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Performance of arecanut var. Shriwardhanee grown in different geographical locations of Konkan region

Dhumal RS, Dr. Kadam JH, Dr. Shirke GD and Jadhav KA

Abstract
Arecanut is an important commercial crop of India and also forms part of ritual offerings in Hindu religion. In Ayurveda, arecanut was long considered as having medicinal properties. The present research was carried out to study the variability in post-harvest characters of Arecanut var. Shriwardhanee grown indifferent geographical locations of Konkan region. The experiment consisted of seven treatments which includes arecanut var. Shriwardhanee growing at different geographical locations from Konkan region. The variation in the ecological factor's effects on the phytochemicals of the arecanut. The maximum physico-chemical parameters were observed in arecanuts from *Shriwardhan* which is source of its origin at par with *Murud*. These arecanuts has less arecoline, tannin and maximum total sugar, reducing sugar, crude protein, crude fat, crude fiber, calcium, phosphrous and iron. Hence the variety Shriwardhanee grown in *Shriwardhan* and *Murud* of Raigad District of Konkan region of Maharashtra can be registered for geographical indication.

Keywords: Arecanut, Shriwardhanee, Physico-chemical parameters

Introduction
The Arecanut (*Areca catechu* L.) is the tropical crop grown in India. *Areca catechu* L is also known as Betel palm or Betel nut tree. The origin of arecanut is not exactly known, but it is believed to be native to Malaysia or Philippines. There are no fossil remains of the genus *Areca*, but the fossil record of closely related genera indicates its presence during tertiary period. The maximum species diversity (24 species) and other indicators suggest its original habitat in Philippines, Malaysia, and Indonesia (Raghavan, 1957) [16] and (Bavappa, 1963) [8].
Traditionally, *A. catechu* has commonly been used to kill parasites and promote digestion. The seed is the main part used as a medicine, and it is commonly processed by stir-baking to a yellowish dark brown colour, or carbonizing by stir-frying. The raw areca and charred areca nuts are the most common clinically used forms (Anonymous, 2010) [2] and (Anonymous, 1977) [3].
Chemical characteristics of the nuts changes with maturity of different varieties and it is observed that two months old tender arecanut offers no resistance while cutting. About four to five months, the outer skin is dark green and inside it is translucent and jelly-like, with the pale coloured streaks making their appearance. Six to seven months old green nut is comparatively hard, but can be cut easily. It has more or less a white core and light brown veins from periphery to core. This stage is ideal for making the processed kalipak or kaliadeke in South India. At about nine months maturity, the ripe fruit has a yellow to orange red colour; the enclosed hard nut has distinct brown polyphenol veins enmeshing white fat, polysaccharides and the white core. Such nuts are used in raw form or after drying as *chalisupari*. The Shriwardhanee is the variety released by Dr. Balasaheb Sawant Kokan Krishi Vidhyapeeth, Dapoli, having less alkaloids content and sweet taste from Shriwardhan, Raigad district of Maharashtra. This variety performs its physico-chemical characteristics under different locations.
The present study on performance of arecanut var. shriwardhanee grown in different locations of Konkan region was conducted with a purpose to find the most suitable location for the cultivation of arecanut in Konkan region and to find phytochemicals present in it at different locations. The variation in the ecological factors affects on the phytochemicals of the arecanut. This study will helpful for identification of the unique phytochemicals as well as their content at different locations which is useful for registration of the Shriwardhanee arecanut for geographical indication.

Material and Methods

Material required

The details of materials used and methods adopted in completing the research work are described as follows;

Plant materials

The samples of arecanut were collected from different geographical locations (latitude and longitude) of Konkan region *viz*, Arecanut Research Station Shriwardhan (18°02'54.0"N 73°00'45.6"E), Roha (18.4269° N, 73.1812° E), Dapoli (17.7478° N, 73.2913° E), Palghar (19° 41' 49.5852" N 72° 45' 49.4100" E), Murud (18° 24' 8.7732" N 76° 14' 28.7160" E), Ratnagiri (17.00 0 N 73.40 0 E) and Vengurla (15.8606261622 N 73.6520257057E), respectively.

Methods

Moisture (%)

a. Initial moisture (%)

Initial moisture content of arecanut was determined by drying it in oven still constant weight is achieved. The moisture content was calculated by taking a difference between the weight of original sample and that of oven dried sample at 45˚c ± 5˚c.

b. Final moisture (%)

The sample was dried upto constant weight is occurred. The final weight of sample was calculated on the dry basis.

$$\text{Moisture content}(\%) = \frac{\text{Ww} - \text{Wd}}{\text{Wd}} \times 100$$

Ww- Initial weight of sampleing
Wd- Final weight of sample after drying.

