

## NUTRITIONAL QUALITY OF DEHYDRATED ELEPHANT FOOT YAM CUBES

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### ABSTRACT

An experiment entitled “Study on nutritional quality of dehydrated elephant foot yam cubes” was carried out during year 2022-2023 at Post Harvest Technology Laboratory, Horticulture section, College of Agriculture, Nagpur. Experiment was laid out in Factorial Completely Randomized Design (FCRD), with two factors, as factor A Pre-treatments viz., citric acid 1% (P<sub>1</sub>), citric acid 2% (P<sub>2</sub>), tartaric acid 1% (P<sub>3</sub>), tartaric acid 2% (P<sub>4</sub>), CaCO<sub>3</sub> 1.5% (P<sub>5</sub>), CaCO<sub>3</sub> 3% (P<sub>6</sub>), tamarind leaves 50 g kg<sup>-1</sup> (P<sub>7</sub>), guava leaves 50 g kg<sup>-1</sup> (P<sub>8</sub>) and factor B drying methods viz., solar drying (D<sub>1</sub>), cabinet tray drying (D<sub>2</sub>) with 16 treatment combinations and replicated thrice. The observations were undertaken at 0, 60, 120 and 180 days of storage. The results of experiment showed that significantly highest values of moisture, carbohydrate and calcium oxalate in pre-treatment CaCO<sub>3</sub> 3% (P<sub>6</sub>) which was followed by CaCO<sub>3</sub> 1.5% (P<sub>5</sub>). While, highest protein and ascorbic acid content was observed in pre-treatment citric acid 2% (P<sub>2</sub>) followed by citric acid 1% (P<sub>1</sub>). Also among the drying methods solar drying (D<sub>1</sub>) recorded highest protein and ascorbic acid content, while cabinet tray drying (D<sub>2</sub>) recorded highest moisture, carbohydrate and calcium oxalate content. Interaction effect of treatment citric acid 2% with solar drying (P<sub>2</sub>D<sub>1</sub>) was found to be superior from 0 to 180 days of storage for protein and ascorbic acid content, while CaCO<sub>3</sub> 3% with cabinet tray drying (P<sub>6</sub>D<sub>2</sub>) found superior for moisture, carbohydrate and calcium oxalate content of dehydrated elephant foot yam cubes.

(Key words : Elephant foot yam, cabinet tray drying, solar drying, biochemical properties, sensory properties )

### INTRODUCTION

Elephant foot yam (*Amorphophallus paeoniifolius*) commonly known as elephant foot yam is a tropical tuber crop grown in Maharashtra, Tamil Nadu, Andhra Pradesh and Kerala and belonging to the family araceae. The nutritive value of this minor tuber crop is considered to be far better than popular tubers like cassava or potato because it contain protein besides carbohydrates. The economic part, corm can be consumed after boiling and also ideal for making chips. Besides being a nutritious food, it has medicinal properties too. This tuber is widely described as a drug in the context of dietetics and medicine. Elephant foot yam are rich in nutrients like minerals (Ca, K, P and Zn), vitamins (A, B<sub>1</sub>, B<sub>2</sub>) and contains starch as a major energy source. (Chattopadhyay *et al.*, 2009).

Elephant foot yam produces corms which are nutritious and available in large quantities for consumption. However, the food value of elephant foot yam is limited due to acidity, which is caused by the presence of needle-like raphides of calcium oxalate. Many processing methods are known to eliminate or reduce the acidity in the tubers. Traditional methods such as pre-soaking, addition of ingredients like tamarind, guava leaves and curd etc. in the cooking medium and other processing methods like boiling,

baking, drying and pre-soaking with chemicals are well known for eliminating acidity. Pre-treating tubers is important for the quality and safety of the final product. Pre-treatment have been used commercially to assure product quality and prevent microbial attack during drying. Pre-treatment like soaking in solution of citric acid, sodium chloride, CaCO<sub>3</sub> etc. are commonly used. Traditionally some pre-treatments are given by the local people in villages which are known to be very effective in reducing acidity.

