Studies on the Effect of Degraded Feathers in Plant Growth Promotion Activity of Centella asiatica L.

M. Indira and R. Rajakumar

Research Journal of Agricultural Sciences
An International Journal

P- ISSN: 0976-1675
E- ISSN: 2249-4538

Volume: 13
Issue: 05

Res. Jr. of Agril. Sci. (2022) 13: 1484–1487

CARAS

Res. Jr. of Agril. Sci. (Sep-Oct 2022)
13(5): 1484–1487

ISSN: 0976-1675 (P)
ISSN: 2249-4538 (E)

www.rjas.org

Full Length Research Article

Studies on the Effect of Degraded Feathers in Plant Growth Promotion Activity of *Centella asiatica* L.

M. Indira[1] and R. Rajakumar*[2]

Received: 20 May 2022 | Revised accepted: 03 Sep 2022 | Published online: 26 Sep 2022

A B S T R A C T

The present investigation aimed to found the effect of feather degraded soil on the growth parameters, proximate contents, vitamins and minerals content of *Centella asiatica* L. (Vallarai). The growth parameters are leaves colour, leaf length, leaf width, number of branches, shoot length (cm) and root length (cm) were recorded. The proximate contents are dry matter, crude fiber, crude protein, ash, crude fat and carbohydrate were analyzed from the *Centella asiatica* leaves. The Vitamins like A, C and B6 were determined and estimated. The mineral contents were estimated this plant sample such as calcium, magnesium, asiatica leaf was (21.1±0.03mg), MIRR1 (21.9±0.08mg), MIRR2 (22.1±0.11mg) and MIRR3 (22.5±0.84mg) recorded respectively. Furthermore, the proximate, vitamins and minerals were enhanced by feather degraded soil than the untreated soil. So, the present study concluded that the feather compost have potential nitrogen content and also used in the agricultural field.

***Key words*:** Degraded feathers, *Centella asiatica*, Morphometeric parameters, Proximates, Vitamins, Minerals

Maintenance of maximum agriculture productivity is a prerequisite to cater the demands of growing population [1]. Throughout the world, synthetic fertilizers are utilized to boost crop productivity. When these fertilizers are used excessively, rainwater gradually carries them into water systems and eutrophication results. Agronomists and environmentalists have recently taken a great interest in numerous biological methods for increasing agricultural output [2]. Preparation of biofertilizers using chicken feather wastes is attracting the focus of many research scientists. Feather meal is a cheap and easily available source of nitrogen (15% N) and may serve as a potential biofertilizer [3].

Feathers are the major by-products of poultry industry and considered as waste. Feathers (composed of protein keratin) are metabolized by a number of microorganisms as a source of carbon and nitrogen. Degradation of feathers results in production of amino acids and peptides which can be employed as precursors for plant growth-promoting metabolites.

The plant growth-promoting activity of protein hydrolysates could also be effectively applied in agriculture [4]. Thus, microbial degradation of feather represents an alternative for development of slow-release nitrogen fertilizers. The degraded product of chicken feathers could generate appropriate amount of tryptophan which is the key source of IAA synthesis [5]. Feather hydrolyzate for application as organic, environmentally friendly, safe and cost-effective fertilizers for sustainable agricultural production as the uncontrolled use of synthetic fertilizers causes adverse effect on human health and environment. Feathers degraded by keratinolytic bacteria can convert to nutritionally useful feather lysate, which contain amino acid, peptides and ammonium ions [6]. The use of feather hydrolysate as a slow-release nitrogenous fertilizers and plant growth promotion of agricultural crops [7]. Soil treated with feather hydrolyzate increase the water holding capacity, N, C, P, K and other mineral content of the soil favouring the growth of plants [8]. So, in the present study focused on the analyses of degraded feathers used as a manure for the growth and development of *Centella asiatica.*

* **R. Rajakumar**
✉ biotechrajakumar@gmail.com

[1-2] P. G. and Research Department of Biotechnology, Maruthupandiyar College, (Affiliated to Bharathidasan University, Tiruchirapalli), Thanjavur - 613 403, Tamil Nadu, India

MATERIALS AND METHODS

Degraded feather

Degraded feathers (fertilizer) were purchased from Indian Biotrack Research Institute, Thanjavur, Tamil Nadu. The collected sample was brought to the laboratory in polythene bag and stored in room temperature for further uses.

