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# Nutritional Characterization and Organoleptic Evaluation of Solar Based Steam Processed Elephant Foot Yam .Var (*Gajendra*)

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**ABSTRACT:**In present study, the experimental trials was completed to assess the nutritional characteristics and organoleptic evaluation of the Elephant Foot Yam (*Suran*).During study it was found that protein content, fiber content, ash content were not significantly different after steaming process, but moisture content and reducing sugar were significantly increased.The average score of colour and appearance varied from 6.50 to 8.38 and maximum observed for treatment P3T2 was 8.38. The score in respect of texture ranged in between 5.63 to 8.75 for various treatments. Maximum texture observed 8.75 for treatment P2T3.The treatment P3T2 was significantly suitable over the rest of treatments. In case of flavour, the score recorded 8.13 was highest in P3T2 and minimum score 6.25 found in P0T0. In case of taste the mean score ranged from 6.13 to 7.63. It was observed lowest score in treatment P1T1 was 6.13 and highest score observed in treatment P3T3 was 7.63. The overall acceptability score for Elephant Foot Yam samples was 7.94 for treatment P3T2 and at par with P2T3 was 7.75. Whereas minimum acceptability score observed 6.28 for treatment P1T1, Organoleptic evaluation of samples revealed that maximum score was observed for treatment P2T3.hence it is observed that sample from this treatments may be most suitable for eating purposes. Elephant Foot Yam flour was more effective for diabetic and piles patient. Result revealed that solar energy could be efficiently utilized for processing of Elephant Foot Yam.

**KEYWORDS:**Elephant Foot Yam, Steaming, Solar, Nutritional, Sensory.

## I. INTRODUCTION

The energy scenario in India shows that cooking consumes a major portion of the total energy. The household sector alone consumes about 11 per cent of the total energy consumption; out of which cooking energy demands a major share. The solar cookers can offer a partial solution to the poor and warmer sunnier developing region of the world. Solar cooking is an alternative to deforestation with all its ecological implications or to the burning of manure, which otherwise could have been used as fertilizer or simply it is needed because it would reduce the number of hours spent in search for firewood in many villages around the world. Solar energy for cooking requires one step, which is conversion of radiant energy to heat using the solar cooker, in order to obtain cooked food. Various types of solar cooker such as box type solar cooker, parabolic cooker and scheffler type concentrating cooker on the basis of temperature requirement are available in the market, but on the basis of temperature applications and for mode of cooking such as boiling, steaming and roasting methods need to select suitable cooker according to their thermal capacity such as low temperature to higher temperature range. Among all cooker as mentioned above scheffler concentrating cooker may have capacity to generate sufficient steam which is suitable for steaming of Elephant Foot Yam.In steaming method,



food is not immersed in water, so the vitamins and minerals do not leach out. When cooked with steam, foods retain their natural color. Steaming also provides naturally flavoured food. As compared to boiling method time saving is possible in steaming method.

Elephant Foot Yam (*Amorphophallus paeoniifolius* (Dennst.) Nicolson) (or, *Amorphophallus campanulatus* Decne) (EFY), is a nutritious but underutilized tuberous vegetable. Because of its higher yield potential, culinary properties, medicinal utility and therapeutic values, it is referred to as King of Tuber Crops (Sengupta *et al.* 2008). Elephant Foot Yam is largely cultivated and it has been used as local staple food in India, Philippines, Indonesia, Sumatra, Malaysia, Bangladesh, India and China. In India, it is cultivated in Andhra Pradesh, West Bengal, Gujarat, Kerala, Tamil Nadu, Maharashtra, Uttar Pradesh, and Jarkhand. Sree Padma, Gajendra, Sree Athira (a hybrid), Bidhan Kusum and NDA-9 are some of the high yielding *Amorphophallus* varieties released for cultivation in India. The production potential of this crop is 50-80 t/ha and net economic return is over 1 lakh rupees per ha. (Ravi *et al.* 2009).

Elephant Foot Yam (*Amorphophallus paeoniifolius*.) is an important tuber crop belongs to family Aracea, which grows in the high rainfall Konkan region of Maharashtra during kharif Season. Locally it is known as suran. This tuber crop is suited to the small and marginal holding farmers due to its flexibility in planting and harvesting. Root and tubers are the second most staple food crops after cereals which are grown throughout the world in hot and humid region (Chandrasekhar and Kumar, 2016). Tropical root crops occupy an important place in human nutrition, the tubers of Elephant Foot Yam are commonly used as a vegetable after cooking and in preparation of indigenous ayurvedic medicines.

