

Ten Myths about Tannins in Sorghums

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Myth #1: Tannins are present in all sorghums

Fact: 99% or more of all sorghums in the USA do not contain tannins. Tannins are present in sorghums with a pigmented testa layer (Fig. 1). The presence of the testa layer is controlled by B_1 - B_2 genes. When B_1 - B_2 is dominant, a pigmented testa is present. Sorghums without a pigmented testa do not contain tannins.

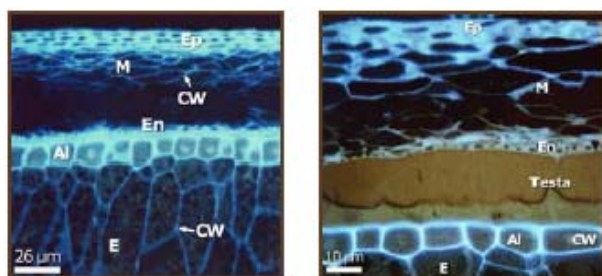


Figure 1. Fluorescence photomicrograph of cross-sections of a non-tannin (left) and a tannin sorghum kernel (right, adapted from Earp et al. 2004).

Myth #2: Tannin sorghums are toxic

Fact: Tannin sorghums have erroneously been reported to contain tannic acid. Tannin sorghums have condensed tannins, which are not toxic. Many foods such as grapes, blueberries, cranberries, dark chocolate, and carobs have condensed tannins. These foodstuffs are consumed without any adverse effects and are now considered as health foods because of the antioxidant properties of the tannins. Tannin sorghums are consumed as human food extensively in Africa and Asia without problems.

Myth #3: Birds and animals will not eat tannin sorghums

Fact: In a field with white, red, and tannin sorghums, birds will first eat white sorghum and then red sorghums before eating the tannin sorghums. Birds and animals consume tannin sorghums but prefer other sorghums when given a choice.

Myth #4: Tannins are measured by total phenol analysis

Fact: The total phenol analysis measures phenolic acids, condensed tannins, and tyrosine. All plants contain phenolic compounds.

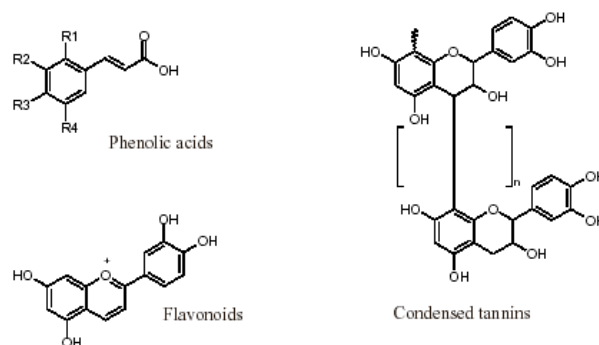


Figure 2. Structures of phenolic compounds.

Myth #5: Tannin sorghums prevent the digestion of nutrients

Fact: Tannins will decrease efficiency of growth in poultry and livestock; however, the amount depends on the animal species, processing the grain before feeding and the diet fed. In general, animals consume more feed to produce about the same or slightly less weight gains. In general, the feed efficiency is reduced by 5 to 10%.

Tannin sorghums do slow and reduce the digestibility of nutrients especially proteins. However, Elkin et al. (1996) demonstrated that sorghums containing equivalent amounts of tannins have different digestibilities. This suggests that tannins are only partially responsible for lower protein digestibility.

Myth #6: It is difficult to test for tannins

Fact: The chlorox bleach test is a good tool to identify sorghum with tannins. For tannin sorghums, bleaching dissolves the pericarp and turns the pigmented testa of tannin types black; non-tannin sorghums do not turn black (Fig. 3). However, the bleach test can yield false-positives on samples that have been molded and weathered. Care must be used when evaluating the bleached samples since some nontannin kernels might have some dark spots (Dykes et al. 2002, Taylor 2001,

Waniska et al. 1992).

