Chapter 2

Review of Literature
REVIEW OF LITERATURE

Fasciolosis

Fasciolosis is a major parasitic disease of livestock with over 700 million production animals at risk of the infection. Fasciolosis is a zoonotic helminth infection and causes of an important economic loss. Fasciolosis disease belongs to the plant-borne trematode zoonoses. Definite host of trematode parasite is very broad and includes many herbivore mammals, including animal and human. Fasciolosis, caused by *F. gigantica* and *F. hepatica*, is one of the most prevalent helminths infections of ruminants in different part of the world inducing significant morbidity and mortality (WHO, 1995). Animal and human cases are being increasingly reported from Europe, the Americas, Oceania, Africa and Asia. Hence, animal and human fasciolosis is considered now as a zoonosis of major global and regional importance.

Epidemiological studies were undertaken in India various slaughter houses, livestock farms and veterinary hospitals and on household buffaloes under the different climatic conditions existing in Punjab (Mqubool *et al.*, 2002).

The causative agents *Fasciola gigantica* and *Fasciola hepatica* geographical distributions which overlap in many regions of Africa and Asia, the differential diagnosis between *F. gigantica* and *F. hepatica* infection is very important because of their different transmission and epidemiological characteristics (Marcilla *et al.*, 2002).

Dar *et al.*, (2003) examined the experimental infections of *Galba truncatula* with *Fasciola gigantica* and *Fasciola hepatica* was carried out under laboratory conditions to determine the characteristics of rediae of both species via their morphometry and to find reliable measurements that might be efficiently used to discriminate between the rediae of both species of Fasciola.

The prevalence and some factors influencing the occurrence of fasciolosis in cattle carried out at selected major abattoirs in Zambia. *F. gigantica* infection is high liver condemnations and trimmings in cattle tendered for slaughter (Phiri *et al.*, 2005).
A phenotypic study of adult fasciola fluke from naturally infected bovines from Gilan was carried out by mean of an exhaustive morphometric analysis using traditional microscopic measurements and an allometric model in Iran (Ashrafi et al., 2006).

Fasciolosis is considered an important limiting factor in livestock production it is also present in a site other than liver, such as subcutaneous tissue and epididymis, brain, lungs, stomach and caecum (Michael, 2004 and Makay et al., 2007).

Trematode parasites *F. gigantica* and *F. hepatica* are well known owing to their worldwide veterinary importance and negative economic impact on livestock production. *F. hepatica* appears to be more pathogenic than *F. gigantica* because of its rapid increase in size and the speed of its progression through the migratory phases of its life cycle. In various parts of different country animal and human fasciolosis is an endemic clinical and epidemiological health problem (Raadsma et al., 2007; Tuma et al., 2007; Maha et al., 2008; Nasser et al., 2010; Sunita et al., 2012 and Dar et al., 2012).

Significant differences were observed between the prevalence of fasciolosis that occurred in the dry season and that of the rainy season. It was also observed that bovine fasciolosis is an obstacle to livestock production and development. Fasciolosis was noticed that a higher infection rate was recorded in older cattle than in youngsters whereas cattle of either sex were equally affected (Fatima et al., 2012; Degheidy et al., 2012 and Ardo et al., 2013).

The epidemiological study was in domestic ruminants such as buffaloes, cow and goat with liver fluke infection in Udaipur district. Infections of *F. gigantica* were found more harmful as compared to *F. hepatica* (Swarnakar et al., 2014).

Fasciolosis causes severe reductions in milk and meat yield as well as losses due to decreased fertility. The host animals become infected with fasciola metacercariae when they ingest contaminated vegetation close to or within water bodies (Vareni et al., 2014).
The prevalence and seasonality of infections by fasciola of goats and buffaloes in Hubei and Anhui provinces of China were reported. *F. gigantica* mainly infected buffalo. This is the first demonstration of Fasciola infection in Hubei province, detection of *F. gigantica* in Anhui province and in Pakistan (Yuan *et al*., 2015; and Khan *et al*., 2015).

In Malaysia and Nigeria, El-Kharga and Egypt the direct and indirect impact of bovine fasciolosis on food security was observed. Livestock production constitutes an important component of Nigeria agricultural development, animal protein, raw materials for agro allied based industries. The highest fascioliasis infection was recorded during inter and autumn. It constitutes a major cause of economic losses at El Kharga abattoir and threat public health (Mohammed *et al*., 2015; Elshraway *et al*., 2017 and Meshesha *et al*., 2017).

**Fasciola gigantica**

The prevalence of *Fasciola gigantica* in West Africa, infection of the snail with the larvae of the trematodes, the geographical distribution and seasonal incidence of the parasite in the definitive host, the free-living stages and with the clinical signs of fasciolosis, fasciolosis diagnosis, treatment, and control.

The giant liver fluke *Fasciola gigantica* is a large trematode parasite closely related to Fasciola hepatica. It occurs in an almost all tropical and subtropical region of the world and is the causative agent of tropical fasciolosis. It is regarded as the most important single helminth parasite of ruminants in the tropics fasciolosis adversely affects milk production, wool quality and quantity and in weight gain of the animal. According to food and agriculture organization report, it is estimated that 300 million bovines and 2.4 million people exposed to fasciolosis worldwide causing enormous losses amounting to more than US$ 3 billion per annum. This huge loss is due to high infection rates of *Fasciola gigantica* in infected areas, the parasites broad host range animal, buffalo, sheep, goats, donkeys and at least 16 species of wild ruminant and the importance of agriculture in those countries where it occurs (Veen, 1980; Dalton, 1999; Fairweather & Boray, 1999 and Spithill *et al*., 1999).
The comparative morphometry of eggs and adults *Fasciola gigantica* under light microscope, morphology of adults under scanning electron microscope and ultrastructure of tegument were studied by many scientists in various part of the world (Sobhona *et al.*, 2000; Srimuzipo *et al.*, 2000; Ashour *et al.*, 2001 and Meaney *et al.*, 2002).

