

## STUDIES ON CHEMICAL COMPOSITION OF SORGHUM CULTURES

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Studies on the chemical composition viz., nitrogen, phosphorus, potassium, starch ash contents and protein quality in certain sorghum varieties showed that all the varieties tested differed significantly in nitrogen, potassium and starch contents, while the phosphorus and ash contents showed no significant differences. All the varieties differed significantly in their protein content and showed no statistical significance as far as leucine content is concerned. Simple correlations showed significant negative correlation between nitrogen and leucine, potassium and leucine and grain yield and leucine. Ash and starch content showed significant positive correlation. Energy values of different varieties, calculated based on starch content varied from 1109.11 to 1315.39 calories per Lb. of sample.

Sorghum is known to be inferior in its nutritive value, compared to other cereals. Relatively little is known about its chemical composition and protein quality and its grain contains relatively low protein level, which has an unbalanced pattern of amino acids. The biological value of the grain sorghum is less due to the excess quantity of leucine. Gopalan (1967) has attributed the cause of the disease 'Pellagra' in the Jowar eating people, due to the high amount of leucine.

In the past, emphasis was mostly on increasing the yield of sorghum and the work on the nutritional aspects received little attention. It is only in the recent years that considerable interest has been shown in breeding cereal grains with high amount of protein and of nutritionally good quality. Earlier attempts for improvement through intensive nitrogenous fertilizer were not successful, since this resulted only in the increase of total protein, without improving its quality as the distribution of amino acids remained unaffected.

Therefore, the knowledge of chemical composition of grain of different varieties would be of additional value in correcting the deficiency of nutrients in the Indian diet. The present study was undertaken to study chemical composition of certain pre-released sorghum cultures.

### MATERIALS AND METHODS

Rapid biuret method as described by Johnson and Craney (1971) was followed for analysing protein. Leucine content was estimated microbiology and the starch content of the sample was estimated by multiplying the dextrose content with 0.90. Ash content was estimated by igniting a known weight of sample and weighing out the residue. Nitrogen was calculated by dividing the protein content with 6.25. Phosphorus was determined by using ammonium metavanadate and ammonium molybdate and deter-

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mined colorimetrically. Potassium was estimated by using flame photometer and the energy value was calculated by using Rabner's factor as given by Leach and Winton (1920).

## RESULTS AND DISCUSSION

**Protein :** The mean protein contents of 14 sorghum varieties varied from 7.37 to 9.70% (Table 1). Similar observation was made by several authors. Deosthale *et al.*, (1972) observed variation in protein content of eight sorghum varieties, which ranged from 8.1 to 10.7% also observed wide variation in protein content ranging from 8.61 to 17.68%. Superiority of one variety over the other is recorded by calculating the calorific value of different varieties. The expression of the fuel values by calculation is most commonly employed method.

Since the quantity of fat in sorghum grain is negligible, consequently the fuel value was calculated on the basis of protein and starch only and it was observed that the variety CSH-5 containing maximum starch had the potential to supply greatest energy per unit weight of the food. The other varieties studied were nearly equal to one another in this respect.

When both grain yield and calorific value were taken into consideration, it was again the CSH-5 which stood first. Therefore this variety could be classified as prime one, if sorghum is to be used as staple food. The N content in different varieties varied significantly from 1.13 to 1.47 per cent (Table 1).

**Phosphorus :** The mean P content varied from 0.25 to 0.49%. The results

obtained were in conformation with the report of many authors. Phosphorus is an element useful for bone building in vertebrates and in this respect, culture 2219 x CS. 3541 was found to be superior. The variety CSH-5 which showed best result regarding fuel value analysed very low value (0.31%) in this respect, compared to variety 2219 x CS. 3541

**Potassium :** The K content, in the varieties studied ranged from 0.43 to 0.66%. Statistical analysis also showed significant difference among the varieties. Potassium is not a constituent, very beneficial for human beings and animals. Therefore the results of K content though were found statistically significant, it is very difficult to prefer one variety over the other on the basis of its content in the grain.

**Starch :** The starch content in grain varied significantly, from 50.49 to 62.22%. Sorghum is valued for its high content of energy in the form of starch. Carbohydrates in sorghum are present mostly in the form of this particular polysaccharide.

**Ash content :** Ash content of the varieties studied ranged from 1.80 to 2.00% and it worked out to be statistically insignificant. The results obtained were in agreement with the observation made by Deosthale *et al.*, (1972) who reported the ash content in sorghum grain as 1.7%.

**Protein quality :** The quality of protein is judged by its amino acid composition, with reference to a standard protein. In judging the protein quality it was thought to study the amino acid leucine in different varieties of sorghum, since this is one of the essential amino

Table 1. Mean contents of different chemical constituents in sorghum grain.