Crude protein (%)

Crude protein in the arecanut was determined by a Micro-Kjeldahl distillation. The samples were digested by heating with concentrated sulphuric acid (H_2SO_4) in the presence of digestion mixture, potassium sulphate (K_2SO_4) and copper sulphate ($CuSO_4$). The mixture was then made alkaline with 40% NaOH. Ammonium sulphate thus formed, releases ammonia which was collected in 4% boric acid solution and titrated again 0.1NHCL. The percent nitrogen content of the sample was calculated by the formula given below. Total protein was calculated by multiplying the amount of percent nitrogen with appropriate factor (Ranganna, 2003) [17].

$$\text{N}(\%) = \frac{1.4 \times (\text{Sample read} - \text{Blank Read}) \times \text{Normalityof HCL} \times 14.01}{\text{Weight of sample (g)}} \times 100$$

Crude fat (%)

Crude fat of arecanut sample was estimated as crude ether extract of the dry material. The dry sample 5 g was weighed accurately into a thimble and plugged with cotton. The thimble was then placed in a Soxhlet apparatus and extracted with anhydrous ether for 3 hrs, cooled in a desiccator and weighed. The Crude fat content was expressed as g/100g (Thimmaiah, 1999) [21].

Crude Fat (%) = Weight of fat Weight of sample (g) × 100

Crude fibre (%)

Extract 2 g of ground sample with ether or petroleum ether used to remove fat. Then boil the dried sample with 200 ml of sulphuric acid for 30 min with bumping chips. Filter through muslin clothand wash with boiling water until washing are free of acid. Boil residue with NaOH for 30 min again filter and wash with 25 ml of boiling sulphuric acid, three times with 50 ml of water and 25 ml of alcohol. Remove the residue and transfer to ashing dish. Dry the residue for 2 hr. at 130±2º C, cool in desiccator and weigh it. Ignite for 30 min at 600±15º C cool in desiccator and weigh (Thimmaiah, 1999) [21].

$$\text{Crude fibre (\%)} = \frac{\text{Loss in weight (g)}}{\text{Weight of sample (g)}} \times 100$$

Total Ash(%)

Ash is an inorganic residue after the material has been completely burn at a temperature of 550 ^{0} C in a muffle furnace. It is the aggregate of all non- volatile inorganic elements. About 5 g of finely ground dried sample was weighed and the ash content of arecanut sample was determined with method suggested by (Ranganna, 2003)[17]. The tare weight of three silica dishes (7-8 cm diameter) was noted and 5 g of the sample was weighed into each silica dish. The contents were ignited on a Bunsen burner and the material was ashed at not more than 525^0 C for 4 to 6 hr, in a muffle furnace. The dishes were cooled and weighed. The difference in weights represented the total ash content and was expressed as percentage.

$$\text{Ash (\%)} = \frac{\text{Weight of crucible with ash(g)} - \text{Weight of crucible(g)}}{\text{Weight of sample taken}} \times 100$$

Acid insoluble ash

Acid Insoluble Ash was determined by the method described in Anonymous, (2016). The ash was boiled in 25 ml of hydrochloric acid for 5minutes.The marc was filtered through Whatman No. 41 filter paper and washed with hot distilled water. The filtrate along with the paper is added to the crucible and fired at 500ºC till constant weight is obtained (Ranganna, 2003)[17].

$$\text{Acid insoluble Ash(\%)} = \frac{(\text{Wt. of crucible} + \text{Ash} - \text{Wt. of crucible})}{\text{Dry weight of sample(g)}} \times 100$$

Carbohydrates (%)

Carbohydrate contain in arecanut kernels was estimated according to (AOAC, 2005) [5].
Carbohydrate% = [100 -(Protein% + moisture% + fat% + ash%)]

Water soluble extractives (%)

5 g of the air-dried arecanut, coarsely powdered was macerated with 100ml of purified water in aclosed flask for 24 hrs, kept in a mechanical shaker for the first 6 hrs and allowed to stand for 18 hrs. There after filtered rapidly through Whatman filter paper No.41. Evaporated 25 ml of the filterate to dryness in a pre-weighed flat-bottomed petri dish dried at 105 ˚C and weighed. Calculated the% w/w water-soluble extractive value with reference to the air-dried drug as follows (Singh *et al.*, 2011) [20] and (Anonymous, 2016) [4].

$$\text{Water soluble extractive value (\%)} = \frac{\text{Weight of residue(g)} \times \text{Volume of extract evaporated}}{\text{Weight of sample (g)}} \times 100$$

Tannin (mg TE/g)

Preparation of *Areca catechu* nut aqueous extract

The *Areca catechu* nut powder (100grams) was soaked in 2 liters of double distilled water for 24 hours at room temperature. Then, the content was filtered and concentrated in a water bath at 100°C until a semisolid residue was obtained. The weight of the extract was noted and the yield was stored in the refrigerator.

