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Effect of ripening stages on physico-chemical characteristics of fresh and osmo-dehydrated *aonla* cv. Chakkaiya segments

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ABSTRACT

A study was conducted to find out the optimum ripening stage for osmo-dehydration of *aonla* segments. Fresh *aonla* fruits were kept at ambient conditions (25-35°C, 50-60% RH) till 10 days and analyzed for various quality parameters. Sensory analysis was also carried out both in fresh and osmo-dehydrated segments. It was observed that 8th day after harvesting was the best ripening stage for dehydration of *aonla* segments on the basis of better firmness, optimum physiological loss in weight and better yield recovery in the finished product. Acidity, pH and ascorbic acid content of the both fresh and dehydrated segments were also found superior when the osmo-dehydration was done after 8th day after harvest.

Key words: *Aonla,* ripening, maturity, osmo-dehydration, sensory quality.

INTRODUCTION

India is the second largest producer of fruits behind china with an annual production of 71.5 million tonnes in an area of 6.3 million hectares (Anon, 2). Approximately 30 per cent of the total produce gets spoiled due to improper post harvest management factors like poor judging on maturity, handling, packaging, transportation and processing. Besides, their shelf-life at ambient conditions and susceptibility to microbiological and physiological disorders limit their storage life (Kumar *et al.*, 6,7). Minor fruits play a vital role in the national economy as they have high scope for exporting to abroad, both fresh and processed form for their nutritive and medicinal value (Anon, 1). Among the minor fruits, *aonla* is one of the minor fruits of commercial significance. It is quite hardy and is highly remunerative without much care. It has acquired wide popularity all over the world due to its therapeutic properties. The fruit is highly nutritive and rich source of ascorbic acid, pectin and tannins and minerals like calcium, iron and phosphorus but the prices and the availability are highly fluctuating.

Among the major processing techniques employed on industrial scale to preserve fruits and vegetables, dehydration is best suited for developing countries, which have poorly established low temperature and thermal processing facilities (Sagar and Khurdiya, 11; Kumar and Sagar, 9). Advances in different dehydration techniques in recent years have enabled the production of wide range of dehydrated products and convenience foods from horticultural commodities, meeting the quality, stability and functional requirements coupled with economy (Khurdiya, 4). Since the *aonla* is a non-climacteric fruit, there is an urgent need to conduct basic studies to find out the optimum stage of maturity for the best dehydration of *aonla* segments. Keeping these points in view, the present investigation was undertaken to study the influence of maturity on osmo-dehydration of *aonla*.

MATERIALS AND METHODS

The matured fruits of *aonla* cv. Chakkaiya were procured from Experimental Orchard, Division of Fruits and Horticultural Technology, IARI, New Delhi. Fresh, firm fruits were selected and washed thoroughly with water to remove adhering dirt and dust and then dried under the fan. The fruits were kept in plastic crates lined with news paper sheets to find out the best stage for the preparation of dehydrated fruit segments at room temperature (25-35°C). The fruits were withdrawn at an interval of two days untill ten days. *Aonla* fruits were blanched in alkali (2%) for 5-8 min. Lye treated fruits were washed thrice in tap water and then soaked in citric acid to neutralize the alkali treatment and to remove the astringency. The blanched fruits were dipped in cold water for two minutes for easy separation of segments manually and seed removal. The weighed amount of *aonla* fruit segments were immersed in sugar solution containing 60°Brix sugar, 0.05 per cent KMS and 0.1 per cent citric acid at 60°C in 1:4 ratio (fruit slices: osmotic solution) without any agitation. Samples were withdrawn from osmotic solution after six hours of immersion time and they were drained quickly and

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wiped gently with tissue paper to remove the sugar solution from outer surface of the segments and were loaded in the aluminum trays (1.05 m × 0.45 m) and dried in cabinet drier (Kilburm make Model - 0248, New Delhi) at 58 ± 2°C till the final drying.

Physical constituents like physiological loss in weight (PLW), specific gravity, pressure, peel, pulp, stone and preparatory losses were calculated at two days interval. Moisture, pH, acidity, ascorbic acid were determined in fresh as well as osmo-dehydrated *aonla* segments as per procedure given by Ranganna (10). The experiment was laid out in completely randomized design. The data obtained were subjected to statistical analysis, using AGRES software.

