Review Article

LANTANA CAMARA: A TOXIC WEED IN LIVESTOCK DEVELOPMENT

N.B. Shridhar[*1], G. Srinivasan[2], U. Sunilchandra[3], Vinay P. Tikare[4] and Prashant Kumar Waghe[5]

Department of Veterinary Pharmacology and Toxicology
Veterinary College, Karnataka Veterinary Animal and Fisheries Sciences University
Shivamogga – 577 204, Karnataka, India

ABSTRACT

Lantana camara is a weed which affects both livestock production and the growth of other plants near them. It is a sturdy plant with multi-colored flowers which can grow well in diverse climatic and soil conditions. Initially cultivated as an ornamental plant and transferred to various regions of the world; the plant has now become one of the common weeds in agricultural land and forest regions. It is found in almost all parts of India and its invasion in forest cover of the country is a great concern as the plant has inhibitory effect on growth of other plants. It has been listed among the ten most toxic weed in the world. Although grazing animals primarily do not consume this plant, scarcity of pasture lands cause the animals to eat this plant. Consumption of this plant cause hepatotoxicity and secondary photosensitization in animals. The toxic compound in this plant is 'Lantadenes' and is predominantly found in leaves of the plant. The history, phytochemistry, toxicity in animals, toxicopathology, treatment and prevention of toxicity are reviewed in this article.

Key words: *Lantana camara*, Toxic weed, Photosensitization, Hepatotoxicity

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INTRODUCTION

The genus 'Lantana' contains about 150 species of perennial flowering plants and it belongs to family, *Verbenaceae* (Lantana *lexico* UK Dictionary. Oxford University Press. Retrieved 2021-03-25). Probably the word 'Lantana' (from the Latin word '*lento'*, to bend) was derived from the ancient Latin name of the genus *Viburnum* which means, it resembles a

[1]Professor and Head, corresponding author Email id: shridharvet@gmail.com

[2]Assistant Professor (contractual)

[3]Associate Professor

[4]Assistant Professor and Head, Department of Veterinary Pharmacology and Toxicology, Veterinary College, Gadag, Karnataka,

[5]Assistant Professor, Department of Veterinary Pharmacology and Toxicology, Veterinary College, Bidar, Karnataka

little in the foliage and inflorescence (Munir, 1996).

Fig 1. *Lantana camara* L

Lantana camara L. grows up to 200 m in tropical, subtropical, and temperate areas (Sharma *et al.,* 1988). It's a toxic herb. West Indians call it Camara (Parsons *and* Cuthbertson*,* 2001). Pink, red, yellow, white, and violet bloom on *L. camara*. Its stems and branches bear spines. Late 1600s Dutch explorers introduced this Brazilian shrub. Explorers brought seeds to Britain, Europe, and North America. *L. camara* migrated fast from Hawaii to Australia, the Pacific, and Southern Asia. Natal birds spread it to warmer South Africa. Nurserymen sold many exquisite types in the 18^{th} and 19^{th} centuries. 650 cultivar names are *L. camara* complex. *L. camara* invades subtropical and tropical grasslands, woods, and orchards. Cattle don't eat the plant unless pasture is scarce. It stunts plant growth, reducing grazing land, and causes photosensitization and hepatotoxicity in animals. Green berries have killed people in tropical areas, yet ripe blue-black berries are eaten (Morton *et al.,* 1994; Ross *et al.,* 1999).

Phytochemistry

Study on Lantana's phytochemistry, started in early 1940s. Two grams of oral lantanin in a sheep exposed to direct sunshine caused photosensitization and jaundice similar to Lantana leaves. The active principle of *L. camara* was named "Lantadene A" because lantanin had already been named for an alkaloid from *Lantana brasiliensis*. Lantadenes are in L. camara's leaves. In a series of chemical experiments on *Lippiarehmanni* and *Lantana camara* triterpenoids, demonstrated that lantadene A and rehmannic acid were identical.

