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Composition and sensory properties of sour cherry cultivars

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Summary: Fruits of different sour cherry varieties cultivated, in 2008 and 2009, under organic farming and integrated cultivation conditions were analysed for their quality attributes, antioxidant activity and subjected to sensory evaluation. Average size, weight, soluble solids, titratable acidity, total polyphenols, free radical scavenging capacity expressed as Trolox equivalent (TEAC), copper and zinc were determined in freshly harvested fruits. The obtained results indicated that, the principal component analysis can separate and distinguish the seasons of fruit production. The farming system seemed to have slight effect on quality the fruit as compared to varietal factors (genotypes). However, the total polyphenol content was uniformly less in 2009. Total polyphenols and free radical scavenging activity were significantly higher in Bosnian type sour cherries, and outstanding in Amarelle type cultivar 'Pipacs'. There was no statistically significant difference between the sensory properties of cultivars tested by panels, except the case of 'Pipacs'. The organoleptic investigation showed marked preference to the fruits of Eva and Petri cultivars.

Key words: sour cherry, organic farming, integrated. antioxidant, polyphenols, sensory

Introduction

Sour cherry production became highly important in the past decades in Hungary. As a result of excellent national sour cherry breeding, exclusively cultivars bred in Hungary are grown. Sour cherry is produced on approximately 16% of fruit orchard areas, while North-Eastern Hungarian local sour cherry cultivars ('Újfehértói fürtös', 'Debreceni bőtermő', 'Kántorjános') give about 50% of the total sour cherry orchard area of Hungary. As a result of breeding, these cultivars ripe continuously, their similar appearance assures a continuous cropping and homogeneous quality for fresh consumption and processing industry as well.

Szabó (2007) did not observe significant difference between the North-Eastern Hungarian cultivars investigated concerning main quality attributes of their fruits. But when certain compositional parameters were compared to the climatic database, close correlations were discovered. For example, the higher amount of rainfall in the vegetation season resulted in lower titratable acidity of the fruits. According to the results of panel tests of the processed products (juice, canned fruits, and deep-frozen fruits) those made from 'Petri' were the best (Szabó, 2007). Polyphenols and free radical scavenging capacity play an important role in health protection, prevention of both cardiovascular diseases and cancer. Sour cherries are a rich source of them,

especially those belonging to the family of so called Bosnian sour cherry cultivars. Papp and co-workers (2010) pointed out the very high antioxidant capacity of an amarelle-type cultivar, Pipacs 1.

The objective of the present investigations was to get compositional and sensory data for different sour cherry varieties grown with different technologies including organic and integrated farming and at different provinces. The storability of main cultivars was also included in this work.

Materials and Methods

Materials

Sour cherries cultivated under integrated conditions were obtained from the Research Institute for Fruit Growing and Ornamentals in Újfehértó, whereas, the fruits of varieties grown under organic farming conditions were obtained from a private farm at Nyíregyháza, in 2008 and 2009. The Érdi bőtermő, Újfehértói fürtös, Debreceni bőtermő, Kántorjános cultivars were grown both with organic farming and integrated conditions. The fruits of the variety VN were from a private farm in Vásárosnamény.

Csengődi, Oblacsinszka, Éva, Petri, VN-1, VN-4, VN-7, Pipacs, D, Pándy 278, Cigány 59 and Cigány 7/1 were

cultivated with integrated farming conditions and requirements.

The free radical 1,1-diphenyl-2-picrylhydrazyl (DPPH) and standard Trolox, (6-hydroxy-2,5,7,8-tetramethyl-cromane-2-carboxylic acid) were obtained from Fluka (Buchs, Switzerland). Other reagents were of analytical grade and purchased from Reanal (Budapest, Hungary).

Methods used

Sour cherries fruits were washed and then the size and weight of 50 fruits was measured according to Hungarian Standard MSZ 967-1:1982. From approximately five kg sample one kg optimally ripened, sound fruit was selected, pitted and disintegrated using a Waring blender. The blended fruit sample was used in the different measurements and chemical analyses.

Soluble solids, titratable acidity (mg/kg) total polyphenols mg/kg as gallic acid equivalent), free radical scavenging activity (TEAC: mmole/kg), copper and zinc (mg/kg) were measured as described previously (Tóth-Markus et al., 2010). The values from chemical analyses were fresh weight-related.

