A Nutritional analysis of selected heterotic hybrids of *Zea mays* L.

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**ABSTRACT**

The current experiment was designed to examine and evaluate the nutritional factors of 16 selected high yielding Maize (*Zea mays* L.) hybrids and their parental lines. A secondary objective of this study was to compare the nutritional factors of the hybrids with that of their parents. 71 genotypes (35 parents, F1 & F2 of 16 selected hybrids, 2 checks) were evaluated in two replications for their nutritional factor. The nutritional factors of hybrids was determined by estimating the content of Protein, Carbohydrates, Amino acids and Ascorbic acid. Lowry’s method, Anthrone’s method, Roe and Keuther method, Yemm et al., method was used to estimate the protein content, carbohydrate content, Ascorbic acid content and Amino acid content respectively. Among the select hybrids, four hybrids (SH1 (L29 x T3), SH8 (L24 x T3), SH13 (L11 x T5), SH15 (L24 x T5)) showed higher quantity of protein, carbohydrate and amino acids. Therefore, these four hybrids can be recommended to the farming community for production. This will help farmers to get good yielding maize with high nutritional factors. The rest of the hybrids can be recommended in their particular segment for nutritional benefits. We concluded that, high-nutrient and high-yielding heterotic maize hybrids were produced for cultivation and suggested to the farmers.

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**INTRODUCTION**

Maize (*Zea mays* L.) is one of the most important cereal crops (*Sleper and Poehlman, 2006*) next to wheat and rice. It is a member of Gramineae family with diploid chromosome number of 2n = 2x = 20. Maize has its importance with human consumption (25%), cattle feed (12%), poultry feed (49%), raw material for the industrial products such as starch (12%) and brewery (1%). 1% of Maize is being used for seed production. It is a cheap form of starch when compared and a major energy source in animal feed (*McKevith, 2004*). Thus, it plays a major role in the world’s agricultural economy. Corn can be used for consumption in different stages of growth (from baby corn to mature grain).

Public health and nutritional richness are key factors in any developed society. A lot of development was made for the genetic enhancement in the nutritional value of the crop. But still we can observe that malnutrition is a big problem. Worldwide around 200 million children under five years of age are
found to be starved of proteins. Malnutrition leads to many health issues like stunted growth, susceptibility to infections and poor brain development.

Breeders should plan their breeding strategy for developing new hybrids depending on the future demand and market requirements (Dadade et al., 2015). The nutritional quality of maize can be improved by selecting the essential amino acids through selection and breeding (Jaradat and Goldstein, 2014). Maize kernels with high methionine and lysine concentrations are important in poultry feed (Moore et al., 2008; Adeyemo, 2012). Since Maize is the main feeding source for poultry industry, the above-mentioned methionine and lysine amino acid rich maize serves as good nutritional feed for poultry.

Plant breeders and geneticists have contributed much to improve the quality of plant proteins. They have identified natural mutations like Maize and barley with high-lysine content and bred in to elite genotypes (Bright et al., 1983; Šramková et al., 2008). However, the improvement in the plant nutritional quality was achieved by accident and not by design (Lindsay, 2002).

In maize Carbohydrate a pre-dominant biochemical component in terms of concentration. In Maize kernel, the percentage of carbohydrate is 72 to 75. Protein is the next largest biochemical in Corn, and it ranges from 8 to 11 % (Singh et al., 2005; Orhun, 2013). Oil is the 3rd largest biochemical component in maize, and it ranges from 3 to 18 % Ilyas et al. (2014).

Selection of genetic resources for quality traits and assessment of relationships between agronomic and quality traits are two important things in a breeding strategy. (Seebauer et al., 2010). In hybrids higher yield is linked with poor quality traits like protein concentration in comparison to the landraces and open-pollinated varieties of the past (Seebauer et al., 2010). Further, open-pollinated landrace populations may contain traits related to nutrient quality that may be stabilized with classical breeding techniques (Jaradat et al., 2010).

To meet the ever-increasing demand of maize for the human population as well as the food-processing industry, hybrid varieties are the only solution, as their yields are, in general, much higher than those of the traditional varieties. Therefore, there is an urgent need for developing corn hybrids that are suited to different climatic conditions.

To estimate the quality of a grain, we need to analyze the quantity of protein, carbohydrate, starch and oil in it. The main aim of the present experiment was to identify hybrids with high nutritional factor for cultivation and promising maize germ plasm with quality traits for further maize research and breeding program.

