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# Effect of different drying techniques on quality parameters of Guava leaves powder

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**Abstract**
*Psidium guajava* L., popularly known as *Guava* belonging to the Myrtle family have been used for various health benefits in several countries. In the present investigation, the efforts have been made to analyze the nutritional and mineral content of the powder of Guava Leaves obtained by applying different drying technique viz. Tray drying, Vacuum Oven and Hot air oven drying at different temperatures 50°C, 60°C and 70°C. It was identified that the Tray drying at 60°C was the best method of drying Guava leaves to obtain a Protein rich product of 9.57% for the fresh powder and 8.85% after 120 days. Vacuum Oven method of drying at 50°C is suitable to obtain a Fiber rich product of 5.3% for the fresh powder and 5.1% after 120 days. To obtain a mineral rich product, Tray drier at 50°C showed little high content of Calcium (0.055%) and Magnesium (0.017%) when compared to other dryers. As the temperature increased from 50°C to 70°C, the Protein content deceased by ~0.27% and Fibre reduced by ~0.15%. Vacuum Oven and Tray dryer at $60^0$C was found to have highest chlorophyll content 9.14mg/L compared to other dryers and temperatures.

**Keywords:** guava leaves, tray dryer, vacuum oven, hot air oven, nutritional composition, mineral content, chlorophyll

## 1. Introduction
Studying the plants regarding their Chemical composition, Nutritional content and their health benefits is increasing nowadays. *Psidium guajava* L., popularly known as *Guava* belonging to Myrtle family [1]. The crushed Guava leaves are aromatic and has dull-green color with pronounced veins. These are native to tropical and subtropical climates, allowing production around the world [2]. The consumption of decoction, infusion, and boiled preparations is the most common way to overcome several disorders in South Asia, Nigeria, Brazil and Philippines. Guava leaves have been used in folk medicine in several countries. This phyto-therapic plant has also been used for the controlling diabetes, hypertension, obesity, gastroenteritis, vomiting, diarrhea, dysentery, wounds, ulcers, toothache, coughs, sore throat and inflamed gums [3, 4, 5]. Guava leaves tea has become more common which helps in the modulation of blood-sugar level because of the Phenolic compounds present in it [6].
The Guava leaves has various bio-active properties. It contains flavonoids like quercetin, which has various pharmacological actions like inhibiting the intestinal movement and reducing the capillary permeability in the abdominal cavity [7]. The extract from Guava leaves showed higher Antimicrobial activity against Gram-positive bacterial and fungal strains *(Nair et al.,* 2007) [8]. Guava leaves essential oil showed the Antioxidant properties and possesses moderate inhibition of β-carotene (Lee *et al.,* 2012) [9]. The decoction of dried Guava leaves (hot aqueous extract) was effective as an Antidiarrhoeal Agent *(Birdi et al., 2010)* [10]. Guava tea showed to be an effective control of epidemic and pandemic influenza viruses showing Antiviral activity *(Sriwilaijaroen et al., 2012)* [11]. The extracts of Psidium guajava leaf may protect pancreatic tissues showing ability of antihyperglycemic and AntiDiabetic *(Huang et al., 2011)* [12]. Psidium guajava leaf extracts inhibited the developer of acne lesions (Propionibacterium acnes) acting as Anti-inflammatory *(Qa'dan et al., 2005)* [13]. The aqueous extract of Psidium guajava leaves has polyphenolic and isoflavonoids which are used as an Anti-tumor chemoprevention *(Bontempo et al.,* 2012*)* [14].
Guava leaves are extraordinarily rich in vitamin C, lycopene and antioxidants. The potassium in the leaves helps normalize blood pressure levels. It is also rich in fibres which adds in weight loss. Guava leaves contain vitamin B3 (niacin) and vitamin B6 (pyridoxine), which help in improving blood circulation to the brain, stimulating cognitive function and relaxing the nerves. Because of presence of Vitamin C and iron, it helps in relieving Cough and cold [15].
The objective is to study the nutritional composition and shelf life of Guava leaves powder obtained from the different dyers (Tray dryer, Vacuum Oven and Hot Air Oven at different temperatures ($50^0$C, $60^0$C & $70^0$C).

## 2. Materials and Methods
In accordance with the objectives of the study, experiments on

drying of Guava leaves were conducted using different drying techniques. Using the data, the drying behavior of Guava leaves viz. temperature and time taken were studied.