The values are given as means and standard deviation of triplicate samples. Principal component analysis was performed using Minitab software version 13,0.

Sensory analysis was performed by a panel consisting of 10-16 assessors. The tasters (women and men) received training in the principles of sensory analyses according to ISO standards. Unstructured line scales of 10 cm anchored on the left side by the term 'none' and on the right side by the term 'extreme' were used for the scoring of each sensory term. Scoring was performed on a five points scale. Profiling and scoring data were collected using the PSA data acquisition software (OP & P, Utrecht, Netherlands).

Statistical evaluation of sensory data: by SPSS 17 software using ANOVA for comparison of the average results of product properties.

Results and Discussion

Table 1 summarises the data obtained on fruit size and weight, while results obtained from chemical

analyses for the different parameters with standard deviations are shown in Tables 2 and 3. From the data it is clear that the size and weight of sour cherry fruit depends rather on the genotype than the cultivation technology, however, fruits from some varieties such as Debreceni bőtermő, íkantorjánosi and Érdi bőtermő cultivated under organic farming conditions had larger size and average weight/piece higher than that of the fruits of the same varieties but cultivated under conventional conditions.

Total polyphenols and free radical scavenging activity was higher in VN and Cigány cultivars. From VN cultivars, VN-1 proved to be most outstanding. The amarelle-type Pipacs studied in 2009 had the highest polyphenol content among all varieties examined. Likely, in their work, Papp and co-workers (2010) have reported high total phenol content and antioxidant capacity in the fruits of the variety Pipacs 1.

Table 1: Size and weight of sour cherries at harvest

Cultivar	Date and provenance	Avg. size	Avg.wt./ piece with stone	Avg.wt./ piece without stone
Érdi bőtermő bio	2008. VI. 23. Nyiregyháza	2.14	7.0	6.4
Érdi bőtermő integrated	2008. VI. 23. Újfehértó	1.97	6.7	6.1
Érdi bőtermő integrated	2009. VI. 15. Újfehértó	2.1	6.5	5.9
VN-1	2008. VI. 18. Vásárosnamény	1.84	4.6	4.1
VN-7	2008. VI. 19. Vásárosnamény	2.06	6.6	6.0
VN-4	2008. VII. 1. Vásárosnamény			
VN-1	2009. VI. 08. Vásárosnamény	1.8	4.6	4.2
VN-7	2009. VI. 15. Vásárosnamény	2.0	5.4	4.9
VN-4	2009. VI. 15. Vásárosnamény	1.85	4.71	4.1
Oblacsinszka	2008. VI. 23. Újfehértó	1.66	4.0	3.4
Csengődi integrated	2008. VI. 23. Újfehértó	2.03	5.8	5.1
Csengődi integrated	2009. VI. 15. Újfehértó	1.88	5.3	4.6
Újfehértói fűrtös bio	2008. VII. 5. Nyiregyháza	1.97	5.3	4.8
Újfehértói fűrtös integrated	2008. VII. 7. Újfehértó	1.94	5.3	4.8
Újfehértói fűrtös integrated	2009. VI. 29. Újfehértó	2.13	5.9	5.3
Újfehértói fűrtös integrated	2009. VII. 06. Újfehértó	1.86	4.7	4.3
Újfehértói fűrtös bio	2009. VI. 29. Nyiregyháza	2.26	6.7	6.0
Kántorjánosi bio	2008. VII. 5. Nyiregyháza	1.92	5.2	4.7
Kántorjánosi integrated	2008. VII. 7. Újfehértó	2.00	5.7	5.1
Kántorjánosi bio	2009. VI. 29. Nyiregyháza	2.25	6.6	6.0
Kántorjánosi integrated	2009. VI. 29. Újfehértó	2.23	6.1	5.5
Kántorjánosi integrated	2009. VII. 06. Újfehértó	1.89	5.9	5.3
Éva integrated	2008. VII. 4. Újfehértó	2.04	5.9	5.3
Éva integrated	2009. VII. 06. Újfehértó	1.91	6.1	5.4
Petri integrated	2008. VII. 5. Újfehértó	2.11	6.3	5.7
Petri integrated	2009. VII. 06. Újfehértó	2.05	6.1	5.5
Debreceni bőtermő bio	2008. VII. 5. Nyiregyháza	2.11	6.4	5.8
Debreceni bőtermő integrated	2008. VII. 3. Újfehértó	2.09	5.7	5.2
Debreceni bőtermő bio	2009. VI. 29. Nyiregyháza	2.33	7.6	6.9
Debreceni bőtermő integrated	2009. VI. 29. Újfehértó	2.01	5.0	4.4
Debreceni bőtermő integrated	2009. VII. 06. Újfehértó	1.84	4.7	4.2
"D" integrated	2009. VII. 06. Újfehértó	1.97	6.3	5.6
Pipacs integrated	2009. VII. 06. Újfehértó	1.91	6.1	5.5

