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PHYSICO-CHEMICAL AND FUNCTIONAL PROPERTIES OF DIFFERENT CULTIVARS OF MAIZE

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Abstract

The study was conducted with the objectives to study the physico-chemical and functional properties of different cultivars of maize. The four maize varieties JC-12, HP-white, Kanchan and P-1844 were analysed for physico-chemical and functional properties. Maize (HP-white) had maximum thousand kernel weight (287.9 g) and moisture content (12.00%) followed by Kanchan (181.8g, 10.65), P-1844 (178.0g; 10.20%) and JC-12(172.49g; 9.10%), respectively. The ash content (1.90%) and crude protein (11.54%) was highest in JC-12 followed by Kanchan (1.73%, 10.57%), P-1844 (1.45%;9.15 %) and HP-white (1.58%, 8.84%), respectively. The L* and b* values were highest for P-1844 followed by Kanchan, HP-white and JC-12. The hydration capacity and swelling capacity was reported highest in P-1844 followed by JC-12, HP-white and Kanchan.

Keywords: Physco, chemical, maize, cultivars, functional, properties.

Introduction:

Maize (*Zea mays* L.) is considered as the most important crop cultivated worldwide under variable climatic ranges because of their higher adaptability to different environmental conditions. Corn (*Zea mays* L.), the world's leading grain crop, plays a major role in human nutrition. Corn, often referred to as maize, is the world's most widely grown food crop, preceded by rice and wheat (FAOSTAT 2018). In most of the developed countries, maize is considered as staple food and is used as animal feed and bio-energy crop for ethanol production. Maize or corn (*Zea mays* L.) is an important annual cereal crop of the world belonging to family Poaceae. Zea is an ancient Greek word which means "sustaining life" and Mays is a word from Taino language meaning "life giver." The word "maize" is from the Spanish connotation "maiz" which is the best way of describing the plant. Various other synonyms like zea, silk maize, makka, barajovar, etc. are used to recognize the plant (Kumar & Jhariya, 2013). It is considered as a staple food in many parts of the world. It is a third leading crop of the world after rice and wheat (Sandhu et al., 2007). The world production of maize was 967 million metric tons (MMT) and in India its production was 23 MMT in 2020–21. Due to its highest yield potential among the cereals, it is known globally as queen of cereals. The largest producer of maize is

United States of America (USA) contributing about 35% of the total world maize production. It is known as mother grain of Americans and it is the driver of the US economy. In India, the major maize growing states are Uttar Pradesh, Bihar, Rajasthan, Madhya Pradesh, Punjab, Haryana, Maharashtra, Andhra Pradesh, Himachal Pradesh, West Bengal, Karnataka, and Jammu and Kashmir, jointly accounting for over 95% of the national maize production. Maize is generally used for animal feed. It is widely processed into various types of products such as cornmeal, grits, starch, flour, tortillas, snacks, and breakfast cereals. Maize flour is used to make chapatis or flat breads which are eaten mainly in a few Northern states of India (Mehta & Dias, 1999). Due to increasing attention being drawn towards the development of nutraceuticals, the phytochemical compounds derived from maize and their health properties have recently become the major focus of studies. Maize kernel is an edible and nutritive part of the plant. It contains vitamin C, vitamin E, vitamin K, vitamin B1 (thiamine), vitamin B2 (niacin), vitamin B3 (riboflavin), vitamin B5 (pantothenic acid), vitamin B6 (pyridoxine), folic acid, selenium, N-p-coumaryl tryptamine, and N-ferrulyl tryptamine. Potassium is a major nutrient present which has a good significance because an average human diet is deficient in it (Kumar & Jhariya, 2013). Maize ranks third in global production. The Food and Agriculture Organization (FAO) predicts that 60 million tonnes more maize grain will be required by 2030. Global production of maize is next to wheat and rice. Especially in Asia, where maize production will double from 165 million tonnes now to almost 400 million tons by 2030, maize demand will continue to grow more rapidly than demand for human consumption.

