Indian Journal of Agricultural Sciences 82 (7): 629–31, July 2012
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https://doi.org/10.56093/ijas.v82i7.21688

Colour and tissue differences in distribution of quercetin in Indian onions (*Allium cepa*) *

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Received: 15 January 2011; Revised accepted: 28 March 2012

Key words: Flavonoid, Quercetin, Onion and bulb

In onions (*Allium cepa*), a variety of colours exists ranging from white, yellow and brown to red with intermediate shades. Flavonoids or flavonols are a group of phenolic compounds that are normally present in vascular plants. Their pharmacological functions have originally been discussed in relation to the prevention of cancer cell proliferation (Ramanathan et al. 1993) and cataracts (Varma et al. 1975). The presence of flavonols has been reported even in bovine retina (Paulter et al. 1986). There is consistent evidence that quercetin may reduce the risk of lung cancer (Neuhouser, 2004). Further more, it has been found that some flavonoids have antioxidative function. It has also been discovered recently that quercetin can protect the human oral cavity from damage induced by reactive nitrogen species and that the protective function of quercetin may be significant when the antioxidant capacity of the saliva is decreased by periodontal diseases (Takahama et al. 2006). Quercetin intake was found to be inversely associated with mortality from coronary heart disease in Dutch elderly men and the mean flavonoid intake was found to be 26 mg/day (Hertog et al. 1993) which was comparable to another Danish study where the intake was calculated to be 23 mg day-1 (Justesen et al. 2000). In a more recent study, the American daily intake of onions was estimated to be 23.5 g/day (Chun et al. 2005) and estimated that quercetin contributed 70% of the total flavonoid intake on daily basis from onions and tea. Precise data on the occurrence of flavonoids in vegetable and fruits are lacking in India. So far, little attention has been paid towards quantitative aspects of determination of flavonoids in onions, one of the major vegetables consumed in Indian houses. The present growing interest in flavonoids and their possible role as contributors in reducing risk of several chronic diseases has provoked us to analyze the quercetin content of short day Indian onions. The aim of the present study was to determine the quercetin content of major onion varieties with different colour and analyze the quercetin concentration with respect to bulb tissue spatial variability, i.e ring wise and in vertical portion of bulbs.

Details of onion varieties and the labels to denote them in the study is given in Table 1. Fresh bulbs of different varieties varying in colour were obtained immediately after the harvest of winter crop in March–April, 2007, from the repository section of Directorate of Onion and Garlic Research, located at Rajgurunagar, Pune. After removal of dry skin three types of samples, viz. (1) composite sample, where in whole bulb of each colour was chopped into small pieces and homogenous sample was prepared, and (2) for ring-wise sample, rings from outer to inner most were grouped in to three portions (Fig 1a.) as follows, A= Outer rings (1 and 2), B= middle rings (3 and 4), C=inner rings (beyond 69

Table 1 Description of short-day Indian onion varieties used for quercetin assay

<table>
<thead>
<tr>
<th>Variety</th>
<th>Bulb colour</th>
<th>Label</th>
<th>Regions grown in India</th>
</tr>
</thead>
<tbody>
<tr>
<td>B 780</td>
<td>Dark red</td>
<td>R 1</td>
<td>Maharashtra and adjoining regions</td>
</tr>
<tr>
<td>N 53</td>
<td>Dark red</td>
<td>R 2</td>
<td>Northern parts of India</td>
</tr>
<tr>
<td>N 2-4-1</td>
<td>Light red</td>
<td>LR 1</td>
<td>Maharashtra and adjoining regions</td>
</tr>
<tr>
<td>ALR</td>
<td>Light red</td>
<td>LR 2</td>
<td>Northern parts of India</td>
</tr>
<tr>
<td>Phule Swarna</td>
<td>Yellow</td>
<td>Y 1</td>
<td>Maharashtra and adjoining regions</td>
</tr>
<tr>
<td>Arka Pitamber</td>
<td>Yellow</td>
<td>Y 2</td>
<td>Karnataka</td>
</tr>
<tr>
<td>Pusa White Round</td>
<td>White</td>
<td>W 1</td>
<td>Northern parts of India</td>
</tr>
<tr>
<td>Phule Safed</td>
<td>White</td>
<td>W 2</td>
<td>Maharashtra and adjoining regions</td>
</tr>
</tbody>
</table>
fourth ring). Each ring portion was minced into fine pieces and homogenous sample was taken for analysis and (3) for vertical bulb portion, onion bulb was divided into three portions (Fig 1b). Where, A= upper portion, i.e. portion of bulb from neck to shoulders. B= middle portion, i.e. portion of bulb from shoulders to lower bend. C= lower portion, i.e. portion of bulb from lower bend to base of bulb.

