



Variation of tannin content in some sorghum grain (*Sorghum vulgare*) varieties grown in the Sudan

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Abstract

Twenty three sorghum varieties were brought from the Gezira Agricultural Research Station to examine their tannin content using the modified vanillin HCl. The tannin content ranged from 0.056 to 1.121% Catechin equivalent (CE). Seed coat color showed variation and was not consistent with the tannin level in most varieties tested. The results of the rapid visual test indicated a significant difference in CE% between seeds having blue color and those with green and yellow colors and between seeds having dark brown and yellow colours. It was concluded that rapid visual test is a reliable measure for tannin estimation unlike that of seed coat color. It is to be recommended that each sorghum variety at marketing should carry a leaflet showing its tannin content.

Keywords: sorghum, tannin, seed coat color, rapid visual test

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Introduction

The failure of the exotic breeds of poultry to produce to their maximum genetic potential is partially attributable to nutrition which is mainly dependant on feed items of no clearly identified nutritional composition. The effect will be very detrimental if such items are included at higher rates. One of these items is sorghum which is normally included at about 60% in most poultry feed in the Sudan. Unfortunately, sorghum grains contain varying amounts of anti-nutritional factors such as tannins (Ahmed, 1985). Various types of sorghum exist in the Sudan (Miller et al., 1964; Burleson et al., 1956; and Byrid et al., 1960). Elkhali and Eltinay, (1999), Osman, (2004), and Hassan and Eltinay, (1995) indicated that Sudanese sorghum varieties have different tannin levels. They also noted the possibility of variations in the tannin content among samples of the same sorghum variety harvested at different conditions and times. Despite these facts the tannins content of sorghum types used in animal feeding was not given the necessary consideration. Sorghum grains are normally included in animal rations regardless to their tannin content. This practice may

lead to preparation of rations with high amount of tannins if the sorghum type used is of high tannin level. Such ration may produce a negative impact on animal performance (Douglas et al., 1991; Kumar et al., 2005). These negative impacts cannot be avoided unless the tannin level in the ration does not exceed the permissible level for the maximum animal performance. Such condition can be insured if the sorghum tannin level is known. Although the studies of Ahmed (1985) and Hassan and Eltinay (1995) determined tannin level of some sorghum types, some of these values contradicted the values observed by Gibril (1998) and El Khalifa and Eltinay (1999). The findings of Boren and Waniska (1992) and Ahmed and Mohamed (1987) suggested that seed coat color is a reliable indicator of tannin level. This assumption contradicted the reports of Blessin et al. (1963) and Bullard et al. (1980). Hence a research work is needed to investigate these conditions and update the present knowledge. Such information is very necessary for poultry nutritionists.

The objectives of this study therefore are:

1. To examine the tannin levels of 23 sorghum varieties.

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2. To investigate the relationship between seed coat color and tannin level in these Sudanese sorghum varieties.
3. To examine the validity of the rapid visual test as a reliable measure for tannin estimation in the tested sorghum varieties.

Materials and Methods

Twenty three cultivars of sorghum (*Sorghum vulgare*); were brought from the Agricultural Research Corporation farm (Wad Medani). The cultivars were locally named: Fatarita Arian, Pi 570462, Fatarita Arafa, Gadambaliya, Safra, Tabat, Wad Mubarak, HSD 5980, Wad Ahmed, Regan, HSD 3439, Dabar, Arafa Gadamak, HSD 6000, Mugud Ahamer, Fatarita Girin, Ajab Sido, Umbenin, Wad Akar, HSD 5774, Yarwasha, HSP 3489 and HSP 5907. Three samples were taken from each cultivar for the visual assessment and chemical analysis.

Visual assessment:

Tannin contents of the sorghum samples were determined using the rapid visual assessment method (Price and Butler, 1977). According to this method, the intensity of the color of seed coat of the cultivars' samples was tested for the tannin content using the standard reference indicated in Table (1).