Tropical fasciolosis caused by infection with *Fasciola gigantica* is regarded as the most important single helminth infection of ruminants and still constitutes as two primary requirements for the establishment of the parasite are snail and environment that suits the development and multiplication fasciolosis is a zoonotic disease that infects a wide variety of mammalian hosts all around the world and snail is intermediate host *Fasciola gigantica* causes traumatic hepatitis, hepatic fibrosis, hyperplastic cholangitis, jaundice, anemia and edema (bottle jaw) in domestic ruminants. The infection of domestic ruminants with fasciola causes economic loss estimated over US$ 200 million per annum to the agricultural sector worldwide with over 600 million animals infected (Ramajo *et al.*, 2001; Gupta and Sing 2002; Velusamy *et al.*, 2004; Ghosh & Data, 2005 and Mas-Coma *et al.*, 2005).

Seasonal patterns of *Fasciola gigantica* infections in cattle in the highveld and lowveld communal grazing areas of Zimbabwe. High prevalence of fasciolosis and establishing the useful diagnostic method to determining patent *F. gigantica* infections in cattle in central java Indonesia were determined through monthly coprological examination. Significantly higher prevalence was found in the highveld compared to the lowveld for adult cattle than calves and in the wet season over the dry season (Pfukenyi *et al.*, 2006).

Soliman *et al.*, (2011) the efficacy of a new rhodanine derivative Ro-354 against adult *Fasciola gigantica* in vitro was investigated by scanning and transmission electron microscope.

Latchumikanthan *et al.*, (2012) observed secretory antigen of adult *F. gigantica* was prepared and purified by two-step alcoholic fractionation and anion exchange chromatography methods.
The anthelmintic activates of artemunate were evaluated based on the relative motility value and the alteration of the tegumental as observed by scanning and transmission electron microscopy (Tansatit et al., 2012).

In the Gorakhpur, the infection of *F. gigantica* larvae in *Indoplanorbis exustus* in Ramgarh Lake and Gida pond was maximum in the month of October and minimum in the month of November (Singh et al., 2012).

Uhuo et al., (2013), Richard et al., (2014) and Islam et al., (2014) were studied the prevalence of fasciolosis by *F. gigantica* was higher during rainy while lowest during the summer season and transmission potential of *F. gigantica* in irrigation water. Effective control and the strategic use of anthelmintics is a need for the treatment of intensive fasciolosis.

The peculiar geography on northeastern hilly region and climatic conditions are mainly responsible for low prevalence of fasciolosis infection in Nagaland, Mizoram region and Taveta division (Chamuah et al., 2014 and Mungube et al., 2015).

Trematode infections of livestock are global veterinary and public health importance causing serious economic losses and high prevalence of *F. gigantica* infection in Kwara state in Nigeria (Elelu et al., 2016 and Zhang et al., 2017).

Most of the infected buffaloes were found by *F. gigantica*. These parasites were identified on the basis of its morphology and histology to be the common cause of fasciolosis in infected buffaloes. The light microscopic study shows that the digestive tract of *Fasciola gigantica* is composed of the oral sucker, buccal tube, pharynx, esophagus, and caecum. Comparative morphometry of eggs and adults *Fasciola gigantica* were observed under light microscope. The surface topography of *F. gigantica* parasites was studied by scanning electron microscopy. The ultrastructural study revealed that vitelline cells of *F. gigantica* are grouped in vitelline follicles. (Srimuzipo et al., 2000; Meaney et al., 2002; Meemon et al., 2010; Ali et al., 2014, Pandya et al., 2015 and Swarnakar and Damor, 2016).
Anthelmintic Medicinal Plant Extract

Anthelmintic drugs are currently used as the most effective tool for the treatment of fasciolosis. Synthetic drugs are not easily available in some of the remotest rural areas of developing countries or have some serious disadvantages such as the development of drug resistance in continuous use adverse drug residual effects. Use of common spices as anthelmintics offer an alternative source can solves these problems and more acceptable to the native users. In Ayurveda and Greco Arabic system of medicine, several species are described as having medicinal effects. The continued usage of current anthelmintic drugs is also posing a major problem of drug resistance in several parasitic species as well as unwanted adverse effect. Such as abdominal discomfort, nausea, vomiting, diarrhea, drowsiness vertigo, rashes is common and they are also contraindicated in certain groups of patients.

The epidemiology and control of gastrointestinal nematodes, fasciolosis and paramphistomiasis in sheep, goats, and cattle and Onchocerca gutturosa and Cysticercus bovis in cattle in tropical regions is reviewed in broad terms fasciolosis causes enormous losses, acute outbreaks are generally seen in the mid-dry season in West Africa (Fabiya, 1987).

Sanyal et al., (1996) studied of efficacy and pharmacokinetics of triclabendazole in F. gigantica infected buffaloes with induced fasciolosis.

