NUTRIENT COMPOSITION OF 15 VARIETIES OF OKLAHOMA SORGHUM GRAIN

W.G. Luce[1], C.V. Maxwell[2], S.E. Hawkins[3], D.W. Weibel[4], M.D. Woltmann[5], and L.E. Bulgerin[6]

Story in Brief

Fifteen varieties of hybrid sorghum grain grown in five Oklahoma locations for two years were analyzed for tannin, dry matter, crude protein, lysine, threonine, isoleucine, methionine, cystine and 12 additional amino acids. Significant differences among varieties were found for tannin, crude protein and lysine expressed as % of crude protein. Little differences among varieties were found for threonine, isoleucine and methonine + cystine expressed as % of sorghum grain or % of crude protein or lysine expressed as % or sorghum grain. Sorghum grain grown in non-irrigated locations was nearly 8% higher in crude protein than sorghum grain grown in irrigated locations but was nearly 6% lower in lysine when expressed as percent of crude protein. Bird resistant varieties were higher in crude protein, lysine as expressed as % of sorghum grain and tannin. These results suggest that significant nutrient composition differences exist among varieties of hybrid sorghum grain expecially between bird resistant and non-bird resistant varieties. Irrigated sorghum grain may also differ significantly in nutrient composition when compared to non-irrigated sorghum grain.

(Key words: Sorghum grain, Protein, Amino acids, Tannin)

Introduction

Sorghum grain is an important crop in Oklahoma with approximately 20 million bushels produced annually and is a major feed grain for livestock in the Southwestern U.S. Sorghum grain is usually characterized as being variable in nutrient content. Previous work at this institution has shown it to vary from 11.1 to 16.5% crude protein on a dry matter basis for nine different varieties. Research evaluating varieties of sorghum grain produced in Oklahoma for various amino acids and tannin was not available and very limited for crude protein and dry matter. Thus 15 varieties of sorghum grain grown in Oklahoma were analyzed for these components.

Experimental Procedure

All hybrid sorghum grain varieties were grown in 1984 and/or 1985 performance trials at five different Oklahoma Agricultural Experiment Branchs as shown in Table 1. No sorghum grain was harvested at Mangum in 1985 because of inadequate rainfall resulting in abandonment of the test plots.

---

[1]Regents Professor, [2]Professor, [3]Assistant Professor, [4]Professor Emeritus, [5]Graduate Student, [6]Laboratory Technician.

Table 1. Hybrid sorghum grain varieties analyzed.

	Location									
	Altus[a]		Goodwell[a]		Haskell[b]		Mangum[b]		Perkins[b]	
Variety	1984	85	1984	85	1984	85	1984	85	1984	85
Asgrow Chaparal	--	+	--	+	--	+	--	--	--	+
Asgrow Topaz	+	+	+	+	+	+	+	--	+	+
Dekalb DK-39Y	+	--	+	--	+	--	+	--	+	--
Dekalb DK-59E	--	+	--	+	--	+	--	--	--	+
Funk GS 384	--	+	--	+	--	+	--	--	--	+
Jacques 308	+	--	+	--	+	--	+	--	+	--
PAG 4462	+	+	+	+	+	+	--	--	+	+
PAG 5572	--	+	--	+	--	+	--	--	--	+
Paymaster BR90	+	+	+	+	+	+	--	--	+	+
Paymaster 930	+	--	+	--	+	--	+	--	+	--
Pioneer Brand B864	+	--	+	--	+	--	+	--	+	--
T-E-Dinero-E	+	+	+	+	+	+	+	--	+	+
T-E-Y 60	+	--	+	--	+	--	+	--	+	--
Warner W-744 DR	--	+	--	+	--	+	--	--	--	+
Warner W-840	+	+	+	+	+	+	+	--	+	+

[a] = Irrigated

[b] = Non-irrigated

+ = Variety grown in that location for respective year.

- = Variety was not grown in that location for respective year.

