IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Nutritional Analysis Of Selected Wild Fruit Species Of *Ziziphus Sp.* Found In Raipur Region, Chhattisgarh.

Sahu, C.[1], Bux, F.[2]*, and Pandey, A.K.[3]

[1] M.Sc. Botany, IV[th] Sem., Department of Botany, Kalinga University, Raipur, Chhattisgarh.
[2] Asst. Professor, Department of Botany, Kalinga University, Raipur, Chhattisgarh.
[3] Asst. Professor, Department of Botany, Kalinga University, Raipur, Chhattisgarh.

ABSTRACT

The goal of the current study was to undertake a comprehensive nutritional examination of the fruit *Ziziphus mauritiana*, often known as 'Indian jujube' or 'ber', in order to determine whether it may be a beneficial dietary source. The fruit samples were taken at the ideal point in their maturation and submitted to a variety of testing techniques to ascertain their precise nutritional profile. We evaluate the nutrition like- protein, carb, amino acid, ascorbic acid, organic acid and free fatty acid etc., from the ripened fruit pulp. The amount of total protein, total carbohydrates, and free amino acids was calculated using the Lowry technique, the Anthrone method, and the spectrophotometric method, respectively. The findings showed that *Ziziphus mauritiana* fruit has an impressive nutritional profile. The fruit is high in protein (9.24 micrograms per milligram of plant tissue), carbohydrates (1.07 µg per mg), amino acids (1.8 ± 0.46 µg per mg of plant tissue), ascorbic acid (6.49 mg per g of plant tissue), organic acid (380 µg per g of plant tissue), and free fatty acids (3.30 mg of oleic acid equivalent), according to the proximate analysis which are necessary for preserving healthy physiological processes.

Keywords: nutritional, *Ziziphus*, analysis, fruit, physiological.

1.INTRODUCTION

India is an incredible land containing a vast amount of diversity in plants. Due to their diversified agro-climatic conditions, which allowed for the development of a great range of fruit species, India is renowned as a "basket of Fruit and Vegetable" in the globe. Due to the wide variety of manufacturing As a result, the processing of these fruits not only increases their output but also has the potential to integrate into farmers' farming systems and increase their revenue. They are also the second-largest producer in the world, after

China. In the years 2022 to 2023, it was predicted that fruit output will amount to 102.76 million ton (Mathangi. 2022). Nutrition is about eating a healthy and balanced diet, by which the body builds with a healthy sign. Every day we take multiple types of nutrition by taking food including protein, carbohydrates, lipids, fat, etc. These molecules are badly needed for body growth. Like proteins are the building blocks of the body they provide repairing of cells and help to make a new one. Carbohydrate refers to the source of energy by which a body is able to work. Lipids are fatty compounds that work as storing of energy and are utilized in making vitamins and hormones in the body. Including this lipid plays an important role in the cell membrane that maintains the fluidity of the cell and helps in the cell signalling process (Miyamoto et al. 2013). Like everyday food, we get nutrition from fruits also. Fruit is a source of natural nutrition containing protein, carbohydrates, fat, vitamins, and multi-type of acids as per our body's needs.

Earth is such a green planet that has many types of plants and many of them are medicinal, vitamin-rich and some are poisonous. Similarly, India is a green country where every state has different fruits and different nutrients in all. In the Raipur region, fruits like – Guava (*Psidiumguajava*L.), Cheku (*Manilkarazapota*L.), Bael (*Aeglemarmelos*L.), and Mango (*Mangiferaindica*) are taken by tribes and localities including – children, young and adult people. Like Raipur in Chhattisgarh, the rest of the district and local people like to eat the local fruits as a source of Vitamins, Minerals, Antioxidant, Fiber. In the coastal region of Odisha Coconut (*Cocosnucifera*L.) is very often consumed by people, Tamarind (*Tamarindusindica*L.) and Jackfruit (*Artocarpusheterophyllus*Lam.) are some fruits usually taken by tribes. Likewise, those fruits contain health benefits that come under large economic and nutritional value. Focusing on research, the *Ziziphus* species is a wild fruit that has beenused as a nutritional source since ancient times, (Sangeethapriya and Siddhuraju, 2014). Wild fruits are the source that meets human needs for survival and this tradition was regulated by ancient times. Even before the fire was known, people used fruit as their diet (Mahapatra et al., 2012). *Ziziphus mauritiana* from the family Rhamnaceae, which is commonly known as *Ber* by local people, *barakoli, karkandhu* (Odia), *bordi* (Gujarati), *chirlimullu* (Malayalam), *boroi* (Manipur). The generic name is derived from Arabic and Greek terms '*Zizouf*' and '*Ziziphon*' respectively and the species name 'Mauritiana' is instructed from the island of Mauritius (Grice, 2002). The *Z. mauritiana* tree is a medium size tree (15m.high) with a woody brown trunk (40cm) thorny and a rapidly developing taproot. Trees are drought resistant and can grow in a wide range of soil (Nyanga and L. K. 2012). Leaves are obliquely elliptic-oblong. Flowers are cymes on axillary. Fruiting time is February to March end (Rathoreet.al,2012). Fruit is about 1-2.5 in length; it is oval or round depending on the variety. Skin is smooth and glossy, thin but tight. Flesh is white crispy and sour-sweet in taste. The seed is a too rigid structure. The fruit has a high nutritive value, being a rich source of protein, carbohydrates, amino acids, organic acids, fatty acids, ascorbic acid, vitamin C, etc. (Maruza et al., 2017). All vitamins work together to support a strong immune system that can fend off illness. In India, ripe fruits are mostly eaten raw, however occasionally they are cooked. Additionally, candid, dry, and powder are made from the ripe fruits (Maruza et al., 2017). *Ziziphus* has a large species diversity including 100 species from tropical and subtropical regions of the world (Bhattarai and Pathak, 2015) among the variety of species India have 17 species of *Ziziphus* like *Z. mauritiana, Z. jujube, Z. oenoplia, Z. nummularia, Z. xylopyrus.* The different varieties

show the different shape and structure and also different in taste also varies in fruiting time depending on the climate. This species is also beneficial for the agricultural field and Being a part of all farming systems and providing food, fuel, fodder, fencing, healthy fresh goods, and products with value additions, *Z. mauritiana* is important socioeconomically to the rural life of the locals. For desert animals including sheep, goats, camels, and cattle, *Z. nummularia*is a great top feed plant because it produces nutrient-rich leaves locally referred to as "Pala"(Singh and Meghwal, 2020).

Classification:

Kingdom – Plantae

Order – Rosales

Family - Rhamnaceae

Genus – Ziziphus

Species -*Mauritania*

The *Ziziphus* species have multiple benefits. They content vitamins, minerals, flavonoids and phenolic also some disease curing properties. Many of the documents about *Ziziphus* species do not show the property of therapeutic and biological activity. Over 7,000 years of cultivation history in China then it was introduced into Korea and Japan in 100 B.C. It is stated that the fruit of *Ziziphus* is valued as a traditional herbal medicine, used to treat induced apoptosis in cancer cells (Guo et al., 2021). In China, *Ziziphus* is well-known as a Chinese medicine with a history of over 4000 years. It accommodates over 170 species of trees and shrubs throughout the world (Muhammad et al., 2022). It is a tropical /subtropical fruit native to the northern hemisphere (Shahrajabian et al., 2019). In the Raipur region species of *Ziziphus l*ike- *Z. mauritiana*, *Z. jujube*, and *Z. oenopiloa* are seen (Verma, Pant, and Hanfi, 1985). People reported this species of *Ziziphus* to have a soothing effect and are approved as a soporific. It is eaten to cure abdominal pain in pregnancy, vomiting and to stop nausea. Not only fruits, leaves, seeds, and bark are also used for treatments like diarrhea and typhoid in children. The root is used to apply to old wounds in Ayurvedic therapy. In pharmacology, these species are used to cure cancer (Goyal et al, 2012).

