

STUDIES ON CHEMICAL COMPOSITION OF SORGHUM CULTURES

B. SREEMANNARAYANA*

Studies on the chemical composition and protein quality of the 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 only. Simple correlations showed significant negative correlation between nitrogen and leucine, potassium and leucine and grain yield and leucine. Ash and starch contents showed significant positive correlation. Energy values or fuel 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 lost 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 value 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 of nutritionally good quality. Earlier attempts for improvement through intensive nitrogenous fertilizers were not successful, as 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 in 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 released and prereleased sorghum cultures.

MATERIALS AND METHODS

The following methods were followed for analysing different constituents in grain samples. Rapid biuret method as described by Johnson and Craney (1971) was followed for analysing protein. Leucine content was estimated microbiologically, and starch content of the sample was estimated by multiplying the dextrose content with 0.90.

Ash content was analysed by igniting a known weight of sample and weighing out the residue. Nitrogen was calculated by dividing the protein content with 6.25.

*Asst. Research Officer, Water Management Scheme, Jargayapet-521 175.

Phosphorus was determined by using ammonium metavanadate and ammonium molybdate and determined colorimetrically.

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

RESULTS AND DISCUSSION

Chemical composition of grain

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%. 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 the most common method employed. Each pound of carbohydrate and protein has a fuel value of 4220 calories.

Since the quantity of fat in Sorghum grain is negligible, the estimation, consequently the fuel value was calculated on the basis of protein and starches only, and it was observed that the variety CSH-5 containing highest starch content 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, for judging the superiority of one variety over the other, it was again the C. S. H.-5 which stood first.

Therefore this variety could be classified as prime one, if Sorghum was to be used as staple food

Nitrogen: The nitrogen content in different varieties varied significantly from 1.13 to 1.47%.

Phosphorus: The mean phosphorus content in grain of the varieties studied 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 variety 2219 x Cs.3541 was found to be superior based on the present study, as far as its utility for consumption was taken into account. The variety C.S.H.-5 which showed best result regarding fuel value recorded very low value (0.31%) in this respect.

Potassium: The potassium 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 62.32%. 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

The results obtained by some of the previous workers were quite different to the results obtained in this

Table-1 Mean contents of different Chemical Constituents in Sorghum Grain

| Variety | On oven dry basis | | | | | | Leucine % (on protein basis) (average of 3 repli- cations) | Yield (kg/ plot) |
|-------------------|----------------------|---------------------|------------------------|-----------------------|---------------|--------------------|--|------------------------|
| | Nitro- gen (%) | Pro- tein (%) | Phos- phorus (%) | Potas- sium (%) | Starch (%) | Ash (%) | | |
| 2219 x CS 3541 | 1.30 | 8.28 | 0.49 | 0.49 | 52.25 | 1.97 | 11.36 | 2.40 |
| 3660 x CS 3541 | 1.36 | 8.84 | 0.39 | 0.55 | 53.55 | 1.93 | 9.75 | 2.90 |
| 2077 x CS 3687 | 1.16 | 7.37 | 0.25 | 0.43 | 52.68 | 1.85 | 10.25 | 2.25 |
| 2947 x CS 3657 | 1.13 | 7.37 | 0.41 | 0.60 | 52.23 | 1.99 | 9.31 | 2.25 |
| 3660 x CS 3687 | 1.49 | 9.70 | 0.31 | 0.55 | 52.75 | 2.01 | 8.90 | 2.31 |
| 36 x 148 | 1.33 | 8.77 | 0.43 | 0.56 | 53.10 | 1.89 | 9.90 | 2.03 |
| 418 x Is 2930-75 | 1.42 | 9.10 | 0.39 | 0.54 | 50.49 | 1.90 | 10.38 | 1.20 |
| 648 x Is 2930-75 | 1.47 | 9.54 | 0.42 | 0.59 | 52.14 | 1.82 | 9.92 | 1.04 |
| 1036 x PD3-1 | 1.37 | 8.51 | 0.33 | 0.57 | 55.59 | 1.91 | 10.33 | 2.27 |
| 3677 x 14-5-17-12 | 1.33 | 8.13 | 0.41 | 0.56 | 52.72 | 2.06 | 10.42 | 1.54 |
| M. S. H. 10 | 1.33 | 8.54 | 0.40 | 0.57 | 52.71 | 1.90 | 9.73 | 1.30 |
| M. S. H. 11 | 1.33 | 8.85 | 0.36 | 0.61 | 52.92 | 1.80 | 9.18 | 2.62 |
| C. S. H. 1 | 1.33 | 8.69 | 0.29 | 0.55 | 59.51 | 1.80 | 10.79 | 1.67 |
| C. S. H. 5 | 1.26 | 8.37 | 0.31 | 0.66 | 62.32 | 2.06 | 9.88 | 3.18 |
| CD (1%) = 0.7809 | N.S. | CD(1%) = 0.0620 | CD(1%) = 4.6017 | N.S. | N.S. | CD(1%) = 1.2385 | N.S. | CD(1%) = 3.3947 |

study. Horon and Marie (1946) reported the starch content of sorghum grain as 81.8%. He had also reported the content as low as 48.8%. Hubbard *et. al.*, (1950) observed the starch content in Sorghum grain as 73.8%.

Ash content : Ash content of the varieties studied ranged from 1.80 to 2.00% and the content worked out to be statistically insignificant. But

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.

In the world today, it is emphasized, that besides increasing the quantity of protein, efforts should also be made to improve the nutri-

Table 2. Correlation between different constituents of Sorghum grain

| Constituents | Correlation co-efficients (<i>r</i> values) |
|-------------------------------|---|
| P Vs Protein in grain | +0.4210 |
| K Vs Protein in grain | +0.0997 |
| N Vs Leucine in grain | -0.7442** |
| P Vs Leucine in grain | -0.3084 |
| K Vs Leucine in grain | -0.5625* |
| Protein Vs Leucine in protein | -0.3037 |
| P Vs Protein in grain | -0.3075 |
| K Vs Starch in grain | -0.1779 |
| Protein Vs Leucine in grain | -0.2811 |
| Ash Vs Starch in grain | +0.9005** |
| Yield Vs Protein in grain | +0.3163 |
| Yield Vs Leucine in grain | -1.0000** |
| Starch Vs Leucine in protein | -0.0986 |
| Ash Vs Protein in grain | -0.232 |
| Starch Vs Protein in grain | -0.0952 |

** Highly significant.

* Significant at 5% level.

tional quality of dietary protein, particularly in the countries, where people subsist largely on the cereal grains which forms major source of protein in their diet. The quality of protein is judged by its amino acid composition, with reference to a standard protein. In judging the protein quality, the amino acid leucine in different varieties of sorghum, was studied since this is one of the essential amino 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 highest fuel value, also made its mark as highest grain yielder among all the varieties, showing the important character of analysing 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 11.58% and 7.28 to 11.49% respectively.

Correlation coefficients :

Correlation coefficients calculated between different constituents are presented in Table. 2

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 and 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.* (1972) observed non-significant negative correlation between protein and leucine in protein. They have also reported non significant inverse correlation between phosphorous and protein.

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