1. INTRODUCTION

Importance and Scope Medicinal Plants

Herbs are staging a comeback and herbal ‘renaissance’ is happening all over the globe. Although herbs had been priced for their medicinal, flavouring and aromatic qualities for centuries, the synthetic products of the modern age surpassed their importance, for a while. However, the blind dependence on synthetics is over and people are returning to the naturals with hope of safety and security (Vaidya, 1997).

It has been estimated that in developed countries such as United States, plant drugs constitute as much as 25% of the total drugs, while in fast developing countries such as China and India, the contribution is as much as 80%. Thus, the economic importance of medicinal plants is much more to countries such as India than to rest of the world. These countries provide two third of the plants used in modern system of medicine and the health care system of rural population depend on indigenous systems of medicine. Of the 2, 50,000 higher plant species on earth, more than 80,000 are medicinal. India is one of the world’s 12 biodiversity centers with the presence of over 45000 different plant species. India’s diversity is unmatched due to the presence of 16 different agro-climatic zones, 10 vegetation zones, 25 biotic provinces and 426 biomes (habitats of specific species). Of these, about 15000-20000 plants have good medicinal value. However, only 7000-7500 species are used for their medicinal values by traditional communities. In India, drugs of herbal origin have been used in traditional systems of medicines such as Unani and Ayurveda since ancient times.

The Ayurveda system of medicine uses about 700 species, Unani 700, Siddha 600, Amchi 600 and modern medicine around 30 species. The drugs are derived either from the whole plant or from different organs, like leaves, stem, bark, root, flower, seed, etc. Some drugs are prepared from excretory plant product such as gum, resins and latex. Some important chemical intermediates needed for manufacturing the
modern drugs are also obtained from plants (e.g. diosgenin, solasodine). Not only, that plant-derived drug offers a stable market worldwide, but also plants continue to be an important source for new drugs.

Among ancient civilizations, India has been known to be rich repository of medicinal plants. The forest in India is the principal repository of large number of medicinal and aromatic plants, which are largely collected as raw materials for manufacture of drugs and perfumery products. About 8,000 herbal remedies have been codified in Ayurveda. The Rigveda (5000 BC) has recorded 67 medicinal plants, Yajurveda 81 species, Atharvaveda (4500-2500 BC) 290 species, Charak Samhita (700 BC) and Sushrut Samhita (200 BC) had described properties and uses of 1100 and 1270 species respectively, in compounding of drugs and these are still used in the classical formulations, in the Ayurvedic system of medicine.

Ayurveda, Siddha, Unani and Folk (tribal) medicines are the major systems of indigenous medicines. Among these systems, Ayurveda is most developed and widely practiced in India. Phytomedicines are also being used increasingly in Western Europe. Recently the US Government has established the “Office of Alternative Medicine” at the National Institute of Health at Bethesda and its support to alternative medicine includes basic and applied research in traditional systems of medicines such as Chinese, Ayurvedic, etc. with a view to assess the possible integration of effective treatments with modern medicines.

Green plants synthesis and preserve a variety of biochemical products, many of which are extractable and used as chemical feed stocks or as raw material for various scientific investigations. Many secondary metabolites of plant are commercially important and find use in a number of pharmaceutical compounds. However, a sustained supply of the source material often becomes difficult due to the factors like
environmental changes, cultural practices, diverse geographical distribution, labour cost, selection of the superior plant stock and over exploitation by pharmaceutical industry. Some of the useful plant drugs include vinblastine, vincristine, taxol, podophyllotoxin, camptothecin, digitoxigenin, gitoxigenin, digoxigenin, tubocurarine, morphine, codeine, aspirin, atropine, pilocarpine, allicin, curcumin, artemisinin and ephedrine among others. In some cases, the crude extract of medicinal plants may be used as medicaments. The biological activities of some important herbal drugs and their active chemical constituents are reported as shown as in Table 1.1 (Rates, 2001).

