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Sangeeta
Centre of Food Science and Technology, CCSHAU, Hisar, Haryana, India

RB Grewal
Centre of Food Science and Technology, CCSHAU, Hisar, Haryana, India

Correspondence
Sangeeta
Centre of Food Science and Technology, CCSHAU, Hisar, Haryana, India

Physical and chemical properties of corn varieties (HQPM-1 and HQPM-7)

Sangeeta and RB Grewal

Abstract
Physico-chemical properties of two high quality protein corn varieties (HQPM-1 and HQPM-7) were studied. The HQPM varieties were analyzed for 1000 kernel weight, bulk density, hydration capacity, hydration index, swelling capacity and swelling index. Flour samples from HQPM varieties were analyzed for moisture, crude fat, crude protein, crude fibre, ash, and total carbohydrates. It was observed that there was no significant differences in physical properties of HQPM-1 and HQPM-7 varieties.

Keywords: Physical and chemical, corn varieties, protein corn varieties

Introduction
Maize (*Zea mays* L.) is third important food crop after rice and wheat, and is a good source of carbohydrates, proteins, fats and some of the important vitamins and minerals. Since it is cheaper than wheat and rice, has great utility as food throughout world (Shobha *et al.*, 2014) [17]. In spite of its rich nutritional value, has not been considered as complete food due to lack of two essential amino acids viz, lysine and tryptophan. However, this problem has been overcome by the development of quality protein maize (QPM), which has twice the quantity of essential amino acids. High level of these two amino acids not only enhance manufacture of complete proteins in the body, but also offers 90% of the nutritional value of skim milk, thereby alleviating malnutrition (Bello *et al.*, 2012) [5]. Maize is extensively used in making tamales, tortillas, arepas, fry bread and popular Mexican drink (Atinuke, 2015) [4].
This study was conducted to compare the physical properties and chemical composition of corn varieties (HQPM-1 and HQPM-7).Physical properties of food crops grains importance during design, improvement and optimization of separation and cleaning (Tarighi *et al.*, 2011) [18]. Maize is a good source of carbohydrates, proteins, fats and dietary fibre. In the world the share of starch from corn is about 83 % (Kumar *et al.*, 2013) [14].
Material and Methods: High Quality Protein Maize varieties available at Regional Research Station, Uchani (Karnal) were procured. The grains were screened to remove defective grains and foreign matter and stored in sealed container at room temperature. Maize flour was prepared by milling in Brabender Quardamat Junior Mill.
Evaluation of grains: Grains of HQPM varieties were assessed for 1000 kernel weight, bulk density, hydration capacity, hydration index, swelling capacity and swelling index.

Thousand Kernel Weight
Thousand grains were counted thrice and weighed. Thousand grain weight expressed as the weight in g per thousand grains.

Bulk Density
Grains were filled in 50 ml measuring cylinder up to 25 ml. The bottom of the cylinder was tapped gently on a laboratory bench to fill grains properly. Grains were weighed. Bulk density was calculated by dividing weight of sample to volume and expressed as g/ml.

Hydration Capacity and hydration index
Seeds weighing 10 g were counted and transferred to a measuring cylinder. To this 50ml water was added and cylinder was covered with aluminum foil and left overnight at room temperature.

The seeds were drained, superfluous water was removed with filter paper and swollen seeds were reweighed. Hydration capacity and hydration index was calculated using the following formula:

$$\text{Hydration capacity (\%)} = \frac{\text{Weight after soaking} - \text{Weight before soaking}}{\text{Weight of seeds}} \times 100$$

$$\text{Hydration capacity (per seed)} = \frac{\text{Weight after soaking} - \text{Weight before soaking}}{\text{Number of seeds}}$$

$$\text{Hydration index} = \frac{\text{Hydration capacity per seed}}{\text{Weight of one seed}}$$

Swelling capacity and swelling index

Seeds weighing 10 gm were counted, transferred to a measuring cylinder and their volume was recorded. To this 50 ml water was added and cylinder was covered with aluminum foil and left overnight at room temperature. The water was drained and volume of soaked seeds was noted in graduated cylinder. Swelling capacity and swelling index was calculated using the following formula:

$$\text{Swelling capacity (\%)} = \frac{\text{Volume after soaking} - \text{Volume before soaking}}{\text{Weight of seeds}} \times 100$$

$$\text{Swelling capacity (per seed)} = \frac{\text{Volume after soaking-Volume before soaking}}{\text{Number of seeds}}$$

$$\text{Swelling index} = \frac{\text{Swelling capacity per seed}}{\text{Seed volume (ml)}}$$

Chemical Evaluation

Flour samples from HQPM varieties were analyzed for moisture, crude fat, crude protein, crude fibre, ash, and total carbohydrates using standard methods of AOAC (1995) [3].

Results and Discussion

Thousand kernel weight of HQPM varieties ranged from 275-288 g (Table 1) and was in the range of value observed for different corn varieties by Guria (2006) [8], Tarighi *et al.*, (2011) [18] and Kumar (2012) [13]. Abiose and Ikujenlola (2014) [1] reported slightly lower (215.30-271.50 g) whereas, Sangamithra *et al.*, (2016) [15] reported higher (287.25-347.25 g) value of 1000 grain weight of corn than the thousand kernel weight found in present study.

Table 1: Physical properties of HQPM varieties.

