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# Comparative Quantification of Total Carbohydrate and Protein Content of Aerial Parts of *Neolamarckia cadamba*

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**ABSTRACT: Nutritive compounds such as carbohydrates and proteins are the main source of energy which is essential for the proper physiological process. In the present study carbohydrate and protein contents of aerial plant parts of *Neolamarckia cadamba* (leaves, bark, unripe fruits and ripe fruits) were analysed using respective standard methods. For analysis extracts of plant parts were prepared in ethanol (1:10 w/v). The highest carbohydrate content of 42.61 ± 2.8 mg/g of GLUEwas observed in bark followed by leaves, ripe fruits and unripe fruits whereas protein content of 40 ± 0.14 mg/g BSAE was found to be highest in leaves followed by unripe fruits, bark and ripe fruits. These findings will help in determining the nutritional potential, quality and benefits of *Neolamarckia cadamba*as food.**

**Keywords:** *Neolamarckia cadamba*, carbohydrate, protein, ethanol, Jharkhand.

## INTRODUCTION

*Neolamarckia cadamba* is an important indigenous medicinal plant that also holds an important place in Ayurveda. It is a widely distributed tree in the world and commonly found all over India. The tree has been frequently used economically in wood industries for making furniture, paper and in the production of pulp. Forages, tribal communities have been using the plant parts of *N. cadamba* such as leaves, bark, roots and fruits for the treatment of various ailments such as spermatorrhoea, throat infection, anemia, and tumor. Leaves of *N. cadamba* are used against swelling, menorrhagia, wound and pain. Barks of the plant are used against skin infection, dysentery and diarrhoea (Devgan *et al.*, 2012). In recent years there has been growing interest towards plant based medicines and drugs due to cost efficiency, easy availability and minimal or no side- effects of plant based medicines. *N. cadamba* has been studied for its phytochemical properties and has been identified as consisting of alkaloids, flavonoids, tannins, phenols, terpenoids and alkaloids (Shikha and Kumar 2022). Various pharmacological studies have revealed that *N. Cadamba* possesses anticancer, anti- inflammation, antidiabetic, antimicrobial and antioxidant activity (Umachigi *et al*., 2007; Chandrashekar and Prasanna 2009; Pant *et al*., 2012; Mishra *et al*., 2018; Munira *et al.*, 2020). However, there is very little work on *N cadamba* as food and its nutritive value. Macronutrients are essential nutrients that are needed in good amounts to keep the body and mind healthy. Macronutrient balance helps in the longevity of lifespan. Carbohydrates and proteins are such macronutrients that are essentially needed in the diet for the proper function of a healthy body. The ratio of carbohydrates and protein is also important as they affect our day to day mental performances (Fischer *et al*., 2002). This present study quantifies the total carbohydrate content and total protein content present in different parts of *N. cadamba*.

## MATERIALS AND METHODS

**Collection and Extraction.** Different plant parts (leaves, barks, ripe fruits and unripe fruits were collected from Ranchi, Jharkhand. Plant parts were washed properly under running water. Leaves and bark were dried at room temperature whereas fruits were dried in an oven at 60°C. Dried plants were subjected to crushed into powder form using mechanical grinder. 2gm of powder of each plant material was extracted with 20 ml of ethanol (1:10 w/v) and kept in a rotary shaker for 24 hrs. Later the mixtures were percolated using filter paper. Each stock solution of plant parts was stored for further usage.

**Total Carbohydrate Content.** Anthrone method (Plummer, 1990) was used for the quantification of total carbohydrate content with glucose as standard solution. For reagent 0.25gm of anthrone was dissolved in 125 ml of $H_2SO_4$. Glucose standard solution was prepared by dissolving 200µg glucose in 1 ml of distilled water. Glucose solutions of different ranges (200µg/ml) were taken into test tubes and distilled water was added to make volume upto 1 ml. 5 ml of anthrone reagent were added to extract solution and standard solution and mixed well. All the test tubes were incubated for 17 minutes at 90°C. Absorbance of samples was recorded using UV- VS spectrophotometer at 620 nm. Total carbohydrate content was expressed in mg of GLU (glucose equivalent)/g of extract against glucose standard curve.