The lantadene A content was estimated to be 6 -7 mg/g dry weight of leaves during the months of July-August, the compound being altogether absent in the flowers, fruits and tender upper shoots (Sharma *et al*., 1979). Hart and co-workers (Hart *et al*., 1976a and 1976b) observed that in leaves of red flower variety (*L. camara* var. *aculeate*), A and B lantadenes were present as major constituents, while betulonic acid predominated in leaves of white flower variety. Reduced lantadene A (22-β-angeloyloxy-3β-hydroxyolean-12-en-28-oic acid) and reduced lantadene B (22-β-dimethylacryloxy- 3β-hydroxyolean-12-en-28-oic acid) have also been shown to be present in *L. camara*. The leaves of pink flower variety is nontoxic and contain very little amount of lantadene A and B (Hart *et al*., 1976b).

In addition to the two major triterpenoids lantadene A and B, leaves of Lantana (red flower) have been found to contain other lantadenes called lantadene C (22-β -2-methylbutanoyloxy-3-oxoolean-12-en-28-oic acid) and lantadene D (22-β-isobutyroyloxy-3-oxoolean-12-en-28-oic acid) (Sharma *et al*., 1990). All the lantadenes have a common core structure of 22-hydroxy-oleanonic acid.

Among the three taxa of the plant (*Lantana camara* var. *aculeate*) – I (white – pink), II (yellow-pink), and III (yellow-red), lantadene A, B and C were the major lantadenes of taxon III and small amount of lantadene D was identified in it. Only small amounts of lantadene A and B were identified in taxa I and II. Taxon III is highly hepatotoxic, whereas taxon I is mild toxic and taxon II is considered to be nontoxic (Sharma *et al*., 1991).

Toxicity of *L. camara* in livestock

Among livestock animals, sheep, cattle and buffalo are highly susceptible, while goats show a little resistance to lantana toxicity (Lal and Kalra, 1960; Sharma *et al*., 1988 and 2007). Among laboratory animals, guinea pigs exhibit the typical signs. So, guinea pigs are the most preferred animal model for lantadene toxicity studies (Sharma *et al*., 1988). Testosterone is considered to be the factor responsible for resistant to lantana toxicity in male rats (Sharma *et al*., 2007; Pass *et al*., 1979a). Kangaroos and Ostriches are also found to be susceptible to lantana toxicity (Johnson *et al*., 1998; Cooper, 2007).

Livestock poisoning from Lantana causes cholestasis, elevated bilirubin, and photosensitization. Liver and kidneys are affected by lantana toxins. Weakness, sluggishness, edematous eyelids and ears, fissures and cracks on muzzle and non-hairy body parts, ulceration of the tip and lower surface of the tongue (if unpigmented), bloody diarrhoea, conjunctivitis, pale conjunctival, vulvar or vaginal mucous membrane and eye sclera are clinical signs of lantana toxicity (Sharma and Makkar, 1981). Oral lantadene leaf powder (4 and 8 g/kg) caused photosensitization, bile-stained liver, and conjunctivitis in sheep with diarrhoea, anorexia, and jaundice plagued photosensitized goats (Obwolo *et al*., 1990). Intravenous LD 50 for sheep is 1-3 mg/kg, whereas oral LD 50 is 60 mg/kg (Sharma *et al*., 2007). Oral administration of 25 mg/kg lantadenes to guinea pigs caused hepatotoxic and nephrotoxic effects, indicating subacute toxicity (Nellis, 1996). Effects on rats, but not milk, placenta, or offspring (Sharma *et al*., 2007; Parimoo *et al*., 2015). Lantadenes impact sperm count, production, and shape (Sharma *et al*., 2007).

During drought, animals consume lantana. Due to liver injury, which causes ruminal stasis, the poison is constantly absorbed and toxicity is maintained (Mello *et al*., 2005). Lantana toxins produce intrahepatic cholestasis and bile secretion suppression without hepatocellular damage (Pass *et al*., 1981). During poisoning, hepatocellular damage causes jaundice

(Sharma *et al*., 2007). Peripheral liver cells are injured. Intrahepatic cholestasis causes bile canaliculi dilation, microvilli loss, and changes in enzyme activity and canalicular membrane composition (Pass *et al*., 1979b). Phylloerythrin, a degraded chlorophyll derivative, accumulates in the liver and causes photosensitization (Trauner *et al*., 1998). Hepatogenous photosensitization results from poor hepatobiliary elimination (Rimington and Quin, 1934). Phylloerythrin accumulates in plasma due to poor hepatobiliary excretion. Inhibited bile secretion causes bilirubin buildup and jaundice (Kellerman and Coetzer, 1985). In advanced poisoning, Foot's reticulin and Van Gieson stains show fibre development in the periportal liver regions (Gopinath and Ford, 1969; Kumar *et al*., 2016).

