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A study on preparation and storage of low calorie RTS beverage of Indian gooseberry and *Kinnow* mandarin

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Abstract

Low calorie blended RTS beverages of Indian gooseberry and *Kinnow* were prepared by replacing sucrose with artificial sweeteners Acesulfame -K and Sucralose. The treatments were analyzed for sensory quality and physico-chemical attributes, at monthly interval during storage for three months at refrigerated temperature. Treatments significantly affected the taste and overall sensory quality of the beverages. Sensory quality of the beverages decreased with the storage intervals. Use of acesulfame-K and sucralose in 25:75 proportions had an overall sensory score of 5.86/9.00 at the end of the storage period of 90 days, which was at par with that in RTS beverage sweetened by cane sugar (6.06/9.00). TSS, acidity and total sugar increased, while ascorbic acid and total phenol decreased with the advancement of storage period. The sugars content in the freshly prepared *aonla- Kinnow* RTS beverages having cane sugar was 9.58 per cent but in the same RTS having acesulfame- K and sucralose (25:75 ratio) was 1.03 per cent only. It was observed from this research that the low calorie beverages sweetened with 25% Acesulfame- K and 75% sucralose were found optimum regarding sensory characteristics.

Key words: *Artificial sweeteners; aonla; Kinnow orange; beverages.*

Introduction

Fruit based beverages continue to receive wide acceptability reflected by augmented awareness of the potentiality of these products as compared to synthetic drinks in the food market. Fruit based beverages are not only refreshing, provide energy but also boast high nutritional appeal. These could be quite handy in elevating problems concerning nutritional deficiency in developing countries like India.

Indian gooseberry (*Emblica officinalis* Gaertn.), popularly known as '*aonla*' belongs to family Euphorbeaceae has come up with tremendous potential for its economic utilization in beverage industry during the past few years. *Aonla* is a quite hardy, prolific bearer and highly remunerative even without much care. Being adapted to dry region and salt affected soils (Singh and Pathak, 1987) *aonla* is worth cultivating in wastelands. The tree bearing capsular fruit with fleshy pericarp is well known for its nutritional and pharmacological properties.

The fruits are particularly rich in ascorbic acid and tannins. The ascorbic acid content of fresh *aonla* fruit varies from 200-900 mg/ 100 g pulp as reported by several workers (Barthakur and Arnold, 1991; Jain and Khurdiya, 2002; Kalra, 1988 and Mehta and Bajaj, 1983). Various types of tannins are responsible for the peculiar taste of astringency in the fruit and thus responsible for the flavour (Kalra, 1988) owing to which *aonla* possess strong antioxidant properties. The most limiting amino acid in plant protein is lysine and methionine (Zemen and Ney, 1988). *Aonla* contains considerable amount of lysine which increases the biological value of its protein (Barthakur and Arnold, 1991). Its fruits also contains fair amount of minerals such as phosphorus, calcium, iron etc (Chauhan *et al*., 1991) It also possesses astringent, de-obstruent, diuretic and antiseptic properties and is said to be used against wide range of diseases such as tuberculosis of lungs, asthma, bronchitis, scurvey, diabetes, anaemia, cancer, leprocy, dysentery, constipation etc. *Aonla* is strong antioxidant and is effective in preventing haemolysis of red blood cells (Vani *et al*. 1997). *Aonla* has been used as an important ingredient in several *ayurvedic* drugs e.g. *Chyavanprasha, Triphala, Arogyavardhini, Ashokarishtha* etc.

Owing to nutritional and pharmaceutical properties, the possibilities of using *aonla* fruits for development of beverages are explored on. Attempts have been made in recent years to commercialize the nutraceutical drinks of pure *aonla* juice or blended with other fruit juices such as lime, ginger, Aloe vera etc.

Kinnow (*Citrus reticulate* Blanco) is a hybrid between 'King' and 'Willow leaf' mandarin. Among the new exotic citrus cultivars grown in India, *Kinnow* is undoubtedly the most priced one. The fruit is quite important as it has a great variety of beverage, nutritious, juicy, industrial and medicinal uses due to its nutritious, juicy attractive colour, distinctive flavor and being rich source of vitamin 'C', vitamin 'B', calcium and phosphours (Sogi and Singh, 2001). Its juice has strong flavour and could well be utilized for blending with *aonla* juice for

preparation of RTS beverages.

