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**Shailendra K Dwivedi**  
College of Horticulture, Rajmata  
Vijayaraje Scindia Krishi  
Vishwavidyalaya, Mandsaur  
Campus, Madhya Pradesh, India

**Avnish Pandey**  
ASPEE College of Horticulture  
and Forestry, Navsari  
Agriculture University,  
Navsari, Gujrat, India

## Development of protocol for preparation and preservation of ginger flavored aonla candy for nutritional and biochemical evaluation

**Shailendra K Dwivedi and Avnish Pandey**

### Abstract

Aonla is an important indigenous fruit crop to Indian subcontinent which is generally used in alternative medicine, health foods, herbal products and beverages. It has a great potential in processed forms but a very little information is available regarding the preparation and storage quality of aonla candies. In the experiments Organoleptic evaluations were done for standardization of sugar concentration for aonla candy preparation. The candy containing 72<sup>0</sup>B recorded the highest Organoleptic scores and selected for further blending with ginger and mint extracts. Six different concentrations of ginger and mint extract were added for preparation of aonla candy. The mature aonla fruits were selected, washed and blanched in boiling water containing 2percent alum for 10 minutes. The segments were separated after cooling the fruits in potable water. The segments were kept for 24 hours in sequentially increasing concentration of sugar syrup for three days to attain 72<sup>0</sup>B TSS. After maintain the desired TSS the excess syrup drained out and the segments were dried in open sun drying. The prepared candy segments were packed in to polyethylene pouches and stored under ambient conditions. During the storage study revealed that the moisture content in the candy was found to decrease with storage period. It decreases from an initial value of about 18percent to a final value of about 13percent at the end of storage. During the four months of storage TSS, acidity, total sugar and browning increased gradually till the end of the experiment while vitamin C, tannin content indicated the decreasing trends. No microbial load was recorded in the treatments. On the basis of organoleptic evaluation and biochemical characters it was concluded that the aonla candy treated with 2 percent ginger extract found to be the most suitable for the aonla candy.

**Keywords:** aonla, candy, TSS, acidity, organoleptic scores, ginger, mint, storage period

### Introduction

Among the horticultural commodities fruits are the first food items known consumed prehistorically by human beings because they are rich in vitamins, nutrients, essential minerals, antioxidants and apart from that they also help in curing a number of diseases. Among those Aonla (*Emblica officinalis* Gaertn.) is an important fruit crop which also known as Indian Gooseberry is a minor sub-tropical deciduous medium size tree belonging to the family Euphorbiaceae. It can be grown successfully in dry and neglected regions of different parts of India. A mature aonla tree can tolerate freezing as well as high temperature from (5°C-46°C). It is rapidly spreading in semi-arid regions of India including Maharashtra, Gujrat, Rajasthan, Andhra Pradesh, Karnataka, Tamil Nadu and the Arawali regions in Haryana, Kandi area in Punjab and in Himachal Pradesh. In Madhya Pradesh, it is commercially cultivated in many districts viz. Mandsaur, Neemach, Ratlam, Jabalpur, Jhabua, Bhopal, Betual, Dewas, Hoshangabad, Chindwara, Sheopur, Tikamgarh, Rewa, etc. However, majority of the fruits are seasonal and highly perishable. There is a need for preserving the seasonal fruits for use in the off-season.

The aonla is quit hardy, prolific bearer and highly remunerative even without much care. The aonla fruit contains about three times higher protein and 160 times higher vitamin C as compared to apple (Borthakul and Arnold 1991) [3]. The beauty of high acceptability of aonla fruits could be due to it's their high medicinal properties and the fact that they are rich source of vitamin C among all other fruits except for Barbados cherry.

Aonla is presently an underutilized fruit, but it has enormous potential in the world market for its various medicinal, culinary and nutraceuticals properties. Aonla is being exported under the category of Ayurvedic and Unani herbs. The fresh fruits are generally not consumed as they are highly acidic and astringent; therefore it is not a popular table fruit. But, it has got very

### Correspondence

**Shailendra K Dwivedi**  
College of Horticulture, Rajmata  
Vijayaraje Scindia Krishi  
Vishwavidyalaya, Mandsaur  
Campus, Madhya Pradesh, India

popularly in processed forms (Nayak *et al.*, 2011) <sup>[10]</sup>. Hence attention has been focused on the preparation of different value added products from it. Aonla can be made into various products such as pickles, preserve (murabba), sauce, jam, jelly, dried chips, supari, laddu tablets, etc.