**Table 1.1: Major plant derived drugs for which synthetic substitute is currently unavailable**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Plant</th>
<th>Use</th>
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<tbody>
<tr>
<td>Vinblastine</td>
<td><em>Catharanthus roseus</em></td>
<td>Anticancer</td>
</tr>
<tr>
<td>Ajmalicine</td>
<td><em>Catharanthus roseus</em></td>
<td>Anticancer</td>
</tr>
<tr>
<td>Rescinnamine</td>
<td><em>Rauvolfia serpentina</em></td>
<td>Tranquilizer</td>
</tr>
<tr>
<td>Cocaine</td>
<td><em>Erythroxylum coca</em></td>
<td>Topical anaesthetic</td>
</tr>
<tr>
<td>Morphine</td>
<td><em>Papaver somniferum</em></td>
<td>Pain killer</td>
</tr>
<tr>
<td>Codeine</td>
<td><em>Papaver somniferum</em></td>
<td>Anticough</td>
</tr>
<tr>
<td>Atropine</td>
<td><em>Atropa belladonna</em></td>
<td>Spasmolytic, cold</td>
</tr>
<tr>
<td>Atropine</td>
<td><em>Hyoscyamus niger</em></td>
<td>Spasmolytic, cold</td>
</tr>
<tr>
<td>Cardiac glycosides</td>
<td><em>Digitalis sp.</em></td>
<td>Congestive heart failure</td>
</tr>
<tr>
<td>Artemisinin</td>
<td><em>Artemesia annua</em></td>
<td>Antimalarial</td>
</tr>
<tr>
<td>Taxol</td>
<td><em>Taxus baccata</em></td>
<td>Antitumour</td>
</tr>
<tr>
<td>Berberine</td>
<td><em>Berberis sp.</em></td>
<td>Leishmaniasis</td>
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<tr>
<td>Pristimerin</td>
<td><em>Celastrus paniculata</em></td>
<td>Antimalarial</td>
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<td>Drug</td>
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<tr>
<td>Elipticine</td>
<td><em>Ochrosia</em></td>
<td>Anticancer</td>
</tr>
<tr>
<td>Indicine N-oxide</td>
<td><em>Heliotropium indicum</em></td>
<td>Anticancer</td>
</tr>
<tr>
<td>Podophyllin</td>
<td><em>Podophyllum emodi</em></td>
<td>Anticancer</td>
</tr>
<tr>
<td>Neriifolin</td>
<td><em>Thevetia</em></td>
<td>Cardio tonic</td>
</tr>
<tr>
<td>Thevenerin</td>
<td><em>Thevetia</em></td>
<td>Cardio tonic</td>
</tr>
<tr>
<td>Digitoxin, Digoxin</td>
<td><em>Digitalis, Thevetia</em></td>
<td>Cardio tonic</td>
</tr>
<tr>
<td>Forskolin</td>
<td><em>Coleus forskohlii</em></td>
<td>Hypotensive</td>
</tr>
<tr>
<td>Magnolol</td>
<td><em>Magnolia bark</em></td>
<td>Peptic ulcer</td>
</tr>
<tr>
<td>Sophoradlin</td>
<td><em>Sophora subprostrata</em></td>
<td>Antiulcer</td>
</tr>
<tr>
<td>Catechin</td>
<td><em>Acacia catechu</em></td>
<td>Antiulcer</td>
</tr>
<tr>
<td>Nimbidin</td>
<td><em>Azadirachta indica</em></td>
<td>Antiulcer</td>
</tr>
<tr>
<td>Glycyrrhizin</td>
<td><em>Glycyrrhiza glabra</em></td>
<td>Antiulcer</td>
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</table>
Classification of Medicinal Plants:

They are classified according to the part used, habit, habitat, therapeutic value etc, besides the usual botanical classification.

