Comparative Study on Macro and Micro Minerals Composition of Selective Red Rice Landraces from Chamba District of Himachal Pradesh-India

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Abstract: Six landraces of red rice from diversity rich areas of district Chamba (Himachal Pradesh, India) viz. Karad, Matali, Begmi, Bhrigu Dhan, Sukara and Chohartu were selected and analyzed for the first time for the presence of macro and micro minerals in them. The mineral composition of these landraces was compared with one improved white rice variety (HPR-2143) under cultivation in the areas of their adoption. Seven mineral elements were analyzed including four macro minerals viz. Mg, Na, K, Mn and three micro minerals viz. Cu, Zn, Fe. Amongst all, maximum content of Fe were documented in Matali (0.063 mg/100g) and minimum in Chohartu (0.029 mg/100g). Zinc was documented maximum in Matali (0.031mg/100g) and minimum in HPR 2143 (0.020 mg/100g) an improved variety. Magnesium content was documented maximum in Matali (0.925-1.386 mg/100g) and Mn content were found to be maximum in Bhrigu dhan (0.053 meq./l) and minimum in Karad (0.006 meq./l). Micro mineral Cu was documented to range from 0.003-0.004 mg/100g. Na was found to be maximum in Matali (17 meq./l) and minimum in Sukara (11meq./l), K was found maximum in Sukara (54 meq./l) and minimum in Begmi (36 meq./l).

Key words: Landraces • Rice • Minerals • Chamba

INTRODUCTION

Plant foods represent the largest segment of dietary diversity. Rice (Oryza sativa L.) is the world’s most important staple food for more than two billion people in Asia and hundreds of millions in Africa and Latin America [1]. Within Southeast Asia, rice provides about 60% of the human food consumption. About 55% of the Asian rice is produced in irrigated areas, which accounts for about 75% of Asia’s total rice production with an estimated 2.2 billion Asian rice farmers and consumers depending upon the sustainable productivity of the irrigated lowland rice ecosystem for their food supply [2].

About 80 percent of world rice production comes from the cultivation of Oryza sativa. There are over 140,000 varieties of rice known to grown world over. Nearly 74% of cropped area under rainfed agro ecosystems is occupied by high yielding varieties and it could be even higher in irrigated ecosystems [3]. High degree of landraces diversity still exist in rainfed agro ecosystems and areas inhabited by tribals [4]. There are several reports about the work on the collection and cultivation of traditional landraces in India [5-8].

Himachal Pradesh is among the rainfed states of India. District Chamba is rich in biodiversity and the tribal people of this district are still growing landraces of red rice and other crops because of their unique properties. The myth with the people of the areas cultivating these red rice landraces is that the cooked rice when fed to pregnant ladies and lactating mothers do not face any health problem and nutrient deficiencies. As a ritual on all ceremonial functions in these areas, rice of these landraces is offered to the families holding the function. These landraces are particular in their habitat as these occur in specific ranges of altitude. In low altitudinal areas people are now using hybrids for cultivation. In present paper a comparative account of macro and micro mineral composition of six landraces and one improved variety has been described.
MATERIALS AND METHODS

Samples: Six red rice landraces viz. Karad, Matali, Begmi, Bhrigu Dhan, Sukara and Chohartu and were collected from the different diversity rich areas of district Chamba (Himachal Pradesh, India), having different altitudinal range varying from 1100-2400 m. Seeds of an improved white rice variety HPR-2143 which is also cultivated in these areas, were also collected to constitute the material for study.

Mineral Analysis: Macro and micro minerals were estimated by the method given by Jackson [9] by using atomic absorption spectrophotometer (Perkin Elmer Spectrophotometer). For this perchloric acid and nitric acid were mixed in the ratio of 1:3. Further 1 g of the sample was taken and mixed with 15 ml of reagent prepared in the flask till it was fully digested. The sample was then kept overnight and heated slowly up to 60°C. Whole of the process was done carefully so as to avoid overheating. The heating process was done till the white residue is left in the flask. The white powder residue left in the flask was mixed with 25 ml of distilled water. The water was added drop wise with constant stirring so that the minerals left in the white powder residue gets completely dissolved in the water which was filtered with the help of Whatman filter paper fitted in the thistle funnel. Presence of mineral was estimated by using atomic absorption spectrophotometer.

Statistical Analysis: Data was statistically analyzed with one way ANOVA software.

