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BIOCHEMICAL COMPOSITIONS OF NEWLY INTRODUCED MAIZE (*Zea mays* L .) VARIETIES

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ABSTRACT

The study was carried out during the period from June 2006 to March 2007 in the laboratory of Post Harvest Technology Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur and Biochemistry laboratory of Sher-e-Bangla Agricultural University, Dhaka. Twelve varieties of maize seeds were evaluated for their nutrition contents. The analysis represent that Pacific 983 showed the significantly highest thousand grain weight (363.1g) with the lowest amount of carbohydrate (58.86%) among the selected varieties. Pacific 60 showed the significantly lowest amount of moisture (7.12%) and ash (1.0%). BARI Hybrid Maize 2 showed the significantly highest amount of protein (13.54%) and its in vitro digestibility was 87.20%, fibre (1.53%), starch (58.49%) and oil (2.86%) among the varieties. BARI maize 7 showed significantly the highest amount of carbohydrate (66.99%) which was followed by BARI Hybrid Maize 2 (66.63%) but it showed the lowest amount of oil (2.10%). Among the varieties, BARI Hybrid Maize 3 contained the lowest amount of starch (47.43%). Hybrid Maize 3 and Khoibhutta showed the significantly highest amount of total sugar (10.96%) and reducing sugar (1.29%) respectively on the other hand khoibhutta and Bornali contained the lowest amount of protein (10.20%) and BARI Maize 5 showed the lowest digestibility(61.72 %).

Keywords: *Biochemical composition, In vitro protein digestibility, Zea mays*

INTRODUCTION

Maize is an important cereal grain in the world providing nutrients for human and animals. The global production of maize in 2003 exceeded 630 M Mt, making it the most abundantly grown cereal crop ahead of wheat (550 M Mt). Furthermore, the production of maize has increased by approximately 30% since 1993 whereas the production of wheat, sorghum and barley has remained relatively constant (FAOSTAT Database, 2004). Maize is used as multipurpose crop. The nutritional value of maize is higher than rice and wheat. Though maize grain is used as the source of carbohydrate it is an important source of proteins, vitamins and minerals also. However, recent studies have demonstrated that the chemical composition and nutritional value of maize is variable, making generic matrix values for maize inaccurate. The chemical composition of maize is dependent on the variety, growing conditions, drying temperature, starch structure, lipid, protein, starch matrices and the presence of various anti-nutritive factors. (Socorro et al. 1989, Herrera-Saldana et al. 1990, Leeson et al. 1993, Leigh 1994, Brown 1996, Collins et al. 1998, Cromwell et al. 1999 and Collins and Moran, 2001).The main fractions of maize are carbohydrates, followed by the protein. Starch is the major component of cereal kernels; 45.6-80.2 %,(Mouhamadou Séne 2000, Nelson et al.1995). The total caloric obtained from 100 gram of maize is 461 while the same is 436 and 447 from wheat and rice respectively. After starch, the next largest chemical component of the kernel is protein. Protein content varies in common varieties from about 8 to 11 percent of the kernel weight. It has shown that maize contained relatively low concentration of crude protein (~80 g/kg) compared with wheat and barley (~110 g/kg). (Oyebiodun G. et al. 1982.) Lysine and methionine are the low level amino acids in cereals also in

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maize. Digestibility is also an important parameter concerning the quality assessment of maize cultivars. Maize also contains low concentrations of other anti-nutritional factors such as phytin, trypsin inhibitors and lectins (Eeckhout and De Paepe, 1994) .Maize oil is very fine cooking medium. Fully refined maize oil contained nearly 90% poly-unsaturated fatty acids. Maize oil has a low level of saturated fatty acids. FAO, (1996) reported that this poor nutritive value of maize can be improved through better maize breeding, storage, cooking and by a fortification process. Every year a big portion of maize imported to minimize the increasing demand as feed and food. Farmers are also cultivating different varieties to fullfil this purposes. If maize is consumed like rice and wheat as the source of carbohydrate then the increasing pressure on rice and wheat production will decrease. Since maize can play an important role in human nutrition then the study was under taken to investigate the various biochemical composition of different varieties of maize.

