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Effect of pre-treatment on quality of value-added dried amla-beet root shreds

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Abstract
Value added amla-beet root shreds of five different combinations basis [C_1= (400, 0); C_2= (300,100); C_3 = (200,200); C_4 = (100, 0); C_5 = (0, 100)] were prepared on weight basis. Each combination contains 400 g shreds. Shreds werepre-treated by blanching followed by mixing up of black salt (3%) and ginger juice (10%) for enhancing sensory quality of the shreds. Pre-treated shreds were dried in convective dryer at three different temperatures 55ºC, 65º C, 75º C. Shreds were analysed for moisture content, water activity, and ascorbic acid content sensory qualities of the prepared samples were evaluated. As the drying temperature increased, the moisture content, water activity of shreds decreased. The results also show that an increase in the drying temperature results in a lower ascorbic acid content. Shreds dried at 55ºC, 65ºC, 75ºC were compared and the best product was obtained at temperature 55ºC with sample containing only alma. The most acceptable product has ascorbic acid content 272.72 mg/100g, water activity of 0.248, L* value 36.78, a* value -11.58, b* value 15.72.

Keywords: Amla, beet root, drying, water activity and ascorbic acid content.

Introduction
Indian gooseberry (Emblica officinalis Gaertn.) also known as aonla is a low cost important fruit valued for its nutritional and medicinal properties. It is one of the richest sources of ascorbic acid (500–1,500 mg/100 g) used as a strong rejuvenator in Indian pharmacopoea (Pathak and Ram 2007) [10] and is very popular for its medicinal properties as mentioned both in ayurvedic and unani system of medicines in India. It is valued as an anti-ascorbic, acidic, cooling laxative and diuretic (Singh *et al*. 1993) [5]. Beetroot (*Beta vulgaris* L.) commonly known as 'chukander', is mainly cultivated in India for its juice and vegetable value. Beetroot is a rich source of potent antioxidants and nutrients, including magnesium, sodium, potassium and vitamin C, and betaine. They are loaded with vitamins A, B_1, B_2, B_6 and C. They are also an excellent source of calcium, magnesium, copper, phosphorus, sodium and iron. Aonla fruits are not consumed in fresh form because of its acidic and bitter taste. It is, therefore, not popular as a table fruit. However, excellent nutritive and therapeutic values of the fruit have great potentiality for processing into several quality products. Amla has been reported to posses expectorant, purgative, spasmolytic, antibacterial, hypoglycemic activity (Jamwal *et al*., 1959; Jayshri and Jolly, 1993) [3, 4]. The aqueous extract has been reported to have anti-pyretic laxative and tonic properties and also showed antibacterial activity (Vinaygamoothy, 1982) [21].
As aonla is highly perishable in nature, the fruit needs processing for increasing shelf-life and value addition; particularly during glut period. Deep red-coloured beet roots are the most popular for human consumption, both cooked and raw as salad or juice. There is growing interest in the use of natural food colors, because synthetic dyes are becoming more and more critically assessed by the consumer. To improve the red color of tomato pastes, sauces, soups, desserts, jams, jellies, ice creams, sweets and breakfast cereals, fresh beet/beet powder or extracted pigments are used (Koul *et al*., 2002; Roy *et al*., 2004) [8, 14]. It also contributes to consumers' health and wellbeing because it is known to have antioxidants because of the presence of nitrogen pigments called betalains, mainly comprise of red–violet-colored betacyanins (betanin, isobetanin, probetanin and neobetanin) and yellow–orange-colored betaxanthyns (Kaur and Kapoor, 2002) [6].
Processing not only reduces the post-harvest losses but also provides higher returns to the growers. Drying is an effective method to increase shelf life of aonla fruits. Fresh beetroots are exposed to spoilage due to their high moisture content. One of the preservation methods ensuring microbial safety of biological products is drying (Mathlouthi, 2001) [12]. Dried beetroots can be consumed directly in the form of chips as a substitute of traditional snacks, that are rich in trans fatty acids (Aro *et al*., 1998) [2] or after easy preparation as a component of instant food (Krejcova *et al*., 2007) [9].

The goal of food preservation is to increase the time for keeping food safe while retaining quality and nutrients. Fruits and vegetables play an important role in human diet and nutrition but are highly perishable due to their high moisture content. Decreasing the moisture content of fresh foods to make them less perishable is a simple way to preserve these foods. This and other preservation methods result in the availability of a greater variety of fruits and vegetables. Drying increases the storage stability of fruits and vegetables making them available throughout the year. Drying products also play a great role in processed foods of all kinds (i.e., in soups) and ways to achieve high quality dehydrated products are desired. In keeping these factors in view, this project have been undertaken to develop a value added product of amla and beetroot in the form of shreds and to study the effect of temperature and combinations on quality of dried amla- beet root shreds.

