Madras Agric. J., 2023; https://doi.org/10.29321/MAJ.10.200X15

RESEARCH ARTICLE

Estimation of Nutritive Composition of *Sauropus androgynus* (Multi Vitamin Plant) at different growth stages and position of leaves

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Received : 11 November 2023

Revised : 22 November 2023

Revised : 28 November 2023

Accepted : 16 December 2023

ABSTRACT

A study was designed to estimate the nutritive composition of Chekkurmanis (Katuk) leaves on two different growth stages *viz*., 60 & 120 days after planting and two different positions *viz*., terminal and basal whorls in plants. Utilization of green leafy vegetables differs from leaves of annuals and shrubs to leaves of trees. Katuk leaves rich in vitamins and minerals are known as protective food. The results of the study showed that Vitamin C, Protein, Calcium, Carbohydrate contents increased with the growth stages from 60 to 120 days. In contrast, Vitamin A content decreased as the plant approached 120 days. There is a significant difference in nutritive value from 60 to 120 days. Vitamin A was observed to be significantly high (4.11 mg/100g) in terminal whorl at 60 days after planting compared to 3.01 mg/100g in the terminal whorl at 120 days. Higher Vitamin A (5.12 mg/100g) was observed in basal whorl leaves at 60 days after planting, while Vitamin C (220.41 mg/100g), Protein (4.99 g/100g), Calcium (4.16%), Carbohydrate (9.83 g/100g) were observed in basal whorls on 120 days after planting. In conclusion, the basal whorls had more embedded nutritive value than the terminal whorl leaves. This study reveals that nutritive composition of *Sauropus androgynus* mainly depends on the growth stages and leaf position in the plant.

Keywords: *Chekkurmanis leaves, Nutritive analysis, Growth Stages, Position (terminal or basal whorl) of leaves.*

INTRODUCTION

Chekkurmanis (*Sauropus androgynus* L.), the vernacular names of the crop are *Katuk* or *Sweet leaf bush*, belongs to the family Euphorbiaceae, is a shrubby glabrous perennial green leafy vegetable, extensively grown in warm humid tropics with ample rainfall. The crop is native of Indoburma region, later introduced to India from Malaya. It is widely distributed in Sikkim, Himalaya, Khasi, Abour and Arka hills, Western Ghats of Kerala. The plant is also cultivated in Australia, as it is nutritious, most prolific, high yielding with appetizing green leaves. Katuk is mainly propagated through semi hardwood cuttings of 20 - 30 cm length stem. The tender leaves and succulent shoots are used for cooking. In India, it is commonly known as Multivitamin or Multi green plant, because of its rich nutritive value, containing large amount of essential mineral elements, with high level of Vitamin A, Vitamin B, Thiamine (B1), Riboflavin (B2), Vitamin C, Carbohydrate, Calcium, Potassium, Phosphorous, Iron and Dietary Protein (Jeevitha *et al*., 2022). Due to presence of antioxidants in the leaves, is utilized for treating many diseases *viz.*, diabetics, cancer, allergy, microbial infection, cholesterol and swelling as reported by Paul and Beena Anto (2011). In India, anciently Katuk leaves were used to improve the eyesight, to cure skin diseases, urinary problems, cardiovascular problems, relieves internal fever and several other illness as stated by Ong (2003). Mineral deficiency and other related diseases can be overcome by intake of leafy vegetables in recommended quantities, as an appropriate amount of vitamins, minerals and phytochemicals are necessary for normal functioning of human metabolic

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processes. To understand the nutritive composition of Chekkurmanis at different growth stages and position of leaves, a study has been taken up at the Horticultural College and Research Institute, Periyakulam.