Clinical signs

Ruminal stasis followed by off-feeding within a couple of hours of consumption and followed by severe constipation are the primary signs. Within 24-48 hrs photosensitization occurs in un-pigmented areas which lead to necrosis on those areas. Severe jaundice develops within 48-72 hrs. In acute or more severe cases death occurs within 2 to 4 days. In less severe cases, death occurs within 1-3 weeks. Female rats exhibit signs like fetal abnormalities, embryo toxicity and implantation losses (Sharma *et al*., 2007; de Mello *et al*., 2003).

Pathology

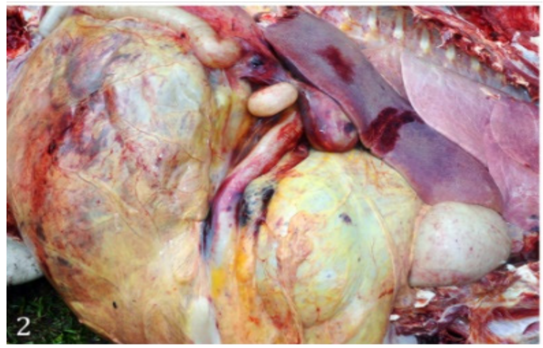
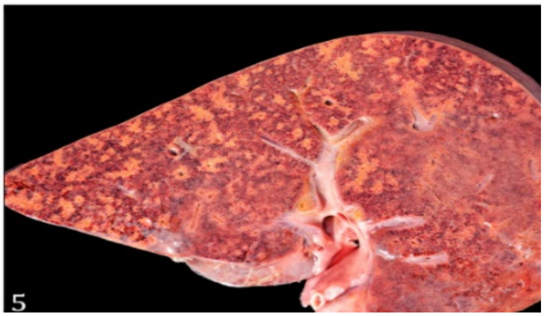


Figure 2

Diffuse jaundice of omentum, serosal surface of multiple organs, multifocal haemorrhages in the omentum, serosa of the abomasum, liver and gallbladder of a cattle affected with lantana toxicity.

Mild hepatomegaly, enhanced lobular pattern and multifocal areas of haemorrhage on the hepatic capsular surface, in addition to multifocal to coalescent serosal haemorrhage in the gallbladder.

Liver irregular cut surface, orange discoloration and enhanced lobular pattern.



Liver cut surface, heterogeneous in appearance, with yellowish areas interspersed with dark and light red foci.

Histopathological examination of liver and bile of a cattle affected with lantadene toxicity showed degenerated periportal parenchymal cells, portal fibrosis, fatty degeneration, bile canaliculi distention, hyperplasia of bile ducts (Uppal and Paul, 1978). Haematological examination reveals, increase in hematocrit values and blood clotting time but decrease in erythrocyte sedimentation rate (Hussain and Roychoudhury, 1992). Increased total and direct bilirubin, increase in serum ALP, AST, GLDH, serum albumin, serum globulin and serum total protein and decrease in albumin/globulin ratio in cattle was reported (Seawright and Hrdlicka, 1977). Fibrosis due to type 1 collagen formation was noticed in chronic toxicity.