**Total Protein Content.** Biuret method (Raghuramulu *et al*., 1983) was used for the quantification of total

carbohydrate content with glucose as standard solution. For reagent 3 gm of copper sulphate and 9 gm of potassium sodium tartrate were dissolved in 0.2 mol/L sodium hydroxide. For protein standard solution 5 mg of Bovine serum albumin (BSA) was added to 1 ml of distilled water. BSA standard solutions of different ranges (5 mg/ml) were taken into test tubes and distilled water was added to make volume upto 1 ml. 3 ml of biuret reagent was added to extract solution and standard solutions and mixed well. All the test tubes were incubated for 10 minutes at 37°C. Absorbance of samples was recorded using UV- VS spectrophotometer at 540 nm. Total carbohydrate content was expressed in mg of BSA (bovine serum albumin equivalent)/g of extract against glucose standard curve.

## RESULTS AND DISCUSSION

Nutritional supplement is essential for the physical and mental endurance of the human body. Carbohydrate and protein are important and major sources of energy that influences physiological process. Carbohydrates are chemically divided into sugars, oligosaccharides and polysaccharides. Although apart from chemical properties of carbohydrate, health and physiological effects also depend on the physical properties of carbohydrates such as structure, solubility, crystallization etc. (Cummings and Stephan 2007).

**Table 1**: **Total carbohydrate contents of *N. cadamba.***

| Sr. No. | Plant Sample | contents (mg/g of GLUE*) |
|---|---|---|
| 1. | Leaves | 41.13 ± 2.10 |
| 2. | Bark | 42.61 ± 2.8 |
| 3. | Ripe fruits | *34.3* ± 2.6 |
| 4. | Unripe fruits | *28.23* ± 1.81 |

*GLUE – Glucose equivalent

In this study total carbohydrate content was found to be highest in bark (42.61 ± 2.8 mg/g) followed by leaves (41.13 ± 2.10 mg/g), ripe fruits (*34.3* ± 2.6 mg/g) and unripe fruits (*28.23* ± 1.81 mg/g) (Table 1). Studies have shown 70 % of caloric values present in human diet are because of carbohydrate intake whereas for protein, an average of0.8 gm – 1.6 gm protein per day is advised in dietary intake (BeMiller, 2010).

**Table 2: Total protein contents of *N. cadamba.***

| S. No. | Plant Sample | contents (mg/g of BSAE*) |
|---|---|---|
| 1. | Leaves | 40 ± 0.14 |
| 2. | Bark | 28.2 ± 0.28 |
| 3. | Ripe fruits | *16.4* ± 0.49 |
| 4. | Unripe fruits | *29.8* ± 0.11 |

*BSAE – Bovine serum albumin equivalent

Estimation of thetotal protein content of *N. cadamba* was found to be highest in leaves (40 ± 0.14 mg/g) followed by unripe fruits (*29.8* ± 0.11mg/g), bark (28.2 ± 0.28 mg/g) and ripe fruits (*16.4* ± 0.49 mg/g). Overall total carbohydrate content was found to be high as compared to total protein content in *N. cadamba*.

From previous studies, 7.35 % protein and 43.71 % carbohydrate content was reported in bark (Moe *et al.*, 2020), 20.19 % crude protein in leaves (Zayed *et al.*, 2014), 46.7 % carbohydrates and 13.4 % of proteins in *N. cadamba* seeds (Yuniarti and Nurhasybi 2015). Pandey *et al.* (2018) investigatedthe nutritional values of fruits at different maturity stages and reported 18.78 % carbohydrate and2.11 % crude protein content in ripe fruits of *N. cadamba* and also concluded that ripe fruits are superior in terms of nutritional values. However, in our result protein content was found to be approximately same in both unripe and ripe fruits. Similar findings have been reported by Osundahunsi (2009) where protein content is unaffected despite the ripening of fruits.

