Indian Journal of Agricultural Sciences **82** (7): 629–31, July 2012

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

A AZIZ QURESHI[1], K E LAWANDE[2], SIBI MANI[3] and VAISHALI B PATIL[3]

Directorate of Onion and Garlic Research, Rajgurunagar, Pune, Maharashtra 410 505

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 favonols 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 flavonols 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

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

Variety	Bulb colour	Label	Regions grown in India
B 780	Dark red	R 1	Maharashtra and adjoining regions
N 53	Dark red	R 2	Northern parts of India
N 2-4-1	Light red	LR 1	Maharashtra and adjoining regions
ALR	Light red	LR 2	Northern parts of India
Phule Swarna	Yellow	Y 1	Maharashtra and adjoining regions
Arka Pitamber	Yellow	Y 2	Karnataka
Pusa White Round	White	W 1	Northern parts of India
Phule Safed	White	W 2	Maharashtra and adjoining regions

*Short note

[1] Senior Scientist (Soil Science) (e mail: aziz_soil@rediffmail.com), Directorate of Oilseeds Research, Rajendranagar, Hyderabad, Andhra Pradesh 500 030;

[2] Vice Chancellor, Dr B S Konkan Krishi Vidhyapeeth, Dapoli 415 712, Maharashtra;

[3]Senior Research Fellow

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 in to 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 1*M* 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).

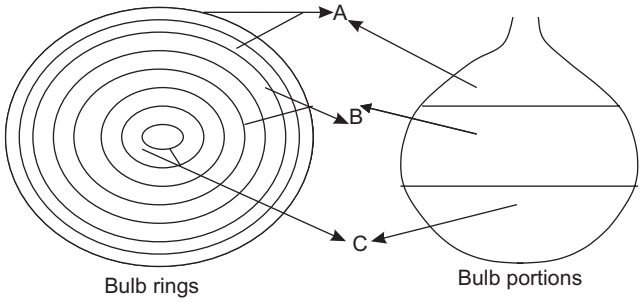

Fig 1 Onion rings A= outer rings, B= middle rings, C= inner rings. 1_b. showing onion bulb portions A= upper, B= middle and C= lower portion

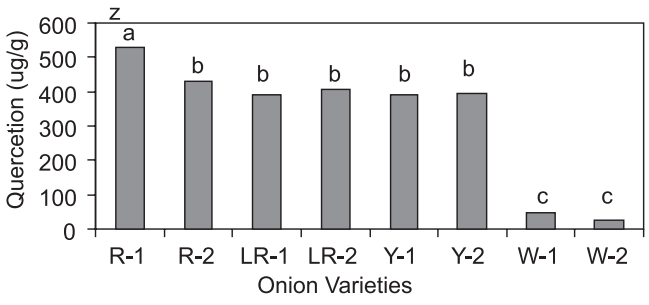

Fig 2 Quercetin levels in different varieties (*see* Table 1 for variety labels). [z]Mean separations within varieties by Duncun's test $P \leq 0.05$. Same letters indicate no significant difference

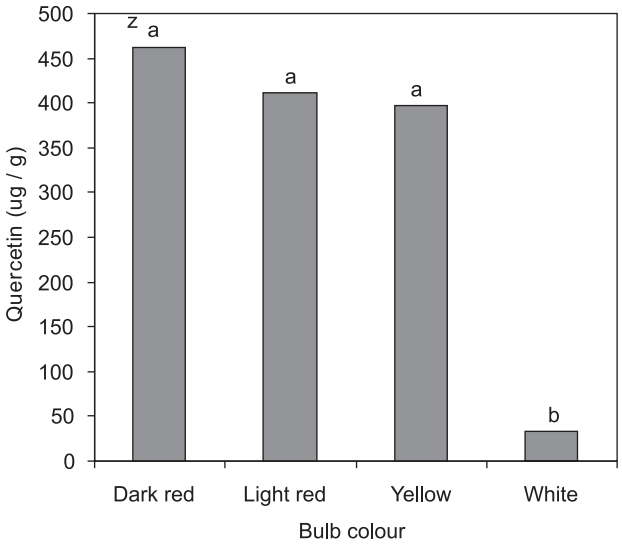

Fig 3 Quercetin variation in coloured onion bulbs. [z] Mean separations within bulb colours by Duncun's test $P \leq 0.05$. Same letters indicate no significant difference

