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Evaluation of mineral element, sugars and proteins compositions in bulbs of eight onion (*Allium cepa* L.) varieties cultivated in Tunisia

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Abstract - *Eight varieties of onion (Allium cepa L.); GIZA 6, Red Amposta, Z6, Morada de Amposta, Yellow Dessex, Early Yellow Texas Grano 502, Keep Red and Blanc Hâtif de Paris were evaluated for their food quality. Moisture content, total soluble sugars, total soluble proteins were examined on bulb as well as their mineral composition. Results demonstrated a significant difference between varieties in all the assays. Red onion varieties had superior values than* ***yellow and white varieties. 'Red Amposta' cv was the*** *richest variety in soluble sugars (4.72%), in calcium (60.47 mg/100g DW),in magnesium (3.17 mg/100g DW) and in sodium (9.11 mg/100g DW) whereas the highest amounts of water (86%), of soluble proteins (3.78%), of potassium (136.82 mg/100g DW) and of phosphorus (107.33 mg/100g DW) were observed in* ***bulbs of 'Morada de Amposta'.***

Key Words: mineral content, onion, proteins, sugars, water

1. Introduction

Onion (*Allium cepa* L.) is one of the most consumed vegetable planted widely across the world with a global annual production of 90 million tones [1. It is a natural part of the daily diet for most of the population and is a crop of great economic importance in all over the world [2]. In Tunisia, onion is very appreciated by consumers and used for flavoring the food; it is considered as the most important crop in all condiment. It is daily used at immature and mature stage in almost all food preparation.

Onions are sources of proteins [3] and sugars [4]. The main non-structural sugars of onion bulb tissue are glucose, sucrose, fructose and fructo-oligosaccharides [5]. In addition, onions bulbs had interesting mineral composition [6] especially potassium and phosphorus [7].

Because phytochemicals in onions vary greatly and mainly due to varietal differences [8], the present study was done in the purpose of the quantification of water soluble sugars and soluble proteins contents on bulbs as well as mineral composition of 8 varieties of onions 'GIZA 6', 'Red Amposta', 'Z6', 'Morada de Amposta', 'Yellow Dessex', 'Early Yellow Texas Grano 502', 'Keep Red' and 'Blanc Hâtif de Paris'.

2. Material and Methods

Bulbs of eight onion varieties: 'GIZA 6' (G6) from Egypt, 'Red Amposta' (RA), 'Z6', 'Morada de Amposta'(MA) from Italy, 'Yellow Dessex'(YD) from Spain, 'Early Yellow Texas Grano 502'(G502), 'Keep Red'(KR) from America and 'Blanc Hâtif de Paris'(BHP) from France, were collected in July 2012 from plants cultivated in the experimental station of Higher Institute of Agronomy, Chott Mariem (Tunisia).

Bulbs without any physical defect were chosen for analysis. The outer skins and ends of the onion samples were removed and washed in running tap water to remove adhering debris. After that, they were cut and put in an oven (Memmert) at 60°C for 48 h [9]. Then, the dried samples were grinded into fine powder using electric blender and stored in plastic bottle in freezer at 4°C until further analysis. Finally, the extraction was accomplished by using methanol according to Cheng method [10]. Sugars were extracted from bulbs according to the method of Dubois [11] and total soluble proteins content was measured using bovine serum albumin (BSA) as a protein standard [12].

For determination of mineral composition, fresh samples of bulbs were cut and extracted in HNO_3 (0.1 N) at ambient laboratory temperature for at least 48h [13]. After filtration, all cations (P, K^+, Na^+, Mg^{2+} and Ca^{2+}) were determined with a flame emission spectrophotometer (JENWAY PFP7).

For determination of total moisture content, 10 g of fresh onion samples were kept inside a hot air oven (Memmert) at 50° C for 24 h [14]. The dried sample was then weighed and the percent moisture content was determined as follows:

Moisture (%) = [{(Weight of original sample – Weight of dried sample) / Weight of original sample} × 100]

Data analysis was done using "SPSS software 13.00". Duncan's Multiple Range test was used to compare between means and determine significance between variables ($p < 0.05$).

