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Studies on changes during storage of flavored aonla (*Emblica officinalis* G.) candy cv. Chakaiya in different packaging containers

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Abstract
The present investigation was executed at the Laboratory of Department of Post-Harvest Technology, College of Horticulture and forestry, Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad (U.P.) India during the year 2015-16. In the experiment changes during storage of flavored candy of aonla fruit was studied. Result of present studies indicated that aonla fruit of cv. Chakaiya had organoleptic evaluation was done to assess the quality of aonla candy made from different concentration of ginger extract. The data on overall ranking of sensory traits which were obtained by addition of score awarded to different sensory traits reveal that treatment of T_5 (ginger extract @ 5% in sucrose syrup) was rated like extremely with significantly higher points as compare to other treatments. Therefore, T_5 treatment candy was packed in LDPE packet, plastic jar and glass jar for the storage studies. Storage studies indicated that LDPE packet was better in comparison to glass jar and plastic jar for the packaging of aonla candy at ambient temperature and candy packed in LDPE packet was found in good condition after six month of storage period.

Keywords: Candy, Aonla, flavored, storage and packaging

Introduction
Aonla (*Emblica officinalis* G.) also known as Indian gooseberry belongs to family Euphorbiaceae. It is native to tropical South Eastern Asia particularly Southern India. Aonla is richest source of vitamin-c next to bar bods cherry. Aonla fruit have very good medicinal value and utilizing from ancient time for the treatment of several ailments like tuberculosis of lungs, asthma, bronchitis Scurvy, diabetes, anemia, weakness of memory, cancer, tension, influenza, cold loss and greyness of hair etc. because of its acidic and astringent nature. Attempts are being made to produce product which are not only nutritionally delicious but also acceptable among the Consumers. The medicinal, nutritional and organoleptic quality of aonla candy can be improved by addition of ginger extract in the aonla candy. Among the food processing industry, aonla candy is now gaining much popularity in the market due to its natural appeal of an original fruit, nutritional quality, easy to handling and transport. Aonla candies have better self-life, an easy preparation technology with low preparation cost and good return, but have no aroma and attractive flavor. Attempts are being made to produce products which are not only nutritionally delicious but also acceptable among the consumers. The medicinal, nutritional and organoleptic quality of aonla candy can be improve by addition of different natural oil/extract in the aonla candy and found that the ginger was best among different natural oil. Ginger (*Zingiber officinalis* L.) is belong to family Zingiberaceae. It is important spice crop of world. It is originated in India and grown in almost all the states. Ginger is also an Ayurvedic crop and its test and flavour is very much acceptable to Indian peoples. It promotes cleaning of the body through perspiration to calm nausea, and to stimulate the appetite. Ginger contains gingerola an oleoresin, (combination of volatile oils and resin) that accounts for the characteristic aroma and therapeutic properties. So, ginger extract is selected as flavouring agent and quality enhancer for aonla candy.

Materials and methods
Experimental materials
In the present study, the Chakaiya cultivars of Aonla fruit were taken in the 1st week of January, 2016 from the main Experiment Station, Department of Horticulture, Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad (U. P.). The fruits were harvested from the trees by hands to avoid any type of physical damage including bruising.

The fruits were transported from orchard to the post harvest technology laboratory of Department of post-harvest technology in the corrugated fiber board boxes by Motorbike.

