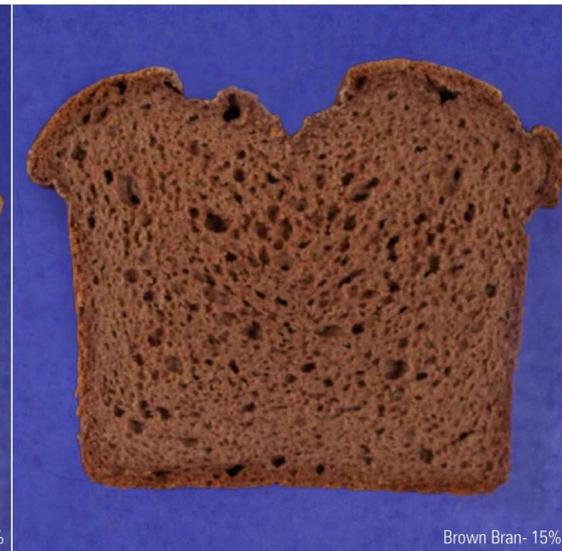
Brown Sorghum Bran in Wheat Free Bread



5% Brown Bran



10% Brown Bran



15% Brown Bran



Brown Sorghum Flour in Wheat Free Bread



20% Brown Sorghum
Flour



30% Brown Sorghum
Flour



40% Brown Sorghum