Analysis tannin content from the aqueous extract of *Areca catechu*

Qualitative phytochemical screening of secondary metabolites was performed using standard protocol. Quantitative estimation of total tannin in the aqueous extract of *Areca catechu* nut extracts: The quantitative analysis of total tannin content in the aqueous extract of *Areca catechu* nut was determined by Folin-Denis method with minor modifications. A stock solution of *Areca catechu* nut aqueous extract was prepared in the concentration of 1 mg/ml. For quantification, to 0.1 ml of *Areca catechu* nut aqueous extract, 1ml of distilled water and 0.5 ml of Folin-Denis reagent were added and mixed thoroughly. This mixture was alkalinized by adding 1 ml of 15% (w/v) sodium carbonate and kept in dark for 30 minutes at room temperature. The absorbance was read at 700 nm. Pure tannic acid (1 mg/ml) was used as standard. Blank consists of all reagents except the extract. Result was expressed as mg tannic acid equivalent per gram of dry weight (mg TE/g) of extract (Vanimakhal and Balasubramanian, 2016) [22]. The total tannin was calculated by using the formula

Total tannin content = TE x V/m

Where
TE = Tannic acid equivalence (mg/ml),
V =Volume of the extract (ml)
m= Weight of the pure plant extract (g)

Sugars

a. Reducing sugar (g/100 g)

The reducing sugars were determined by the method given by Lane and Eynon (1923) [11] as described by (Ranganna, 2003) [17]. A known weight of sample was taken in 250 ml volumetric flask. To this, 100 ml of distilled water was added and the contents were neutralized by 1 N sodium hydroxide. Then, 2 ml of 45 percent lead acetate was added to it. The contents were mixed well and kept for 10 minutes. Two ml of 22 percent 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. 4 filter paper. This filtrate was used for determination of reducing sugars by titrating it against the boiling mixture of Fehling 'A' and Fehling 'B' solutions (5 ml each) using methylene blue as indicator to a brick red end point. The results were expressed on percent basis.

b. Total sugar (g/100 g)

For inversion at room temperature, a 50 ml aliquot of clarified deleaded solution was transferred to 250 ml volumetric flask, to which, 10 ml of 50 per cent HCl was added and then allowed to stand at room temperature for 24 hrs. It was then neutralized with 40 percent NaOH solution. The volume of neutralized aliquot was made to 250ml with distilled water. This aliquot was used for determination of total sugars by titrating it against the boiling mixture of Fehling 'A' and Fehling 'B' (5ml each) using methylene blue as indicator to a brick red end point. The results were expressed on percent basis. (Ranganna, 2003) [17].

Calcium (mg/100 g)

Transfer 5 g of oven-dried and powdered plant material to a flat shaped silicab as in which is previously weighed. Heat over a gas burner or on a hot plate at low heat. When sufficiently charred, transfer the basin to a muffle furnace maintained at 300 °C. Allow the ashing to proceed slowly and when no more glowing carbon can be seen, gradually raise the temperature of muffle furnace to a very dull red heat (about 500-550 °C) (if the ashing is carried out carefully the resulting ash is greyish white or grey). If the weight of crude ash is required cool the basin in a desiccator and weight. Moisten the ash with little water, cover the basin with a clock glass and add 40 ml of dilute HCI (1:1) into the covered basin carefully to avoid any loss by effervescence. Place the basin covered with clock glass on a water bath and digest for 20-30 min. Remove and rinse the cover, add 1ml of conc. HNO_3 to oxidize any ferrous salts and evaporate the contents to dryness. Continue heating for half to 1h. on the water bath to dehydrate the silica (if required heat for one hour in an oven at 110 °C to complete the dehydration). Moisten with 10 ml of dilute HCI (1:1), add 50 ml of water and warm on the bath until all soluble salts are in solution. Filter through an 11-12.5 cm Whatman No. 44 filter paper and collect the filtrate in a suitable volumetric flask. Transfer the insoluble residue from the basin to the filter using a rubber tipped stirring rod to remove particles of silica adhering to the sides of the basin and wash with hot dilute HCl (1:20).Transfer the filter containing the washed insoluble material to a weighed basin and ignite to remove the filter paper and any carbon present in the crude ash at a bright red heat. Cool and weigh as insoluble residue (contains essentially of silica and small amounts of other elements). Moisten the residue with water; add 2- 3 drops of H_2S0_4 and 10 ml of hydrofluoric acid for each 0.5 g of silica. Evaporate slowly over a hot plate in a fume hood (do not allow to boil) until fumes of H_2S0_4, are produced (do not remove H_2SO_4 completely as some of the iron and aluminium may be rendered insoluble again).Cool, add 2ml of dilute HCI (1:1) and a little warm water. Transfer the solution to the volumetric flask containing the filtrate previously obtained, dilute to the mark and use suitable aliquots for the determination of calcium (the same solution can also be used for determination of magnesium, potassium, sodium and manganese. Iron, copper and zinc can also be estimated from this solution if precautions are taken to avoid the interference of any of these elements). (Thimmaiah, 1999) [21].

