J. Sci. Trans. Environ. Technov. 2008, 1(4): 170-173

Pharmaceutical significance of the responses of *Ziziphus mauritiana* Lam. to mite-induced gall

M. Gopi and S. Amerjothy*

Department of Plant Biology & Plant Biotechnology, Presidency College, Chennai 600 005, Tamil Nadu, India.

Abstract

A mite-induced gall on *Ziziphus mauritiana* Lam. (Rhamnaceae) is quite prevalent in semiarid scrub forests of India. The galls are fairly large, amorphous, tumourous bodies on the axillary buds. They are it is reddish brown with involutions. This paper describes the structure and biochemical compounds of the gall. The gall was found to be rich in nutraceuticals, such as minerals, vitamins and enzymes.

Keywords : plant galls, mite-induced gall, *Ziziphus mauritiana*, *Eriophyes cerrnuus,* nutraceutical values, pharmaceutical significance

INTRODUCTION

Plant-galls are morbid outgrowths on the plant organs caused by certain parasitic phytophagous insects, which are endowed with gall inducing trait during the course of evolution. They are pathological responses of the plants against the stimuli induced by parasitic organisms feeding on the plant tissues. The phytophagous insects have evolved balanced parasitic mode of nutrition and meticulous skill for selecting their specific host plants. The feeding injury and the salivary chemicals introduced into the plant tissues are the triggering factors for gall initiation. The reactivities of the host tissues in response to the insect's stimulus such as the salivary or body secretion of the insects and responses of the host plant cells, further enhance the growth and development of the gall.

During the stimulus response processes, several chemical compounds are irreversibly shunted to the gall on which the insects feed. Thus, the gall serve as sink for several metabolities mobilized from different sources of the plant. As such merely because of their morbid nature, the galls cannot be disregarded as worthless plant products. In a sense, the plant gall represents a biotechnological product. Several aspects of the gall-biotechnology remain to be investigated; the economic utility of the gall is the area that deserves to be pursued. But the plant galls have not gained as much popularity as other vegetables in the food and neutraceutics arena. Many galls, especially certain smut fungal galls have claims for food values in Indian folklore. Certain galls have been ascribed with high credentials in ancient Indian Systems of Medicine. To cite a few galls, 'Karkata Shringi', a petiole / leaf gall on *Pistacia integirima* Stew. ex Brandis (Anacardiaceae) and Nut-gall or Mayaphal on *Quercus infectoria* Oliv. have been used in Siddha and Ayurvedha formulations for several centuries in India (Mani, 2000).

*Corresponding Author
email: *s_amerjothy@yahoo.co.in*

The chemical compounds stored in the galls happen to be of industrial and pharmaceutical values as well. The huge, fleshy pouch galls on the leaves of *Terminalia chebula* and the gallnut on *Q. infectoria* are a few galls widely used in Indian medicine. Large, curiously horn-shaped galls on the leaves of *P. integerrima* of Anacardiaceae are found to be sold in all Indian crude-drug markets in the name of "*Karkata singi*".

The jujube fruits (*Ziziphus mauritiana* Lam.*)* called as *Illanthai*, in Tamil are edible. The fruit is used fresh, dried or preserved. The bark is used for tanning and the leaves are used as fodder. The dried leaves are refringerant, cleans and heals the wounds, improves the taste and reduces thirst. Taste sensation vanishes for sometime when leaves are chewed. It also acts as an expectorant, diuretic and reduces urine sugar. Powdered bark is a domestic dressing to old wounds and ulcers. This species bears a kind of *lac*. In northern India, it is called *Beree-Iclilakh*, which is used for dying leather, cotton and silk. The jujube plant produces abundance of shoot axis galls. The histology and neutraceutical and economical values of the stem gall in *Ziziphus mauritiana* have been described in this paper.