Table 2: Titratable acidity and Brix degree of different varieties of sour cherry cultivated under conventional and organic farming conditions at different provenances.

Cultivar	Date, provenance	Brix degree	Titratable acidity g/kg
Érdi bőtermő bio	2008. VI. 23. Nyiregyháza	15.6	9.49±0.03
Érdi bőtermő integrated	2008. VI. 23. Újfehértó	15.8	9.18±0.24
Érdi bőtermő integrated	2009. VI. 15. Újfehértó	16.8	10.72±0.08
VN-1	2008. VI. 18. Vásárosnamény	20.5	11.24±0.75
VN-1	2009. VI. 08. Vásárosnamény	21.1	10.07±0.11
VN-7	2008. VI. 19. Vásárosnamény	16.0	11.29±0.87
VN-7	2009. VI.15. Vásárosnamény	17.8	10.89±0.18
VN-4	2009. VI. 15. Vásárosnamény	16.8	9.92±0.08
Oblacsinszka	2008. VI. 23. Újfehértó	16.8	19.01±0.46
Csengódi integrated	2008. VI. 23. Újfehértó	16.6	10.35±0.34
Csengódi integrated	2009. VI.15. Újfehértó	15.9	9.17±0.22
Újfehértói fürtös bio	2008. VII. 5. Nyiregyháza	17.8	14.72±0.08
Újfehértói fürtös integrated	2008. VII. 7. Újfehértó	19.1	17.01±0.09
Újfehértói fürtös integrated	2009. VI. 29. Újfehértó	18.0	14.02±0.26
Újfehértói fürtös integrated	2009. VII. 06. Újfehértó	17.0	19.29±0.07
Újfehértói fürtös bio	2009. VI. 29. Nyiregyháza	16.5	13.45±0.05
Kántorjánosi bio	2008. VII. 5. Nyiregyháza	17.2	16.44±0.07
Kántorjánosi integrated	2008. VII. 7. Újfehértó	18.9	13.48±0.09
Kántorjánosi bio	2009. VI. 29. Nyiregyháza	17.3	14.96±0.18
Kántorjánosi integrated	2009. VI. 29. Újfehértó	17.4	13.12±0.04
Kántorjánosi integrated	2009. VII. 06 Újfehértó	16.1	14.36±0.34
Éva integrated	2008. VII.4. Újfehértó	18.8	13.80±0.08
Éva integrated	2009.VII. 06. Újfehértó	15.9	14.24±1.04
Petri integrated	2008. VII. 5. Újfehértó	17.0	13.69±0.03
Petri	2009. VII. 06. Újfehértó	15.6	14.28±0.74
Debreceni bőtermő bio	2008. VII. 5. Nyiregyháza	15.4	11.08±0.02
Debreceni bőtermő integrated	2008. VII. 3. Újfehértó	18.5	12.57±0.09
Debreceni bőtermő bio	2009. VI. 29. Nyiregyháza	15.5	11.92±0.19
Debreceni bőtermő integrated	2009. VI. 29. Újfehértó	16.8	13.69±0.16
Debreceni bőtermő integrated	2009. VII.06 Újfehértó	16.1	13.12±0.12
"D" integrated	2009. VII.06 Újfehértó	14.6	11.98±0.03
Pipacs integrated	2009. VII.06 Újfehértó	20.2	21.34±0.32
Storage in 2008			
Érdi bőtermő integrated	2008.VIII.2. Újfehértó	18.2	6.70±0.03
Újfehértói fürtös integrated	2008.VIII.2. Újfehértó	19.2	5.78±0.12
Kántorjánosi integrated	2008.VIII.2. Újfehértó	17.3	6.54±0.01
Éva integrated	2008.VIII.2. Újfehértó	18.5	7.84±0.12
Petri integrated	2008.VIII.2. Újfehértó	16.9	6.95±0.18
Debreceni bőtermő integrated	2008.VIII.2. Újfehértó	17.9	7.66±0.58