Phosphorus (mg/100 g)

Pipette out 2 ml of the extract into a test tube and make up the volume to 4.2 ml with water. Pipette out 0, 0.2, 0.4, 0.6, 0.8 and 1.0 ml of the diluted standard phosphate solution into a series of test tubes and make up the volume to 4.2 ml with water in all the tubes. The 'o' tube is treated as blank. Add 0.6 ml of acid molybdate reagent, mix and add 0.2 ml of ANSA reagent to each tube. After 10 min, read the absorbance at 660

nm against the blank. Calculate the amount of phosphorus present in the sample using the standard curve and express it as per cent (Thimmaiah, 1999) [21].

Iron (mg/100 g)

Take 4 ml of the diluted extract in a test tube, add 1ml of water. Pipette out 0, 1, 2, 3, 4 and 5 ml of diluted standard iron solution into a series of test tubes and makeup the volume in each tube to 5 ml with water. The '0' tube serves as the blank. Add 1 ml of thio-glycollic acid to each tube and mix well. After incubation at room temperature for 10 min, read the absorbance at 535 nm (within the next hrs.) against the blank. (Ranganna, 2003) [17].

Arecoline (%)

Determination of arecoline content by HPLC

Ground, moisture free and defatted arecanut powder (10% w/v) was extracted with water, methanol, ethanol, acetone, ethyl acetate, chloroform, hexane and n-butanol at 180 rpm on an orbital shaker for 1 hr. The extract was centrifuged at 7000 × g for 20 min at 25° c and filtered through Whatman no.1 filter paper. Supernatant was collected, evaporated in a rotary evaporator at 59º c to a final volume of 2 ml and stored in the dark at 4° c for further analysis. The extracts were analysed for total arecoline content.

Arecoline content of the extract was determined by HPLC using the method described by (Aromdee *et al.*, 2003) [6] with some modifications. The jasco HPLC system fitted with UV-visible detector at 216 nm was used at an isocratic flow of 0.8 ml min^{-1} at 45ºc. The detection of analytes was accomplished with a C_{18} column (spherisorb ODS2, 5µm, 4.6×250 mm analytical column, waters, Milford, MA).The mobile phase composition used was potassium dihydrogen phosphate (10g L^{-1}), phosphoric acid (3.5 ml L^{-1}), triethyl amine (8 ml L^{-1}) and acetonitrile (12 ml L^{-1}), and was filtered through 0.22 µ before use. The pH of the mobile phase was adjusted to 4.5 with either triethyl amine or phosphoric acid. The standard graph was prepared using arecoline hydromide (99%) intherange10-90 µg. The regression equation correlating the area under the peak (Y) and arecoline (x) was Y=60326X (R^2=0.998) (Chavan and Singhal, 2013) [9].

Statistical analysis

To improve experimental and statistical accuracy, the treatments and replications were determined as part of the experiment using a Completely Randomized Design (CRD). The observations were made in replicates of four, and critical differences were calculated to compare the findings of the analysis of various treatments using mean value and ANOVA. Using a completely randomized design, data were analyzed and interpreted, and only significant changes between treatment means at a 5% level of significance allowed for the drawing of valid findings. This was done as suggested by (Panse and Sukhatme, 1985) [14] and (Ambedkar, 2014) [1].

The experiment was conducted at Post Graduate Institute of Post-Harvest Technology and Management Killa-Roha, under Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. Dist. Ratnagiri (M. S.) during winter and summer season (October to June) 2021-2022.