**MATERIALS AND METHODS**

Present study was carried out in the Department of Biotechnology, Karpagam Academy of Higher Education, Coimbatore (Tamil Nadu). Thirty-five genetically diverse Maize inbred lines, F1, F2 seeds of 16. Select high yielding maize hybrids and F1, F2 seed of two check varieties were used as material for this experiment (Table 1 & Table 2). To get F2 seeds, the F1 seeds of the select hybrids were sown and shelved, 10 plants were selected from each entry for this shelving program. The parental lines, F1 hybrids and F2 seed were used in lab studies for the estimation of their nutritional quality. The seeds were crushed into powder form for the analysis. Four nutritional factors, i.e. total content of carbohydrate (mg/g), total content of protein (mg/g), Ascorbic acid content (mg/g), and total content of Amino acids (mg/g). Grains from five random plants of each parental lines, F1 and F2 seeds of selected hybrids and check varieties were used for this experiment. The observation results were analyzed by statistical analysis using mean values of replications.

**METHODOLOGY**

In the present study, the estimation of carbohydrates, proteins, Amino acids and Ascorbic acids was done. In seventy one maize genotypes (Table 1 & Table 2). Lowry’s method was followed for the estimation of protein content (Waterborg and Matthews, 1984). Anthrone method for the estimation of carbohydrates, Roe and Kuether (1943) for the estimation of Ascorbic acid content and Yemm et al. (1955) for the estimation of amino acid content.

**Estimation of protein content**

For the estimation of protein, Maize kernels were crushed in to powder. Lowry’s method was followed for this experiment (Lowry et al., 1957). Bovine Serum Albumin was used as standard protein. The working standards of BSA were prepared by taking 0, 0.2 ml, 0.4 ml, 0.6 ml, 0.8 ml & 1ml in test tubes. Zero was used as blank. The total volume of each test tube was made up to 1 ml with distilled water. To all the test tubes 4.5 ml Reagent-I was added and the tubes were kept for incubation for 10 minutes. Then 0.5 ml of reagent-II was added and left for incubation for 30 minutes. Then the OD values were
Table 1: Maize germ plasm used for the experiment

| S.No. | Code | Line number | S.No. | Code | Line number |
|-------|------|-------------|-------|------|-------------|
| 1     | T1   | TM-0019     | 19    | L14  | TM-0123     |
| 2     | T2   | TM-0034     | 20    | L15  | TM-0126     |
| 3     | T3   | TM-0068     | 21    | L16  | TM-0296     |
| 4     | T4   | TM-0072     | 22    | L17  | TM-0297     |
| 5     | T5   | TM-0125     | 23    | L18  | TM-0298     |
| 6     | L1   | TM-0003     | 24    | L19  | TM-0299     |
| 7     | L2   | TM-0020     | 25    | L20  | TM-0300     |
| 8     | L3   | TM-0030     | 26    | L21  | TM-0301     |
| 9     | L4   | TM-0031     | 27    | L22  | TM-0302     |
| 10    | L5   | TM-0032     | 28    | L23  | TM-0304     |
| 11    | L6   | TM-0064     | 29    | L24  | TM-0305     |
| 12    | L7   | TM-0065     | 30    | L25  | TM-0306     |
| 13    | L8   | TM-0067     | 31    | L26  | TM-0307     |
| 14    | L9   | TM-0071     | 32    | L27  | TM-0308     |
| 15    | L10  | TM-0103     | 33    | L28  | TM-0309     |
| 16    | L11  | TM-0106     | 34    | L29  | TM-0310     |
| 17    | L12  | TM-0111     | 35    | L30  | TM-0311     |
| 18    | L13  | TM-0118     |       |      |             |

