

Flemingia vestita: A review on its nutritional and medicinal properties

Birinchi Bora

Assistant Professor, Department of Food Nutrition and Dietetics, Assam Down Town University, Assam, India

Abstract

Flemingia vestita, an underutilized tuber, also known as Sohphlang, is traditionally eaten as a snack, used for stomach ailments and de-worming by the people of Meghalaya, the Northeastern state of India. It possesses a good nutritional value such as presence of carbohydrates, proteins, phosphorus, iron and calcium. Being a valuable medicinal tuber having antimicrobial, anti-fungal properties and traditionally used as an anthelmintic which is scientifically validated. It also contains genistein, daidzein, formononetin and pseudobaptigenin which are bioactive isoflavones, acts as protective antioxidant and maybe used in reducing the risk of many diseases like cancer and CVD. For the local people of Meghalaya, it is a valuable and economical crop and may have other great potential in future. It is a promising and beneficial crop to the farmers as it has the ability to fix nitrogen back into the soil. The overall objective of this review is to give an outlook on *Flemingia vestita* tuber and its nutritional, antioxidant and medicinal properties.

Keywords: *Flemingia vestita*, nutritional, antioxidant, anthelmintic and medicinal properties

Introduction

Meghalaya being one of the states with a huge range of ecological and geographical conditions, the land gives opportunity for the farming of different kinds of species of tubers crops [2]. Roots and tubers have been serving as a nutritious but inexpensive food for the source of starch and energy for the tribal people in India [5]. *Flemingia vestita* is one unique kind of tuber that is found to be growing in the wild mountain slopes of the Himalayas. It is distributed in Sichuan and Yunnan provinces of China, Nepal and Khasi hills of Northeast, India. This edible tuber is eaten raw as a snack and it has a crunchy and nutty flavour. The tuber is commercially cultivated only in Meghalaya as a cash crop due to its demand in the local market [31]. *Flemingia vestita* (also known as *Flemingia procumbens* Roxb.; *Moghania vestita* (Benth.) ex Baker Kuntz; *Moghania procumbens* (Roxb.) which is also locally called as Sohphlang. It belongs to the legume family and has the ability to fix nitrogen back into the soil and may improve soil fertility [3].

Plants are the prime sources of medicines that are used from time immemorial as herbal remedies for health care, prevention and cure of various diseases and ailments [7]. Tubers not only are rich sources of carbohydrates but also have medicinal properties due to their presence of bioactive compounds [21]. Raw extract of medicinal plants that are

used in traditional medicine are popular sources of natural antioxidants and are helpful to fight against free radicals [34]. The locals in the Meghalayan community give *Flemingia vestita* tubers to children as a vermifuge i.e.; expelling of worms, stomach ache and [2].

The tuber is directly eaten raw for the treatment of intestinal worms [6]. The Isoflavone and Genistein extract of this tuber were found to be effective against the sheep liver fluke *Fasciola hepatica* [30] and human tapeworms such as *Echinococcus multilocularis* and *E.granulosus metacestodes* [40].

Nutritional and Antioxidant Properties

Sohphlang is rich in nutrients like phosphorus, a good amount of proteins, iron, calcium and carbohydrates.

Table 1: Nutritive composition of *Flemingia vestita* tuber

Nutrients	Amounts/100g
Carbohydrates	27.02 gm
Protein	2.99 gm
Iron	2.64 mg
Phosphorus	64.06 mg
Calcium	19.77 mg

Source: (Mani, 2018)

Table 2: Nutritional comparison of (Sohphlang, tapioca, sweet potato, and yam).

Sl no.	Proximate components & micro nutrients	Sohphlang	Tapioca	Sweet potato	Yam
1.	Moisture (%)	67.89	75.23 ± 0.55	69.21 ± 0.83	74.28 ± 0.63
2	Protein (%)	2.99	1.03 ± 0.10	1.33 ± 0.12	2.18 ± 0.26
3	Ash (%)	0.11 ± 0.7	1.12 ± 0.01	0.96 ± 0.07	1.64 ± 0.19
4	Fat (%)	0.55 ± 0.07	0.20 ± 0.01	0.26 ± 0.06	0.17 ± 0.02
5	Dietary fiber (%)	4.32 ± 1.03	4.61 ± 0.12	3.99 ± 0.05	4.08 ± 0.07
6	Starch (%)	27.02	15.36 ± 0.12	18.82 ± 1.74	14.94 ± 0.35
7	Sugar (%)	0.27 ± 0.08	2.14 ± 0.05	3.63 ± 0.05	1.15 ± 0.75
8	Phenol (% GAE)	0.196 ± 0.05	-	-	-
9	Iron (mg/100 g)	2.67	0.81 ± 0.18	0.35 ± 0.03	0.77 ± 0.22
10	Zinc (mg/100 g)	0.58 ± 0.041	0.17 ± 0.05	0.16 ± 0.05	0.33 ± 0.09