Results and Discussion

Effect of different locations on the Physico-chemical parameters of the Arecanut

The data pertaining to the physico- chemical parameters of the arecanut are presented in Table. 1. It was observed that the maximum carbohydrate (20.30%), crude protein (20.16%), crude fat (16.66%), crude fiber (16.33%), total ash (1.36%), acid insoluble ash (0.325%), total sugar (1.76 g/100g), reducing sugar (1.20 g/100g), calcium (0.493 mg/100g) and phosphorus (124.66 mg/100g), iron (1.477 mg/100g) and water soluble extractives (18.00%) and minimum tannin (90.33 mg TE/g) and Arecoline (0.142%) was observed in arecanuts from shriwardhan while initial and final moisture was observed to be non significant. As well as the minimum initial moisture (38.66%), final moisture (5.33%), crude protein (18.63%), reducing sugar (1.04 g /100g), calcium (0.453 mg /100g), iron (1.22 mg /100g) was observed in arecanuts from Roha while carbohydrate (18.98%), phosphorus (107.66 mg /100g), was observed in arecanuts from Dapoli, lowest mean acid insoluble ash (0.30%), total sugar (1.55g /100g), water soluble extractive (14.00%) was observed in arecanuts from Ratnagiri as well as lowest mean crude fat (14.93%) was observed in arecanuts from Palghar, the lowest mean Arecoline (0.142%),Tannin (90.33 mg TE/g) was observed in the arecanuts from the Shreewardhan and the lowest mean Crude fibre (13.80%), total ash (1.19%) was observed in arecanuts from Vengurla.

Table 1: Effect of different locations on the Physico-chemical parameters of the Arecanut

Location	Initial moisture (%)	Final Moisture (%)	Carbohydrate (%)	Crude protein (%)	Crude Fat (%)	Crude fiber (%)	Total ash (%)	Arecoline (%)
Murud	39.33	6.33	20.16	20.13	16.00	15.45	1.30	0.158
Shreewardhan	39.33	7.00	20.30	20.16	16.66	16.33	1.36	0.142
Roha	38.66	7.33	19.30	18.63	15.50	14.61	1.25	0.197
Dapoli	39.00	7.33	18.98	19.38	15.16	14.78	1.20	0.172
Ratnagiri	39.33	5.33	19.32	19.60	15.46	14.80	1.22	0.162
Vengurla	40.33	6.33	19.33	19.33	15.13	13.80	1.19	0.187
Palghar	40.33	6.33	19.43	19.00	14.93	14.36	1.31	0.183
SEm+	1.78	1.34	0.25	0.19	0.34	0.47	0.03	0.0006
CD at 5%	NS	NS	0.74	0.57	1.01	1.38	0.08	0.0017

Location	Acid insoluble ash (%)	Tannin (mg TE/g)	Total Sugar (g/100g)	Reducing sugar (g/100g)	Calcium (mg /100 g)	Phosphorus (mg/100 g)	Iron(mg /100 g)	Water soluble extractive (%)
Murud	0.308	90.63	1.71	1.16	0.480	123.66	1.457	17.25
Shreewardhan	0.325	90.33	1.76	1.20	0.493	124.66	1.477	18.00
Roha	0.307	91.66	1.63	1.04	0.453	121.00	1.220	16.66
Dapoli	0.304	91.00	1.57	1.07	0.467	107.66	1.337	15.66

Ratnagiri	0.300	92.00	1.55	1.12	0.480	122.33	1.307	14.00
Vengurla	0.313	92.33	1.56	1.13	0.467	123.33	1.257	16.00
Palghar	0.310	93.16	1.65	1.10	0.457	113.33	1.333	14.00
SEm+	0.003	0.506	0.01	0.01	0.0064	3.67	0.026	0.86
CD at 5%	0.009	1.494	0.04	0.04	0.0190	10.84	0.078	2.55