Drying is one of the oldest method of preservation of fruits and vegetables. Drying enhances storage life, minimizes losses during storage and saves shipping and transportation cost. Basic objective of dehydration is the removal of water from the raw material to extend their shelf of food products. Therefore, the objective of the present study was to identify suitable pre-treatment for removing acidity in elephant foot yam and safe storage of tubers by dehydration.

### MATERIALS AND METHODS

Elephant foot yam tubers were procured from the local market of Chandrapur, Maharashtra. The elephant foot yam tubers were then washed with clean water to remove adhering soil and other undesirable material. Tubers then

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were peeled using peeling knife and cut into cubes of around 2 cm x 2 cm size. The cubes were soaked in different solutions of citric acid, tartaric acid and calcium carbonate ( $\text{CaCO}_3$ ) according to the treatments for 60 minutes after peeling to remove the acidity compound from the cube samples followed by blanching at 90°C. And also the cubes were given treatment by blanching with tamarind leaves and guava leaves. Half of the cubes of every treatment samples were subsequently dried in solar dryer for 3 days and half of the cubes were dried in cabinet tray dryer at 55°C for 24 hrs. The dried yam cubes were then packed in HDPE bags and stored in ambient storage condition. The observations for moisture, protein, carbohydrate, calcium oxalate and ascorbic acid were taken from 0 to 180 days of storage at 60 days interval. Moisture content was measured using hot air oven method. The amount of protein was estimated by the method of Lowry *et al.* (1951) using BSA as the standard. The analysis of calcium oxalate content (%) was carried out according to Padmaja *et al.* (2005). The estimation of carbohydrate was done by using the method described by Masuko *et al.* (2005). The ascorbic acid content in dehydrated elephant foot yam cubes was estimated by using the method described by Ranganna (1986). The statistical analysis was carried out using factorial completely randomized design (FCRD) method as suggested by Panse and Sukhatme (1985).

## RESULTS AND DISCUSSION

The data in respect of effect of different pre-treatments and drying methods and their interaction on different biochemical parameters of dehydrated elephant foot yam cubes at ambient storage condition was recorded from 0 to 180 days and are presented in Table 1a and 1b and Table 2a and 2b.

The moisture, carbohydrate and calcium oxalate were found to be significant at 0, 60, 120 and 180 days of storage. In Table 1a and 1b, from 0 to 180 days of storage observations, the highest values was obtained by the effect of treatment of  $\text{CaCO}_3$  3% ( $P_6$ ), next to this treatment, treatment was  $\text{CaCO}_3$  1.5% ( $P_3$ ) and minimum values was recorded of treatment citric acid 2% ( $P_2$ ). Among the drying methods cabinet tray drying ( $D_2$ ) recorded highest values of moisture, carbohydrate and calcium oxalate content in dehydrated elephant foot yam cubes and solar drying ( $D_1$ ) recorded the minimum values of moisture, carbohydrate and calcium oxalate. Interaction effect was found to be significant (Table 2a and 2b) with the highest values obtained by the treatment  $\text{CaCO}_3$  3% + cabinet tray drying ( $P_6D_2$ ) followed by  $\text{CaCO}_3$  3% + solar drying ( $P_6D_1$ ) and

$\text{CaCO}_3$  1.5% + cabinet tray drying ( $P_3D_2$ ), while the lowest was observed in treatment citric acid 2% + solar drying ( $P_2D_1$ ). The similar results of increase in moisture content with the advancement of storage period was also reported by Siva Kumar *et al.* (1991) and Jadhav *et al.* (2009) also reported increase in moisture content of bitter gourd slices throughout storage period due to gain of atmospheric moisture. Spencer (1973) concluded that, controlled sun dried samples measured the decrease in carbohydrate content over the period of its storage due to the increase in moisture and loss of many minerals and nutrients. Calcium oxalate content decreased with the increase in time duration of drying treatment in velvet bean (Kala and Mohan, 2012). Sahu and Pandit (2016) reported that convective drying method decreased the calcium oxalate content of dehydrated elephant foot yam cubes due to heat stress.