### 2.1 Materials

**Raw Material:** The Guava leaves were collected from the Osmania University, Hyderabad. The freshly collected Guava leaves were sorted, washed then kept for drying processes**.**

**Equipment:** Electronic balance, Tray dryer, Hot air Oven, Vacuum dryer, Desiccator, Muffle furnace, Soxhlet apparatus.

### 2.2 Methods

#### 2.2.1 Preparation of Guava leaves for drying:

**Sorting:** The stems and other unwanted parts of the collected fresh Guava leaves were removed.

**Washing:** The leaves were washed with slightly warm water to remove the dirt particles and the excess water was drained out from leaves. The Guava leaves were then cleaned by a dry cloth to remove the water particles. After the complete removal of water particles, the leaves were then kept in thin layers in the trays for actual drying process.

#### 2.2.2 Methods for Drying

In this study Guava leaves were subjected to three different drying techniques (*Tray drying, Vacuum drying and Hot air oven drying*) at three different temperatures (*50°C, 60°C, 70°C*) to obtain the best possible quality dried product. Initial Guava leaves samples of 20g were weighed accurately for Oven, Tray and Vacuum drying process. The driers were pre-heated to corresponding temperature before the drying process.

a. **Tray drying**: The dryer was pre-heated to required temperature and then the Guava leaves of 20g were spread in thin layers on the trays. Once the drying process started, the weights of the sample were collected at every 20 min until a constant weight was reached. The process was done by taking three samples of 20g each at three different temperatures 50°C, 60°C & 70°C.
b. **Vacuum drying**: The vacuum chamber was pre-heated to required temperature and then Guava leaves of 20g were placed inside the chamber. The drying process was started by creating the vacuum inside the chamber. The weights of the sample were collected at every 20 min until a constant weight was reached. The process was done by taking three samples of 20g each at three different temperatures 50°C, 60°C & 70°C.
c. **Hot air Oven drying**: The Oven was pre-heated to required temperature and then the Guava leaves of 20g were spread in single layers on the trays. The weights of the sample were collected at every 20 min until a constant weight was reached. The process was done by taking three samples of 20g each at three different temperatures 50°C, 60°C & 70°C.

#### 2.2.3 Method of Packaging

The powders obtained from different drying methods are packed in HDPE pouches with double protection. They are then stored for 120 days at ambient temperature for shelf life studies.

### 2.3 Determination of Proximate Analysis

The proximate analysis of Guava leaves was carried out by standard method.

**Ash:** Ash content of material represents inorganic residue remaining after destruction of organic matter or the mineral content present in the sample. Keep the silica dish in muffle furnace at not more than 525°C for 4-6 hours. Take the weight of ash and determine the % ash by formula, as given in standard method [16].

$$\%\ Ash\ (dry\ basis) = \frac{Weight\ after\ Ashing}{Weight\ before\ Ashing} \times 100$$

**Crude Fat**: Ether soluble material in a food was extracted from dried sample using a Soxhlet Extraction apparatus. The ether was evaporated, and residue was weighed. Water soluble materials were not extracted since the sample has been thoroughly dried, prior to extraction with petroleum ether. The ash content was found more in cabinet drying method as compare other drying methods [16].

$$\%\ Fat\ Content = \frac{Weight\ of\ ether\ soluble\ material}{Weight\ of\ the\ sample} \times 100$$

**Crude Fiber**: Crude fiber was organic residue which remains after the food sample has been treated under standardized conditions with standard boiled acid and alkali solutions Fibro-Tron was very sophisticated instrument for analysis of crude fiber of sample with standard boiled acid and alkali solutions. The crude fiber was determined by standard method [16].

$$\%\ Crude\ Fiber = \frac{Loss\ in\ Weight}{Weight\ of\ the\ sample} \times 100$$

**Protein**: Crude protein present in the sample is digested with sulfuric acid in the presence of a catalyst, at 380. The nitrogen released from the protein s and non-protein constituents of the sample is converted to ammonium sulfate. The ammonia nitrogen reacts with sali-cylate nitroprusside reagent in the presence of NaOH, to form a green colored complex, whose absorbance is measured at 685nm. The crude protein concentration is calculated by multiplying concentration of nitrogen (Kjeldhal nitrogen-N) obtained with a factor of 6.25 [16].

$$Crude\ Protein = N \times 6.25$$

**Moisture:** The sample is heated at temperature $105^0 \pm 2^0$C for 6 hours in oven that gives gravimetric determination of the mass losses [16].