2. Materials and methods

2.1 Sample preparation

Fresh matured amla and beet root were collected from local market, Udaipur. The diseased, bruised and spotted fruits were sorted out and then thoroughly washed in running tap water to remove dust and other extraneous materials from the surface of fruits. Fresh fruit samples are washed and cut into small segments by using a manual shredder. Five different combinations of amla- beet root shreds were made on weight basis [(400, 0); (300,100); (200,200); (100, 0); (0, 100) g].Each combination had 400 g shreds. Each combination was blanched in one litre boiling water for 3min and dipped immediately in normal water for 3 min to prevent excess cooking, then the blanched product was kept in strainer. Three percent (12 g) of black salt and 10 percent (40 ml) ginger juice was given to each combination and kept for 12 h for uniform absorption (Prajapathi *et al*., 2010) [11]. The product was conditioned to remove surface moisture. Shreds were dried in tray dryer at three different temperatures (55, 65, 75^{0}C) in trays. Trays were changed in rotation from lower shelf to upper one to ensure uniform drying. Drying was carried out until constant weight was achieved. Weights before and after drying were measured. Theprocess flow chart used for development of amla-beet root shreds is presented in Fig 1.

2.2 Determination of moisture content

The moisture content of the fresh shreds was determined before drying by using hot air oven method. (AOAC, 2000). A small sample of 50-60g shreds was dried in hot air oven for 24 hours at 105 ºC. The moisture content of sample was calculated by using following equation.

$$\text{Percent of moisture content (wb)} = \frac{W_1 - W_2}{W_1} \times 100$$

Where,
W_1 = mass of original sample, g,
W_2 = mass of the sample after drying, g

2.3 Determination of water activity

Water activity of dried and fresh samples were measured directly in hygrolab make water meter (Kaur and Singh, 2014) [7]. Triplicate samples were measured at 25ºC.

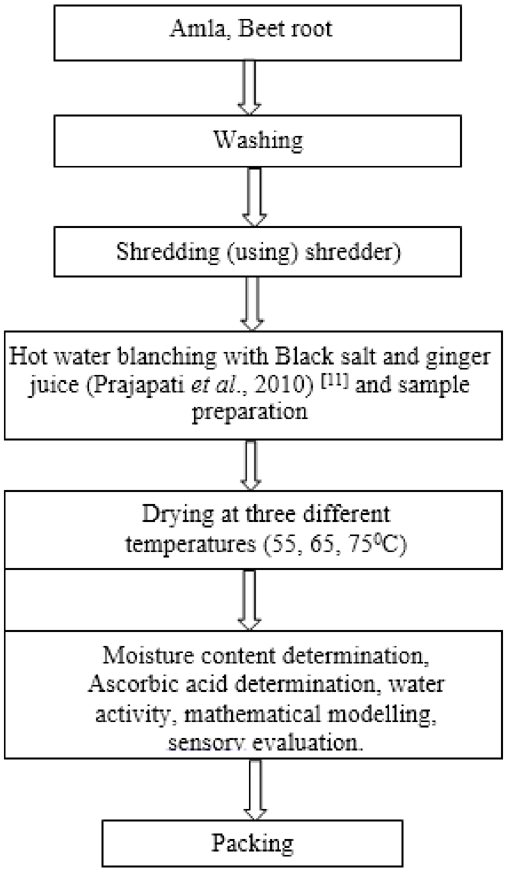

Fig 1: Process flow chart used for development of amla-beet root shred

2.4 Determination of colour

Colour is often used as an indication of quality and freshness for food products. Hence it has become important for food processors to be able to evaluate and grade their products based on colour. Hunter Lab Colorimeter will be used to determine colour. There are several colour scales used in a Hunter Lab Colorimeter such L*, a*, b* units, where L* indicates luminosity or brightness, a* corresponds to greenness (-)/ redness +) and b* corresponds to blueness (-)/ yellowness (+) (Karpagavalli *et al*. 2014) [5].