1. Previously no work was done in Naya Raipur on the fruit. Analysis of *Z. mauritania* is beneficial to identify the nutritional content found in naya Raipur region.
2. To study the nutrient content of the *Ziziphus mauritiana* species for the future aspects.
3. To calculate the nutrient like- protein, carbohydrate, amino acid, ascorbic acid, fatty acid and organic acid for adding a better nutrient in diet.
4. To know the nutrients of *Ziziphus mauritiana* species and use them for making some nutritional and fast food like- energy drink, biscuit, candy etc.

This article represents the organic and inorganic component in the edible part of this plant; it also shows anticancer, anti-allergy and anti-inflammatory properties. Other than that, it contains pharmaceutical properties. Butt et al., 2021analyze the value of protein (7.9 g to 8.7 g), fat (0.8 g to 1.5 g), and carbohydrate (79.5 g to83.2 g). minerals like, Calcium (Ca), Potassium(K), Magnesium (Mg), Sodium (Na), Phosphorous(P), Iron (Fe), Zinc (Zn), Copper (Cu), Manganese (Mn). This article also evaluates the phenolic compound present in the leaves of the plant (Butt et al., 2021).

According to the current study, *Z. mauritiana's* edible wild fruits were abundant in vitamin C and other vital macro- and micronutrients. These fruits were gathered from areas in Punjab, Haryana, Rajasthan, and Himachal Pradesh. These fruits therefore showed the potential for usage as a food alternative in the human diet due to their high nutritional value. Additionally, increasing consumption and future domestication of these fruits might help rural and tribal populations that struggle with food shortages and hunger. It is necessary to examine and contrast the composition of wild fruits with that of other types of conventional fruits (Sareen et al., 2020).

This study represents the benefits of leaf, seed and fruit due to its large economical and pharmaceutical value. In Malaysia the*Z. mauritiana* gain a unique identification since ancient for its uses in Islamic traditional use for large health benefits. It reported that according to Mohd et al., 2020 analysis of crude protein, carbohydrate, fat is nearly (14.59%), (63.24%) and (1.89%) respectively and physicochemical characteristic including pH (potential of Hydrogen), TSS (total soluble solids) and TA (Titratable acidity) (Mohd et al.,2020).

2. STUDY AREA

Naya Raipur is the newly carved city with the boundary including Raipur, Arang, Mahasamund, Rajim, and Abhanpur. Raipur is located nearly thirty kilometers from Naya Raipur. Kotni is the village that comes under the Naya Raipur several villages near to Kotni including Palaud, Tandul, Kuhera, Parsada, Tendua, Pachera. Kotni has a warm environment. Summer generally starts from March to July. The middle of summer has reached around 45-50 ºC. At the end of July to September the rainy season started. The geographical location of Kotni is 21.17ºN latitude, and 81.82ºE longitude.

This area included a variety of plant vegetation which is herb, shrub, grass, tree, and climber. *Ziziphus mauritiana* is the thorny shrub. Fresh, sour and sweet '*ber*' fruit were collected from Naya Raipur, Kotni village in Chhattisgarh in the month of January to March 2023, when the fruit is in season. The fruit was collected from the field near the Kalinga University in Kotni (Pandey, 2021).