All sorghum grain samples were analyzed on a dry matter basis for tannin, dry matter, crude protein, lysine, threonine, isoleucine, methionine and cystine. Amino acid concentrates were determined from acid hydrolysates by ion exchange chromatography using a Beckman model 121 automatic amino acid analyzer. Values for methionine (an essential amino acid) and cystine (a non-essential amino acid) were combined in all the data reported since cystine can meet up to 50% of the methionine requirements of swine. Tannin content was estimated using the vanillin assay.

Results and Discussion

Least square means for dry matter, crude protein and tannin for each variety are shown in Table 2. Little differences were noted among varieties for dry matter with a range of only 88.64 to 89.32%. Crude protein values expressed on a dry matter basis among varieties were significant ($P<.01$) ranging in value from 10.86% for the Dekalb DK-39Y variety to 13.02% for Dekalb DK-59E.

The tannin content among varieties were significant ($P<.01$). This was expected since three of the varieties in the study were high tannin-bird resistant; Paymaster BR90, Pioneer Brand B864 and Warner W-744DR. These three varieties had a tannin content of 2.36, 2.51 and 2.51% respectively. The other 12 varieties ranged in tannin from .01 to .23%.

Table 2. Effect of variety on dry matter, crude protein and tannin content of sorghum grain.[a]

Variety	Dry Matter	Crude[b] Protein	Tannin[b]
	%	%	%
Asgrow Chaparral	88.84 ± .21[c]	12.48 ± .51[c]	.19 ± .27[c]
Asgrow Topaz	89.12 ± .14	11.28 ± .33	.10 ± .17
Dekalb DK-39Y	88.69 ± .19	10.86 ± .47	.06 ± .25
Dekalb DK-59E	88.80 ± .21	13.02 ± .51	.23 ± .27
Funk GS 384	88.73 ± .21	12.77 ± .51	.22 ± .27
Jacques 308	88.89 ± .19	12.61 ± .47	.01 ± .25
PAG 4462	89.09 ± .14	11.74 ± .30	.11 ± .19
PAG 5572	89.32 ± .21	12.71 ± .51	.17 ± .27
Paymaster BR 90	88.82 ± .14	11.42 ± .35	2.36 ± .19
Paymaster 930	88.86 ± .19	12.96 ± .47	.03 ± .25
Pioneer Brand B864	88.64 ± .19	12.12 ± .47	2.51 ± .25
T-E-Dinero-E	88.94 ± .14	11.73 ± .33	.09 ± .17
T-E-Y 60	88.94 ± .19	11.08 ± .47	.02 ± .25
Warner W-744 DR	88.75 ± .21	11.83 ± .51	2.51 ± .27
Warner W-840	89.21 ± .14	11.60 ± .33	.05 ± .17

[a]Percent of sorghum grain on a dry matter basis

[b]Significant differences among varieties ($P < .01$)

[c]Standard error

Least square means for lysine, threonine, isoleucine and methionine + cystine expressed as percent of sorghum grain on a dry matter basis are shown in Table 3. No significant differences ($P > .10$) were observed among varieties. Least square means for the same amino acid expressed as percent of crude protein is shown in Table 4. Little differences were noted among varieties for threonine, isoleucine and methionine + cystine. However, a difference among varieties for lysine expressed as percent of crude protein was significant ($P < .01$). Lysine threonine, isoleucine and methionine + cystine means for all varieties increased linearly as crude protein increased ($P < .01$). Partial correlation coefficients for lysine, threonine, isoleucine and methionine + cystine and crude protein were .55, .44, .83 and .36 respectively.

Two locations where sorghum grain samples were collected (Altus and Goodwell) were irrigated during both years while three locations (Haskell, Mangum and Perkins) were non-irrigated both years (Table 1). Nutrient differences between irrigated and non-irrigated (dry land) sorghum are presented in Table 5. Sorghum grain grown in non-irrigated plots was higher in crude protein ($P < .01$), isoleucine when expressed as percent of crude protein ($P < .05$) and methionine + cystine when expressed as % of crude protein ($P < .05$). Sorghum grain grown on irrigated plots was higher in lysine when expressed as percent of crude protein ($P < .01$) and threonine expressed as percent of crude protein ($P < .10$). Little difference was noted for other nutrients analyzed (Table 5). No significant differences ($P > .10$) between years among varieties were found for any nutrient analyzed. However, a significant treatment X year interaction for irrigated and non-irrigated sorghum grain was found (Table 6). Considerably less rainfall during the months of July and August in 1984 than in 1985 for the non-irrigated locations of Haskell and Perkins may explain the reduced yields and interaction.