Evaluation of ginger concentration for preparation of aonla candy

3 kg of blemish free mature and uniform size of fresh fruits, for each treatment were taken and washed properly with fresh water. Thereafter, the fruits were blanched in boiling water with 2% alum for five minutes. After boiling the aonla fruits segments were separated by hand and washed 3 times with the fresh water. Prepare twenty seven liter sugar syrup containing 50% TSS were divided into nine equal volume in nine containers thereafter, added ginger extract in the volume of T_0: Control (not added), T_1: @ 1% ginger extract in sucrose syrup, T_2: @ 2% ginger extract in sucrose syrup, T_3: @ 3% ginger extract in sucrose syrup, T_4: @ 4% ginger extract in sucrose syrup, T_5: @ 5% ginger extract in sucrose syrup, T_6: @ 6% ginger extract in sucrose syrup, T_7: @ 7% ginger extract in sucrose syrup and T_8: @ 8% ginger extract in sucrose syrup at slightly hot stage and mixed thoroughly. After blanching and washing of above fruit segments were steeped into nine above different containers containing sugar syrup of 50% TSS and ginger extract of different concentration for 24 hour. Then next day, segments were drained and concentration of syrup was maintained 60% by adding sugar and again segment of each treatment were steeped, after 24 hours concentration of the syrup was maintained 70% by above process and segment were left in it for 3 days. Thereafter, segments were drained and washed to remove adhering layer of sugar by 3-4 quick dips into hot water after putting into muslin cloth. These pieces were dried in the hot air oven at 50 ºC for 8-10 hours (Fig.1) the candies were evaluated by sensory test (Organoleptic rating) and the panel of 10 judges on the basis of 9 point hedonic scale.

Study the storage life of aonla candy in different containers

The prepared candy of T_5 treatment was packed 200 g in polythene bag, plastic jar and glass jar with three replications. Thus eighteen container of each packaging were packed for six month storage study. Polythene bag was sealed with sealing machine and jars with plastic cap. Monthly observations were recorded on the Total Soluble Solids (%), Acidity (%), Browning (Non-enzymatic) and Ascorbic acid (mg/100gm) were determined by the method of Rangana, 2010, Standardization of Dye were determined by the method of Jonson, B.C., 1948 [2], Sugars (%) were determined by Saffer Somogyi Method, The total phenols were determined by the method of Swain and Hills (1959) and the organoleptic evaluation for accessing the taste, colour, flavour and texture of the samples, were conducted by panel of 10 judges who scored on a 9 point hedonic scale by (Amerine *et.al*. 1965) [1]. The Statistical analysis of the data was done by the method described by Panse and Sukhatme (1961) [6] using C.R.D. factorial experiment.

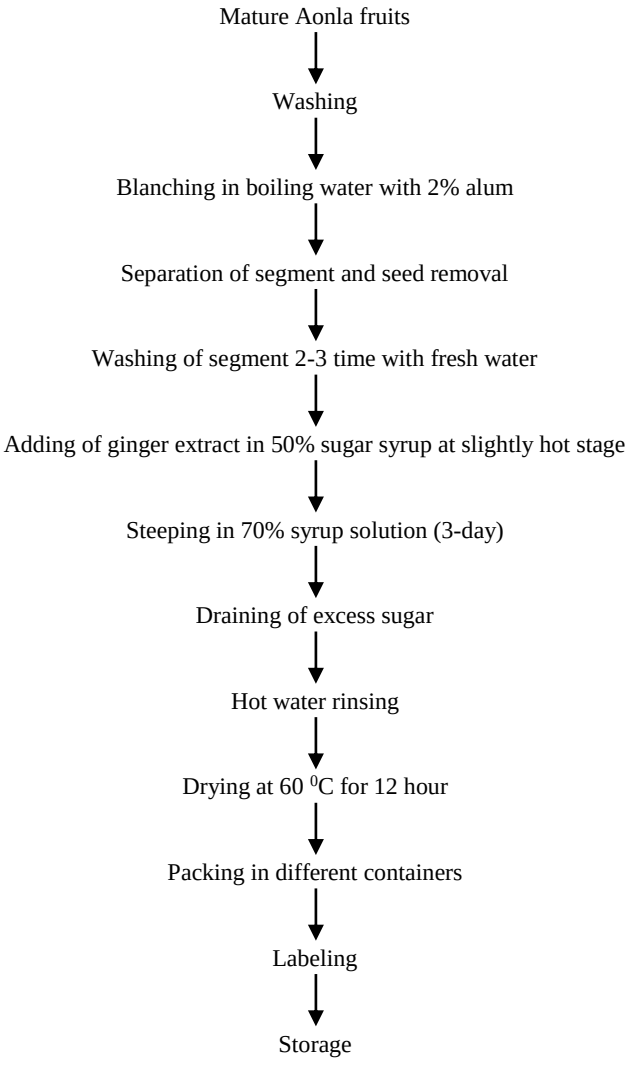

Fig 1: Flow sheet for preparation of ginger enriched candy.