MATERIALS AND METHODS

The healthy and disease-free rooted cuttings of *Sauropus androgynus* collected from Orchard, Agricultural College and Research Institute, Tamil Nadu Agricultural University (TNAU), Madurai, Tamil Nadu, were used as planting materials for the present study. Field trial was taken up at Horticultural College and Research Institute, Periyakulam. The experiment was conducted at Field No. 26 of Western Block Farm, Department of Vegetable Science, Horticultural College and Research Institute, Periyakulam, which is located at 80° East longitude, 11° North latitude, at an altitude of 300 M above Mean Sea Level. The nature of soil in the experimental site was sandy loam. Chekkurmanis leaf samples were collected from terminal and basal whorls of the plants at 60 and 120 days after planting, to assess the nutritive composition of young (terminal whorls) and matured (basal whorls) leaves. The leaves were washed with tap water to remove adhering sand, dust and other contaminants on the surface. Fresh leaf samples were used for analyzing vitamins, carbohydrate and protein, while the leaf samples dried in hot air oven at 60° C for six hours were used for calcium analysis. All the analyses were carried out in three replicates. Estimation of Vitamin A described by Jensen (1978). Estimation of Vitamin C described by Harris and Ray (1935). Estimation of Carbohydrate by anthrone method suggested by Hodge and Hofreiter (1962). Estimation of Protein were analyzed separately by Biuret method as per Layne (1957). Estimation of Calcium analysis by versenate method suggested by Jackson (1973).

Statistical analysis

All the analyses were performed in triplicate and Analysis of variance (ANOVA) was carried out using statistical package WINDOWSTAT to evaluate variation between two levels of growth stage and leaf position of the plant.

Result and discussion

Table 1. represents the nutritive composition of terminal and basal whorls of Chekkurmanis leaves at two different growth stages *viz*., 60 and 120 days after planting and two positions in plants.

Vitamin A

The fresh leaves from terminal and basal whorl of *Sauropus androgynus* contained 4.11mg/100g and 5.12mg/100g Vitamin A respectively on 60 days, while 3.01mg/100g and 4.26mg/100g on 120 days. There existed significant difference ($P < 0.05$) in Vitamin A content in terminal and basal whorl leaves on 60 &120 days. High Vitamin A content was found in basal whorl leaves on 60 days compared to terminal leaves on 120 days. This trend of Vitamin A content in Chekkurmanis leaves is analogous with results reported by Padmavathi and Rao (1990) and less than the values reported by Devi *et al*. (2007). This content considerably reduced with later growth stage of the plant. This ensures the fact that Vitamin A is redistributed to every organ of plant as reported by Hocmuth *et al*. (2004). It is essential for effective functioning of visual system, reproduction, immune system, growth and development as stated by Sommer and WHO (1995).

In the present study, Vitamin A content of Chekkurmanis decreased when the plant were in advanced growth stage. Similar aspect was identified in *C. argentea* by Adegbaju *et al*. (2019) and Biesiada *et al*. (2007) for Leek, Zucchini and Kohlrabi. The values obtained from this study shows higher Vitamin A than *Amaranthus digitata, Hibiscus sabdariffa* and *Vigna unguiculata* as noticed by Patricia *et al*. (2014) and moringa leaves by Abbas *et al*. (2018).

Vitamin C

The Vitamin C content in terminal and basal whorl of fresh Chekkurmanis leaves were 112.26 mg/100g and 123.33 mg/100g respectively on 60 days, while on 120 days after planting the content were 199.30 mg/100g and 220.41 mg/100g respectively. The Vitamin C content raised considerably with age. There existed significant difference ($P < 0.05$) in Vitamin C content in terminal and basal whorl leaves on 60 &120 days. High Vitamin C (220.41 mg/100g) content was noted in basal whorl leaves on 120 days and lesser value (92.26 mg/100g) in terminal leaves on 60 days. Similar trend was observed in *Telifairia occidentalis* by Platel and Srinivasan (2017), Musa *et al*. (2012) and Jeevitha *et al*. (2022). The previous study in Chekkurmanis by Padmavathi and Rao (1990) and Singh *et al*. (2011) reported that vitamin C content was 244.00 mg/100g and 314.30 mg/100g respectively in terminal and basal whorls, which was higher than this study result. According to Lee and Kadar (2000), the maturity of leaves is a major factor that determines the compositional value of vegetables. Further Korus (2010) observed that Vitamin C content depends on degree of plant maturity and variety. In this study, Vitamin C attained

the maximum value of 220.41 mg/100g in basal whorl leaves on 120 days. It is very high when compared with *Amaranthus digitata* (70.00 mg/100g) and *Hibiscus sabdariffa* (30.00 mg/100g) as reported by Patricia *et al*. (2010) and *Moringa oleifera* (0.56 mg/100ml) as reported by Achikanu *et al*. (2013).