Figure 2.1: India map showing the Indian States including Chhattisgarh

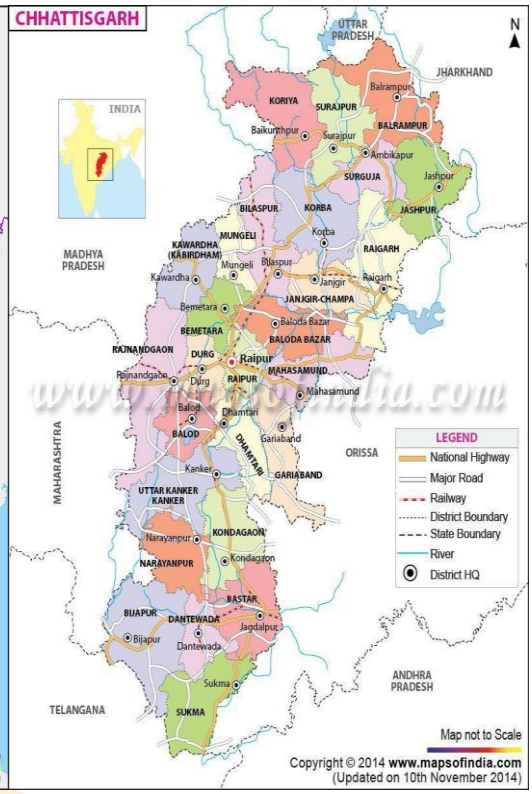

Figure 2.2: Map of Chhattisgarh showing various districts and capital Raipur

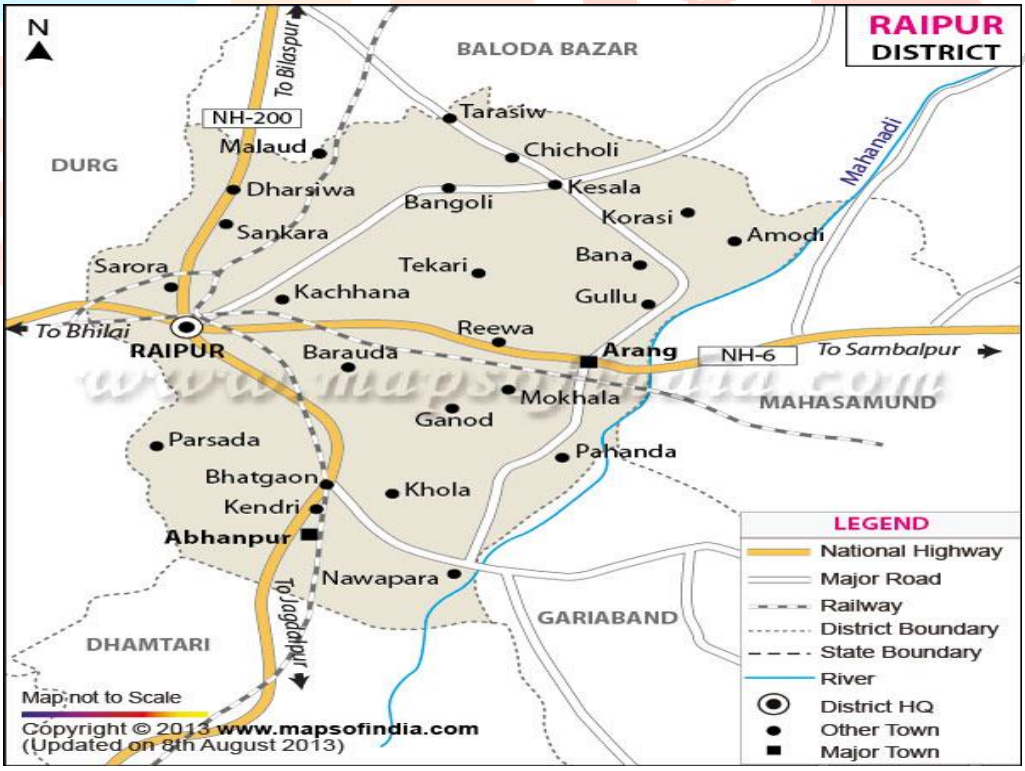

Figure 2.3: Map of Raipur city capital Chhattisgarh

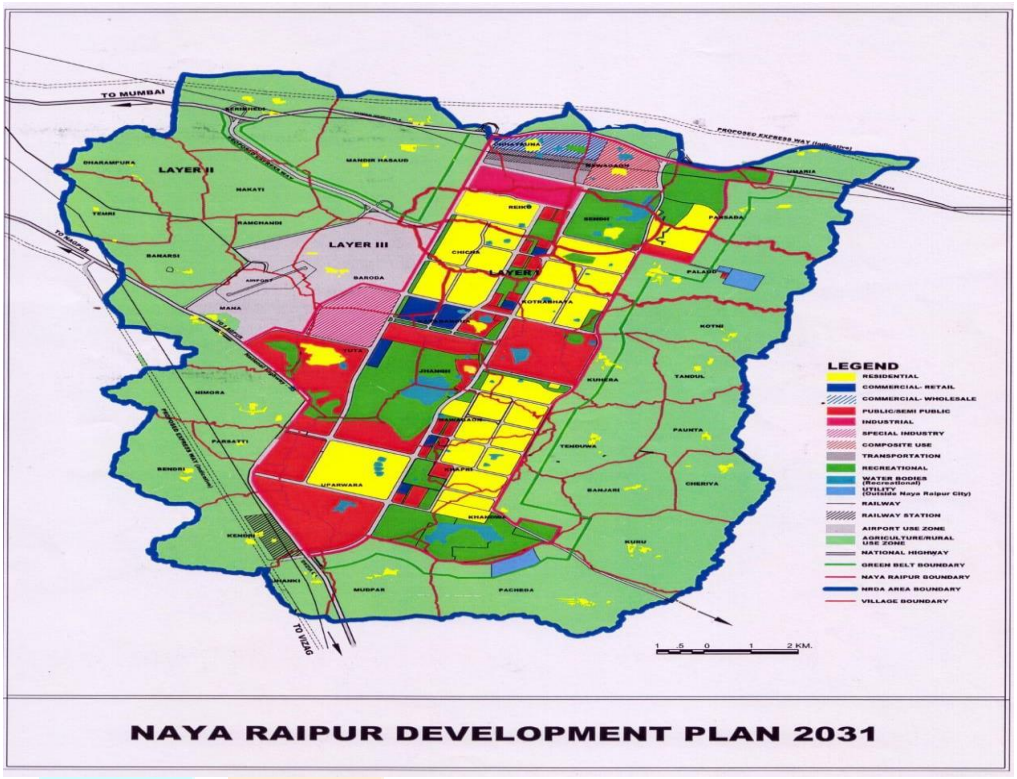

Figure 2.4: Map of Naya Raipur with showing the villages and new city near to Naya Raipur.(Courtesy: NRDA)

3. Material and Methods

Sample collection:

For nutrient analysis, the fruit sample was collected from the area of Kotni village near to the Kalinga University. Both ripe and unripe fruit were plucked and washed with running tap water to get rid of the dirt then let the fruit air dry after the fruits are dry and keep the sample in the refrigerator for further analysis.This sample were collected between January to march.

Estimation of protein:

The estimation of protein was performed according to the Lowry method. Taking a 500 mg sample fresh plant. Grind with pastel and mortar with the help of 10 ml of phosphate buffer saline and then centrifuge under 3500 rpm(Revolutions Per Minute) for 5 minutes. The supernatant was collected for the determination of protein content. Take 0.1 and 0.2 of supernatant. Make the final volume 1 ml and add 5 ml of Lowry's solution. After 5 minutes, add 0.5 ml of folin-ciocalteau reagent into the mixture. After 30 minutes of incubation, the absorbance of the sample was recorded with Spectrophotometer at 660 nm. The sample preparation has been done with various concentrations of 40, 80, 100,160, and 200µg/ml standard protein solution of Bovine serum albumin (Lowry et.al., 1951).

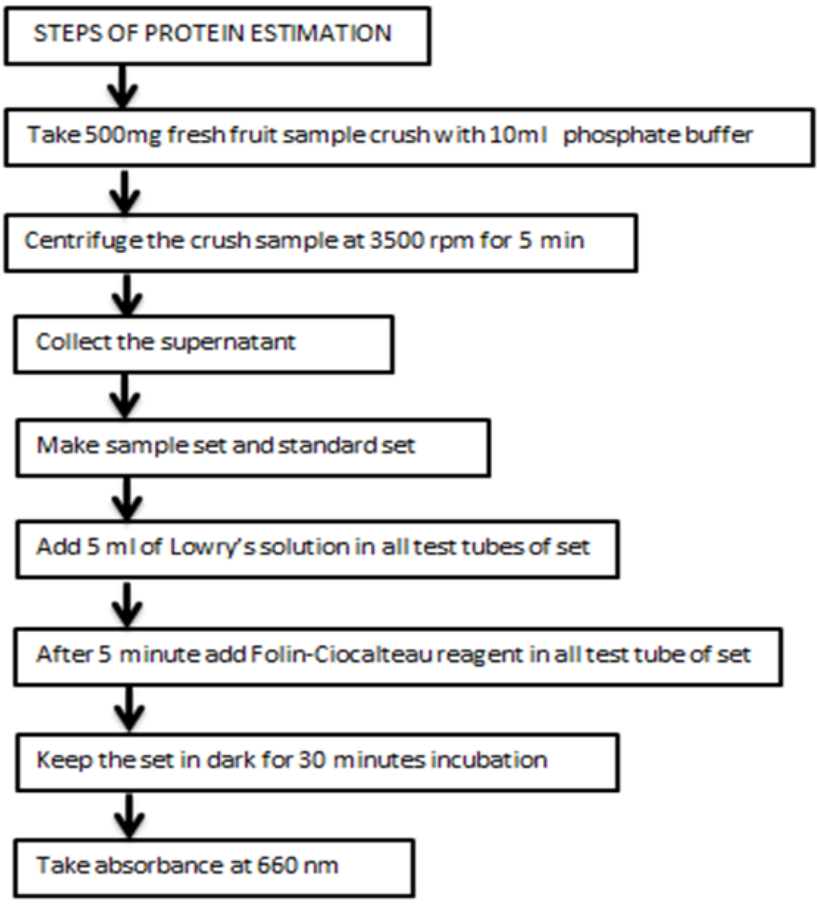

Figure 3.1: Steps followed for protein estimation

Estimation of Carbohydrates:

