Physico chemical and malting characteristics of pearl millet hybrids

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Abstract
Present study reports physico chemical and malting characteristics of two pearl millet hybrids viz HHB 234 and WHC 901. Hybrid WHC 901 had significantly (P≤0.05) higher seed weight, seed density and swelling index whereas HHB 234 had significantly (P≤ 0.05) higher hydration capacity and hydration Index. Both under controlled conditions (27±2 °C) as well as at room temperature, per cent germination was higher for HHB 234. Consequently, malting loss was also higher for HHB 234.

Keywords: Pearl millet hybrids, seed weight, swelling index, malting loss, per cent germination

Introduction
The COVID-19 pandemic and its impact on all 17 SDGs has shown that what began as a health crisis has quickly become a human and socio-economic crisis. While the crisis is hindering progress towards the SDGs, it also makes their achievement all the more urgent and necessary. (UN 2020) [11]. In this current scenario with escalating population and unrestricted use of natural resources, lots of underutilized crops are being explored and promoted for their potential to replace the staple crops of rice and wheat. Millets can be the answer in present scenario. Rightly termed as Nutri-cereals, millets are highly nutritive, rich in fibre and minerals as well as gluten-free. Recently, the UN General Assembly adopted by consensus, a resolution sponsored by India and supported by over 70 nations declaring 2023 as the International Year of Millets. This aims at raising awareness about the health benefits of the grain and their suitability for cultivation under changing climatic conditions. Despite the fact that millets are highly nutritious, their consumption is still limited to the conventional and poor population due to lack of awareness towards its nutritional values. Presence of phytic acid and other phytotoxins that inhibit the digestion and absorption of protein and certain minerals, affects the utilization of full nutritional potential of millets. However, simple domestic processing techniques like malting and fermentation can help improve the nutritional potential of millets (Sindhu et al., 2005; Kumari et al., 2018) [9,6]. Pearl millet [Pennisetum glaucum (L..)] is grown widely in the arid and semi-arid tropical regions in Indian subcontinent. It is the third most widely cultivated food crop in India after rice and wheat. Over the years, changing food habits and inconvenience in food preparations has made pearl millet obsolete (Sindhu, 2011; Saini et al., 2021) [10,8]. In an effort to bring pearl millet back to our food plate, enormous progress has been made in the genetic improvement of pearl millet in India during last several decades (Yadav & Rai, 2013; Berwal et al., 2017) [14,2]. Present study reports the physicochemical and malting characteristics of two pearl millet hybrids widely popular in Haryana, India.

Materials & Methods
Procurement of varieties
Pearl millet hybrid HHB-234 and WHC 901/445 were procured in a single lot from the Bajra Section of the Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar.

Physico-chemical properties of grains
Pearl millet varieties were evaluated for Physico-chemical parameters (Seed weight, Seed density, Seed volume, Hydration capacity, Hydration index, Swelling capacity and Swelling index) by the methods described earlier by Williams et al. (1983) [13].
Malting
Malting was carried out by method described earlier by Chaudhary and Sindhu (2016) [9]. Malting loss was calculated as follows:

\[ \text{Metabolic loss} = W_1 - W_2 \]  
(1)

\[ \text{W}_1: \text{Dry weight of initial sample} \]
\[ \text{W}_2: \text{Dry weight of kilned malt} \]

\[ \text{Vegetative loss} = W_3/W_2 \times 100 \]  
(2)

\[ \text{W}_3: \text{Weight of root and shoot} \]
\[ \text{W}_4: \text{Weight of kilned derooted malt} \]

Total malting loss was calculated as sum of Metabolic loss and Vegetative loss

Sensory evaluation
A modified sensory evaluation score sheet based on Six Point Hedonic Scale was used to gather data for sensory analysis by a panel of ten semi trained judges. The developed malt was evaluated for colour, aroma and texture with the following scores and description: Six (6) as liked very much; five (5) as liked moderately; four (4) as liked slightly; three (3) as disliked slightly; two (2) as disliked moderately and one (1) as disliked very much.

Results & Discussion
Physico-chemical properties
Thousand seed weight of pearl millet varieties HHB-234 and WHC 901 was 8.20 and 9.01 g, respectively (Table 1). Significant (P≤0.05) difference in seed weight was observed among both pearl millet varieties. Seed density of Pearl millet varieties also varied significantly (P≤0.05) and it was 0.92 g/ml in HHB 234 and 0.94 g/ml in WHC 901 variety. Seed volume of both varieties HHB 234 and WHC 901 was 0.02 g/ml. Hydration capacity of HHB-234 was 0.01g/seed and WHC 901 was 0.005g/seed. Significant differences in hydration capacity were observed between the two varieties. Hydration index of both the varieties varied significantly (P≤0.05) and it was 1.22 g/seed in HHB 234 and 1.11 g/seed in WHC 901 respectively.

