Research Article

Chemical and Phytochemical properties of Fresh and Dry Kadam (*Neolamarckia cadamba*) Leaves

Kajol Batta* and Hradesh Rajput

Department of Food Technology, ITM University Gwalior (M.P), India

Abstract

The study aims at evaluating the chemical and phytochemical properties of fresh and dry Kadam (*Neolamarckia cadamba)* leaves powder. Powder of kadam leaves was prepared by sun drying in a duration of 3-4 hours, followed by grinding into fine particle size. Both the fresh and dried powder were subjected to proximate and phytochemical analysis. Moisture content, crude fibre content and total ash content in Fresh Kadam and dried Kadam leaf powder vary from 73.30 to 13.33%, crude fibre from 2.55 to 13.00% and total ash from 1.00 to 3.67%. Ca and Fe were the predominant mineral elements present in the fresh and dried *cadamba* leaf powder, in the range of 186, 6.30 and 398, 13.80 mg/100g respectably. The phytochemical analysis exhibit ascorbic acid and total phenols content of fresh and dried Kadam leaves ranged from (567.29 to 422.71) and (9.60 to 22.10) mg/100 g, respectively. Dried Kadam leaves possess high Antioxidant activities, 117.57%. The paper concludes that *N. cadamba* could be incorporated in various food preparations and commercial applications. This paper also suggests that as leaves of Kadam is rich in alkaloids, tannins which are astringent components, it can be blended with tea leaves (Camellia sinensis) and formulated as beverages. Fruits can also be used in bakery sector and beverage industry owing to its high micronutrients content and tangy flavour.

Keywords: *Neolamarckia cadamba*, Kadam, chemical composition, micro nutrient, antioxidant activity, phenolic compounds and products

***Correspondence**
Author: Kajol Batta
Email: battakajol5@gmail.com

Introduction

Neolamarckia cadamba, also named as Kadam is one of the significant medicinal plants belonging to the Rubiaceae family. Being a tropical deciduous tree, *N.cadamba* is localized to South Asia [1]. In India it is distributed over temperate Himalayas, Garhwal, Himachal Pradesh, Sikkim, Assam, and Manipur. Besides India, it is also cultivated in Nepal, Myanmar, and western China [2]. Tree is large, reaching the height of ~ 45 m with a broad U-shaped crown and straight bole. It takes 6-8 years for full growth. Flowering time begins after the tree has attained 4-5 years of growth. Fruit of *Neolamarckia cadamba* appears as small, fleshy pockets packed closely together to form a fleshy yellow-orange infructescence [3]. Plant can grow in variety of soil; growth is accelerated in fertile soil and retarded in poorly aerated soil [4].

The plant as a whole is used for medicinal purpose throughout the world. It possesses Anti-diabetic, Antioxidant, Antimicrobial, Anti-inflammatory effects. The presence of flavonoids in leaves of *Neolamarckia cadamba* makes it effective in the treatment of diabetes. Quercetin-3-rhamnoglucoside, kaempferol are also present in leaves [5]. It also possesses analgesic and anti-inflammatory activity at varying doses (50, 100, 300 and 500 mg/kg) [3]. Leaves can be converted into paste and applied over affected area to reduce swelling and can also use in gargling [6]. Phytochemical examination on bark ethanol extract revealed that they contained flavonoids; quinine, triterpenoid, saponins and tannin, because of which it shows antidiabetic activity. Decoction of stem-bark is given to the patient of dyspepsia, as it strengthens body, cures fever and urinary problems.