MATERIALS AND METHODS

Storage seeds of twelve maize varieties (*Zea mays*) namely Barnali, Shuvra, Khoibhutta, Mohar, BARI Maize 5, BARI Maize 6, BARI Maize 7, BARI Hybrid Maize 2, BARI Hybrid Maize 3 and Pacific 11, Pacific 60, Pacific 983 were selected for the study. The studies on different parameters-seed weight, moisture, ash, fibre were carried out in triplicate. Moisture content of maize flour sample was determined by drying in an oven at 100°C for overnight. Ash was determined at 600 °C to burn off all organic material. Crude fiber was determined according to the AOAC methods (2004). The crude fiber method essentially determines the cellulose and lignin content. The total sugar and starch content in maize were determined colorimetrically based on the method of McCready et al. (1950). The reducing sugar content was determined by dinitrosalicyclic acid method as described by Borel et al. (1952). Fat was analysed by Soxhlet Extraction method as described in AOAC (2004). The protein content of food stuff is obtained by estimating the nitrogen content of the material and multiplying the nitrogen value by 6.25 (according to the fact that nitrogen constitutes on average 16% of a protein molecule). The estimation of nitrogen is done by Kjeldhal method (Peter 1932). The digestibility of cereal protein was determined by the method of Akeson and Stahmann (1964). In this method protein is digested by pepsin, followed by pancreatin.

RESULTS AND DISCUSSION

The results on various physoco-chemical parameters such as moisture, ash, fibre and chemical composition such as total sugar, reducing sugar, starch, total carbohydrate, oil, protein and in vitro protein digestibility of 12 varieties of maize are presented in Table 1,2 and 3 respectively. The result showed that thousand grain weight of pacific was 983 (363.1 g), significantly higher than all other varieties. The lowest thousand grain weight (203.5g) was given by Khoibhutta. The thousand grain weight reported by Bhuiyan et al. (2003) was more or less similar with the present value. This variation might be due to varietal variation and grain size of maize.

The moisture content of different varieties of maize varied from 7.12% to 10.80% (Table 1). The result showed that the variety Pacific 60 gave significantly the lowest amount of moisture (7.12%) followed by the variety Pacific 983 (8.18%). The variety BARI Maize 7 contained the highest amount of moisture (10.80%) followed by Bornali (10.34%). The present value was more or less similar with the reported value of 11.61% moisture by Bressani et al. (1958) and Cravioto et al. (1945). Moisture content varries among the varieties might be due to varietal variation and different levels of sun drying after harvesting.

The variety Shuvra contained significantly the highest amount of ash (1.62%). The lowest amount of ash (1.0%) was observed in the varieties Pacific 11 and Pacific 60. The present values were in agreement with the reported value1.3% to1.2% of Iken et al. (2002). Ash content varies among the varieties might be due to varietal variation.

Table 1. 1000 grain weight, moisture and ash content of different varieties of maize .

Name of varieties (Treatment)	Weight of 1000 seeds (gm) (at 13% moisture level)	Moisture (%)	Ash (%)
Khoibhutta	203.5 j	9.91 abc	1.44 abc
Shuvra	313.7 f	9.86 bc	1.62 a
Mohar	332.7 d	9.76 bc	1.36 abc
Bornali	232.1 i	10.34 ab	1.27 bcd
BARI Maize 6	306.3 g	7.36 de	1.45 abc
BARI Maize 7	279.0 h	10.80 a	1.37 abc
BARI Hybrid Maize 2	322.8 e	10.25 abc	1.48 ab
BARI Hybrid Maize 3	352.5 b	9.37 c	1.53 ab
BARI Maize 5	311.9 d	9.63 bc	1.46 abc
Pacific 11	313.8 f	9.94 abc	1.00 d
Pacific 60	346.8 c	7.12 e	1.00 d
Pacific 983	363.1 a	8.18 d	1.16 cd
LSD (0.05)	4.33	0.829	0.267

Figures in a column followed by a common letter do not differ significantly at 5% level by DMRT.

BARI Hybrid Maize 3 contained the highest amount (10.96%) total sugar which found significantly higher than other varieties (Table 2). This was followed by Pacific 60 (10.21%). The BARI Maize 6 contained the lowest amount of total sugar (6.03%) among all the varieties. These values were much higher than the reported value (4.4%-5.0%) by Iken et al. (2002).

