



Effect of nutrient solution on the quality of endive (*Cichorium endivia* L.) in hydroponic cultivation

INTRODUCTION

Endive is a valuable leaf vegetable with a characteristic bitter taste. The content of mineral compounds and vitamins in endive is higher than in lettuce. High biological value of the species is also proved by low content of compounds which are harmful to health. An excessive content of nitrates in vegetables is not undesirable because resulting from their reduction there appear nitrites and nitro-compounds which are harmful to consumer's health. Obtaining vegetables with high biological value includes many cultivation factors, such as cultivars, microclimatic conditions and rational fertilization. The aim of the investigation was the assessment of the effect of nutrient solution on the quality of endive in hydroponic cultivation in different period of the year.

MATERIAL AND METHODS

The study concerned the reaction of endive plants cultivated hydroponically in nutrient film technique (NFT) system to changes in nutrient solution parameters. The experiment was carried out in a greenhouse with controlled microclimate during two (spring and autumn) cultivation cycles. The study involved four endive cultivars, three crispum leaf cultivars: 'Galanti', 'Perceval', and 'Barundi', and one latifolium leaf cultivar (escarole chicory) – 'Kethel'. After having been planted into cultivation gutter with NFT system, the plants were supplied with a nutrient solution which is standard for endive. Towards the end of plants' vegetation, i.e. 10 days before the harvest, 1/3 of the plants were supplied with a standard nutrient solution with addition of 30 mmol NaCl, another 1/3 of the plants were supplied with water only, while the control plants were supplied with a standard nutrient solution during whole vegetation period. After the harvest the commercial plant weight was determined, and endive leaves were tested for the content of dry matter, ascorbic acid, sugar extract, chlorophyll, nitrates, P, K, Ca, carotenoids, and polyphenols. Endive plants were also assessed for antioxidant properties. Sensory evaluation was performed and bitterness index was determined.

The obtained results were analyzed statistically using analysis of variance and the Tukey test, for significance level $\alpha=0.05$.

RESULTS

The study showed the influence of cultivation term, nutrient solution and cultivar on the yield and biological value of endive. The endive accumulated significantly more nitrates in the autumn than in spring growing cycle (Fig. 1). Addition of NaCl to nutrient solution resulted in the increase in the content of sugar extract (Fig. 2), P, K, carotenoids, polyphenolic acids (Table 1), and in the bitterness index of endive leaves, and the decrease in commercial plant weight.

Replacing the nutrient solution with water at the end of vegetation significantly reduced the nitrate content in the leaves of endive (Fig. 1). The highest antioxidant activity was observed in the control plants. The majority of parameters tested depended on the cultivar of endive. In spring growing cycle the highest percentage of AA was evaluated in 'Perceval' and 'Kethel' cultivars and in autumn only in 'Perceval'.

CONCLUSIONS

1. Nitrate accumulation in endive leaves was much higher in the case of the plants grown during autumn as compared to the plants grown in spring.
2. Biological value of endive depended on cultivation term, nutrient solution and cultivar.

Table 1. The content of carotenoids and phenolic compounds in endive leaves depending on nutrient solution

Nutrient solution	Neoxanthin	Violaxanthine	Lutein	Zeaxanthin	α -Carotene	β -Carotene
Control	6.3 c*	7.2 c	20.7 c	12.7 c	11.6 c	19.3 a
NaCl	15.8 a	16.6 a	44.3 a	26.1 a	20.8 a	22.1 a
H ₂ O	8.4 b	7.9 b	26.1 b	15.1 b	13.0 b	24.2 a
	Chlorogenic acid	Caffeic acid	Chicoric acid	Rutin	Luteolin	Astragalgin
Control	22.5 b	13.2 b	10.7 c	21.3 a	8.4 a	36.5 c
NaCl	47.3 a	15.1 a	23.0 a	14.3 c	3.6 c	39.7 b
H ₂ O	21.9 c	15.6 a	17.0 b	17.7 b	6.5 b	47.2 a

* Values in column marked with the same letter do not differ significantly at $\alpha=0.05$ (Tukey test)

