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Correlation Between Grain Yield and Protein, Carbohydrates and Oil content in Selected Genotypes of *Zea mays* Desi Genotypes

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ABSTRACT: Analysis of proteins, carbohydrates, oil content and grain yield are significant for estimating the quality of seeds. The present study was designed for the identification of promising maize genotypes with important traits for further maize crop improvement. The proximate analysis work was done in Department of Genetics and Plant Breeding, SHUATS Prayagraj U.P on 11 genotypes belong to Prayagraj were evaluated for diversity on the basis of grain yield protein, carbohydrate and oil contents. In all genotypes of maize it was found that the carbohydrates were found in maximum and oil contents were found in minimum amount. The results showed that the grain 57.6 to 137.33 yield was ranging from protein contents ranged from 4% to 11.23%, carbohydrate contents ranged from 10.21% to 28.44%, and oil contents ranged from 4% to 12.3%. These findings would be useful for the quality products formed from maize.

Keywords: *Zea mays*, percent yield, Carbohydrates, Oil contents, Proteins.

INTRODUCTION

One of the most adaptable emerging crops, maize (*Zea mays* L.) can grow in a variety of agroclimatic settings. It is the world's important cereal crop after Wheat and Rice and is known as Queen of Cereals. Maize being a C_4 plant has the highest potential of per day carbohydrate productivity. Dr. Norman. Borlaug believes that, maize has the highest yield potential among cereals, the last two decades, saw the revolution in rice and wheat, the next few decades will be known as maize era. The suitability of maize to diverse environment is by any other crop as the expansion of maize to new areas and environment. However in the warmer parts of the temperate region and in humid subtropical climate. Maize is widely cultivated crop throughout the world.

It is consumed directly as food at different growth stages (baby corn to mature grain) (Aus. Gov., 2008). It provides bulk of raw materials for the livestock and many agro-allied industries in the world (Bello *et al*., 2010; Randjelovic *et al*., 2011). Several vital nutrients are included for metabolism in addition to vitamins A, B, and E. (Orhun, 2013). The area and production of maize in India is 8.50 mha and 21.28 mt respectively with productivity ranging about 2507 kg/ha. In Uttar Pradesh, the area and production during 2009-10 was 0.71 mha and 1.04 mt respectively with productivity of 1465 kg/ha**.** Maize is grows worldwide on an approximately 161 million ha annually with a production of 685 million metric tons (Agriculture Statistics at a Glance, 2012).

The state Andhra Pradesh is one of the major maize producing states in the country. It occupies 20.9 % of the total production in India. Area under maize is increasing rapidly in the state, because of better environment. Thus, there is a greater scope to increase maize productivity to a global level (IASRI, 2010). About 23% percent of maize production in India is consumed directly as food, 51% goes for poultry feed, 12% goes for animal feed, beverages, and seed 1% each with the increasing trends of maize production, the projected demand of maize (22.73 m t) by the end of 11^{th} five-year plan (Directorate of Economics and Statistics, Department of Agriculture and Cooperation, 2011-12). It also includes several vital nutrients for metabolism in addition to vitamins A, B, and E. In carbohydrate the amount of starch is 72 to 73 percent in the maize kernel and the amount of other carbohydrates such as glucose, sucrose and fructose are m1 to 3 percent in the maize kernel (FAO, 1993; Iken *et al*., 2002; Barikmo *et al*., 2004; Orhun, 2013). Protein is the maize kernal is the second largest component which ranges from 8 to 11 percent (FAO, 1993**;** Iken *et al*., 2002; Singh *et al*., 2004; Orhun, 2013). The third largest component in the maize kernel is oil which ranges from 3 to 18 percent (Alexander, 1971; FAO, 1993; Heiniger *et al*., 2001; Chen, 2010; Orhun, 2013).

MATERIAL AND METHODS

In the present study 11 desi genotypes of maize (Table 1) were evaluated for protein, carbohydrate, and oil contents. Protein content was estimated by Folin-Lowry's method, carbohydrates by phenol sulphuric acid method of Roberts *et al.* (2011) and total oil contents by ether extract method of Ajayi *et al.* (2004).

Table 1: List of genotypes used for the current study.