Table 2: Selected high yielding Maize hybrids used for the experiment

| S.No. | F1 (select & Superior from 150 hybrids) | Cross combination | Cross code | Sample used | Sample used |
|-------|----------------------------------------|-------------------|------------|-------------|-------------|
| 1     | SH-1                                   | TM-00310 × TM-00068 | L29 × T3 | F1          | F2seed      |
| 2     | SH-2                                   | TM-00310 × TM-00125 | L29 × T5 | F1          | F2seed      |
| 3     | SH-3                                   | TM-00020 × TM-00068 | L2 × T3  | F1          | F2 seed     |
| 4     | SH-4                                   | TM-00032 × TM-00068 | L5 × T3  | F1          | F2 seed     |
| 5     | SH-5                                   | TM-00302 × TM-00068 | L22 × T3 | F1          | F2 seed     |
| 6     | SH-6                                   | TM-00106 × TM-00068 | L11 × T3 | F1          | F2 seed     |
| 7     | SH-7                                   | TM-00311 × TM-00068 | L30 × T3 | F1          | F2 seed     |
| 8     | SH-8                                   | TM-00305 × TM-00068 | L24 × T3 | F1          | F2 seed     |
| 9     | SH-9                                   | TM-00299 × TM-00068 | L19 × T3 | F1          | F2 seed     |
| 10    | SH-10                                  | TM-00020 × TM-00125 | L2 × T5  | F1          | F2 seed     |
| 11    | SH-11                                  | TM-00032 × TM-00125 | L5 × T5  | F1          | F2 seed     |
| 12    | SH-12                                  | TM-00302 × TM-00125 | L22 × T5 | F1          | F2 seed     |
| 13    | SH-13                                  | TM-00106 × TM-00125 | L11 × T5 | F1          | F2 seed     |
| 14    | SH-14                                  | TM-00311 × TM-00125 | L30 × T5 | F1          | F2 seed     |
| 15    | SH-15                                  | TM-00305 × TM-00125 | L24 × T5 | F1          | F2 seed     |
| 16    | SH-16                                  | TM-00299 × TM-00125 | L19 × T5 | F1          | F2 seed     |
| 17    | CHECK-I                                | 30V 92            | F1        | F2 seed     |
| 18    | CHECK-II                               | NK-6240           | F1        | F2 seed     |
Table 3: Parental lines - Protein, Carbohydrate, Ascorbic acid & Amino acids estimation

| Sample ID | Protein mg/g | Carbohydrate mg/g | Ascorbic acid mg/g | Amino acids mg/g |
|-----------|--------------|-------------------|-------------------|-----------------|
| T1        | 21.883       | 133.775           | 273.516           | 101.845         |
| T2        | 20.144       | 85.691            | 141.013           | 118.097         |
| T3        | 21.795       | 126.427           | 209.454           | 99.070          |
| T4        | 15.407       | 125.079           | 218.716           | 120.427         |
| T5        | 20.281       | 157.869           | 133.317           | 95.233          |
| L1        | 9.823        | 92.700            | 327.698           | 77.939          |
| L2        | 6.154        | 27.466            | 387.525           | 85.573          |
| L3        | 6.520        | 143.937           | 198.936           | 64.940          |
| L4        | 7.182        | 138.489           | 200.264           | 76.957          |
| L5        | 10.372       | 83.144            | 379.093           | 86.211          |
| L6        | 5.583        | 111.603           | 348.695           | 36.848          |
| L7        | 6.201        | 91.896            | 321.063           | 112.473         |
| L8        | 7.537        | 125.665           | 270.394           | 81.828          |
| L9        | 10.310       | 54.552            | 275.01            | 102.018         |
| L10       | 6.513        | 94.679            | 378.449           | 62.678          |
| L11       | 4.576        | 113.548           | 223.82            | 47.711          |
| L12       | 9.969        | 90.692            | 209.876           | 62.341          |
| L13       | 7.901        | 95.312            | 236.632           | 75.537          |
| L14       | 8.322        | 56.493            | 259.722           | 72.715          |
| L15       | 4.167        | 119.254           | 129.237           | 97.314          |
| L16       | 5.635        | 157.151           | 133.224           | 126.147         |
| L17       | 3.909        | 68.158            | 235.52            | 132.387         |
| L18       | 8.372        | 71.918            | 268.447           | 160.307         |
| L19       | 7.183        | 132.673           | 150.564           | 82.588          |
| L20       | 11.004       | 139.635           | 380.169           | 123.617         |
| L21       | 5.856        | 135.935           | 271.764           | 127.142         |
| L22       | 7.496        | 112.704           | 193.691           | 90.830          |
| L23       | 3.499        | 83.185            | 240.846           | 156.378         |
| L24       | 10.868       | 72.993            | 273.763           | 135.948         |
| L25       | 15.903       | 164.269           | 396.108           | 101.584         |
| L26       | 7.240        | 96.745            | 361.573           | 106.538         |
| L27       | 11.259       | 130.638           | 332.468           | 137.166         |
| L28       | 6.161        | 142.207           | 235.92            | 123.342         |
| L29       | 3.920        | 138.481           | 291.237           | 132.710         |
| L30       | 14.137       | 146.652           | 214.554           | 147.480         |

recorded at 660 nm. A standard graph was prepared by plotting the standard concentrations on the X-axis and OD values on the Y-axis (Figure 1). From standard graph, the protein content was estimated in the given sample.