$$\%\ Moisture\ Content = \frac{Initial\ weight\ of\ sample\ -\ Final\ Weight\ of\ sample}{Initial\ weight\ of\ the\ sample} \times 100$$

### 2.4 Determination of Mineral contents

**Calcium:** Calcium is precipitated as Calcium Oxalate. The precipitate is dissolved in hot dilute $H_2SO_4$ and titrated with

standard Potassium Permanganate [17].

$$Calcium\ \left(\frac{mg}{100g}\right) = \frac{Titer \times 0.2 \times total\ volume\ of\ ash\ solution \times 100}{Volume\ taken\ for\ estimation \times Wt\ of\ sample\ taken\ for\ ashing}$$

**Magnesium:** Magnesium is converted into Magnesium pyro phosphate, which is estimated gravimetrically [17].

$$Magnesium\ \left(\frac{mg}{100g}\right) = \frac{48.64}{222.6} \times \frac{Wt\ of\ Ash \times 100}{Ash\ taken\ for\ estimation} \times \frac{100}{Wt\ of\ sample} \times 100$$

### 2.5 Determination of Chlorophyll content

The color absorbance of the solution (Acetone, $MgCO_3$ powder and Leaf sample) was estimated by a spectrophotometer using 660nm and 643nm wavelength against the solvent [17].

$$Chlorophyll\ a\ \left(\frac{mg}{Litre}\right) = 9.90\ \times OD\ at\ 660nm - 0.777\ \times OD\ at\ 643nm$$

$$Chlorophyll\ b\ \left(\frac{mg}{Litre}\right) = 17.6\ \times OD\ at\ 643nm - 2.81\ \times OD\ at\ 660nm$$

$$Total\ Chlorophyll\ \left(\frac{mg}{Litre}\right) = 7.12\ \times OD\ at\ 660nm + 16.8\ \times OD\ at\ 643nm$$

## 3. Results and Discussions

The effect of drying at various temperatures using different dryers (Tray, Vacuum & Hot air Oven) is presented below.

### 3.1 Drying at 50$^0$C

The drying of Guava leaves was done at 50$^0$C using different dryers i.e., Tray dryer, Hot air Oven and Vacuum dryer. The nutritional analysis of products obtained from different dryers is presented below.