A. Based on part used

i) Whole plant: *Boerhavia diffusa, Phyllanthus niruri*

ii) Root: Dasamoola

iii) Stem: *Tinospora cordifolia, Acorus calamus*

iv) Bark: *Saraca asoca*

v) Leaf: *Indigofera tinctoria, Lawsonia inermis, Aloe vera*

vi) Flower: *Biophytum sensitivum, Mimusops elenji*

vii) Fruit: *Solanum species*

viii) Seed: *Datura stramonium*

B. Based on habit

i) Grasses: *Cynodon dactylon*

ii) Sedges: *Cyperus rotundus*

iii) Herbs: *Vernonia cineria*

iv) Shrubs: *Solanum species*

v) Climbers: *Asparagus racemosus*

vi) Trees: *Azadirachta indica*

C. Based on habitat

i) Tropical: *Andrographis paniculata*

ii) Sub-tropical: *Mentha arvensis*

iii) Temperate: *Atropa belladona*

D. Based on therapeutic value

Antimalarial: *Cinchona officinalis, Artemisia annua*
Anticancer: *Catharanthus roseus, Taxus baccata*

Antiulcer: *Azadirachta indica, Glycyrrhiza glabra*

Antidiabetic: *Catharanthus roseus, Momordica charantia*

Anticholesterol: *Allium sativum*

Antiinflammatory: *Curcuma domestica, Desmodium gangeticum*

Antiviral: *Acacia catechu*

Antibacterial: *Plumbago indica*

Antifungal: *Allium sativum*

Antiprotozoal: *Ailanthus sp., Cephalis ipecacuanha*

Antidiarrhoeal: *Psidium guajava, Curcuma domestica*

Hypotensive: *Coleus forskohlii, Alium sativum*

Tranquilizing: *Rauvolfia serpentina*

Anaesthetic: *Erythroxylum coca*

Spasmolytic: *Atropa belladona, Hyoscyamus niger*

Diuretic: *Phyllanthus niruri, Centella asiatica*

Astringent: *Piper betle, Abrus precatorius*

Anthelmentic: *Quisqualis indica, Punica granatum*

Cardiotonic: *Digitalis sp., Thevetia sp.*

Antiallergic: *Nandina domestica, Scutellaria baicalensis*

Hepatoprotective: *Silybum marianum, Andrographis paniculata*

E. Based on Ayurvedic formulations in which used

a) The ten roots of the Dasamoola (*Dasamoolam*)

i) *Desmodium gangeticum*

ii) *Uaria lagopoides*

iii) *Solanum jaccuminii*

iv) *Solanum indicum*
v) *Tribulus terrestris*

vi) *Aegle marmelos*

vii) *Oroxylum indicum*

viii) *Gmelina arborea*

ix) *Steriospermum suaveolens*

x) *Premna spinosus*

b) The ten flowers of the Dasapushpa (*Dasapushpam*)

i) *Biophytum sensitivum*

ii) *Ipomoea maxima*

iii) *Eclipta prostrata*

iv) *Vernonia cinerea*

v) *Evolvulus alsinoides*

vi) *Cynodon dactylon*

vii) *Emelia sonchifolia*

viii) *Curculigo orchioides*

ix) *Cardiospermum halicacabum*

x) *Aerva lanata*

c) The four trees of the Nalpamara (*Nalpamaram*)

i) *Ficus racemosa*

ii) *Ficus microcarpa*

iii) *Ficus religiosa*

iv) *Ficus benghalensis*

d) The three fruits of the Triphala (*Thriphalam*)

i) *Phyllanthus emblica*

ii) *Terminalia bellerica*

iii) *Terminalia chebula*
1.1 *Prunus persica* L. (Rosaceae):

**Botanical Name:** *Prunus persica* L.

**Common Name:** Peach (English), Aadoo (Hindi)

**Kingdom:** Plantae

**Division:** Tracheophyta

**Order:** Rosales

**Family:** Rosaceae

**Genus:** *Prunus*

**Subgenus:** Amygdalus

**Species:** *persica*

![Figure 1.1: Photograph of fruits and leaves of *Prunus persica*](image)
The tree is 15 to 25 feet tall with an equal or greater spread. Peach trees form a rounded crown with upwardly-reaching branches clothed in three to six-inch-long, dark green, deciduous leaves. The lovely flowers which appear in April before the new leaves unfold are available in single, semi-double, and double forms in colors ranging from pure white to deep red and bicolors. The flowers are susceptible to damage by late spring frosts or especially cold winters. The luscious three-inch diameter fruits mature in July to August. Bright yellow fall color really stands out in many years.