Aonla candies are becoming more and more popular because of their high acceptability, minimum volume, higher nutritional value, longer storage life and simple packaging. Now a days aonla candies have now been blended/mixed with other richly valuable and effective herbs like ginger, tulsi, aloe vera mint etc. Herbal inclusion not only gives a new flavor but also enriched the candy with more medicinal qualities. In present investigation an attempt has been made to develop a nutritionally rich aonla and ginger based product as aonla candies from fruits of aonla cv. NA-7 to study shelf life of the product.

## Materials and Methods

### Collection of raw materials

Mature aonla fruits of cv. NA-7 were procured from the experimental farm of College of Horticulture, Mandasaur, MP, India. Matured, uniformed and disease free fruits were selected. Fruits were washed in potable water to remove

adherent dirt (Figure 1). Ginger and mint were collected from the local market of the Mandasaur, MP.

### Extraction of ginger-mint extract

Fresh ginger rhizomes were washed thoroughly with potable water and peeled manually. By addition of equal portion of water ginger rhizomes were grated. Ginger extract was filtered by muslin cloth. Same method was used for extraction of mint extract.

### Physico-chemical analysis

The physical properties of the fruits like Skin colour, average fruit weight, polar length, diameter, specific gravity, pulp seed ratio were estimated using standard methods. The biochemical parameters, *viz.* total soluble solids (TSS), acidity, vitamin-C, tannin, total sugar, reducing sugar, non-reducing sugar and non-enzymatic browning were estimated as per method described by the Ranganna, (1997) <sup>[15]</sup>. The product was also assessed organoleptically on the 9 point Hedonic scale as described by Ranganna, (1997) <sup>[15]</sup>. The data were analyzed statistically and reported at the 5 percent significance level (Panse and Sukhatme, 1961) <sup>[11]</sup>.