3. Results and discussion

Analysis of the moisture content (Table 1) revealed significant difference among the eight studied varieties. Values ranged from 81.61 to 86.01 %. Maximum values were noted in red varieties 'KR' (86.01 %), 'RA' (85.81%) and 'Z6' (85.17%) whereas minimum ones was noted in yellow one 'G502' (81.61%). Our results are supportive to other observations [9,15]. The high moisture content of the studied *Allium cepa* L. varieties reveals that they need care for appropriate preservation as they will be prone to deterioration. It makes them susceptible to infection by micro-organisms. The high water content helps the body as the body does not need to use some of its own water to digest them. This means that the body uses less energy and resources to digest and can then assimilate all the nutrients much faster. Less pressure is therefore put on the digestive system [16].

Table 1. Contents (%) of moisture, total sugars and total proteins in bulbs of eight varieties of onion

Variety	Moisture content	sugars content	protein content
BHP	84.14 ^{b}	3.51 ^{d}	1.37 ^{h}
YD	83.22 ^{abc}	2.62 ^{e}	1.95 ^{f}
G502	81.61 ^{c}	3.63 ^{cd}	1.55 ^{g}
RA	85.81 ^{ab}	4.72 ^{a}	3.53 ^{b}
Z6	85.17 ^{abc}	3.91 ^{bc}	3.11 ^{c}
MA	82.13 ^{bc}	3.81 ^{c}	3.78 ^{a}
KR	86.01 ^{a}	4.11 ^{b}	2.66 ^{e}
G6	83.11 ^{abc}	3.66 ^{cd}	2.93 ^{d}

Means in the same colon followed by the same letter are not significantly different at 5% level according to Duncan test.

Results concerning total soluble sugars content (Tab.1) revealed an important difference between varieties. 'RA' *cv* had the highest value (4.72 %) followed by 'KR' (4.11%) and 'Z6' (3.91%) whereas the lowest content was obtained in 'YD' *cv* (2.62 %). These observations were supportive to few other observations, where it has been found that total soluble sugars content in case of onion varies between 2 and 4.5 % [17] and between 3 and 4.8% [14]. However, in other study [18], amounts of sugars in onions bulbs were higher (6.02-7.39 %). From our observations, it can be inferred that 'RA' and 'KR' varieties could be considered important to human by supplying energy whereas 'YD' *cv* (2.62 %) would be a better food source at least for diabetic persons. In fact, it was proved that sugar composition of the cultivars varied approximately: half of the mono- and di-saccharides content is glucose [5].

For total soluble proteins content, results are presented also in Table 1. 'MA' variety showed the highest amounts followed by 'RA' and 'Z6' with respectively 3.78, 3.53 and 3.11 % whereas 'BHP' *cv* had the lowest value (1.37 %). These results were also matched in other finding [13] (1.49- 2.62%) but lower than data found by research group of Babu[14] (4-11.2%) and Lee [19] (6-15%). In fact, the higher protein contents of the studied onion cultivars, indicates that its intake can contribute to the formation of hormones which controls a variety of body functions such as growth, repair and maintenance (replacement of wear and tear of tissues) of body[9]. In addition, it may be useful as a preferred option to animal proteins for diabetics as the later tend to be high in saturated fats. This confirms that onion is an energy-giving food.

Analysis of the mineral composition (Table 2) showed that there was significant ($p<0.01$) variation between the studied varieties in contents of calcium (14.22 – 76.33 mg), phosphorus (46.17- 107.33 mg), sodium (0.11- 9.47 mg), potassium (87.75- 136.82 mg) and magnesium (0.11 - 3.17 mg). Potassium and phosphorus were the highest in 'MA' *cv,* calcium was the highest in 'BHP' *cv*, sodium was the highest in 'Z6' *cv* and magnesium was the highest in 'RA' *cv* (Table 3). Similar varietal variation was noted in all constituents in other researches on onions [6,20,21]. Also, many works confirm that potassium, phosphorus and calcium are the major minerals in onion bulbs [7,9,22].