MATERIALS AND METHODS

The mite gall on *Ziziphus mauritiana* Lam. occurs in plenty and available in all seasons. The galls were collected from 22 years old tree and processed as per Johansen (1940) for its anatomical studies as well as for extracting the dye from it. Anatomical studies (Sass, 1940) were carried out through sectioning the gall and observing the sections under the microscope after suitable staining as described in O' Brien *et al*. (1964). The preliminary qualitative phytochemical analysis of the gall powder was carried out for detecting active principles of the secondary metabolites of the gall (Kokate, 1994). Fluorescence analysis of the gall powder was observed in day/visible light and UV light (Chase and Pratt, 1949). The neutraceutical evaluations of the gall tissue as well as normal tissue of the plant were done by

estimating calorific value, vitamins and minerals which were also used for focusing the food values of the plant (Sethi, 2001).

Procedure for Extracting the Dye and Dyeing

The gall was soaked overnight in plain water for 12 hours and the extract was filtered next morning and the cotton materials previously mordanted with Myrobalam were dyed with the extract. Four samples were made using different mineral salts *viz.,* Aluminium Sulphate, Ferrous Sulphate, Stannous Chloride and Dichromate.

RESULTS AND DISCUSSION

Morphology of the Gall

The gall is induced by a mite, *Eriophyes cerrnuus*. The gall arises equally readily on young as well as older branches and is tuberculate and callus-like. It occurs mostly in the axillary buds or sometimes on the tender leaves and petiole. The gall is a bright reddish callus-like mass of tuberculate surface (Plate 1, Fig. 1).

Anatomical Studies on the Gall

The mites infect the meristematic axillary buds of the plant; the buds consist of apical meristem, leaf primordial and bud scales. The anatomy of the stem is typically dichotomous (Plate 1, Fig. 2). The mites are usually dispersed by wind and when deposited on the buds, they feed on the surface cells of the young organs. The feeding stimulus causes proliferation of the epidermal and subepidermal cells, which develop into tuberculate masses (Plate 1, Fig. 3). The mite population so increases using the crevices of the tissue masses which provide a conducive domecile to feed and live (Plate 1, Fig. 4). Though the galls appears to be cauliflorous masses, microscopic observation reveals that these are several 'meristematic apices' with distinct apical cells and lateral cell segments (Plate 1, Fig. 5). Due to puncturing of the cells and feeding impacts of the mites, the apical cell system gets converted into tumourous mass (Plate 1, Fig. 5). Increasing mite population coupled with indefinite proliferation of the plant tissue is a curious biological phenomenon.

Phytochemical analysis of the Gall

The preliminary phytochemical analysis of the gall extract revealed the presence of saponin, phenol, coumarin, tannin and alkaloids (Table 1). The presence of alkaloids in the gall tissue indicated its pharmaceutical and industrial application potentials. The fluorescence analysis of the gall tissue gave mostly yellow or brown in sun light and green shades under UV light (Table 2).

Neutraceutical Studies of the Gall

For neutraceutical evaluation of the gall, the gall tissues were processed and analysed for calorific, vitamin and mineral values and compared with normal tissues of the plant. Such a comparison revealed that normal tissues have more calorific values than the gall tissues; but the fat content was higher in the gall tissues (Table 3). The vitamin content of the gall tissue was higher when compared to the normal tissue (Table 4). Calcium, Magnesium and Iron are comparatively higher in the gall tissues (Table 5).

This results highlight that the gall tissues possess biochemical pool due the intervention of the mites. The continuous feeding activity of mites, renders the formation of a huge callus like mass of tissue in the surface of the stem and the defense mechanism of the host plant gives an array of by-products of secondary metabolites. The high content of vitamins and minerals in the gall tissue as compared to normal tissue indicates its neuroceuting value. Thus, even though the gall is pathological in nature, it also could play important role in the medicinal arena due to its diverse biochemical constituents.