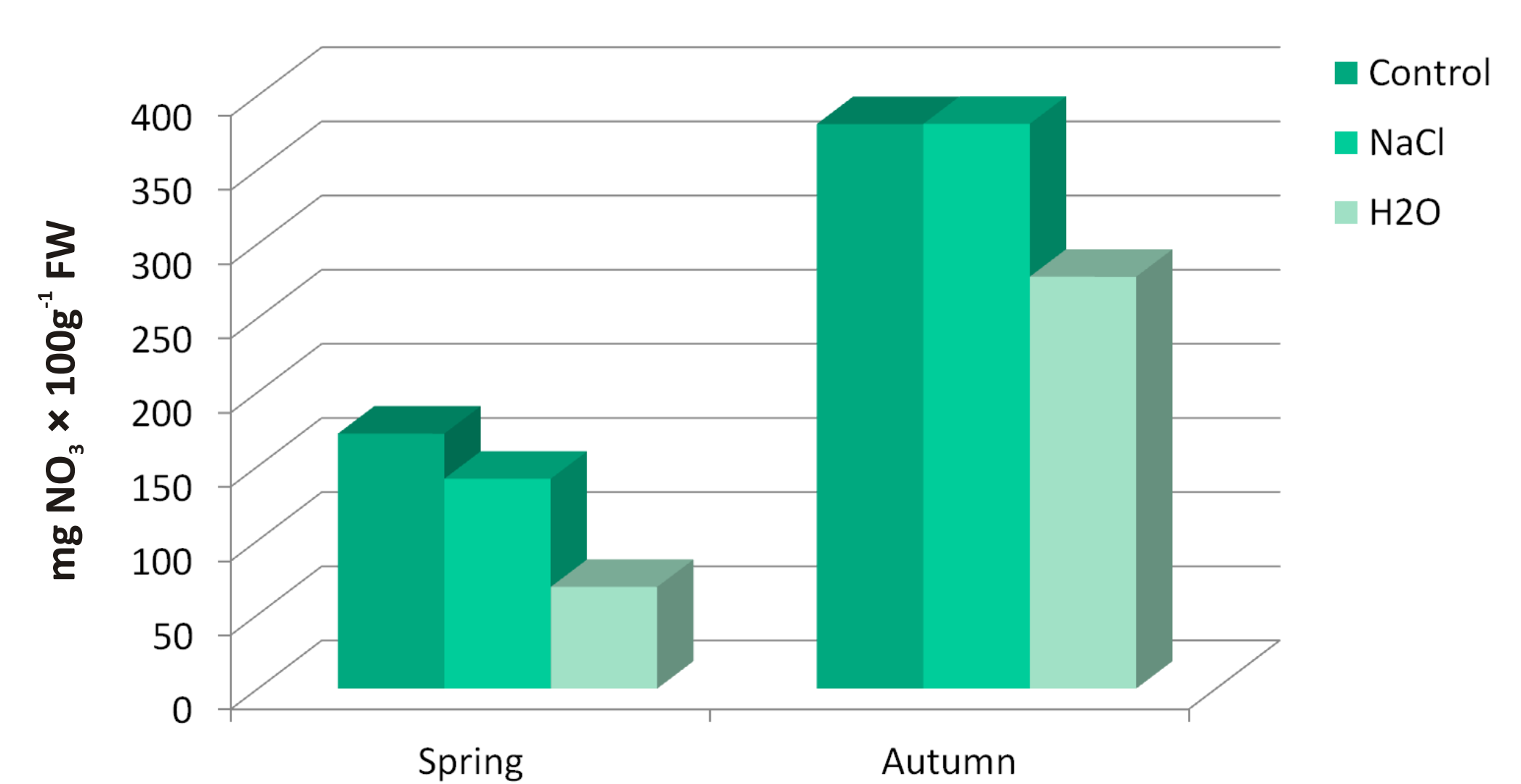


Figure 1. The nitrate content in the leaves of endive depending on the nutrient solution and the crop cycle