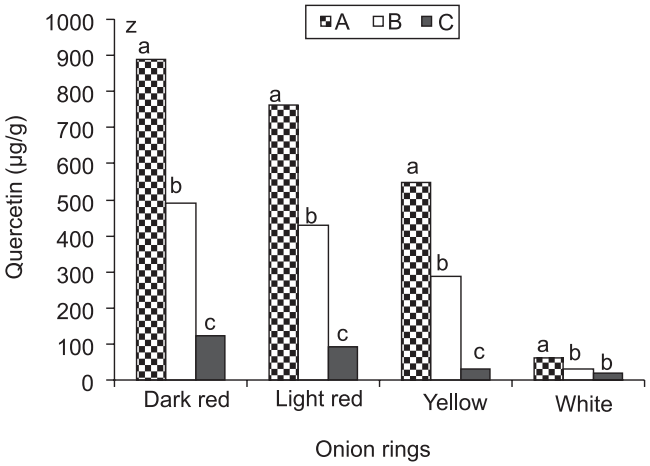

Fig 4 Quercetin content in onion rings (A, B and C, *see* Fig 1_a for ring position). [Z]Mean separations within onion ring positions by Duncun's test $P \leq 0.05$. Same letters indicate no significant difference

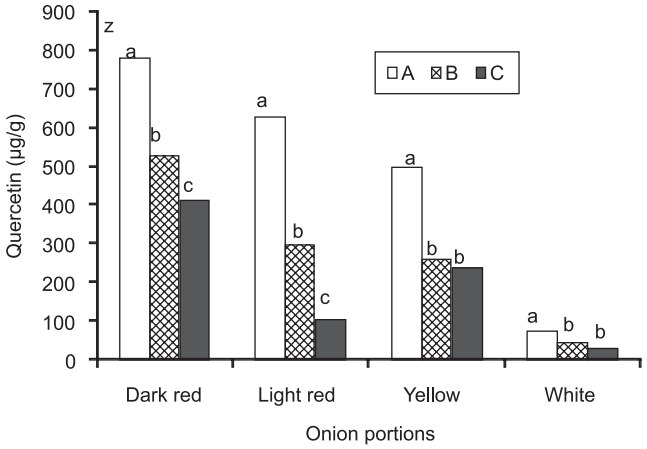

Fig 5 Quercetin content in bulb portions (A, B and C, *see* Fig 1_b for bulb position) of different coloured bulbs. [Z]Mean separations within bulb portions by Duncun's test P=0.05. Same letters indicate no significant difference

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 selenium for taking up this study.

REFERENCES

Chun O K, Kim D O, Smith N, Schroeder D, Han J T and Lee C Y. 2005. Daily consumption of phenolics and total antioxidant capacity from fruit and vegetables in the American diet. *Journal of the Science of Food and Agriculture* **85**: 1715–24.

Hertog M G L, Feskens E J M, Hollman P C H, Katan M B and Kromhout D. 1993. Dietary antioxidant flavonoids and risk of coronary heart disease: The Zutphen Elderly Study. *The Lancet* **342**: 1007–11.

Justesen U, Knuthsen P, Lyhne Andersen N and Leth T. 2000. Estimation of daily intake distribution of flavonols and flavanones in Denmark. *Scandinavian Journal of Nutrition* **44**: 158–60.

Neuhouser M. 2004. Dietary flavonoids and cancer risk: Evidence from human population studies. *Nutrition and Cancer* **50**: 1–7.

Okamoto D, Noguchi Y, Muro T and Morishita M. 2006. Genetic variation of quercetin glucoside content in onion (*Allium cepa* L.). Journal of Japanese Society of Horticultural Science **75** (1): 101–8.

Paulter E L, Maga J A and Tengerdy C. 1986. A pharmacologically potent product in the bovine retina. *Experimental Eye Research* **42:** 285–8.

Ramanathan R, Das N P and Tan C H. 1993. Inhibitory effects of 2-hydroxy chalcone and other flavonoids on human cancer proliferation. *International Journal of Oncology* **3:** 115–9.

Sachiko Hirota, Taeko Shimoda and Umeo Takahama. 1998. Tissue and spatial distribution of flavonal and peroxidase in onion bulbs and stability of flavonol glucosides during boiling of scales. *Journal of Agriculture and Food Chemistry* **46**: 3497–502.

Takahama U and Hirota S. 2000. Deglucosidation of quercetin glucosides to the aglycone and formation of antifungal agents by peroxidase-dependent oxidation of quercetin on browning of onion scales. *Plant Cell Physiology* **41**: 1021–9.

Takahama U, Hirota S and Oniki T. 2006. Quercetin-dependent scavenging of reactive nitrogen species derived from nitric oxide and nitrite in the human oral cavity: interaction of quercetin with salivary redox components. *Archives of Oral Biology* **51**: 629–39.

Varma S D, Mikuni I and Kinoshita J H. 1975. Flavonoids as inhibitors of lens aldose reductase. *Science* **12**: 1215–16.