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# **Indigenous plants active against helminthiasis of animals in India: An overview**

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# **IMPETUS FOR VALIDATION OF PLANT-BASED ANTHELMINTICS**

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- **45000 plant species in India**
- **Several thousands possess medicinal properties**
- **About 2000 species appear in the literature**
- **500 species commonly used in indigenous system**
- **About 90% species available for screening**
- **4000 species screened for various activities**

# GENERAL ASPECTS

|                      |  |
|----------------------|--|
| Helminthic infection | Major limiting factor in livestock production                        |
| Warm & humid climate | Favours development of worm eggs to infective larvae throughout year |
| Helminth species     | >300 species parasitize livestock in India                           |

# COMMERCIAL SYNTHETIC ANTHELMINTICS

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- **Strategic, tactical use, suitable rotational strategies**
- **Development of anthelmintic resistance**
- **Higher cost**
- **Non-availability in rural areas**
- **Toxicity/environmental pollution**

# Major helminth parasites against which plants have been evaluated *in vitro*

*Ascaridia, Ascaris, Bunostomum, Dipylidium, Fasciola, Fasciolopsis, Gastrothylax, Gigantocotyle, Haemonchus, Heterakis, Hymenolepis, Moniezia, Oesophagostomum, Paramphistomum, Rallietina, Setaria, Strongylus, Taenia*

# Major helminth parasites against which plants have been evaluated *in vivo*

*Ascaridia, Bunostomum,  
Dipylidium, Fasciola,  
Fasciolopsis, Haemonchus,  
Hymenolepis, Oesophagostomum,  
Paramphistomum, Rallietina,  
Strongylus, Taenia*

# Plant parts and preparations studied against helminths

|                     |   |
|---------------------|---|
| <b>Parts</b>        | Leaves, seeds, flowers, roots, tubers, stems, fruits                                      |
| <b>Preparations</b> | Decoction, aqueous extract, alcoholic extract, essential oil, dried powder of plant parts |

# EVALUATION

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## *In vitro* studies

- Gross visual motility of whole worms
- Isometric recording of SMA of nematodes/trematodes
- Alterations in parasite enzymes/metabolism
- Disruption of tegument

## *In vivo* studies

- Egg count
- Dead/live parasites in slaughtered animals



# Active principles possessing anthelmintic activity

| <b>Plant species</b>         | <b>Active principle</b> |
|------------------------------|-------------------------|
| <i>Semecarpus anacardium</i> | Anacardic acid          |
| <i>Carica papaya</i>         | Benzylisothiocyanate    |
| <i>Ananas comosus</i>        | Bromelain               |
| <i>Calotropis procera</i>    | Calotropain             |
| <i>Embelia ribes</i>         | Embelin                 |
| <i>Flemingia vestita</i>     | Genistein               |
| <i>Butea frondosa</i>        | Palasonin               |

# *In vitro* activity of plant preparations against helminth parasites of domestic animals

| <b>Plant species</b>           | <b>Part/extract/active principle of the plant used</b> | <b>Helminth parasite</b>        | <b>Reference</b>          |
|--------------------------------|--|---------------------------------|---------------------------|
| <i>Allium sativum</i>          | Bulb alcoholic extract                                 | <i>Gigantocotyle explanatum</i> | Singh et al., 2008        |
| <i>Andrographis paniculata</i> | Leaf aqueous extract                                   | <i>Haemonchus contortus</i>     | Singh et al., 2011        |
| <i>Arecha catechu</i>          | Nut aqueous extract                                    | <i>Fasciola gigantica</i>       | Jeyathilakan et al., 2010 |

|                           |   |                             |                       |
|---------------------------|---|-----------------------------|-----------------------|
| <i>Azadirachta indica</i> | Leaf and flower extract                   | <i>Setaria digitata</i>     | Banu et al.,1992      |
|                           | Alcoholic extract                         | <i>Fasciola gigantica</i>   | Kushwaha et al., 2004 |
|                           | Aqueous and alcoholic extracts of flowers | <i>Setaria cervi</i>        | Mishra et al., 2005   |
|                           | Leaf aqueous extract                      | <i>Haemonchus contortus</i> | Singh et al., 2008    |
|                           | Leaf methanolic extract                   | <i>Haemonchus contortus</i> | Arora et al., 2010    |
| <i>Bauhinia variegata</i> | Leaf methanolic extract                   | <i>Haemonchus contortus</i> | Bhardwaj et al., 2010 |