Further it is presumed that if table sugar (sucrose) is replaced by artificial sweetener while preparation of *aonla*: *Kinnow* nutraceutical beverage can avoid problems of dental decay and would prove more useful for diet conscious population and diabetic patients. There are a number of artificial sweeteners available in the market such as Aspartame, cyclamate, sucralose, Acesulfame- K etc. (ADA, 2004). These are non- nutritive sweeteners; not metabolized by the body and do not contribute energy or calorie to the diet.

Material and Method

Extraction of juice: Fresh, fully ripe, sound *aonla* and *Kinnow* were used for extraction of juice. *Aonla* fruits were cleaned, thoroughly washed, blanched and juice was extracted by crushing in fruit mill and pressing in basket press followed by filtering through muslin cloth. *Kinnow* fruits were pealed and juice was extracted by screw type juice extractor. Juice from *aonla* and *Kinnow* was separately heated to 90° C for 1 minute to inactivate enzyme, cooled immediately to be used for preparation of RTS beverages.

Preparation of RTS beverage:The *aonla* and *Kinnow* beverages were prepared by blending of *aonla* and *Kinnow* juice in 40: 60 proportions. The RTS beverages with sucrose to be treated as control was prepared by following standard procedure and specifications (Blended Juice: 10%, TSS: 12 % (adjusted by sucrose), Acidity: 0.3%, Sodium benzoate: 0.1 % and water). While RTS beverages with artificial sweeteners were prepared by using the same formulation except sugar was replaced by combinations of artificial sweeteners equal to the sweetness of same amount of sugar. The various treatment combinations and recipe of the various treatments are presented in Table 1 and 2, respectively, while flow sheet for the preparation of beverages is presented in Fig 1.

Table 1: Details of the treatments

Notation	Sweeteners combinations		
	Sucrose	Acesulfame K	sucralose
	(%)	(%)	(%)
T1	100	0	0
T2	0	100	0
T3	0	75	25
T4	0	50	50
T5	0	25	75
T6	0	0	100

Fig1: Flow chart for the preparation of *aonla* based blended ready-to-serve (RTS) beverages