2.5 Ascorbic acid analysis

Ascorbic acid of fresh and dried shreds were determined using 2, 6- dichloroindophenol titrimetry (AOAC 2000) method. A stock standard solution was prepared by dissolving 50 mg of ascorbic acid in 50 ml oxalic acid solution. A working standard solution was prepared by diluting 10 ml of stock standard solution in 100 ml with oxalic acid. About 5 ml of the working standard solution were placed in a 100 ml conical flask and 5 ml of oxalic acid was added to it. The mixture was titrated against 2-6 dichloroindophenol dye until pink end point is obtained. The amount of dye consumed was equivalent to the amount of ascorbic acid present in the conical flask.

$$Ascorbic\ acid = \frac{Ascorbic\ acid(mg)\ content\ in\ std\ stock\ solution}{wt\ of\ sample\ (g)}$$
$$\frac{Total\ sample\ volume\ (ml)}{5\ ml\ of\ equolate\ of\ sample\ juice}\ X\ 100$$

2.6 Sensory evaluation
Dried sample should have a typical taste, colour, appearance and overall acceptability. To test these organoleptic characteristics, sensory evaluation was carried out with the help of a panel. The different attributes of the product were evaluated by a panel of six judges using 9-point Hedonic rating scale (Ranganna, 1986) [13].

2.7 Statistical analysis
The standard statistical technique ‘Analysis of Variance’ (ANOVA) was applied to study the effect of variables such as temperature, combination and their interactions on water activity, L*, a*, b* values and ascorbic acid content. All data were expressed as mean from triplicate samples. Differences were considered statistically significant at $p<0.01$ level.

3. Results and discussions
3.1 Effect on moisture content

Table 1: Initial and final moisture content of combinations of amla-beet root shreds

Combinations (amla, beet root)	Moisture content (wb%)	Final moisture content at 55^{0}C	Final moisture content at 65^{0}C	Final moisture content at 75^{0}C
C_1 (100%, 0))	90.90±2.74	9.17	8.42	5.74
C_2 (75%, 25%)	90.93±0.57	10.34	9.95	7.41
C_3 (50%, 50%)	90.60±0.81	9.82	9.09	7.54
C_4 (25%, 75%)	92.70±1.12	11.76	9.25	8.06
C_5 (0,100%)	94.05±0.89	10.34	9.85	8.02

As the inlet drying temperature is increased, moisture content was decreased. The moisture content of the samples were lower at the higher inlet drying temperature. This is because at higher inlet drying temperature, the rate of heat transfer to the particle is greater, favouring the moisture evaporation.

3.2 Effect on water activity
The water activities of all samples were measured by using a Hygrolab-3 water activity meter at room temperature and three replications were taken and mean value is presented in Table 2. The water activity ranged between 0.219 to 0.255 which is safe limit to avoid microbial growth and enzymatic reactions. Thus, it can be seen that amla-beet root shreds prepared in this study were found to be reach safe level of final moisture content. As regards to individual effect of temperature it revealed that as temperature increased water activity decreased. This was related to water loss during drying process. At higher temperature, the water evaporation rate was higher, influencing the moisture and content consequently water activity of the product. The maximum value of water activity a_w (0.255) was observed at air temperature of 55ºC for combination C_2. Similar results were reported by Thankitsunthorn *et al.*, 2009 [20].

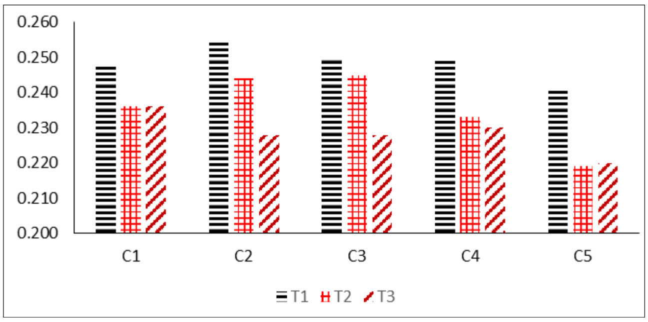

Fig 3.1: Effect of drying air temperature on water activity

3.3 Effect on ascorbic acid content
Ascorbic acid is a precursor of vitamin C and is lost during drying process because it is heat liable nutrient. The retention of vitamin C depends upon the water content, the size of food sample, amount of air circulation when food is dried, the level of humidity in the air entering the dryer and the air temperature and time of expose inside the dryer. As regards to effect of temperature, it revealed that as the temperature increased the retention of ascorbic acid decreased. The retention of ascorbic acid decreased from 55 to 75°C for all samples because it is thermo-sensitive compound and long period of exposure of hot air during drying. From Table3.1 it is clear that higher retention of ascorbic acid 272.72 mg/100g at 55°C air temperature. Beneficial effect of blanching was observed on retention of ascorbic acid content of dried product was also observed by many workers (Sethi 1986; Tripathi *et al.*, 1988; Sagar and Kumar, 2006; Singh *et al.*, 2006) [17, 19, 18] in aonla. It may be due to inactivation of oxidase enzyme. It was also observed that adding black salt is helpful in retaining ascorbic acid. Similarly ginger juice mixing increases ascorbic acid retention.