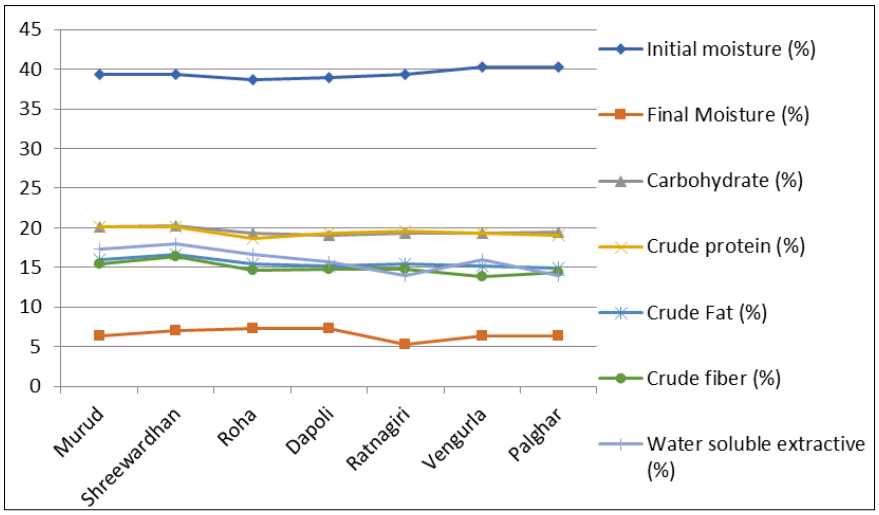

Fig 1: Effect of different locations on the initial moisture, final moisture, carbohydrate, crude protein, crude fat, crude fiber, water soluble extractive content of the Arecanut

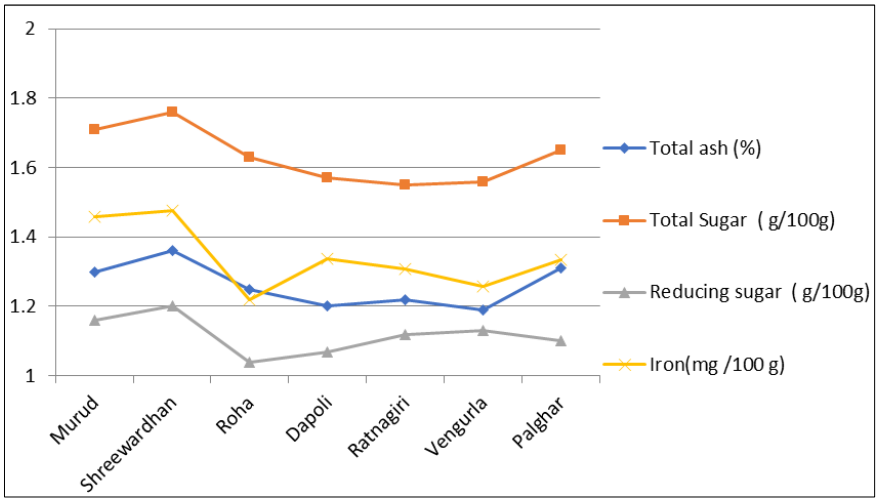

Fig 2: Effect of different locations on the total ash, total sugar, reducing sugar and iron content of the Arecanut

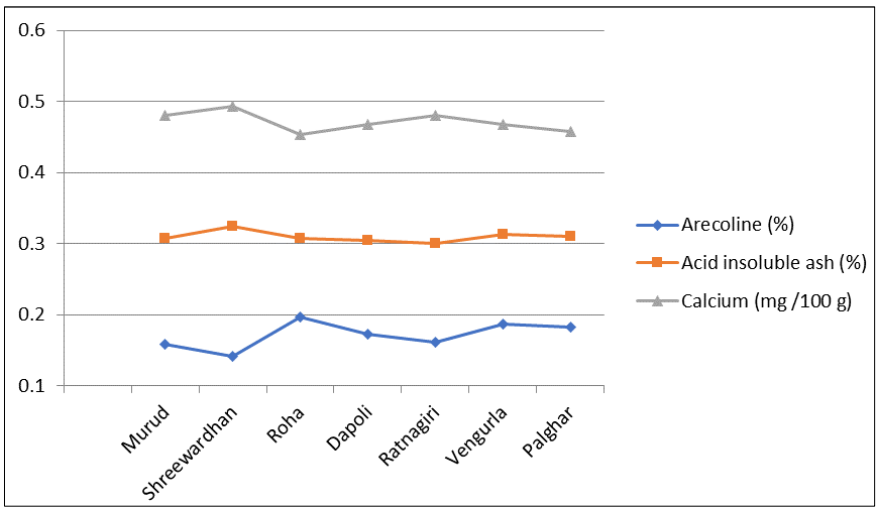

Fig 3: Effect of different locations on the arecoline, acid insoluble ash and calcium content of the Arecanut

