Short Research Article

Nutritional Evaluation and Value Addition of Drumstick Leaves

ABSTRACT

The study was conducted by laboratory techniques in the department of Food Science and Nutrition, College of Community Science, Acharya Narendra Dev University of Agriculture & Technology, Kumarganj, Ayodhya, during 2020-22secession. The study on title "Nutritional Evaluation and value addition of Drumstick Leaves" was undertaken to determine the physical and nutritional composition of immature and mature drumstick (Moringa oleifera) leaves. The proximate composition of drumstick leaves was investigated in the studies. The moisture content of fresh immature and mature leaveswas found to be 73.8 and 71.6 %. Protein estimated by Lowery method, the protein content of immature leaves 22.22 and mature leaves 22.90 %. ~~Crude~~ The crudefiber content in immature leaves 2.26 and mature leaves 6.68 %. According to the proximate analysis of ~~the~~all nutrient it has been found that in the ~~drumstics~~ drumstickleaves calcium in immature leaves 1990 mg /100 g and in mature leaves 2029 mg /100 g. Phosphorus value in immature leaves337mg/100g and in mature leaves 350 mg /100 g~~that~~ which is higher than other nutrients. In this series Vitamin 'C' content in ~~fresh~~ freshimmature leaves is216mg/100g and in mature leaves 207 mg /100 g. Fresh drumstick leaves were successfully used for preparing different nutritive food products-bhujia, paratha, saagand juice.Eating ~~drumstick based~~drumstick-based food products is good for those suffering from malnutrition. *Moringa oleifera* leaf powder should be advocated for supplementation in household diets, especially in rural and urban communities. Drumstick(*Moringaoleifera)*is one of the promising plants which could contribute to increased intake of essential nutrients and health promoting phytochemicals. Leaves can be consumed raw, boiled, or stored as a dry powder for several months without losing their nutritious content.

Key words: Nutrition, Phytochemicals, Malnutrition, Supplementation, Health promoting, Mediational properties.

Introduction-

Moringa oleifera, *Lam syn*. Moringa pterygosperma, Gaertn(FamilyMoringaceae), is a small to medium-sized tree with creamy-white, sweetly scented flowers and light-green tripinnately complex foliage that makes it a focus point in the tropics and subtropics. It is origin of India that grows naturally in the sub-Himalayan areas of Northern India. It is commonly known as *Sajina*, drumstick tree (English); *Sajna* (Bengali); Horseradish tree, *Sahinjan*, *mungna* (Hindi); *Sobhanjana*, *Sigru*, *Murunga*, *dvishiguru* (Sanskrit) *Murinna*, *Sevaga*, *Segata* (Marathi); *Sohanjana* (Panjabi); *Muringatishnagandha* (Malyalam); and *Sehjan* (Urdu) in varied Indian languages and regions. It also thrives well in Pakistan, Bangladesh, Shri Lanka,

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tropical Africa, Arabia, Philippines, Cambodia and Central North and South America.(Pandey A. P., 2012)

Moringa oleifera is one of the promising plants which could contribute to increased intake of essential nutrients and health promoting phytochemicals. Moringa oleifera is the most well-known of the thirteen species of the genus *Moringacae*. It is native to India but has been planted around the world and naturalised in many locales. Recent studies indicate that its leaves have immense nutritional value. They are loaded with vitamins, minerals and all of the essential amino acids. Moringa oleifera has in the past two decades been advocated as an excellent source of essential nutrients (protein, iron, calcium, vitamins, carotenoids, and ~~others~~ otherphytochemicals).(Madukwe, 2013)

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Almost every part of the drumstick, including the bark, root, flower, fruits, leaves and seeds are ~~highly~~ highpotential ~~of~~ forproteins, vitamins, and minerals, including potassium, calcium, phosphorus, iron, folic acid, and beta carotene. It is described as "God has created one of the most amazing trees." Leaves can be consumed raw, boiled, or stored as a dry powder for several months without losing their nutritious content.(Pandey, 2012.)