Plantation of Centella asiatica

Several plant cuttings of randomly sampled individual plants of *C. asiatica* were collected from Indian Biotrack Research Institute Garden, Karuvakurichi, Mannargudi. The cuttings of plantlets were more or less uniform size containing four leave condition were planted in earthen shallow pots in

greenhouse conditions. Ten plants for each treatment were planted separately for experiment. Planting was done in September 2021 and sufficient amount of water was provided for irrigation purpose for each treatment. All pots and treatments were rotated each week to counter any positional effects of pots within treatments [9].

Soil treatment

The soil was treated by degraded feather with different concentration such as 25, 50, 75mg and untreated soil was considered as a control [10].

Control: Soil only
MIRR 1: Soil 1kg / Degraded feather 25mg
MIRR 2: Soil 1kg / Degraded feather 50mg
MIRR 3: Soil 1kg / Degraded feather 75mg

Growth measurement

Data on yield and morphological traits were recorded in October 2021. Replications, selected randomly were used for the observations. The phenotypic characters such as colour of leaves, leaf length (cm), leaf width (cm), number of branches (ns), shoot length (cm) and root length (cm) were measured [11].

Proximate analysis of Centella asiatica

The moisture content was determined by drying at 105°C in an oven until a constant weight reached. For total ash determination, the leaf sample was weighed and converted to dry ash in a muffle furnace at 450°C for incineration. The crude fat content was determined by extraction with n-hexane using a Soxhlet apparatus. Kjeldahl method was used for crude protein determination [12]. Carbohydrate content was determined by calculating the difference between the sums of all the proximate compositions from 100%.

Vitamin and mineral analysis [13]

The amount of vitamin A was determined using ultra performance liquid chromatography (UPLC) method [14], Vitamin C [15] and vitamin B_6 was estimated by AOAC [16]. The minerals such as calcium, magnesium, iron, phosphorus and sodium were determined [17].

RESULT AND DISCUSSION

In the present investigation was revealed that the following results from the *Centella asiatica*. Growth traits are observed at 30th days such as colour of leaves are dark green, leaf length (2.81±0.05cm), leaf width (3.12±0.11cm), number of branches (6.35±0.00ns), shoot length (12.7±0.08cm) and root length (0.86±0.12cm) are highly observed in the treatment of MIRR 3 (combination). These growth parameters of Control (untreated), MIRR 1 and MIRR 2 treatments were less than the MIRR 3 (Table 1). The *Centella asiatica* measured traits of leaves varied significantly with soil type, the leaf traits, the extent of variation was the highest. There was no significant difference in leaf number among the various soil treatments. Growth of root was also affected significantly with soil type [18]. The plant treated by both *NPKOZ* Pot (M = 20.00, SE = 2.97) and NPKOZ Verti (M = 21.20, SE = 1.88) exceeded more than 20 leaves. The *Centella asiatica* root length 12 – 15 cm, root diameter 1.5 – 2.5 cm, leaf length 1.5 – 2.0 cm and leaf broad 0.5 – 1.0 cm noted from the untreated clay and leaf broad 0.5 – 1.0 cm noted from the untreated clay soil [19-20]. The leaf surface area (12.58%), leaf blade width (12.43%), and leaf blade length (10.28%), which were collectively greater than the eigenvectors of the total variation of morphological parameters [21]. The *Centella asiatica* leaf size varied from 5.00 to 7.70cm in length and from 5.30 up to 9.00cm in width. Leaf area ranged between 27.69 and 79.22cm [22].