*P. persica* L. (Peach) named as *Amygdalus persica* is a perennial & deciduous tree of the subfamily Prunoideae of the family Rosaceae. There are about 100 genera and 3,000 species in Rosaceae family (Judd *et al.*, 1999). Prunus has nearly 200 species cultivated for their edible fruits and seeds (Rheder, *et al.*, 1940). The leaves are anthelmintic, insecticidal, sedative, diuretic, demulcent, expectorant, vermicidal and are used in leucoderma and in piles. Leaf paste is used to kill worms in wounds and fungal infections. The treatment of gastritis, whooping cough and chronic bronchitis is carried out internally with leaves (Kritikar and Basu, 1984).

The flowers are considered as laxative and diuretic and are used to treat constipation and oedema. The fruit is used as a demulcent, an anti-scorbutic and a stomachic. Fruit being aphrodisiac, anti-pyretic, act as a tonic to the brain, enhance the blood, removes bad smell from the mouth. The seeds are used as an anthelmintic and emmenagogue. The oil extracted from seeds is known as “kapha”, used as an abortifacient, good in deafness, piles, stomach troubles of children and earache.

Peach kernels are used for blood diseases, menstrual disorders, coughs and rheumatism in China and Malaya (Kritikar and Basu, 1984). The kernel oil is applied to impetigo. The bark is used in leprosy and jaundice. Leaves of *P. persica* have been investigated
for their antioxidant (Deb et al., 2010) and anti-inflammatory (Shin et al., 2010) activities in the past.

**Distribution:** The plant is self-fertile. Suitable for: light (sandy), medium (loamy) and heavy (clay) soils and prefers well-drained soil. Suitable pH: acid, neutral and basic (alkaline) soils. It cannot grow in the shade. It prefers moist soil. It is commonly cultivated in West Asia, Europe, Himalayas and India up to an altitude of 1000 ft.

**Morphology:** *Prunus persica* is a deciduous tree growing to 6 m. The flowers are hermaphrodite (have both male and female organs) and are pollinated by Bees.

**Leaf:** Green colour, alternate, simple, serrate margin, elliptic & lanceolate shaped, pinnate venation, deciduous persistence, Leaf blade length is 4 to 8 inches,

**Flower:** Flower color is pink, red or white, Flower characteristics are showy & spring flowering

**Fruit:** Round, 3 to 6 inches length, red or yellow color & fleshy covering.
1.2 *Trichosanthes dioica* Roxb. (Cucurbitaceae)

The plants in cucurbitaceae family compose of about 110 genera, 640 species. The most important genera are *Cucurbita, Cucumis, Ecballium, Citrullus, Luffa, Bryonia, Momordica, Trichosanthes* (more than 30 species), (Khare, 2007).

*Trichosanthes*, a genus of family Cucurbitaceae is an annual or perennial herb distributed in tropical Asia, Polynesia, & Australia. Over 20 species are recorded in India of which two namely *T. anguina* & *T. dioica* are cultivated as vegetable. Other important species found in thought the world are *T. palmata, T. cordata, T. nervifolia, T. cucumerina, T. wallichiana, T. cuspidia, T. incisa, T. laciniosa, T. kirilowii* etc. (The wealth of india, 1998).

![Figure 1.2: Photographs of fruits, leaves & seeds of *Trichosanthes dioica*](image)
Botanical Name: *Trichosanthes dioica* Roxb.