Table 1: The color guide of the Rapid Visual estimations of tannins level

Seed coat color	Tannin level estimation
Yellow	Little or no tannin (low)
Green	Low (low medium)
Dark green	Intermediate (high medium)
Blue	High

The results of the rapid visual estimations were then classified according to their tannin content (CE%) tests into low, low medium, high medium and high corresponding to yellow, green, dark green and blue colours, respectively. Seed coat color for the samples was also visually determined as it appears.

Tannins analysis

Samples were cleaned and the quantity of tannins content estimation was carried out using the modified vanillin – HCL (MV – HCL) as described by Price et al. (1978).

Statistical Analysis

The descriptive statistics (means and standard error) were measured to describe the tannins contents of the examined sorghum varieties. Analysis of variance was used to examine differences between tannins level groups (low, low medium, high medium and high)

according to the rapid visual estimation results. The variations in tannins contents between colours groups according the seed coat color (White, red, grey, yellow, brown and white with red spots) were also examined by analysis of variance. Least significant difference (LSD) test was used to assess significance of difference between means as described by Gomez and Gomez (1984). The coefficient of the spearman rank order correlation was used to examine the relation between the seed coat color and rapid visual tests.

Table 2: Tannin content (CE%) of the examined sorghum grain varieties

S/no	Sorghum variety	Tannin content
1	Ajab Sido	0.66± 0.08
2	Arafa	0.51± 0.14
3	Dabar	0.43± 0.14
4	F.Aryana	0.06 ± 0.05
5	F.Giran	0.66± 0.08
6	Gadambalia	0.12± 0.05
7	Gadamak	0.51± 0.14
8	HSD3439	0.22± 0.05
9	HSD5774	0.82± 0.15
10	HSD5980	0.38± 0.14
11	HSD6000	0.53± 0.09
12	HSP3989	0.99± 0.05
13	HSP5907	1.12± 0.60
14	Mugud Ahmar	0.64± 0.47
15	PL 570462	0.06± 0.09
16	Regan	0.27± 0.47
17	Safra	0.14± 0.05
18	Tabat	0.15± 0.05
19	Umbenin	0.67± 0.65
20	Wad Ahmed	0.40± 0.14
21	Wad Akar	0.81± 0.60
22	Wad Mubarak	0.19± 0.05
23	Yarwasha	0.94± 0.50

Values are means of three determinations ± Standard error
CE = Catechin equivalent

Results and Discussion

Tannins content of the studied sorghum varieties

Tannins contents of the sorghum varieties observed in the current study are shown in Table (2). The results reveal that, the tannin content of the samples ranges between (0.06- 1.12% CE). Among these varieties, the tannin levels of the hybrids sorghum varieties Pi 570462, HSD 3439, HSD 5980, HSD 6000, HSD 5774, Yarawasha, HSD 3989 and HSD 5907 are not reported before. For the other varieties, the observed values of their tannin content (CE %) were not similar to the values reported before. For examples, the tannin content for the variety Wad Ahmed was reported by Ahmed (1985), Hassan and Eltinay (1995), Gibril (1998) and El-Khalifa and Eltinay (1999) as 0.96, 1.6, 1.36 and 1.16%, respectively unlike the figure 0.40% determined in this study. The tannin content of Dabar

Table 3: Seed coat color and the rapid visual test color of the tested sorghum varieties

S/No	Sorghum Variety	Tannin content (CE%)	Seed coat color	Rapid visual test Color
1	Fatarita Ariana	0.05	White	Yellow
2	Pi 570462	0.06	Red	Yellow
3	Fatarita Arafa	0.11	White	Yellow
4	Gadambaliya	0.12	Grey	Yellow
5	Safra	0.14	Yellow	Yellow
6	Tabat	0.15	White	Yellow
7	Wad-Mubarak	0.19	White	Yellow
8	HSD3439	0.22	White	Green
9	Regan	0.27	Brown	Green
10	HSD5980	0.38	Brown	Green
11	Wad-Ahmed	0.40	White	Green
12	Dabar	0.42	White	Green
13	Arafa Gadamak	0.51	Grey	Green
14	HSD6000	0.53	Grey	Green
15	Mugud Ahamar	0.64	Red	Dark Brown
16	Fatarita Giran	0.65	White	Dark Brown
17	Ajab Sido	0.66	White	Dark Brown
18	Um Benin	0.67	White and red spots	Dark Brown
19	Wad-Akar	0.81	White and red spots	Dark Brown
20	HSD 5774	0.82	Red	Dark Brown
21	Yarawasha	0.94	White	Blue
22	HSD 3989	0.99	Red	Blue
23	HSD5907	1.12	White and red spots	Blue