**Estimation of carbohydrate content**

The carbohydrate content can be estimated by polysaccharide hydrolysis into simple sugars (monosaccharides) by acid treatment. 100 mg of the maize kernel powder was taken in a test tube and kept in hot water for 3 hours with 5ml of 2.5 N-HCl and cooled to room temperature; then the tube was neutralized using solid sodium carbonate until the effervescence stopped. The volume was made to 100 ml using distilled water and kept for centrifugation. 1 ml of aliquots was prepared with the supernatant formed in the test tube. Using working standard 0, 0.2, 0.4, 0.6, 0.8 and 1ml of standard samples were prepared. '0' was used as blank. Then using distilled water volumes were made up to 1ml in all the tubes. 4ml of Anthrone's
Table 4: F1 hybrids - Protein, Carbohydrate, Ascorbic acid & Amino acids estimation

| SAMPLE ID | Protein mg/g | Carbohydrate mg/g | Ascorbic acid mg/g | Amino acids mg/g |
|-----------|--------------|--------------------|--------------------|------------------|
| F1-SH1    | 11.368       | 95.376             | 55.308             | 70.348           |
| F1-SH2    | 14.379       | 110.066            | 35.307             | 95.165           |
| F1-SH3    | 20.405       | 49.533             | 55.233             | 94.162           |
| F1-SH4    | 13.300       | 54.903             | 100.626            | 61.860           |
| F1-SH5    | 6.460        | 62.956             | 59.900             | 78.476           |
| F1-SH6    | 7.514        | 51.729             | 85.786             | 68.850           |
| F1-SH7    | 5.569        | 86.398             | 89.149             | 76.269           |
| F1-SH8    | 14.050       | 99.670             | 32.618             | 82.769           |
| F1-SH9    | 4.689        | 66.467             | 69.141             | 72.591           |
| F1-SH10   | 13.082       | 96.137             | 58.983             | 95.265           |
| F1-SH11   | 15.713       | 69.559             | 56.026             | 83.734           |
| F1-SH12   | 11.432       | 37.555             | 43.498             | 102.125          |
| F1-SH13   | 8.036        | 37.404             | 74.962             | 79.859           |
| F1-SH14   | 3.511        | 124.322            | 71.336             | 87.259           |
| F1-SH15   | 16.287       | 34.401             | 71.799             | 55.273           |
| F1-SH16   | 10.685       | 108.844            | 101.77             | 106.753          |
| F1-CH1    | 2.900        | 166.760            | 89.520             | 96.034           |
| F1-CH2    | 8.600        | 122.216            | 110.641            | 145.368          |

*CH = Check variety and SH = Selected hybrid based on high yield
*F1 = Hybrid seed use for planting

Table 5: F2 hybrid - Protein, Carbohydrate, Ascorbic acid & Amino acids estimation

| Sample ID | Protein mg/g | Carbohydrate mg/g | Ascorbic acid mg/g | Amino acids mg/g |
|-----------|--------------|--------------------|--------------------|------------------|
| F2-SH1    | 23.174       | 176.077            | 177.546            | 123.064          |
| F2-SH2    | 22.905       | 134.794            | 210.412            | 130.483          |
| F2-SH3    | 30.002       | 123.282            | 194.041            | 122.254          |
| F2-SH4    | 14.709       | 141.237            | 156.282            | 154.184          |
| F2-SH5    | 20.150       | 198.915            | 179.36             | 114.835          |
| F2-SH6    | 6.038        | 176.021            | 139.601            | 137.706          |
| F2-SH7    | 8.807        | 130.035            | 161.454            | 126.186          |
| F2-SH8    | 16.667       | 174.523            | 112.145            | 131.222          |
| F2-SH9    | 13.936       | 145.910            | 207.456            | 101.508          |
| F2-SH10   | 19.229       | 121.059            | 183.470            | 122.326          |
| F2-SH11   | 12.334       | 128.804            | 162.051            | 128.006          |
| F2-SH12   | 20.977       | 159.036            | 181.245            | 90.181           |
| F2-SH13   | 18.658       | 157.236            | 144.145            | 137.577          |
| F2-SH14   | 17.839       | 125.367            | 192.575            | 121.404          |
| F2-SH15   | 19.108       | 181.369            | 177.464            | 132.485          |
| F2-SH16   | 15.670       | 129.923            | 113.631            | 134.655          |
| F2-CH-I   | 7.444        | 150.543            | 174.146            | 119.044          |
| F2-CH-II  | 9.329        | 145.277            | 274.165            | 110.797          |