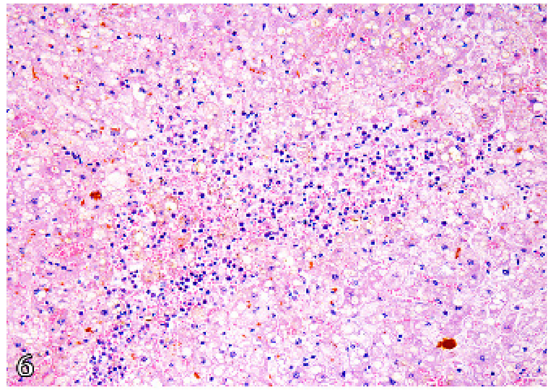
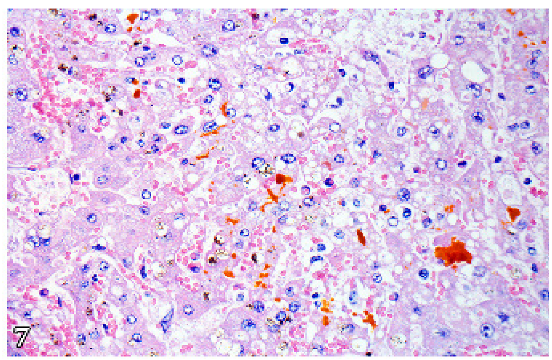
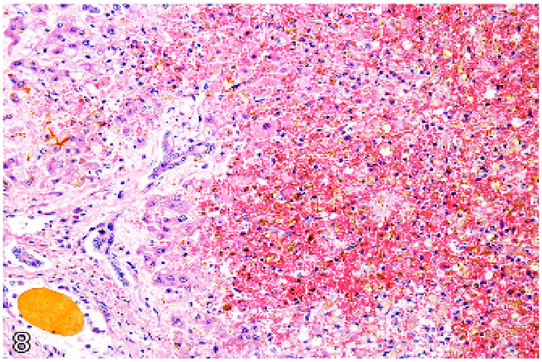


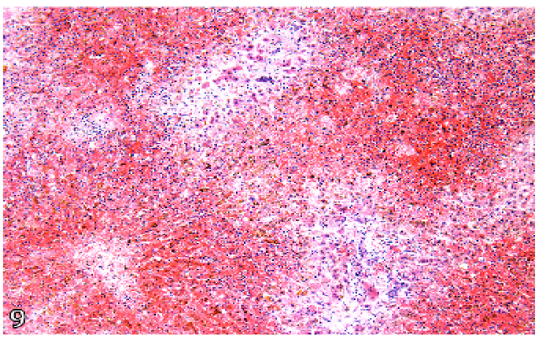
Fig. 3. Hepatic histological findings of acute *Lantana camara L.* poisoning in dairy cattle Centrilobular necrosis with haemorrhage and neutrophilic inflammatory infiltrate. Adjacent to this area, there is marked hepatocellular cytoplasmic vacuolation and prominent cholestasis. HE, 20X.



Evidence of cholestasis in canaliculi and bile ducts and severe hepatocellular cytoplasmic vacuolation. HE, 40X.



Bridging coagulative necrosis and marked haemorrhage in the centrilobular area, extending to the midzonal area, forming bridges. There are also mild periportal fibrosis and bile duct proliferation. HE, 20X.



Necrosis and haemorrhage in the hepatic parenchyma with hepatocellular vacuolization and prominent cholestasis. HE, 10X.

Histopathological alterations in different animals

Fatty degeneration, periportal parenchymal cells degeneration, bile canaliculi distention, portal fibrosis, oedema of gall bladder and hyperplasia of bile ducts were noticed in cattle. In goats, inter-sinusoidal space haemorrhage, cirrhosis and proliferation of bile ductules, coagulative necrosis, fatty degeneration of proximal convoluted tubules of kidneys, bile ductules proliferation in the liver were noticed. Vacuolation in centrilobular cells with bile mainly in chronic cases were noticed in sheep (Kumar *et al*., 2016).

Haematological alterations in different animal species

Increased hematocrit values and blood clotting time and decrease in ESR (Erythrocyte Sedimentation Rate) were reported in cattle. In sheep, transient increase in neutrophils number and hematocrit value and decrease in thrombocytes number were noticed. Progressive decrease in haemoglobin, PCV (Packed Cell Volume), and total erythrocyte count and increase in blood clotting time and leukocyte count has been reported in goat (Kumar *et al*., 2016).