The estimation of carbohydrates was performed according to the Anthrone reagent method.100 mg plant part grind with phosphate buffer saline add 5ml of 2.5 N HCl. Keep the solution under the water bath for 4 hours, then cool to room temperature, and with the help of sodium carbonate the solution neutralize until effervescence ceases. Add 95ml of distilled water and makeup to the volume of 100ml. centrifuge at 3500 rpm for 10 minutes. The supernatant was taken and used for the estimation of the carbohydrate. Add 0.5 ml and 1 ml of supernatant in different test tubes. Make the final 1ml. add 4 ml of freshly prepared chilled Anthrone reagent, kept these tubes in a water bath for 8 minutes then cool rapidly by kept those test tubes in refrigerator. A standard set of solutions of glucose reagents from 20, 40, 60, 80, and 100µg /ml also prepare in the same manner. Absorbance was taken with the help of a Labtronics UV- visible spectrophotometer at 630nm. The same procedure was followed with a standard solution of glucose of various concentrations of 20,40,60,80 and 100µg/ ml (Dreywood, 1946).

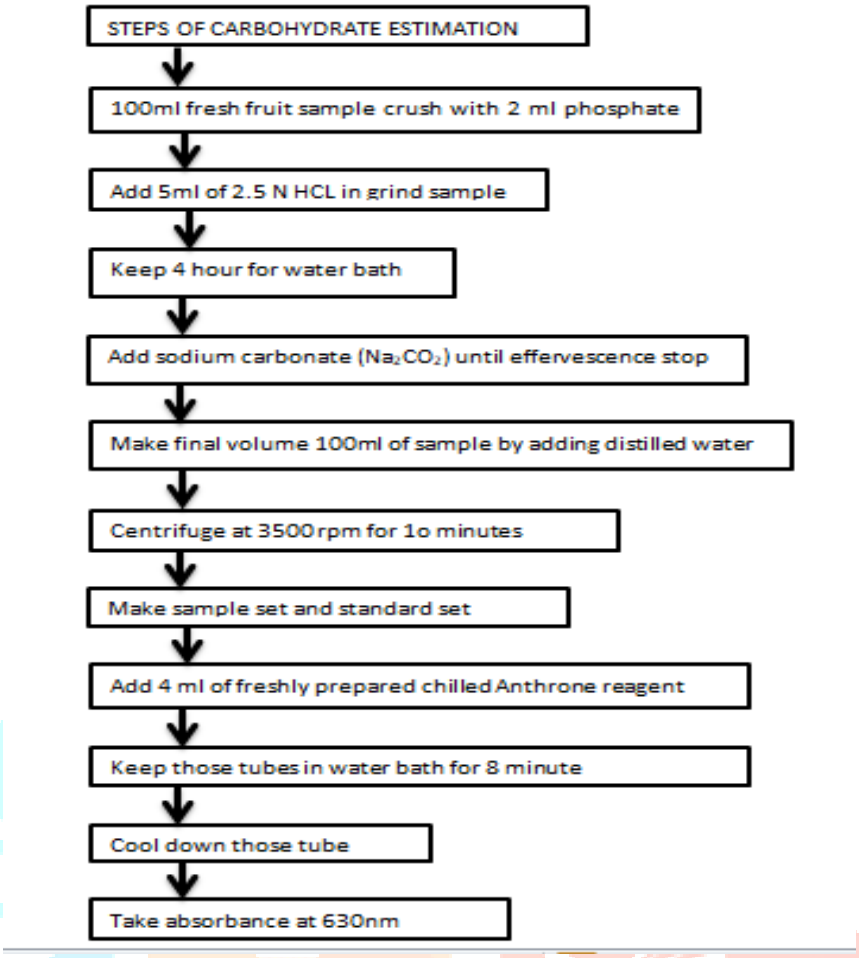

Figure 3.2: Steps followed for Carbohydrate estimation

Estimation of free amino acid:

The stock solution was prepared by using 0.0148mg of glycine dissolved in 14.8 ml of distilled water. From the stock solution, 1ml of this solution and dissolved into 9ml of distilled water to prepare the standard.in separate tests, tubes pipette out 1, 2, 3, 4, and 5 ml of working standard. In 3 test tubes, 1ml and 2ml of plant samples were also taken. Add 0.5 ml of acetate buffer and 0.5 ml of Ninhydrin solution to each test tube. Place test tubes in a hot water bath for 20-30 minutes until a purple color is developed. Then the mixture is transferred to a 50ml volumetric flask. Makeup to a volume of 50 ml by adding distilled water reading was recorded at 570nm with the help of a UV- spectrophotometer (Ito et al., 2017).

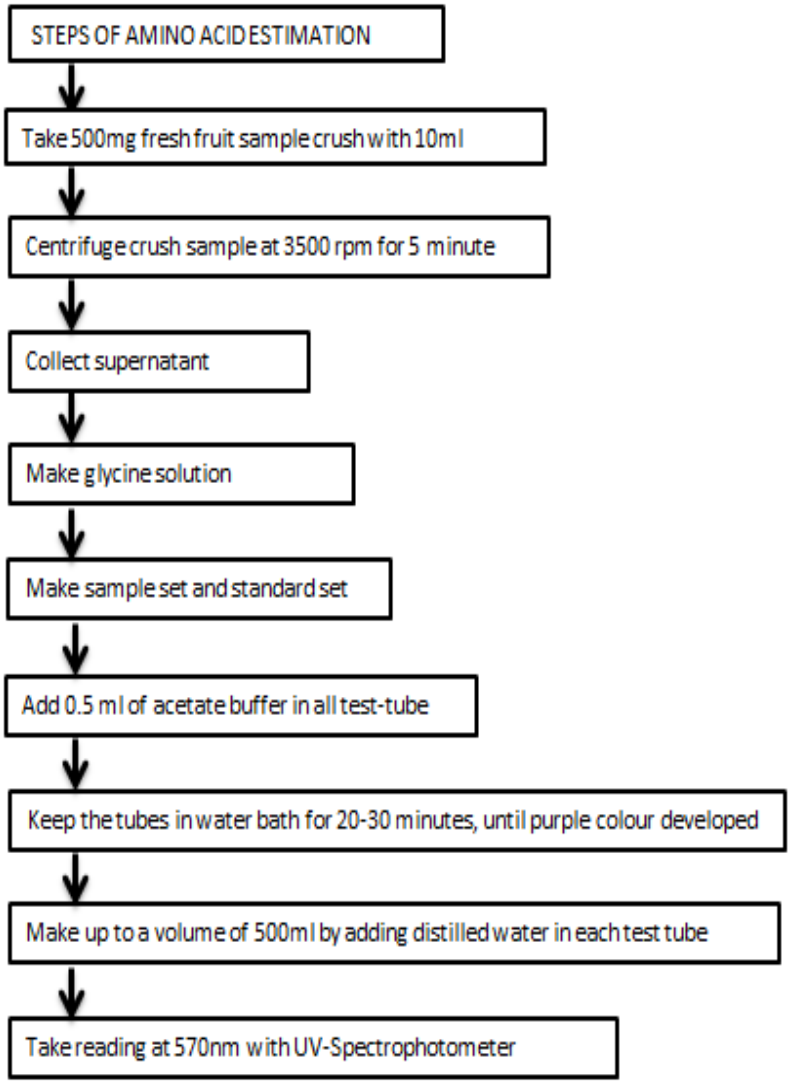

Figure 3.3: Steps followed for Amino acid estimation

Estimation of Ascorbic acid:

Pipette out 5ml of the working standard solution into 100ml of the conical flask. Add 10 ml of 4 percent oxalic acid and titrate against the dye (v_1 ml). The end point is the appearance of pink color which persists for a few minutes. The amount of dye consumed is equivalent to the amount of ascorbic acid. Extract the sample (0.5-5g depending on the sample) in 4 percent oxalic acid and makeup to a known volume (100ml) and centrifuge. Pipette out 5ml of this supernatant, add 10ml of 4 percent oxalic acid, and titrate against the dye (V_2 ml) (Sadasivam, S., & Balasubramanian, T. 1987).