Swelling capacity of both the varieties was similar (0.01ml/seed). Swelling index of HHB 234 was 0.75 ml/seed and WHC 901 was 0.79 ml/seed. Swelling index of WHC 901 was significantly (P≤0.05) higher than that of HHB 234.

It is important to understand the physico chemical characteristics as these are known to be correlated to cooking time which is a major criterion for acceptance of any new variety or hybrid (Williams et al., 2006) [12]. Seed weight and volume have also been found positively correlated to fat and carbohydrate content and negatively correlated to fiber content of seeds (Kaur et al., 2005) [5]. The water absorbing capacity of seeds depends on cell wall structure, composition of seed and compactness of the cells in the seed (Muller, 1967) [3]. The higher water absorption may indicate greater permeability of seed coat and softer cotyledons (Kaur et al., 2005) [5].

Per cent germination and malting loss
The percent germination of pearl millet variety HHB 234 at controlled temperature (27±2 °C) varied from 77 to 89 per cent for 24 and 72 hours whereas at shelf temperature (20±2 °C) it was 48 and 71 per cent respectively. In variety WHC 901, germination was 18 per cent at 24h, 31 per cent at 48h and 42 per cent at 72h at controlled temperature (27±2 °C). At shelf temperature, 8 per cent germination at 24h, 21 per cent at 48h and 31 per cent at 72h was recorded (Table 2).

Malting loss in variety HHB 234 was found to be 8.09 per cent at 24h, 8.37 per cent at 48h and 9.7 per cent at 72h respectively at controlled temperature (27±2 °C) whereas at shelf temperature (20±2 °C), malting loss was found to be 7.23 per cent at 24h, 7.51 per cent at 48h and 7.84 per cent at 72h. In WHC 901 malting loss at controlled temperature was 7.10 percent at 24h, 7.92 per cent at 48h and 9.10 per cent at 72 hours whereas at shelf temperature, 6.98 per cent at 24h, 7.11 per cent at 48 h and 7.89 per cent at 72h (Table 2).

Sensory evaluation
When pearl millet flour was malted at controlled temperature (27±2 °C), no significant differences were observed in color, texture and overall acceptability when evaluated organoleptically using six-point hedonic scale by judges. The aroma of HHB 234 malted at 24 and 48 hours had significantly (P≤0.05) higher scores as compared to WHC 901 (Table 3).

When pearl millet flour was malted at room temperature, no significant differences were observed in colour, aroma and texture when evaluated organoleptically using six-point hedonic scales by judges. The overall acceptability of HHB 234 malted at 48 hours was significantly (P≤0.05) higher as compared to its 24/72 hr counterparts (Table 4).

Malting is an important process that helps in the mobilization of seed reserves and elaboration of the activity of α- and ß- amylase and protease, thereby making these more digestible. It is important to understand the malting characteristics of any new variety/hybrid as it affects their utilization in further product development. Malting conditions with lower malting loss and acceptable colour and aroma need to be standardized for better utilization of pearl millet in development of value-added nutritious products with higher digestibility and bioavailability of nutrients. Badau et al. (2006) [1] studied malting properties in ten pearl millet cultivars and reported that metabolic loss (malting loss), vegetative loss (seedling yield) and total malting loss increased significantly (P < 0.05) with an increase in germination time and varied widely among cultivars. This information can serve as a guide for selection of suitable pearl millet cultivars for malting (Embushu and Nantanga, 2019) [4].

Table 1: Physico-chemical properties of different varieties of pearl millet

<table>
<thead>
<tr>
<th>Variety</th>
<th>Seed Weight (g/1000 seeds)</th>
<th>Seed density (g/ml)</th>
<th>Seed volume (g/ml)</th>
<th>Hydration capacity (g/seed)</th>
<th>Hydration Index</th>
<th>Swelling Capacity (ml/seed)</th>
<th>Swelling Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>HHB 234</td>
<td>8.20±0.32</td>
<td>0.92±0.01</td>
<td>0.02±0.00</td>
<td>0.010±0.01</td>
<td>1.22±0.01</td>
<td>0.01±0.01</td>
<td>0.75±0.02</td>
</tr>
<tr>
<td>WHC 901</td>
<td>9.01±0.07</td>
<td>0.94±0.01</td>
<td>0.02±0.00</td>
<td>0.005±0.01</td>
<td>1.11±0.01</td>
<td>0.01±0.00</td>
<td>0.79±0.02</td>
</tr>
<tr>
<td>t (cal)</td>
<td>2.46*</td>
<td>1.23*</td>
<td>NS</td>
<td>1.95*</td>
<td>1.55*</td>
<td>NS</td>
<td>1.57*</td>
</tr>
</tbody>
</table>

Values are mean ± SE of three independent determinations, NS – Non-significant
*Significant at 5% level of significance
There is no doubting that inclusion of millets in our food plate is imperative for food security. Pearl millet hybrids can successfully be subjected to malting to produce malt of acceptable color and aroma. This characteristic can be useful in higher demand of crop for brewing or development of value added traditional and novel food products.

References