Extracts from indigenous medicinal plants viz. Carica papaya, Mallotus philippinensis and Azadirachta indica were screened against F. gigantica in vitro to develop safer, cheaper and effective remedy for fasciolosis in ruminants (Kushwaha et al., 2005).

The effective control of fasciola currently includes the strategic and tactile use of anthelmintic drugs and careful management of grazing lands, including control of stocking rates and appropriate rotation strategies. Because of the limited availability of drugs, high cost, development of resistance, chemical residue in milk and meat, toxicity problem and failed snail control measures the majority of world population depend on traditional remedies. The plant kingdom is known to provide a rich source of anthelmintic, antibacterial and insecticide (Githori et al., 2006).
Jabbar et al., (2006) studied some plants such as *L. amplexicaule, M. philippinensis, W. somnifera, A. indica, A. juss* and *C. colocynthis* for medicinal value and their documentation could provide a foundation for the scientific study and verification of those plants.

Hegazi et al., (2007) investigated the *Dakahlia propolis* was a typical poplar propolis. Evidence of inhibitory activity of propolis on the vitality and hatchability of immature *F. gigantica* eggs were tested in three localities of Egypt.

*In vitro*, the anthelmintic activity of the extracts of stem and leaves of *Meryta denhami* and *Artocarpus lakoocha*, essential oils of *Cymbopogon nardus, areca catechu, Erythrina indica, Zingiber officinale* and *Azadirachta indica* and triclabendazole were evaluated against adult *F. gigantica* were studied. The morphological variation and histopathological changes in treated and control fluke were studied by light and scanning electron microscopy (Shehab et al., 2009; Saowakon et al., 2009; Jenthilakhan et al., 2010a and b).

An *in vitro* effect of plant extract of *B. egyptiaca* in comparing with triclabendazole on adult *F. gigantica* through histopathological and scanning electron microscopy of the worms (Ebedi et al., 2011).

The efficacy of ethnomedicinal plant aqueous extracts such as *Allium sativum, Lawsonia inermis* and *Opuntia indica in vitro* in comparison with the chemotherapeutic agent Oxyclozanide on *F. gigantica* adult (Jeyathilakan et al., 2012).

The *in vitro* adulticidal effect of an aqueous and methanolic extract of *Caparis decidua* stem, *Moringa olifer* leaves with albendazole was exanimate against *F. gigantica* worms. Demonstrate that *C. decidua* stem may have anthelmintic activity especially at higher doses (Sumaia et al., 2012).

Shalaby et al., (2012) investigated the comparative morphological effects of Ivermectin and *Nigella sativa* oil combination and each of them separately against adult helminth parasites includes *Haemonchus contortus, Moniezia expansa,* and *F. gigantica.*
Triclabendazole has been used to control fasciolosis since 1983 as a veterinary drug. This may pose a serious problem as no other effective drug is available. The emergence of resistance has prompted the search for new compounds or for better use of existing drug (Massoud et al., 2012).

Indian traditional spices such as *Allium sativum, Ferula asafoetida, Ocimum sanctum, Syzygium aromaticum, Terminalia catappa* and Thymoquinone and Curcumin have several medicinal and pesticidal properties such as antioxidant, antiviral, antibacterial, antifungal, molluscicida, antihelminthic and larvicidal the *in vitro* toxicity of species such as *A. sativum, F. asafoetida* and *S. aromaticum* on the liver fluke *F. gigantica* (Kumar et al., 2014 and Mahardika et al., 2017 and Ullah et al., 2017).

On the basis of above review of literature following three medicinal plants have been selected for anthelmintic effects against *Fasciola gigantica* in buffaloes (*Bubalus bubalis*).

1. Seeds of *Centratherum anthelminticum* (Kalijiri).
2. Fruits of *Citrullus colocynthis* (Indrayan or Kharatumba).

1. *Centratherum anthelminticum* (Kalijiri, Somraj)

**Classification**

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Plantae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order</td>
<td>Caryophyllales</td>
</tr>
<tr>
<td>Family</td>
<td>Asteraceae</td>
</tr>
<tr>
<td>Subfamily</td>
<td>Chenopodioideae</td>
</tr>
<tr>
<td>Tribes</td>
<td>Atripliceae</td>
</tr>
<tr>
<td>Genus</td>
<td><em>Centratherum</em></td>
</tr>
<tr>
<td>Species</td>
<td><em>anthelminticum</em></td>
</tr>
</tbody>
</table>
Kalijiri is scientifically named as *Centratherum anthelminticum*. Belongs to the Asteraceae family in an erect, annual herb and is an Indian medicinal plant though it is vastly used for culinary purposes. The seed of *C. anthelminticum* is 5 to 6 mm long, dark brown in color having a characteristic odor and intensely bitter taste. The surface of the seed is comprised of about 10 ridges. The ridges are covered with trichomes. The seed is oblong shaped, pointed from one side and hairy tapered from the other end. *C. anthelminticum* seeds contain 18% fixed oil and 2% volatile oil and also reported to contain flavonoids.

The major classes of the chemical constituent present in this plant are glycosides, carbohydrates, phenolic compounds and tannins, flavonoids, proteins, saponins, sterols, lipids, and fats. Bitter cumin (*C. anthelminticum*) was reported phenolic compounds antioxidant and antihyperglycemic, antimicrobial activity.