Data revealed that protein and ascorbic acid content was found to be significant at all stages of interval from 0 to 180 days of storage. (Table 1a and 1b) The highest values were obtained by the effect of pre-treatment of citric acid 2% ( $P_2$ ) followed by pre-treatment citric acid 1% ( $P_1$ ), guava leaves 50 g  $\text{kg}^{-1}$  ( $P_8$ ) and tamarind leaves 50 g  $\text{kg}^{-1}$  ( $P_7$ ) and minimum values was recorded in pre-treatment  $\text{CaCO}_3$  3% ( $P_6$ ). Among the drying methods cabinet tray drying ( $D_2$ ) recorded lowest values of protein and ascorbic acid content in dehydrated elephant foot yam cubes and solar drying ( $D_1$ ) recorded the maximum values of protein and ascorbic acid content. Interaction effect was found to be significant from 0 to 180 days of storage (Table 2 a and 2 b) with the highest values obtained in treatment citric acid 2% + solar drying ( $P_2D_1$ ) followed by citric acid 1% + solar drying ( $P_1D_1$ ), citric acid 2% + cabinet tray drying ( $P_2D_2$ ) and citric acid 1% + cabinet tray drying ( $P_1D_2$ ), while the lowest value was observed in treatment  $\text{CaCO}_3$  3% + cabinet tray drying ( $P_6D_2$ ). The protein and ascorbic acid content was found to be decreased with the advancement of storage period. The decrease in protein content in dehydrated elephant foot yam cubes with an increase in storage period might be due to denaturation and breakdown into smaller peptides and thus leaching out of nitrogenous compounds due to pre-treatments. Similar results of decrease in protein content were also registered by Ogbonnaya and Lawal (2015) in yam. The decrease in ascorbic acid content in dehydrated cubes might be due to degradation of ascorbic acid to dehydroascorbic acid by oxidative enzyme in dehydration during storage period of 90 days, because it is very sensitive to heat and pressure treatments (Reddy and Chikkasubbanna, 2009). Vithu *et al.* (2021) also observed that, the level of ascorbic acid decreased with the increasing temperature and storage period.

**Table1a. Effect of different pre-treatments and drying methods on moisture, protein and carbohydrate content of dehydrated elephant foot yam cubes during storage**

Treatments	Moisture (%)				Protein (%)				Carbohydrate (%)			
	(Days)				(Days)				(Days)			
	0	60	120	180	0	60	120	180	0	60	120	180
<b>Pre-treatment</b>												
P1	8.24	8.40	8.52	8.55	4.38	4.35	4.34	4.33	75.29	75.25	75.07	74.87
P2	8.15	8.36	8.43	8.51	4.43	4.41	4.40	4.38	75.27	75.04	74.87	74.70
P3	8.74	9.15	9.25	9.39	3.90	3.72	3.70	3.69	77.04	76.72	76.58	76.28
P4	8.71	9.13	9.20	9.34	3.88	3.61	3.59	3.58	77.09	76.98	76.94	76.50
P5	8.89	9.44	9.38	9.54	3.64	3.52	3.50	3.23	77.75	77.71	77.60	77.35
P6	9.02	9.77	9.55	9.71	3.60	3.51	3.42	3.19	78.65	78.17	78.04	77.81
P7	8.49	8.69	8.82	8.93	4.09	4.09	4.08	4.07	76.51	76.24	76.08	75.81
P8	8.36	8.58	8.71	8.84	4.22	4.19	4.17	4.16	76.04	75.79	75.64	75.39
SE (m) ±	0.006	0.006	0.006	0.004	0.006	0.011	0.012	0.012	0.005	0.003	0.008	0.005
CD at 5%	0.017	0.018	0.018	0.012	0.018	0.033	0.035	0.036	0.015	0.009	0.024	0.015
<b>Drying methods</b>												
D1	8.53	8.88	9.01	9.12	3.96	3.76	3.74	3.73	76.62	76.45	76.27	76.06
D2	8.62	8.99	8.95	9.08	3.92	3.68	3.66	3.65	76.78	76.62	76.58	76.24
SE (m) ±	0.003	0.003	0.003	0.002	0.003	0.005	0.006	0.006	0.002	0.001	0.004	0.003
CD at 5%	0.009	0.009	0.009	0.006	0.009	0.015	0.018	0.017	0.006	0.003	0.012	0.009
<b>Interaction</b>												
SE (m) ±	0.011	0.011	0.010	0.007	0.01	0.018	0.020	0.020	0.008	0.005	0.014	0.009
CD at 5%	0.032	0.033	0.029	0.021	0.03	0.054	0.059	0.059	0.024	0.014	0.042	0.027