Maize is generally grouped into six varieties namely dent corn, flint corn, pod corn, popcorn, flour corn, and sweet corn. It is widely grown almost in all countries. As per the IGC 2016, the overall production of corn worldwide was approximately about 1.04 BT. In USA, corn is one of the most important cereal crops, producing 36.05 MMT of corn in 2016. Over the last several years, maize producers enjoyed a steady increase in annual income. In 2015/16, the United State of America delivered more than 33.0% of the total corn production. As per the financial survey of MP, the production of sweet corn in India during 2017-18 was 43.80 lakh MT and the area under sweet corn was 13.17 lakh Ha. In India, maize is grown in a wide range of environments, extending from extreme semi-arid to sub-humid and humid regions. The crop is also very popular in the low- and mid-hill areas of the western and north-eastern regions. Broadly, maize cultivation can be classified into two production environments i.e., traditional maize growing areas, including Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh and non-traditional maize areas, including Karnataka and Andhra Pradesh. In traditional areas, the crop is often grown in marginal eco-regions, primarily as a subsistence crop to meet food needs. In contrast, maize in the non-traditional areas is grown for commercial purposes–i.e., mainly to meet the feed requirements of the booming poultry sector. Maize is a major crop of ancient culture and is still crucial part of the staple food of many countries around the world. Corn has gone through a process of selection and improvement that produces many kernel types. Due to its great genetic diversity, today's maize does not have the similar chemical composition, with differences in its properties and end-use. For example, corn produces a variety of products such as breakfast cereals and snack foods (Salinas-Moreno et al., 2003) and the starch is separated (Ji et al., 2003). The study was undertaken to investigate and compare the different varieties of maize for physicochemical and functional properties.

Materials and Methods

The cultivar (JC-12 ,HP-white, Kanchan and P-1844) of maize were procured from Eternal University, Baru Sahib, Local farmers of Punjab and Himachal Pradesh. The chemicals used were obtained from Sigma-Aldrich Chemicals Pvt. Ltd. New Delhi (India). Thousand kernel weight was measured by as per method discussed by (Sandhu & Singh, 2007). Bulk density of sweet corn grains was analyzed following the procedure given by (Okaka & Potter, 1977). Hydration capacity (g) and Swelling capacity (ml/seed) were analyzed following the procedure given by Williams et al., (1983). The moisture content was determined by following the method given by Horwitz, (1975). Crude Ash content of the samples is described by using procedure described by AACC (2000). Crude protein was analyzed following micro-kjeldhal method as per the procedure described in AACC (2000) with Kjeldhal Unit (Pelican). Crude fat was determined as per method described by (Rangnna, 2007) using Soxoplus (Pelican). Crude fiber was estimated by standard method of analysis AACC (2000) using Automatic Fibraplus unit.

The color value was measured using Ultra visible Hunter color. A glass container containing sweet corn seeds was placed against the light source, covered with a black cover and ‘L’, ‘a’, and ‘b’ color values were reported. Prior to doing color measurements, the device was calibrated using black and white tiling. The 'L*' number specifies the degree of brightness, with values ranging from 0 to 100 indicating dark to light. The 'a*' number indicates the intensity of the red – green color, with a +ve value suggesting more red. The 'b*' number shows the extent to which the yellow – blue color is present, with a larger +ve value suggesting more yellow.