## II. METHODOLOGY

The Konkan region of Maharashtra is long narrow strip between 15° 37' and 20° 20' N latitude and 72° 7' E and 74° 30' E longitude comprises Greater Mumbai, Palghar Thane, Raigad, Ratnagiri and Sindhudurg district with the total geographical area of 22.72 lakh ha. The climate of Dapoli is warm and humid with the mean annual rainfall 4721.1 mm. During study fresh and healthy corms of Elephant-Foot Yam (*Amorphophallus paeoniifolius*.) (Variety Gajendra) were procured from the Central Research Station Wakawali, Dist: ratnagiri under Balasaheb Sawant Krishi Vidyapeeth Dapoli, Maharashtra, India. The procured corms were washed and sliced into a rectangular shape of size 3 × 2 × 1 cm. The experiment of steaming for yam was carried out at experimental site (Energy Park) under department of electrical and other energy sources of CAET Dapoli. The batch wise 3kg of slices with thickness of 10mm were taken in the steaming pot. During experimentation the effect of steam treatment on Elephant Foot Yam sample were studied by passing the generated steam in to the steaming vessel for 10, 15 and 20 minutes duration and studied the combined effect of steam pressure, steaming duration and drying methods on production of Elephant Foot Yam flour samples. The steaming was carried out at three different steam pressures which are 0.9, 1.2 and 1.5 kg/cm<sup>2</sup> respectively. During experimentation with steaming vessel batch wise slices were added and steaming process were carried out until proper steaming of Elephant Foot Yam slices in steaming vessel was done. To check the Elephant Foot Yam samples has properly cooked or not, firstly cut open the food with a small knife so you can check that based on experience force required to insert a pointed knife or fork. The softening of the Elephant Foot Yam slices so assessed. After stemming samples were dried for open sun drying (OSD), oven drying (OD) and solar drying (SD) methods. After steaming and drying methods studied the nutritional status of Elephant Foot Yam flour such as protein content, fibre content, fat content, Oxalate content and reducing sugar content were determined using standard methods described as below.

### Determination of protein content

The protein content of Elephant Foot Yam and mace powdered samples were determined by Micro-Kjeldahl's method AOAC (2010).

### Determination of fiber content

The fiber content of Elephant Foot Yam powdered samples were determined them the fat free sample available in filter paper from fat extraction method AOAC (2010).

### Determination of fat content

Fat content of Elephant Foot Yam powdered samples were determined by Soxhlet fat extraction method of AOAC (2010). In this method, initially weight of empty flask was weighed. 2 g powder was wrapped in filter paper. The sample with filter paper was kept in siphoning tube and condenser was fixed above it and siphoned for 9-12 times with the petroleum ether in Soxhlet apparatus. After removing assembly, evaporation of petroleum ether was allowed by heating round bottom flask. Residue remained at the bottom of the flask and was reweighed with flask. The quantity of residue was determined as fat content of powder. The fat content was calculated by using following formula



$$\text{Fat (\% dry basis)} = \frac{(W_1 - W_2)}{W} \times 100$$

Where,

W = wt. of sample, g.

W<sub>1</sub> = Initial wt of sample + ether, g.

W<sub>2</sub> = Final wt of Sample + ether, g.

### Determination of Oxalate content

The UV-spectrophotometric method of (Nip *et al.* 1989) followed for the determination of Oxalate content. Total Oxalate was measured by weighing 1.0 g sample dried tubers in beaker and boiled in 150 ml water containing 27.5 ml 6 M HCl plus two drops of caprylic alcohol (ocatanol) for 25 min. The mixture was cooled, transferred to a 200 ml volumetric flask and made up to mark. The mixture was then filtered through Whatman 541 filter paper. The first 80 ml filtrate was discarded and rest was retained for analysis. A volume of 10ml of this filtrate were evaporated to near dryness at 40-45°C in a vacuum oven, and redissolved in 10 ml of 0.01 M H<sub>2</sub>SO<sub>4</sub>. The total Oxalate in the sample was analysed using a UV-spectrophotometer.

### Reducing Sugar content

A known quantity (25 g) of fresh ground tuber sample was taken in 250 ml volumetric flask. To this, 100 ml of distilled water was added and the content was neutralized by 1 N sodium hydroxide. Then, 2 ml of 45 % lead acetate was added to it. The contents were mixed well and kept for 10 minutes. Appropriate quantity (4 ml) of 22.5 per cent potassium Oxalate was added to it to precipitate the excess of lead. The volume was made to 250 ml with distilled water and solution was filtered through Whatman No. 40 filter paper. This filtrate was used for determination of reducing sugar by the method described by Ranganna (1977). The result obtained was expressed on fresh weight basis.