Common Name: Pointed Gourd (parwal)

Kingdom : Plantae

Division : Magnoliophyta

Class : Magnoliopsida

Order : Cucurbitales

Family : Cucurbitaceae

Genus : *Trichosanthes*

Species : *dioica*

Pointed gourd (*Trichosanthes dioica*) is known by the name of *parwal, palwal, parmal, patol, potala* in different parts of India and Bangladesh and is one of the important vegetables of this region (Basu, 2001). The fruit & leaves is the edible part of the plant which is cooked in various ways either alone or in combination with other vegetables or meats (Singh *et al.* 1999).

Juice of leaves of *T. dioica* is used as tonic, febrifuge & in subacute cases of enlargement of liver & spleen (Indian materia medica, 1996), in Charaka Samitha leaves & fruits used for treating alcoholism & jaundice. Leaves are used in oedema & alopecia ( Khare, 2007). The plant is also used as antipyretic, diuretic, cardiotonic, anthelmintic & laxative (Basu, 2001).
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Distribution

*Trichosanthes*, a genus of family Cucurbitaceae is an annual or perennial herb distributed in tropical Asia and Australia. *Trichosanthes dioica* is cultivated throughout the plain of Northern India, extending to Assam and East Bengal (Basu, 2001).

Cultivation

The pointed gourd is usually propagated through vine cuttings and root suckers. Seeds are not used in planting because of poor germination and inability to determine the sex of plants before flowering. As a result, crop established from seed may contain 50% nonfruiting male plants. Both pre-rooted and fresh vine cuttings are used for propagation. Vine cuttings made in the fall of previous year and rooted during winter. Fresh vines used for field planting should have 8–10 nodes per cutting. The distance between plants is kept between 1.5–2.0 m × 1.5–2.0 m (Singh et al. 1989). A female: male ratio of 9:1 is optimum for ensuring maximum fruit set (Maurya et al. 1985).

Morphology

The plant is a perennial, dioecious and grows as a vine. Vines are pencil thick in size with dark green cordate, ovate, oblong, not lobed, rigid, leaves. Roots are tuberous with long tap root system. Flowers are tubular white with 16–19 days initiation to anthesis time for pistillate flowers and 10–14 days for staminate flowers. Stigma remains viable for approximately 14 hours and 40–70% of flowers set fruit.

Based on shape, size and striation, fruits can be grouped into 4 categories:

- Long, dark green with white stripes, 10–13 cm long
- Thick, dark green with very pale green stripes, 10–16 cm long
- Roundish, dark green with white stripe, 5–8 cm long
- Tapering, green and striped, 5–8 cm long (Singh et al. 1999).
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Chemical Constituents

Early chemical study revealed that addition to a number of tetra & pentacyclic triterpenes, the toxic bitter principles cucurbitacins, a group of often highly oxygenated tetracyclic compounds with a unique carbon skeleton & almost always a carbonyl group in ring C, could be consider as a taxonomic character in Cucurbitaceae.

Figure 1.3: Structure of Cucurbitacin- J (Molecular formula- C_{30}H_{42}O_{7})

Figure 1.4: Structure of Cucurbitacin-B (Molecular formula- C_{32}H_{46}O_{8})
Figure 1.5: Structure of Cucurbitacin-D (Molecular formula- \( \text{C}_{30}\text{H}_{44}\text{O}_{7} \))

Figure 1.6: Structure of Cucurbitacin- E (Molecular formula- \( \text{C}_{32}\text{H}_{44}\text{O}_{8} \))

Pointed gourd is rich in vitamins and contains 9.0 mg Mg, 2.6 mg Na, 83.0 mg K, 1.1 mg Cu, and 17.0 mg S per 100 g edible part (Singh et al. 1999). The seeds of Trichosanthes dioica contain a large amount of peptides. The seed peptides have the unique property of being resistant to the action of silver nitrate, a sensitive reagent commonly used to stain proteins (Kabir et al. 2000).
The various chemical constituents present in *T. dioica* are vitamin A, vitamin C, tannins, sapponin (Chopra & Nayar).

Phytochemical evaluations of Aqueous and Ethanolic extracts have showed the presence of saponins & tannins (Ghaisas *et al.* 2008). The seeds extract of *T. dioica* contain 7- oxidihydrokarounidol-3-benzoate as the most predominant component in the highly polar fraction of the nonsaponifiable lipid (Toshihiro *et al.* 1997).