Moringa oleifera contains a higher amount of vitamin A than carrots, a higher extent of vitamin C than oranges, and more calcium and potassium content than milk and bananas respectively. Additionally, moringa is richer in iron than spinach by 9 times, also more in fibre than oats by 4 times, and has a protein quality similar to that of egg and milk protein, which is more easily digested and absorbed. (Mahmood, 2010)

Moringa trees have a remarkable range of medicinal properties and nutritional value are~~are having a remarkable range of medicinal properties as high as nutritional values~~. Most parts of the plant., leaves, seeds, fruit or pods, roots, stem, and bark are used as medicines or foods in various countries with ~~especial~~ specialreferences to the traditional communities. (Fahal, 2018). Because of its chemical contents, Moringa oleifera is used as an alternative to imported dietary supplements in underdeveloped countries to treat and combat malnutrition, particularly among infants and nursing mothers. (Amabye, 2015)

Moringa is considered ~~as a~~ thebest friend of mothers. It results in a tremendous increase in milk production of lactating women. ~~It's~~ Itsall parts; leaves, fruits root, gum, bark, seed, flower and seed oil are being used for cure different ailments i.e. inflammation, cardiovascular, intestinal, haematological and anti-fever. The seeds of Moringa exhibit

antimicrobial activity and are acrid in taste. Flowers of the Moringa contain nine essential amino acids, wax quercetin, glucose and sucrose. (Mushtaq, 2021)

Material and methods:

The study was conducted in the Department of Food Science and Nutrition, College of Community Science, Acharya Narendra Dev University of Agriculture & Technology, KumarganjAyodhya.The drumstick leaves, pods and seeds (Moringa oleifera) were procured/ collected from different plants in the Acharya Narendra Dev University of Agriculture and Technology, Kumarganj and Krishi Vigyan Kendra, Barasin, Sultanpur. The procured/ collected samples were utilized for physical analysis, chemical analysis and product development.

~~For~~ To~~de~~hydrate the leaves ~~were~~ use ~~the~~ these~~method~~: Collect the leaves, Washed with water, Drain in basket, Oven dry 60℃, Grinding in mixture, Stored in air tight containers.

For moisture content was calculated by AOAC, 2000.~~For ash~~Ash estimation in the sample was estimated by employing the standard method of analysis (AOAC, 2000). For Crude fat was estimated by employing the standard method of analysis (AOAC, 2000) using the Automatic SOCS plus Solvent Extraction System.

~~Crude~~ The crudeprotein content of the plant sample was ~~estimated~~ estimatedby Loweryet al., (1951). Reagent: 2% Na_2CO_3 in distilled water (reagent A), 0.5 % $CuSO_4$, NaOH in 1% copper sulfate, sodium hydroxide (reagent B), 50 ml of reagent (A) was mixed with 1 ml of reagent (B), reagent (C~~), Folin's~~), Folin's reagent.The residue left after 80% ethanol extraction from protein analysis was hydrolyzed in 5.0 ml of 1 N NaOH ~~for~~ overnight and then centrifuged at 4000 rpm for 20 minutes. ~~Supernatant~~ The supernatantwas kept aside and the residue was again hydrolyzed with 5.0 ml 1N NaOH for 1 hour and centrifuged. Both the supernatant ~~were~~ waspooled and volume was made to 10 ml. The total protein was estimated in the supernatant by Folin's reagent. Procedure: 0.5 ml aliquot was taken in test tube, mixed with 5.0 ml of reagent (C) and allowed to stand for 10 minutes, thereafter, 0.5 ml of Folin'sreagent was added with instant mixing. After 30 minutes O.D. was read at 750 nm through Spectronic-20 against reagent the blank solution. A standard curve was prepared with graded concentration of bovine serum albumin.

$$\text{Protien/100g} = \frac{\text{G.F.} \times \text{O.D.} \times \text{Total volume)}}{\text{Aliquot taken} \times \text{Weight of sample}} \times 1000$$

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Crude fiber estimated by FIBRA PLUS FES 2 apparatus.

Dry matter: Moisture value was subtracted from 100; the difference gave values of available dry matter.Total carbohydrates estimated byNIN, 1983.

Vitamin C was estimated by employing the standard method of analysis (AOAC, 1980).This method is based on the reduction of 2-6 dicholorophenol indophenol dye by ascorbic acid. This dye which is blue in an alkali solution and red in an acid solution is reduced by ascorbic acid to a colourless form. The solution is quantitative and practically specific for ascorbic acid in solution.