*Centratherum anthelminticum* has been used for medicinal purposes since ancient times. Its seeds are anthelmintic and antiseptic. They are used to cure kidney troubles, asthma, hiccups, sores and white leprosy. Powdered seeds are also used externally to treat paralysis of legs. Roots are useful in curing diarrhea, stomach ache, ulcers and cough and the flowers are purgative. The seeds of kilijiri are generally popular for its usage in culinary practices and the entire plant is considered to be useful for treating diseases. Kalijiri is used extensively in traditional medicine to treat a range of diseases from vitiligo to hyperglycemia. It is considered to be antiparasitic, antimicrobial and science has backed up claims of its use to reduce fever or as a painkiller. New research shows that this humble spice also contains high levels of antioxidants. Used in Ayurveda, Unani, Homeopathy, and Sidha as spermicidal and antiviral, antimicrobial, anthelmintic, antidiabetic, febrifuge, tonic, stomachic, diuretic and useful for refreshment (Singhal *et al*., 1992).

The effect of *C. anthelminticum* seeds extract containing a mixture of polyphenolic compounds was tested on rat intestinal glucosidases postprandial hyperglycemia in rats. *C. anthelminticum* seeds useful for the management of diabetes mellitus and control of Anopheles larvae (Ani and Naidu, 2008 and Srivastava *et al*., 2008).
Punima et al., (2009) observed that the petroleum ether and alcohol extracts of *C. antheminticum* seeds possessed analgesic and antipyretic activities. The extracts showed significant inhibition of elevated body temperature when compared to corresponding control.

Kumar et al., (2010) were identified genus and species for diuretic effects by treatment of medicinal plants; *C. antheminticum, Xylopia aethiopica, Alepidea amatymbica* and *Steganotaenia araliacea* etc. Pathological conditions like a backache, prostatitis, sciatica, kidney stones, bladder ache, lymphatic swelling, scalding urine, gonorrhea, skin eruptions, premenstrual syndrome, water retention and obesity can be treated by diuretic agents.

*C. antheminticum* seeds are used as an anthelmintic against earthworm and tapeworm infestations to cure ulcers, skin disease leucoderma also used as emetic, purgative, asthma, kidney trouble, blood purifier, hiccoughs, inflammatory swelling, good for sores, itching of the eyes, depilatory, tonic, stomachic, antimycotic and diuretic properties, intestinal colic, dysuria and snake bite (Ashok et al., 2010 and Patel et al., 2011).

A wide range of secondary metabolites such as aliphatifatty acids, flavones, saponins, steroids, and glycosides have been reported from the *C. antheminticum*. Its extracts are reported to possess a wide range of pharmacological activities such as analgesic, antibacterial, antifungal, antidiuretic, anti-filarial, analgetic, antimicrobial, anti-hyperglycemic, antimicrobial, antimalarial and antipyretic properties (Amir et al., 2011).

Medicinal plant extracts such as *Cassia fistula, Centratherum antheminticum* have shown antimicrobial, paralytic, antinociceptive, antioxidant and wound healing activity of different fungi, bacteria, and animals (Sumi & Oommen, 2011; Irshad et al., 2012 and Sahoo et al., 2012).

*C. antheminticum* is an ethnomedicinal plant in India and a common ingredient in Ayurveda medicine. Ethanolic extract of *C. antheminticum* seeds have good antibacterial, antioxidant, antidiabetic, antimicrobial, anti-urolithiatic, anti-inflammatory, analgesic and anticancer property (Patel et al., 2012; Paydar et al., 2013 and Javad et al., 2013; Ashok et al., 2013; Bhatia and Paliwal, 2014 and Galani and Panchal, 2014; Negi et al., 2014 and Bhatia and Paliwal, 2015).
Ethanolic seed extract of *C. anthelminticum* effective in improving hyperglycemia, hypertriglyceridemia, hypercholesterolemia, antioxidant and antidiabetic and hyperinsulinemia in fructose-induced type 2 diabetic rabbits by either decreasing insulin resistance or inhibiting fructose absorption in the intestine (Mudassir *et al.*, 2015).

About 4 extracts (hexane, acetone, ethanol and methanol extraction) from the seeds of *Centratherum anthelminticum* were extracted. The antifungal and antimicrobial activity of different extract were tested against human and plant pathogenic bacteria. Ethanol extract showed significant role in inhibiting almost all tested pathogenic organisms and antitubercular activities at various concentration (Gopikrishna *et al.*, 2016 and Mehta *et al.*, 2016).

2. *Citrullus colocynthis* (Bitter Apple)

**Classification**

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>- Plantae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phylum</td>
<td>- Embryophyta</td>
</tr>
<tr>
<td>Class</td>
<td>- Dicotyledoneae</td>
</tr>
<tr>
<td>Order</td>
<td>- Cucurbitales</td>
</tr>
<tr>
<td>Family</td>
<td>- Cucurbitaceae</td>
</tr>
<tr>
<td>Genus</td>
<td>- <em>Citrullus</em></td>
</tr>
<tr>
<td>Species</td>
<td>- <em>colocynthis</em></td>
</tr>
<tr>
<td>Local Name</td>
<td>- Indrayan, garhtumba and Kharatumba</td>
</tr>
</tbody>
</table>