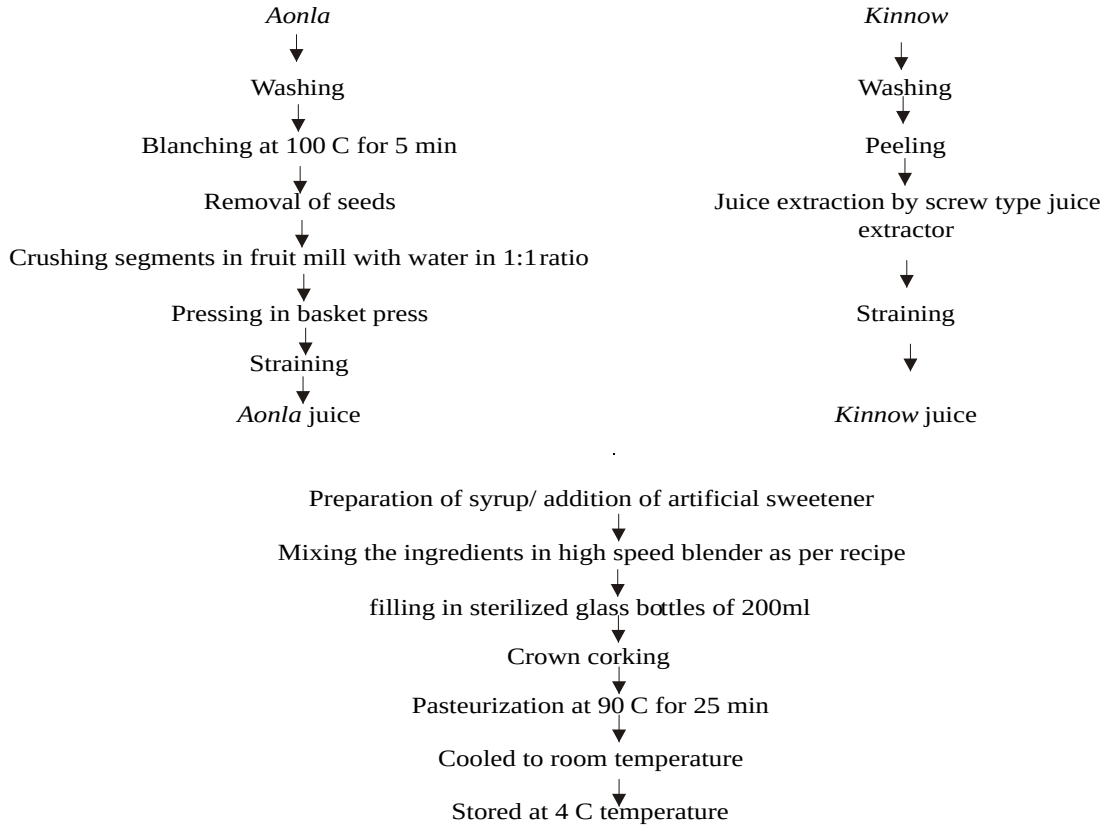

Table 2. Recipe for preparation of beverages (2400 ml each).

Treatment	Juice (ml)		Sweetener(g)			Citnic Acid (g)	Sodium Benzoate	Water (mg)
	Aonla	Kinnow	Sucrose	Acesulfam-k	Surcralose			
T_1	96	144	279	0	0	6.32	2.4	1872.3
T_2	96	144	0	1.39	0	6.32	2.4	2149.9
T_3	96	144	0	1.05	0.12	6.32	2.4	2150.1
T_4	96	144	0	0.69	0.23	6.32	2.4	2150.3
T_5	96	144	0	0.35	0.35	6.32	2.4	2150.6
T_6	96	144	0	0	0.47	6.32	2.4	2150.8

Thus, prepared beverages was filtered and filled in previously sterilized glass bottles (200 ml) leaving 2.5 cm head space and sealed airtight by crown corking. Then the bottles were pasteurized at 90°C for 25 minutes and cooled to room temperature and stored at 4 ± 1°C for storage studies. Samples were drawn at a regular interval of 30 days and evaluated for various quality attributes.

Sensory evaluation: For sensory evaluation of the beverages, the product was judged for colour, taste and aroma on a 9-point hedonic scale (Ranganna, 1978) by a panel of 6 trained judges which comprised of scientists and students. The marks given by them were averaged to get Overall rating.

Proximate analysis: The TSS content (°Brix) of *aonla* and *Kinnow* blended RTS beverage was directly measured by the "Erma" Hand Refractometer (0-30) and value obtained was corrected at 20ºC (AOAC, 1995). The acidity (%) of *aonla* and *Kinnow* blended RTS beverage was determined by diluting the known volume of RTS beverage with distilled water and titrating the same against standard N/10 sodium hydroxide solution, using phenolphthalein as an indicator. The ascorbic acid content of *aonla* based blended RTS beverage was determined by diluting known volume of RTS beverage with 3 per cent metaphosphoric acid as buffer and titrating against 2, 6-dichlorophenol indophenol dye solution until the stable faint pink colour was obtained (AOAC, 1995). The results were expressed as mg ascorbic acid per 100ml of RTS beverage. Total sugar content (%) was determined by using Anthrone's reagents method (Dubois *et al*., 1951). Phenols content (%) of RTS beverage was determined by Folin-ciocalteau phenol reagent (Sadasivam and Manickam, 1991).

Results and Discussion

Sensory qualities: The colour, aroma and taste were important consideration for overall acceptance of *aonla* and *Kinnow* blended RTS beverage (Table 3). The perusal of the data indicates that the treatments had non-significant effect on the colour and aroma but had significant effect on the taste of the RTS during entire storage period. Similar findings were reported by Porto-Cadoso and Andre-Bolini (2007).