Sample	1000 kernel weight (g)	Bulk density (g/ml)	Hydration index	Swelling index
HQPM varieties				
HQPM 1	275.5±0.05	0.73±0.00	0.45±0.007	0.72±0.006
HQPM 7	288.3±0.00	0.74±0.00	0.43±0.003	0.62±0.007

Varietal difference, cultural practices, fertilizer used and the fluctuation in the weather data could be responsible for variation (Khan, 2016) [11] in thousand kernel weight of maize observed in present study and that of previous workers. Bulk density of HQPM varieties (0.73-0.74 g/ml) was lower than the value (1.14–1.19 g/ml and 1.15–1.19 g/ml) reported by Guria (2006) [8] and Kumar (2012) [13], respectively and higher than the bulk density (679–632 kg/m^3 and 421.47 – 594.57 kg/m^3) observed by Tarighi *et al.*, (2011) [18] and Sangamithra *et al.*, (2016) [15], respectively. Variation in bulk density of HQPM varieties may be attributed to the variety, moisture content, seed size and contamination level (Guria, 2006) [8]. Hydration index of HQPM varieties (0.43-0.45) was similar to hydration index observed by Kumar (2012) [13] but swelling index observed in present study was higher (0.62-0.72) than the value (42.87-52.50) observed by Kumar (2012) [13]. The amount of water absorbed into the maize kernel during soaking depends primarily on the soaking water temperature, time, initial moisture content, variety of the seeds, soaking duration, acidity level of the water and physicochemical properties (such as seed structure and size) of the food material (Agarry, 2014) [2].

Table 2: Chemical composition of HQPM varieties.

Sample	Moisture	Crude protein	Crude fat	Crude fibre	Ash	Total carbohydrates
HQPM varieties						
HQPM 1	9.13±0.08	10.95±0.03	4.67±0.13	2.27±0.01	1.44±0.00	80.62±0.14
HQPM 7	9.16±0.03	11.02±0.00	4.66±0.08	2.62±0.01	1.37±0.007	80.32±0.09

The moisture content is an indication of storage stability; lower the moisture content in grains more is the stability of product (Kulpand Ponte, 2000) [12]. Moisture content of HQPM varieties ranged from 9.13-9.16 % and was in the range observed by Kumar, (2012) [13] but higher than the moisture content reported by AbioseandIkujenlola (2014) [1], Ikujenlola *et al.*, (2013) [10], Guria (2006) [8] and Ikujenlolaand Adurotoye (2014) [9].

HQPM-1 and 7 varieties contained 10.95 and 11.02 % protein, respectively which was comparable with the value (10.70 % and 7.22-10.67 %) observed by Carrillo *et al.*, (2004) [6] and Bello *et al.* (2012) [5], respectively. Higher protein content of corn varieties has been reported by IkujenlolaandAdurotoye (2014) [9]; AbioseandIkujenlola (2014) [1]; Ikujenlola *et al.*, (2013) [10] and Sharma *et al.*, (2015) [16].

Lipids are relatively minor constituents in cereal grains (Kulpand Ponte, 2000) [12]. Crude fat content of HQPM-1 and 7 varieties was 4.67 and 4.66 %, respectively (Table 2). Abioseand Ikujenlola (2014) [1] and Fasasi *et al.*, (2006) [7] also reported comparable values for fat content of corn varieties whereas, Carrillo *et al.*, (2004) [6] and Bello *et al.*, (2012) [5] reported higher crude fat (6.1 and 6.11-6.91 %, respectively) and IkujenlolaandAdurotoye, (2014) [9]; Ikujenlola *et al.*, (2013) [10] and Sharma *et al.* (2015) [16] observed lower fat content (1.80, 3.50-3.87 and 2.94, respectively) in corn varieties than the fat content observed in present study.

HQPM varieties contained 2.27-2.62 % crude fibre (Table 2) which was comparable to the value observed by Abioseand Ikujenlola, (2014) [1]. Bello *et al.* (2012) [5]; Ikujenlolaand Adurotoye, (2014) [9] and Sharma *et al.*, (2015) [16] found

higher crude fibre (3.50-5.08 %) whereas, Ikujenlola *et al.*, (2013) [10] reported lower percentage of crude fibre (1.83-2.00 %) than the crude fibre content of HQPM observed in the present study.

Ash content of HQPM-1 and 7 varieties was 1.44 and 1.37 %, respectively (Table 2) which was comparable with the values of ash content (1.60, 1.70 and 1.50-1.62 %) reported by Carrillo *et al.* 2004 [6]; Ikujenlola *et al.*, (2013) [10] and AbioseandIkujenlola (2014)[1], respectively. Bello *et al.*, (2012) [5] observed higher whereas, IkujenlolaandAdurotoye (2014) [9] and Sharma *et al.*, (2015) [16] observed lower ash content than the ash content observed in present study.

Carbohydrates are the major constituent (50-80 %) of cereals. HQPM- 1 and 7 varieties of corn contained 80.62 and 80.32 % carbohydrates, respectively which was comparable with the value (81.6 %) reported by Carrillo *et al.*, (2004) [6] but lower than the value (86.74 %) observed by Fasasi *et al.*, (2006) [7]. Bello *et al.*, (2012) [5]; Ikujenlolaand Adurotoye, (2014) [9]; Abioseand Ikujenlola (2014) [1]; Ikujenlola *et al.*, (2013) [10] and Sharma *et al.*, (2015) [16] reported lower carbohydrates content of corn varieties than the value observed in the present study.

Conclusion

The present study revealed that there was no significant differences in physical properties of HQPM-1 and HQPM-7 varieties. Protein, fat, fibre, ash and total carbohydrates ranged from 10.95-11.02%, 4.66-4.67%, 2.27-2.62%, 1.37-1.44% and 80.32-80.62% respectively, for both the corn varieties.

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