Both total phenols and antioxidant activity were lower in 2009 than the level found in 2008. The total polyphenol content of the cultivars in the two seasons is shown in *Figure 1*. Similar results were published by *Stracke* and co-workers (2009) who made a three-year comparison of the polyphenol contents and antioxidant capacities in organically and conventionally produced (Golden Delicious) apple. Their main conclusion was that production method had a less impact on the variation in the polyphenol content and antioxidant capacity of apples than the impact of climate of the production season.

The storage potential of cultivars was investigated at 2°C and at normal atmosphere. Six cultivars from integrated farming (Érdi bőtermő, Újfehértói fürtös, Kántorjánosi, Éva, Petri, and Debreceni bőtermő) were included in the storage experiment. After storage for four weeks, acid content of sour cherries decreased drastically. Shrinkage of Érdi bőtermő sample as a consequence of water loss was the remarkable change during storage. Also, the average weight of one fruit decreased from 6,7 g to 5,77 g with marked increase in soluble solids (Brix). In case of Éva and Petri varieties, the average weight per piece, Brix and total polyphenols changed within measurement uncertainty, but titratable acidity markedly decreased and the sensorial quality parameters of the fruits showed substantial deterioration. The decrease of acid content was around 50%. (changed from 27% to 54% in Érdi bőtermő). All stored fruits had an unpleasant, stale flavour. The polyphenol content and free radical scavenging capacity of stored fruits also decreased by 34 and 37%, in Kántorjánosi and Újfehértói cultivars respectively. *Szabó* (2007) reported that there was no significant difference between the cultivars investigated regarding storability.

The dataset for the cultivar pairs produced under bio and integrated conditions were compared using principal component analysis based on correlation matrix. According to the loading plot (*Figure 2*) the first component is connected with the size of the fruit, antioxidant capacity, total phenolics, soluble solids (Brix) and acidity while the second factor was composed by concentration of copper and zinc. First two principal components explain 65% of the variability in the data.

The samples from different seasons are separated on principal analysis score plot (*Figure 3*). For the sake of transparency, only the bio-integrated sample pairs were plotted. In 2009, the bio orchard was severely damaged by hail, and fruits had to be immediately harvested. The integrated 'Debreceni bőtermő', 'Kántorjánosi' and 'Újfehértói' fruits were picked once together with bio samples, and also one week later at optimal ripeness. Figure shows that maturity change in one week makes a shift of points comparable to the effect of organic or integrated cultivation. Organic fruits had generally higher copper content.

Table 3: Poly-phenols, antioxidant activity, and some micro-element content of different varieties of sour cherry cultivated under conventional and organic farming conditions at different provenances