|                       |                                       |                                |                                       |
|-----------------------|---------------------------------------|--------------------------------|---------------------------------------|
| <i>Butea frondosa</i> | Decoction of seeds                    | <i>Ascaridia galli</i>         | Sharma & Sisodia, 1976                |
|                       | Benzene extract of seeds              | <i>Fasciola gigantica</i>      | Upadhyay et al., 2009                 |
|                       | Ether and alcoholic extracts of seeds | <i>Ascaridia galli</i>         | Shilaskar & Parashar, 1989            |
|                       | Alcoholic extract                     | <i>Fasciola gigantica</i>      | Kushwaha, 1998; Kushwaha et al., 2004 |
|                       |                                       | <i>Gastrothylax crumenifer</i> | George, 2004                          |

|                           |                   |                                |                            |
|---------------------------|-------------------|--------------------------------|----------------------------|
| <i>Calotropis procera</i> | Leaf extract      | <i>Setaria digitata</i>        | Banu et al., 1992          |
| <i>Carica papaya</i>      | Alcoholic extract | <i>Ascaridia galli</i>         | Shilaskar & Parashar, 1989 |
| <i>Cedrus deodara</i>     | Essential oil     | <i>Gastrothylax crumenifer</i> | George, 2004               |
| <i>Cymbopogon nardus</i>  | Essential oil     | <i>Ascaridia galli</i>         | Kaushik et al., 1981       |
| <i>Datura metal</i>       | Aqueous extract   | <i>Fasciola gigantica</i>      | Jeyathilakan et al., 2010  |

|                           |                           |                                |                      |
|---------------------------|---------------------------|--------------------------------|----------------------|
| <i>Datura quercifolia</i> | Aqueous extract of fruits | <i>Ascaridia galli</i>         | Kaushik et al., 1981 |
| <i>Embelia ribes</i>      | Aqueous extract of seeds  | <i>Paramphistomum cervi</i>    | Lal et al., 1976     |
| <i>Eucalyptus grandis</i> | Essential oil             | <i>Gastrothylax crumenifer</i> | George, 2004         |
| <i>Hedychium spicatum</i> | Alcoholic extract         | <i>Fasciola gigantica</i>      | Hajare, 2000         |
|                           | Essential oil             | <i>Gastrothylax crumenifer</i> | George, 2004         |

|                          |                                      |  |                                      |
|--------------------------|--------------------------------------|--|--------------------------------------|
| <i>Flemingia vestita</i> | Alcoholic extract of root-tuber peel | <i>Artefechinostomum surfrartyfex</i>                            | Roy & Tandon, 1996                   |
|                          |                                      | <i>Raillietina echinobothrida</i> ,<br><i>Paramphistomum</i> sp. | Tandon et al., 1997                  |
|                          |                                      | <i>Raillietina echinobothrida</i>                                | Pal & Tandon, 1998; Das et al., 2004 |
|                          |                                      | <i>Fasciolopsis buski</i>  | Kar et al., 2002                     |
|                          | Genistein                            | <i>Raillietina echinobothrida</i>                                | Tandon et al., 1997                  |
|                          |                                      | <i>Fasciolopsis buski</i>  | Kar et al., 2004                     |

|                                |                              |                                |                          |
|--------------------------------|------------------------------|--------------------------------|--------------------------|
| <i>Mallotus philippinensis</i> | Alcoholic extract            | <i>Fasciola gigantica</i>      | Hajare, 2000             |
|                                |                              | <i>Gastrothylax crumenifer</i> | George, 2004             |
| <i>Melia azedarach</i>         | Aqueous extract of seeds     | <i>Haemonchus contortus</i>    | Arora et al., 2010       |
| <i>Mentha spicata</i>          | Methanolic extract of leaves | <i>Haemonchus contortus</i>    | Sharma & Varshneya, 2008 |
| <i>Nigella sativa</i>          | Essential oil from seeds     | <i>Gastrothylax crumenifer</i> | George, 2004             |



|                          |  |                                 |                       |
|--------------------------|--|---------------------------------|-----------------------|
| <i>Peganum harmala</i>   | Alcoholic extract                          | <i>Fasciola gigantica</i>       | Hajare, 2000          |
| <i>Piper longum</i>      | Alcoholic extract of fruits                | <i>Gigantocotyle explanatum</i> | Singh et al., 2008    |
| <i>Pongamia glabra</i>   | Ether extract of seeds                     | <i>Haemonchus contortus</i>     | Arora et al., 2010    |
| <i>Tagetes patula</i>    | Methanolic extract of flowers              | <i>Haemonchus contortus</i>     | Bhardwaj et al., 2010 |
| <i>Rhynchosia minima</i> | Leaf aqueous & ethanolic extracts of seeds | <i>Ascaridia galli</i>          | Mali & Mahale, 2008   |