CE = Catechin equivalent

Table 4: Tannins content of the different seed coat color groups

Seed coat color	White	Red	Grey	Yellow	Brown	White and with spots	SE	P	Sign
No. of observations	10	4	3	1	2	3			
Tannins CE%	0.38	0.63	0.38	0.14	0.33	0.87	0.19	0.146	NS

CE = Catechin equivalent

Table 5: Tannins content of the different rapid visual test color groups

Rapid visual test groups	Yellow	Green	Dark Brown	Blue	SE	P	Sign
No. of observations	7	7	6	3			
Tannins CE% mean	0.12 ^a	0.39 ^{ab}	0.71 ^{bc}	1.02 ^c	0.03	0.00	S ^{***}
Tannins CE% range	0.06-0.51	0.22-0.53	0.66-0.81	0.94-1.12	-	-	-

CE = Catechin equivalent

variety, had the values of 0.19, 0.26, 0.24 and 0.42% observed by Ahmed and Mohamed (1987), Gibril (1998), El Khalifa and Eltinay (1999) and the present study, respectively. The variations in tannin content of the same sorghum variety was also evident for Safra, Wad Akar, Ajab sido, Umbenin and Feterita Iryana sorghum varieties when the present results were compared with those of Ahmed and Mohamed (1987) who reported the values 0.7, 0.21, 0.23, 0.17, and 0.14%, respectively. These variations could be due to the storage duration, impurities of samples due to cross pollination and deterioration in breed characteristic with time and repeated planting. These discrepancies in tannin contents may sometimes provide wrong information that may result in errors in ration formulation for poultry. The current results indicated that for the proper ration mixing, the tannin content of the used sorghum variety is to be known. In other words poultry nutritionists and feeders should not

depend on previous CE% values recorded for a particular sorghum variety. It is to be recommended that each sorghum variety carries a leaflet showing its tannin content.

Tannin content and seed coat colour

The tannin content, seed coat color and the color determined by the rapid visual test of the sorghum varieties are given in Table (3) and depicted in Figure (1). The tannin contents of some investigated varieties showed consistency with the seed coat color as shown in table (3) others showed the opposite. For example, red seed coat color is seen with low tannin sorghums (Pi 570462, HSD3439 and HSD5980), while white seed coat color is seen (yarawasha) with high tannin. Another example is that Regan and HSD 5980 with brown color but intermediate tannin level. These observations were confirmed by the results shown in Table (4), where the different colors of seed coat did