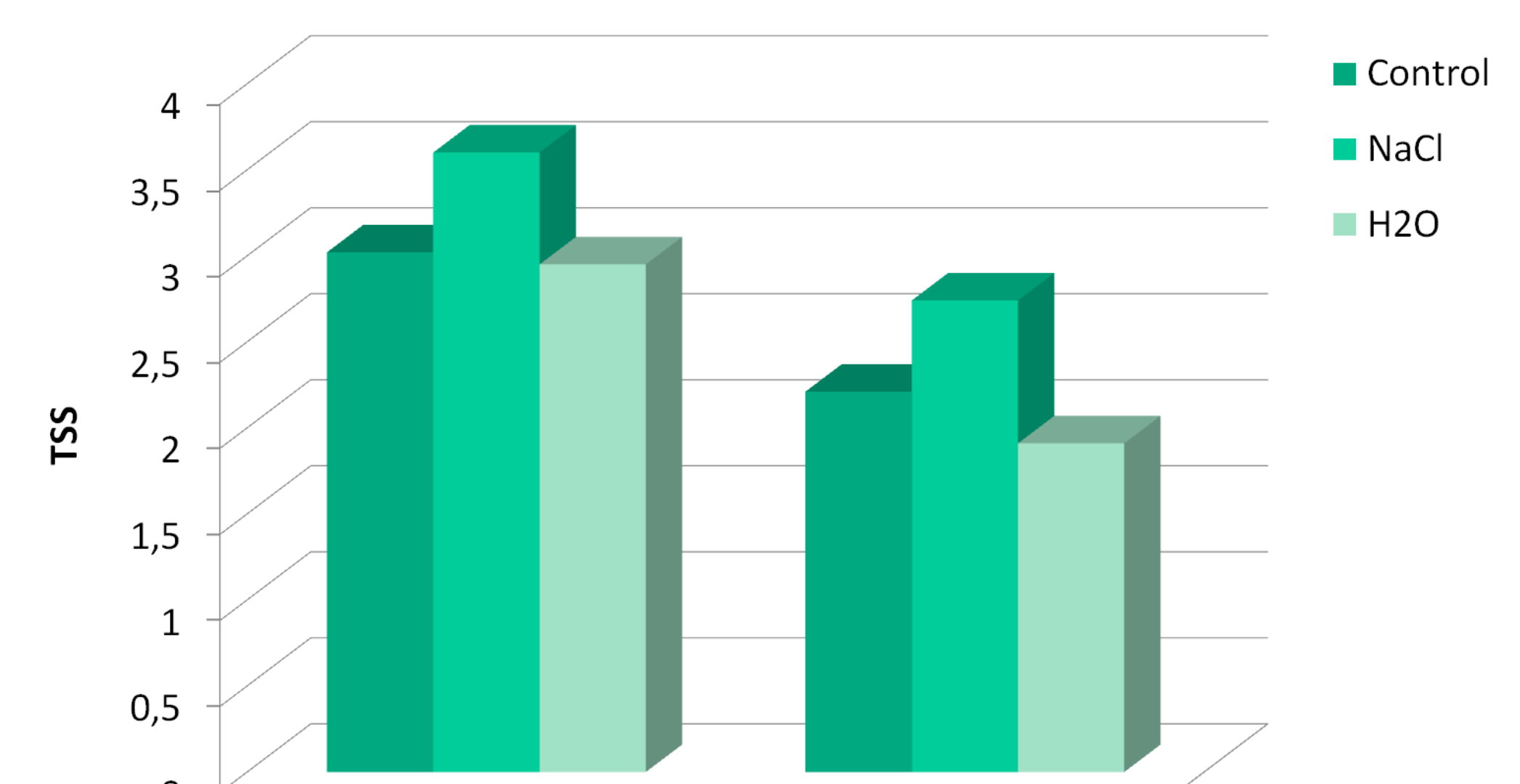


Figure 2. The sugar extract (TSS) content in the leaves of endive depending on the nutrient solution and the crop cycle