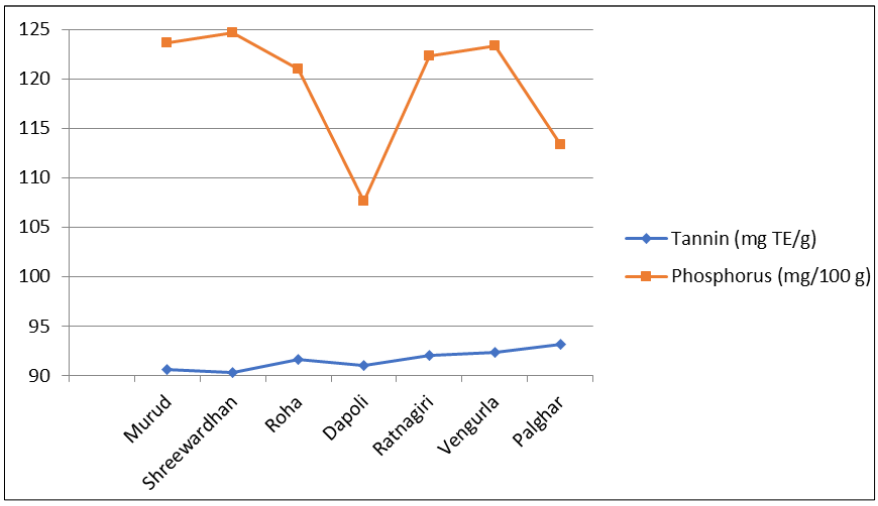

Fig 4: Effect of different locations on the tannin and phosphorus content of the Arecanut

Moisture

The data observed that the average maximum mean initial moisture was recorded in the Vengurla and Palghar while minimum mean initial moisture was recorded in the Roha. The effect of different locations on initial moisture was found to be non-significant. The difference in initial moisture content with different locations in arecanut was noticed may be due to the varied water stress conditions. The average maximum mean final moisture was recorded in the Roha and Dapoli while minimum mean final moisture was recorded in the Ratnagiri. The difference in final moisture content with different locations in arecanut was found to be non-significant It may be due to different processing techniques. The supportive result was observed by (Gurumurthy, 2018) [10].

Carbohydrates

Human body obtains maximum amount of energy from carbohydrates i.e. 60-70% of energy we get daily is obtained from carbohydrates and also helps in matabolism of fat in body. The data observed that the average maximum mean carbohydrate was recorded in the Shriwardhan while minimum mean carbohydrate was recorded in the Dapoli. The difference in the carbohydrate contents with different locations in arecanut was noticed may be due to the different agronomical practices and the difference in application of fertilizers. The supportive result was observed by (Shwetha *et al.*, 2019) [19].

Crude Protein

Proteins carry nutrients in the body upto cellular level. Antibodies which take part in body immunity are made up of proteins. All enzymes are made up of proteins. The data observed that the average maximum mean crude protein was recorded in the Shriwardhan while minimum mean crude protein was recorded in the Roha. The difference in the crude protein contents with different locations in arecanut was noticed may be due to the difference in local geographical conditions. The supportive result was observed by (Lantz *et al.*, (1958) [12] in Horse bean.

Crude fat

Fats deposited beneath the skin helps to control body temperature and useful in absorption of most of fat soluble vitamins known to us. The data observed that the average maximum mean crude fat was recorded in the treatment Shriwardhan while minimum mean fat was recorded in the Palghar. The difference in each concentrations of the crude fat with different locations in arecanut was noticed due to different geographical locations. A similar result was observed by (Shwetha *et al.*, 2019) [19] and (Pathak and Mathur, 1954) [15].

Crude fiber

Fiber decreases mortality risk from circulatory, digestive, and inflammatory diseases. Fiber imparts hardness to mature arecanut which is highly essential for preparation of processed quality arecanut. The data observed that the average maximum mean crude fiber was recorded in the Shriwardhan while minimum mean crude fiber was recorded in the Vengurla. The variability in fiber contents with different locations may be due to difference in agronomic practices. Closely related results are observed by (Mohankumar, 2008) [13]. Fiber is responsible for the hardness of the nuts, which takes place after the mature- green stage, when nuts are taken to prepare the cut and boiled types known as kalipak. The diversity in tannin and fiber content may be due to variability in processing technique, climate, varieties, water stress and soil conditions (Gurumurty, 2018) [10].

Total Ash

Total ash is used to measure the total amount of material remaining after incineration. The data observed that the average maximum mean total ash was recorded in the treatment Shriwardhan, while minimum mean total ash was recorded in the Vengurla. The variability in total ash contents with different locations may be due to different agronomical practices stress. Closely related results are observed by (Sharan *et al.*, 2012) [18].