Amount of ascorbic acid mg per 100 ml sample:

$$\frac{0.5\text{mg}}{V_1\text{ ml}} \times \frac{V_2\text{ml}}{5\text{ml}} \times \frac{100\text{ ml}}{\text{wt. of the sample}} \times 100$$

Where; V_1= working standard +(4%) oxalic acid

V_2 = supernatant + (4%) oxalic acid

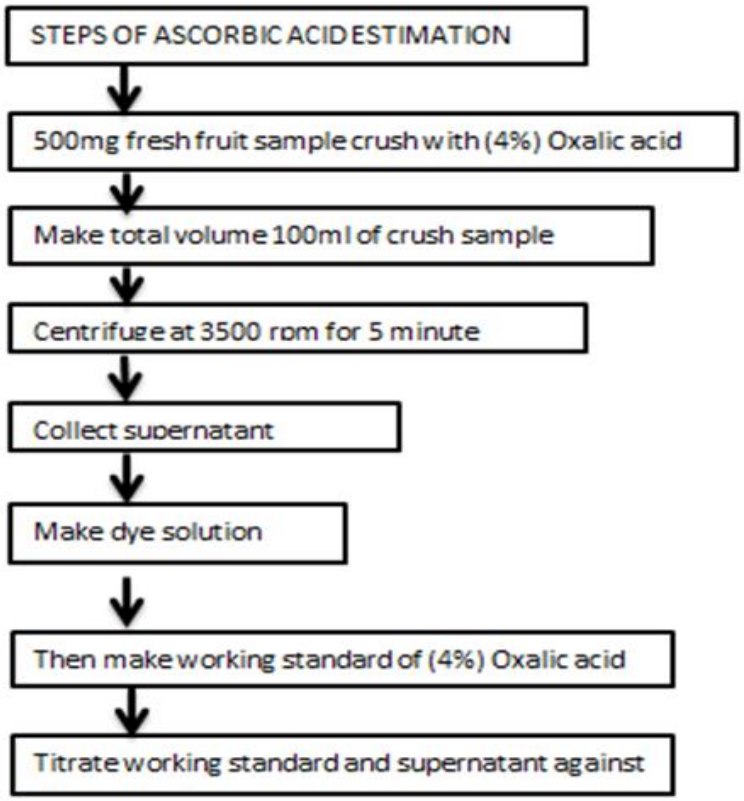

Figure 3.4: Steps followed for Ascorbic acid estimation

Estimation of organic acid:

10ml extract is taken in a 100 ml conical flask and a few drops of phenolphthalein are added. Finally, the content is titrated against the N/20 NaOH solution. The end point of the titration is indicated by the appearance of pink coloration of the solution for about 20 seconds. Standardization of the N/20NaOH solution is done by the N/20 Oxalic solution. The amount of free organic acid is determined and expressed as an equivalent volume of N/20 NaOH solution. (Santra, 2015)

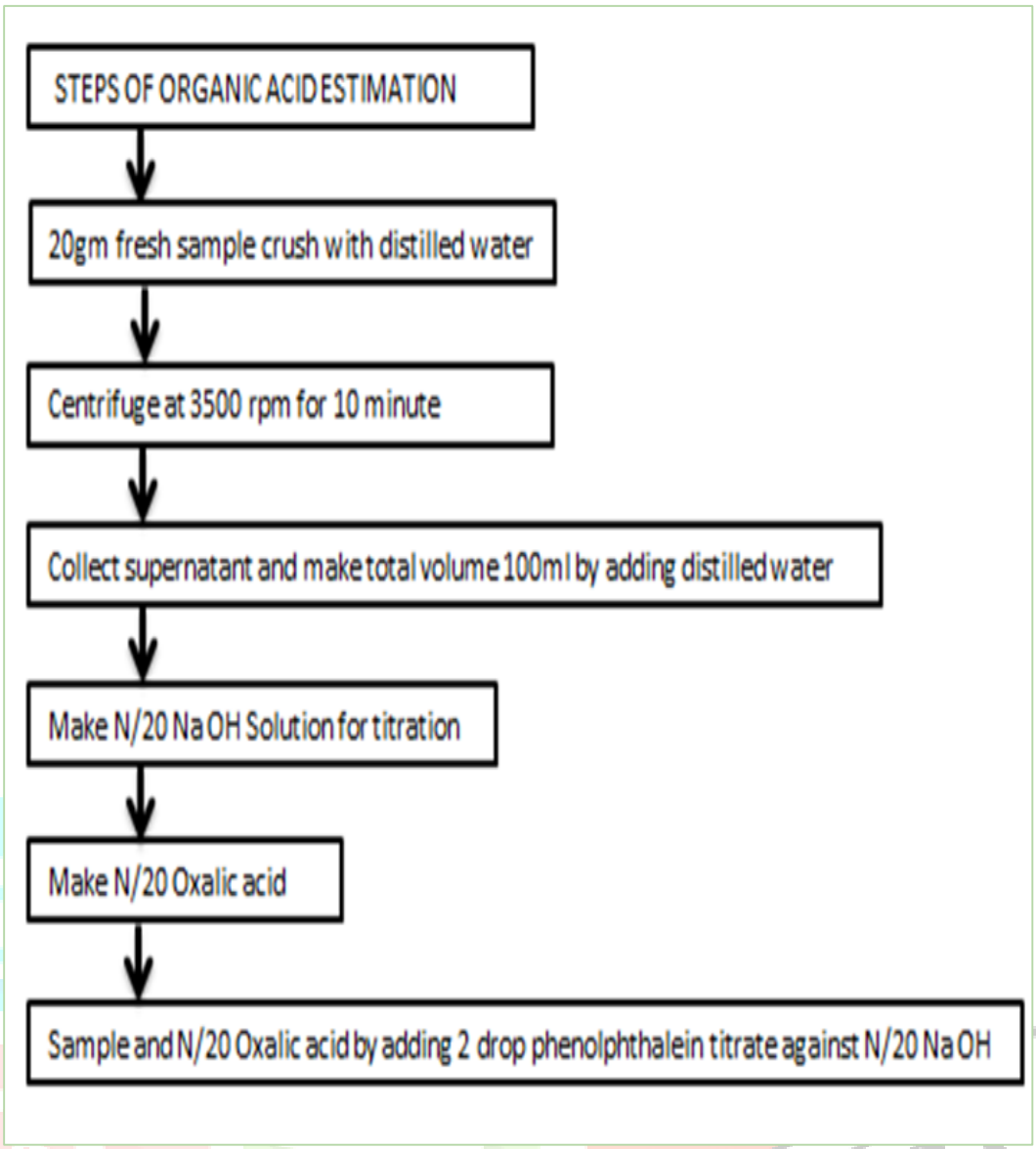

Figure3.5:Steps followed for Organic acid estimation

Estimation-free fatty acid:

1-10gm of oil or melted fat is dissolved in 50 ml of the neutral solvent in a 250 ml conical flask. A few drops of phenolphthalein are added. The contents are titrated against 0.1N potassiumhydroxide. Shake constantly until a pink colour which persists for fifteen seconds is obtained. The free fatty acid content is expressed as Oleic acid equivalent by using this formula. The acid number is defined as the mg KOH required neutralizing the free fatty acid present in 1gm of sample. (Santra,2015).

$$\text{Acid value (mg KOH/gm)} = \frac{\text{Titrate value} \times \text{normality of KOH} \times 56.}{\text{Weight of sample(gm)}}$$

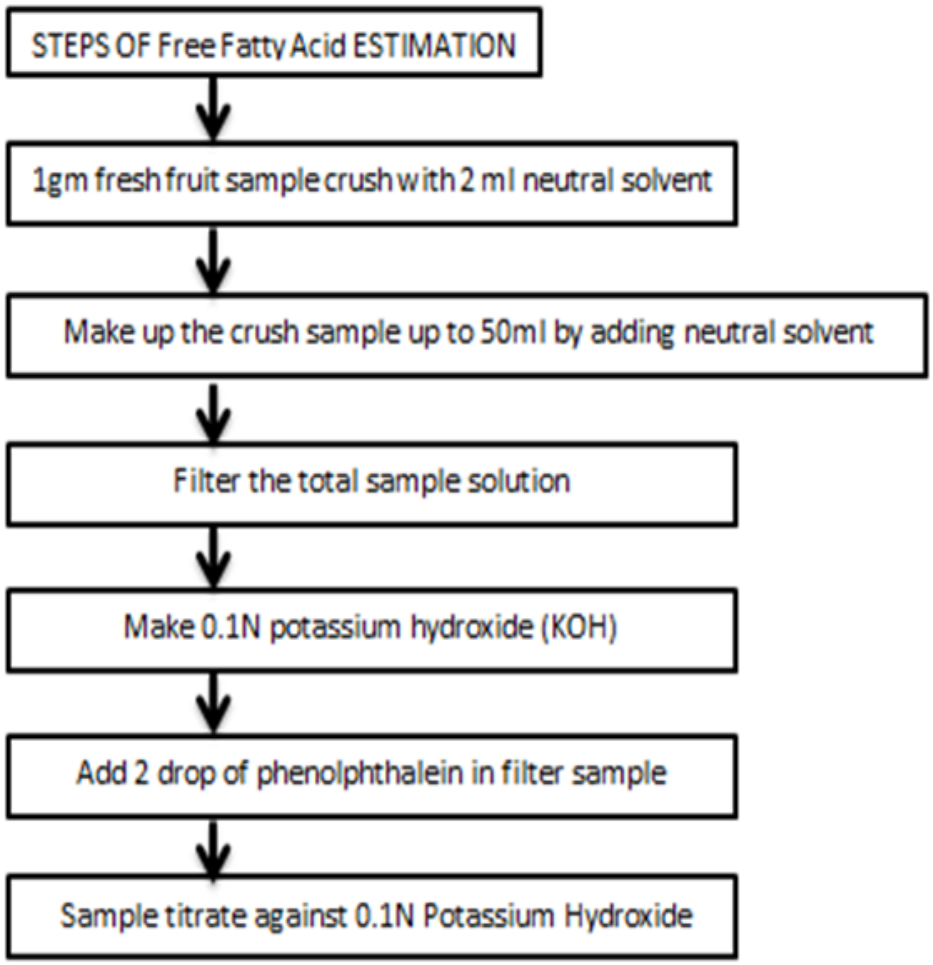

Figure 3.6: Steps followed for Free Fatty estimation

4.Result and Discussion

The result of the present study represents about the Protein, Carbohydrate, Amino acid, Ascorbic acid, Organic acid, Free Fatty acid content were evaluate in µg per mg of the wild fruit *Z. mauritiana.*

Table 1: Tabel showing the nutrient content value of *Ziziphus mauritiana*

Ziziphus mauritiana	
Parameters	**Plant Tissue Content**
Total Protein content	9.2433 (µg per mg) plant tissue
Total Carbohydrate content	1.07352 (µg per mg) plant tissue
Total Amino acid content	1.8 ± 0.46 (µg per mg) plant tissue
Total Ascorbic acid content	6.49 mg per 25 mg plant tissue
Total Organic acid content	380µg per 1 gm plant tissue
Total Free Fatty acid content	3.30 mg oleic acid equivalent

Table 2:showing different values absorbance for Protein estimation standard curve.

Concentration	Absorbance
40	0.05
80	0.08
120	0.101
160	0.123
200	0.134

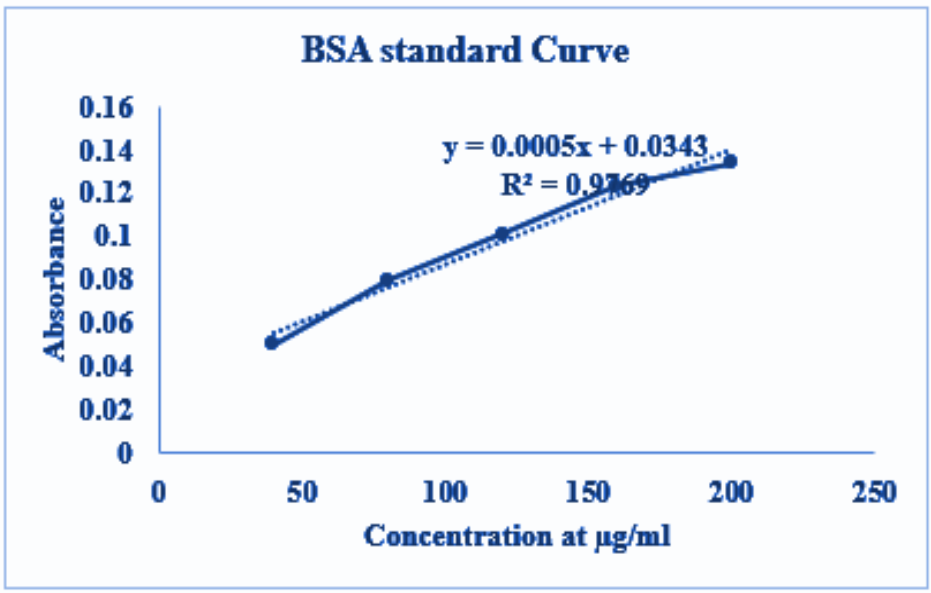

Figure 4.1: Protein standard curve.

The graph showing above is represent the curve of protein, that is created concentration against absorbance and form a straight line curve.