Vitamin C supports synthesis of hormone, iron absorption and collagen, which is extensively used in cosmetics and pharmaceuticals. It acts as water soluble antioxidant, which plays a major role in free radical scavenging activity and activates immune system (Locato *et al*., 2013).

identical with earlier research reported in *Sauropus androgynus* by Chakraborty *et al*. (2019), but lower than as reported by Devi *et al*. (2007). Carbohydrate is a fundamental element for normal functioning of human body. Ingestion of carbohydrate enriched leaves adds energy level to diet by providing favourable nutrition. Amount of carbohydrate in basal leaves of katuk is higher than *T. occidentalis* but lower than *C. aconitifolius* as indicated by Otitoju *et al*. (2014) and equal to the *Senna occidentalis*, *Solanum nodiflorum, Physalis viscose* by Odhav *et al.* (2007), moringa leaves as observed by Abbas *et al*. (2018).

Table 1. Nutritive composition of terminal and basal leaves of Chekkurmanis leaves

Days after planting (DAP)	Position of leaf	Vitamin A (mg/100g)	Vitamin C (mg/100g)	Carbohydrate (g/100g)	Protein (g/100g)	Calcium (%)
60 DAP	Terminal whorl	4.11^{b}	112.26^{b}	5.71^{b}	2.63^{b}	1.69^{b}
	Basal whorl	5.12^{a}	123.33^{a}	6.20^{a}	3.04^{a}	2.08^{a}
120 DAP	Terminal whorl	3.01^{b}	199.30^{b}	8.81^{b}	4.25^{b}	2.94^{b}
	Basal whorl	4.26^{a}	220.41^{a}	9.83^{a}	4.99^{a}	4.16^{a}
SEd		0.114	4.492	0.139	0.101	0.056
CD (P < 0.05)		0.280	10.992	0.342	0.248	0.137

Mean values carrying superscript letters represent significant difference at P < 0.05

Carbohydrate

The carbohydrate value observed in terminal and basal whorl of fresh leaves were 5.71g/100g and 6.20g/100g respectively on 60 days, while 8.81g/100g and 9.8 g/100g respectively on 120 days. Carbohydrate content was high (9.83g/100g) in basal leaves on 120 days and low (5.71g/100g) in terminal leaves on 60 days. The basal whorl leaves consisted of more carbohydrate (6.20g/100g & 9.8g/100g) when compared with terminal whorl leaves (5.71g/100g & 8.81g/100g) on 60 and 120 days. There existed significant difference (P < 0.05) in carbohydrate content on the terminal and basal whorl leaves on 60 &120 days. The content also significantly increased which respect to the maturation of the plants and this finding is in line with the findings of Adegbaju *et al*. (2019). The amount of carbohydrate observed in this study was

Protein

Fresh leaves of terminal and basal whorl leaves of Chekkurmanis contained protein content in the range of 2.63 g/100g & 3.04 g/100g respectively at 60 days, while it was 4.25 g/100g & 4.99 g/100g respectively at 120 days. There existed significant difference (P < 0.05) in protein content on the terminal and basal whorl leaves on 60 &120 days. Previously Singh *et al*. (2011) published the literature and reported that protein content of Chekkurmanis leaves were 5.25 g/100g. From the result of this study, the protein content of *Sauropus androgynus* increased with age of the plant. According to Bamishayie (2011), the protein content of moringa leaves was moderately low at initial stage (27.61%) and finally reached higher values on later stage (28.08%). The highest protein content (4.99 g/100g)