Table 1. Qualitative phytochemical analysis of extract of mite (*Eriophyes cerrnuus*) induced stem gall of *Ziziphus mauritiana* (Stem Gall Extract–Colour : Brown or reddish)

No.	Test	Inference[a]
1.	Saponin	+
2.	Quinones	-
3.	Phenol	+
4.	Coumarin	+
5.	Tannin	+
6.	Alkaloids	+
7.	Steroids	-
8.	Flavonoid	-

[a]+ Present; - Absent

Table 2. Flourescence analysis of extract of mite (*Eriophyes cerrnuus*) induced stem gall of *Ziziphus mauritiana*

S.No.	Reagent	Colour observed under	
		Sun Light	UV Light
1.	Hexane	Pale Brown	Light green
2.	Benzene	Yellow	Green
3.	Methanol	Yellow	Green
4.	Ethanol	Yellow	Yellowish green
5.	Chloroform	Brown	Green
6.	Ether	Yellow	Green
7.	Sulphuric acid	Brown	Green
8.	Hydrochloric acid	Yellow	Yellowish green
9.	Water	Brown	Green

STIMULUS - RESPONSES ON PLANT TISSUES

***Eriophes cernuus* Massee (Acarina) Mite**

***Zizyphus mauritiana* Lam. (Rhamnaceae)**

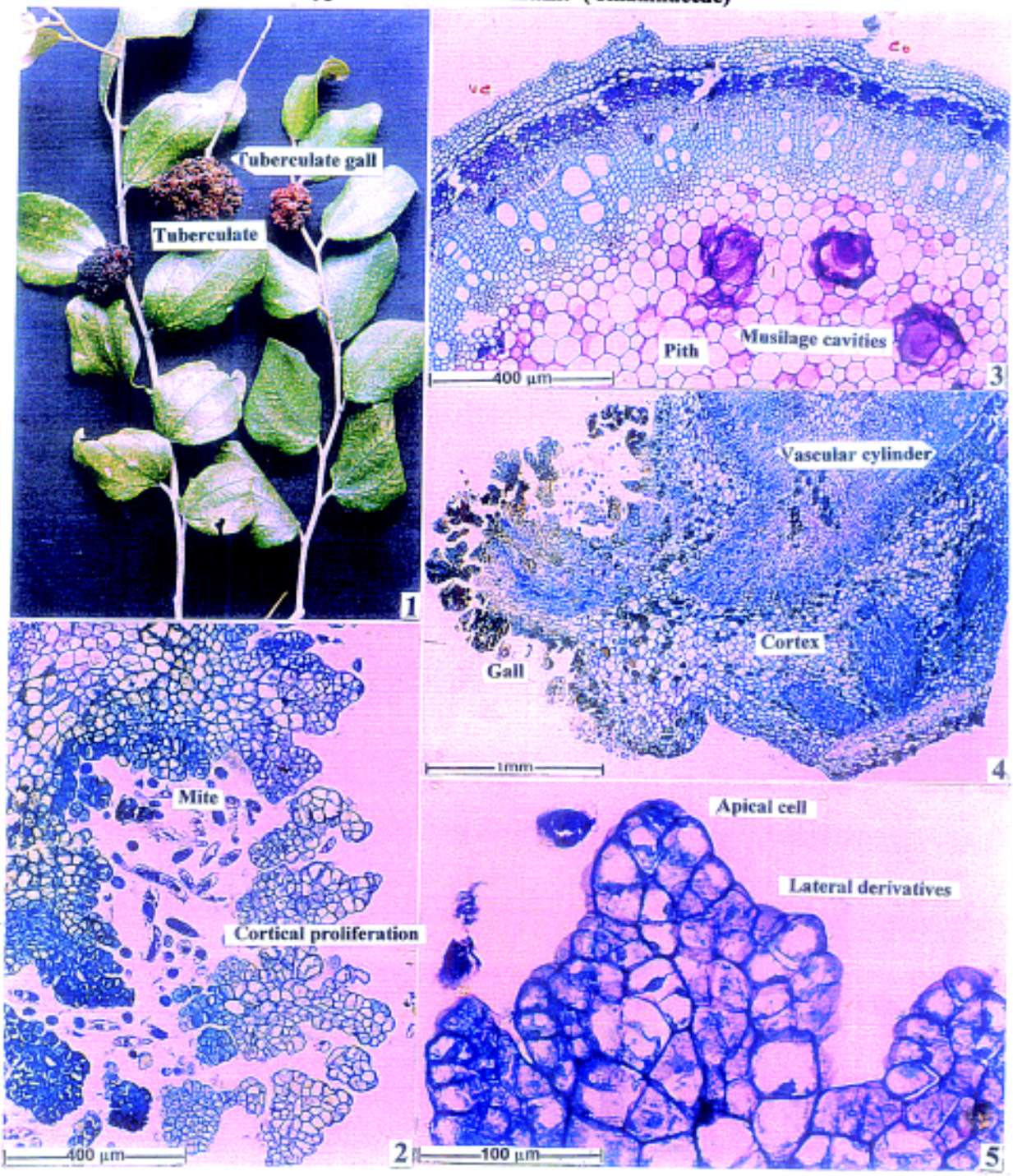

Table 3. Calorific value of normal tissue and gall tissue of *Ziziphus mauritiana*

S. No.	Variable	Normal Stem	Gall Stem
1.	Carbohydrate	34.56%	5.78%
2.	Fat	0.45%	0.785%
3.	Protein	19.67%	15.89%
	Calorific value	220.5 calories (app.)	93.75 calories (app.)

Table 4. Vitamin content of normal stem and gall stem of *Ziziphus mauritiana* (mg/g)

S. No.	Parameter	Normal Stem	Gall Stem
1.	Vitamin B1	0.0012	0.0014
2.	Vitamin B2	0.0022	0.0025
3.	Vitamin B6	0.3458	0.4215
4.	Vitamin B12	0.0013	0.0012