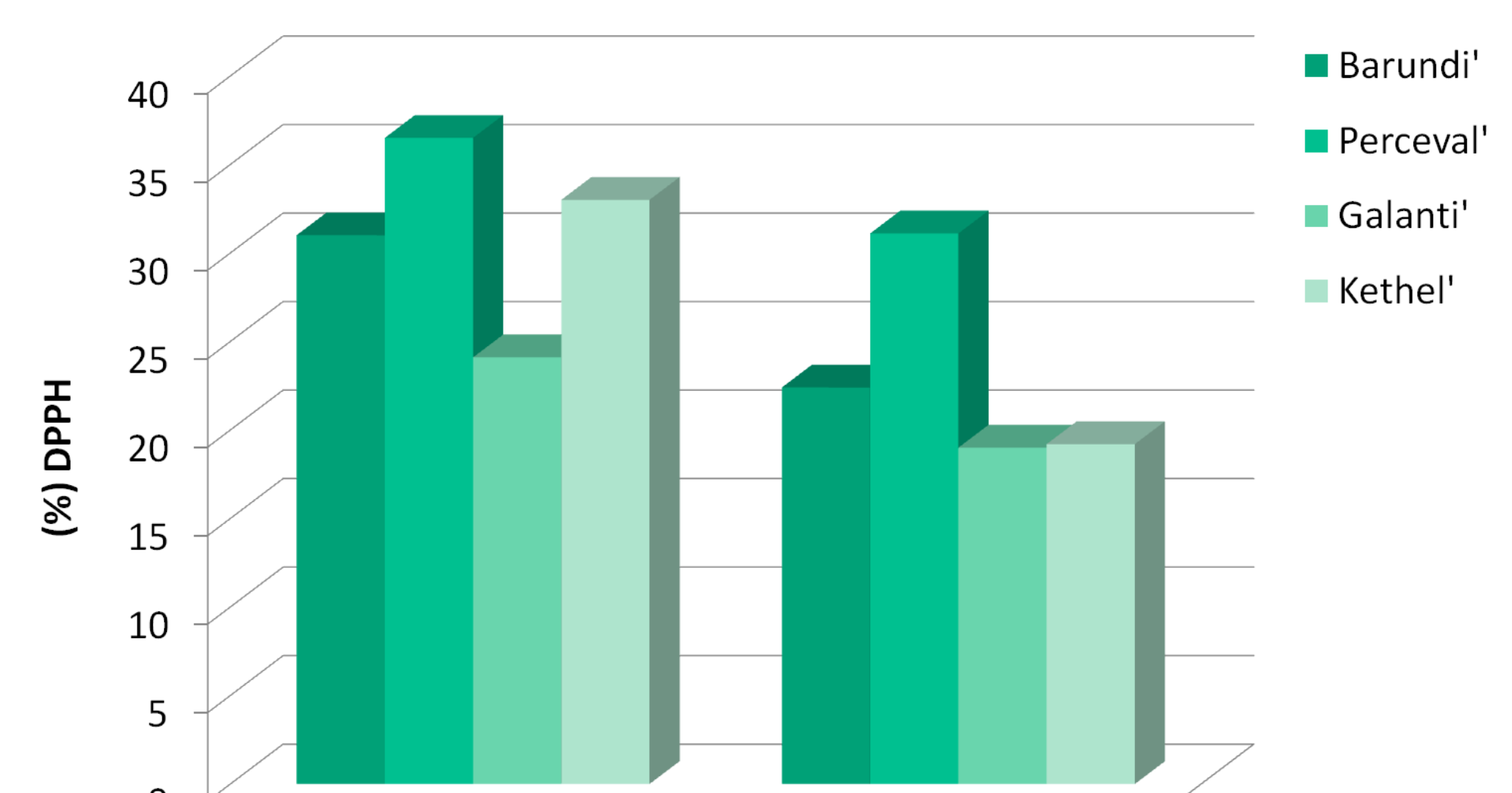


Figure 3. The antioxidant activities of different cultivars of endive on DPPH radical depending on the crop cycle