**Table1b. Effect of different pre-treatments and drying methods on calcium oxalate and ascorbic acid content of dehydrated elephant foot yam cubes during storage**

Treatments	Calcium oxalate (mg 100g <sup>-1</sup> )				Ascorbic acid (mg 100 g <sup>-1</sup> )			
	(Days)				(Days)			
	0	60	120	180	0	60	120	180
<b>Pre-treatment</b>								
P1	16.45	16.20	15.95	15.80	13.89	12.98	12.34	11.72
P2	15.25	14.88	14.75	14.55	13.90	13.03	12.36	11.75
P3	26.52	26.22	26.02	25.87	11.37	10.56	9.89	9.24
P4	26.25	25.95	25.65	25.50	10.91	10.08	9.43	8.73
P5	31.20	30.78	30.53	30.38	9.29	8.70	7.97	7.15
P6	36.00	35.65	35.50	35.34	8.58	7.73	6.83	6.19
P7	22.15	21.25	21.05	20.90	12.55	11.58	10.74	10.08
P8	19.85	19.48	19.23	19.13	13.38	12.60	11.83	11.08
SE (m) ±	0.22	0.35	0.35	0.35	0.03	0.08	0.09	0.10
CD at 5%	0.65	1.05	1.05	1.05	0.09	0.24	0.27	0.29
<b>Drying methods</b>								
D1	23.70	23.34	23.10	22.91	11.93	11.10	10.35	9.64
D2	24.72	24.27	24.10	23.96	11.04	10.73	10.00	9.35
SE (m) ±	0.11	0.18	0.18	0.18	0.02	0.04	0.04	0.05
CD at 5%	0.32	0.51	0.51	0.51	0.05	0.12	0.11	0.14
<b>Interaction</b>								
SE (m) ±	0.39	0.61	0.61	0.61	0.06	0.14	0.15	0.17
CD at 5%	1.17	1.82	1.82	1.83	0.18	0.41	0.44	0.51

**Table 2 a. Interaction effect of different pre-treatments and drying methods on moisture, protein and carbohydrate content of dehydrated elephant foot yam cubes during storage**

Treatments	Moisture (%)				Protein (%)				Carbohydrate (%)			
	(Days)				(Days)				(Days)			
	0	60	120	180	0	60	120	180	0	60	120	180
P <sub>1</sub> D <sub>1</sub>	8.19	8.39	8.50	8.54	4.51	4.48	4.47	4.46	75.63	75.44	75.27	75.11
P <sub>1</sub> D <sub>2</sub>	8.29	8.40	8.53	8.57	4.25	4.22	4.21	4.20	75.15	75.05	74.86	74.63
P <sub>2</sub> D <sub>1</sub>	8.03	8.23	8.34	8.42	4.54	4.53	4.51	4.49	75.12	74.89	74.75	74.51
P <sub>2</sub> D <sub>2</sub>	8.27	8.48	8.54	8.59	4.32	4.29	4.28	4.27	75.41	75.18	75.39	74.89
P <sub>3</sub> D <sub>1</sub>	8.66	9.06	9.16	9.30	3.95	3.78	3.76	3.75	76.94	76.65	76.54	76.25
P <sub>3</sub> D <sub>2</sub>	8.82	9.24	9.33	9.48	3.84	3.66	3.64	3.63	77.15	76.78	76.61	76.31
P <sub>4</sub> D <sub>1</sub>	8.60	8.95	9.05	9.18	3.97	3.80	3.79	3.78	76.83	76.59	76.46	76.17
P <sub>4</sub> D <sub>2</sub>	8.81	9.31	9.34	9.49	3.78	3.42	3.40	3.39	77.35	77.16	77.61	76.83
P <sub>5</sub> D <sub>1</sub>	8.87	9.42	9.53	9.68	3.76	3.26	3.14	3.20	77.55	77.51	77.37	77.11
P <sub>5</sub> D <sub>2</sub>	8.90	9.45	9.57	9.74	3.51	3.40	3.39	3.17	77.95	78.06	77.83	77.60
P <sub>6</sub> D <sub>1</sub>	8.94	9.06	9.83	9.99	3.82	3.25	3.22	3.20	78.43	78.26	78.09	77.85
P <sub>6</sub> D <sub>2</sub>	9.10	9.78	9.93	10.09	3.38	3.23	3.16	3.04	78.87	78.57	78.19	78.16
P <sub>7</sub> D <sub>1</sub>	8.45	8.70	8.83	8.92	4.18	4.04	4.03	4.02	76.35	76.23	76.07	75.84
P <sub>7</sub> D <sub>2</sub>	8.52	8.67	8.80	8.93	3.99	4.14	4.13	4.12	76.67	76.25	76.08	75.78
P <sub>8</sub> D <sub>1</sub>	8.34	8.56	8.69	8.82	4.24	4.21	4.19	4.18	75.91	75.68	75.54	75.31
P <sub>8</sub> D <sub>2</sub>	8.38	8.61	8.74	8.86	4.20	4.17	4.15	4.14	76.17	75.90	75.74	75.47
SE (m) ±	0.011	0.011	0.010	0.007	0.01	0.018	0.020	0.020	0.008	0.005	0.014	0.009
CD (5%)	0.032	0.033	0.029	0.021	0.03	0.054	0.059	0.059	0.024	0.014	0.042	0.027