The leaf and bark of *Neolamarckia cadamba* possess antifungal activity against Aspergillus fumigatus and Candida albicans [7]. Fruit of *Neolamarckia cadamba* is rich source of essential oil, main constituents being, linalool, geraniol, curcumene, terpinolene, camphene and myrcene [8]. Fruits can be used as expectorant and vital fluid [9]. The fruit of *Neolamarckia cadamba* is abundant in minerals like iron (28.3 mg/100 g), calcium (123.7 mg/100 g), Zinc (11.05 mg/100 g), copper (4.19 mg/100 g), magnesium (71.04 mg/100 g), potassium (36.7 mg/100 g), sodium (10.7 mg/100 g), and manganese (13.7 mg/100 g) [10]. This is higher than various regular items like apple, pear, etc [11]. The natural products give the vibe of horripilation due to its acrid taste. Due to its astringent taste, and the shortage of technology, the *Neolamarckia cadamba* fruit has not been much utilized. However, fruit juice, squash, nectar, RTS had been prepared.

Kadam tree is utilized in pulp, paper and wood industry. Due to the sensation of pilomotor reflex, fruit of kadam finds limited use among tribal people in the preparation nectar and similar products [12]. Flowers of *Neolamarckia cadamba* structures a significant wellspring of essential oil and are utilized in the preparation of 'attar' (Indian perfumes). Fruit of *N. cadamba* is rich source of essential oil, main constituents being, linalool, geraniol, curcumene, terpinolene, camphene and myrcene [8].

Materials and Methods

Analysis of Raw Material

Fresh *Neolamarckia cadamba* leaves were gathered from the department of Food Technology, Institute of Technology and Management (ITM) University, Gwalior. The fresh leaf was cleaned, dried (sun drying) and grind into fine powder. The powder was properly packed and stored for further use. All the chemicals utilized in the present research were procured by ITM University, Gwalior (**Figure 1**).

Figure 1 Collection of Fresh Kadam Leaves

Proximate Composition

Association of Official Analytical Chemists (AOAC) [13] method was adopted to carry out proximate analysis of fresh and dry *Neolamarckia cadamba* leaves [13]. *Neolamarckia cadamba* leaf was used as a sample in determination of moisture content by weighing in petri plate and drying in oven at 110^{o}C, % moisture is then calculated on the basis of weight loss. Ash content was determined using muffle furnace operated at 546^{o}C for 3 hours. Crude fibre content was determined using digestion method and acid content by using normality equation. All determination were made in triplicates (**Figure 2**).

Sample of fresh and dry *Neolamarckia cadamba* leaf powder was weighed into a clean Gooch crucible and placed in a muffle furnace along with blank (without sample) at 500^{o} C for 4 hours. After ignition sample was placed in a desiccator for about half an hour to avoid any error in calculation. 5ml ash solution was diluted using Water and HCl in the ratio of 1:1. The beaker is then placed in a water bath (covered with a lid) for 30 minutes. After this, the lid is washed with water and HCl ratio of 1:1 and again placed in the water bath (uncovered) for another 30 minutes. Addition of 10 ml of water and HCl ratio of 1:1 is done and solution is filtered and volume was raised up to 100ml with 1:1 ratio of HCl and water. This ash solution was utilized in estimation of calcium (using titration method) and iron (using U.V Spectrophotometer at 489nm).

Phytochemical analysis

Determination of Ascorbic Acid

Ascorbic acid is estimated using dye reduction method. It reduces the dye, 2,6- dicholorophenol indophenol and in turn oxidised to dehydro ascorbic acid. [13, 14]. Results obtained in this determination was formulated as milligrams of ascorbic acid/100 g fresh weight. Before titration with sample, it is first treated with 40% formaldehyde solution to remove sulphur which can interfere with ascorbic acid estimation (**Figure 3**).

$$\text{Ascorbic acid (mg/100g)} = \frac{\text{Dye Factor} \times \text{Volume made up}}{\text{Weight of the sample} \times \text{Aliquot taken}} \times 100$$

Figure 2 Kadam Leaf Powder

Figure 3 Preparation of Tubes for Phytochemical analysis of Fresh and Dry Kadam Leaves