Cultivar	Date, provenance	Polyphenols mg/kg	DPPH mmol/kg	Copper mg/kg	Zinc mg/kg
Érdi bőtermő bio	2008. VI. 23. Nyíregyháza	1380±51	13.9±1.1	1.09	0.39
Érdi bőtermő integrated	2008. VI. 23. Újfehértó	1413±76	15.3±1.6	0.66	0.29
Érdi bőtermő integrated	2009. VI. 15. Újfehértó	1232±10	10.2±0.1	0.48	0.35
VN-1	2008. VI. 18. Vásárosnamény	3490±199	32.2±2.1		
VN-1	2009. VI. 08. Vásárosnamény	3085±83	26.3±0.3		
VN-7	2008. VI. 19. Vásárosnamény	2156±104	22.4±0.8		
VN-7	2009. VI. 15. Vásárosnamény	2175±15	19.3±0.4		
VN-4	2008. VII. 1. Vásárosnamény	2134±42	23.5±1.3		
VN-4	2009. VI. 15. Vásárosnamény	1748±106	14.50±1		
Oblacsinszka	2008. VI. 23. Újfehértó	2551±22	23.1±0.4		
Csengődi integrated	2008. VI. 23. Újfehértó	2326±86	22.5±0.1		
Csengődi integrated	2009. VI. 15. Újfehértó	1628±20	12.5±0.3	0.42	0.43
Újfehértói fűrtös bio	2008. VII. 5. Nyíregyháza	1928±40	19.8±1.2	0.94	0.19
Újfehértói fűrtös integrated	2008. VII. 7. Újfehértó	1645±38	16.2±1	0.94	0.41
Újfehértói fűrtös integrated	2009. VI. 29. Újfehértó	1430±21	13.9±0.7	0.48	0.36
Újfehértói fűrtös integrated	2009. VII. 06. Újfehértó	1513±36	15.3±0.6	0.69	0.34
Újfehértói fűrtös bio	2009. VI. 29. Nyíregyháza	1352±10	11.2±0.3	0.75	0.24
Kántorjánosi bio	2008. VII. 5. Nyíregyháza	1732±43	19.8±0.4	1	0.27
Kántorjánosi integrated	2008. VII. 7. Újfehértó	1915±89	20.5±1.7	0.9	0.26
Kántorjánosi bio	2009. VI. 29. Nyíregyháza	1376±14	12±0	0.80	0.26
Kántorjánosi integrated	2009. VI. 29. Újfehértó	1198±4	11.2±0	0.43	0.28
Kántorjánosi integrated	2009. VII. 06. Újfehértó	1422±221	15.5±0.8	0.52	0.26
Éva integrated	2008. VII. 4. Újfehértó	1639±3	18.5±0.2	0.89	0.71
Éva integrated	2009. VII. 06. Újfehértó	1207±9	13.7±0.1	0.58	0.70
Petri integrated	2008. VII. 5. Újfehértó	1548±42	16.8±1	0.82	0.41
Petri	2009. VII. 06. Újfehértó	1388±59	14.5±0.8	0.49	0.31
Debreceni bőtermő bio	2008. VII. 5. Nyíregyháza	1283±58	15.2±1	0.97	0.33
Debreceni bőtermő integrated	2008. VII. 3. Újfehértó	1689±98	18±1	0.87	0.43
Debreceni bőtermő bio	2009. VI. 29. Nyíregyháza	1033±42	9.8±0.3	1.056	0.36
Debreceni bőtermő integrated	2009. VI. 29. Újfehértó	1009±39	11±2	0.40	0.32
Debreceni bőtermő integrated	2009. VII. 06. Újfehértó	1352±17	9.8±0.4	0.55	0.36
"D" integrated	2009. VII. 06. Újfehértó	1442±165	13.4±1	0.51	0.41
Pipacs integrated	2009. VII. 06. Újfehértó	6230±181	58.4±0.5	0.69	0.29
Pándy 279	2008. VII. 01. Újfehértó	1266±889	13.2±0.4		
Cigány 59	2008. VI. 30. Újfehértó	2217±34	21.6±0		
Cigány 7/1	2008. VI. 30. Újfehértó	1803±66	19.2±1.9		
Storage in 2008					
Érdi bőtermő integrated	2008. VIII. 2. Újfehértó	1354±2	13.9±0.5		
Újfehértói fűrtös integrated	2008. VIII. 2. Újfehértó	1030±39	10.5±1.4		
Kántorjánosi integrated	2008. VIII. 2. Újfehértó	1269±32	12.4±0.5		
Éva integrated	2008. VIII. 2. Újfehértó	1614±32	16.2±0.8		
Petri integrated	2008. VIII. 2. Újfehértó	1535±94	14.8±1		
Debreceni bőtermő integrated	2008. VIII. 2. Újfehértó	1550±49	14.8±1		

Before the sensory test, the training of experts and the selection of descriptors happened according to relevant MSZ ISO standards.

The assessors (women and men) could not find a significant difference between sour cherry varieties except for Pipacs, which was characterised with a tart, bitter, sour taste. Panel members preferred Éva and Petri varieties.

Organic and integrated sample pairs were also compared and panel members preferred the integrated ones in crop year 2008. Figure 4 shows the sensory profile of organic and integrated 'Kántorjánosi' cultivar.

These results are considered as preliminary, as the experiment is continued in summer 2010.