Two main phytosterol present in *T. dioica* namely, 24α-ethylcholest-7-enol & 24β-ethylcholest-7-enol (Kongtun *et al.* 2003). Seeds of *T.dioica* also contain lectin, a carbohydrate (specifically galactose) binding protein which is homologous to Type-II ribosome inhibitory proteins (Type-II RIP).

Clinical investigations

Crude drug *T. dioica* is known to have antiulcerous effect in polyherbal preparation.

Two formulations have been clinically investigated as given below:

1) Rai & Tripathi, (1968) have showed that Patoladi kasaya a polyherbal formulation, consisted of 11 herbs viz., *Patola, Haritaki, Bibhitaka, Amalaki, Kutaki, Cirayata, Amrta, Pittapapada, Sunthi, & Bhrngaraja* exhibited complete improvement in 50% cases & partial improvement in 40% cases with peptic ulcer (10 patients case study).

2) Tripathi & Pathak, (1975) have worked another Patoladi kasaya which consisted of only four herbs namely *Sunthi, Patola, Amrta, Kutaki* in the 33 case study of duodenal ulcer. It kept the patients symptoms/complication free when given in dose of 40 ml/day in two divided doses. It normalized both hyper & hypoacidity of these patient.
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1.3 Helminthiasis

The phytochemical constituents and their standardization are accelerated with the development of instrumental analysis and this field becomes important and new for investigation.

As the half of world suffering from bacterial and helminthes infection, the source of infection being very common due to poor sanitation, poor family hygiene, malnutrition, and crowded living conditions. The sources of infections are:

1) Human being: The commonest source of infection is human being themselves.

2) Animals: Many pathogens are able to infect both human being and animals. Animals act as source of human infection.

3) Insects: Blood sucking insect may transmit pathogen to human beings. Besides acting as vector, some insect may also act as a reservoir for hosts.

4) Soil and water: Some pathogens can survive in the soil for very long periods. Water may act as the source of infection either due to contamination with pathogenic microorganism or due to presence of aquatic vector.

5) Food: Contaminated food act as a source of infection. So there is a need to develop antibacterial and anthelmintics drug from herbal source. Anthelmintic activity was carried out by measuring the time for paralysis of worm. Anthelmintic drugs are use to eradicate or reduce the number of parasites of intestinal tract or tissue of the body. Most of the drugs were discovered by traditional screening methods; their mechanisms have been clarified recently.

They act through-

1. Affecting the energy metabolism

2. By paralyzing the parasite

An anthelmintic drug can act by causing paralysis of the worm or by damaging its cuticle leading to partial digestion or to rejection by immune mechanisms.
Anthelmintic drugs can also interfere with metabolism of worm and since the metabolic requirements of these parasites vary greatly from one species to another, the drugs that are highly effective against one type of worm can be ineffective against others.

Helminthes infections are the most common infections in man which affects the large proportions of the world’s population. In the treatment of parasitic diseases, the anthelmintics drugs are used indiscriminately. Recently the use of anthelmintics produces toxicity in human beings. Hence the development and discovery of new substances acting as anthelmintics are being derived through plants which are considered to be the best source of bioactive substances. Various plants were used in venereal diseases, to promote healing of wounds, swellings, abscesses, rheumatism and treating pain in lower extremities, skin diseases, leucorrhoea, dysentery, dysuria and fever. Anthelmintics are those drugs that are used in expelling out the worms that are parasitic in nature by either stunning them or by killing them. They are also known as vermifuges or vermicides.

Natural anthelmintic includes the following list of components:

Tobacco, Walnut, Wormwood, Clove, Kalonji seeds, Garlic, Malefern, Pineapple Diatomaceous earth, Soya and other legumes, Honey, water and vinegar are mixed with warm water act as vermifuges.

In other words, anthelmintics are drugs that are used for the treatment of infections caused by the worms, flukes, nematodes, round worms, tapeworms etc.