Flour



Sumac Sorghum Bran in Wheat Free Bread



5% Sumac Bran



10% Sumac Bran

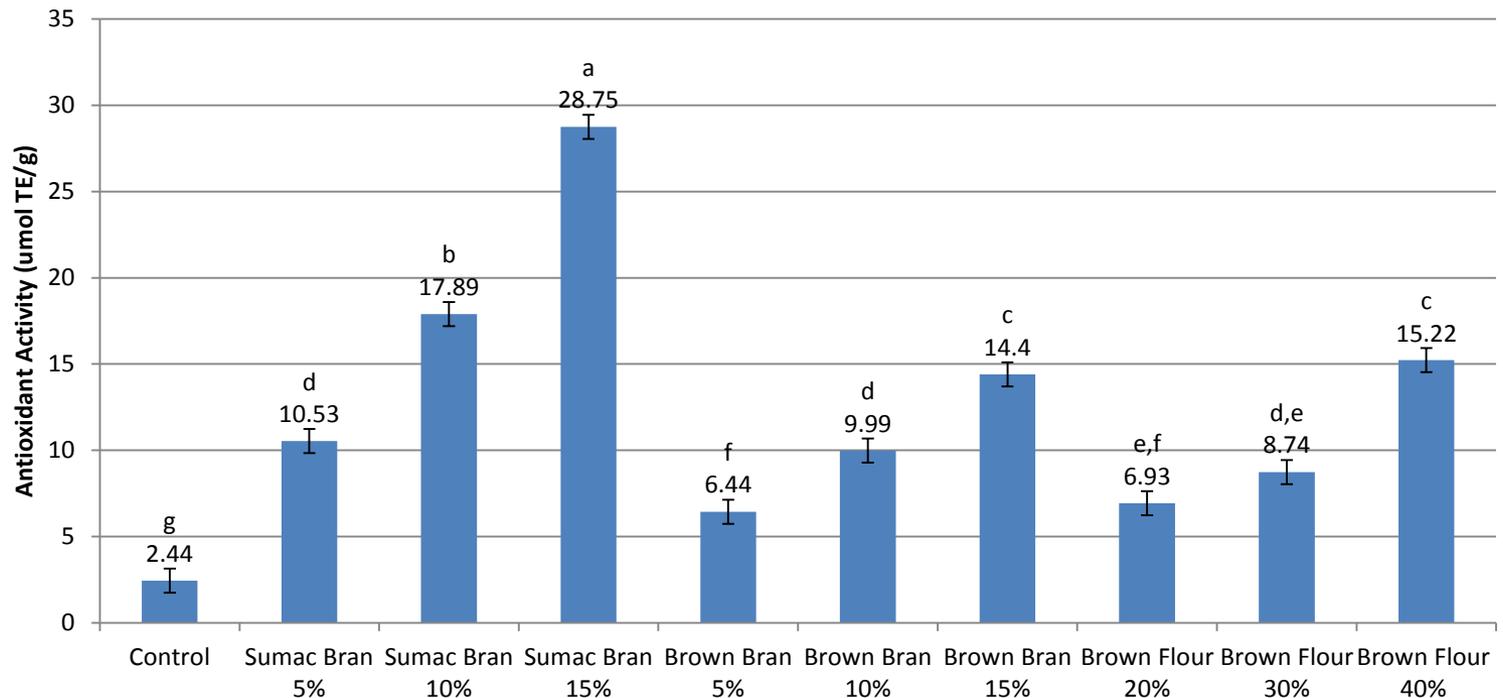


15% Sumac Bran



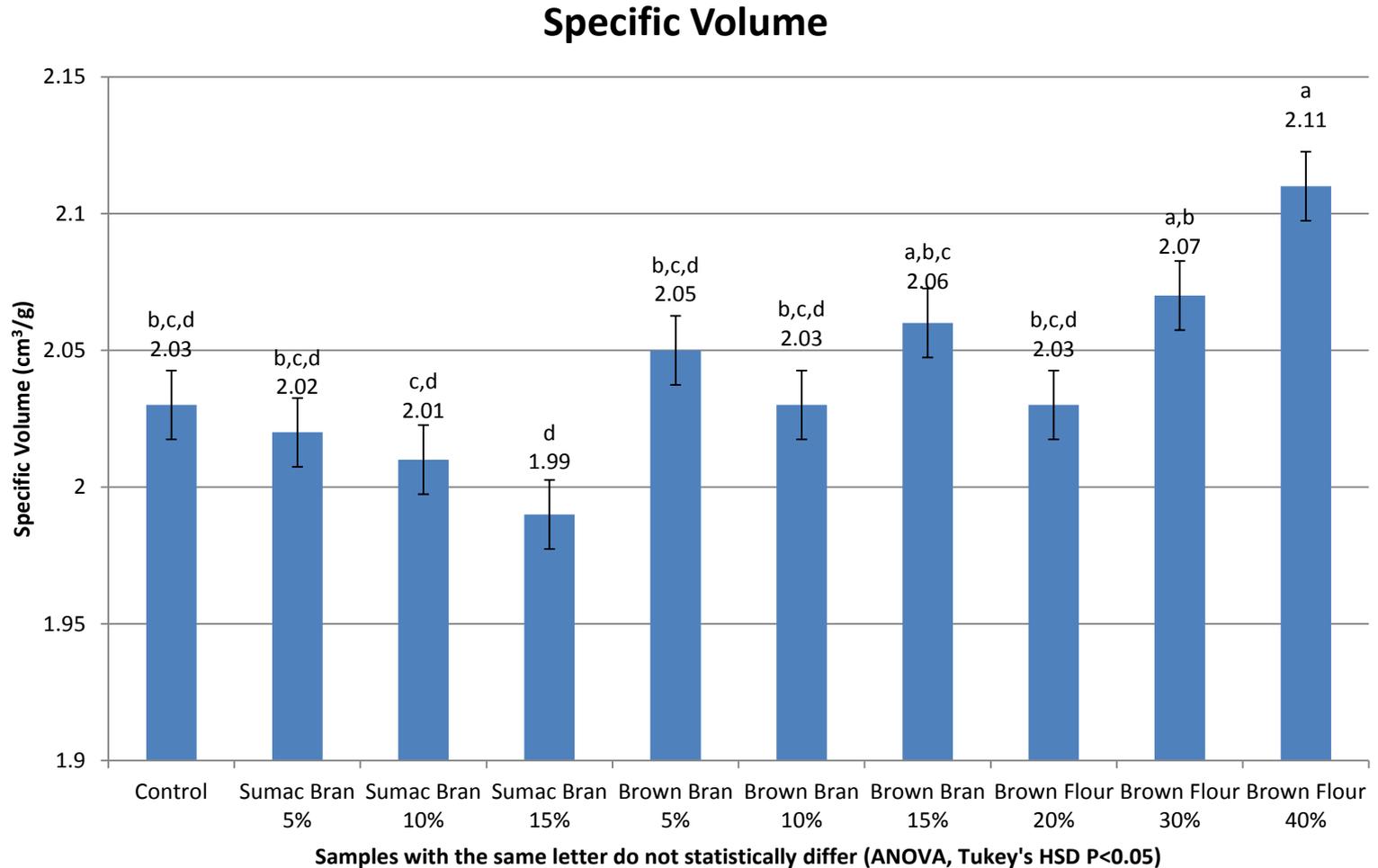
Antioxidant Activity of Specialty Sorghum Breads