Colorimetric methods have been used for many years to measure sorghum tannins. These include the Vanillin/HCl assay and the HCl/Butanol assay. These methods are quick and economical to perform and give an estimate of tannin content.

Normal-phase HPLC analysis with fluorescence detection efficiently separates tannins according to their degree of polymerization (Gu et al. 2002, Awika et al. 2003). This research will provide significant new information on sorghum tannins.



Figure 3. Chlorox bleach test of non-tannin and tannin sorghums.

Myth #6: All red sorghums have tannins

Fact: Grain color is not a reliable indicator of tannins in sorghum (Fig. 4). Only sorghums with a pigmented testa layer contain tannins. The presence of tannins in sorghums is controlled by the B_1-B_2 gene. Sorghums with a white, red, or yellow pericarp may or may not have tannins. The grain in Fig 4 with a testa has condensed tannins and cannot be distinguished from the ones without pigmented testa.

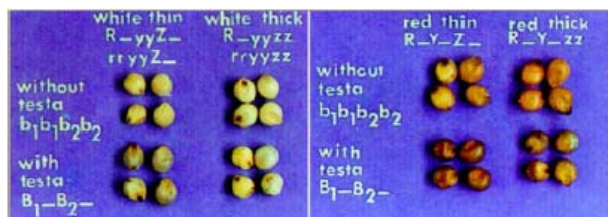


Figure 4. Variation in appearance of sorghum tannins. (Adapted from Rooney and Miller 1982).

Myth #7: Tannic acid is present in tannin sorghums

Fact: Tannic acid has never been found in sorghum even though tannic acid has been used as a reference (standard) in some of the analyses. Only condensed tannins are

present in tannin sorghums. Early experiments used tannic acid in feeding trials to evaluate the effect of tannins on feeding value. This information was prior to our current understanding that sorghum does not contain tannic acid.

Myth #8: Sorghum tannins are unhealthy for humans and animals

Fact: Tannin sorghums are an outstanding source of antioxidants (Table 1) that can be used in a wide variety of applications including preservation of ground meat (Jeschke 2004). Recent evidence strongly indicagtes that tannins are of benefit to human health. Tannins are known to bind to proteins making them indigestible since some animal studies have shown that they are excreted in the feces intact. However, in vitro data indicate that the microflora in the colon can degrade polymeric tannins into low molecular phenolic acids which could be absorbed through the colon. Tannins are nontoxic and may slow digestibility in humans, which is an advantage to type II diabetics.

Myth #9: Tannin sorghums make unacceptable food products

Fact: Many acceptable products, such as porridges and alcoholic beverages, have been developed from tannin sorghums in Africa (Awika and Rooney 2004). Good-quality breads containing tannin sorghum bran have high antioxidant and dietary fiber levels with a natural dark brown color and excellent whole grain flavor (Gordon 2001). In addition, healthy bread mixes containing tannin sorghum bran, barley flour, and flaxseed have been developed (Rudiger 2003). Tannin sorghums are often preferred for production of sorghum beers and alcoholic beverages because of their dark color (Rooney and Awika 2004). The tannins affect malt enzyme activity but brewers avoid problems by using alkaline treatments during malting.

Table 1. Antioxidant activity (ORAC) levels of tannin sorghum brans compared to common fruits. (Adapted from Awika 2003).

Commodity	ORAC (dry wt.)
Tannin sorghum bran	2400–3100
Blueberries	87–870
Strawberries	356–400
Plums	452–600
Grapes	100
Watermelon	15
Orange	80–150

Myth #10: There are NO uses for tannin sorghum

Fact: Tannin sorghums have been used in the production of good-quality breads, malt, beer, and distilled beverages (Maltai). Tannin sorghum brans have higher antioxidant activity *in vitro* than fruits (Table 1). Sorghum tannins can be used as antioxidants in meat systems (Jeschke 2004) and they may retard oxidative damage due to high-energy irradiation (McDonough et al. 2004).

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