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Pasting properties of maize flour from variety HQPM-1 and HQPM-7

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Abstract
Pasting properties of two varieties of high quality protein maize (HQPM-1 and HQPM-7) were analyzed during 2015-2016. HQPM flour were assessed for various pasting characteristics viz. Peak Viscosity, Peak time, Break down, Final viscosity, Set back and Pasting temperature. It was observed that peak, trough, breakdown, final and setback viscosity of corn variety HQPM-7 was higher than HQPM-1.

Keywords: Maize, protein, flour, variety

Introduction
Maize (*Zeamays* L.) ranks third to rice and wheat6 as the most important cereal crop, mainly used as staple food and animal feed in most of the developing countries. The typical corn kernel contains approximately 70-73% starch, 9-10% protein, 4-5% fat, 1-2% ash, 2% sugar and 3% crude fibre (UNIDO, 1986). Maize has acquired a well deserved reputation as a poor man's nutricereal, however, it is deficient in two essential amino acids. Quality protein maize varieties with opaque-2 mutant gene contain about twice the levels of lysine and tryptophan. 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)[4].
The present investigation was undertaken to explore the pasting properties of flour of two varieties of maize i.e. HQPM-1 and HQPM-7.

Material and methods
The experiment was conducted at Choudhary Charan Singh Haryana Agricultural University, Hisar during 2015-2016**.** 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.
Samples of HQPM flour were assessed for various pasting characteristics viz. Peak Viscosity, Peak time, Break down, Final viscosity, Set back and Pasting temperature using Rapid-Visco Analyzer, Newport Scientific Australia.
Twenty five ml of distilled water was weighed into a canister. 3.5 g sample was weighed and transferred in canister. Paddle was placed into the canister and jogged to disperse the sample. Paddle and canister was inserted into Rapid-Visco Analyzer (RVA) and wait for the command for pressing down the tower from the thermocline windows till the temperature of RVA reached 50 ºC. Pressed down the tower and wait till the test was run for 13 min. Canister was removed on completion of test. From Thermocline windows following observations were recorded:

Peak Viscosity: Maximum viscosity developed during or soon after the heating portion of the test.

Trough viscosity: Maximum viscosity after the peak, normally occurring around the commencement of sample cooling.

Peak time: Time taken at which peak viscosity occurred.

Pasting temperature: Temperature where viscosity first increases by at least 25 cP over a 20sec. period using the standard-1 profile.

Break down viscosities: Peak viscosity minus trough viscosity.

Final viscosity: Viscosity at the end of the test.

Set back: Final viscosity minus trough viscosity.

Results and Discussion

Pasting encompasses the changes that occur after gelatinization upon further heating and these include further swelling of granules, leaching of molecular components from the granules and eventual disruption of granules especially with the application of shear forces and usually studied by observing changes in the viscosity of a starch system based on rheological principles (Tester and Morrison, 1990) [12].

Table 1: Pasting properties of corn varieties HQPM-1 and HQPM-7.

Sample	Peak Viscosity (cP)	Trough Viscosity (cP)	Breakdown Viscosity (cP)	Final Viscosity (cP)	Setback Viscosity (cP)	Peak time (min.)	Past. temp. (ºC)	Gelatinization temp. (ºC)
HQPM varieties								
HQPM 1	1389±26.85	1263±23.64	126±4.58	3847±93.29	2584±90.19	5.82±0.07	81.58±0.47	95.10±0.03
HQPM 7	1409±20.89	1275±13.78	134±10.01	3869±77.07	2593±63.56	5.73±0.13	81.01±0.24	95.10±0.03