5.	Vitamin E	0.0003	0.0021
6.	Vitamin K	Nil	Traces
7.	Folic acid	0.0271	0.0275

Table 5. Mineral content of normal and gall tissue of *Ziziphus mauritiana* (mg/g)

S.No.	Parameter	Normal Stem	Gall Stem
1.	Calcium	1.987	2.118
2.	Magnesium	0.4345	0.5371
3.	Iron	0.3666	0.4234
4.	Sodium	0.0134	0.013
5.	Potassium	0.0175	0.016
6.	Phosphorus	0.0234	0.023
7.	Zinc	0.1156	0.1156
8.	Calcium panthothenate	0.0112	0.0041
9.	Heavy Metals	Less than 15 ppm	Less than 10 ppm

ACKNOWLEDGEMENT

Our thanks are due to Plant Anatomy Research Centre (PARC), West Tambaram, Chennai – 45, for providing necessary facilities.

REFERENCES

Chase, C.R. and Pratt, R. 1949. Fluorescence of powdered vegetable drugs with particular reference to development of a system of identification. *J. Am. Pharm. Associ. Sci*., 38: 324 – 331.

Johansen, 1940. *Plant Microtechnique*. McGraw Hill Book Co., New Delhi.

Kokate, C.K. 1994. *Practical Pharmacognosy*. Vallabh Prakashan, New Delhi, India.

Mani, M.S. 2000. *Plant Galls of India*. Second Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

O'Brien, T.P., Feder, N. and McCull, M.E. 1964. Polychromatic Staining of Plant cell walls by toluidine blue. O. *Protoplasma* 59: 364 – 373.

Sass, J.E. 1940. *Elements of Botanical Microtechnique*. McGraw Hill Book Co., New York.

Sethi, P.D. 2001. *Quantitative Analysis of Pharmaceutical Formulation*. CBS Publishers & distributors, New Delhi.