Onion flavonoids: functional compounds for health benefit

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Introduction

Onion (*Allium cepa* L.), of Liliaceae family, mainly used as condiment, since antiquity has been known for therapeutic properties. Recent researches confirmed these medicinal effects and the consumption of onion seems to prevent the rise of serum cholesterol after a fatty meal (Bordia et al., 1975) and to control the growth of *Helicobacter pylori* which is one of the risk factor for stomach carcinoma (Dorant et al., 1996).These pharmacological properties of onion can be ascribed both to organosulfur compounds which are responsible for the typical odor and flavor and to flavonoids, in particular quercetin which was well known for its anticarcinogenic properties (Deschner et al., 1991). In last years, onion has been receiving more attention by consumers who have been showing an increasing interest towards the nutraceuticals (functional compounds) which provide health benefits including prevention of diseases. Foods with a high content of flavonoids, in addition to their nutritive value, can have a good protective effect on human health.

Aim of the research was to evaluate some commercial cultivars of different colored onions (white, golden and red) for the fresh bulb yields and for the flavonoid contents.

Table 1 - Morpho-physiological and yield parameters of the tested onion cultivars.

Cultivar	Day length	Bulb shape	Bulbs yield[a] (kg m^{-2})	Dry matter (%)	Flavonoids yield[a] (g m^{-2})
Golden					
Festival	intermediate	roundish	3.56	8.97	1.87
Tamara	long	globe	3.77	7.67	2.33
Daytona	long	globe	4.14	8.83	3.86
Dorata Density	long	spindle	3.56	8.51	3.48
Castillo	intermediate	oblate	6.65	6.79	5.23
Santana	long	globe	3.08	8.39	2.31
Red					
Tropea rossa tonda	short	globe	3.46	4.81	2.64
Rossa Lilia	long	spindle	4.23	8.31	2.06
Redwing	long	globe	3.75	8.95	2.18
White					
Gladstone	long	roundish	4.86	7.24	0.01
Southport	long	oval	4.98	7.84	0.02
White Hawk	long	roundish	3.37	5.64	0.01
Mean			4.12	7.66	2.17
LSD[b] (p≤0.05)			*0.82*	*1.39*	*1.13*
LSD[b] (p≤0.01)			*1.12*	*1.89*	*1.54*

[a] On fresh weight basis; [b] least significant differences.

Table 2 - Quali-quantitative composition of flavonoids[a].

Cultivar	Quercetin	Quercetin monoglyc.	Quercetin diglyc.	Rutin	Isorham-netin	Isorham. monoglyc.	Total flavonoid
Golden							
Festival	55.9	374.0	43.1	1.8	3.8	47.2	525.8
Tamara	66.5	460.0	37.9	4.7	2.7	45.1	616.9
Daytona	111.7	713.4	41.3	5.7	6.5	54.2	932.8
Dorata Density	95.4	725.2	73.3	13.6	5.9	65.7	979.1
Castillo	65.0	610.9	50.6	9.0	n.d.	50.7	786.2
Santana	92.3	547.3	49.2	6.3	6.5	48.2	749.8
Mean (golden)	81.1	571.8	49.2	6.9	5.1	51.9	765.8
LSD[b](p≤0.05)	*n.s.*	216.3	*n.s.*	*n.s.*	*n.s.*	*n.s.*	273.4
LSD[b](p≤0.01)		*n.s.*					*n.s.*
Red							
Tropea rossa	557.8	125.9	11.4	1.8	50.4	15.6	762.9
Rossa Lilia	57.5	352.1	32.6	2.7	3.7	38.3	486.9
Redwing	76.6	418.6	30.4	1.7	6.3	48.1	581.7
Mean (red)	230.6	298.9	24.8	2.1	20.1	34.0	610.5
LSD[b](p≤0.05)	398.4	100.2	*n.s.*	*n.s.*	23.6	14.4	*n.s.*
LSD[b](p≤0.01)	*n.s.*	*n.s.*			*n.s.*	*n.s.*	
White							
Gladstone	0.7	0.8	n.d.	n.d.	n.d.	n.d.	1.5
Southport	0.7	2.0	n.d.	n.d.	n.d.	tr.	2.7
White Hawk	0.6	0.6	tr.	n.d.	tr.	n.d.	1.2
Mean (white)	0.7	1.1	n.d.	n.d.	n.d.	n.d.	1.8
LSD[b](p≤0.05)	*n.s.*	*n.s.*					*n.s.*
LSD[b](p≤0.01)							

[a] Each value is expressed in mg kg^{-1} on fresh material and is the mean of six data;
[b] least significant differences ; n.d.=not detected; tr.=trace(<0.5).

Materials and methods

Plant material

Twelve onion cultivars of different skin colors, purchased as seeds from commercial suppliers, were grown in an experimental farm of the University of Bologna, placed in Po Valley, adopting a randomized block design with three replications. Six months after planting, the onions were harvested and stored at 4°C until extraction.