Peak viscosity of flour of HQPM-1 and 7 varieties was 1389 and 1409 cP, respectively (Table 1). Atinuke 2015 [3] and Farasara, *et al.,* (2014) [6] reported lower (479.50 and 1237.7-1276.9 cP, respectively. Whereas, Abiose and Ikujenlola, (2014)[1] and Ikujenlola and Adurotoye, (2014)[7] observed higher (187.33-288.67 RVU and 208.67 RVU, respectively) peak viscosity of flour of maize varieties than the peak viscosity observed in present research work. The differences observed in the peak viscosities of the flour of HQPM varieties flours may be attributed to different rates of water absorption and swelling of starch granules of these flours during heating (Ragaee and Abdel-Aal, 2006) [11]. Trough viscosity is the point at which the viscosity reaches its minimum during either heating or cooling processes. It measures the ability of the paste to withstand breakdown during cooling (Iwe *et al*., 2016) [8]. Torugh viscosity of flour of HQPM-1 and 7 varieties was 1263 and 1275 cP, respectively (Table 1). Lower trough viscosity (Farasara, *et al.*, 2014) [6] and (Atinuke, 2015) [3] and higher trough viscosity (Abiose and Ikujenlola, 2014 and Ikujenlola and Adurotoye, 2014) [1, 7] for different corn varieties have been observed than the trough viscosity observed in present study. The breakdown viscosity is regarded as a measure of the degree of disintegration of starch granules or paste stability during heating (Dengate, 1984) [5]. Breakdown viscosity of flour of HQPM-1 and 7 varieties was 126 and 134 cP, respectively. Atinuke, 2015 [3] found lower breakdown viscosity of maize flour (112.5 cP) whereas, Farasara, *et al.*, (2014) [6]; Abiose and Ikujenlola (2014) [1] and Ikujenlola and Adurotoye (2014) [7] observed higher breakdown viscosity (147-264 cP, 112.67-113.17 RVU and 67.92 RVU, respectively) of maize flour than observed in present study. Differences in breakdown viscosity of HQPM varieties are related to differences in the rigidity/fragility of the swollen granules (Li *et al.*, 2014) [9]. Final viscosity defines the quality of particular starch based flour since it indicates the ability of the flour to form a viscous paste after cooking and cooling. It also gives a measure of the resistance of the paste to shear force during stirring (Adebowale *et al*., 2008) [2]. Final viscosity of flour of HQPM-1 and 7 varieties was 3847 and 3869 cP, respectively (Table 1) which was higher than the final viscosity (2017.4-2630.8 and 1654.5 cP) observed by Farasara, *et al.,* (2014) [6] and Atinuke (2015) [3] for different maize varieties. Variation in final viscosity of flour of HQPM varieties may be attributed to the aggregation of the amylose molecules in the paste (Miles *et al*., 1985) [10]. Setback viscosity is the measure of syneresis upon cooling of cooked paste. The setback viscosity can be used to predict the storage life of a food product prepared from the flour. Higher setback viscosity value indicates the higher tendency of amylose to retrograde (Zaidul *et al*., 2007) [13]. Setback viscosity of flour of HQPM varieties was 2584-2593 cP (Table 1) which was higher than setback viscosity observed by Farasara *et al.*, (2014) [6] and Atinuke 2015 [3] for maize varieties. Pasting temperature and time is the minimum time taken by flour for cooking (Iwe *et al*., 2016) [8]. Peak time and Pasting temperature of flour of HQPM varieties ranged from 5.73-5.83 min. and 95.10-95.10 ^{0}C, respectively (Table 1). Peak time of flour of HQPM varieties recorded in present study was in the range of values (5.40-6.93 min.) of peak time of maize variety (Abiose and Ikujenlola, 2014) [1]. Peak time observed by Atinuke (2015) [3] and Ikujenlola and Adurotoye (2014) [7] was higher whereas pasting temperature observed by Farasara, *et al.,* (2014) [6] and Atinuke 2015 [3] for flour of maize varieties was lower than the values observed in present study.

Conclusion

The present study indicated that peak, trough, breakdown, final and setback viscosity of corn variety HQPM-7 was higher than HQPM-1.

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