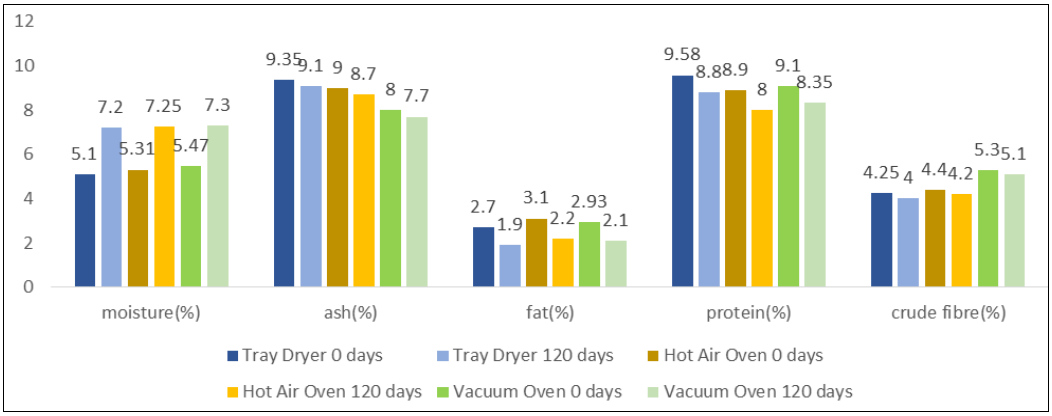


**Fig 1:** Nutritional composition of Guava leaves powder at 50$^0$C using different techniques

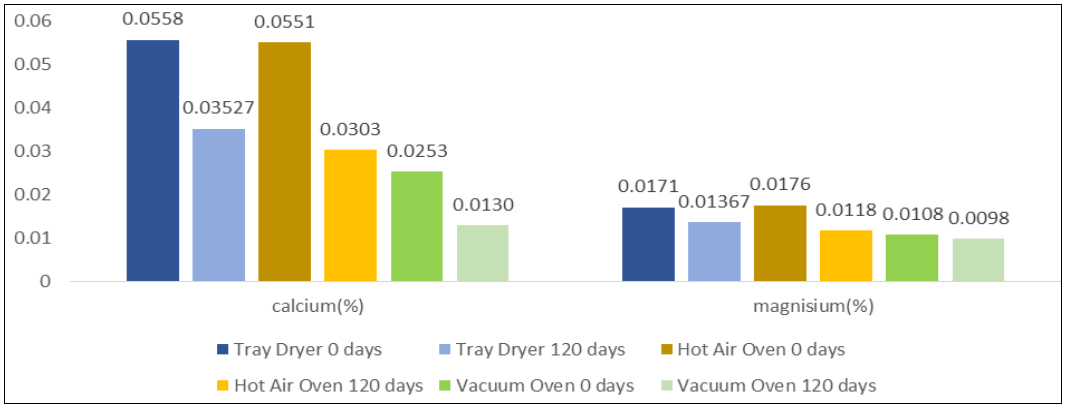


**Fig 2:** Mineral composition of Guava leaves powder at 50$^0$C using different techniques

The product obtained from Tray dryer at 50$^0$C has least moisture content (5.1%) and a high Protein content (9.58%) compared to the other dryer products. High percentage of Fat is observed in Hot Air Oven dried product (2.93%) and High Fibre content product (5.3%) is obtained from Vacuum Oven drying. Tray Dryer and Hot Air Oven dried products have high Calcium content (appx. 0.055%) and high Magnesium content (appx. 0.017%) compared to Vacuum oven drying method.

The shelf life of the Guava leaves powder was studied from 0$^{th}$ day to 120$^{th}$ day. The moisture content increased by 2.1% from 5.1% to 7.2% for 120 days. The other nutritional content like protein, fibre, fat and ash reduced during the shelf life study. The minerals (Calcium and Magnesium) also reduced after 120 days. Even after 120 days, Tray dryer product has high protein content (8.8%).

### 3.2 Drying at 60$^0$C

The drying of Guava leaves was done at 60$^0$C using different dryers i.e., Tray dryer, Hot air Oven and Vacuum dryer. The nutritional analysis of products obtained from different dryers is presented below.