*Citrullus colocynthis* commonly known as bitter apple and *C. colocynthis* is belonging to family Cucurbitaceae is distributed throughout India and it is mostly cultivated in Rajasthan and Gujarat. *C. colocynthis* is an annual herbaceous plant. The stem is angular, stem and leaves are rough, 3 to 7 lobed, 5 to 10 cm long. Flowers are monoecious, solitary, peduncled, axillary, corolla 5 lobed and ovary villous is a fruit commonly known for its bitterness, found in India, Sudan, Iran, and Iraq. It is small scribed perennial creeping herb with
prostate or climbing stems, bearing smooth spherical fruits which are mottled green, young and yellow when ripe. Fruit is useful against fever, intestinal parasites, hepatic and abdominal diseases, visceral and cerebral congestions. Root extract is used for jaundice, urinary diseases, rheumatism etc. *Citrullus colocynthis* seeds are grey and they are edible but similarly bitter, nutty flavored and rich in fat and protein. Seeds are diuretic (Dasture, 1962; Trease & Evans, 1970; Anonymous, 1970; Vohora & Khan, 1981 and Shah & Qadry, 1985).

*C. colocynthis* leaves and pulp reduced the heart rate and the force of concentration in isolated rabbit heart. The ethanol leaves extract exhibited a secondary anti-inflammatory activity but were severely toxic. At lower does, however, no anti-inflammatory activity was observed (Wasfi, 1994).

The effect of oral administration of *C. colocynthis* fruits and leaves of *Rhazya stricta*. A mixture of two plants *C. colocynthis* fruits and *R. stricta* leaves in Najdi sheep (Adam et al., 2000).

Polysaccharide extracts of *Anacyclus pyrethrum*, *C. colocynthis*, and *Alpinia galanga* tested for their immunostimulating activity in mice. The extract of *C. colocynthis* showed much weaker and variable immune stimulating activity (Bendjeddou et al., 2003; Al qarawi et al., 2003).

The aqueous extract of *C. colocynthis* fruit was tested for its antimicrobial activity against certain pathogenic fungal and bacterial. The inhibitory effect of *C. colocynthis* fruit aqueous extract may attribute to active compounds present in the extract (Alkamel et al., 2005).

*Citrullus colocynthis* used by diabetic patients as hypoglycemic agent but it has been reported to cause gastrointestinal disorders after consumption in some patients (Dehghani et al., 2006 and Dehghani, 2007).

The pulp and seeds of *C. colocynthis* were assessed for effects on the lipid profile of hyperlipidemic in New Zealand rabbits. The pulp and seeds extracts of *C. colocynthis*, the lipid profile were significantly reduced when compared to the control group (Zamani et al., 2007).
*C. colocynthis* is a medicinal plant traditionally used in as abortifacient and to treat constipation, edema, bacterial infections, cancer, diabetes and antimicrobial efficiency of *C. colocynthis* on seven bacteria *Bacillus subtilis, E. coli, Klebsiella pneumoniae, Proteus vulgaris, Pseudomonas aeruginosa, Salmonella typhi* and *Staphylococcus aureus*. Preliminary phytochemical screening of the plant showed the presence of large amounts of phenolic and flavonoids. *C. colocynthis* is useful in hypoglycemia, tumors, ascites, leucoderma, ulcers, asthma, bronchitis, urethrorrhea, jaundice, dyspepsia, constipation, elephantiasis, and splenomegaly. Fruit extract also exhibits nematicidal properties (Kumar et al., 2008 and Peter and Paul, 2008).

Dhanotiya et al., (2009) studied the petroleum ether fruits extract of *C. colocynthis* and steroidal compound isolated from this extract were tested in Wistar rats for their effect on prostatic hyperplasia induced by testosterone.

*C. colocynthis* endemic in Southern Tunisia is used in folk medicinal against dermatological, gynecological, many inflammatory diseases and pulmonary infections. *C. colocynthis* shows antibacterial and antifungal properties (Marzouka et al., 2009 and Marzouka et al., 2010).

The fruits of *C. colocynthis* contain seventeen compounds were broadly identified and divided into five classes such as alcohols, ketones, epoxy compounds, hydrocarbons and acid (Gurudeeban et al., 2010).

Ahmad et al., (2010) examined the effect of growth regulators and different explants type in callus induction increase of cucurbitacin in leaf, stem and root explants of *C. colocynthis*.

The medicinal *C. colocynthis* pulp hydro ethanol extract possesses potent hypolipidemic and antioxidant actions in alloxan-induced diabetic rats and therapeutic activities on parasites (Selvaraj et al., 2010; Dallak, 2011 and Dhanotia et al., 2011).

Sanadgol et al., (2011) observed that the *C. colocynthis* was used in Iranian traditional medicine as a healing agent for reducing obesity-related diabetes troubles.
Atef et al., (2011) revealed that the medicinal plant *C. colocynthis* fruit may have protective effects on the kidney functions and tissues. *C. colocynthis* prevent nephropathy as one of micro vascular complications of diabetes mellitus.

*C. colocynthis* showed broad-spectrum antimicrobial activity against clinical microorganisms isolated from HIV positive patients (Gurudeeban et al., 2011).

*C. colocynthis* root effect on the biochemical parameters of normal and alloxan-induced on diabetic rats and diet therapy. The pulp and seed of *C. colocynthis* fruit effect on decreased blood glucose in diabetic rabbits and considered to be effective and safe alternative treatment for liver toxicity (Agarwal et al., 2012; Dashti et al., 2012 and Mukerjee et al., 2012).

The alcoholic extracts of *C. colocynthis* possess good antimicrobial activity against selected test bacteria and fungi (Menghani et al., 2012).