Where; x and y are axis of graph and R^2 stand for

Regression value formula:

y= 0.0005x+0.0343, R^2 =0.9769

Total protein content was recorded 9.2433µ gram per milligram plant tissue in *z. mauritiana*.

The BSA (Bovine serum albumin) standard curve represent the total protein content was recorded 9.2433µg per mg of plant tissue in *Ziziphus mauritiana*. Total protein content value was calculated using the formula as shows in figure 2.

In some previous study they concluded that the average amount of crude protein per 100 g of digestible dry weight was around 7.9 and 8.7 g. it is a good amount for Ziziphus species as per the study (Nyanga et al., 2013). Also in other study the evaluation of the total protein per 100g is found to be 6.18 ± 0.13mg. Including the molecule minerals are found in a good amount(Keta, 2017).

Table 3: A table showing different values and absorbance for Carbohydrate estimation standard glucose curve.

Concentration	Absorbance
20	0.1323
40	0.2533
60	0.3896
80	0.493
100	0.6283

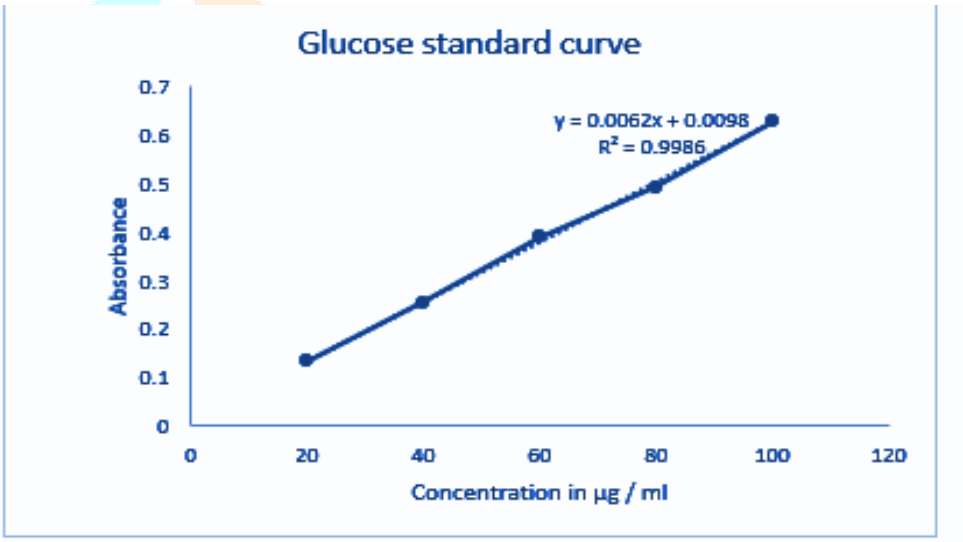

Figure 4.2: glucose standard curve.

The graph showing above is represent the curve of glucose, that is created concentration against absorbance and form a straight line curve. Where; x and y are axis of graph and R^2 stand for Regression value: formula: y=0.0062x+0.0098, R^2 =0.9986 Total carbohydrate content was recorded 1.07352µ gram per milligram plant tissue in *Z. mauritiana.*

Carbohydrate content was evaluated by using Anthrone method. With the help of standard curve of glucose and formula for total carbohydrate content value in per mg plant tissue is about 1.07352 µg in *Z. mauritiana* as per the conducted study, shown in the figure 3. In some other study they calculate the carbohydrate present in between 79.5 ± 0.0 and 83.2 ± 0.0 g (Nyanga et al., 2013). In a study of *Z. Mauritiana* analysis the value of carbohydrate 40.45±0.45% in the wild fruit that is use for making some nutritious food foe local people (Abubakar et al., 2017).

Table 4: A table showing different values and absorbance for Amino Acid estimation standard curve:

Concentration	Absorbance
40	0.044
80	0.108
120	0.158
160	0.213
200	0.265

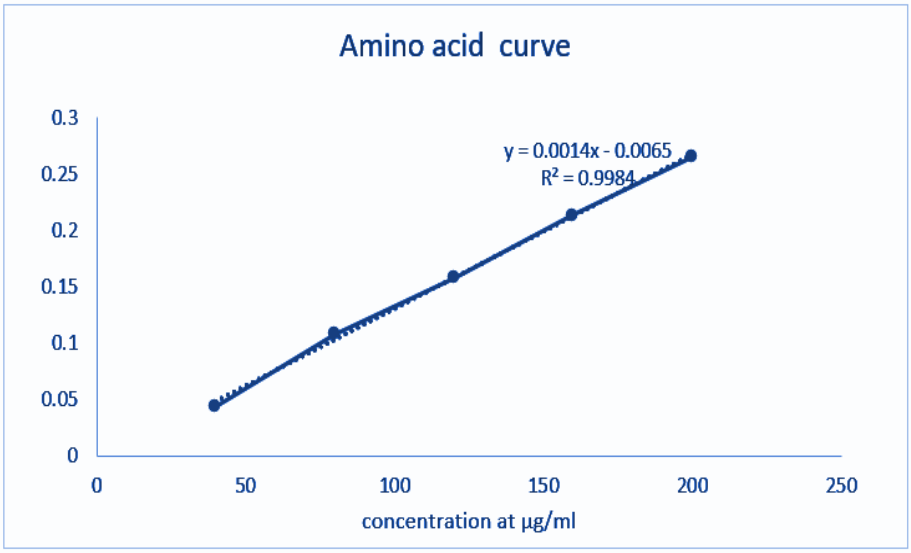

Figure 4.3: Glycine standard curve for amino acid.

The graph showing above is represent the curve of Amino acid, that is created concentration against absorbance and form a straight line curve. Where; x and y are axis of graph and R^2 stand for Regression value: formula: $y=0.0014x-0.0065$, $R^2=0.9984$

Total amino acid was recorded 1.8 ± 0.46 µ gram per milligram plant tissue

In the present study the amino acid content was determined by using the standard curve of glycine shown in the figure 4. Value was calculated by the formula. Total amino acid contain recorded as 1.8 ± 0.46 µg per mg plant tissue. Total Ascorbic acid content 6.490mg per 25 mg plant tissue in *Ziziphus mauritiana*. In some previous study the fruit pulp aqueous extract, with values of 0.351 and 0.247 for vitamin C, respectively. Vitamin c is also known as ascorbic acid present in some fruit pulp (Abubakar et al., 2017). The total Organic acid present is 380 µg in per 1gm plant tissue in *Ziziphus mauritiana*. Total Free Fatty acid content 3.30 mg oleic acid is equivalent gram plant tissue as per the present study on *Ziziphus mauritiana*.

5. Conclusion

Ziziphus mauritiana species of *Ziziphus* species are particularly beneficial to satisfy physiological demands in humans, according to the current body of research. Because this wild fruit has a significant amount of nutrients, according to the study report, it will eventually have significant commercial value as a food source, a component in energy drinks, etc.