Initially, the beverage had high sensory values pertaining to colour, aroma and taste but with the advancement of storage period, a decrease in their values and hence, in the overall acceptance was noticed upto 90th day. These results are in conformity to the results of Jain and Khurdiya (2004); Gomez and Khurdiya (2005) *in aonla* beverages, and Gaikwad *et al* (2013) in *aonla*: ginger RTS beverages sweetened by artificial sweeteners. Among the various treatment combinations the highest overall acceptance was observed for RTS beverages sweetened by sucrose alone, which remained highest during entire period of storage as compared to use of Acesulfame- K and Sucralose. While among RTS beverages sweetened by artificial sweeteners, the highest overall acceptance was observed in those sweetened by Acesulfame-K and Sucralose (in 25:75 ratio) with an overall rating of 5.86 at the end of the storage period. These findings are in conformity to that of Ahmed *et al*. (2008). At the end of the storage period minimum taste value (4.86) was observed in RTS sweetened by Acesulfame K alone, while using acesulfame K and sucralose in 25:75 ratio gave better taste value (5.86) which was comparable with the best taste value (6.06) of RTS beverage sweetened by sucrose. This phenomenon has been explained by Ahmed *et al. (2008)* who reported that sensation of sweetness caused by artificial sweeteners (the sweetness profile) is sometimes notably different from sucrose, so they are often used in combination to achieve the most natural sweet taste.

TSS: Analysis of variance revealed significant effect (P = 0.05) of variations in sweeteners proportions. It is evident from Table 4 that TSS of all treatments showed an increasing trend during the storage period of 90 days, which is possibly due to hydrolysis of polysaccharide (starch) into monosaccharide (sugars) and concentration of *aonla* and *Kinnow* blended RTS beverage due to dehydration. A similar increase in TSS content with the increase in storage period was observed in juice of mandarin, sweet orange and lemon (Mehta and Bajaj, 1983) and in lime: *aonla* and mango: pineapple spiced RTS beverage (Deka, 2000). Further, it was observed that the TSS content of *aonla* and

Kinnow blended RTS beverages was significantly higher throughout the storage period in samples sweetened by sucrose (T_1) as compared to those by artificial sweeteners. Similar findings have been reported by Porto-Cadoso and Andre-Bolini (2007) in peach nectar.

Acidity: The results presented in Fig. 2 indicate a gradual increase in acidity content during storage of *aonla* and *Kinnow* blended RTS beverage irrespective of the treatments. This could be attributed to the chemical interaction between the organic constituents of *aonla* and *Kinnow* blended RTS beverage affected by the temperature and action of enzymes. A gradual increase in acidity has also been reported by Gaikwad *et al.* (2013) and Butt *et al.* (2000) in mango drinks sweetened by aspartame and cyclamate. However, the acidity content of *aonla* and *Kinnow* blended RTS beverages did not differ significantly among samples sweetened by sucrose or those by artificial sweeteners. This is probably due to adjustment of the acidity to 0.3 per cent in all the samples initially by using citric acid.

Ascorbic acid (Vitamin C): The results presented in Fig. 3 reveals a steady decline in the ascorbic acid content with the advancement of storage period in all the treatments. Smoot and Nagy (1980) reported that the decrease in ascorbic acid in hermetically sealed juice is primarily via anaerobic pathway and it highly depends on storage time and temperature. The loss of ascorbic acid during storage at room temperature might be due to degradation of ascorbic acid in dehydro- ascorbic acid. Similar findings have been reported by Butt *et al.* (2000) in mango drinks sweetened by aspartame and cyclamate, Jain (2001) in *aonla* drinks and Deka *et al.* (2005) in mixed fruit beverages.

The results also indicates that the treatments involving use of sweeteners viz. sucrose or Acesulfame- K and Sucralose in different combinations were found to have non-significant effect on the ascorbic acid content of the RTS beverage during entire storage period, since the composition of *aonla* and *Kinnow* juice was constant i.e. 40:60 in all the treatments.

Total sugars: A progressive and marked increase in total sugar content of the RTS beverages was observed irrespective of the treatments, throughout the storage period (Table 4). The increase in total sugar might be due to the hydrolysis of polysaccharides like pectin, cellulose, starch, etc. and its conversion into simple sugars. Similar findings have already been reported by Deka and Sethi (2001) in mango juice blends and Bharadwaj and Mukherjee (2011) in *Kinnow* juice blends.

The results showed the treatments involving use of artificial sweeteners viz. Acesulfame- K, Sucralose and their combinations were found to have significant effect on the total sugar content of the RTS beverages during entire period of storage. The total sugar content (calorific value) remain higher (in the range of 9.58-11.38 per cent in RTS beverages sweetened by cane sugar (sucrose) as compared to RTS beverages sweetened by acesulfame-k, sucralose or their combinations, throughout the storage. Similar findings have been reported by Ahmed *et al.* (2008); Gaikwad *et al.* (2013) and Pastor *et al.* (1996).