*CH = Check variety and SH = Selected hybrid based on high yield
*F2 = Outcome of F1 seed planted
reagent was added to the tubes. The test tubes were kept in hot water for eight minutes and cooled rapidly. The solution’s colour turned to dark green. The intensity of the solution can be read by noting OD values at 630 nm. The standard graph was plotted using concentration on the X-axis and OD values on the Y-axis (Figure 2). Using the standard graph, the carbohydrate content was estimated in the given sample.

**Estimation of Ascorbic acid content**

100 mg of sample was weighed and the volume was made to 1 ml using 4% TCA. The tube was kept for centrifugation at 2000 rpm for 10 mins. The clear supernatant was collected and the volumes were made into 2.0 ml using 4% TCA. To the test tube 0.5 ml of DNPH reagent was added, then two drops of 10% thiourea solution added. The test tubes were kept for incubation for 3 hours at 37°C. The osazones were dissolved in 2.5 ml of 85% H₂SO₄ in cold, with no appreciable rise in temperature. Then samples were incubated for 30 minutes at room temperature, colour intensity was read at 540 nm (Roe and Kuether, 1943). The standard graph was plotted using concentrations on the X-axis and OD values on the Y-axis (Figure 3). Using the standard graph, the Ascorbic acid content was estimated in the given sample.

**Estimation of Amino acid content**

Sample extract was dissolved in 100 mg/ml concentration of 85% ethanol, and 1ml of Ninhydrin solution added (0.8 stannous chloride dissolved in 500 ml of 0.2 M citrate buffer [pH 5.0]). Then the solution was added with 2g of Ninhydrin in 500ml methanol. The volume was made into 2ml with distilled water. The tube was kept in a boiling hot water for 20min. Then 5ml of the diluent solvent (water and n-propanol mixture in equal volumes)
In case of protein content, the F₁ dominant over their F₂ found that all parental lines in the present study are than its parents lines. In Ascorbic acid content we
In the study, it has been observed that the F₁ and F₂seeds of select hybrids and check varieties. The observations were studied in three replicates, and mean values were used for analysis. Since F₂seed is used as food, feed and for industrial purpose, the study was well-focused on the analysis of F₂ seed of 16 select high yielding hybrids to compare with two popular Maize checks in the market.

The nutritional factors of Maize can be determined by the presence of protein, carbohydrate, Ascorbic acid and the content of amino acids. Here in our experiment, we have chosen two Maize hybrids (NK 6240 & 30 V 92) as checks, which are popular in the market. We compared our 16 high yielding selected hybrids for nutritional quality with check hybrids. Since we use the outcome of F₁ seed for consumption, we checked the nutritional factors of F₂ seeds. In the study, it has been observed that the F₂ seed has more total protein and carbohydrate content than its parents lines. In Ascorbic acid content we found that all parental lines in the present study are dominant over their F₁ and F₂ seed.

In case of protein content, the F₂ samples range from 8.6 to 30.0 mg/g, whereas check-I and check-II have values of 7.44 and 9.32 mg/g. 14 hybrids have shown significant superiority over checks in case of protein content. They are SH3 (30.00 mg/g), SH1 (23.17 mg/g), SH2 (22.90 mg/g), SH12 (20.97 mg/g), SH5 (20.15 mg/g), SH10 (19.23 mg/g), SH15 (19.11 mg/g), SH13 (18.66 mg/g), SH 14 (17.84 mg/g), SH 8 (16.67 mg/g), SH16 (15.67 mg/g), SH4 (14.71 mg/g), SH9 (13.94 mg/g), SH11 (12.33 mg/g). Since these hybrids are already proven in the field for their yield they are now qualified for their high quantity of proteins.