Table 3. Effect of variety on lysine, threonine, isoleucine and methionine + cystine content of sorghum grain.[ab]

Variety	Lysine	Threonine	Isoleucine	Methionine + Cystine
	%	%	%	%
Asgrow Chaparral	.24 ± .01[c]	.39 ± .03[c]	.52 ± .03[c]	.37 ± .05[c]
Asgrow Topaz	.24 ± .01	.36 ± .02	.47 ± .02	.36 ± .03
Dekalb DK-39Y	.24 ± .01	.33 ± .03	.41 ± .03	.30 ± .04
Dekalb DK-59E	.26 ± .01	.40 ± .03	.51 ± .03	.35 ± .05
Funk GS 384	.25 ± .01	.39 ± .03	.49 ± .03	.36 + .05
Jacques 308	.27 ± .01	.40 ± .03	.51 ± .03	.31 ± .04
PAG 4462	.26 ± .01	.37 ± .02	.48 ± .02	.35 ± .03
PAG 5572	.27 ± .01	.41 ± .03	.51 ± .03	.43 ± .05
Paymaster BR 90	.27 ± .01	.35 ± .02	.46 ± .02	.29 ± .03
Paymaster 930	.24 ± .01	.37 ± .03	.52 ± .03	.36 ± .04
Pioneer Brand B864	.28 ± .01	.38 ± .03	.49 ± .03	.31 ± .04
T-E-Dinero-E	.25 ± .01	.38 ± .02	.48 ± .02	.32 ± .03
T-E Y-60	.25 ± .01	.36 ± .03	.45 ± .03	.33 ± .04
Warner W-744 DR	.25 ± .01	.27 ± .03	.47 ± .03	.32 ± .05
Warner W-840	.26 ± .01	.38 ± .02	.48 ± .02	.35 ± .03

[a] Percent of sorghum grain on a dry matter basis

[b] No significant differences among varieties ($P > .10$)

[c] Standard error

Table 4. Effect of variety on lysine, threonine, isoleucine and methionine + cystine expressed as % of crude protein.[a]

	Lysine[b]	Threonine	Isoleucine	Methionine + Cystine
	(% of CP)	(% of CP)	(% of CP)	(% of CP)
Asgrow Chaparral	1.95 ± .08[c]	3.12 ± .21[c]	4.20 ± .15[c]	2.99 ± .35[c]
Asgrow Topaz	2.12 ± .06	3.20 ± .14	4.18 ± .10	3.17 ± .22
Dekalb DK-39Y	2.27 ± .08	3.08 ± .19	3.85 ± .14	2.83 ± .32
Dekalb DK-59E	2.06 ± .09	3.01 ± .21	3.93 ± .15	2.62 ± .35
Funk GS 384	2.00 ± .09	3.01 ± .21	3.86 ± .15	2.88 ± .33
Jacques 308	2.14 ± .08	3.20 ± .19	4.07 ± .14	2.50 ± .32
PAG 4462	2.19 ± .06	3.19 ± .15	4.06 ± .10	2.94 ± .24
PAG 5572	2.14 ± .09	3.19 ± .21	4.03 ± .15	3.30 ± .35
Paymaster BR90	2.34 ± .06	3.09 ± .14	4.02 ± .10	2.61 ± .24
Paymaster 930	1.88 ± .08	2.83 ± .19	4.05 ± .14	2.75 ± .32
Pioneer Brand B864	2.28 ± .08	3.16 ± .19	4.06 ± .14	2.59 ± .32
T-E Dinero-E	2.15 ± .06	3.25 ± .14	4.10 ± .10	2.77 ± .22
T-E-Y-60	2.29 ± .08	3.29 ± .19	4.07 ± .14	3.03 ± .32
Warner W-744 DR	2.14 ± .09	2.38 ± .21	3.99 ± .15	2.70 ± .35
Warner W-840	2.26 ± .06	3.24 ± .14	4.14 ± .10	3.00 ± .22

[a] Dry matter basis

[b] Significant differences among varieties ($P < .01$)

[c] Standard error

Table 5. Irrigated vs. non-irrigated sorghum grain.