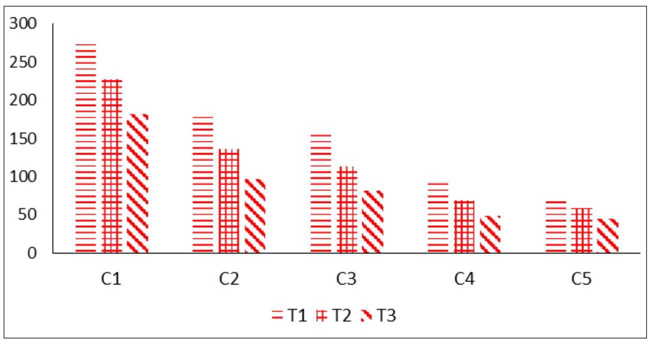

Fig 3.2: Effect of temperature and combination on ascorbic acid content

Table 2: Properties of dried amla-beet root shreds

S. No	Combinations	Water activity	L* value	a*value	b* value	Ascorbic acid content (mg/100g)
1	T_1C_1	0.248	36.78	-11.58	15.72	272.72
2	T_1C_2	0.255	29.93	-1.71	14.53	181.81
3	T_1C_3	0.250	26.63	4.11	10.13	159.09
4	T_1C_4	0.249	20.64	10.6	7.55	94.18
5	T_1C_5	0.241	16.18	14.29	5.66	72.59
6	T_2C_1	0.236	30.37	-11.26	14.05	227.27
7	T_2C_2	0.244	26.00	-1.06	12.73	136.36

8	T_2C_3	0.245	23.74	3.17	9.13	113.63
9	T_2C_4	0.219	19.06	8.45	7.07	68.18
10	T_2C_5	0.233	15.07	12.79	4.36	58.63
11	T_3C_1	0.236	24.12	-11.07	13.10	181.81
12	T_3C_2	0.228	21.67	0.90	10.83	96.18
13	T_3C_3	0.228	18.18	2.54	8.59	81.09
14	T_3C_4	0.230	15.60	7.48	5.33	48.27
15	T_3C_5	0.220	11.53	10.33	2.92	44.54
16	S. Em.±	0.0043	0.1744	0.1150	0.1113	2.996
17	CD at 1 % level	0.0167	0.6781	0.4474	0.4329	11.6524

3.4 Effect on colour

L* values of dried samples were shown in Table 3.1 and regarding the effect of temperature, it revealed that as the drying temperature increased, the L*value of colour decreased significantly for all the combinations. As regards to individual effect of drying air temperature, it revealed that as the temperature increased from 55 to 65ºC, the L*value of colour decreased due to elevated temperature. Also the L*value of colour further decreased with increase in temperature due to long period of exposure of hot air. From Table 2.1, the combination C_1 dried at temperature 55ºC was lighter compared to all other samples whereas combination C_5 dried at temperature 75ºC was found darker which can be observed by higher L* value of 36.78 and lower value of 11.53 respectively.

The chromaticity coordinate a* measures red when positive and green when negative. Parameter 'a' was most sensitive parameter in case of beet root as it was an indicator of retention of belatins. Table 3.1 shows a* values for different combinations dried at different temperatures. From Table 3.1, it can be revealed that a* values goes on increasing with increase in beet root content in combination and decreasing values are observed with increase in drying temperature value. Maximum redness was observed in combination C_5 which contains beet root only at