For minerals estimation by acid digestion,calcium was ~~determination~~ determinedby a flame-photometer, Jackson 1973.The phosphorus was determined in the digested leaves material by Vanadate-molybdate phosphoric yellow colour method as ~~describe~~ describedby Jackson 1973.

$$Protien\ \text{content}\ \% = \frac{50 \times 100 \times B \times C}{A \times 1000000}$$

B stand for ppm, and P in the test solution is taken for reading. C stand for 50 (digested volume is made up 50 ml). A stand for test solution in ml taken from the digested.

$$\text{~~C~~a}\% = \frac{R \times 100 \times \text{Aiquate taken in m}l}{\text{Weight of sample} \times 1000000}$$

R stand for ~~taken~~ takingthe reading by flame-photometer.

Product Development

Standardised of value added Products Development of drumsticks (Moringa oleifera) preparation of drumstick leaves saag, ingredients ~~use~~ usedare Drumsticks leaves-120g, Grams flour/ maze flour- 10 g, Mustered Oil-15 ml, Onion-35g, Garlic- 4 clove, Green chili-1, Salt- ¼ , Garam masala- 2.5 g. Method of cooking w~~W~~ashed the drumstick leaves and, then cook it in a pressure cooker with little water. Open the pressure cooker and added gram/ maze flour and mix properly. Take a pan, added oils to it and heated it. Added chopped green chillies, onion, garlic and sauted it. Added mash leaves, gram masala and cover and cook. Serve the prepared drumstick saag with roti and rice.

Preparation of drumstick leaves (bhujia) are use the ingredients drumsticks leaves – 100 g, Potato- 15 g, Garlic-4 clove, Oil- 15 ml, Onion- 15 g , Green chili- 1, Salt- 1/4tsp. Method of cooking Washed the ~~drumsticks~~ drumstickleaves and chopped finely. Took a pan, added

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oil to it and heated it . Added chopped green chilies, onion, garlic and fried it. Added chopped leaves, soaked grams, and covered and cooked till ~~and soaked grams to it and covered and cooked till become~~ soft. Served the cooked drumstick bhujia with roti and rice.

Preparation of drumstick leaves paratha use ingredients are Wheat flour (containing 10 % moringa leaves powder, 90% wheat flour)-90g, Fresh Leaves -10g, Onion-1, Chillies- 1, Carom seed - 1/8 tsp, Salt -1/6 tsp, Oil -2.5 ml, Water-15 ml, Method of cooking washed the drumstick leaves thoroughly and chopped them finely. Put the drumsticks leaves, finely chopped, onion, green chilies, salt and carom seeds in a vessel and kneaded well using required amount of water. Made small bolls out of the dough and rolled in to shape of a chapati. Applied oil on a hot pan and cooked it from both side and serve it with vegetables.

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Preparation drumstick leaves juice use ingredients are drumsticks leaves- 10g, Salt- 1 pinch, Lemon juice- 15 ml, Water- 200ml, Sugar- 1 gram, Jaljera powder- 3/4 tsp Method of cooking put ground drumstick leaves, jaljeera powder, salt, lemon juice, sugar in a mixture jar and blend well. Sieved it with the help of sieve. Served the prepared lemon juice with cold water.

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Result and Discussion:

The physical parameter of drumstick leaves given in **Table:1** the immature drumsticks leaves color is light green and mature drumstick color is dark green, the shape of drumsticks is pinnate. The weight of 100 immature and mature drumsticks leaves was 0.68, 3.76 respectively.

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The data given in **Table:2** shows the moisture content of immature drumsticks leaves was maximum. As the maturity of leaves the moisture per centage decreased. The moisture percentage in immature leaves, mature leaves, was 11.8, 9.2 %~~per cent~~ respectively.

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The data given in ~~table:3~~**table 3** shows the proximate composition of different parts of drumsticks.(Amabye, 2015) reported 3.3 4 4 ±1.36per cent moisture in dried Moringa oleifera leaf powder.(El Sohaimy, 2015) reported 10.74±0.05g per 100gram moisture in leaf.