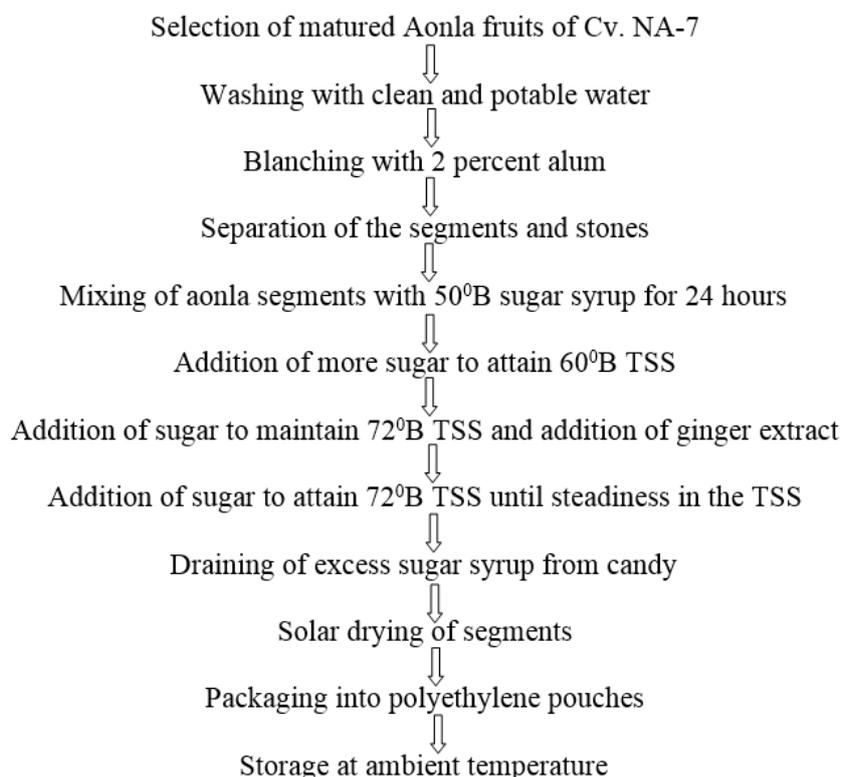


Fig 1: Flow chart for preparation of Aonla candy

## Results

### Physico-chemical properties of the fresh fruits

The physico-chemical characteristics of the fresh aonla fruits clearly depicted in the table no. 1. The skin colour of the fruits was observed as yellowish green. The average fruit weight was recorded 42.2g. The average length was recorded 3.72 cm while polar width was recorded 4.35 cm. The specific gravity of the fruits was recorded 1.08. The pulp seed ratio was recorded 18:1. Total fibre content 1.28 percent was recorded. Total moisture content 85.15 percent was recorded in fresh fruits. Fruit contains content 108°B TSS while acidity was recorded as 1.68 percent as ascorbic acid. Total ascorbic acid

was 385.78 mg/100g of total fresh fruits. Total sugars were recorded 10.72 percent into the fresh fruits. The tannin content was recorded as 1.75 percent.

### Standardization of TSS content for preparation of aonla candies

The mean scores of colour, flavor texture astringency and over all acceptability of the candy prepared with different TSS content (66-76° B) given in the table No 2. The mean data exhibited that the various TSS have significantly influenced the Organoleptic parameters. The candy containing 72°B TSS recorded the highest colour value (8.80) followed

by candy containing 68°B TSS (8.25 Score) while lowest colour value (6.47) recorded in T<sub>6</sub> (76°B). Highest Organoleptic score for flavor was recorded (8.65) in the treatment containing 72 °B of TSS followed by T<sub>3</sub> (8.25) while lowest scores (6.85) was recorded in T<sub>1</sub> containing 660 B of TSS. The treatment T<sub>4</sub> recorded the highest Organoleptic score (8.35) for the texture while T<sub>1</sub> recorded poorest score (6.25). The highest astringency (8.88) was recorded in T<sub>4</sub> followed by T<sub>5</sub> (8.64). The treatment T<sub>4</sub> recorded highest (8.82) overall acceptability followed by T<sub>5</sub> (8.55), T<sub>6</sub> (8.33), T<sub>3</sub> (7.78) and T<sub>2</sub> (7.15). The poorest overall acceptability was recorded in T<sub>1</sub> having 6.28.

#### Standardization of herbal extract content for preparation of aonla candies

Mean score for, flavor astringency and overall acceptability of the candies prepared by addition of different concentration of ginger and mint are depicted in to table no. 3. Data indicating that the T<sub>5</sub> containing 2 percent of mint extract is containing highest colour score (8.80) followed by T<sub>2</sub>, T<sub>6</sub>, T<sub>1</sub>, T<sub>4</sub> and poorest 6.60 in T<sub>3</sub>. The treatment T<sub>2</sub> indicating the highest flavor score (8.75) followed by T<sub>5</sub>, T<sub>4</sub>, T<sub>1</sub>, T<sub>6</sub> and T<sub>3</sub>. Maximum astringency score (8.82) was recorded in T<sub>2</sub> containing 2 percent of ginger extract followed by T<sub>1</sub>, T<sub>4</sub>, T<sub>3</sub>, T<sub>5</sub> and poorest score was recorded in T<sub>5</sub> having 6.63 Organoleptic score. The overall acceptability was highest (8.84) recorded in the T<sub>2</sub> containing 2 percent of ginger extract followed by T<sub>1</sub>, T<sub>3</sub>, T<sub>5</sub>, T<sub>4</sub>. Treatment 6 treated with 2.5 percent mint extract recorded poorest Organoleptic score (7.16).

#### Changes in biochemical characters during storage of the product

Storage study of the aonla candy depicting in the table number 4 & 5. The result indicating that the during 120 days of storage of aonla candy TSS increased (72-75.4° B) till end of the experiment. Similar increasing trend was recorded with acidity (0.51 to 0.65 percent). During the storage of a candy Vit. C (ascorbic acid) content was continuously decreased till 120 days of storage which was in the range of 132.80 to 56.48 mg/100g of sample. Tannin content was decreased from 0.25percent to 0.16percent. Total sugar and Non reducing sugar increased 68.62-73.36 and 38.55-46.40 respectively. The reducing sugar content was decreased from 27.32 to 24.24 percent during the entire storage period of Aonla candy. The non enzymatic browning of the prepared and stored product showed an increasing trend during the storage. It was recorded 0.04 to 0.18 percent.