Result and Discussion

The data recorded on changes in total soluble solids content of aonla candy in different packaging containers during storage is presented in table-1. The TSS content was increased significantly after fourth month of storage in each packaging containers. However, minimum TSS content was increased in candy packed in LDPE packet. TSS content was increased gradually till the end of storage. Interaction between packaging containers and storage period on TSS content was also found non-significant. The minimum changes in acidity were found in candy packed in LDPE packet followed by plastic jar. Acidity per cent was increased significantly from 1st month to till the end of storage under each packaging containers. Interaction between packaging containers and storage period was found significant presented in table-2. Ascorbic acid content decreased significantly among all packaging containers and minimum change was noticed in LDPE packet. Interaction between packaging container and storage period was non-significant presented in table 3. Reducing sugar was increased continuously in all packaging containers till the end of storage period and significant change was found after 3rd month of storage presented in table-4. The minimum changes in reducing sugars were noticed in candy packed with LDPE packet followed by plastic jar. Interaction between packaging containers and storage period was also found significant. The significant difference was observed in non-reducing sugar content among all packaging containers. LDPE packet retained maximum non reducing sugar. Non-reducing sugar decreased significantly from second month till the end of storage in all packaging containers presented in table 5. Interaction between packaging containers and storage period was found significant. The non-significant difference in total sugars content was observed during storage among all packaging containers presented in table 6. It is evident from the data that minimum changes in total sugars were observed in candy packed with LDPE packet. Interaction between packaging containers and storage period was significant. It is evident from the table that browning increased significantly among all packaging containers. A minimum change was noticed in glass jar fallowed by LDPE packet. Browning was increased significantly from after first month till the end of storage in all packaging containers presented in table 7. Interaction between packaging containers and storage period was significant. It is evident from the table that total phenols content decreased non-significantly in all packaging containers presented in table 8. A least change were found in LDPE packet and found significantly superior over other containers. The phenol contents were decreased gradually from second month to till the end of storage. Interaction between different packaging containers and storage period was found non-significant. It is evident from the table that organoleptic quality of LDPE packet was found best over other packaging containers till the end of storage presented in table 9. Chemical constituents such as TSS, acidity, reducing sugars, total sugars and browning increased during storage in each packaging container (LDPE packet, plastic jar and glass jar) with the increase in duration. Whereas, ascorbic acid, non-reducing sugar, total phenol and organoleptic quality gradually decreased during storage. LDPE packet found superior over other packaging containers because least change were observed in biochemical constituent. TSS, acidity, reducing sugars, total sugars and browning of aonla candy increased slightly during storage at ambient temperature in each packaging container. The minimum changes was found in LDPE packet. Similarly, LDPE packet was found superior over other containers which were also reported by Pathak (1988) [7] in aonla candy, Kumar (1990) [3] papaya candy, Kumar *et al.* (1992) [4] ber candy, Mishra (2005) [5] beal candy. An increased TSS of candy may be possible due to hydrolysis of polysaccharides and oligosaccharides into monosaccharide (reducing sugars) and evaporation of moisture from the candy. The acidity content increased during storage due to presence of pectin substances in the product. An increase in reducing sugars and total sugars might be due to the inversion of non-reducing sugar to reducing sugars and hydrolysis of polysaccharides into monosaccharide. Browning increase mainly due to non-enzymatic reaction between nitrogenous compound and sugars, nitrogenous compound and organic acid, sugars and organic acid and among organic acid themselves. The carbenole group of a cyclic sugar combines with basic proteins, reducing sugars, amino acid complex causing browning. Change in ascorbic acid, non-reducing sugar, total phenols and organoleptic quality during storage of aonla candy declined continuously with the progress of storage period in each packaging container. Minimum change were observed in LDPE packet followed by plastic jar. The losses of ascorbic acid, non-reducing sugar, total phenols and organoleptic quality was also noticed in aonla candy (Pathak, 1988; Tripathi *et al*. 1988; Singh *et al*. 1993) [7, 10, 9], papaya candy (Kumar, 1990) [3], ber candy (Kumar *et al.* 1992) [4] ber candy (Singh. 2012), intermediate moister beal preserve. The difference in loss of ascorbic acid in different containers may be due to moisture proof ness of containers and transparency against light of the container. Because candy become toughafter four month storage in plastic jar due to loss of moisture from the product may be due to leakages of air from the container. Reducing of ascorbic acid content could be due to oxidation with trapped oxygen in container which results formation of dehydro ascorbic acid (Kumar, 1990) [3]. The phenolic compound play an important role to determining the color and flavor of the product, but its loss might be due to these compounds are highly volatile and easily oxidizable, which condensed into brown pigments. This may be probably due to greater movement of oxygen, water vapor and oxidation of ascorbic acid, organic acid and polyphenols during storage. Organoleptic score of aonla candy decreased continuously in each packaging containers during storage. The acceptability of product was maintained up to six month in each container. LDPE packed candy was found best throughout the storage period followed by plastic jar. It may be possible to good retention of texture, color, ordure and taste in LDPE packed. The deterioration in the acceptance of plastic jar and glass jar packed candy was not due to odd flavors or taste but it was due to the tough texture of candy. The tough texture of candy may be due to the rapid loss of moisture by very tiny air leakage in the both packaging containers resulting tough texture of candy.