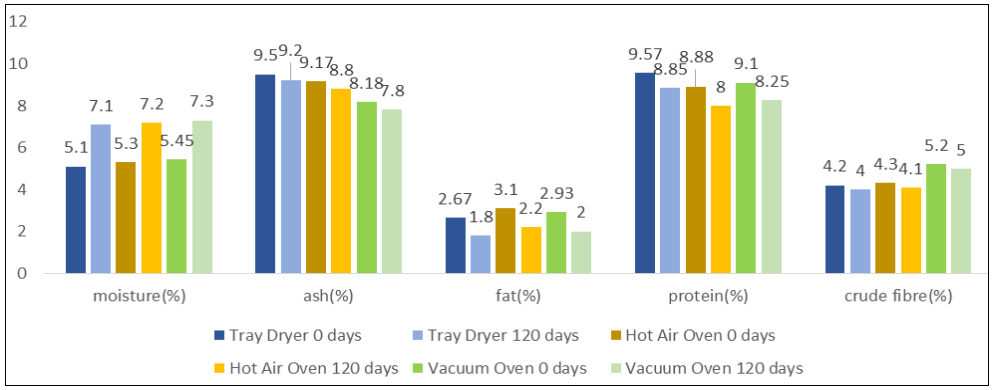


**Fig 3:** Nutritional composition of Guava leaves powder at $60^0$C using different techniques

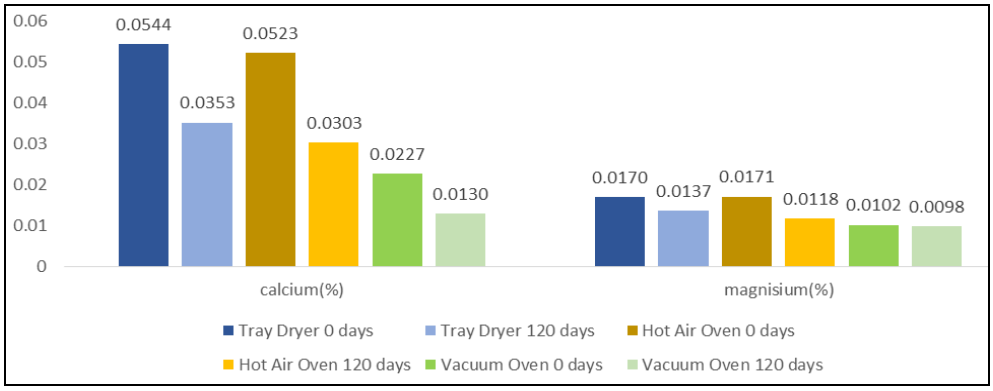


**Fig 4:** Mineral composition of Guava leaves powder at $60^0$C using different techniques

The product obtained from Tray dryer at $60^0$C has least moisture content (5.1%) and a high Protein (9.57%) compared to the other dryer products. High percentage of Fat (3.1%) is observed in Hot Air Oven dried product and High Fibre content (5.2%) product is obtained from Vacuum Oven drying. Tray Dryer has high Calcium content (appx. 0.054%). Also, high Magnesium content (appx. 0.017%) is observed in both Tray dryer and Hot Air Oven. Hot Air Oven dried product has least Calcium and Magnesium content.

Protein content decreased by ~0.02% as the temperature increased by $10^0$C for all the dryers whereas moisture content remained almost same. Fibre content and Fat content also reduced by 0.05 to 0.1% as temperature increased.

The shelf life of the Guava leaves powder was studied from $0^{th}$ day to $120^{th}$ day. The moisture content increased by 2% from 5.1% to 7.1% for 120 days. The other nutritional content like protein, fibre, fat and ash reduced during the shelf life study. The minerals (Calcium and Magnesium) also reduced after 120 days. Even after 120 days, Tray dryer product has high protein content (8.85%) which is ~0.05% greater than the product at $50^0$C.

### 3.3 Drying at $70^0$C

The drying of Guava leaves was done at $70^0$C using different dryers i.e., Tray dryer, Hot air Oven and Vacuum dryer. The nutritional analysis of products obtained from different dryers is presented below.

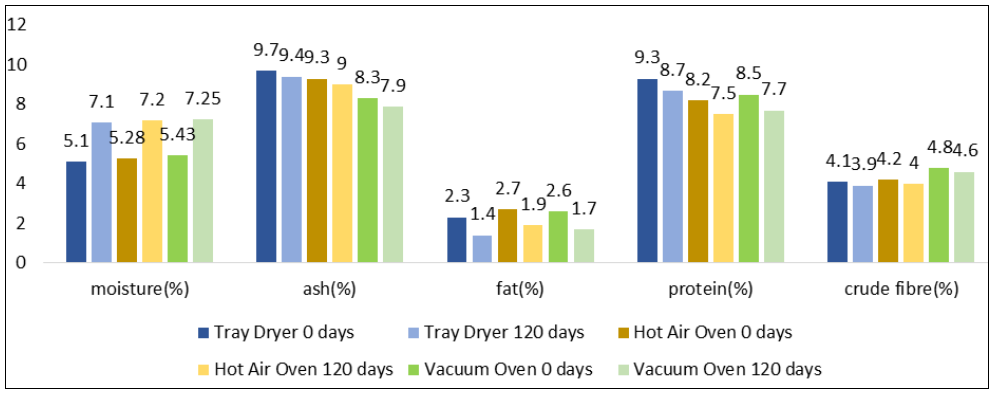


**Fig 5:** Nutritional composition of Guava leaves powder at $70^0$C using different techniques

The product obtained from Tray dryer at 70$^0$C has least moisture content (5.1%) and a high Protein (9.3%) compared to the other dryer products. High percentage of Fat (2.7%) is observed in Hot Air Oven dried product and High Fibre content (4.8%) product is obtained from Vacuum Oven drying. Tray Dryer has high Calcium content (appx. 0.035%) and high Magnesium content (appx. 0.013%). Hot Air Oven and Vacuum oven dried products have least Calcium and Magnesium content.