Total phenols: Phenolic compounds are naturally occurring antioxidants, usually found in fruits and vegetables. *Aonla* is a rich source of phenolic compounds; the main phenolic compound found in *aonla* being gallotannic acid (Kalra, 1988).

The results presented in Table 4 indicate that the total phenol content of the RTS beverages decreased with the increase in storage period at ambient temperature. At the end of the storage period the total phenol content varied between 0.63-0.75 per cent. Similarly, Verma and Gehlot (2007) observed decrease in total phenols of *bael* ready-to-serve beverage during storage and Reddy and Chikkasubbanna (2008) reported decreasing trend in tannins of lime-*aonla* blended squash during storage of 90 days. The total phenol content among RTS beverages did not differ significantly due to various treatments of sweeteners.

From the finding of the present study, it can be concluded that the despite the acidic and astringent taste the nutritive benefits of *aonla* can be utilized by blending its juice with *Kinnow* juice in 40: 60 ratio for the development of RTS beverages without significant loss of sensory attributes. Further, the cane sugar used in the preparation of RTS beverages can be substituted by artificial sweeteners viz. acesulfame-K and sucralose in 25:75 proportions for the development of low calorie (diet) drink having other chemical components and sensory attributes same as that of RTS prepared by adding cane sugar for calorie conscious

Table 3. Sensory evaluation of *aonla* and *Kinnow* blended RTS beverages during storage

Treat code	Colour (score out of 9)				Aroma (score out of 9)				Taste (score out of 9)				Overall rating (score out of 9)			
	Storage periods (days)				Storage periods (days)				Storage periods (days)				Storage periods (days)			
	0	30	60	90	0	30	60	90	0	30	60	90	0	30	60	90
T_1	6.83	6.60	6.40	5.40	7.58	7.00	6.24	5.00	7.33	6.90	6.50	6.20	7.23	6.83	6.26	6.06
T_2	6.80	6.66	6.46	5.39	7.56	6.98	6.22	4.93	6.10	5.63	5.10	4.86	6.00	5.53	6.16	4.80
T_3	6.90	6.70	6.33	5.43	7.53	6.95	6.20	5.00	6.83	6.33	5.93	5.63	6.70	6.23	6.16	5.53
T_4	6.80	6.66	6.10	5.43	7.58	7.06	6.30	5.00	7.06	6.56	6.06	5.73	6.86	6.46	6.43	5.66
T_5	6.86	6.63	6.16	5.44	7.51	7.00	6.21	5.30	7.10	6.53	6.13	5.86	7.00	6.58	6.20	5.86
T_6	6.83	6.53	6.43	5.40	7.54	6.83	6.12	5.13	6.26	5.70	5.30	5.00	6.16	5.70	6.23	5.00
SEm ±	0.053	0.073	0.064	0.247	0.405	0.569	0.667	0.123	0.047	0.050	0.042	0.060	0.0461	0.060	0.051	0.051
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	0.138	0.146	0.122	0.175	0.135	0.175	0.149	0.149

Table 4. Total soluble solids (%), total sugars (%) and total phenol (%) content of *aonla* and *Kinnow* blended RTS beverages during storage

code	TSS (Brix)				Total sugars (%)				Total Phenol (%)			
	Storage periods (days)				Storage periods (days)				Storage periods (days)			
	0	30	60	90	0	30	60	90	0	30	60	90
T_1	12.00	12.14	12.71	13.30	9.58	10.19	10.62	11.38	1.13	0.96	0.63	0.75
T_2	1.38	1.50	2.11	2.50	1.04	1.58	2.03	2.74	1.13	0.87	0.52	0.66
T_3	1.39	1.48	2.08	2.49	1.03	1.53	2.08	2.68	1.14	0.84	0.57	0.70
T_4	1.38	1.48	2.08	2.49	1.05	1.57	2.10	2.73	1.11	0.89	0.59	0.68
T_5	1.39	1.48	2.08	2.49	1.05	1.58	2.06	2.73	1.13	0.83	0.56	0.69
T_6	1.38	1.48	2.08	2.49	1.03	1.55	2.09	2.79	1.13	0.85	0.55	0.64
SEm ±	0.003	0.006	0.009	0.006	0.012	0.015	0.029	0.027	0.031	0.028	0.030	0.023
CD at 5%	0.010	0.017	0.028	0.018	0.035	0.043	0.086	0.780	NS	NS	NS	NS