Determination of Total phenolic content

Determination of Total phenolics was carried out using photometric method with Folin reagent, as per AOAC [13]. Methanol extract of sample was prepared and diluted with water then FC reagent was added and after a gap of 3 minutes saturated sodium carbonate solution was added and left undisturbed for 1 hour. The prepared test sample was then analysed at 765nm absorbance. Galic acid is used as standard in evaluation total phenolic content in sample. This experiment was carried out in triplicate and average values were tabulated. The values obtained was expressed as mg of gallic acid equivalent (GAE) per 100 grams with reference to gallic acid standard curve.

$$\text{Total Phenols (mg/100 gm)} = \frac{\text{Concentration of phenol from graphs} \times \text{Final Volume}}{\text{Weight of sample} \times \text{Aliquot taken}} \times 100$$

Determination of Antioxidant activity

Antioxidant activity was estimated using 2,2 – diphenyl – 1 – picryl hydroxyl (DPPH) and tris buffer [15, 16]. DPPH is prepared by dissolving 4mg in 100% methanol and Tris buffer is prepared by dissolving 1.25g in 100ml D.W. Five grams of sample was extracted by 100 ml. 80 % methanol. 1ml of methanol extracted sample was mixed with 1ml of tris buffer and 2ml of DPPH. Similarly, control was prepared using distilled water in place of sample.

$$\text{Radical scavenging activity (\%)} = \frac{\text{Absorbance of control (0 minute)} - \text{Aborbance of sample (30 minute)}}{\text{Absorbance of control (0 minute)}}$$

Statistical analysis

All the experiments were performed in triplicates and the data obtained was statistically analysed using MS excel software.

Result and Discussion

Chemical Analysis

Proximate analysis of *Neolamarckia cadamba* leaves depicts their nutritional value. Analysis comprises of determination of moisture, crude fibre, ash, mineral analysis, of fresh leaves of *Neolamarckia cadamba* and dry leaf powder is depicted in **Table 1**.

Table 1, illustrates the result of chemical analysis of fresh and dry *N. cadamba leaves*. It can be stated that dried leaves are rich in crude fibre and ash content, 13.33%, 3.67%. Contrarily, Fresh cadamba leaves possess lower contents than those outlined for dried leaves displayed in the same Table 1.

Another study has reported ash content of kadam leaves powder, 6.29% and moisture content, 4.0% [17].

Table 1 Chemical analysis of fresh and dried *Neolamarckia cadamba* leaf powder

Parameters	FNL	DNLP
Moisture(%)	73.30±7.63	13.33±5.77
Total Ash (%)	1.00± 0.50	3.67±0.58
Crude Fibre (%)	2.55± 0.08	13.00±0.50

*FNL- Fresh *Neolamarckia cadamba* leaves
*DNLP- Dry *Neolamarckia cadamba* leaves powder

Elemental Analysis

Soil is considered as the important source of micronutrients (minerals and salts). However, the quality, quantity and bioavailability of a particular mineral element depends upon the properties of soil such as pH, clay and humid complex and mineralogy [18]. Determination of calcium was carried out using titrimetric method and Iron determination was done using U.V spectrophotometer. Calcium present in the sample is precipitated as calcium oxalate by treating it with ammonium oxalate. The precipitate obtained is subjected to filtration, washing and then finally dissolved in hot dilute H_2SO_4 and titrated with standard potassium permagnate solution [14].

Table 2 revealed that calcium content in fresh leaves is 186 mg/100g and that in dry leaves, 398mg/100g. Iron content is also reported high in dry leaves, 13.80 mg/100g while that in fresh leaves, 6.30 mg/100g.