S. No	Variety	On oven dry basis					
		Nitrogen (%)	Protein (%)	Phosphorus (%)	Potassium (%)	Starch (%)	Ash (%)
1.	2219 x CS 3541	1.30	8.28	0.49	0.49	52.25	1.97
2.	3660 x CS 3541	1.36	8.84	0.39	0.55	53.55	1.93
3.	2077 x CS 3687	1.16	7.37	0.25	0.43	52.68	1.85
4.	2947 x CS 3657	1.13	7.37	0.41	0.60	52.23	1.99
5.	3660 x CS 3687	1.49	9.70	0.31	0.55	52.75	2.01
6.	36 x 148	1.33	8.77	0.43	0.56	53.10	1.89
7.	418 x IS 2930-75	1.42	9.10	0.39	0.54	50.49	1.90
8.	648 x IS 2930-75	1.47	9.54	0.42	0.59	52.14	1.82
9.	1036 x PD3-1	1.37	8.51	0.33	0.57	55.59	1.91
10.	3677 x 14-5-17-12	1.33	8.13	0.41	0.56	52.72	2.06
11.	M.S.H. 10	1.33	8.54	0.40	0.57	52.71	1.90
12.	M.S.H. 11	1.33	8.85	0.36	0.61	52.92	1.90
13.	C.S.H. 1	1.33	8.69	0.29	0.55	59.51	1.80
14.	C.S.H. 5	1.26	8.37	0.31	0.66	62.32	2.06

'F' test significant	'F' test N.S.	'F' test significant	'F' test significant	'F' test NS	'F' test significant
SEm = ±0.1850	SEm = ±0.093	SEm = ±0.015	SEm = ±1.0908	SEm = ±0.732	SEm = 0.3080
C.D. at 0.05 = 0.5600		C.D. at 0.05 = 0.0454	C.D. at 0.05 = 3.2986		CD at 0.05 = 0.9314
C.D. at 0.01 = 0.7809		C.D. at 0.01 = 0.0620	C.D. at 0.01 = 4.6017		CD at 0.01 = 1.2385

acids, which determines the protein quality. The leucine content in grain of different sorghum varieties were expressed on protein basis and varied from 8.90 to 11.36%. The variety CSH-5, which showed out while evaluating on the basis of fuel value, also made its mark as highest grain yielder among all the varieties, showing the important character of ana-

lysing less leucine content which ultimately determines the protein quality.

The results obtained in this study were similar to those reported by several other workers. Dyoe and Shellenberger (1965) reported the leucine content of sorghum grain protein as 10.19%. Deosthale and Mohan (1970) also reported the leucine content as

Table 2. Grain yield (Kg/Plot).

S. No	Variety	Yield (kg/plot) Average of 3 replications	Leucine % (on protein basis) Average of 3 replications
1.	2219 x CS 3541	2.40	11.36
2.	3660 x CS 3541	2.90	9.75
3.	2077 x CS 3687	2.25	10.25
4.	2947 x CS 3687	2.25	9.31
5.	3660 x CS 3687	2.31	8.90
6.	36 x 148	2.03	9.90
7.	418 x IS 2930-75	1.20	10.38
8.	648 x IS 2930-75	1.04	9.92
9.	1036 x PD 3-1	2.27	10.33
10.	3677 x 14-5-17-12	1.54	10.42
11.	M.S.H. 10	1.30	9.73
12.	M.S.H. 11	2.62	9.18
13.	C.S.H. 1	1.67	10.79
14.	C.S.H. 5	3.18	9.88

\*F, test of significant\*\*

S.Em =  $\pm$  0.8013

C.D. at 5% = 2.9774

C.D. at 1% = 3.3947

\*F\* test non-significant

S.Em =  $\pm$  0.5012

C.D. = Non significant

11.58% and 7.28 to 11.49% respectively.

#### Correlation coefficients :

The grain yield Vs leucine correlation was very high and negative. The ash Vs starch correlation was very high and positive. The nitrogen Vs leucine correlation was negative and high on Potassium Vs leucine content also showed significant negative correlation.

These observations were in agreement with the results obtained by

Bressani and Rios (1962) who reported that the protein is negatively correlated with leucine, but was highly significant. Deosthale and Mohan (1970) also observed no correlation between protein and leucine protein. Deosthale *et al.* again in 1972 observed non-significant negative correlation between protein and leucine protein. They have also reported non-significant inverse correlation between phosphorus and protein.

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Table 3: Correlation between different constituents of sorghum grain.

S. No.	Constituents	Correlation coefficients (r' values)
1. P	Vs Protein in grain	+ 0.4210
2. K	Vs Protein in grain	+ 0.0997
3. N	Vs Leucine in grain	- 0.7442**
4. P	Vs Leucine in grain	- 0.3084
5. K	Vs Leucine in grain	- 0.5625*
6. Protein	Vs Leucine in grain	- 0.3057
7. P	Vs Protein in grain	- 0.3075
8. K	Vs Starch in grain	- 0.1779
9. Protein	Vs Leucine in grain	- 0.2811
10. Ash	Vs Starch in grain	+ 0.9005**
11. Yield	Vs Protein in grain	+ 0.3163
12. Yield	Vs Leucine in grain	- 1.0000**
13. Starch	Vs Leucine in grain	- 0.0986
14. Ash	Vs Protein in grain	- 0.292
15. Starch	Vs Protein in grain	- 0.0952

\*\* Highly significant ;

\* Significant, at 5% level.

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