11	Copper (mg/100 g)	0.15 ± 0.03	0.19 ± 0.04	0.17 ± 0.02	0.23 ± 0.08
12	Sodium (mg/100 g)	18 ± 8.02	10.86 ± 0.10	29.60 ± 5.32	15.28 ± 0.07
13	Potassium (mg/100 g)	130 ± 34.18	255 ± 36.3	345	463 ± 74.1

Source: (Pandey *et al.*, 2018, Singh and Arora, 1973, Longvah *et al.*, 2017)

F. Vestita comprises mainly and is a rich source of flavonoids like Isoflavonoids, genistein, formononetin, pseudobaptigenin and daidzein [4]. Flavonoids are found naturally in fruits, vegetables and beverages like tea and wine and good sources of natural antioxidants that scavenge free radicals and can be used in the control of various diseases in human [1]. Flavonoids are consumed daily as natural compounds that are widely present in several food products such as fruits and vegetables [23]. And they have an extended range of pharmacological properties such anti-inflammatory, anti-tumour and also anti-cardiovascular disease activities [33].

Isoflavones like Daidzein and Formononetin have been reported to show Pharmacological effects such as anti-cancer, anti-cardiovascular diseases, anti-diabetes, antioxidants and anti-inflammation properties [32]. Genistein is known for containing a broad range of biological activities such as cardiovascular diseases, osteoporosis, obesity, diabetes, depression and breast cancer [29].

Scientists studied to assess the nutritional and antioxidant properties of *Flemingia vestita*, where the cultivated sohphlang (CS) and Market sohphlang (MC) flour were analyzed for its nutrient composition. And the results showed that the CS flour exhibited good nutritional properties than the MS flour. And HPLC result showed that genistein may be a predominant compound among the phenolic compound identified, which may be compared with soybean [12].

Medicinal Properties Antihelmintic Activity

The effect of the extract from the peel of *Flemingia vestita* and genistein, for nitric oxide (NO) and the enzyme nitric oxide synthase (NOS) was studied in *Fasciolopsis buski* which is a large intestinal fluke of human host. During biochemical trails, the NOS activity showed a big rise in the parasites treated with the test materials and reference drug and then comparison was done to the treated controls. The plant-derived components have an inducing effect in the increase in NOS activity within the treated parasites [12]. The treatment of 20mg /ml of crude peel extract of *F.vestita* alongwith treatment of 0.5mg/ml of genistein on a parasite (*Fasciolopsis buski*) has resulted in the decrease in various levels of free amino acid. And also have increases in the levels of glutamic acid, glutamine, phosphoserine, citrulline and GABA. In treatment with *F.vestita* and genistein, the ammonia levels were increased by 40.7%, 66.4% and 18.16%. The changes in the amounts of the amino acids and components related to nitrogen after the extract treatment indicated that there was a change in the amino acid metabolism within the parasite [12].

It was recorded that effect of *F.vestita* root-tuber extract taken by ethanol on a leguminous plant on *Fasciolopsis buski* and *Artyfechinostomum sufrartyfex* by a scanning electron microscope. Within a time period of 1.1-1.4, 0.8-1.0 and 0.3-0.5 h, *A.sufrartyfex* became paralyzed significantly. Observations done by stereo scanning on *A.sufrartyfex* treated with 20mg extract/ml phosphate-buffered saline (PBS) had revealed that there was a sloughing off of most of the spines or deformation

alongwith the wrinkles and rupture of the general tegument. When *F.buski* was exposed to 20 mg extract/ml PBS a severe tegumental alterations and deformities were also observed [19].