Table 2 Mineral analysis of Fresh and Dry *Neolamarckia cadamba* leaves (mg/100g)

Parameters	FNL	DNLP
Calcium (mg/100g)	186.00±6.0	398.00±11.14
Iron (mg/100g)	6.30±2.21	13.80±3.56

*FNL- Fresh *Neolamarckia cadamba* leaves
*DNLP- Dry *Neolamarckia cadamba* leaves powder

Natural antioxidants and antioxidant activities

Analysis of phytochemical properties (Total phenol content, Ascorbic acid determination and antioxidant activity) is carried out in fresh and dry *N. cadamba* leaves and data obtained is being tabulated in **Table 3**. The results illustrated in Table 3 revealed that the ascorbic acid and total phenols content of fresh and dried *Neolamarckia cadamba* leaves vary from (567.29 to 422.71), (9.60 to 22.10) mg/100 g, respectively. Antioxidant activities of fresh and dried Neolamarckia cadmba leaves was determined using DPPH radical scavenging method are confer in Table 3. Radical scavenging activity of methanolic extracts of fresh and dried *Neolamarckia cadamba* leaf samples were in the range of 90.47-117.57 % activity respectively.

Other studies have reported antioxidant activity of *Neolamarckia cadamba* leaves to be 88.06%, 90.03%, 89.24% and 88.63% [19] and Total phenol content to be 4.0 mg/100g [20]. Reduction in ascorbic acid content in dry leaves might be due increased activity of ascorbic acid oxidizing enzymes by heat generated during drying which leads to destruction of ascorbic acid and leaching of vitamin C in washing water [21]. Values gives an indication that these leaves could be incorporate into different food preparations and became a valuable source of immunity booster.

Table 3 Phytochemical screening of fresh and dried *Neolamarckia cadamba* leaves

Parameters	FNL	DNLP
Ascorbic acid (mg/100g)	567.29±2.60	422.71±9.28
Total phenols (mg/100g)	9.60±1.50	22.10±1.10
Antioxidant activity(%)	90.47±1.10	117.57±1.55

*FNL- Fresh *Neolamarckia cadamba* leaves
*DNLP- Dry *Neolamarckia cadamba* leaves powder

Conclusion

It can be stated that there are more than 50,000 medicinal plant which are richest source of bioactive components and possess significant food value but still underutilized in food sector [22]. *Neolamarckia cadamba* is one such underutilized plant in food processing industries. The plant possesses medicinal properties of great importance such as antioxidant, analgesic, anti-inflammatory etc *Neolamarckia cadamba* is one of the most supreme medicinal plant. In spite of having high nutritive value, its used is limited to pharmaceutical field. This study highlights all the essential nutrients present in fresh and dry leaves of *Neolamarckia cadamba*, making it useful in food preparation.

Despite of the fact that this plant is a rich source of antioxidant, ascorbic acid, protein, fibre and having potential for utilization in different food products, the cadamba is still going towards medicinal and pharmaceutical areas only. Consequently, usage of cadamba as food ingredient and wellbeing items, for example, enhancements and taste enhancer are an arising idea.