Antioxidant Activity



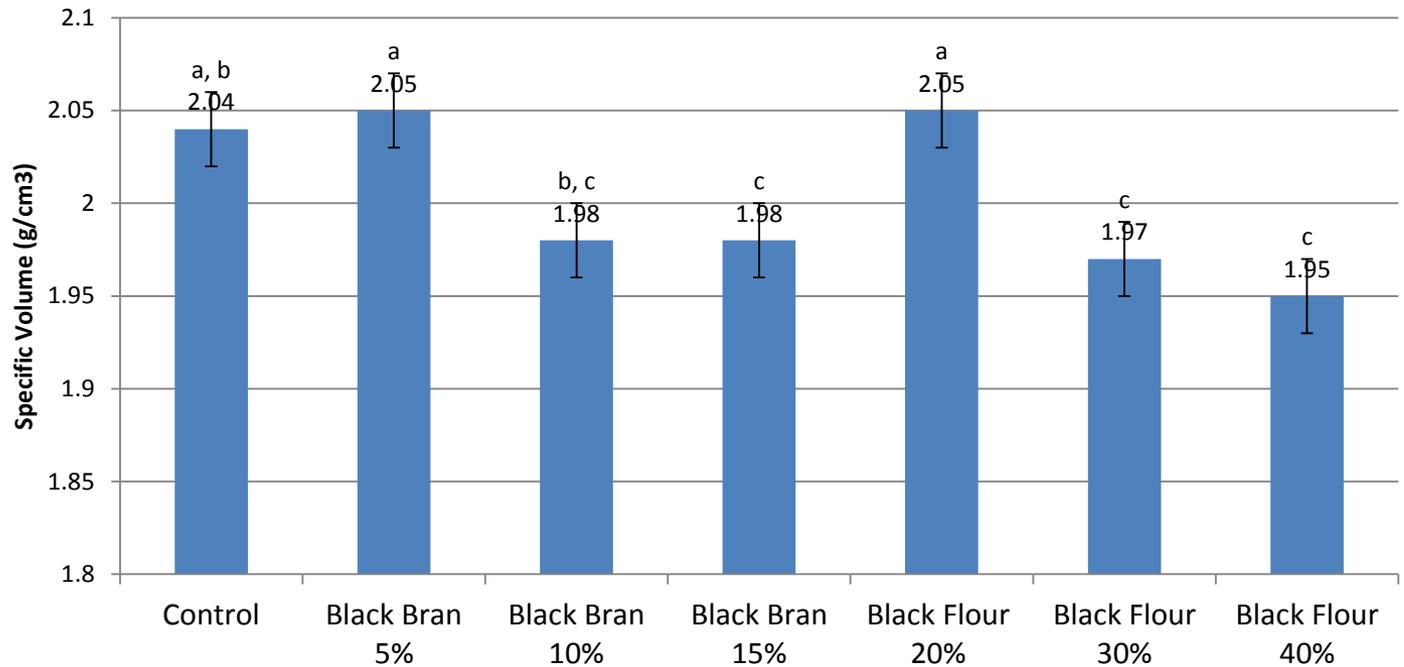
Samples with the same letter do not statistically differ (ANOVA, Tukey's HSD $P < 0.05$)

Specific Volume of Wheat Free Breads Using Specialty Sorghum



Specific Volume of Wheat Free Breads Using Specialty Sorghum

Specific Volume



Samples with the same letter do not statistically differ (ANOVA, Tukey's HSD $P < 0.05$)