Table 1 Effect of degraded feather on the growth and development of *Centella asiatica*

Phenotypic characteristics	Control	MIRR 1	MIRR 2	MIRR 3
Colour of leaves	Flourescent	green	Green	Dark Green
Leaf length (cm)	1.73±0.08	1.91±0.11	2.43±0.12	2.81±0.05
Leaf width (cm)	2.11±0.05	2.75±0.11	2.93±0.08	3.12±0.11
Number of branches (ns)	3.55±0.33	4.55±0.00	4.33±0.33	6.35±0.00
Shoot length (cm)	10.6±0.29	11.4±0.17	11.8±0.14	12.7±0.08
Root length (cm)	0.33±0.03	0.66±0.080	0.43±0.14	0.86±0.12

The values are expressed with mean ± standard deviation

In the present study is takes that the proximate analysis were revealed the following results such as dry matter (93.8±0.09%), crude fiber (3.24±0.06%), crude protein (12.8±0.55%), ash (3.17±0.05), crude fat (2.76±0.43%) and carbohydrate (78.68±1.71%) are high found to be recorded in MIRR 3. All the proximate content are high quantity when compared with the other treatments like control, MIRR 1, MIRR 2 (Table 2). The proximate composition *of Centella asiatica* leaf meal (CSP) was presented. Dry matter content of CSP was 90.44% while those of crude protein, crude fibre, ether extract and total ash are 13.06%, 16.14%, 2.01% and 4.07% noted [23]. The 50% Carbonized Rice Hull + 50% Composted sawdust was got the highest dry matter content, 50% Vermicast + 50% Cocopeat was obtained the ash content of 1.64%, Garden Soil + Vermicast + Cocopeat + Composted Sawdust (25% each) was obtained the highest protein content with 1.42% and 50% Carbonized. Rice Hull + 50% Composted Sawdust was obtained the heaviest weight with 1.95% [24] and the *Centella asiatica* ash content of 0.77-3.54g/100g was reported [25].

Vitamin and mineral contents were analyzed from the experimental plant. The vitamins like A, E, C, B_1 and B_6 were analyzed from *Centella asiatica* leaf and observed vitamin A, C and B_6 in each concentration of degraded feather treated and untreated Pots. Vitamin A was quantified as followed 0.29±0.05mg in control, 0.32±0.07mg in MIRR 1, 0.31±0.01mg in MIRR2 and 0.35±0.08 mg in MIRR3 were recorded. Vitamin C was quantitatively and followed by 0.67±0.21mg in control, 0.68±0.03mg in MIRR1, 0.71±0.11mg in MIRR2 and 0.73±0.55mg MIRR3 recorded and vitamin B_6 was analyzed and quantitatively and followed by 0.68±0.00mg in control, 0.71±0.87mg in MIRR1, 0.69±0.35mg in MIRR2 and 0.73±19.1mg in MIRR3 was recorded respectively and 0.73±19.1mg (Table 3). The *Centella asiatica* leaf meal contains appreciable quantity of calcium, magnesium, iron, phosphorus and sodium. Vitamins A, C and B_6 are readily available in the leaf meal while E and B_1 are not available [26]. The determined in low amount of vitamin C content in *Centella asiatica* leaves and also had been higher amount of protein and iron content [27]. The *Centella asiatica* have rich in the content of vitamins: vitamin C (7 mg/100 g), vitamin A (738 IU), vitamin B1 (0.09 mg/100 g) was estimated in the respective method [28]. Consumption of 100g of *C. asiatic* leaves could

cover 10 to 21% of vitamin A was observed [29], stated that the imported variety *Centella asiatica* had significantly higher content of iron content (74.3 ± 34.1mg/100g dry weight) was noted in the results of the plant.

Table 2 Proximate analysis of degraded feather treated *Centella asiatica*

Parameters percentage (%)	Control	MIRR 1	MIRR 2	MIRR 3
Dry matter	91.3±0.05	92.5±0.03	89.7±0.01	93.8±0.09
Crude fiber	2.53±0.07	3.05±0.03	2.87±0.11	3.24±0.06
Ash	11.4±0.31	11.8±0.08	12.1±0.29	12.8±0.55
Crude protein	3.11±0.14	2.84±0.34	2.99±0.87	3.17±0.05
Crude fat	2.34±0.07	2.49±0.02	2.38±0.14	2.76±0.43
Carbohydrate	63.05±1.02	68.73±0.86	73.55±0.97	78.68±1.71