# Active principles possessing anthelmintic activity

| Active principle    | Helminth parasite   | Reference                         |
|---------------------|---|-----------------------------------|
| Benzyliothiocyanate | <i>Raillietina</i> spp.,<br><i>Ascaridia galli</i>                        | Kumar, 1988;<br>Kumar et al.,1991 |
| Bromelain           | <i>Oesophagostomum columbianum</i> ,<br><i>Bunostomum trigonocephalum</i> | Garg & Atal, 1963                 |
| Calotropain         | <i>Oesophagostomum columbianum</i> ,<br><i>Bunostomum trigonocephalum</i> | Garg & Atal, 1963                 |

|           |   |                             |
|-----------|---|-----------------------------|
| Embelin   | <i>Paramphistomum cervi</i> ,<br><i>Oesophagostomum columbianum</i> ,<br><i>Trichuris ovis</i> ,<br><i>Dipylidium caninum</i> | Gupta et al.,<br>1976       |
| Genistein | <i>Raillietina echinobothrida</i>   | Tandon et al.,<br>1997      |
| Palasonin | <i>Setaria cervi</i> , <i>Fasciola hepatica</i>   | Sabir et al., 1977          |
|           | <i>Ascaridia galli</i>  | Kumar et al.,<br>1983, 1995 |
|           | <i>Haemonchus contortus</i>   | Sathianesan et<br>al., 1984 |
|           | <i>Raillietina</i> spp.   | Kumar, 1988                 |

# *In vivo* activity of plant preparations against helminth parasites of domestic animals

| <b>Plant species</b>          | <b>Part/extract/active principle used</b> | <b>Helminth parasite</b>             | <b>Reference</b>         |
|-------------------------------|---|--------------------------------------|--------------------------|
| <i>Allium sativum</i>         | Raw and aqueous extract                   | <i>Ascaridia galli</i>               | Das and Thakuria, 1974   |
| <i>Aristolochia bracheata</i> | Alcoholic extract                         | <i>Ascaridia galli</i> in chicks     | Rao et al., 1982         |
| <i>Azadirachta indica</i>     | Methanolic extract of leaves              | <i>Haemonchus contortus</i> in goats | Arora et al., 2010       |
| <i>Butea frondosa</i>         | Decoction of seeds                        | <i>Ascaridia galli</i> in poultry    | Sharma and Sisodia, 1976 |
|                               | Aqueous extract of seeds                  | Hookworms in dogs                    | Joshi, 1970              |
|                               | Alcoholic extract                         | <i>Ascaridia galli</i> in chicks     | Rao et al., 1982         |

|                         |                             |                                      |                      |
|-------------------------|-----------------------------|--------------------------------------|----------------------|
| <i>Carica papaya</i>    | Aqueous extract of seeds    | <i>Ascaridia galli</i> in chicks     | Rao et al., 1982     |
| <i>Cucurbita maxima</i> | Extract of seeds            | Nematodes in calves                  | Pradhan et al., 1992 |
| <i>Embelia ribes</i>    | Extract of seeds            | <i>Ascaridia galli</i> in fowls      | Dama & Kirdak, 2002  |
|                         |                             | <i>Haemonchus contortus</i> in goats | Arora et al., 2010   |
|                         | Leaf powder                 | <i>GI nematodes</i> in sheep & goats | Kumar et al., 2010   |
| <i>Melia azedarach</i>  | Extracts of seeds           | <i>Haemonchus contortus</i> in goats | Misri et al., 2002   |
|                         | Methanolic extract of seeds | <i>Haemonchus contortus</i> in goats | Arora et al., 2010   |

|                               |                              |  |                            |
|-------------------------------|------------------------------|--|----------------------------|
| <i>Pongamia glabra</i>        | Ether extract of seeds       | <i>Haemonchus contortus</i> in goats                   | Arora et al., 2010         |
| <i>Psoralea corylifolia</i>   | Ether and alcoholic extracts | Avian <i>Ascaridia galli</i>                           | Shilaskar & Parashar, 1985 |
| <i>Punica granatum</i>        | Extract of rind              | Nematodes in calves                                    | Pradhan et al., 1992       |
| <i>Swertia chirata</i>        | Aqueous extract of seeds     | Nematodes in goats                                     | Jain & Sahni, 2009         |
| <i>Vernonia anthelmintica</i> | Alcoholic extract            | <i>Hymenolepis nana</i> ,<br><i>Fasciolopsis buski</i> | Singh et al., 1985         |