The moisture content of aonla candies prepared from different cv. NA-7 having TSS 72°B and 2 percent ginger extract aonla cultivars was recorded during storage shown in graph no. 1. The data revealed (Fig 2) that the moisture contents continuously decreased with an increase in storage period. After 120 days of storage of Aonla candies the moisture content decreased from an initial range of 18percent to a final of 13percent. It is also clear from Table 7 which indicating that none of the microbial colonies were found during storage period of the candies.

The organoleptic evaluation of the product was assessed on the basis of color, flavour, texture and the overall acceptability (Table 6). Generally, a continuous decrease in to the quality of the product was recorded during entire storage period. The product was acceptable even after 120 days of storage.

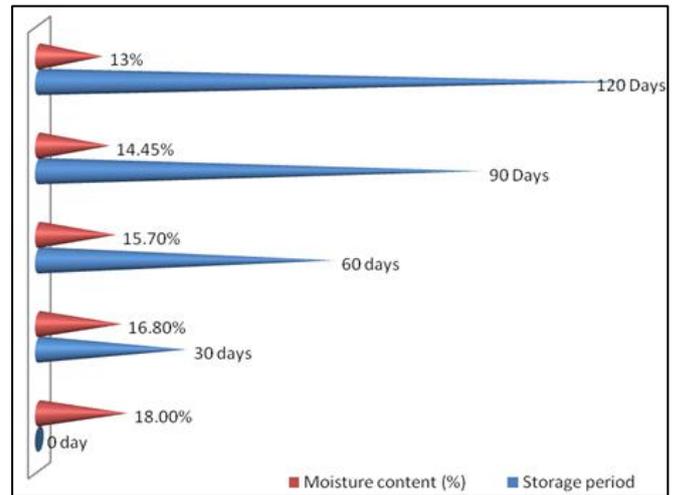


Fig 2: Change in moisture percentage in the aonla candy during storage

#### Discussion

The mean weight of aonla fruit harvested in this investigation was recorded 42.20 gram. Ghorai and Sethi (1996) [5] recorded an average fruit weight of 43.5 g for cv. Krishna. Singh and Pathak (1987) [22, 23] mentioned an average fruit weight of 38.2 g. The difference in average fruit weight might be due to varietal characteristics and agro-climatic conditions in which they are being cultivated. The pulp:stone ratio was recorded 18:1. Singh *et al.* (2005) [19] reported maximum seed weight in cv. Krishna. The fibre content in present investigation was recorded 1.28 percent. Sharma *et al.* (1989) [18] observed 3 to 4percent fibre in aonla fruits, which seemed to be the highest value reported in literature. The moisture content in fruit was noticed 85.15 percent. Pathak *et al.* (2003) [12] reported that moisture content ranged from 85.2 to 87.7percent in various aonla cultivars. A variability in physical composition of aonla cultivars have also been reported by many other workers (Pathak, 1988; Deen, 1992) [13, 4], which might possibly be because of differences in genetic characters of cultivars, soil, cultural practices and agro climatic conditions. The total soluble solids (TSS) content of fresh fruits was recorded 10.8°B. The TSS content of aonla fruits varied widely depending on the variety and agro climatic conditions. So aonla cultivar harvested at full maturity differ significantly in TSS content. Variability of TSS content in aonla cultivars was also reported by (Sharma *et al.*, 1989;) [18]. Our findings are relatively close to those of Singh and Pathak, who reported 10.7 and 10.2percent TSS in fresh fruits of Krishna and Chakaiya cultivars of Aonla respectively. Similarly, Singh *et al.* (2004) indicated in his study that the TSS content of 9.4percent in cv. Chakaiya, while Singh and Arora (1967) [25] reported slightly higher TSS (10.9percent) in cv. Chakaiya. In present study titratable acidity of fruits was recorded 1.68percent. Organic acids are responsible for sourness in the fruits. Variability in titratable acidity was also reported by Singh (1997) [21]. The data recorded on titratable acidity in present study is close to the findings of Singh and Pathak (1987) [22, 23], who reported 1.5 titratable acidity in Chakaiya cv of aonla. Pathak (1988) [13]; Singh and Singh (1994) [26] have reported higher values for titratable acidity than the present findings which might be due to variation in agro-climatic conditions or stage of harvest. Ascorbic acid content was recorded 385.78 mg/100 g of fresh fruits. Ascorbic acid plays an important role in human health & nutrition and due to this reason aonla fruits are preferred by