The values are expressed with mean ± standard deviation

Table 3 Effect of degraded feather on the growth and development of *C. asiatica* and its analysis of vitamins

Vitamins	Control	MIRR 1	MIRR 2	MIRR 3
A	0.29±0.05	0.32±0.07	0.31±0.01	0.35±0.08
E	-	-	-	-
C	0.67±0.21	0.68±0.03	0.71±0.11	0.73±0.55
B_1	-	-	-	-
B_6	0.68±0.00	0.71±0.87	0.69±0.35	0.73±19.1

The values are expressed with mean± standard deviation

Table 4 Effect of degraded feather on the growth and development of *C. asiatica* and its analysis of minerals

Minerals	Quantity (mg/100g)			
	Control	MIRR 1	MIRR 2	MIRR 3
Calcium	21.1±0.03	21.9±0.08	22.1±0.11	22.5±0.84
Magnesium	2.88±0.01	2.98±0.07	2.94±0.00	3.05±0.06
Iron	0.17±0.08	0.18±0.04	0.18±0.01	0.19±0.07
Phosphorus	2.67±0.24	2.53±0.01	2.74±0.33	2.94±0.05
Sodium	7.48±0.03	7.89±0.11	8.05±0.14	8.35±0.38

Mineral contents were estimated in each untreated and treated plant of *Centella asiatica.* The mineral contents were estimated this plant sample such as calcium, magnesium, asiatica leaf was (21.1±0.03mg), MIRR1 (21.9±0.08mg), MIRR2 (22.1±0.11mg) and MIRR3 (22.5±0.84mg) recorded respectively. The magnesium was observed followed the control (2.88±0.01mg), MIRR1 (2.98±0.07mg), MIRR2 control (2.88±0.01mg), MIRR1 (2.98±0.07mg), MIRR2 (2.94±0.00mg) and MIRR3 (3.05±0.06mg) recorded. The iron content of each sample was control (0.17±0.08mg), MIRR 1 (0.18±0.04mg), MIRR 2 (0.18±0.01mg) and MIRR 3 (0.19±0.07mg) recorded. The phosphorus content may have control (2.67±0.24mg), MIRR 1 (2.53±0.01mg), MIRR 2 (2.74±0.33mg) and MIRR 3 (2.94±0.05mg) recorded. The sodium has in control (7.48±0.03mg), MIRR 1 (7.89±0.11mg), MIRR 2 (8.05±0.14g) and MIRR 3 recorded (8.35±0.38mg) was recorded respective plant materials. The minerals such as Ca (171 mg/100 g), P (32 mg/100 g), K 468.59 mg/100 g) and Fe (5.6 mg/100g) was analyzed [30]. According to the facts of the latest study, C. asiatica leaves had a sizable amount of ash, crude fibre, and carbohydrates. The primary nutrient found in leaves is carbohydrate [31]. Ash content overall in plant matter consists of both physiological and non-physiological ash, and acid insoluble ash, which is a component of total ash and a sign of the presence of silica, in contrast, water soluble ash is the water-soluble percentage of the total ash, particularly as sand and siliceous earth [32] and the proximate analysis showed that the leaves of *C. asiatica* contained significant amounts of protein and ash. Ash content is high, which suggests rich mineral supplies for human nutrition.

CONCLUSION

During the last few decades, researchers have focused on the organic wastes for use as fertilizers for sustainable agricultural crop productions, as the increasing use of composted wastes will reduce the costs of commercial fertilizers and will be more beneficial to the environment. Degraded feathers are rich in amino acids, which makes them a valuable source for biofertilizer and animal feeds. In the present study, feathers treated soil has the more quantity of nutritional and proximate content in *C. asiatica*. From this concluded that the degraded feathers to enhance in the growth, development and nutritive content in *C. asiatica.* The degraded feathers to improve the nutritive value of soil and successfully employed as an economic source of nitrogen fertilizers for plants. So, our study concluded that the feather compost have potential nitrogen content and also used in the agricultural field.