A sample weighing 0.5g was macerated with methanol in pestle mortar placed on ice cubes. The macerated extracts were refrigerated for 24 hr. The extract was filtered under vacuum. The clear filtrate was used for further analysis. Extract of 0.5 ml was mixed with 1.5 ml of methanol in a cuvette, to which 0.1 ml of 10% aluminum chloride, 0.1 ml 1M potassium acetate and 2.8 ml of distilled water were added. The reaction mixture was incubated for 30 min. at room temperature. The absorbance of reaction mixture was measured at 415nm with UV-Visible spectrophotometer. The calibration curve was plotted by preparing quercetin solutions at concentrations between 4 to 24 µg/ml in methanol.

Quercetin concentration of eight major onion varieties was estimated (Fig 2). The highest quercetin content of 530 µg/g was recorded in R 1 (B 780). However, varieties R 2 to Y 2, had quercetin values, which were statistically at par to each other. While, white varieties W-1 (43 µg/g) and W 2 (24 µg/g) had the least quercetin level compared to other coloured bulbs.

Onion bulbs commonly grown in Indian conditions were grouped into four predominant colours, viz. Dark red, light red, yellow and white onions. The quercetin content varied significantly with bulb colour (Fig 3). Dark red onion bulbs had highest quercetin values (462 µg/g) and the least was found in the white bulbs (34 µg/g). The findings are in agreement of Okamoto Daisaku et al. (2006) who recorded high amounts of quercetin glucoside in red onions than white.

Onion cultivars of different colours were analyzed for quercetin concentration with respect to the ring position in bulbs (Fig 4). It was noticed that ring position had significant influence on the quercetin content. Outer rings ‘A’ had highest value and differed significantly from other two positions ‘B’ and ‘C’. Quercetin content in the outer rings was higher than inner ones irrespective of bulb colour (Fig 4). However, the highest concentration was noticed in the outer rings of dark red bulbs (890 µg/g). Among the rings of white bulb, quercetin value of the middle and inner position was statistically at par to each other. Takahama and Hirota (2000) reported that quercetin concentration declined with the decline in the colour of onion scales, i.e. from outer dark dry scales to inner pale fleshy.

Significant variation in quercetin values with respect to bulb portion was recorded (Fig 5). The highest value was recorded for upper portion ‘A’ and the least in the lower portion ‘C’ of bulbs irrespective of bulb color. The above results are in corroboration with the findings of Sachiko Hirota et al. (1998).
SUMMARY

The above investigation revealed that quercetin content varied spatially in the bulb portions as well as in the rings of short-day Indian onions. It was high in top portion of bulb or in the outer rings. Dark coloured bulbs had greater amounts of quercetin in comparison to white bulbs. These findings would provide essential information for majority of people in India, South Asia and Gulf who consume onion in salads about the coloured bulbs that it contains more quercetin levels. Hence, consumption of coloured bulbs particularly the top portion or outer rings is more beneficial in meeting the dietary requirement of quercetin, which is an essential health compound.

ACKNOWLEDGEMENTS

The authors express gratitude to Indian Council of Agricultural Research, New Delhi for the approval of AP-Cess fund project on taking up this study.

REFERENCES