the community not only as a table fruit but in a processed form too. In aonla cultivars, ascorbic acid content varies from place to variety and place to variety. The ascorbic acid content in aonla fruits grown world-wide ranged from 200 to 1800 mg/100 g of fruit pulp (Ram, 1983). Singh (1982) have reported 500 to 750 mg/100 g ascorbic acid in different aonla cultivars. Meghwal and Azam (2004) [7] have reported highest ascorbic acid content in cv. Krishna which supports our findings. The differences in ascorbic acid content of fruits in present study and those reported in literature may be attributed to various factors including agro-climatic conditions in which fruits are grown and the maturity of fruits. The tannins content was recorded 1.75percent in fresh aonla fruits. Aonla is a rare example of fruits which is rich in tannins. Variability in the tannins content was also reported by Srivastava and Kumar, (1994) [29]. Our findings are in close conformity to those of Mehta *et al.* (2005) [8], who reported 1.51 and 1.40percent tannins in cvs Krishna and Chakaiya, respectively. The total sugar content was recorded 10.42percent in fresh fruits. Taetotia (1968) [31] has reported 7 to 9percent total sugars and 1 to 4percent reducing sugars in various cultivars of aonla. Singh *et al.* (1993) [24] observed a slight higher value of reducing sugars in different aonla cultivars and lower values for total sugars, while Mehta *et al.* (2005) [8], recorded higher values for total and reducing sugars as compared to data obtained in the present study. This might be due to variation in climatic conditions, maturity stage and varieties characteristics.

The moisture content here was also found to decrease with an increase in storage period. The decrease in moisture content in the various aonla candies with an increase in storage period might be due to the evaporation of moisture from the product. Decrease in moisture with storage of candies were also reported by Mehta *et al.* (2005) [8] in galgal peel candy. TSS gradually increases with increase in storage period. This might be due to conversion of polysaccharides into sugars during hydrolysis process. Increase in TSS might also be attributed to the reduction in moisture content of the product with storage. Increase in TSS with storage was also found to be reported by Tandon *et al.* (2003) [31], Kumar and Singh (2001) [6] in aonla candy. Acidity content continuously increased during entire storage period. Pectic acid has been reported to increase the acidity in fruit products, hence, degradation of pectic substances into soluble solids might

have contributed towards an increase in acidity of aonla products. An increase in acidity with storage period has also been observed in aonla preserve. Similar results were also observed by Sethi (1980) [17]; in aonla products. These results were compared to the results obtained by Rani and Bhatia (1985) [16] in which the acidity decreases with storage. The ascorbic acid content of the products decreased continuously during storage.

Reduction in vitamin ‘C’ could be due to oxidation by trapped oxygen in the jars which results in formation of dehydroascorbic acid. Loss in ascorbic acid content was also observed by Sethi (1980) [17] in aonla preserve, and Kumar and Singh (2001) [6] in aonla products. Decrease in ascorbic acid content might be attributed to the increase in Tannin. Decrease in tannin content was also reported by Mehta and Tomar (1979) [9]; Tandon *et al.* (2003) [31]. The total sugars, reducing sugars and NEB (non-enzymatic browning) increased gradually in candy during storage, while non-reducing sugar and sensory quality decreased in the product prepared from all the varieties flavored with different herbs.

On the basis of the observations recorded on various biochemical characters and organoleptic quality, it is clear that aonla candy having 72° B TSS and 2 percent ginger extract is suitable method for the preparation of candy. The aonla cv NA-7 showed great potential for preparation of nutritionally rich and Organoleptically acceptable product. The product have great potential for the further industrial exploitation.