According to the current study, the protein, carbohydrate, amino acid, ascorbic acid, organic acid, and fatty acid from *Z. mauritiana* were evaluated for usage in upcoming fast-moving consumer goodsitems (FMCG). The six basic nutrients that a healthy body needs are vitamins, minerals, protein, water, carbohydrates, and fats. The body benefits from and maintains nutritional dosages from the combination of micronutrient and macronutrient nutrients. Micronutrients are vitamins and minerals that a human needs in little doses, whereas macronutrients, such as water, protein, carbohydrates, and fats, are needed in big quantities. These two types of nutrients, micro and macro, both are present in comparable quantities in plant sources. We obtain the whole set of nutrients for a healthy body by eating foods derived from plants, such as fruits and vegetables.

6. References

Abubakar, S., Osuji, C., Etim, V. A., &Gbolahan, G. M. (2017). Proximate, minerals and antioxidant prospective of sub–saharan processed local biscuit (Akuri) from wild edible fruit *Ziziphus mauritiana* (Lam). *J. Environ. Life Sci*, 2(1): 1-6.

.**Bhattarai, K. R., &Pathak, M. L. (2015).** A new species of *Ziziphus* (Rhamnaceae) from Nepal Himalayas. *Indian Journal of Plant Sciences*, *4*(2), 71-77.

Butt, S. Z., Hussain, S., Munawar, K. S., Tajammal, A., &Muazzam, M. A. (2021). Phytochemistry of *Ziziphus Mauritiana*; its Nutritional and Pharmaceutical Potential. Scientific Inquiry and Review, 5(2), 1-15.

Dreywood, R. (1946). Qualitative test for carbohydrate material. *Industrial & Engineering Chemistry Analytical Edition*, *18*(8), 499-499.

Goyal, M., Nagori, B. P., &Sasmal, D. (2012). Review on ethnomedicinal uses, pharmacological activity and phytochemical constituents of *Ziziphus mauritiana* (Z. jujuba Lam., non-Mill). *Spatula DD*, *2*(2), 107-116.

Grice, A. C. (2002). The biology of Australian weeds.39. Ziziphus mauritiana Lam. *Plant Protection Quarterly*, *17*(1), 2-11.

Guo, M., Zhang, Z., Li, S., Lian, Q., Fu, P., He, Y., ...& Zhao, X. (2021). Genomic analyses of diverse wild and cultivated accessions provide insights into the evolutionary history of jujube. *Plant biotechnology journal*, 19(3), 517-531.

Ito, H., Ueno, H., & Kikuzaki, H. (2017). Free amino acid compositions for fruits. *Journal of Nutrition and Dietetic Practice*, 1(1), 1-4.

Keta, J. N. (2017). Proximate and mineral elements analysis of Ziziphus mauritiana fruits. *UMYU Journal of Microbiology Research*, *2*(1), 247-250.

Lowry, O. H., Rosebrough, N. J., Farr, A. L., & Randall, R. J. (1951). Protein measurement with the Folin phenol reagent. *Journal of biological chemistry*, *193*, 265-275.

Mahapatra, A. K., Mishra, S., Basak, U. C., & Panda, P. C. (2012). Nutrient analysis of some selected wild edible fruits of deciduous forests of India: an explorative study towards non-conventional bio-nutrition. *Advance Journal of Food Science and Technology*, *4*(1), 15-21.

Maruza, I. M., Musemwa, L., Mapurazi, S., Matsika, P., Munyati, V. T., &Ndhleve, S. (2017). Future prospects of Ziziphus mauritiana in alleviating household food insecurity and illnesses in arid and semi-arid areas: A review. *World Development Perspectives*, 5, 1-6.

Mathangi, S. (2022). Studies on drying characteristics physico chemical and functional properties of ziziphus mauritiana fruit pulp, P.hD, Thesis, Periyar University.

Mirheidari, F., Khadivi, A., Saeidifar, A., &Moradi, Y. (2022). Selection of superior genotypes of Indian jujube (*Ziziphus mauritiana* Lamk.) as revealed by fruit-related traits. *Food Science & Nutrition*, *10*(3), 903-913.

Miyamoto, T., Wright, G., & Amrein, H. (2013). Nutrient sensors. *Current Biology*, *23*(9), R369-R373.

Mohd Jailani, F. N. A., Zaidan, U. H., Hanizam Abdul Rahim, M. B., AbdGani, S. S., &Halmi, M. I. E. (2020). Evaluation of constituents and physicochemical properties of Malaysian underutilized *Ziziphus mauritiana* (Bidara) for nutraceutical potential. *International Journal of Fruit Science*, *20*(3), 394-402.

Muhammad, N., Luo, Z., Yang, M., Liu, Z., & Liu, M. (2022). The nutritional, medicinal, and drought-resistance properties of *ziziphus* mill. Make it an important candidate for alleviating food insecurity in arid Regions—a case of Pakistan. *Horticulturae*, 8(10), 867.

Nyanga, L. K., Gadaga, T. H., Nout, M. J., Smid, E. J., Boekhout, T., &Zwietering, M. H. (2013). Nutritive value of masau (Ziziphus mauritiana) fruits from Zambezi Valley in Zimbabwe. *Food Chemistry*, 138(1), 168-172.

Pandey, A. K. (2021). An ethno botanical study of medicinal plants in Atal Nagar (New Raipur) of Chhattisgarh, India. *International Research Journal of Plant Science*, 12(1), 1-18.

Rathore, S. K., Bhatt, S. H. A. S. H. A. N. K., Dhyani, S., & Jain, A. (2012). Preliminary phytochemical screening of medicinal plant Ziziphus mauritiana Lam. fruits. *International Journal of Current Pharmaceutical Research*, *4*(3), 160-162.

Sangeethapriya, M., &Siddhuraju, P. (2014). Health related functional characteristics and antioxidant potential of mucilage (dietary fiber) from Zizyphus mauritiana fruits. *Food Science and Human Wellness*, *3*(2), 79-88.

Sareen, A., Gupta, R. C., Bansal, G., & Singh, V. (2020). Comparison of key mineral elements in wild edible fruits of Ziziphus Mauritiana and Z. nummularia using atomic absorption spectrophotometer (AAS) and flame photometer. *International Journal of Fruit Science*, *20*(sup2), S987-S994.

Santra, S.C. (2015). Practical Botany, New Central Book Agency Volume –II, 2015 pg 62-72

Singh, A., &Meghwal, P. R. (2020). Socio-economic and horticultural potential of Ziziphus species in arid regions of Rajasthan India. *Genetic Resources and Crop Evolution*, *67*, 1301-1313.

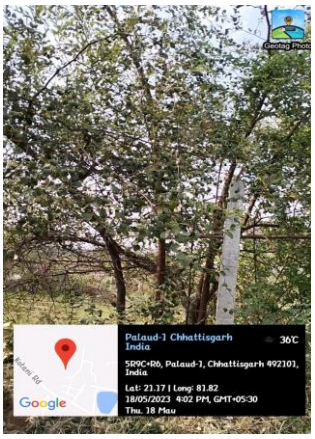

Fig. 7.1 Area of sample collection

Fig.7.2 Leaves of *Z. mauritiana*

Fig. 7.3 Collected fruit sample of *Z. mauritiana*

Fig.7.4: Set of standard Protein Solution estimation of Ascorbic Acid

Fig. 7.5: Oxalic acid titrate against dye during

Fig.7.6: Set of Standard Amino acid solution