Flavonoid extraction, analysis and quantification

- Fresh material (5 g) was extracted with 50 mL of methanol:water:acetic acid (50:42:8, v:v:v) for 48 hours, filtered and stored at -20°C until analysis.
- The analyses were performed by HPLC using a 10 µm reversed phase Bondclone 10 C_{18} column, 300x3.9 mm and adopting a gradient solvent system of water:formic acid (95:5, v:v) (A) and methanol (B), from 95% to 5% of A using a linear gradient over 30 min, at a flow rate of 1.5 mL/min and detection at λ370 nm.
- The flavonoids were quantified on the basis of a calibration curve obtained from standard solutions of reference compounds.

Results and discussion

The different photoperiod (**Table 1**) of the tested cultivars did not seem to influence the bulb yield. The cultivar "Castillo" showed the significantly higher bulb yield (6.65 kg m^{-2}) whereas "Santana" was the less yielding (3.08 kg m^{-2}). Also the dry matter content was very variable ranging from 4.81% in "Tropea rossa tonda" to 8.97% in "Festival".

The extracts were characterized by the presence of quercetin, rutin (quercetin-3-O-rhamnoglucoside), quercetin monoglycoside, quercetin diglycoside, isorhamnetin and isorhamnetin glycoside (**Table 2**) with a predominance of quercetin compounds. Traces of kaempferol were found only in the cultivar "White Hawk".

The golden and red onions yielded, on average, high amounts of total flavonoids (765.8 and 610.5 mg kg^{-1} respectively) whereas the white onions contained only trace amounts (1.8 mg kg^{-1}). "Castillo" was the cultivar with the significantly higher (p≤0.05) flavonoid yield (5.23 g m^{-2}) whereas the white onions showed very scanty yields.

Marked differences in the distribution of flavonoids among the golden and red cultivars were also observed (**Figure 1**). The cultivar "Tropea rossa tonda", greatly differed from the other ones being characterized by a higher amounts of quercetin and isorhamnethin (557.8 and 50.4 mg kg^{-1} respectively) and lower contents of quercetin and isorhamnethin monoglycosides (125.9 and 15.6 mg kg^{-1} respectively). This finding seemed to confirm that high contents of quercetin are found only in colored onions as reported also by other authors (Laul et al., 1984).

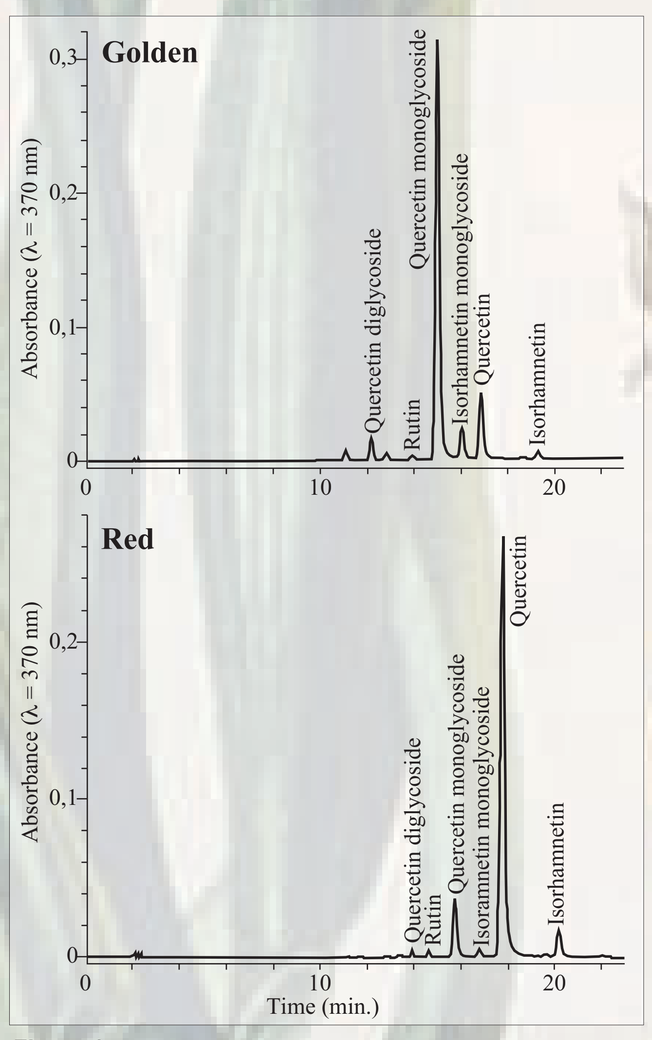

Figure 1

Conclusions

The studied onion cultivars evidenced a great variability on flavonoid contents.

The lack of flavonoids found in some cultivars, reduce their importance as health protection food. Considering the great variability in flavonoid content among the cultivars, it should be useful to develop a selection program extended to numerous types and varieties of this species.

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References

Bordia A, Bansal HC, Arora SK, Singh SV. 1975. Atherosclerosis 21, 15-19.

Deschner EE, Ruperto J, Wong G, Newmark HL. 1991. Carcinogenesis 7, 1193-1196.

Dorant E, Van Den Brandt PA, Goldbohm A, Sturmans F. 1996. Gastroenterology 110, 12-20.

Laul M S, Bhalenao S D, Muhmoley G V, Shah G R, Palal V S.1984. Indian Food Packer 38 (6), 30-39.