

Antioxidant properties of sorghums assessed by three methods

AWIKA,¹ JM, Rooney¹, LW, Wu², XL, Prior², RL, and Cisneros-Zevallos³, L.



Texas A&M University
¹ Cereal Quality Lab, Soil and Crop Sciences,
² Children's Nutrition Center, Little Rock, AK
³ Horticulture Department
 College Station, TX 77840



Abstract

Specialty sorghums and their products were analyzed for antioxidant potential using three methods; oxygen radical absorbance capacity (ORAC), 2,2'-azinobis (3-ethyl-benzothiaziline-6-sulfonic acid) (ABTS), and 2,2-diphenyl-1-picrylhydrazyl (DPPH). The antioxidant activities were compared to those of common fruits and vegetables. The sorghums were also analyzed for phenol contents.

The sorghum brans had 3-4 times antioxidant activity of the grains. Brown sorghum brans had the highest antioxidant (ORAC) activity (2400 to 3100 μmol TE/g). The black and red sorghum brans also had high ORAC activity (1000 and 700 μmol TE/g, respectively). White sorghum brans had very low ORAC activity (64 μmol TE/g). Common fruits and vegetables have ORAC values ranging from less than 80 to about 900 μmol TE/g, DM basis.

The ABTS and DPPH methods correlated highly with ORAC ($R^2 = 0.98$). The ABTS method was found most suitable for sorghums; it had a cost advantage over ORAC and was more consistent across samples than DPPH. Phenol contents of the sorghums correlated highly with their antioxidant activity ($R^2 = 0.96$ to 0.98).

Specialty sorghums have high antioxidant activity relative to fruits and vegetables and have high potential as a source of nutraceuticals in foods. The more common antioxidant assay methods, ABTS and DPPH, have similar predictive power as ORAC on sorghum antioxidant activity.

Introduction

- Specialty sorghums have high levels of antioxidants.
- Brown sorghums contain tannins with high antioxidant properties
- Antioxidant compounds are concentrated in bran.
- Methods for antioxidant assay should ideally predict actual health benefits.
- ORAC has shown relevance to biological antioxidant status. However, it requires expensive specialized equipment that limits its application.
- Objective was to compare ORAC with the common ABTS and DPPH methods in evaluating antioxidant activity of sorghum and sorghum products.



Sorghum diversity



Materials & Methods

- sorghums: Brown (Sumac and Hi Tannin), black (Tx430) grown in 1999 and 2001, red (Tx2911), white, and red wheat bran.
- Sorghums were decorticated using PRL dehuller to obtain bran.
- Processed samples: extrudates of brown, black, and white sorghums; bread and cookies containing black and brown sorghum brans.
- All samples analyzed for:
 - phenols using Folin-Ciocalteu method.
 - antioxidant activity by ORAC, ABTS and DPPH methods.

Results and Discussion

Phenol contents and antioxidant properties of sorghum and sorghum products measured by three methods

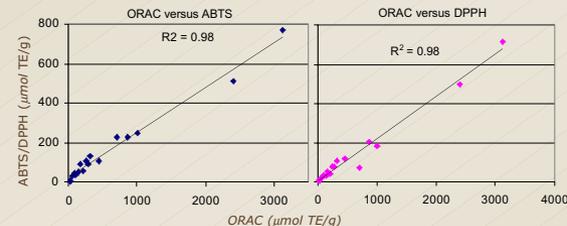
Sample	ORAC ^a	ABTS ^a	DPPH ^a	Phenol ^b
White grain	22	6	6	3
White grain extrudate	26	7	6	3
White bran	64	28	21	6
Red grain	140	53	28	7
Red bran	710	230	71	20
Black 2001 grain	219	57	41	6
Black 2001 extrudate	94	37	32	5
Black 2001 bran	1,008	250	184	26
Bread (30% Black 1999 bran)	92	45	28	5
Cookie (50% Black 1999 bran)	170	90	51	9
Hi Tannin (brown) grain	453	108	118	13
Hi Tannin grain extrudate	286	90	74	6
Hi Tannin bran	2,400	512	495	55
Sumac (brown) grain	868	226	202	23
Sumac bran	3,124	768	716	66
Bread (30% Sumac bran)	254	108	78	8
Cookie (50% Sumac bran)	324	130	106	14
CV	6.8	3.5	5.3	6.0

^aμmol TE/g DM basis

^bmg GAE/g DM basis (Folin-Ciocalteu method)

- ORAC values were 2-3 times higher than ABTS or DPPH values.
- ABTS and DPPH values were comparable for brown and white sorghums.
- DPPH values were significantly lower than ABTS for black and red sorghums, due to sample color interference with DPPH.
- Both ABTS and DPPH correlated highly with the ORAC method for the sorghums (top right).
- ORAC is believed to have some predictive value on the actual biological antioxidant status.
- ABTS and DPPH may have potentially similar predictive value on sorghum antioxidants.
- ABTS was most suitable for sorghums; it had a cost advantage over ORAC and no color interference observed with DPPH.
- Brown sorghums and their brans had the highest phenol and antioxidant potential; white sorghums had the lowest.
- Phenol levels correlated strongly with antioxidant activity:
 - phenol vs ORAC: $R^2 = 0.96$, $n = 17$
 - phenol vs ABTS: $R^2 = 0.98$, $n = 17$
 - phenol vs DPPH: $R^2 = 0.96$, $n = 17$.
- Phenol content of sorghum and sorghum products is a good predictor of antioxidant activity.

Correlation between ORAC and ABTS/DPPH



How does sorghum compare to common high antioxidant fruits?



ORAC μmol TE/g dry basis

- Sorghum brans were a superior source of antioxidants compared to common high antioxidant fruits.
- Wheat bran had low antioxidant activity.

Conclusions

- Specialty sorghum brans have higher antioxidant levels than common fruits.
- Brown sorghums have the highest antioxidant potential; these sorghums have tannins that are absent in other sorghums.
- The ABTS and DPPH methods are correlated with the ORAC measurements.
- The ABTS method is less expensive and a good alternative to the other methods.

References

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Wu, XL. Arkansas Children's Nutrition Center, Little Rock, AR.

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