References

[1] Australian Tropical Rainforest Plants, Neolamarckia cadamba. Centre for Australian National Biodiversity Research, Canberra, 2010.
[2] A. Dubey, S. Nayak, D. C. Goupale. Anthocephalus cadamba: A Review. Pharmacognosy Journal, 2011, 2:71-6.
[3] M.J. Bhandary, K.R. Chandrashekar, K.M. Kaveriappa. Medical ethnobotany of the siddis of Uttara Kannada district, Karnataka, India. Journal of Ethnopharmacol, 1995, 47:149-158.
[4] H. Krisnawati, M. Kallio, M. Kanninen. Ecology, silviculture and productivity: Anthocephalus cadamba Miq. CIFOR, Bogor. Indonesia, Center for International Forestry Research (CIFOR), 11p.
[5] N. Banerji. New saponins from stem bark of Anthocephalus cadamba MIQ. Indian Journal of Chemistry- B, 1977, 15:654-5.
[6] S. K. Bhardwaj, J. S. Laura. Antibacterial properties of some plants extract against plant pathogenic bacteria Rathyibacter tritici. International Journal of Biosciences and Biotechnology Research Asia, 2008, 4(2): 693–698.
[7] D. A. Patel, V. C. Darji, A. H. Bariya, K.R. Patel, R. N. Sonpal. Evaluation of antifungal activity of Neolamarckia cadamba (roxb.) bosser leaf and bark extract. International Research Journal of Pharmacy, 2011, 2:192-3.
[8] The wealth of India, A dictionary of Indian raw materials and industrial products. NISCAIR press publishers, New Delhi, 2006, 305-308.
[9] C. P. Khare, Indian herbal remedies: rational Western therapy, ayurvedic and other traditional usage, botany. New York: Springer, 2011.
[10] A. Pandey, A. S. Chauhan, D. J. Haware, P. S. Negi. Proximate and mineral composition of Kadamba (Neolamarckia cadamba) fruit and its use in the development of nutraceutical enriched beverage. Journal of Food Science and Technology, 2018, 55:4330–4336.
[11] I. Pal, A. Majumdar, K. L. Khaled, S. Datta. Quantitative estimation of some essential minerals in the fruit of Neolamarckia cadamba. IOSR Journal of Pharmacy and Biological Sciences, 2014, 9:20–22.
[12] T. Islam, A. Das, K. Shill, P. Karmakar, S. Islam, M. Sattar. Evaluation of membrane stabilizing, anthelmintic, antioxidant activity with phytochemical screening of methanolic extract of Neolamarckia cadamba fruits. Journal of Medicinal Plants Research, 2015, 9(5):151-158.
[13] AOAC (1990). 15th Official methods of Analysis. Association Official Analysis Chemists, Washington D. C. USA. Pp. 807-928.
[14] S. Ranganna, Handbook of analysis and quality control for fruit and vegetable products. Tata McGraw Hill Pub Col. Ltd., New Delhi, India, 1986, pp 1112.
[15] D. Zhang, Y. Hamauzu. Phenolics, ascorbic acid, carotenoids and antioxidant activity of broccoli and their changes during conventional and microwave cooking. Food Chemistry, 2004, 88: 503 – 509.

[16] K. Shimada, K. Fujikawa, K. Yahara and T. Nakamura. Antioxidant properties of xanthan on the antioxidation of soybean oil in cyclodextrin emulsion. Journal of Agriculture and Food Chemistry, 1992, 40:945-48.
[17] S. Chalamalasetty, V. Narasimha. Standardization of Kadamba (Anthocephalus Cadamba (ROXB.)) Miqleaf W.S.R. to its pharmacognostical evaluation. An International Journal of Research in AYUSH and Allied Systems, 2018, 5(5):1881-1887.
[18] V. S. Nambiar, S. Seshadri. Bioavailability trials of beta carotene from fresh and dehydrated drumstick leaves (Moringa oleifera) in a rat model. Plant Foods for Human Nutrition, 2001, 56(1):83–95.
[19] M. Chandel, U. Sharma, N. Kumar, B. Singh, S. Kaur. Antioxidant activity and identification of bioactive compounds from leaves of Anthocephalus cadamba by ultra-performance liquid chromatography/electrospray ionization quadrupole time of flight mass spectrometry. Asian Pacific Journal of Tropical Medicine, 2012, 977-985.
[20] A. M. Don Paul, S. R. Weerakoon, S. Somaratne. Antioxidant Properties of Leaf, Twig and Calli Extracts of Neolamarckia cadamba (Roxb.) Bosser in Sri Lanka. Research Journal of Medicinal Plants, 2016, 10: 314-319.
[21] B. Lakshmi, and V. Vimala. Nutritive value of dehydration green leafy vegetable powder. Journal of Food Science and Technology, 2000, 37(5) : 465-471.
[22] B. S. Padam, H. S. Tin, F. Y. Chye, M. I. Abdullah. Banana by-products: an under-utilized renewable food biomass with great potential. Journal of Food Science and Technology, 2014, 51:3527.

Publication History
Received 11.07.2021
Revised 12.08.2021
Accepted 13.08.2021
Online 28.08.2021