A vermifugal/vermicidal activity of *Flemingia vestita* was reported by causing a flaccid paralysis accompanied by alterations in the structural architecture of the tegumental interface and metabolic activity in *Raillietina echinobothrida*, the cestode of domestic fowl [2]. *In vitro* test were conducted with reference to homeostasis of Ca²⁺ by using pure genistein and crude root-peel extract and therefore the occurrence of some metal ions was detected within the parasite. In the parasitic tissue, a significant amount of Ca²⁺ (~400 µg/g dry tissue wt.) was found to be present besides magnesium, iron, zinc lead and chromium, whilst manganese, cadmium and nickel were below the extent of detection. The Ca²⁺ concentration was decreased significantly by 39%- 49%, within the parasite tissue exposed to the test materials as compared to the respective controls. Under same treatments it was also observed that the efflux of Ca²⁺ also increases by 91 to 160% into the medium. The phytochemicals of *F.vestita* causes the antihelmintic stress inside the parasite that creates a change in the Ca²⁺ homeostasis and also could be also related with the related contraction and consequent paralysis [2].

The effect of the crude root-peel extract (5 mg/ml) and pure genistein (0.2 mg/ml) from *F.vestita* which was tested in respect of glycogen metabolism in the fowl tapeworm, *Raillietina echinobothrida* [23]. The concentration of glycogen was found to be lowering by 15-44%, alongwith an increase of activity of the active form of glycogen phosphorylase (GPase a) by 29-39%. There is also a lowering of activity of the active form of glycogen synthase (G Sase a) by 36- 59% in treated parasites as compared to untreated controls, but the total activity (a + b) of both the enzymes was not affected.

The effect of phytochemicals of *Flemingia vestita*, in particular genistein, which influence the key enzymes of gluconeogenesis like fructose 1, 6-bisphosphatase, phosphoenolpyruvate carboxykinase and pyruvate carboxylase in *R.echinobothrida* was recorded, which is probably a function of high energy demand of the parasite under anthelmintic stress [2].

Researchers studied on the mode of action of genistein and its effect on the activity of tegumental enzymes of the parasite *Raillietina echinobothrida* using acid phosphatase (AcPase), adenosine triphosphatase (ATPase) and 5'-nucleotidase (5'-Nu). The activity of AcPase, AlkPase, ATPase and 5'-Nu was suppressed by 87, 95, 88 and 57% respectively by the crude extract of *F.vestita* (50 mg/ml) and genistein (0.5 mg/ml) [16].

A study conducted *in-vitro* activity of root, tuber and peel extract of *F.vestita*, which was tested against helminth parasites. Live parasites like the *Ascaris suum* found in pigs, *A.lumbricoides* found in human beings, *Acaridia galli*, *Heterakis gallinarum* and *Raillietina echinobothrida* found in domestic fowl, *Paramphistomum* sp. from cattle were collected in 0.9% physiological buffered saline (PBS) and

maintained at $37 \pm 1^\circ\text{C}$. There were structural alterations in the tegument of the treated parasites. This study showed that the *F. vestita* plant extract has the vermifugal activity against trematodes and cestodes [28].

Antibacterial Activity

The antimicrobial effect of methanolic extract of the root peel and tuber of *Flemingia vestita* on bacteria such as *E. coli*, *Shigella dysenteriae* and *Bacillus subtilis* and *Apergillus niger* which is a fungus was studied and reported [13]. The bacteria were treated with 10 μL methanol extract of the peel (FVC) and the tuber extract (FV) and maintained at a temperature of 37°C for 24-48 hours in nutrient agar and potato dextrose agar for antifungal assay on *Apergillus niger*. *Flemingia vestita* skin (FVC) showed better antibacterial activity compared to the tuber of *Flemingia vestita* (FV) while the antifungal property was less which may be due to the resistance property of the fungus. The antibacterial properties of *Flemingia vestita* could be due to the presence of terpenoids and tannin.