Table 1: Changes in total soluble solids content (%) of aonla candy during Storage period.

Period	5% Ginger extract in sucrose syrup			
	LDPE packet	Plastic jar	Glass jar	Mean
0	70.32	70.32	70.32	70.32
1	70.46	70.46	70.46	70.46
2	70.50	70.75	70.70	70.65
3	71.27	71.65	71.45	71.46
4	71.76	72.20	71.95	71.97
5	72.16	72.80	72.50	72.49
6	72.75	73.50	73.00	73.08
Mean	71.32	71.48	71.67	71.49

	SEm±	CD at 5%
Containers (C)	0.41	1.17
Storage period (T)	0.624	1.78
Interaction C × T	1.08	3.08

Table 2: Effect of different concentration of ginger extract on changes in acidity content (%) of aonla candy during storage period.

Period	5% Ginger extract in sucrose syrup			
	LDPE packet	Plastic jar	Glass jar	Mean
0	0.59	0.59	0.59	0.59
1	0.60	0.60	0.60	0.60
2	0.61	0.61	0.61	0.61
3	0.62	0.63	0.65	0.63
4	0.63	0.64	0.68	0.65
5	0.66	0.67	0.71	0.68
6	0.69	0.70	0.73	0.71
Mean	0.63	0.63	0.65	0.64

	SEm±	CD at 5%
Containers (C)	0.004	0.01
Storage period (T)	0.01	0.02
Interaction C × T	0.01	0.03

Table 3: Effect of different concentration of ginger extract on changes in ascorbic acid content (mg/100 g) of aonla candy during storage period.

Period	5% Ginger extract in sucrose syrup			
	LDPE packet	Plastic jar	Glass jar	Mean
0	111.75	111.75	111.75	111.75
1	108.75	108.50	107.95	108.40
2	106.65	105.00	105.25	105.63
3	100.50	100.00	99.50	100.00
4	96.75	96.55	96.25	96.52
5	91.25	91.05	90.85	91.05
6	86.85	86.25	85.75	86.28
Mean	100.36	99.87	99.61	99.95

	SEm±	CD at 5%
Containers (C)	0.57	1.62
Storage period (T)	0.87	2.47
Interaction C × T	1.50	4.28

Table 4: Effect of different concentration of ginger extract on changes in reducing sugars content (%) of aonla candy during storage period.

Period	5% Ginger extract in sucrose syrup			
	LDP packet	Plastic jar	Glass jar	Mean
0	33.00	33.00	33.00	33.00
1	33.10	33.10	33.15	33.12
2	33.40	33.55	33.80	33.58
3	33.90	34.20	34.65	34.25
4	34.35	35.05	35.80	35.07
5	34.70	35.90	36.60	35.73
6	35.40	36.80	37.70	36.63
Mean	33.98	34.51	34.96	34.48

	SEm±	CD at 5%
Containers (C)	0.21	0.584
Storage period (T)	0.31	0.89
Interaction C × T	0.54	1.55

Table 5: Effect of different concentration of ginger extract on changes in non-reducing sugar content (%) of aonla candy during storage period.