LITERATURE CITED

1. Perez-Montano F, Alias VC, Bellogin RA, Del Cerro P, Espunny MR, Jimenez GI. 2014. Plant growth promotion in cereal and plant: from microorganism capabilities to crop production. *Microbial Research* 169(5/6): 325-336.
2. Bhange K, Chaturvedi V, Bhatt R. 2016. Ameliorating effects of chicken feathers in plant growth promotion activity by a keratinolytic strain of *Bacillus subtilis* PF1. *Bioresource Bioprocess* 3(13): 1-10.
3. Jeong JH, Lee OM, Jeon YD, Kim JD, Lee NR, Lee CY, Son HJ. 2010. Production of keratinolytic enzyme by a newly isolated feather-degrading *Stenotrophomonas maltophilia* that produces plant growth-promoting activity. *Process Biochemistry* 45: 1738-1745.

4. Tiwary E, Gupta R. 2010. Medium optimization for a novel 58 kDa dimeric keratinase from *Bacillus licheniformis* ER-15; biochemical characterization and application in feather degradation and dehairing of hides. *Bioresource Technology* 101: 6103-6110.
5. Tsavkelova E, Oeser B, Oren-Young L, Israeli M, Sasson Y, Tudzynski B, Sharon A. 2012. Identification and functional characterization of indole-3-acetamide mediated IAA biosynthesis in plant associated *Fusarium species*. *Fungal Genet. Biolol*. 49: 48-57.
6. Tamreihao K, Mukherjee S, Khunjamayum R, Devi LJ, Asem RS, Ningthoujam DS. 2018. Feather degradation by keratinolytic bacteria and biofertilizing potential for sustainable agricultural production. *Jr. Basic Microbiology*. 1-10.
7. Tamreihao K, Ningthoujam DS, Nimaichand S, Singh ES. 2016. Biocontrol and plant growth promoting of a *Streptomyces corchorusii* strain UCR3-16 and preparation of powder formulation for application as biofertilizer agents for rice plant. *Microbiol. Research* 192: 260-270.
8. Liu Q, Long K, Lu F, Chen J. 2017. Biodegradation and antibacterial activity of a feather-degrading strain of bacterium. *Biocatal Agric Biotechnology* 9: 195-200.
9. Akhtar N, Ilyas N, Meraj TA, Aboughadareh AP, Sayyed RZ, Mashwani ZR, Poczai P. 2022. Improvement of plant responses by nano-biofertilizer: A step towards sustainable agriculture, *Nanomaterials* 12(6): 965.
10. Nurfatiha M, Mohd HI, Ayu AI, Bokhari Z, Nurul AMZ. 2018. Morphology, leaf gas exchange and quality of pegaga (*Centella asiatica*) under different nitrogen fertilization rates. *Annual Research and Review in Biology* 28(2): 1-11.
11. Piscitelli C, Lavorgna M, De Prisco R, Coppola E, Grilli E, Russo C. 2020. Tomato plants (*Solanum lycopersicum* L.) grown in experimental contaminated soil: Bioconcentration of potentially toxic elements and free radical scavenging evaluation. *PLoS One* 15(8): 1-14.
12. Chandrika UG, Prasad Kumara PAAS. 2015. Gotu Kola (*Centella asiatica*): Nutritional properties and plausible health benefits. *Advances in Food and Nutrition Research* 76: 125-157.
13. Xu L, Wang Y, Ji Y, Li P, Cao W, Wu S. 2021. Nutraceutical study on *Maianthemum atropurpureum*, a wild medicinal food plant in Northwest Yunnan, China. *Front. Pharmacology* 12: 710487.
14. Wang ZT, Lan Z, Lu J, Jiang DG. 2005. Introduction of GB/T 5009- 2003, methods of food hygienic analysis-physical and chemical section. *Chin. Jr. Food Hyg*. 17: 193-211.
15. Achi NK, Onyeabo C, Ekeleme-Egedigwe CA, Onyeanula JC. 2017. Phytochemical, proximate analysis, vitamin and mineral composition of aqueous extract of *Ficus capensis* leaves in South Eastern Nigeria. *Jr. App. Pharm. Sci*. 7(3): 117-122.