Khoibhutta contained significantly the highest amount of reducing sugar (1.29%) and the BARI Maize 6 showed the lowest amount of that (0.16 %). The BARI Hybrid Maize 2 contained the highest amount of fibre (1.53%) and also was at par with the varieties BARI Maize 7 and Mohar (1.52% and 1.50%) respectively. The variety pacific 11 possesses the lowest amount of fibre (0.50%) and was at par with the variety BARI Maize 5. This variation might be due to varriation among the varieties. The highest amount of starch (58.49%) was found in BARI Hybrid Maize 2 and was also at par with the variety Khoibhutta (56.64%). BARI Hybrid Maize 3 contained the lowest amount of starch (47.43%). The present values were found lower than the reported values (62.6%) by Belitz and Grosch (1985).This variation might be due to variation among the varieties and also for genetical and environmental factors. Carbohydrate is the major nutrient component of the maize kernel. Usually starch, total sugar and crude fibre are considered the main constituent of the carbohydrate. The results of carbohydrate of different varieties maize are presented in Table 2. It was observed that the BARI Maize 7 gave significantly the highest amount of carbohydrate (66.99%) followed by the variety BARI Hybrid Maize 2 (66.63%). The variety Pacific 983 contained the lowest amount of carbohydrate (58.86%) followed by BARI Hybrid Maize 3 (59.42%). These present values were found more or less similar with the values reported by Shahjahan (2002) 58.68% to 65.79%. Agronomic practices, environmental factors as well as variation among the genotype might influence the carbohydrate contents. Total carbohydrate and its main constituents were also presented in the Figure 1.

The amount of oil contents did not differ largely among the varieties (Table 2). The variety BARI Hybrid Maize 2 contained the highest amount of oil (2.86%) and The BARI Maize 7 contained significantly the lowest amount of oil (2.10%). The present data found some lower than the reported values by Shahjahan (2002) 2.77% to 3.25% oil. This variation might be due to varietal differences.

Table 2. Analysis of carbohydrate, reducing sugar and oil of different maize varieties (g/100 g).

Name of varieties (Treatment)	Total Sugar (%)	Reducing sugar (%)	Crude Fibre (%)	Starch (%)	Carbohydrate (%)	Oil (%)
Khoibhutta	7.46g	1.29 a	1.37 b	56.64ab	65.46abc	2.58 ab
Shuvra	7.33h	0.68 f	0.88 e	52.22bcd	60.43cd	2.60 ab
Mohar	7.54f	0.32 i	1.50 a	52.49abcd	61.53abcd	2.69 ab
Bornali	7.17i	0.42 g	1.12 c	53.34abcd	61.63abcd	2.46 b
BARI Maize 6	6.03 k	0.16 j	1.01 d	52.59abcd	59.63cd	2.14 c
BARI Maize 7	9.83 d	1.17 b	1.52 a	55.64abc	66.99a	2.10 c
BARI Hybrid Maize 2	6.61j	0.84 c	1.53 a	58.49a	66.63ab	2.86 a
BARI Hybrid Maize 3	10.96 a	0.74 e	1.0 d	47.43d	59.42d	2.62 ab
BARI Maize 5	8.30 e	0.38 h	0.52 f	54.07abc	62.89abcd	2.76 ab
Pacific 11	10.12c	0.68 f	0.50 f	50.31cd	60.93bcd	2.80 a
Pacific 60	10.21b	0.42 g	1.0 d	54.21abc	65.42abc	2.76 ab
Pacific 983	7.35 h	0.77 d	0.98 d	49.76cd	58.86d	2.76 ab
LSD (0.05)	0.051	0.015	0.927	56.64ab	65.46abc	0.272

Figures in a column followed by a common letter do not differ significantly at 5% level by DMRT.