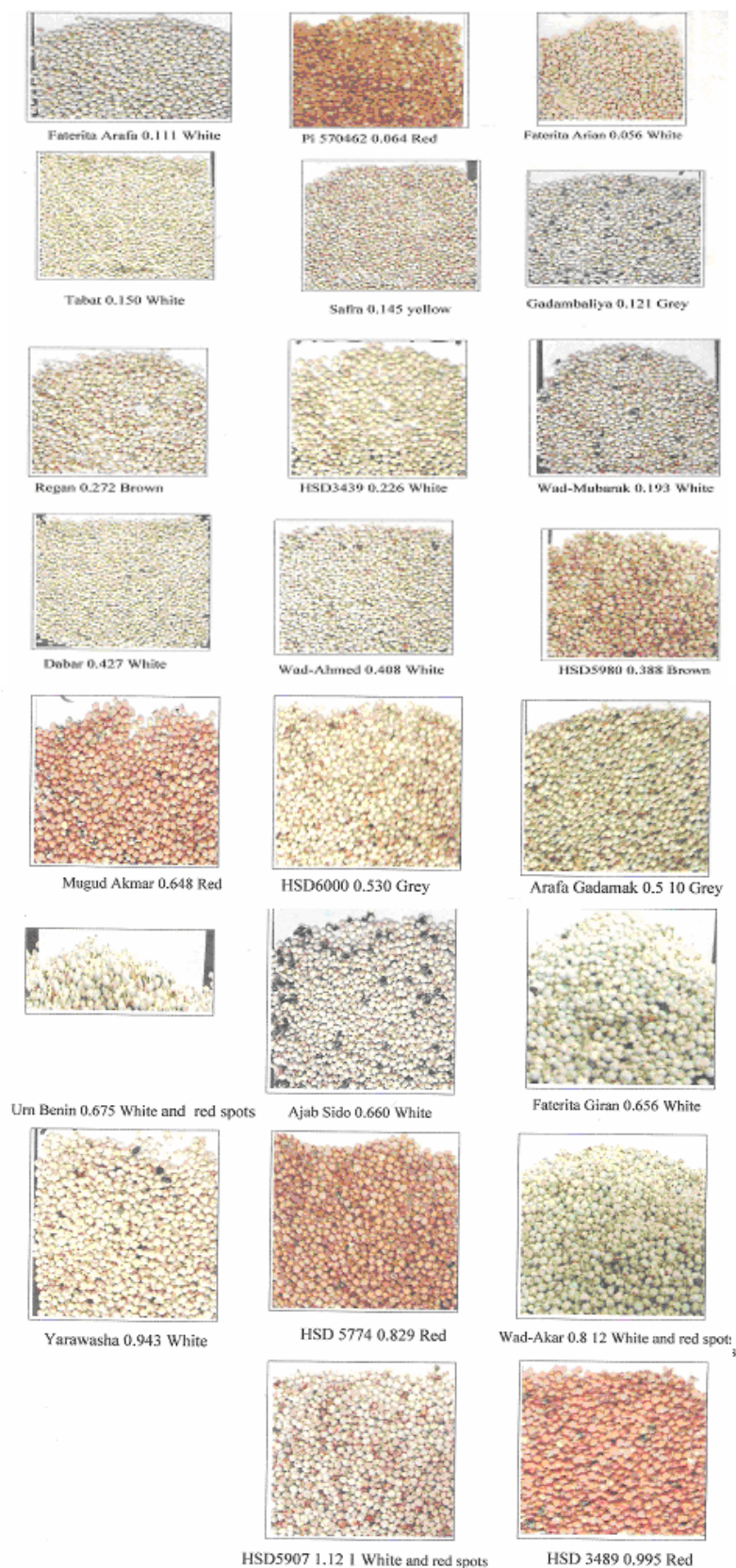


Fig.1: Photographs of the studied Sudanese sorghum grain varieties

not show variation in the tannin concentration. These results agreed with the results suggested by Blessin et al. (1963) and Bullard et al. (1980) who reported no association between tannin content of the seed and its coat colour.

On the other hand the present results contradict with the findings of Harris and Burns (1973) and Ahmed and Mohamed (1987). They reported an association between tannin content of the seed and its coat colour. Ahmed and Mohamed (1987) stated that white seed coat color sorghums have low tannin, light yellow seed coat color sorghums have intermediate tannins and red and brown seed coat color sorghums have high tannin levels. So it can be concluded that seed coat color is not a reliable indicator of tannin content in Sudanese Sorghums.

In the same context, the results of the rapid visual test shown in table (5) indicated a significant difference in CE% between seeds having blue color and those with green and yellow colours. The results also showed a significant difference in CE% between seeds having dark brown and yellow colours. However no difference in CE% was seen between those having green and yellow and green and dark brown colours. This result confirms the validity of the rapid visual test as a reliable measure for tannin determination in Sudanese sorghums. The coefficient of the spearman rank order correlation between seed coat color and rapid visual test is insignificant ($r = 0.22$). This indicated the poor relationship between the two tests.

The study concluded that there are considerable variations in tannin contents between the different sorghum varieties and this makes it imperative to know the tannin content of the sorghum variety used in poultry feed. It was also concluded that rapid visual test is a reliable measure for tannin estimation unlike that of seed coat color and there is no any relation between the two tests.

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