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(Mushtaq B. P., 2021) reported that *Moringa oleifera* leaves powder contained 9.77±0.537 %~~per cent~~ moisture. (El-Massry, 2013) reported moisture content in fresh moringa leaves, dried leaves. The respectively values were 74.35 ±2.1, 5.8 ±2.3%~~per cent~~. The protein content of immature leaves was 22.22 %~~per cent~~ whereas, in mature leaves, it was 22.90%~~per cent~~. The crude protein content of dry leaves powder of *Moringaoleifera* was reported

by(Amabye, 2015) , the values were 10.7 ±0.81 and 26.79 ± 1.8 per cent, respectively. ~~Crude~~ The crudeprotein content of dried *Moringaoleifera* leaves was also reported by (El-Massry, 2013)However higher values of protein were found both in mature and immature leaves in the present study.(Moyo, 2011)reported 30.29 ~~per cent~~ crude protein in dried moringa leaves which ~~was~~ wereeven higher than those found in the present investigation. The crude fat content of immature leaves was 1.41 per cent whereas, crude fat content of mature leaves, was 2.2, ~~per cent~~. (Gopalakrishnan, 2016)found 1.7, 5.2 and 2.3 per 100 ~~g~~ram fat in fresh leaves, dry leaves, and leaves powder of *Moringaoleifera*. Crude fibre value was 6.68 per cent in mature leaf and 2.26 per cent in immature leaves.(Gopalakrishnan, 2016) found 0.9, 12.5 and 19.2 per 100 gm fiber in fresh leaves, dry leaves, leaves powder, of *Moringaoleifera*. Total ash content of mature leaves 7.1 5per cent and immature leaves 6.8 per cent. (Sánchez-Machado, 2010.)reported 14.60 ± 0.9per cent ash in leaves However, in the present study the ash content was less than those reported by them. (El-Massry, 2013) reported 3.64±0.7 and 7.92±0.9 ~~per cent~~% ash in fresh and dried leaves of *Moringa oleifera*. The present values are in almost similar trends. (Moyo, 2011) reported 7.64 ~~per cent~~% ash in dry *Moringaoleifera* leaves. (Amabye, 2015) found 7.2 9±0.84per cent ash in dried moringa leave powder these values are almost comparable that with the present results. However, higher 14.60 ± 0.9 ~~per cent~~% ash was reported by (Sánchez-Machado, 2010.) in edible parts of moringa leaves on dry weight basis.

The carbohydrate content of different parts of moringa namely immature leaves, mature leaves, 51 and 56 ~~gram~~gper 100 ~~gram~~g. Similar result was also reported by(Amabye, 2015). (El-Massry, 2013) reported lower values for carbohydrate in moringa fresh and dry leaves. The values were 26.37±2.1, 14.41± 2.3 per cent, respectively. (Gopalakrishnan, 2016) found 12.5g, 41.2g and 38.2g carbohydrate in moringa fresh leaves, dry leaves, leaves~~powder, respectively~~powder, respectively. The energy content was 306 in immature and 334 kcal in mature.(El-Massry, 2013) reported 286.91, 295.58 Kcal per 100 gram energy in, moringa fresh leaves, moringa dried leaves, respectively. (Amabye, 2015) reported 366.2± 4.23 Kcal energy in *Moringaoleifera* leaf powder.

Calcium content in immature and mature leaves was 1190 and 2029 mg per 100g the results presented in tables 4. (Yaméogo, 2011)reported calcium content of cool moringa leaves and dry moringa leaves. The values were 847.1 and 2098 mg calcium per 100 gram. (El-Massry, 2013)~~reported 738.94~~reported 738.94 ± 1.1 and 2078 ± 0.1 mg per 100 gram calcium on dry weight basis in fresh leaves and dry leaves, respectively .(Amabye, 2015) found 2016.5 ± 26

gram calcium in *Moringaoleifera* leaf powder. The results presented in tables 4. shows that immature and mature leave contained 337 and 352 mg per 100 gram phosphorus in dry moringa leaves. (Yaméogo, 2011)found 111.5 mg per 100 g phosphorus in cool leaves of moringa oleifera while, 2098 mg per 100 gram phosphorus was found in dry moringa leaves.(El-Massry, 2013) reported the phosphorus content in fresh moringa leaves (89.77±1.3 mg) and dry leaves (346.87 ± 0.3 mg per 100 g), gram on dry weight basis. Dry mater per centage in immature and mature leaves was 88 and 91 ~~per cent~~% respectively.