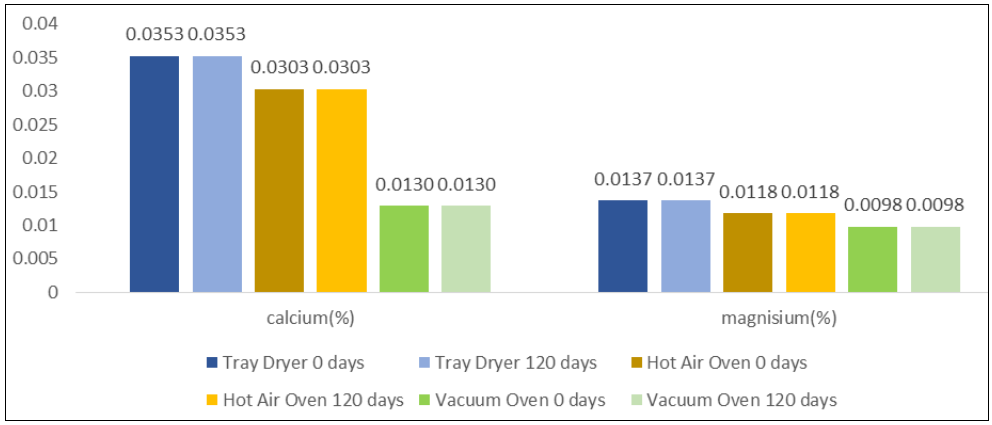


**Fig 6:** Mineral composition of Guava leaves powder at 70$^0$C using different techniques

Protein content decreased by ~0.3% as the temperature increased by 20$^0$C for all the dryers whereas moisture content remained almost same. Fibre content and Fat content also reduced by 0.3 to 0.5% as temperature increased. Calcium and Magnesium content also decreased as the temperature increased from 50$^0$C to 70$^0$C.

The shelf life of the Guava leaves powder was studied from 0$^{th}$ day to 120$^{th}$ day. The moisture content increased by 2% from 5.1% to 7.1% for 120 days. The other nutritional content like protein, fibre, fat and ash reduced during the shelf life study. The minerals (Calcium and Magnesium) also reduced after 120 days.

### 3.4 Chlorophyll Content

The Chlorophyll content of the powders obtained from different dryers at different temperatures for fresh powder and stored powder (120 days) is presented below.

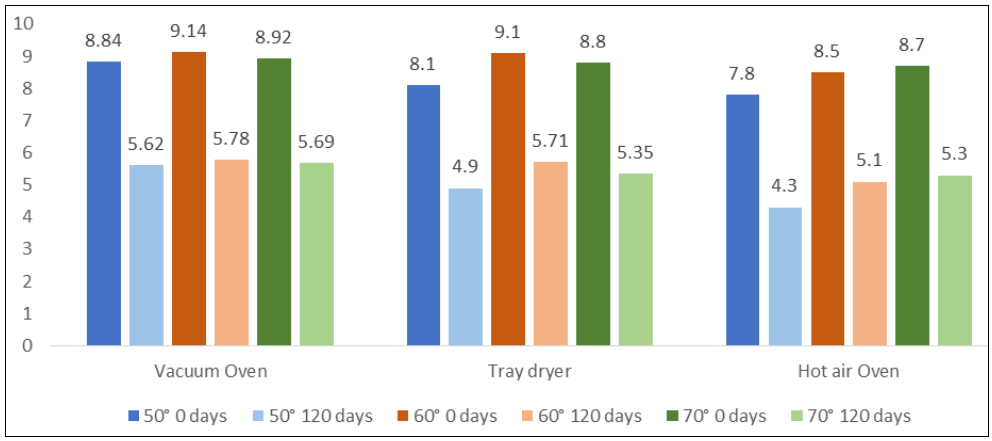


**Fig 7:** Chlorophyll content of Guava leaves powder at 50$^0$C, 60$^0$C and 70$^0$C

The Chlorophyll content for the Guava leaf powder obtained from Vacuum Oven and Tray dryer at 60$^0$C has the highest value of ~9.1mg/L when compared with other dryers and temperatures. The shelf life study indicated that the Chlorophyll content reduced drastically by ~4% for 120 days. The powders obtained at 50$^0$C has less Chlorophyll because of the longer duration of the drying time.

## 4. Conclusion

It can be concluded that the Tray drying method at 60°C was the best method of drying Guava leaves to obtain a Protein rich product of 9.57% for the fresh powder and 8.85% after 120 days (with less moisture content compared to others). Whereas, Vacuum Oven method of drying at 50°C is suitable to obtain a Fiber rich product of 5.3% for the fresh powder and 5.1% after 120 days. To obtain a mineral rich product, Tray drier at 50°C showed little high content of Calcium (0.055%) and Magnesium (0.017%) when compared to other dryers. As the temperature increased from 50°C to 70°C, the Protein content deceased by ~0.27% and Fibre reduced by ~0.15%. Vacuum Oven and Tray dryer at 60$^0$C was found to have highest chlorophyll content 9.14mg/L compared to other

dryers and temperatures. The above result was similar to the result observed by Satwase AN *et al*., 2013 [18].

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