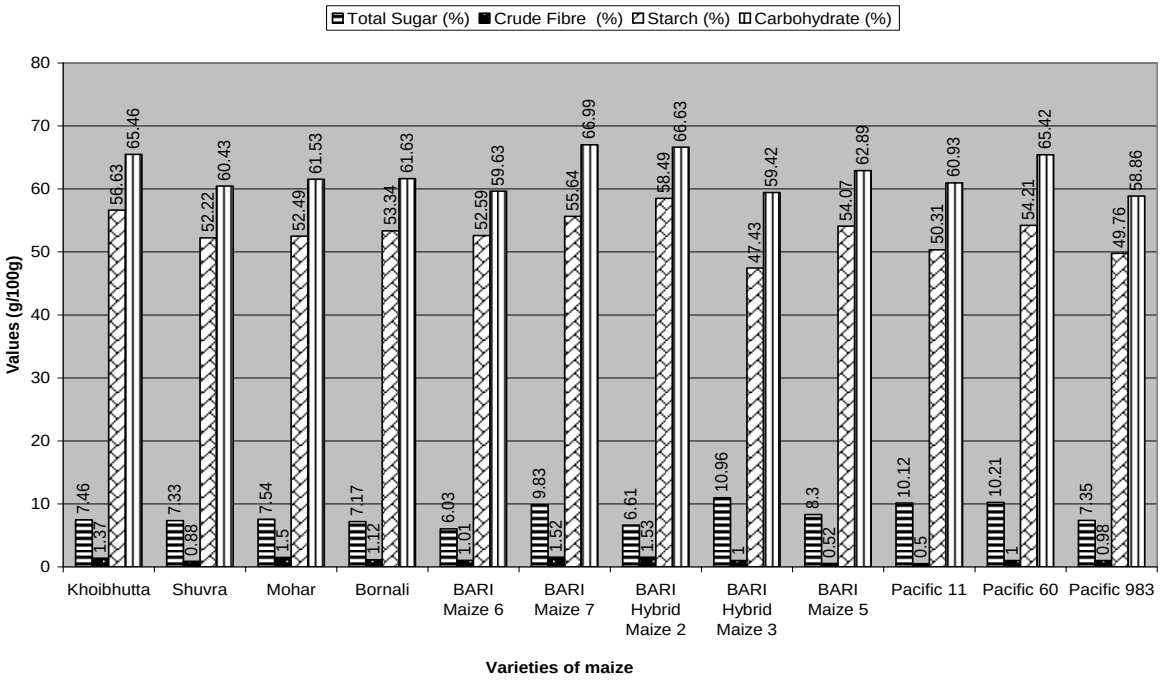

Figure 1: Major Constituents of different carbohydrate of varieties of maize

The results showed that among the maize varieties BARI Hybrid Maize 2 contained significantly the highest amount (13.54%) of protein which was also at par with the varieties Mohar (13.29%) and BARI Hybrid Maize 3 (13.28%). The varieties Khoibhutta and Bornali both contained significantly the lowest amount of protein (10.20%). The total protein content found higher than the reported value by Gopalan (1981) 11.1% protein and Shahjahan (2002) 8.25% to 11.17 protein. Protein contents of the varieties vary might be due to varietal variation,different soil type and use of different level of nitrogen fertilizer.

Table 3. Analysis of protein and In vitro protein digestibility of different maize varieties.

Name of varieties (Treatment)	Protein (%)	In vitro protein digestibility (%)
Khoibhutta	10.20 e	62.12 i
Shuvra	12.58 b	62.21 i
Mohar	13.29 a	67.37 f
Bornali	10.20 e	76.56 b
BARI Maize 6	10.60 de	69.56 e
BARI Maize 7	10.81 cde	71.29 d
BARI Hybrid Maize 2	13.54 a	87.20 a
BARI Hybrid Maize 3	13.28 a	71.26 d
BARI Maize 5	11.18 cd	61.72 j
Pacific 11	11.47 c	65.28 g
Pacific 60	11.45 c	72.53 c
Pacific 983	12.19 b	63.49 h
LSD (0.05)	0.6313	62.12 i

Figures in a column followed by a common letter do not differ significantly at 5% level by DMRT.

In case of in vitro protein digestibility the BARI Hybrid Maize 2 showed the highest percentage (87.20%) and the BARI Maize 5 gave significantly the lowest percentage (61.72%) of digestibility (Table 3). This variation might be due to varietal variation.

CONCLUSION

From this initial scale research we can concluded that aamong the selected varieties BARI hybrid maize 2 and BARI Maize 7 might be considered as an alternative of wheat and rice as the source of carbohydrate and protein, which might help to reduce the increasing demand of rice and wheat. We should encourage the farmer's for cultivation of BARI hybrid maize 2 and BARI maize 7 instead of wheat.

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