**Table 2 b. Interaction effect of different pre-treatments and drying methods on calcium oxalate and ascorbic acid content of dehydrated elephant foot yam cubes during storage**

Treatments	Calcium oxalate (mg100g <sup>-1</sup> )				Ascorbic acid (mg100g <sup>-1</sup> )			
	(Days)				(Days)			
	0	60	120	180	0	60	120	180
P <sub>1</sub> D <sub>1</sub>	15.10	14.90	14.70	14.60	13.91	13.05	12.39	11.77
P <sub>1</sub> D <sub>2</sub>	17.80	17.50	17.20	17.00	13.41	13.01	12.18	11.37
P <sub>2</sub> D <sub>1</sub>	13.80	13.40	13.20	12.90	14.01	13.16	12.53	11.94
P <sub>2</sub> D <sub>2</sub>	16.70	16.37	16.50	16.20	13.79	12.90	12.19	11.56
P <sub>3</sub> D <sub>1</sub>	25.40	25.10	24.90	24.70	11.60	10.78	10.07	9.43
P <sub>3</sub> D <sub>2</sub>	27.63	27.33	27.13	27.03	11.13	10.34	9.71	9.04
P <sub>4</sub> D <sub>1</sub>	24.20	24.00	23.70	23.50	11.79	10.92	10.25	9.56
P <sub>4</sub> D <sub>2</sub>	28.30	27.90	27.60	27.50	10.03	9.25	8.62	7.91
P <sub>5</sub> D <sub>1</sub>	30.10	29.47	29.27	29.07	9.52	9.13	8.34	7.50
P <sub>5</sub> D <sub>2</sub>	32.30	32.10	31.80	31.70	9.06	8.27	7.59	6.79
P <sub>6</sub> D <sub>1</sub>	37.30	36.90	36.70	36.60	8.83	8.06	7.17	6.59
P <sub>6</sub> D <sub>2</sub>	34.70	34.40	34.30	34.10	8.32	7.39	6.48	5.79
P <sub>7</sub> D <sub>1</sub>	21.70	21.43	21.23	21.03	12.77	11.65	10.82	9.95
P <sub>7</sub> D <sub>2</sub>	22.60	21.07	20.87	20.77	12.32	11.51	10.67	10.20
P <sub>8</sub> D <sub>1</sub>	19.30	18.90	18.60	18.50	13.55	12.78	11.99	11.26
P <sub>8</sub> D <sub>2</sub>	20.40	20.07	19.87	19.77	13.21	12.42	11.66	10.90
SE (m) ±	0.39	0.61	0.61	0.61	0.06	0.14	0.15	0.17
CD (5%)	1.17	1.82	1.82	1.83	0.18	0.41	0.44	0.51

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