Period	5% Ginger extract in sucrose syrup			
	LDPE packet	Plastic jar	Glass jar	Mean
0	27.30	27.30	27.30	27.30
1	27.30	27.30	27.30	27.30
2	27.10	27.05	27.05	27.07
3	27.00	26.90	26.85	26.92
4	26.80	26.70	26.40	26.63
5	26.65	26.40	25.90	26.32
6	26.50	25.90	24.50	25.97
Mean	26.95	26.79	26.61	26.79

	SEm±	CD at 5%
Containers (C)	0.15	0.44
Storage period (T)	0.234	0.67
Interaction C × T	0.41	1.16

Table 6: Effect of different concentration of ginger extract on changes in total sugars content (%) of aonla candy during storage period.

Period	5% Ginger extract in sucrose syrup			
	LDPE Packet	Plastic jar	Glass jar	Mean
0	60.30	60.30	60.30	60.30
1	60.40	60.40	60.45	60.42
2	60.50	60.60	60.85	60.65
3	60.90	61.10	61.50	61.17
4	61.15	61.75	62.20	61.70
5	61.35	62.30	62.50	62.05
6	61.90	62.70	63.20	62.60
Mean	60.93	61.31	61.57	61.27

	SEm±	CD at 5%
Containers (C)	0.35	0.10
Storage period (T)	0.54	1.53
Interaction C × T	0.93	2.64

Table 7: Effect of different concentration of ginger extract on changes in browning (OD) of aonla candy during storage period.

Period	5% Ginger extract in sucrose syrup			
	LDPE Packet	Plastic jar	Glass jar	Mean
0	0.04	0.04	0.04	0.04
1	0.07	0.07	0.07	0.07
2	0.08	0.08	0.09	0.8
3	0.11	0.11	0.10	0.11
4	0.12	0.13	0.11	0.12
5	0.13	0.14	0.12	0.13
6	0.14	0.15	0.13	0.14
Mean	0.10	0.10	0.09	0.10

	SEm±	CD at 5%
Containers (C)	0.001	0.002
Storage period (T)	0.001	0.003
Interaction C × T	0.002	0.004

Table 8: Effect of different concentration of ginger extract on changes in total phenols content (mg/100 g) of aonla candy during storage period.

Period	5% Ginger extract in sucrose syrup			
	LDPE packet	Plastic jar	Glass jar	Mean
0	85.86	85.86	85.86	85.86
1	85.58	85.58	85.58	85.58
2	85.50	85.33	85.50	85.44
3	85.20	84.99	84.70	84.96
4	84.95	84.74	84.50	84.73
5	84.60	84.41	84.40	84.47
6	84.40	84.09	84.20	84.23
Mean	85.16	85.00	84.96	85.04

	SEm±	CD at 5%
Containers (C)	0.51	1.44
Storage period (T)	0.77	2.21
Interaction C × T	1.34	3.80

Table 9: Effect of different packaging containers on changes in organoleptic quality of aonla candy during storage period.

Storage period (in month)	5% Ginger extract in sucrose syrup					
	LDPE packet		Plastic jar		Glass jar	
	Organoleptic score	Rating	Organoleptic score	Rating	Organoleptic score	Rating
0	8.78	LVM	8.78	LVM	8.78	LVM
1	8.78	LVM	8.78	LVM	8.78	LVM
2	8.78	LVM	8.48	LVM	8.68	LVM
3	8.68	LVM	8.28	LVM	8.58	LVM
4	8.48	LVM	8.08	LVM	8.28	LVM
5	8.38	LVM	7.88	LM	8.18	LVM
6	8.28	LVM	7.78	LM	8.08	LVM

*9.0 Like extremely, ** 8.0 Like very much, *** 7.0 Like slightly

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