**Roundworms**

The migration of the larval forms and eggs transmission through skin contact in moist soil and in tropical areas causes migraine, eosinophilia and pulmonary related problems. The common infections occurring with intestinal worms include nematodes *Ascardia galli*, *Ascaris lumbricoides*, *Trichuris trichiura*, *Necator americanus* and *Ancylostoma duodenal* with the household aggregation of infection.
The eggs are deposited on perianal area that is due to self infection. These infections also occur due to the contaminated surfaces like carpets, curtains etc. The airborne and inhalation of the small number of eggs are transmitted through ingestion of the infected food because the humans are the accidental hosts. After the ingestion of the infected products the immunological lungs, liver and central nervous system damages occur.

**Flukes**

Flukes are the parasitic trematodes of Schistosoma species which are transmitted through direct contact with fresh water. They penetrate into the intact human skin and enter the capillaries and then migrate to the central and portal system where they mature. The eggs are then shed in the faeces and urine.

**Tapeworms**

Humans are the intermediate host for the *Taenia solium* with the development of the tissue cysts. After the ingestion of the uncooked beef (*T. saginata*) or pork it develops the cysts and it causes the mild abdominal symptoms. The infestations of the central nervous systems caused due to the pork tapeworm or flukes are known as neurocysticercosis which is treated through albendazole and praziquantel (Yadav *et al.* 2011).
Ascaridia galli

Figure 1.7: Photograph of Ascaridia galli

Ascaridia is a genus of parasitic roundworms belonging to the ascarids that infects chickens, turkeys, ducks, geese, grouse, quails, pheasants, guinea fowls and other domestic and wild birds. A reference photograph of Ascaridia galli is as shown as in Figure 1.7 (Kamdi et al. 2014). They occur worldwide and are very common in chicken. Several studies report incidences of up to 90% in various countries. It is much more abundant in traditional farming with outdoor run than in industrial production facilities.

Adult Ascaridia worms are they largest roundworms found in domestic birds. They are up to 12 cm long and of a whitish color, rather transparent. Females are longer than males. As in other roundworms, the body of these worms is covered with a cuticle, which is flexible but rather tough. The worms have a tubular digestive system with two openings, the mouth and the anus. They also have a nervous system but no excretory
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organisms and no circulatory system, i.e. neither a heart nor blood vessels. The female ovaries are large and the uteri end in an opening called the vulva, which in these worms is located close to the middle of the body. Males have a sucker close to the anus and a copulatory bursa with two equal spicules for attaching to the female during copulation.

Life cycle of Ascaridia worms

Ascaridia worms have direct life cycle. Adult female worms in the small intestine pass eggs with the feces. Once in the environment infective larvae develop inside the eggs in about 12 days by 33°C, but usually slower but lower temperatures. Such eggs can remain infective in the birds’ litter for one year and longer. They do not develop at temperatures below 12°C, but may survive slight frost. Earthworms can ingest large amounts of infective eggs and act as mechanical vectors.

Birds become infected after eating infective eggs, either directly with contaminated food or water, or indirectly through infected earthworms. Ingested eggs release the larvae in the gut's lumen where they molt and remain for about 10 days. Subsequently they penetrate into the gut's lining where they spend 1 to 7 weeks and molt again. Afterwards they return to the gut's lumen where they complete development to adult worms and the females start producing eggs.

The prepatent period (Time between infection and first eggs shed) is 6 to 8 weeks, depending on the worm species and the host (Ramadan et al. 1992).

Prevention and control of Ascaridia infections

To prevent or at least reduce Ascaridia infections it is recommended to keep the birds' bedding as dry as possible and to frequently change it, because development of the worm's eggs needs humidity. Strict hygiene of feeders and drinkers are a must to avoid
or reduce their contamination with eggs. Pasture rotation is also recommended. All these measures are particularly important for young birds. For birds kept outdoors it is advisable to restrict their access to humid environments where earthworms are usually more abundant.