RESULTS AND DISCUSSION

Physiological loss in weight (PLW) enhanced with ripening period significantly (Table 1). The PLW was maximum (2.96%) on the 10th day after harvest. Temperature and RH of the environment also has significant effect on PLW of fruits. Similar findings have been reported by Kumar *et al*. (8) and Gowda and Huddar (3). Specific gravity dropped gradually from 1.07 to 1.04 with an increase in ripening period. However, the reduction was non-significant. Specific gravity of 1.00 and above are generally not considered good for processing, resulting in product with hard texture, cooked flavour and comparatively greater metallic absorption and discoloration. Ripening period has great influence on firmness of fruit (Kumar *et al*., 8). Maximum pressure was recorded on the day of harvest, while the minimum was noticed on 10th day after harvest. A similar observation was observed by Khurdiya (4), and Sagar and Khurdiya (11) during fruit ripening process of mango. This may be due to respiration which plays a vital role in the loss of weight. Temperature and RH of the environment also has significant effect on PLW of fruits. Similar findings have been reported by Selvaraj *et al*. (12), Kumar *et al*. (6) and Kumar *et al*. (8). Maximum edible portion was recorded on 8th day (92.23%) and then reduced with further ripening period though it was statistically not significant, while seed percentage reduced with an increase in ripening period. Minimum seed percentage was noticed on the 10th day after harvest. Similar findings have been reported by Kumar and Singh (5). A rise in preparatory loss was observed with an increase in ripening period. Maximum loss (1.19%) was recorded on the 10th day after harvest, while the minimum (0.94%) was noticed on the day of harvest. This change was statistically non significant. Since *aonla* is a non-climacteric fruit not much variation was found in most of the physical characteristics with the extending storage period. Concurrent observations were recorded by Sharma *et al*. (13) in apricot.

Moisture content, TSS and pH showed increasing trend with an increase in ripening period and the maximum moisture and pH was observed on the 8th and 10th day after harvest (Table 2). The ripening period profoundly affected the TSS content of the fruit. Similar findings have been reported by Kumar and Singh (5). The increase in TSS might be due to hydrolysis of polysaccharides into simple sugars. The changes were steady as reported by Selvaraj *et al.* (12). Acidity and ascorbic acid decreased with increase in ripening period. The decrease in acidity and ascorbic acid were significant. Maximum was observed on the day of harvest, while the minimum was observed on the 10th day after harvest. Analogous observation on acidity was observed by Kumar *et al*. (7,8). The fall in ascorbic acid content might be due to its oxidation and enzymatic degradation during ripening. The changes in ascorbic acid content have been reported by Sagar and Khurdiya (11). Reducing and total sugars increased with extending ripening period. Maximum sugars were recorded on the 10th day after harvest.

Table 1. Effect of maturity stages on physical characteristics of *aonla*.

Days after harvest	PLW (%)	Sp. gr.	Pressure (kg/cm^2)	Seed (%)	Edible portion (%)	Preparatory loss (%)
0	0.00^a	1.07	4.26^d	7.46	91.31	0.94
2	1.26^b	1.06	3.74^c	7.15	91.7	0.96
4	1.67^c	1.06	3.42^{bc}	6.91	92.0	1.02
6	2.03^d	1.05	3.18^{ab}	6.86	92.12	1.09
8	2.41^e	1.04	3.05^b	6.82	92.23	1.15
10	2.78 ^{f}	1.04	2.89^a	6.77	92.04	1.19
$CD_{0.05}$	0.23	NS	0.47*	0.05	NS	0.02

In each column, means with similar alphabets do not vary significantly at P = 0.05 by DMRT

Table 2. Effect of maturity stages on the chemical characteristics of *aonla*.

Days after harvest	Moisture (%)	TSS (°B)	Acidity (%)	pH	Ascorbic acid (mg/100 g)	Reducing sugars (%)	Total sugars (%)
0	85.5	10.3	2.84^{c}	2.35	629.5	1.98^{a}	9.34
2	85.6	10.3	2.61^{bc}	2.46	625.4	2.09^{ab}	9.45
4	85.8	10.5	2.45^{ab}	2.48	622.8	2.17^{ab}	9.67
6	85.9	10.6	2.37^{ab}	2.50	622.1	2.29^{b}	9.76
8	86.4	10.9	2.26^{a}	2.51	621.9	2.31^{b}	9.82
10	86.7	10.9	2.24^{a}	2.51	621.6	2.32^{b}	9.83
$CD_{0.05}$	NS	NS	0.28	0.02	NS	0.24	0.04