Data illustrated in table 5. The vitamin 'C' content was highest in fresh immature leaves (216 mg per 100gm). The mature fresh leaves contained 207 mg per 100 g vitamin 'C' was present.(Gopalakrishnan, 2016) found the vitamin 'C' content in fresh leaves 220, in dry leaves 15.8, leaves powder 17.3 mg per 100gm. The values are almost in similar trend. (El-Massry, 2013) reported 825.3±1.17 mg per 100 gram in fresh moringa leaves. The values are much higher than those found in the present investigation. (El Sohaimy, 2015) found vitamin 'C' content 245.13±0.46 mg per 100 gram in moringa leaves. (Arwani, 2019) found the vitamin 'C' content in unblanched*Moringa oleifera* 193.04±0.01mg per 100 gram.

Physical, chemical and nutritional attributes of drumstick leaves. The leaves were found be riches in minerals like calcium and phosphorus and vitamin 'C'. Use of moringa leaves in day to day life need to be encouraged. Several value added products can be prepared from fresh drumstick leaves saag, bhujia, paratha, juice. Eating drumstick based food products is good for those suffering from malnutrition. It is essential that the nutrients of this wonder tree are exploited for a variety of purposes. *Moringaoleifera* leaf powder should be advocated for supplementation in household diets especially in rural and disadvantaged communities.

Reference

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Table:1 Physical parameters of drumstick (*Moringa oleifera*) leaves.

Parts /Parameters	Colour	Shape	Weight (g) of 100 leaves
Immature leaves	Light Green	Pinnate	0.68
Mature leaves	Dark green	Pinnate	3.76

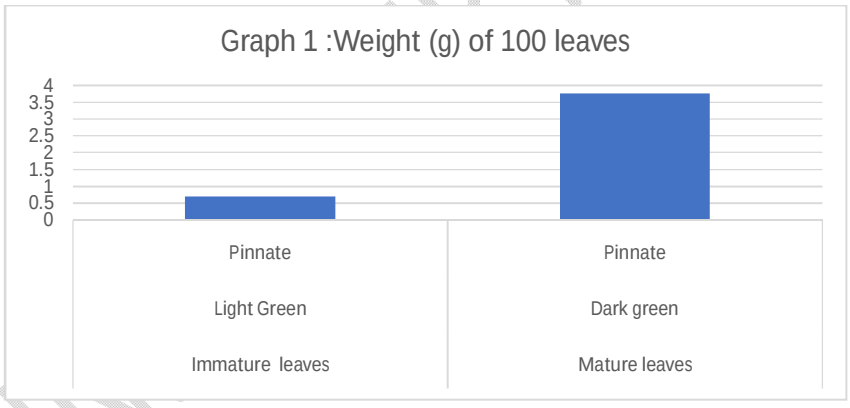

Table:2 Moisture content of fresh moringa leaves.

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Drumstick parts	Moisture (%)
Mature leaves	73.8
Immatureleaves	71.6

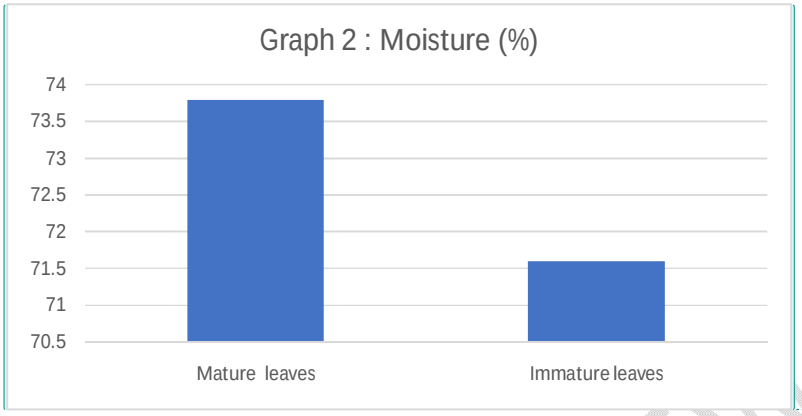

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Table:3 Proximate composition of drumstick (*Moringa oleifera*) leaves per 100 gram:

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Parameters /Parts	Leaves		Mean
	Immature	Mature	
Moisture (g)	11.8	9.2	10.50
Crude Protein (g)	22.22	22.90	22.56
Crude Fat (g)	1.41	2.20	1.80
Crude Fibre (g)	2.26	6.68	4.47
Total Ash (g)	6.8	7.15	6.97
Carbohydrate (g)	51	56	53.50
Energy (kcal)	306	334	320
Calcium (mg/100)	1990	2029	2009
Phosphorus(mg/100)	337	352	344
Dry Matter (%)	88	91	89

*All values are on dry matter basis

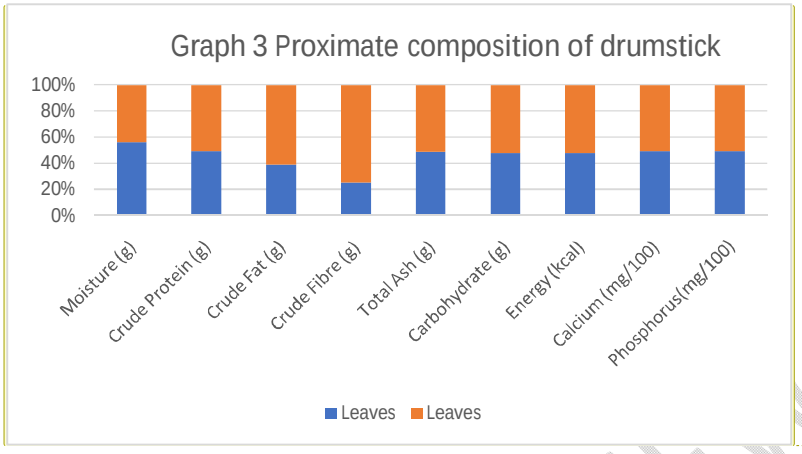

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Table:5 Vitamin 'C' content of drumstick (*Moringa oleifera*) leaves

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Vitamin 'C' /Parts	Leaves		Mean
	Immature	Mature	
Vitamin 'C'(mg/100)	216	207	211

*Fresh basis

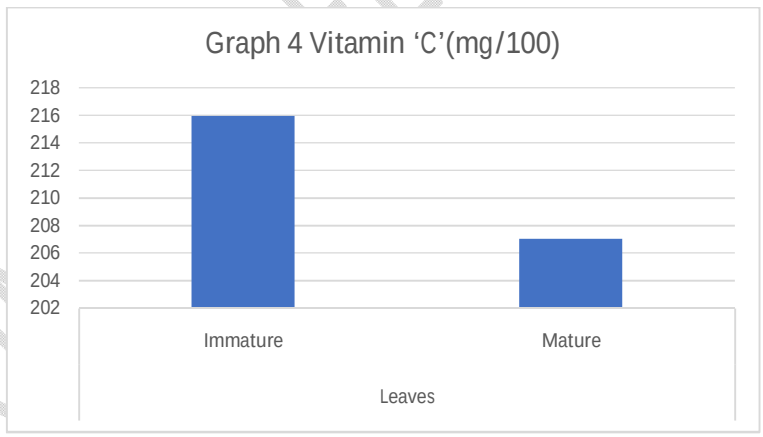
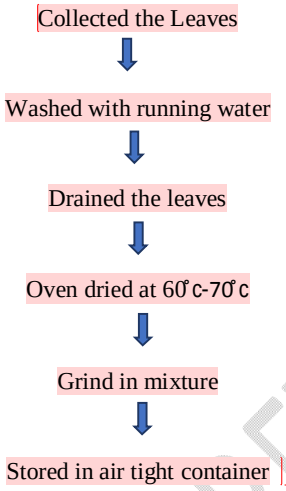


Fig.1 Flow diagram of the leaves powder preparation



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