Sr. No.	Genotype	Genus and species	Origin	Provinces
1.	NBPGR36548-1	*Zea mays*	India	Allahabad
2.	MZ1916	*Zea mays*	India	Allahabad
3.	MZ1912	*Zea mays*	India	Allahabad
4.	HKI1-3	*Zea mays*	India	Allahabad
5.	MZ1909	*Zea mays*	India	Allahabad
6.	MZ1915	*Zea mays*	India	Allahabad
7.	NBPGR 36548	*Zea mays*	India	Allahabad
8.	MZ1911	*Zea mays*	India	Allahabad
9.	MZ1910	*Zea mays*	India	Allahabad
10.	MZ1908	*Zea mays*	India	Allahabad
11.	MZ1913	*Zea mays*	India	Allahabad

Estimation of grain yield percentage. The fully matured maize cobs were dried in shady condition for 2 to 3 days and the dried cobs were shelled and the grains were separated from the shank. All the grains in the single cob were weighed using the weighing balance and grain yield was calculated.

Estimation of Protein. Maize sample was crushed and to the sample reagent 1 (48ml of Na_2CO_3+0.1 gm NaOH) +10 ml of 1% Na-K Tartrate in H_2O C+ 0.5% $CuSO_4$.5 H_2O in H_2O and the sample was centrifuged for half an hour and 0.2 -1.0ml of working sample was pipetted out into clean test tubes labelled as S1-S5. Test solution of 0.2ml was taken into test tube and labelled as T1. The volume was made upto 1ml of distilled water. Distilled water (1ml) served as blank. To all the test tubes 4.5ml of alkaline $CuSO_4$ reagent was added and incubated at room temperature for 10 minutes. In all the test tubes 0.5ml of Folin's Ciocalteau reagent was added. The contents were mixed well and the blue colour developed was read at 640 rpm after 15 minutes. From the standard graph the amount of protein in the given unknown solution was calculated.

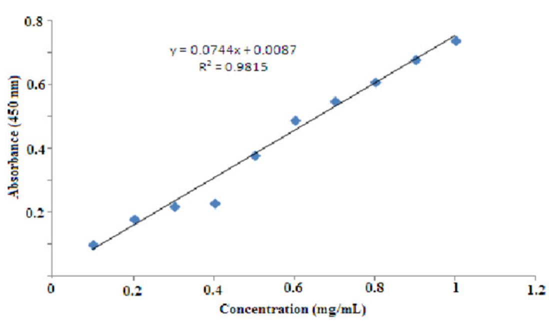

Fig. 1. Standard graph of protein.

Estimation of carbohydrates by Phenol sulphuric acid method. Estimation of carbohydrates is done by phenol sulphuric acid method in selected maize accessions. Powder of each accession (0.1g) was mixed in 5 mL of 2.5 N-HCl and heated in water bath for 3 hours. It was then neutralized by adding sodium carbonate and volume increased up to 100 ml. Glucose was used as standard for carbohydrate estimation. Each experimental sample (standard and maize accessions) was mixed with 1 ml of 5% phenol solution and 5ml of 96% sulphuric acid solution and kept at 30°C for 20min absorbance was drawn at 490nm and linear regression equation (Eq. 1) is taken from standard curve (Fig.2) is utilized in estimation of carbohydrate in selected maize accessions.

$$X = (Y-0.2981)/ 0.0237 \quad (1)$$

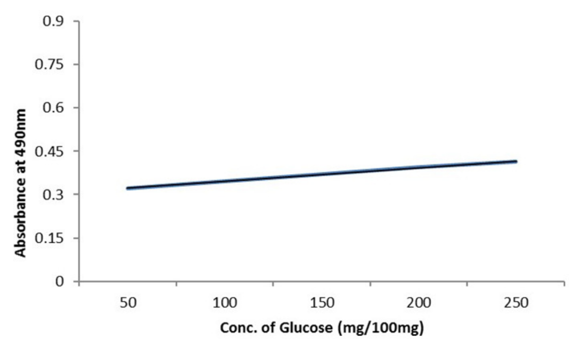

Fig. 2. Standard graph of total carbohydrates.

Estimation of oil by ether extract method. Estimation of oil content by ether extract method in each maize accession was done by using Soxhlet apparatus as described by Ajayi *et al.* (2004). 5g of each accession was placed in thimble and placed in chamber which was 2/3 filled with n-hexane. 15-20 cycles of n-hexane is runed in sochex meter and the oil extraction was stopped. Then oil and n-hexane were separated on rotary evaporator. The oil percentage was calculated by using following formula

$$\text{Oil percentage} = \frac{\text{Final weight - intial weeight}}{\text{Total weight of sample}} \times 100$$

RESULTS AND DISCUSSION

The results of the present study showed protein content ranging from 10.35% to 16.47%. The minimum amount of protein content was found in MZ1909 (10.35%) whereas the maximum amount of protein content was found in NBPGR3658-1 (16.47%). The results are in concordance with the results of Orhun *et al.* (2013); Sofi *et al.* (2009) ; FAO (1993) in which the protein content ranged from 8 to 11%. If the amount of protein is more than there is a chance that the amount of zein protein is increased and the amount of non-zein protein (containing lysine) is decreased as reported by Mitchell *et al*. (1952). The diverse protein content of maize genotypes in the present study indicate that it can be helpful for further breeding programs.