was recorded in basal whorl of the plant on 120 days after planting and the lowest content (2.63 g/100g) was recorded on terminal whorl of the plant 60 days after planting. The protein values found in basal leaves of Chekkurmanis on 120 days after planting were higher than *Petroselinum crispum* (2.97 g/100g), *Anethum graveolens* (3.46 g/100g), *Lactuca sativa* (1.62 g/100g), *Brassica oleraceae* (1.21 g/ 100g) as reported by Caunii *et al.* (2010), but lower than *Moringa oleifera* leaves (6.7 g/100g) as reported by Gopala Krishnan *et al.* (2016). Therefore, *Sauropus androgynus* has the potential to serve as a very good source of protein for the reduction of protein malnutrition. It also acts as neurotransmitter and carries the oxygen in blood. Deficiency of protein causes malnutrition diseases *viz.,* kwashiorkor and marasmus and results in stunted growth. It is also useful for immune function, creation of enzymes and hormones and maintains fluid balance in the body.

Calcium

Calcium content of dried leaf samples collected from both terminal and basal whorl of leaves was in the range of 1.69% and 2.08% respectively on 60 days, whereas it was 2.94% and 4.16% respectively on 120 days. There existed significant difference ($P < 0.05$) in calcium content in the terminal and basal whorl leaves on 60 &120 days after planting. Calcium percentage obtained in this study is more (4.16%) than that (0.7%) as stated by Padmavathi and Rao (1990). In the present study, the highest calcium content observed in basal leaves at 120 days was 4.16%. This finding is in agreement with Modi (2007), who observed more calcium content in long day interval than short day interval in amaranthus plant. In contrast, the lowest calcium content of 1.69% was recorded in the terminal leaves on 60 days. The highest calcium content in basal leaves might be due to immobility (non-translocation) of calcium in the plant. This concept is in agreement with the authors Taiz & Zeiger (2002) and Hochmuth *et al*. (2004).

When the plants approach maturity, the nutrient content (calcium) in the leaves gets increased. This concept is in agreement with the values reported by Platel and Srinivasan (2017) for Chekkurmanis crop and similar trend with age of plant was observed in tender and mature stages of *Celosia argentea* plant by Adediran *et al*. (2015). Calcium plays an important role in nervous system, cell signaling and muscle contraction. It also helps to maintain healthy teeth and bones. Calcium is also utilized by cells for transferring ions and triggers several enzymes secretion in human body by Sadler (2011). The values found in this study are higher than some of underutilized green leafy vegetables such as *Digera arvensis* (0.50%), *Amaranthus tricolor* (0.23%) *and Cucurbita maxima* (0.30%) as reported by Gupta *et al*. (2004), *Hibiscus sabdariffa* (0.4%) and *Ipomea aquatica* (0.09 %) by Singh *et al*. (2011), *Alternenthra sessilis* (2.0 %) and *Celosia argentea (*2.03%) as reported by Rekha Sinha (2018) and *Moringa oleifera* (1.14%) by Srivastava *et al*. (2018).

Conclusion

The results of the study indicate that *Sauropus androgynus* is an excellent source of Vitamin A & C, Carbohydrate, Protein and Calcium than any other leafy vegetables. Further, the green leafy vegetables are fine source of vitamins, minerals and other minor elements. The study reveals that basal whorl of leaves consist of more nutrient content than terminal whorl leaves and there existed significant difference between the nutritional constituents in leaves upon growth of the plant.

Funding and acknowledgment

The authors are grateful to the Department of Vegetable Science, HC & RI, Periyakulam for providing technical support of our research

Ethics statement

No specific permits were required for the described field studies because no human or animal subjects were involved in this research

Consent for publication

All the authors agreed to publish the content

Competing interests

There is no conflict of interest in the publication of the content

Author's contribution

Research grant – GJG, EN, Idea conceptualization- GJG, Experiment – EN, writing original draft- EN, DRK, Data analysis- DRK, reviewing and editing – SS, BKS.

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