In each column, means with similar alphabets do not vary significantly at P = 0.05 by DMRT

Ripening stages affect the colour of the fresh *aonla* segments significantly (Table 3). Colour increased with the increasing period of time till 8th day which scored highly, compared to other ripening stages. Likewise, flavour and texture score were also higher on 8th day after harvest. The better score on texture in the optimum stage was due to conversion of protopectin into pectin, however further increase in ripening period led to change of pectin into pectinic acid, which disintegrated the cell structure. Similar observation was made by Sharma *et al*. (13). Over all acceptability score was also higher in 8th day after harvest. Chemical characteristics of dehydrated *aonla* segments were statistically not significant despite the fact that minute variation in content was detected with the ripening stages (Table 4). Moisture content on dehydrated *aonla* segments increased with the increase in ripening period and the maximum moisture was observed on the 10th day after harvest. Similar observation was made by Kumar *et al*. (8) in osmo-dehydrated guava slices. However, acidity and ascorbic acid were decreased significantly with an increase in ripening period. This change in dehydrated product acidity and ascorbic

Table 3. Effect of maturity stages on the sensory characteristics of fresh *aonla*.

Days after harvest	Colour	Flavour	Texture	Over all acceptability
0	7.81	8.02	7.81	7.88
2	8.14	8.18	7.95	8.09
4	8.32	8.26	8.24	8.27
6	8.44	8.41	8.56	8.47
8	8.52	8.49	8.63	8.55
10	8.51	8.47	8.61	8.54
$CD_{0.05}$	0.03	NS	0.02	0.05

Table 4. Influence of maturity stages on the quality of osmo-dehydrated *aonla* segments.

Days after harvest	Moisture (%)	Acidity (%)	Ascorbic acid (mg/100 g)	Reducing sugars (%)	Total sugars (%)
0	8.75	8.26	3499.78	12.08	44.36
2	8.79	8.21	3478.51	12.19	45.12
4	8.88	8.05	3471.24	12.34	45.94
6	8.94	8.01	3464.65	12.65	46.27
8	9.07	7.97	3447.73	12.79	47.01
10	9.11	7.94	3403.52	12.92	47.18
$CD_{0.05}$	NS	0.01	3.84	NS	0.23

acid has direct correlation with their level in fresh fruits. Similar observation was made by Kumar *et al.* (7). Maximum reducing sugar was observed on the 10th day after harvest. Similar to reducing sugar, total sugars also increased with an increase in ripening period. However, slight reduction in total sugars was observed on the 10th day of ripening.

Sensory score of dehydrated segments on colour, flavour, texture and over all were also higher on the 8th day after harvest (Fig. 1). The sensory score was poor in dehydrated product prepared from unripe fruits. This may be due to poor and non uniform colour, thick texture of fruit slices and less

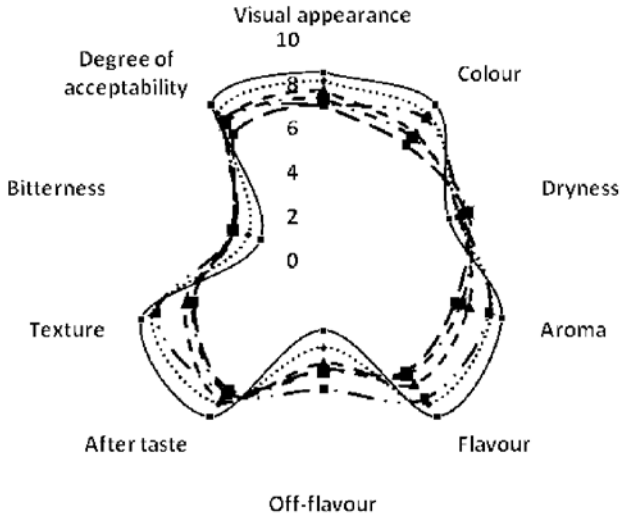

Fig. 1. Effect of ripening stages on sensory score of osmo-dehydrated aonla segments.

flavour while on the other hand at later stage this may be due to it's over ripeness, soft tissues, which make them unsuitable for drying of slices and cause poor sensory score. Similar observation was made by Kumar *et al.* (6) in *aonla*. Osmo-dehydrated *aonla* segments have great potential to be used throughout the year and also during the off-season. Osmotic drying could be recommended and easily adoptable to the small scale industries, which are operating in the rural areas.

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