Arecoline

Arecoline is a nicotinic acid based mild parasympathomimetic stimulant alkaloid found in arecanut. used in medicinally as an antihelmintic. Arecanut is a rich source of polyphenols but also contain toxic alkaloids, arecoline. Separation of these bioactive polyphenols from toxic constituents could propel the safe and beneficial use of betelnut processing industries to produce arecoline free products with the aim to develop an effective method for maximum extraction of polyphenols with

minimum arecoline. The data observed that the average maximum mean Arecoline was recorded in the Roha while minimum mean arecoline was recorded in the Shriwardhan. The variability in arecoline with different locations may be due to the difference in climatic conditions as well as soil parameters. The results are in conformity with (Chavan and Singhal, 2013) [9] in arecanut.

Acid insoluble ash

Acid insoluble ash is the residue obtained after boiling the total ash with dil. HCL and igniting the remaining insoluble matter. The data observed that the average maximum mean acid insoluble ash was recorded in the Shriwardhan, while minimum mean acid insoluble ash was recorded in the Ratnagiri. The variability in acid insoluble ash contents with different locations may be due to difference in avalibility of water. The closely results related with (Sharan *et al.*, 2012) [18].

Tannin

Tannin in arecanut was being used for dyeing clothes and tanning leather. It can be used as an adhesive in ply board manufacture. The data observed that the average maximum mean tannin was recorded in the Palghar while minimum mean tannin was recorded in the Shriwardhan. The variability in tannin contents with different locations may be due to difference in climatic conditions. The results are closely related with Gurumurthy, (2018) [10] and (Atanassova and Christova-Bagdassarian, 2009) [7].

Sugars

Sugar is a form of carbohydrate that the body converts to glucose that can be readily used in the body. The data observed that the average maximum mean total sugar was recorded in the Shriwardhan while minimum mean total sugar was recorded in the Ratnagiri. The variability in total sugar contents with different locations may be due to the different geographical conditions. Closely related results are observed by (Gurumurthy, 2018) [10] and (Atanassova and Christova-Bagdassarian, 2009) [7]. The data observed that the average maximum mean reducing sugar was recorded in the Shriwardhan while minimum mean reducing sugar was recorded in the Roha. The variability in reducing sugar contents with different locations may be due to difference in climatic conditions. Closely related results are observed by (Gurumurthy, 2018) [10] and (Atanassova and Christova-Bagdassarian, 2009) [7].

Calcium

Calcium is essential for growth of bones and teeth. It also gives strength to them. It plays an important role in blood coagulation. The data observed that the average maximum mean calcium was recorded in the Shriwardhan while minimum mean calcium was recorded in the Roha and Palghar. The variability in calcium contents with different locations may be due to different soil properties and climatic conditions. The results are in conformity with by (Gurumurthy, 2018) [10] and (Mohankumar, 2008) [13] in arecanut.

Phosphorus

Phosphorus is important constituent of DNA and RNA, regulates acid and base balance The data observed that the average maximum mean phosphorus was recorded in the Shriwardhan while minimum mean phosphorus was recorded in the Dapoli. The variability in phosphorus contents with different locations may be due to the difference in climatic conditions. Closely related results are observed by (Gurumurthy, 2018) [10] and (Mohankumar, 2008) [13] in arecanut.

Iron

Iron is an important enzyme required for metabolism. Myoglobin is present in muscles for contraction assistance. The data observed that the average maximum mean iron was recorded in the Shriwardhan, while minimum mean iron was recorded in the Roha. The variability in iron contents with different locations may be due to the difference in soil factors. The relationship between soil pH and macro and micro nutrient solubility determines the availability of different soil nutrients to plant. The results are closely related with (Gurumurthy, 2018) [10] and (Mohankumar, 2008) [13] in arecanut.

Water soluble extractive:

Water soluble extractive content is the proportion of the biomass that is lost as a result of extraction with water. The data observed that the average maximum mean water soluble extractive was recorded in the Shriwardhan while minimum mean water soluble extractive was recorded in the Ratnagiri and Palghar. The variability in water soluble extractives with different locations may be due to the difference in climatic conditions. Closely related results are observed by (Gurumurthy, 2018) [10] and (Mohankumar, 2008) [13] in arecanut

Conclusion

It is concluded from the experiment that the variety Shriwardhanee grown at Shriwardhan region has uniqueness in its parameters like less arecoline, tannin and maximum total sugar, reducing sugar, carbohydrate, crude protein, crude fat, crude fiber, calcium, phosphrous and iron. The variety grown in Shriwardhan and Murud was at par with most of the parameters. Hence the variety Shriwardhanee grown in Shriwardhan and Murud can be registered for geographical indication.

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