Various studies have shown carbohydrate to protein ratio directly influences the physical and physiological state of body. Foo *et al.* (2009) studied the low carbohydrate and high protein diet and found that ratio affects the obesity and related complications. Low carbohydrate high protein lowers the body mass index (BMI), manages satiety and improves the level of lipid in body (Kushner and Doerfler 2008).

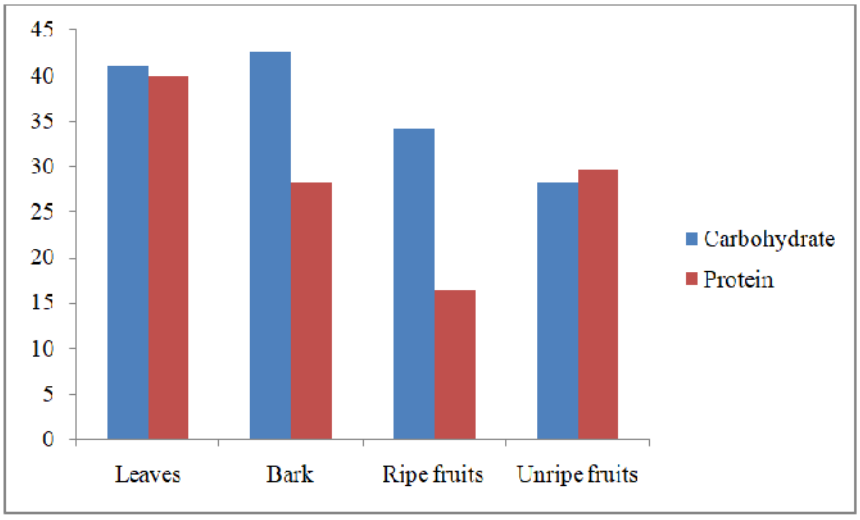


**Fig. 1.** Comparative graph of carbohydrate and protein contents of *N. cadamba* plant parts.

Study has also revealed that combined effect of carbohydrate and protein intake helps in maintaining protein balance and reduces muscle damage (Koopman *et al.*, 2004; Baty *et al.*, 2007). Disruption in regulation of carbohydrate metabolism leads to disorders like obesity, diabetes, acrochordons and gastrointestinal disorders (Demir and Demir 2002; Wilt *et al.*, 2008; Shepherd *et al.*, 2013; Paul *et al*., 2021).

According to some of the studies plant based carbohydrates and proteins have more positive effects on body over animal based carbohydrates and proteins. McMacken and Shah (2017) reported that higher intake of animal based foods such as protein and fat leads to high risk of type 2 diabetes whereas plant based protein in diet helps in reducing type 2 diabetes and was also supported by Ali *et al.* (2020). Seidelmann *et al.* (2018) studied dietary carbohydrate and mortality and observed that carbohydrates with plant based protein and fat promotes healthy ageing. It has also been reported that plant based carbohydrates helps in managing insulin, body mass and weight (Kahleova *et al.*, 2018). Studies have revealed that plant based protein is associated with low cardiovascular mortality, chronic kidney disease and uremic toxin (Song *et al.*, 2016; Chen *et al*., 2016). According to Liu *et al.* (2020) switching to plant based proteins may decrease hepatocellular carcinoma.

## CONCLUSIONS

Based on the above comparative result no major differences were observed between total carbohydrate and protein content however significant differences can be observed among the carbohydrate and protein content of plant parts. Among all plant parts leaves were found to have good amount of carbohydrates and protein. Overall it was concluded that studied plant parts of *N. cadamba* contain a reasonable amount of protein and carbohydrates and can be incorporated into the diet as supplements for nutritional purposes.

## FUTURE SCOPE

This present analysis of carbohydrate and protein content of *N. cadamba* plant parts are providing nutritional data which shall benefit the nutrition, food and health sector.In addition, this study will help *N. cadamba* to become more approachable as food and supplements

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