AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D.C. 20523

BIBLIOGRAPHIC INPUT SHEET

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1. SUBJECT CLASSIFICATION

A. PRIMARY: AGRICULTURE

B. SECONDARY: CEREAL CROP

2. TITLE AND SUBTITLE

RAT GROWTH RESPONSE RELATED TO GRAIN SORGHUM

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4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
NOVEMBER 1977	3 PAGES	ARC 599.3233-5774

7. REFERENCE ORGANIZATION NAME AND ADDRESS

PURDUE UNIVERSITY
DEPT. OF AGRONOMY
LAFAYETTE, INDIANA 47907

8. SUPPLEMENTARY NOTES (Sponsoring Organization, Publications, Availability)

9. ABSTRACT

Feeding trials of 125 grain sorghum samples selected from the world collection were conducted to stdy the effect of amino acid content and polyphenols on weight grain in rats as a part of a grain sorghum protein quality improvement project. The 14-day feeding trials revealed that the weight gain in rats was significantly influenced by polyphenol content in grain sorghum. Slow growth or even weight loss was found when the high polyphenol grain sorghum samples were fed with vitamin and mineral supplementation. The influence of the polyphenols masked the differences in protein level and other amino acid quality factors in the feed. Supplementation of grain samples high in polyphenols with soybean oil meal (0,5,10 and 15 percent soybean oil meal) greatly increased the amount of weight gain, but did not alter the comparative weight gain responses of individual samples in the high or low polyphenol groups. Correlations of amino acid, protein with weight gain in high and low polyphenol sorghum lines and removal of polyphenols by chemical dehulling and supplementation with individual amino acids were also studied.

10. CONTROL NUMBER	11. PRICE OF DOCUMENT
PN-AAA-317	$1.95
12. DESCRIPTORS	**13. PROJECT NUMBER**
Feeding trials amino acid polyphenol protein	931-17-130-452
	14. CONTRACT NUMBER AID/csd - 1175
	15. TYPE OF DOCUMENT RESEARCH PAPER

AID 590-1 (10-73)

RAT GROWTH RESPONSE RELATED TO GRAIN SORGHUM[1]

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Sorghum is the third most important food crop in the world. Protein quality is of major concern along with quantity in human diets and in animal feeding. Protein percentages in sorghum range from under six percent to over 18 percent in various experimental grain types. The average protein in most grain sorghum and other cereal grains in commercial production is about 10 percent. Certain amino acids such as lysine, threonine, tryptophan, isoleucine, methionine and cystine must be present in sufficient quantitites along with other essential amino acids. The amount of variation in certain amino acids is known to be considerable in sorghum.

Yield trials, chemical analysis and feeding trials in rats are in progress to evaluate the nutritive quality of grain sorghum. In biological evaluation, the added digestibility problems related to tannin content (catechin equivalents) with the complexity of amino acid balance complicated the evaluation of lines in grain sorghum. Strong influence of the substances represented by polyphenol on the rate of rat gain has resulted in screening for the catechin equivalents (Vanillin HCl catechin equivalent) level before estimating a rat growth response based on crude protein or amino acid balance. The use of only protein amount and amino acid content of samples, without consideration of tannin content is unreliable.

A study of 14-day feeding trials revealed that the weight gain in rats was significantly influenced by tannin content in grain sorghum. Slow growth or even weight loss was found when high tannin grain sorghum samples were fed with vitamin and mineral supplementation for 14 days. The influence of tannin masked the differences in amino acid quality factors in the sorghum grains. This is due to the fact that high tannin somehow reduces the digestibility of the protein. Evidences for the reduction of digestibility of the protein due to high tannin content in grain sorghum was supported in other experiments with chicks.

In a study involving urea on the relationship between tannin and IVDMD (In vitro Dry Matter Disappearance), it was found that tannin somehow reduces the digestibility of the protein more than it reduces the digestibility of the carbohydrates.

Variations in amino acid levels in chick blood plasma were inversely related to the amount of tannin in grain fed, indicating uptake or assimilation rate differences associated with amounts of tannin found in grain samples. Rate of gain and feed efficiency were adversely influenced by feeding sorghum grains high in tannin or by addition of tannic acid to chick ration.

Supplementation of grain samples high in tannin with soybean oil meal greatly increased the amount of weight gain in rats. It is concluded in the feeding trials that higher tannin content in grain sorghum significantly leads to slow growth in rats or even weight loss. Perhaps tannin interferes with the digestibility of available protein in grain. Although supplementation of soybean oil meal greatly increased the growth rate in rats, selection of lines with low tannin content and the inheritance of limiting amino acids in relation to tannin to assess the nutritive value of grain sorghum needs to be studied.

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[1] Paper presented at the Midwestern Section of the American Society of Animal Science, Chicago, Illinois, November 24, 1972.

(This research is supported by the U.S. Agency for International Development through a contract entitled "Inheritance and Improvement of Protein Quality and Content in Sorghum bicolor (L.) Moench".

Table 1. Average protein percent and amino acid composition in grain sorghum.

Parameter	Mean
Protein	12.6*
Lysine	2.1**
Histidine	2.0
Arginine	3.6
Aspartic Acid	7.8
Threonine	3.3
Serine	4.5
Glutamic Acid	23.2
Proline	8.2
Cystine	0.9
Glycine	3.1
Alanine	9.9
Valine	5.4
Methionine	1.0
Leucine	14.3
Isoleucine	4.1
Tyrosine	4.5
Phenylalanine	5.2

* Expressed as percent.

** All amino acids are expressed in percent of protein.

Table 2. Rat growth in relation to protein and catechin equivalent.

Protein Percent	Catechin Equivalent	Total 14-day gain (grams)
8.2	2.3	1.2
9.4	1.7	2.1
10.4	1.4	5.6
11.6	0.4	7.0
13.1	0.9	6.6
9.0	6.9	-3.3
10.4	0.5	3.9
11.8	0.5	5.7
12.3	0.5	11.6
12.4	6.3	3.7
14.3	0.4	7.6

Table 3. Growth performance of rats in various levels of protein, tannin and soybean oil meal supplementation.

Protein (percent)	Tannin (percent catechin equivalent in grams)	Soybean oil meal	13-day weight gain/rat (in grams)
High (12.3)	Low (0.52)	0	13
		5	33
		10	49
		15	55
Low (10.3)	Low (0.61)	0	9
		5	30
		10	46
		15	53
High (12.4)	High (6.3)	0	3
		5	23
		10	37
		15	52
Low (10.3)	High (4.62)	0	3
		5	24
		10	38
		15	50