### Moisture content

The moisture content of Elephant Foot Yam were determined by using standard procedure of (A.O.A.C.-2000) by using hot air oven method. 50 gm of sample of product were placed in oven at 105°C until constant weight was obtained. After completion of drying, the samples were taken out and placed in desiccators to cool down. The drop weight in Elephant Foot Yam was determined based on its initial weight and final weight.

$$\text{Moisture content (w.b.)} = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

Where,

W<sub>1</sub> = Weight of crucible, g

W<sub>2</sub> = Weight of crucible+ Sample, g

W<sub>3</sub> = Weight of crucible+ Sample after heating, g

### Ash content

Ash content of raw sample and powder were estimated by using standard method of AOAC (2000) Three gram of sample was weighed and transferred in pre-weighed porcelain crucible. The weighed sample was charred till smoke ceases. The crucible was then transferred to muffle furnace maintained at 550+50°C and incinerated until light grey ash was obtained. The crucible was cooled in desiccators and final weight of ash and crucible was recorded. Ash content was calculated by using following equation.

$$\text{Ash content, \%} = \frac{(w_2 - w)}{(w_1 - w)} \times 100$$

Where,

w<sub>2</sub> = weight of crucible with ash.

w<sub>1</sub> = weight of crucible and elephant foot yam flour.

w = weight of crucible.

### Organoleptic Evaluation for Steam Cooked Elephant Foot Yam Samples

For the Organoleptic test, Elephant Foot Yam were steam cooked. All samples were evaluated using an acceptance test applying a hedonic scale of nine points, with extremes ranging from very much disliked (1) to very much liked (9). Attributes related to appearance, aroma, taste, texture and overall acceptance were evaluated.

Consumers were aged between 20 and 60 years old employees and students trained at the College of Agricultural Engineering and Technology under state agricultural university Dr. Balasaheb Sawant Konkon Krishi Vidyapeeth Dapoli. Participated for sensory evaluation of steam cooked samples of Elephant Foot Yam. Each sample of Elephant Foot Yam steam cooked was served on white plates encoded with randomly selected numbers. After consuming each sample, evaluator was instructed to drink water to cleanse the taste. The samples were evaluated in triplicate and in separate sessions. Organoleptic evaluation of Elephant Foot Yam (*Amorphophallus paeonifolius*).

### III. EXPERIMENTAL RESULTS

Nutritional properties (Protein, fiber, fat, moisture, ash, reducing sugar) were studied. Statistical analysis was done using Factorized Completely Randomized Design (FCRD). It was observed that there was minor variability observed in protein content of Elephant Foot Yam flour. Similarly there was decreasing trend were observed corresponding to steaming pressure and steaming duration. Similarly for control sample maximum protein content observed 3.96 percent in open sun drying method, whereas for OD and SCD method observed same as 3.94 percent of protein content. Maximum 2.08 % of fiber content was observed at pressure 0.9 kg/cm<sup>2</sup> and steaming duration 10 minutes. It was observed that as there was increase the steaming time exposure for yam correspondingly decrease the fiber content of Elephant Foot Yam flour, but statistically it is not significant. Similar results were reported by Wanasundera and G. Ravindran, (1992) for yam tuber (*Dioscoreaalata* and *Dioscoreaesculenta*). Minor change in fat content varied with the steaming duration indicated that steam treatment may changes the structure of yam flour, but effect was statistically not significant for steaming durations. Among all drying method maximum fat content observed in open sun drying method i.e. 0.39 percent, which was at par with oven drying method 0.38 percent Results also showed that percent of fat content in Elephant Foot Yam was comparatively very low (0.15-0.25 %) after boiling reported by Paramita *et al.* (2016). Since flour obtained from Elephant Foot Yam after steaming may best for cholesterol patient. Minimum oxalate content 8.43 observed in drying with solar dryer method, which was significantly less than oven drying and Open sun drying method. Similar finding reported that sample dried at higher temperature observed lower oxalate content (Srikant *et al.*, 2019). The average moisture content of control sample of sun dried, solar dried and oven dried Elephant Foot Yam flour 7.99 (8.68 % d.b), 7.66 (8.32 % d.b) and 7.72 (8.39 % d.b) per cent respectively. Average moisture content of steam processed with open sun dried flour varied from 8.56-8.90 per-cent. Similarly moisture content of steam processed with solar dried and oven dried flour varied from 8.36 - 8.60 to 8.39 - 8.62 percent respectively. Similarly Minor change in ash content indicated retention of minerals, which might result in change in ash content. However ash content was found lower in steam treated samples i.e. 2.94 than in raw flour, similar findings reported by (Adegunva *et al.*, 2011) The results obtained for organoleptic evaluation of steam cooked Elephant Foot Yam samples are given below in Table-1.