The carbohydrate content of F₂ ranges from 122.2 mg/g to 176.07 mg/g, whereas checks show 150.54 mg/g (CH-I) and 145.28 mg/g (CH-II). In case of carbohydrate content F₂ has shown superiority over parents and their F₁. Eight hybrids have shown superiority over best check in case of carbohydrate content, i.e. SH5 (198.92 mg/g), SH15 (181.37 mg/g), SH1 (176.08 mg/g), SH6 (175.02 mg/g), SH8 (174.52 mg/g), SH12 (159.04 mg/g), and SH13 (157.24 mg/g). These hybrids may prove themselves to be good carbohydrate sources.

Ascorbic acid is known as the source of vitamin C present in maize, and serves as one of the nutritional parameters. Parents have shown superiority over F₁ and F₂ in case of Ascorbic acid content. Among Parents, it ranges from 32.62 to 396.11 mg/g. These findings correlate with the observations of Seebauer et al. (2010). The amount of quality traits has been reduced in hybrids compared to the wild varieties, land races and open-pollinated varieties. (Seebauer et al., 2010). So, we can use the parental lines with good ascorbic acid content for the breeding program with good combining-ability lines in order to increase the traits that contribute to the quality parameters in the hybrids.

The Amino acid content in F₂ ranges from 36.85 to 160.31 mg/g. 13 hybrids have shown superiority over best check in the total Amino acid content, i.e. SH4 (154.18 mg/g), SH6 (137.71 mg/g), SH13 (137.58 mg/g), SH16 (134.66 mg/g), SH15 (132.49 mg/g), SH8 (131.22 mg/g), SH2 (130.48 mg/g), SH11 (128.00 mg/g), SH7 (126.19 mg/g), SH1 (123.06 mg/g), SH10 (122.33 mg/g), SH3 (122.25 mg/g), and SH 14 (121.4 mg/g).

Further, in periods of famine or economic stress, maize may be the only food available. Modified maize with increased protein content will help in the recovery of malnourished children and other victims of protein deficiency. When selecting a grain for yield alone, the genetic gain is always superior to one with multiple characters or traits. Adding protein content to yield as a selection criterion slows down the breeding progress because of its low heritability (Rosales et al., 2011).

CONCLUSIONS

The conclusion and recommendations pertain to genotype selection for high-yielding and nutrient-rich maize hybrids for cultivation. Since the sixteen Maize hybrids were already proven for their yield, the present study was focused on finding hybrids that can add nutritional factors in addition to yield. Improvement in terms of quality and quantity is the only solution to meet the increasing demand for food and to overcome malnutrition.

The 14 hybrids, namely SH3 (30.0 mg/g), SH1 (23.17 mg/g), SH2 (22.90 mg/g), SH12 (20.97
mg/g), SH5 (20.15 mg/g), SH10 (19.23 mg/g), SH15 (19.11 mg/g), SH13 (18.66 mg/g), SH14 (17.84 mg/g), SH8 (16.67 mg/g), SH4 (14.71 mg/g), SH9 (13.94 mg/g), and SH11 (12.33 mg/g) can be recommended for cultivation and farmer adaptation based on their protein content.

Seven hybrids i.e. SH5 (198.92 mg/g), SH15 (181.37 mg/g), SH1 (176.08 mg/g), SH6 (175.02 mg/g), SH8 (174.52 mg/g), SH12 (159.04 mg/g), and SH13 (157.24 mg/g) have shown superiority over checks in terms of carbohydrate content.

Thirteen hybrids have shown superiority in case of Amino acid content. They are SH4 (154.18 mg/g), SH6 (137.71 mg/g), SH13 (137.58 mg/g), SH16 134.66 mg/g), SH15 ( 132.49 mg/g), SH8 (131.22 mg/g), SH2 (130.48 mg/g), SH11 (128.00 mg/g), SH7 (126.19 mg/g), SH1 (123.06 mg/g), SH10 (122.33 mg/g), SH3 (122.25 mg/g), and SH14 (121.4 mg/g).

From the above findings it can be concluded that all the hybrids may not have all the nutritive factors traits. The four hybrids i.e. SH1, SH8, SH13, and SH15 have shown superiority in maximum quality parameters (Protein, carbohydrate, Amino acid content) associated with high yield. Therefore, we can recommend these four maize hybrids for cultivation. This will help farmers to get good yield and offer the much-needed nutritional quality.

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