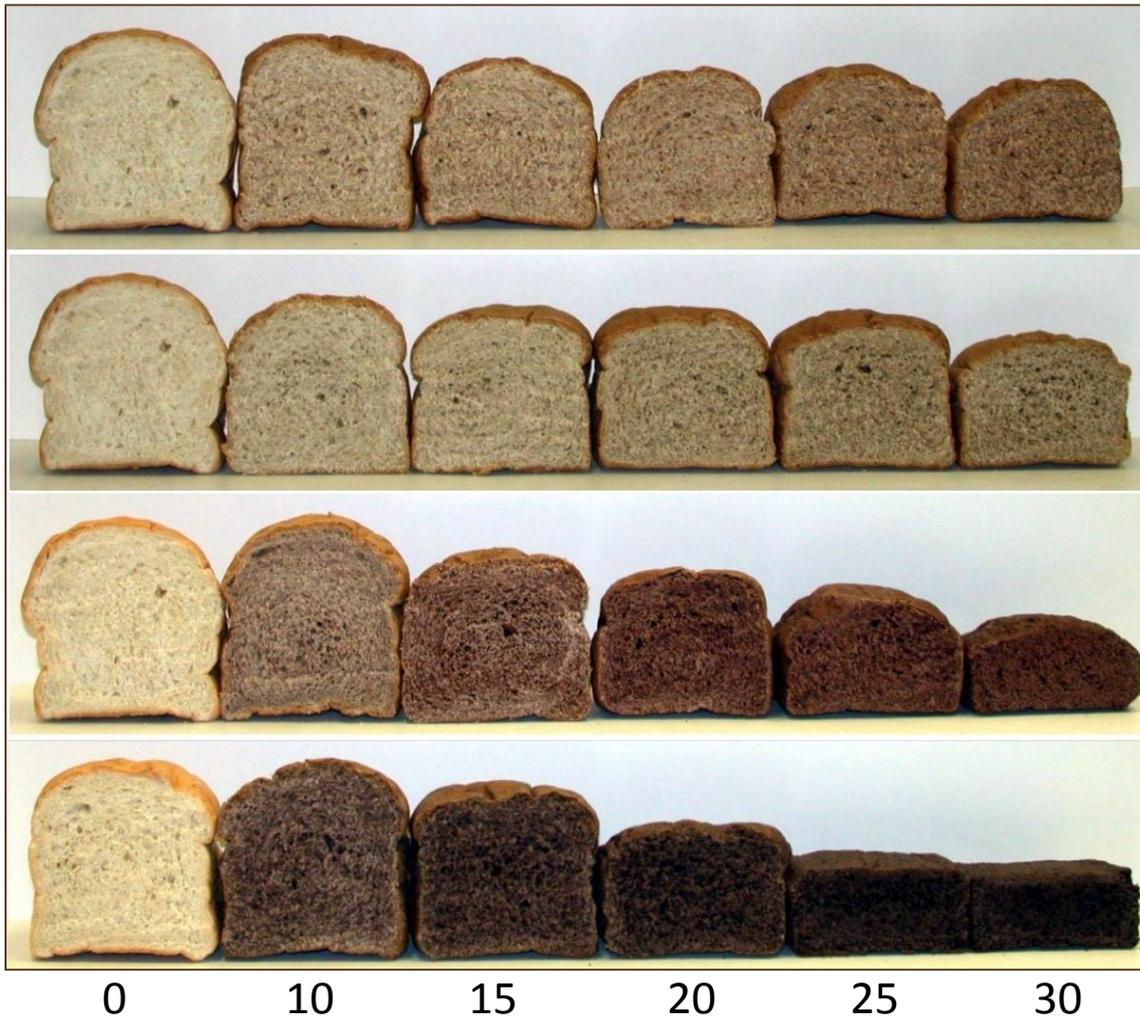


Aspects of Developing Foods Using Specialty Sorghums

- Percentage of usage of flour or bran will affect finished product quality.
 - As bran or flour addition increases, color will darken.
- Variety and particle size of sorghum will affect aspects of the finished product.
 - This is due to pericarp thickness and shape of flour or bran particles after milling
 - Specific Volume will be influenced by particle size & shape