Estimation of carbohydrate content in maize. In the present study carbohydrate content ranged from 52% to 69% (Table 2). The maximum amount of carbohydrate was found in genotype HKI1-3 and the least amount in MZ1916. This result showed similarity with the results of Iken *et al.* (2002) in which the carbohydrate amount was ranged 72 to 73% Iken *et al*. (2002). The amount of carbohydrate was more than our result. The amount of difference seen in carbohydrate content was due to nitrogen application because more amount of nitrogen application caused to decrease the carbohydrate content. More the application of nitrogen content lesser will be the carbohydrate content, lesser the amount of nitrogen content more will be the carbohydrate content (Singh *et al*., 2004). On the basis of carbohydrate, diversity was present in the maize accessions and this diversity will be helpful for further breeding programs.

Estimation of oil content in maize. The results in the present study showed that the oil content ranged from 4.0 % to 12.3 %.The minimum amount of oil content was found in MZ1912 (4.0%) and the maximum amount of oil content was found it NBPGR36548-1 (12.3%).The result shows similarity with the results of Orhun *et al.* (2013); Chen (2010); Heiniger *et al*. (2001); FAO (1993); Alexander (1971). In the present maize genotypes on the basis of oil content genotypes are helpful for further breeding programs.

Correlation of qualitative characters to the grain yield. The results showed that NBPGR 36548 was found to have good grain yield and also have good amount of protein, carbohydrates and oil content which was around (122.9,10.35%, 64.03%, 12.3%) respectively, so this genotype can be further used in the breeding program where as the genotype MZ1915 was found to have exorbitant amount of grain yield, protein and carbohydrate but low in oil content which was around (144.96, 11.5%, 63.45%, 5%) respectively, so this can be genotype can be used in improving only for improving grain yield, protein, and carbohydrate and cannot be used for improving oil content due to the low amount of oil content. The genotype HKI1-3 had low grain yield but contain good amount of protein, carbohydrate, and oil content but low in grain and which was about (57.6, 14.35%, 69.23%, 11.5%) respectively. Whereas MZ1913 was found to be inferior variety with low amount of grain yield, protein, carbohydrate, and oil content. Remaining variety was found to contain moderate amount grain yield and other quantitative characters.

Table 2: Protein, carbohydrate and oil content in selected maize accessions.

Sr. No.	Genotypes	Grain yield per plant	Protein content	Carbohydrate content	Oil content
1.	NBPGR36548	122.9	10.35%	64.03%	12.3%
2.	MZ1916	66.83	16.47%	52.25%	7.5%
3.	MZ1912	67.26	11.13%	52.3 %	4.0%
4.	HKI1-3	57.6	14.35%	69.23%	11.5%
5.	MZ1909	74.6	10.77%	60.19%	9.8%
6.	MZ1915	144.96	11.5%	63.45%	5%
7.	MZ1908	137.33	9.41%	68.96%	8.3%
8.	NBPGR36548-1	87.3	6.95%	66.25%	8.7%
9.	MZ 1914	126.9	9.03 %	62.43%	3.6 %
10.	MZ1913	126.1	7.91 %	61.21%	8.1 %

CONCLUSIONS

From the above study conducted on maize in rabi season it was concluded that MZ 1915 was the inferior genotype with low amount of yield as well as protein, carbohydrate, and oil content. Hence the genotype NBPGR36548 can be used to improve grain yield as well as the qualitative characters. Whereas the genotype MZ1913, MZ1916, MZ1912 HKI 1-3 can be used to improve protein content and carbohydrate content. Whereas genotype MZ1912 can be used to improve the oil content.

FUTURE SCOPE

The study lays a strong foundation for several promising avenues of future research. Firstly, it paves the way for more targeted and efficient breeding programs aimed at developing maize varieties with enhanced traits such as higher yield and improved nutritional content. Additionally, the identified genotypes with superior traits offer a valuable resource for product development, whether for animal feed, human consumption, or industrial applications. Furthermore, as climate change continues to impact agricultural productivity, there is a pressing need to develop maize varieties resilient to environmental stresses. Collaborative efforts across disciplines will be essential for tackling these challenges comprehensively and ensuring sustained progress in maize research and crop improvement.

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