**Table: 1 Overall acceptability score for steam cooked Elephant Foot Yam samples**

Treatments	Colour and Appearance	Flavour	Body and Texture	Taste	Overall Acceptability
P0T0	6.38	6.25	5.63	5.63	5.97
P1T1	6.50	6.38	6.13	6.13	6.28
P1T2	7.13	7.00	6.75	6.75	6.91
P1T3	7.63	7.50	7.38	7.25	7.44
P2T1	7.13	6.75	6.63	6.75	6.81
P2T2	7.50	7.63	7.63	7.25	7.50
P2T3	8.00	7.88	7.75	7.38	7.75
P3T1	7.50	7.13	7.00	7.00	7.16
P3T2	8.38	8.13	7.63	7.63	7.94
P3T3	8.00	7.63	7.13	7.38	7.53
S.D	0.64	0.63	0.69	0.62	0.63



The overall acceptability score for Elephant Foot Yam samples was 7.94 for treatment P3T2 and at par with P2T3 was 7.75. Whereas minimum acceptability score observed 6.28 for treatment P1T1, this indicated that with increase the steam exposure time for various sample treatments showed the increase the sensory score for various attributes like colour and appearance, flavor, body and texture and test of Elephant Foot Yam, except for treatment P3T3. The average score of colour and appearance varied from 6.50 to 8.38 and maximum observed for treatment P3T2 was 8.38. The score in respect of texture ranged in between 5.63 to 8.75 for various treatments as mentioned above. Maximum texture observed 8.75 for treatment P2T3. The treatment P3T2 was significantly suitable over the rest of treatments. In case of flavour, the score recorded 8.13 was highest in P3T2 and minimum score 6.25 found in P0T0. In case of taste the mean score ranged from 6.13 to 7.63. It was observed lowest score in treatment P1T1 was 6.13 and highest score observed in treatment P3T3 was 7.63.

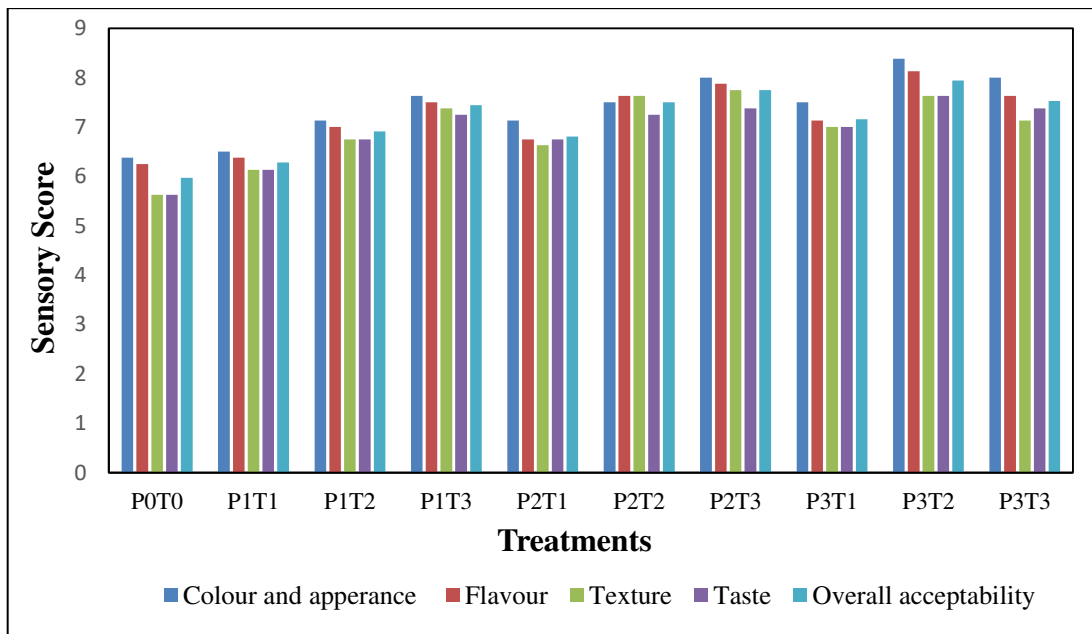


Fig.1 Organoleptic evaluation of various parameter of Elephant Foot Yam samples.

Graphical representation from Fig 1 indicated that there was not much variability observed in the organoleptic score of various treatment from steam treated, but compare with untreated sample there was significant difference was observed. In steaming method, as the food was not immersed in water, so the vitamins and minerals did not leach out. When cooked with steam, foods retain their natural color and flavour. Result revealed that the solar energy could be utilized for agroindustry and processing of agricultural produce to save commercial fuels such as LPG, natural gas and kerosene.

#### IV. CONCLUSION

Elephant Foot Yam flour was nutritionally rich and wide scope for product preparation in processing industries, similarly nutritional content like protein, fiber and fat content in Elephant Foot Yam processed sample were not much varied. Flavor and test of solar based steam cooked sample were improved and reduced the oxalate content at safer level after steaming to solve the problem of itching and acidity problem in throat of the peoples. Solar based steam cooking method implementation is needed in commercial sector to reduce the major energy consumption from conventional fuels in processing sector.

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