Prasanthreddy et al., (2012) reported the anti-ulcer properties of the extracts may be attributed to the presence of phytochemical like flavonoids, saponins, alkaloids, and tannins present in the extract with various biological activities.

The fruit of *C. colocynthis* is consumed by some patients of Msila region, Algeria for its antidiabetic, antirheumatic and anti-haemorrhoids activities without considering its safety (Soufane et al., 2013).

Bnyan et al., (2013) observed the antibacterial efficiency of ethanolic extract of *C. colocynthis* was showed inhibitory activity against *E. coli*, *Proteus mirabilis*, *Staphylococcus aureus* and *Streptococcus agalactia*. Water extract exhibited less or no activity against all types of bacteria.

The molluscicidal activity of *Punica granatum* commonly grown in Taif and three wild plants *Solanum incanum*, *Calotropis procera* and *C. colocynthis* was investigated against *Biomphalaria arabica* the intermediate host of *Schistosoma mansoni* in Saudi Arabia (Khalid et al., 2013).

Fruit pulp extract of *C. colocynthis* obtained from Libya, content glucosidal as other principal that may cause a teratogenic effect in rats given during at the early stage of pregnancy (Elgerwi et al., 2013).
Ullah et al., (2013) evaluated the anti haemonchosis activities of the aqueous methanolic extract rhizome of *Curcuma longa*, the fruit of *C. colocynthis* and seeds of *Peganum harmala*.

*C. colocynthis* plant investigated for used in the treatment of ophthalmic, neuralgia, migraine bronchitis, abortifacient, cathartic, purgative, fever, cancer, amenorrhea, jaundice, leukemia, rheumatism, tumor, leishmaniasis, cytotoxic activities and phytochemical analysis. The extract and fractions were tested against major parasites (Baloch et al., 2013 and Talole et al., 2013).

*C. colocynthis* is a very important medicinal plant which is used by various tribes for treatment of many diseases in Rajasthan, India. Seventeen recipes are based on root, twelve on fruits, five in seeds, two on the whole plant, three on leaf and in two recipes both roots and fruits are used (Meena et al., 2014 a and b).

Mehni et al., (2014) studies antibacterial activity of plant extracts of *C. colocynthis* in a low concentration against some plants bacterial diseases. Compound gallic acid was the first time reported in *C. colocynthis* plant.

Easigo is polyherbal formation used for constipation and is composed of *Cassia angustifolia*, *Operculina turpethum*, *Terminalia chebula*, *C. colocynthis*, *Zingiber officinale*, *Carum copticum* and *Ipomea hederacea*. Aqueous extract of Easigo is a potent laxative agent (Kumar et al., 2014).

Ullah et al., (2015) evaluated the acaricidal activities of the aqueous methanolic extracts of the rhizome of *Curcuma longa*, the fruit of *C. colocynthis* and the seed of *Peganum harmala*. Crude aqueous methanol extracts of the three plants and their combination were found effective against *Rhipicephalus microplus* larvae of ticks.

The crude oil from *C. colocynthis* fruit showed that the major constituents were mainly the triglycerides, free fatty acids, phospholipids and sterols along with other minor unidentified constituents (Dash et al., 2015).
Swarnakar et al., (2015) reported the in vitro studies anthelmintic activity of an aqueous and alcoholic extract of *C. colocynthis* on amphistome *Orthocoeleum scoliocoelium*. Aqueous and alcoholic extract of *C. colocynthis* found to be potential sources for novel anthelmintic and justify their ethnoveterinary use.

Extensively recorded and discussed, an investigation of morphological and biological detailed information of *C. colocynthis* aspects of important plants from India (Rani et al., 2017).

*Citrullus colocynthis*, *Physalis alkekengi*, and *Solanum nigrum* displayed potent in vitro antimalarial activity. The existence of anti-plasmodial compounds was detected in these plant extracts (Haddad et al., 2017).

3. *Trachyspermum ammi* L. (Ajwain)

Classification

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Plantae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Division</td>
<td>Magnoliophyta</td>
</tr>
<tr>
<td>Class</td>
<td>Magnoliopsida</td>
</tr>
<tr>
<td>Order</td>
<td>Apiales</td>
</tr>
<tr>
<td>Family</td>
<td>Apiaceae</td>
</tr>
<tr>
<td>Genus</td>
<td><em>Trachyspermum</em></td>
</tr>
<tr>
<td>Species</td>
<td><em>ammi</em></td>
</tr>
</tbody>
</table>

*Trachyspermum ammi* L. commonly known as Ajwain belonging to family Apiaceae is distributed throughout India and it is mostly cultivated in many parts of India, Pakistan, Afghanistan, Egypt and Europe. In India, some states like Madhya Pradesh, Uttar Pradesh, Gujarat, Maharashtra, Bihar, West Bengal and Rajasthan have been cultivated huge quantity of ajwain from ancient time. The plant is used traditionally as a stimulant, carminative, flatulence, atonic dyspepsia, diarrhea, abdominal pains, piles, and bronchial problems, lack of appetite, galactagogue, asthma, and amenorrhoea.
*T. ammi* is used in food and medicine. Ajwain seeds are used to flavour vegetables and fish in India cuisine and are fried in oil or ghee (clarified butter) to mellow the acid taste. The roots are diuretic in nature and the seeds possess excellent aphrodisiac properties. The seeds contain 2-4% brown coloured oil known as ajwain oil. The main component of this oil is thymol which is used as gastrointestinal ailments, lack of appetite and bronchial problems. The oil exhibits fungicidal, antimicrobial and anti-aggregatory effects on humans and animals. It is an important remedial agent for flatulence, atonic dyspepsia, and diarrhea.