RESULTS AND DISCUSSION

Amongst six landraces along with one white seeded variety analyzed, macro mineral Mg was documented maximum in Matali (1.386 mg/100g) followed by 1.310 mg/100g in Bhrigu Dhan, 0.041 mg/100g in Karad, 1.288 mg/100g in Begmi, 1.198 mg/100g in Sukara, 1.196 mg/100 g in Chohartu and minimum amount of this macro mineral was documented in HPR-2143 (0.925 mg/100g). Na content was found maximum in Karad (17 meq./l) followed by Chohartu (16 meq./l), Begmi and Bhrigu Dhan (17 meq./l), HPR-2143 (13 meq./l) and minimum amount this macro mineral was estimated in Sukara (11 meq./l). Macro mineral K was found to be maximum in Sukara 54 meq./l, followed by 51 meq./l in Chohartu, 46 meq./l in Bhrigu Dhan, 45 meq./l in Matali, 41 meq./l in Karad and minimum amount of this element was documented in HPR-2143 and Begmi (36 meq./lt). Maximum amount of the Mn was documented in Bhrigu Dhan (0.053 mg/100g) followed by 0.037 mg/100g in Sukara, 0.032 mg/100g in Begmi, 0.025 mg/100g in Matali, 0.022 mg/100g in Chohartu, 0.019 in HPR-2143 and minimum amount of this element was documented in 0.006 mg/100g in Karad. Cu was documented to present at same amount in all the seven varieties ranged from 0.003-0.004mg/100g. These values are comparable with the values of macro and micro mineral composition for pigmented rice [10,11].

Maximum Fe content was documented in Matali (0.063 mg/100g) followed by Chohartu (0.053 mg/100g), Karad (0.041 mg/100g), Bhrigu Dhan (0.038 mg/100g), Sukara (0.029 mg/100g) and minimum was documented in HPR-2143. However, in pigmented rice iron content in the ranged from 0.91-1.66 mg/100 g sample. The differences in iron content of rice may be affected by their growing environments and genetic differences [12]. Higher iron content was observed in landraces than high yielding varieties [13]. In contrast to landraces, the most commonly grown high yielding varieties were at the lowest end of the scale with an average iron content of around 10 mg/kg. The highest value cited in that same study was 26 mg/kg for a landrace.

The maximum content of Zn was documented in Matali (0.031 mg/100g) followed by 0.029 mg/100g in Bhrigu Dhan, 0.025 mg/100g in Begmi, 0.024mg/100g in Karad, 0.022 mg/100g in Chohartu and minimum amount of this element was documented in HPR-2143 (Table 1 & Fig. 1). As with iron, zinc concentration is substantially higher in certain landraces than in commonly grown high yielding varieties. Furthermore, varieties that are high in iron content are often also high in zinc. Iron content of rice varied from 14-60 µg [10,11]. Some higher yielding varieties are reported to contain zinc content ranging from 14 to 59 mg/kg [14].
Table 1: Macro and micro mineral composition of seven red rice landraces

<table>
<thead>
<tr>
<th>Landrace Name</th>
<th>Mg (mg/100g)</th>
<th>Mn (mg/100g)</th>
<th>Na (meq./lt)</th>
<th>K (meq./lt)</th>
<th>Fe</th>
<th>Cu</th>
<th>Zn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karad</td>
<td>1.307±0.002f</td>
<td>0.006±0.00d</td>
<td>17±0.01g</td>
<td>41±0.02h</td>
<td>0.041±0.001b</td>
<td>0.024±0.002c</td>
<td>0.003±0.00d</td>
</tr>
<tr>
<td>HPR-2143</td>
<td>0.925±0.000e</td>
<td>0.019±0.00d</td>
<td>13±0.01g</td>
<td>36±0.01h</td>
<td>0.026±0.002c</td>
<td>0.020±0.001c</td>
<td>0.003±0.00d</td>
</tr>
<tr>
<td>Matali</td>
<td>1.386±0.002f</td>
<td>0.025±0.002d</td>
<td>17±0.03g</td>
<td>45±0.02h</td>
<td>0.063±0.001a</td>
<td>0.031±0.001c</td>
<td>0.004±0.000d</td>
</tr>
<tr>
<td>Begmi</td>
<td>1.288±0.2f</td>
<td>0.032±0.002d</td>
<td>14±0.02g</td>
<td>36±0.01h</td>
<td>0.038±0.001b</td>
<td>0.025±0.001c</td>
<td>0.003±0.00d</td>
</tr>
<tr>
<td>Bhrigu dhan</td>
<td>1.310±0.03f</td>
<td>0.053±0.001d</td>
<td>14±0.01g</td>
<td>46±0.01h</td>
<td>0.038±0.002b</td>
<td>0.029±0.003c</td>
<td>0.004±0.000d</td>
</tr>
<tr>
<td>Sukara</td>
<td>1.198±0.07f</td>
<td>0.037±0.001d</td>
<td>11±0.02g</td>
<td>54±0.01h</td>
<td>0.029±0.001c</td>
<td>0.025±0.002c</td>
<td>0.003±0.001d</td>
</tr>
<tr>
<td>Chohartu</td>
<td>1.196±0.002f</td>
<td>0.022±0.001d</td>
<td>16±0.01g</td>
<td>51±0.02h</td>
<td>0.053±0.001a</td>
<td>0.022±0.001c</td>
<td>0.004±0.000d</td>
</tr>
</tbody>
</table>

All the landraces showed the richness of macro and micro mineral composition. The amount of macro and micro mineral were also documented much more than the high yielding varieties, hence proving their importance for culinary credentials.

ACKNOWLEDGEMENT

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REFERENCES