Specialty Sorghums in Wheat Bread



0-30% Wheat
bran

0-30% White
sorghum bran

0-30% Brown
sorghum bran

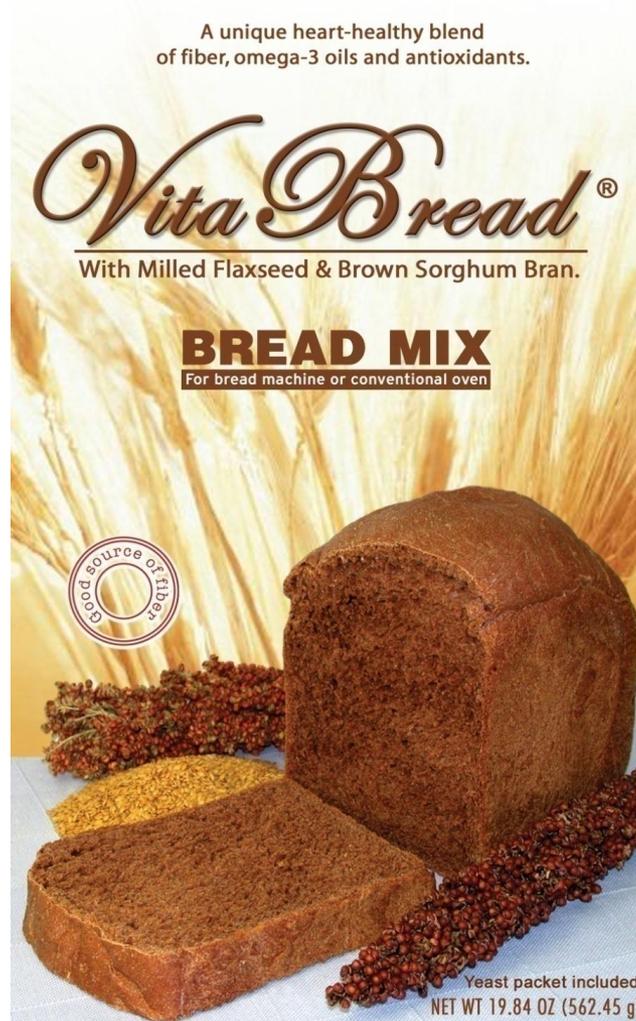
0-30% Black
sorghum bran

Specialty Sorghums in Wheat Bread

- When tested in wheat bread formulations, black sorghum bran produced the lowest specific volume loaves.
- If using sorghum bran in wheat bread, it is recommended to add gluten or other dough strengthening agents when you use more than 10% bran in your formulation.



Specialty Sorghums in Wheat Bread



Sorghum Extrusion

- Sorghum can be used for breakfast and snack type extruded products.

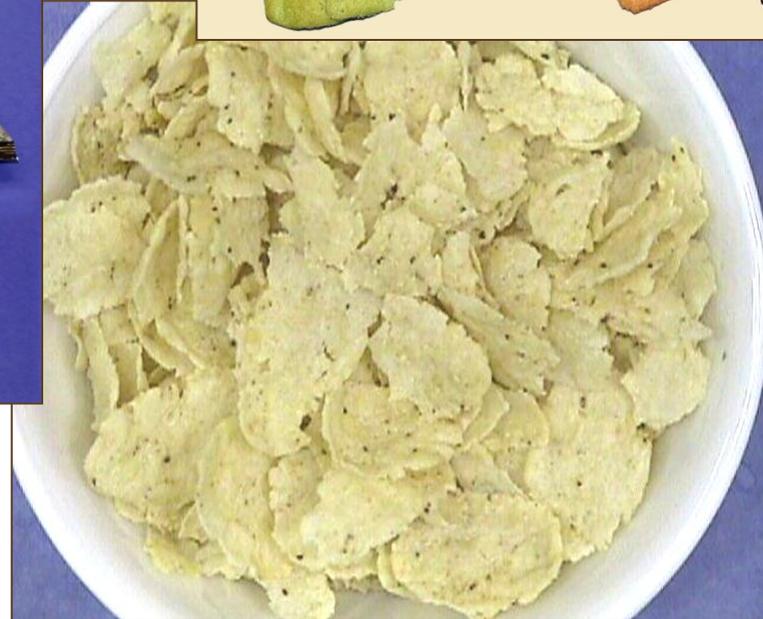


Sugar coated 80% white
sorghum extrudate

Sugar coated 80% high tannin
sorghum extrudate

Sugar coated 80% black
sorghum extrudate

Japanese Sorghum Snacks



Sorghum Bran in Cookies

- Colored sorghum bran can be used as an inclusion in cookies to improve dietary fiber levels.
- Brown sorghum bran was added at a 5% flour basis to these cookies to create a healthy fun snack.



Specialty Sorghum in Tortilla Chips



In Conclusion

- Sorghum is an excellent grain for use in foods due to the wide variety of pH stable colors, high dietary fiber content, low glycemic index, high antioxidant content, as well as being naturally gluten free.
- Increased availability of specialty sorghums gives companies a wide array of colors and an excellent source of dietary fiber that can be easily used in new products.