Estrogenic Activity

The potential of the extract of *Flemingia vestita* tubers in ethanol was found to be estrogenic when used in ovariectomized rat model. Treatment with the ethanolic extract of *Flemingia vestita* tubers showed dose independent increase in uterine weight, glycogen levels, G6PDH levels, and estrogen and progesterone levels when compared with the ovariectomized control. High dose of plant extract among the three dose levels have revealed an significant increase in the uterine weight ($p < 0.001$), 17- β estradiol and progesterone levels ($p < 0.001$), G6PDH and LDH levels ($p < 0.001$) uterine glycogen content ($p < 0.001$), as well as significant decrease in HDL and triglycerides levels ($p < 0.001$) which was compared to ovariectomized which was kept as control. The uteri sections of ovariectomized rats were histo-pathologically evaluated and it was found that the high dose of the plant extract show increase in the endometrial. Thus, these data reveals that dose of 500mg/kg body weight of ethanolic extract of *Flemingia vestita* tubers exhibits good estrogenic activity in rat models which are ovariectomized [21].

Conclusion

Flemingia vestita is an edible tuber that has been used since ages by the local people of Meghalaya as a source of nutrient and for its antihelmintic properties. This review paper demonstrated some of the benefits and uses of *Flemingia vestita* of its nutritional value, antihelmintic, antibacterial, and antifungal properties. It can serve as a versatile source of food and nutritional security to the people; it is also a good nitrogen fixer and is very much helpful for farmers in fixing the nitrogen back in the soil. This tuber is underutilized and used only in a part of the state but may have a lot of potential for the future generation both agriculturally and economically.

References

1. Bose S, Sarkar D, Bose A, Mandal SC. Natural flavonoids and its pharmaceutical importance, The Pharma Review, 2018, 61-75.
2. Das TK, Singh NA. Indigenous Tuber Crops Production System Practiced by the Tribe of West Garo Hills District of Meghalaya, 2017.
3. Gangwar AK, Ramakrishnan PS. Cultivation and use of lesser-known plants of food value by tribals in north-east India. Agriculture, ecosystems & environment, 1989;25(2-3):253-267.
4. Ghalot K, Lal VK, Jha S. Phytochemical and pharmacological potential of *Flemingia* Roxb. ex WT Aiton (Fabaceae). International Journal of Phytomedicine, 2011;3(3):294-307.
5. Gogoi S. Value of Starch in Indian Traditional Food System. In Chemical Properties of Starch, 2020. Intech Open.
6. Hrcakova G, Velebny S. Pharmacological potential of selected natural compounds in the control of parasitic diseases. Springer Science & Business Media, 2012.
7. Kalia AN. Textbook of industrial Pharmacognosy. Oscar publication, New Delhi, India, 2005.
8. Kar PK, Tandon V, Saha N. Anthelmintic efficacy of *Flemingia vestita*: genistein-induced effect on the activity of nitric oxide synthase and nitric oxide in the trematode parasite, *Fasciolopsis buski*. Parasitology International, 2002;51(3):249-257.
9. Lee JY, Kim HS, Song YS. Genistein as a potential anticancer agent against ovarian cancer. Journal of Traditional and Complementary Medicine, 2012;2(2):96-104.
10. Longvah T, Anantan I, Bhaskarachary K, Venkaiah K, Longvah T. Indian food composition tables. Hyderabad: National Institute of Nutrition, Indian Council of Medical Research, 2017.
11. Mani A. Nutritive value of some underutilized fruit and vegetables crops. Allied Horticulture Technology, 2018;17:71-73.
12. Marboh V, Mahanta CL. Characterisation and antioxidant activity of sohphlang (*Flemingia vestita*), a tuberous crop. Journal of Food Science and Technology, 2020;17:1-2.
13. Marshallong KL. Qualitative phytochemical study of bioactive Compounds from natural source (*Elaeagnus latifolia* And *Flemingia vestita*) and screening of antimicrobial and antifungal activity (Doctoral dissertation, Assam Bon Bosco University), 2017.
14. Naguleswaran A, Spicher M, Vonlaufen N, Ortega-Mora LM, Torgerson P, Gottstein B *et al.* *In vitro* metacestodicidal activities of genistein and other isoflavones against *Echinococcus multilocularis* and *Echinococcus granulosus*. Antimicrobial agents and chemotherapy, 2006;50(11):3770-3778.
15. Nedunchezhiyan M, Lenka A, Jata SK. Tuber Crops Interventions to Improve Livelihood Security in Disadvantaged Districts of Odisha. Journal of Root Crops, 2013;39(2):207-210.
16. Pal P, Tandon V. Anthelmintic efficacy of *Flemingia vestita* (Leguminosae): Genistein-induced alterations in the activity of tegumental enzymes in the cestode, *Raillietina echinobothrida*. Parasitology International, 1998;47(3):233-243.
17. Pandey A, Nivedhitha S, Bhardwaj R, Rathi RS, Singh R, Passah S. A study of a promising root tuber-producing crop, "Soh-phlong" (*Flemingia procumbens* Roxb., Fabaceae) from Meghalaya, India. Genetic Resources and Crop Evolution, 2019;66(2):555-565.
18. Rao HS. Isoflavones from *Flemingia vestita*. Fitoterapia, 1991;63:458.