Results and Discussion

The physicochemical properties of corn are shown in Table1. The average moisture content, ash, crude fat and protein of maize cultivars viz JC-12 (09.10% ± 0.15,1.90% ± 0.05%,4.33± 0.15, 11.54±0.52%),HP-white(12.00±0.18%,1.58±0.06%,4.23±0.08,8.84±0.16%),Kanchan(10.65±0.19%,1.73±0.05%,5.65±0.33, 10.57±0.33%)andP-1844(10.20±0.26%,1.45±0.07%,3.94±0.17,9.15±0.09%),respectively. Enyisi et al., (2014) reported a moisture content of corn ranging from 11.6% to 20%, which was slightly higher than the findings of the present study. This difference could be attributed to variations in environmental factors, indicating that the grains were harvested and stored under different conditions. These environmental factors, such as humidity levels, temperature, and storage conditions, can significantly influence the moisture content of corn grains. According to (Enyisi et al., 2014) the ash content of corn was found to range from 1.10% to 2.95%. In contrast, (Sandhu & Singh, 2007) reported that the ash content of corn flour from different varieties ranged from 0.19% to 1.66%, which was lower than the findings of the present study. This difference in results could be attributed to variations in the extraction rate used to obtain the corn flour. Furthermore, Mlay et al., (2005), reported a significantly higher ash content of 5.1% in corn bran compared to flour. This suggests that the extent of bran removal from the flour can impact the acid content. The PC (protein content) of corn grains has been reported by (Idikut et al., 2009; Mlay et al., 2005) and to fall within the range of 8.91% to 11.65% and 8.0% to 11.5%, respectively. Similar correlation was reported earlier by Shevkani et al. (2014). The test weight, bulk density, swelling capacity and hydration capacity of different maize cultivars viz. JC-12 (172.49 ± 14.47, 0.877 ± 0.03, 0.17 ± 0.02, 0.03 ± 0.02), HP-white (287.9±0.46, 0.741±0.01, 0.19 ± 0.03, 0.03 ± 0.02), Kanchan (181.8±0.32, 0.782±0. 03, 0.14 ± 0.02, 0.02 ± 0.01) and P-1844 (178.0±0.26, 0.701±0. 03, 0.28 ± 0.05, 0.07 ± 0.02), respectively.

Table: 1: Physico-chemical properties of different cultivars of maize

Parameters	**JC-12**	**HP-White**	**Kanchan**	**P-1844**
Test Weight (g)	172.49 ± 14.47	287.9±0.46	181.8±0.32	178.0±0.26
Bulk Density (g/ml^{-3})	0.877 ± 0.03	0.741±0.01	0.782±0.03	0.701±0.03
Hydration Capacity (g);	0.03 ± 0.02	0.03 ± 0.02	0.02 ± 0.01	0.07 ± 0.02
Swelling Capacity (m^3)	0.17 ± 0.03	0.19 ± 0.03	0.14 ± 0.02	0.28 ± 0.05
Ash (%)	1.90 ± 0.05	1.58±0.06	1.73±0.05	1.45±0.07
Moisture Content (%)	09.10 ± 0.15	12.00±0.18	10.65±0.19	10.20±0.26
Crude Protein (%)	11.54 ± 0.52	8.84±0.16	10.57±0.33	9.15±0.09
Crude Fat (%)	4.33± 0.15	4.23±0.08	5.65±0.33	3.94±0.17
L*	6.72±0.81	63.10±0.86	65.70±0.4	69.24±0.83
a*	5.84±0.21	12.10±0.17	12.72±0.18	11.32±0.14
b*	21.30±0.27	24.54±0.31	27.84±0.38	26.16±0.27

According to Sandhu & Singh, (2007), the bulk density (BD) of corn grains falls within the range of 0.645 to 0.774 g/ml. The variation in BD among corn grains can be attributed to differences in grain size and moisture content. Soliman & Abd El Maksoud, (2007) found that the bulk density exhibited a linear decrease as the moisture content of corn grains increased. The color value L*, a* and b* were highest for (6.72±0.81,5.84±0.21,21.30±0.27), HP-white(63.10±0.86,12.10±0.17,24.54±0.31), Kanchan(65.70±0.4,12.72±0.18,27.84±0.38), and P-1844, (69.24±0.83,11.32±0.14,26.16±0.27), respectively. According to Cortes et al, (2006), the presence of phenolics with antioxidant properties contributes to the red and blue coloration. The yellow color of corn grains can be attributed to the presence of specific carotenoids such as lutein and zeaxanthin.

Conclusion

In conclusion, this research provided valuable insights into the physicochemical properties of four maize cultivars, JC-12, HP-white, Kanchan, and P-1844. The study highlighted variations in moisture content, ash, crude fat, and protein levels, which can be attributed to environmental factors, processing techniques, and genetic differences. Bulk density was found to be influenced by grain size and moisture content. The color values of the corn grains were linked to the presence of specific carotenoids and phenolics. These findings contribute to the understanding of maize characteristics and have implications for selecting cultivars for various applications. It underscores the importance of considering these factors in further research and agricultural practices involving maize cultivation and processing.

Declarations

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this manuscript**.**

Ethical Approval

This article does not contain any studies with animals or humans performed by any of the authors.

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