Table 2. Mineral content (mg/100g DW) in bulbs of eight varieties of onion
(Means in the same colone followed by the same letter are not significantly different at 5% level according to Duncan test.)

Variety	K	P	Ca	Na	Mg	Ca/P	Na/K
BHP	107.56 d	57.47 e	76.33 a	1.87 f	1.21 e	1.33 a	0.017 f
YD	93.88 e	55.73 e	30.91 f	0.11 g	2.11 d	0.55 d	0.001 g
G502	87.75 e	66.82 d	27.13 g	9.43 a	0.87 f	0.40 e	0.107 a
7RA	124.11 b	91.32 b	60.47 b	9.11 b	3.17 a	0.66 c	0.073 c
Z6	112.43 d	57.13 e	14.22 h	9.47 a	2.33 c	0.25 f	0.084 b
MA	136.82 a	107.33 a	54.13 c	8.75 c	2.67 b	0.50 d	0.064 d
KR	115.22 cd	87.11 c	33.11 e	7.11 d	0.11 h	0.38 e	0.062 d
G6	121.13 bc	46.17 f	43.11 d	3.14 e	0.77 g	0.93 b	0.026 e

Potassium is an essential nutrient and has an important role in the synthesis of amino acids and proteins which helps to repair worn out tissues [23]. The high concentration of K in the samples is not surprising because plants absorb it as K^+ ion in large amounts from the soil than any other nutrient except N and Ca [24]. Phosphorus is an important component of the body, about 85% of the 600g required is found in the body skeleton in the form of calcium phosphate, the remaining 15% is found in the soft body tissues and blood largely as phospholipids, phosphoproteins and nucleic acids as well as inorganic phosphate [25] (Paul, 2006). It is also an important component of energy intermediates [26]. Calcium is the major component of bone [27] and helps in teeth development [28]. It was showed that the medicinal values of some plant species used in homeopathic system may be due to the presence of Ca, Cr, Cu, Fe, Mg, K and Zn [29]. The presence of magnesium and sodium even in lower amounts compared to others varieties [7,9] and vegetables [30] (2-150 mg/100g Na)gives also importance to the studied cultivars.

Mangesium is an essential constituent of chlorophyll and also regulate the activities of many enzymes in plant [24] and low sodium diet has been reported to be beneficial in the prevention of high blood pressure [31]. The ratios of sodium to potassium (Na/K) and calcium to phosphorus (Ca/P) were also calculated (Table 2); Na/K ratio ranged between 0.001 ('YD' *cv*) and 0.107 ('G502' *cv*) whereas (Ca/P) ration was between 0.25 ('Z6' *cv*) and 1.33 ('BHP' *cv*). (Na/K) ratio in the body is of great concern for prevention of high blood pressure: (Na/K) ratio less than one is recommended. Hence, in the present study, all he samples would probably reduce high blood pressure disease because they had (Na/K) less than one especially 'BHP' *cv*.

Modern diets which are rich in animal proteins and phosphorus may promote the loss of calcium in the urine [32]. This had led to the concept of the (Ca/P) ratio. If the ratio (Ca/P) is low (low calcium, high phosphorus intake) more than the normal amount of calcium may be lost in the urine, decreasing the calcium level in bones. Food is considered good if the ratio is above one and poor if the ratio is less than 0.5 [33]. In our result, two varieties were classed to be as good sources of minerals dor bone formation ('BHP' and 'G6'), three varieties as moderate sources ('YD', 'RA' and 'MA') and three as poor sources ('G502', 'Z6' and 'KR').

4. Conclusion

In this research, studying the composition of onion bulbs revealed significant difference in all phytochemicals and between the various varieties in study. Generally, red varieties showed maximum values especially 'Red Amposta', 'and 'Morada de Amposta'. Therefore, results of the present investigation seems to be beneficial in the way that it allowed us to selected some varieties with nutritional value ('RA' and 'MA') that could be interesting to introduce them in Tunisian farm.

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