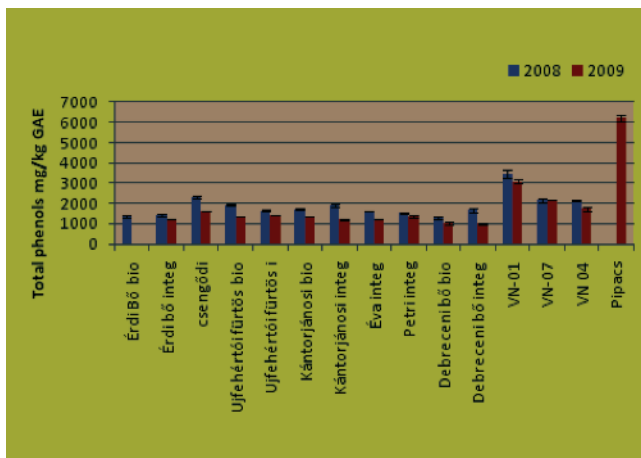


Figure 1: Total phenols of sour cherries in the cultivation seasons of 2008 and 2009.

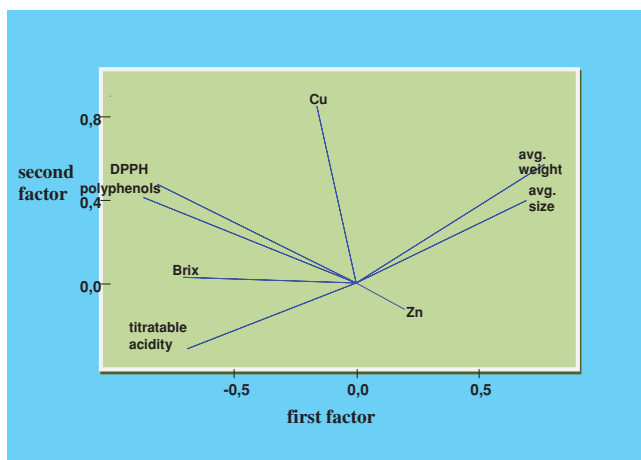


Figure 2: Principal component analysis, loading plot of sour cherry data

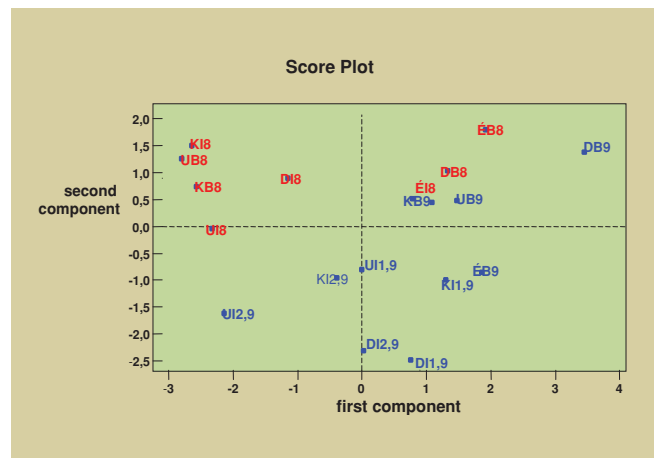


Figure 3: Principal component analysis, score plot of sour cherry data

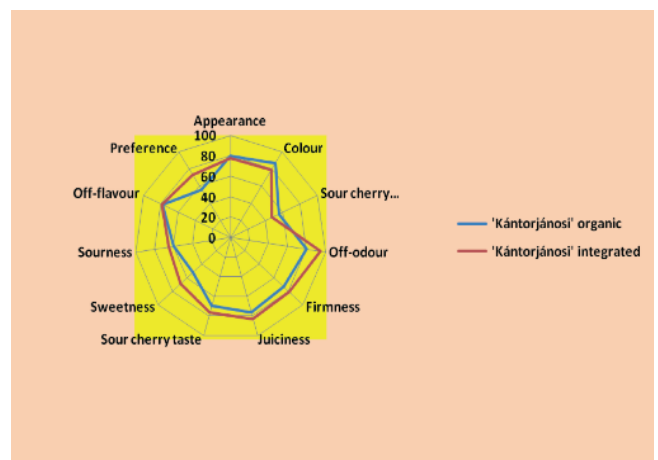


Figure 3: Principal component analysis, score plot of sour cherry data

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