The seed of *T. ammi* in bitter, pungent and it acts as anthelmintic, carminative, laxative and stomachic. It also cures abdominal tumors, abdominal pains, piles and bears anti-inflammatory and antioxidant activity seeds contain an essential oil containing about 50% thymol gives them an aroma and flavor resembling thyme with a stronger bite. Thymol is a strong germicide, antispasmodic, fungicide and also used in toothpaste and perfume. *T. ammi* seeds are also known as a digestive aid and combine well with fennel to relieve gas and bloating. A side dish of *T. ammi* seeds often accompanies food in the Middle East. Its seeds contain about 50% thymol a well known and antibacterial essential oil and along with thyme can be used to enhance the immune system to ward off cold and flu and other viral infections.

*T. ammi* is also traditionally known as a digestive aid and relief for abdominal discomfort due to indigestion and an antiseptic. In southern parts of India, dry *T. ammi* seeds are powdered and soaked in milk, which is then filtered and fed to babies. Many assume it relieves colic in babies and for children it also improves digestion and appetite. *T. ammi* can be used as a digestive mixture in large animals. In India, it is often added to heavy fried dishes to aid digestion. A study conducted using the essential oil suggests that it has some use in the treatment of intestinal dysbiosis.

*T. ammi* benefit comes from being able to inhibit the growth of undesired pathogens while not adversely affecting the beneficial flora. Seeds possess aromatic, bitter, digestive, diuretic, diaphoretic, expectorant, tonic, antiseptic, antispasmodic properties. They are used in the treatment of influenza, asthma, coughs, colds, colic, diarrhea, cholera, indigestion, edema, rheumatism.
Helminthic infections are now being recognized as the cause of much chronicill health and sluggishness among the tropical people. More than half of the world populations suffer from worm infections of one type or the other. The traditional system of medicine reports the efficacy of chenopodiul oil, *Embelia ribes*, *T. ammi* and *Piper beetle* oils etc. for eliminating helminths. The present study reports the strong anthelmintic activity of the essential oil of *Artemisia pallens* wall against *Pheritima posthuma*, *Taenia solium* and *Ascaris lumbricoides*. The helminths have been found to be more susceptible to the oil than to piperazine phosphate of similar concentration. *T. ammi* has been ascribed to possess anthelmintic and stomachic properties in an indigenous system of medicine. The present screening not only confirms the correct usage of the plant by the rural inhabitants but also enhances the creditability of ethnobotanical explorations (Nakhare et al., 1991).

The antihyperlipidaemic effect of *T. ammi* seeds powder in albino rabbits. Petroleum ether extract reduced atherogenic index more effectively than methanol extract (Javed et al., 2006).

Some scientist has been studied the indigenous knowledge and important role in gastrointestinal problems of *T. ammi*. They reported the in vitro activity of a methanolic extract of fruits of *T. ammi* against adult bovine filarial *Setaria digitata* worms has been investigated (Hamayun et al., 2006; Chamundeewari et al., 2007 and Mathew et al., 2008)

*T. ammi* is one such plant having been prescribed for digestive, respiratory, renal, dental and many other maladies in Asian traditional medicine. The Ayurveda has an important system of medicine and drug therapy in India. *T. ammi* shows the information regarding the pharmacological activity. *T. ammi* can be catabolism of lipoproteins and inhibition of lysosomal lipid hydrolytic enzymes secreted by the liver. *T. ammi* was tested for in vitro antifungal activity on *Aspergillus niger*, antibacterial activity and have causative agents of different destructive disease. (Javed et al., 2009; Avasthi et al., 2010; Kaur et al., 2010; Pathak et al., 2010 and Wadhwa et al., 2010).
Methanolic extracts of *Thuja occidentals*, *Vernonia anthelmintica*, *Dryopteris chrysocoma* and *T. ammi* were tested *in vitro* for their antibacterial and antifungal activities. The extracts showed significant results against different fungal strains (Jahan *et al.*, 2010).

Kumar *et al.*, (2011) studied *T. ammi* was one such plant prescribed for germicide, antispasmodic, antifungal agent and platelet aggregation inhibitory action, antifungal potency and blood pressure lowering action and many other maladies in Asian traditional medicine.

*T. ammi* is an herb also known as Bishops Weed and it is probably originated in Egypt and the eastern Mediterranean area. It acts as good appetizer, laxative, and stomachic. It is used as an effective remedy for managing ailments like vomiting, mouth diseases, pile, abdominal tumor and abdominal pain. Seeds of *T. ammi* possess various pharmacological activities like antifungal, antioxidant, antimicrobial, antinociceptive, cytotoxic activity, hypolipidaemic, antihypertensive, antispasmodic, broncho dilating actions, anti lithiasis, diuretic, abortifacient, antitussive, nematicidal, anthelmintic and anti-filarial activity (Yadav *et al.*, 2011; Paul *et al.*, 2011; Chauhan *et al.*, 2012; Chatterjee *et al.*, 2012)