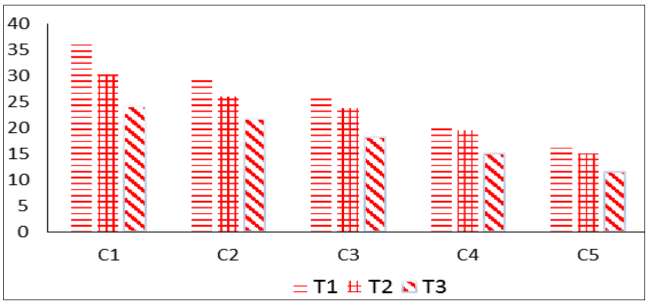

Fig 3.3: Effect of temperature and combination on L* value

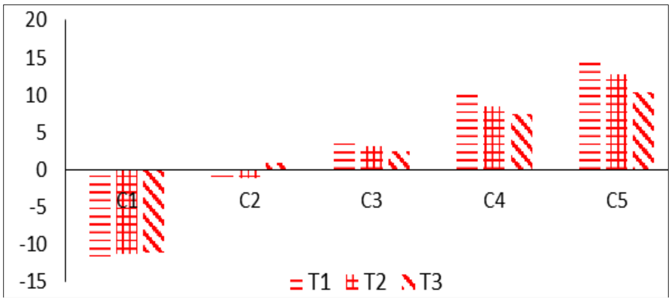

Fig 3.4: Effect of temperature and combination on a* value

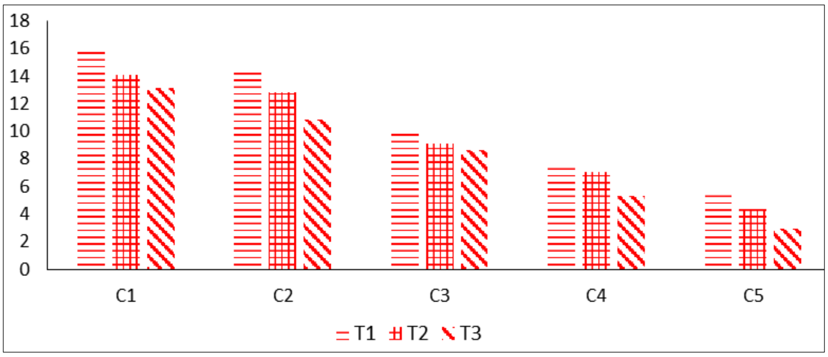

Fig 3.4: Effect of temperature and combination on b* value

Temperature 55ºC and minimum was observed for combination C_1 which contains only amla. The chromaticity coordinate b* measures yellow when positive and blue when negative. From Table 3.1 it can be revealed that maximum yellowness was observed in combination C_1 at temperature 55ºC and it decreases with increase in temperature. From ANOVA (Table 3.1) the effect of process variables onwater activity, L*, a*, b* values and ascorbic acid content was found to be significant at 1% level of significance.

3.5 Sensory evaluation

A separate analysis of variance was done for each characteristic, viz. colour, taste, texture and overall acceptability from the individual scores of test panel. The analysis was carried out to find the difference among the characteristics and panel of judges for the dried amla-beet root shreds. The results are presented in Table 3.2. The results reveal that the difference among the treatments is significant at 1% level of significance. Samples of tray dried amla-beet root shreds at the temperature 55, 65 and 75ºC were served for the evaluation to a twenty panel lists at a time. The mean sensory score of samples are shown in Table 3.2.The colour, flavor, appearance scores of dried samples was found in range of 4 to 9. The maximum score of overall acceptability was found for sample C_1 dried at temperature 55 ºC. From Table 3 it was found maximum 9.00 *i.e* liked very extremely for sample C_1 dried at 55ºC.ANOVA shows that temperature, combination and interactions was found significant at 1% level. acceptability of dried amla- beet root shreds'

Table 3: ANOVA for overall acceptability value of dried amla-beet root shreds.

Combinations	Colour	Taste	Texture	Overall acceptability
T_1C_1	9	9	9	9
T_1C_2	7	8	7	7.33
T_1C_3	6	6	7	6.33
T_1C_4	5	5	4	5.67
T_1C_5	8	4	5	5.67
T_2C_1	7	8	8	7.33
T_2C_2	6	6	6	6.00
T_2C_3	5	5	6	5.33
T_2C_4	4	5	4	4.33
T_2C_5	4	4	4	4.00
T_3C_1	7	7	7	7.00
T_3C_2	5	5	6	5.33
T_3C_3	5	5	5	5.00
T_3C_4	4	4	4	4.00
T_3C_5	4	4	4	4.00
S. Em.±	0.1072	0.1057	0.0994	0.1026
CD at 1 % level	0.4167	0.4109	0.3867	0.3990

4. Conclusion

This study show that an increase in the drying temperature results in a lower ascorbic acid content. The most acceptable product has ascorbic acid content 272.72 mg/100g, water activity of 0.248, L* value 36.78, a* value -11.58, b* value 15.72.The sensory values for dried amla-beet root shreds were more than 8 for colour, taste, flavour and overall acceptability for sample C_1.

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