Item[a]	Irrigated	Non Irrigated	SEM[b]	Significance[c]
Crude protein, %	11.56	12.47	.17	**
Lysine, % of SG[d]	.25	.26	.004	
Lysine, % of CP[e]	2.21	2.08	.03	**
Threonine, % of SG	.36	.37	.01	
Threonine, % of CP	3.16	3.00	.07	†
Isoleucine, % of SG	.47	.50	.01	*
Isoleucine, % of CP	4.05	4.03	.05	
Methionine + Cystine				
% of SG	.31	.37	.02	*
% of CP	2.73	2.96	.11	
Dry matter, %	88.89	88.93	.07	

[a]Dry matter basis

[b]Standard error of mean

[c]** = $P<.01$, * = $P<.05$, † = $P<.10$

[d]SG = sorghum grain

[e]CP = crude protein

Table 6. Significant treatment X year interactions for nutrient content of sorghum grain.

Item	1984 Irrigated	1984 Non-Irrigated	1985 Irrigated	1985 Non-Irrigated
Crude protein, %**	11.18	13.23	11.93	11.72
Lysine				
% of crude protein**	.23	.20	.21	.22
Threonine				
% of sorghum grain*	.35	.40	.38	.35
Isoleucine				
% of sorghum grain*	.45	.53	.48	.47

** Significant season X treatment interaction ($P<.01$)
* Significant season X treatment interaction ($P<.05$)

Table 7 compares nutrient composition of resistant vs. non-bird resistant varieties of sorghum grain. Paymaster BR90, Pioneer Brand B864 and Warner W-744DR were the bird resistant varieties with the remainder being non-bird resistant. Bird resistant varieties were higher in crude protein ($P<.10$), lysine expressed as % of sorghum grain ($P<.05$) and tannin ($P<.01$).

Non-bird resistant varieties were higher in threonine expressed as % of sorghum grain ($P<.05$), threonine expressed as % of crude protein ($P<.01$), isoleucine expressed as % of crude protein ($P<.10$), methionine + cystine expressed as % of sorghum grain ($P<.10$) and methionine + cystine expressed as % of crude protein ($P<.05$). Little difference was noted for lysine expressed as % of crude protein or isoleucine expressed as % of sorghum grain or dry matter.

Table 7. Resistant vs. non-bird resistant sorghum grain.

Item[a]	Bird Resistant	Non-bird Resistant	SEM[b]	Significance[c]
Crude protein	14.67	12.00	1.01	†
Lysine, % of SG[d]	.27	.25	.004	*
Lysine, % of CP[e]	2.16	2.12	.05	
Threonine, % of SG	.34	.38	.01	*
Threonine, % of CP	2.80	3.15	.09	**
Isoleucine, % of SG	.48	.49	.01	
Isoleucine, % of CP	3.83	4.06	.08	†
Methionine, + Cystine				
% of SG	.31	.35	.33	†
% of CP	2.52	2.89	.12	*
Dry matter, %	88.78	89.00	.08	
Tannin, %	2.42	.11	.09	**

[a]Dry matter basis

[b]Standard error of mean

[c]** = $P<.01$, * = $P<.05$, † = $P<.10$

[d]SG = sorghum grain

[e]CP = crude protein

These results suggest that significant nutrient composition differences occur among varieties of hybrid sorghum grain especially between bird resistant and non-bird resistant varieties. Irrigated and non-irrigated sorghum grain may also differ significantly in nutrient composition. Consideration of these variables is critical to the optimal utilization of sorghum grain.