The *T. ammi* plant is used traditionally as a stimulant carminative, flatulence, atonic dyspepsia, diarrhea, abdominal tumors, abdominal pains, piles and bronchial problems, lack of appetite, galactagogue, asthma, and amenorrhoea. Medicinally it has been proven to possess various pharmacological activities. The information concerning pharmacognostic, phytochemistry and pharmacological studied of *T. ammi* (Dwivedi *et al.*, 2012 and Jeet *et al.*, 2012)

Phytochemical constituents of extracts of some traditionally used Indian spices namely *Cinnamomum cassia*, *Murraya koenigii*, *Myristica Fragrans*, *Piper nigrum*, and *T. ammi* were determined. The *T. ammi* plants have an important contribution to health care system for the treatment of various ailments in India since ancient time. The main component of *T. ammi* oil is thymol, which is used
in the treatment of gastrointestinal ailments lack appetite, germicide, antispasmodic, fungicide and bronchial problems. The seeds possess stimulant, aphrodisiac, antispasmodic and carminative properties and extracts showed the phenolic and flavonoids contents and antioxidant activity. It is an important remedial agent for flatulence, atonic dyspepsia and diarrhea. The seed of *T. ammi* is bitter, pungent and it acts as anthelmintic, carminative, laxative and stomachic. The essential oils of *T. ammi* and *Myroxylon pereira* and some of their constituents have potential as botanical insecticides against *A. aegypti* mosquito larvae (Kamleshiya *et al.*, 2012; Moazeni *et al.*, 2012; Saxena *et al.*, 2012 and Seo *et al.*, 2012).

The ethanol extract of *Cinnamomum zeylanicum* and *T. ammi* revealed a significant scope to develop a novel broad spectrum of antibacterial herbal formulation and can be used for cooked preservation (Usha *et al.*, 2012).

Zaman *et al.*, (2012) revealed that the anti-tick efficacy of combined aqueous herbal extracts, seeds of *T. ammi*, leaves of *Azadirachta indica*, leaves of *Nicotiana tabacum*, flowers of *Calotropis procera*.

Ethnoveterinary knowledge is highly significant for the persistence of traditional community-based approaches to veterinary care and animal health is crucial to local economies and food security. The methanol extract of *T. ammi* showed antiepileptic activity, which may be due to the presence of thymol (Abbasi *et al.*, 2013 and Rajput *et al.*, 2013).

The antibacterial activity of an extract of *Opuntia stricta*, *T. ammi*, *Terminalia chebula* and *T. citrina*, extracts revealed antibacterial activity against gram-positive and gram-negative bacteria. The phytochemical and antiulcer activity of *T. ammi* aqueous extract found against ethanol-induced a gastric ulcer (Ahmed *et al.*, 2014).

Apte *et al.*, (2014) and Charde *et al.*, (2014) exhibited the gastrointestinal helminths become resistant to currently available anthelmintic drugs, therefore, it was a foremost problem in the treatment of helminth diseases. *T. ammi* was
originated in Egypt but is now primarily grown and used in South Asian countries. India, Saudi Arabia and Pakistan are the leading users of T. ammi. New emerging trends observed in multidrug resistance among several groups of microorganisms against different classes of antibiotics led to the development of different strategies.

Effects of T. ammi indicate a definite potential their utilization as biopesticides towards optimizing food storage. T. ammi seeds revealed to possess antiseptic, stimulant, carminative, diuretic, anesthetic, antimicrobial, antiviral, nematicidal, antiulcer, antihypertensive, antitussive, bronchodilatory, antiplatelet, hepatoprotective and antihyperlipidemic effects (El- Sayed et al., 2014; Khan et al., 2014 and Zarshenas et al., 2014).

T. ammi essential oil has an array of various organic and inorganic compounds. T. ammi has many pharmacological effects and pharmaceutical uses. Phytochemical analysis was carried out for this extract to check the presence of carbohydrate, proteins, steroids, resins, tannins, glycosides, flavonoids, saponins and quinines (Jan et al., 2015 and Reji et al., 2015).

Soni et al., (2016) and Sarfraz et al., (2016) observed two Indian spices T. ammi and Myristica fragrans were studied for essential oil yielding pattern insecticidal activity, antibacterial activity, and composition. The beta-pinene, alpha-pinene, alpha-p-month-1-en-4-ol, limonene, and elemicin were found as major constituents of T. ammi essential oil. The effect of aqueous extract of T. ammi seeds on growth and biofilm of Candida albicans in vitro. T. ammi extract effect showed completely inhibits growth and biofilm of the pathogen at a concentration of 8%.

T. ammi tested positive for alkaloids, carbohydrates and sugar, phenolic compounds, flavonoids, protein and amino acid, gum, and mucilage, and tannins, while the negative result was found for saponins, acetonic extract of T. ammi revealed strong antibacterial activity and antifungal (Hassan et al., 2016).
*T. ammi* seeds were extracted treated with hydrochloric acid and again hydro distilled to extract volatile compounds. Antibacterial activity of *T. ammi* was examined against *Staphylococcus aureus*, *E. coli*, *Pseudomonas aeruginosa* and *Enterococcus faecalis* (Omidpanah *et al.*, 2016).

Chahal *et al.*, (2017) revealed that the various chemical constituents in *T. ammi*, various biological and pharmacological properties have been reported. The study is an effort to collect all the information regarding the chemical composition and biological activities of *T. ammi*.

Systematic scrutiny of literature and research gaps identified, prompted to undertake the research work on “Studies on anthelmintic effect of some medicinal plants on *Fasciola gigantica* in buffaloes (*Bubalus bubalis*)”.