Biochemical alterations in different animal species

Increase in total and direct bilirubin, increase in serum ALP, AST, GLDH, Serum albumin, globulin and total protein, increase in phylloerythrin levels and decrease in albumin/ globulin ratio was reported in cattle and where as in sheep there is no change in the serum AST, ALP and ALT levels. In goats rise of serum AST, creatinine, GGT, serum bilirubin and BUN levels were reported (Kumar *et al.,* 2016)

Treatment for lantadene toxicity

Specific therapy for lantadene toxicity is not identified. The conventional treatment methods which can be followed are (Sharma *et al*., 2007; McSweeney and Pass, 1983)

1. Further exposure of the animals to noxious weed can be avoided
2. The animal can be kept in a well shaded areas away from direct sunlight, if photosensitization develops.
3. Intravenously excessive amounts of glucose saline solution can be administered
4. Hepatoprotective agents to tone up the liver can be administered.
5. Rumenotomy can be performed to remove the toxic ruminal contents.
6. Administration of saline purgatives to facilitate removal of gastro-intestinal contents.
7. The ruminal contents can be replaced with a suspension containing electrolytes, chaffed forage and rumen liquor from a healthy animal.
8. Single dose of activated charcoal (5 g/kg) can be administered to bind the toxin in the rumen and to prevent further absorption. Lantana poisoned cattle can be successfully treated by giving 2.5 kg of powdered activated charcoal in 20 liters of multiple electrolyte solution by stomach tube while in sheep, 0.5 kg activated charcoal in 4 liters of fluid is enough.
9. Bentonite (5 g/kg) was judged to have promise as a cheap alternative to activated charcoal for therapy of Lantana poisoning of cattle.
10. Administration of H_1 antihistamines and antibiotics are useful for control of photo sensitization lesions and secondary bacterial infections.
11. Powder obtained from the plant *Tephrosia purpurea* can be administered about 50- 60 g per animal orally.

Prevention

1. Vaccination: After injecting the conjugates of these compounds with appropriate proteins into sheep and cattle, antibodies against lantadene A and B were discovered. On administration of lantadene A or lantana to the vaccinated animals, although the protection was weak but a decrease in the severity of toxicity has been observed.
2. Biodegradation of lantadenes: Organisms like *Pseudomonas picketii* and *Alcaligenes faecalis* are found to be degraders of lantadene A. But they are slow degraders of lantadene A. Further research is needed for isolation of microbes with better capacity for degradation of toxic lantadenes, identification of the genome involved

and transferring it to rumen microflora (Sharma *et al*., 2007; McSweeney and Pass, 1983).

Allelopathic effects of *L. camara*

The term "Allelopathy" describes plant interactions that stimulate or impede growth. Allelopathy may cause Lantana's plant-suppressing impact. Lantana inhibits root and lateral root growth, not shoot and germination. Lantana's allelopathic impact may be related to phenolic chemicals, which must be discovered (Ghisalberti, 2000).

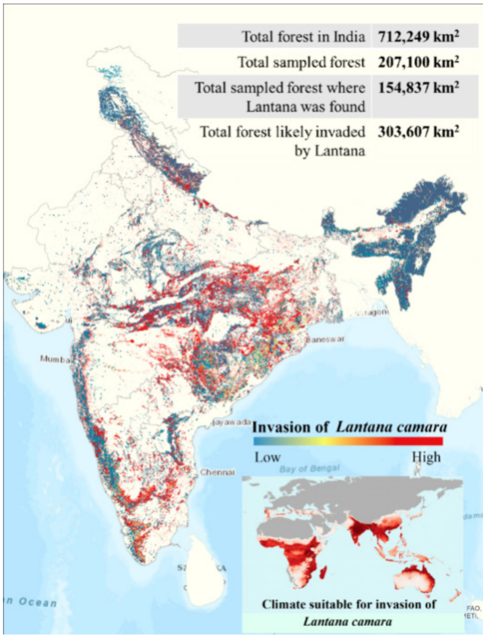


Fig. 4. Prevalence of Lantana in India. Red dot signifies the highest density of lantana and blue signifies the least density. The world map on the bottom right shows the suitable area for lantana invasion (Mungi *et al*., 2020).

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