19. Roy B, Tandon V. Effect of root-tuber extract of *Flemingia vestita*, a leguminous plant, on *Artyfechinostomum sufrartyfex* and *Fasciolopsis buski*: a scanning electron microscopy study. *Parasitology research*,1996;82(3):248-252.
20. Shailajan S, Kumaria S, Pednekar S, Menon S, Choudhury H, Matani A. Estrogenic potential of *Flemingia vestita* Benth Tubers in ovariectomized rat model. *Pharmacognosy Journal*, 2016, 8(1).
21. Shailajan S, Kumaria S, Pednekar S, Menon S, Joshi H, Matani A. Chromatographic evaluation of a phytoestrogen Genistein from *Flemingia vestita* Benth: An endemic plant of Northeast India. *Phcog Commn*,2014;4(4):2-8.
22. Sharma V, Ramawat KG. Tuberos Medicinal Plants of India. *Bulbous Plants: Biotechnology*, 2016, 311.
23. Singh B, Singh JP, Kaur A, Singh N. Phenolic compounds as beneficial phytochemicals in pomegranate (*Punica granatum* L.) peel: A review. *Food chemistry*,2018;261:75-86.
24. Singh HB, Arora RK. Soh-phlong, *Moghania vestita* A leguminous root crop of India. *Economic botany*,1973;27(3):333-8.
25. Sun MY, Ye Y, Xiao L, Rahman K, Xia W, Zhang H. Daidzein: A review of pharmacological effects. *African journal of traditional, complementary and alternative medicines*,2016;13(3):117-32.
26. Talang HD, Rymbai H, Devi MB, Jha AK, Chaudhuri P. Sohphlang—a potential indigenous leguminous tuber crop of Meghalaya. *International Journal of Minor Fruits, Medicinal and Aromatic Plants (IJMFM & AP)*, 2019, 53.
27. Tandon V, Das B, Saha N. Anthelmintic efficacy of *Flemingia vestita* (Fabaceae): effect of genistein on glycogen metabolism in the cestode, *Raillietina echinobothrida*. *Parasitology international*,2003;52(2):179-183.
28. Tandon V, Pal P, Roy B, Rao HS, Reddy KS. *In vitro* anthelmintic activity of root-tuber extract of *Flemingia vestita*, an indigenous plant in Shillong, India. *Parasitology research*,1997;83(5):492-498.
29. Thangavel P, Puga-Olguín A, Rodríguez-Landa JF, Zepeda RC. Genistein as potential therapeutic candidate for menopausal symptoms and other related diseases. *Molecules*,2019;24(21):3892.
30. Toner E, Brennan GP, Wells K, McGeown JG, Fairweather I. Physiological and morphological effects of genistein against the liver fluke, *Fasciola hepatica*. *Parasitology*,2008;135(10):1189-1203.
31. Van Valkenburg JL, Bunyaphatsara N. (eds). *Plant Resources of South-East Asia no. 12 (2). Medicinal and poisonous plants 2*. Backhuys Publishers, Leiden, The Netherlands. *Nordic Journal of Botany*,2001;21(6):580-580.
32. Vishnuvathan VJ, Lakshmi KS, Srividya AR. Medicinal uses of formononetin-a review. *The Journal of Ethnobiology and Traditional Medicine*,2016;126:1197-1209.
33. Wen K, Fang X, Yang J, Yao Y, Nandakumar KS, Salem ML, Cheng K. Recent Research on Flavonoids and their biomedical applications. *Current Medicinal Chemistry*, 2021;28(5):1042-1066.
34. Zengin G, Aktumsek A, Guler GO, Cakmak YS, Yildiztugay E. Antioxidant Properties of Methanolic Extract and Fatty Acid Composition of *Centaurea urvillei* DC. subsp. *hayekiana* Wagenitz. *Records of Natural Products*, 2011, 5(2).