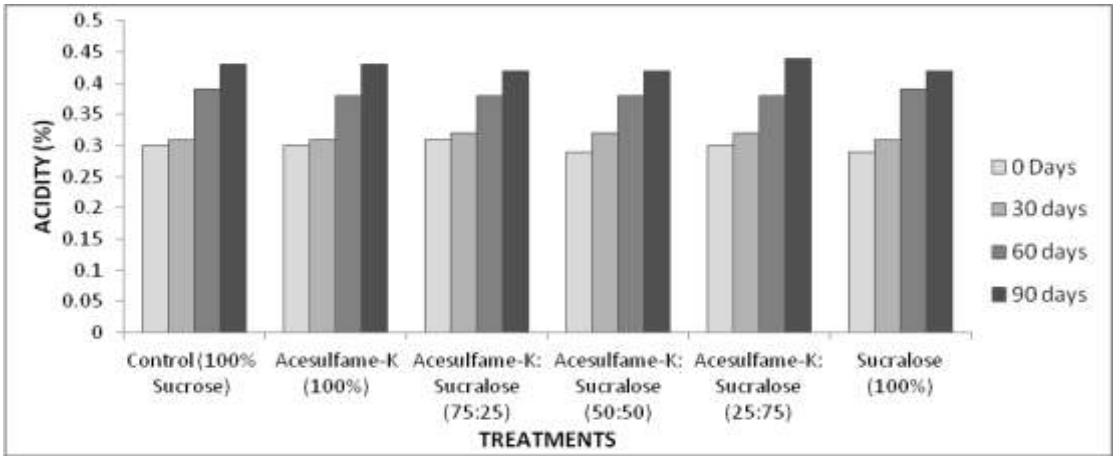

Fig. 2. Acidity (%) of *aonla* and *Kinnow* blended RTS beverages during storage

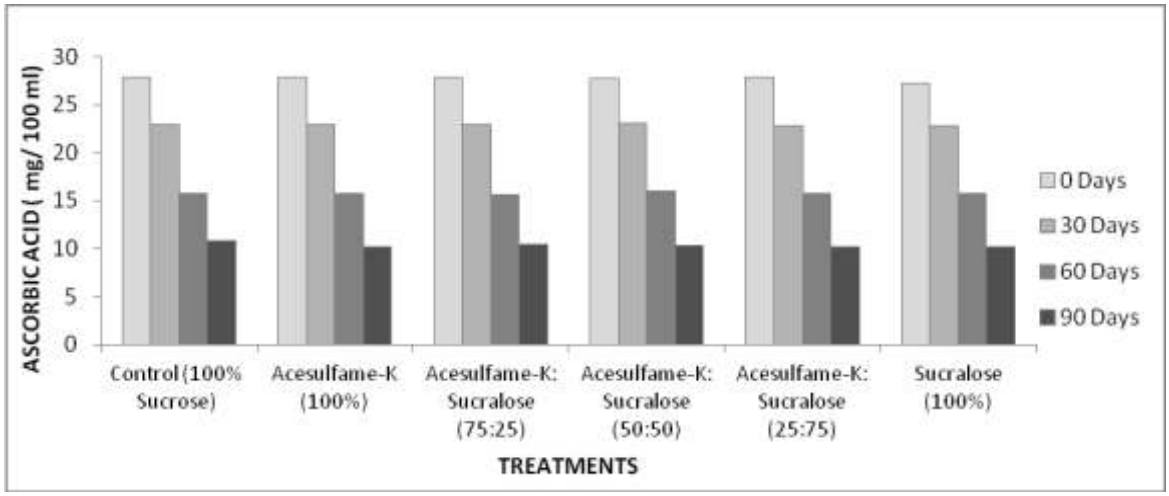

Figure 3. Ascorbic acid content (mg/ 100 ml) of *aonla* and *Kinnow* blended RTS beverages during storage

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