16. AOAC. 2010. Minerals: In Official Methods of Analysis, Washington, DC. *Association of Official Analytical Chemists* 16(3): 99-103.
17. Carpenter DE, Hendricks DG. 2003. *Mineral Analysis, in Food Analysis*. (Eds) Nielsen S. S. Kluwer, Academic/Plenun Publishers, New York, Chap. 12: 5.
18. Anjana D, Pramod KJ. 2009. Variation in growth of *Centella asiatica* along different soil composition. *Botany Research International* 2(1): 55-60.
19. Noor ANA, Nik AN, Norfarah SMN, Muhammad AJ. 2018. Improving the growth of *Centella asiatica* using surfactant modified natural zeolite loaded with NPK nutrients. *Asian Jr. Agri. and Biol*. 6(1): 55-65.
20. Patel DK. 2015. Growth pattern study on *Centella asiatica* (L.) urban in herbal garden. *International Journal of Herbal Medicine* 3(5): 09-12.
21. Ali Alqahtani, Jun-Lae C, Ka Ho W, Kong ML, RN, George QL. 2017. Differentiation of three *Centella species* in Australia as inferred from morphological characteristics, ISSR molecular fingerprinting and phytochemical composition. *Front. Plant Sci*. 8: 1980.
22. Shukurova MK, Myint D, Yi SS, Saw OM, Watanabe KN. 2021. Morphological description and ethnobotanical review of the orphan crop Myin-Hkwa (*Centella asiatica* L.) from Myanmar. *Front. Sustain. Food Syst*. 5: 680862: 1-9.
23. Alagbe JO. 2019. Effects of dried *Centella asiatica* leaf meal as an herbal feed additive on the growth performance, hematology and serum biochemistry of broiler chicken. *International Journal of Animal Research* 3(23): 1-7.
24. Lasaro AG. 2021. Growth evaluation and proximate analysis of Gotu Kola (*Centella asiatica* L.) in response to, organic growing media combinations. *Asian Journal of Fundamental and Applied Sciences* 2(2): 65-76.
25. Sheetal GA, Jyothi L, Manjunath MN, Prakash J. 2005. Analysis of nutrient and antinutrient content of underutilized green leafy vegetables. *Food Science and Technology* 38(4): 339-345.
26. Ajayi OA, Olumide MD, Tayo GO, Akintunde AO. 2020. Evaluation of chemical and elemental constituents of *Centella asiatica leaf* meal. *African Journal of Agricultural Research* 16(5): 661-666.
27. Ranovona Z, Mertz C, Dhuique C, Servent A, Dornier M, Danthu P. 2019. The nutrient content of two folia morphotypes of *Centella asiatica* (L) grown in Madagasca. *African Journal of Food Agriculture Nutrition and Development* 19(3): 14654-14673.
28. Hashim P, Sidek H, Helan MHM, Sabery A, Palanisamy UD, Ilham M. 2011. Triterpene composition and bioactivities of *Centella asiatica*. *Molecules* 16: 1310-1322.
29. Chandrika UG, Salim N, Wijepala GDDJ, Perera KSU, Goonetilleke AKE. 2011. Carotenoid and mineral content of different morphotypes of *Centella asiatica* L. (Gotukola). *International Journal of Food Sciences and Nutrition* 62(5): 552-557.
30. Belwal T, Andola HC, Atanassova MS, Joshi B, Suyal R, Thakur S. 2019. Gotu kola (*Centella asiatica*), non-vitamin and non-mineral. *Nutritional Supplements* 1: 265-275.
31. Ogunka-Nnoka CU, Igwe FU, Agwu J, Peter OJ, Wolugbom PH. 2020. Nutrient and phytochemical composition of *Centella asiatica* leaves. *Medicinal and Aromatic Plants* 9: 346.
32. Prasad SK, Laloo D, Kumar M, Hemalatha S. 2013. Quality control standardization and antioxidant activity of roots from *Eriosema chinense*. *Pharmacogn. Journal* 5: 149-155.