**Table 1:** Physico-chemical characteristics of aonla fruits cv. NA-7

Characteristics	Remarks
Skin colour	Yellowish green
Average fruit weight (g)	42.20
Polar length (cm)	3.72
Diameter (cm)	4.35
Specific gravity	1.08
Pulp seed ratio	18:1
Fiber (%)	1.28
Moisture (%)	85.15
TSS (°Brix)	10.80
Acidity (%)	1.68
Ascorbic acid (mg/100g)	385.78
Total sugars (%)	10.72
Tannin (%)	1.75

**Table 2:** Organoleptic evaluation of the aonla candies prepared with different concentration of sugar

Treatments	Aonla candy	Colour	Flavour	Texture	Astringency	Overall acceptability
T <sub>1</sub>	66°B TSS	7.65	6.85	6.25	6.86	6.28
T <sub>2</sub>	68°B TSS	8.25	7.96	7.68	7.08	7.15
T <sub>3</sub>	70°B TSS	7.62	8.25	7.94	8.13	7.78
T <sub>4</sub>	72°B TSS	8.80	8.65	8.35	8.88	8.82
T <sub>5</sub>	74°B TSS	7.36	8.18	7.64	8.64	8.55
T <sub>6</sub>	76°B TSS	6.47	7.65	7.25	8.37	8.33
CD at 5%		0.19	0.26	0.09	0.18	0.13

**Table 3:** Organoleptic evaluation of different concentration of ginger and mint extracts for preparation of aonla candies

Treatments	Extract percentage	Flavour	Colour	Astringency	Overall acceptability
T <sub>1</sub>	72°B TSS+1.5 ginger extract	8.24	7.80	8.46	8.54
T <sub>2</sub>	72°B TSS+2.0 ginger extract	8.75	8.55	8.82	8.84
T <sub>3</sub>	72°B TSS+2.5 ginger extract	7.13	6.60	8.27	8.21
T <sub>4</sub>	72°B TSS+1.5 mint extract	8.35	7.25	8.32	7.95
T <sub>5</sub>	72°B TSS+2.0 mint extract	8.38	8.80	7.68	8.08
T <sub>6</sub>	72°B TSS+2.5 mint extract	7.94	8.10	6.63	7.16
CD at 5%		0.17	0.13	0.21	0.14

**Table 4:** Changes in TSS, acidity and vitamin C in the aonla candy during storage.

	TSS (°Bx)					Acidity (%)					Vitamin C (mg/100 g)					Tannin (%)				
	Storage period (days)					Storage period (days)					Storage period (days)					Storage period (days)				
	0	30	60	90	120	0	30	60	90	120	0	30	60	90	120	0	30	60	90	120
NA-7	72.0	72.2	72.8	73.6	75.4	0.51	.053	0.56	0.60	0.65	132.80	114.70	96.81	74.56	56.48	0.25	0.23	0.21	0.18	0.16
CD (5%)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

**Table 5:** Changes in total sugars, non-reducing sugars, reducing sugars and non-enzymatic browning in the aonla candy during storage

	Total sugar (%)					Non-Reducing Sugar					Reducing sugar					Non-enzymatic browning				
	Storage period (days)					Storage period (days)					Storage period (days)					Storage period (days)				
	0	30	60	90	120	0	30	60	90	120	0	30	60	90	120	0	30	60	90	120
NA-7	68.62	68.88	69.62	71.24	73.36	38.55	39.61	42.38	43.81	46.40	27.32	26.53	25.54	24.75	24.24	0.04	0.10	0.13	0.15	0.18
CD (5%)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.28	0.21	0.32	0.38	0.27	NS	NS	NS	NS	NS

**Table 6:** Changes in colour, flavor, texture and overall acceptability in the aonla candy during storage. Organoleptic Evaluation

	Colour					Flavour					Texture					Overall acceptability				
	Storage period (days)					Storage period (days)					Storage period (days)					Storage period (days)				
	0	30	60	90	120	0	30	60	90	120	0	30	60	90	120	0	30	60	90	120
NA-7	8.80	8.40	7.70	6.70	5.50	8.65	8.45	8.20	7.80	7.30	8.35	8.05	7.55	6.85	5.75	8.82	8.52	8.12	7.62	6.92
CD (5%)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

**Table 7:** Changes in microbial load in the aonla candy during storage period

	Microbial load (TPC)				
	Storage period (days)				
	0	30	60	90	120
Value	00	00	00	00	00
CD (5%)	NS	NS	NS	NS	NS

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