# ***In vivo* activity of combination of plant preparations against helminth parasites of domestic animals**

| <b>Product name</b> | <b>Constituent</b>  | <b>Helminth parasite</b>  | <b>Reference</b>        |
|---------------------|---|---|-------------------------|
|                     | <i>Azadirachta indica</i> , <i>Butea frondosa</i> , <i>Nigella sativa</i> and <i>Piper longum</i>   | <i>Haemonchus contortus</i> , <i>Oesophagostomum columbianum</i> , <i>Paramphistomum cervi</i> in goats | Raje et al., 2004       |
|                     | <i>Acacia auriculiformis</i> and <i>Centella asiatica</i>   | <i>Dirofilaria immitis</i> in dogs  | Sarkar et al., 1998     |
| <b>Helminta</b>     | Phenothiazine, Piperazine, Stannous oxide, <i>Vernonia anthelmintica</i> , Senna leaves and embelin | <i>Ascaridia galli</i> , <i>Railletina</i> spp. in poultry  | Matta & Ahluwalia, 1979 |

|        |   |  |                          |
|--------|---|--|--------------------------|
| Janata | <i>Artemisia<br/>maritima,</i><br><i>Brassica nigra,</i>                                    | Helminth<br>parasites in<br>goats  | Shirale &<br>Maske, 2003 |
|        | <i>Cassia<br/>lanceolata,</i><br><i>Vernonia<br/>anthelmintica,</i><br><i>Embelia ribes</i> | <i>Haemonchus<br/>contortus,</i><br><i>Strongylus,</i><br><i>Trichstrongylus,</i><br><i>Nematodirus</i> in<br>crossbred cattle | Sharma, 1993             |
| Krimos | Herbal<br>preparation   | <i>Ascaridia galli,</i><br><i>Heterakis<br/>gallinae</i> in<br>poultry   | Mukherjee,<br>1996       |



|        |   |   |                         |
|--------|---|---|-------------------------|
| Sonex  | Nicotine sulphate,<br><i>Embelia ribes</i> and<br><i>Punica granatum</i>            | <i>Ascaridia galli</i> ,<br><i>Raillietina</i><br>spp. in poultry | Matta & Ahluwalia, 1979 |
| Taenil | Male fern, <i>Mallotus philippinensis</i> ,<br>Barbrung, Senna,<br>Ajwain and Saunf | <i>Taenia</i> ,<br><i>Dipylidium</i> in dogs                      | John & Raghavan, 1987   |
|        |   | <i>Hymenolepis</i><br>spp. in ducks                               | Barua & Gogoi, 1988     |
|        |   | Poultry tapeworms   | Tuli & Bali, 1991       |

|        |  |                                   |                            |
|--------|--|-----------------------------------|----------------------------|
| Wopell | <i>Mallotus philippinensis</i> ,<br><i>Butea frondosa</i> ,<br><i>Embelia ribes</i> ,<br><i>Acacia catechu</i> and<br><i>Droyptheris felix-mas</i> | <i>Ascaridia galli</i> in poultry | Hafeez & Venkatarata, 1989 |
|        | <i>Azadirachta indica</i> ,<br><i>Nigella sativa</i> ,<br><i>Butea frondosa</i> and<br><i>Piper longum</i>   | GI helminths in goats             | Ramteke et al., 2008       |

# Division of Pharmacology & Toxicology, IVRI, Izatnagar

| <b>Plant</b>                   | <b>Part</b> | <b>Active principle/extract</b> | <b>Activity against helminth parasite</b> |
|--------------------------------|-------------|---------------------------------|---|
| <i>Prunus persica</i>          | Leaves      | Essential oil                   | <i>H. contortus</i>                       |
| <i>Butea frondosa</i>          | Seeds       | Palasonin                       | <i>S. cervi, A. galli, F. gigantea</i>    |
| <i>Carica papaya</i>           | Seeds       | Benzyliothiocynate              | <i>A. galli</i>                           |
| <i>Mallotus philippinensis</i> | Seeds       | Alcoholic extract               | <i>F. gigantea, G. crumenifer</i>         |
| <i>Hedychium spicatum</i>      | Root        | Alcoholic extract/essential oil | <i>F. gigantea, G. crumenifer</i>         |

# Division of Pharmacology & Toxicology, IVRI, Izatnagar

| <b>Plant</b>              | <b>Part</b> | <b>Active principle/extract</b> | <b>Activity against helminth parasite</b> |
|---------------------------|-------------|---------------------------------|---|
| <i>Peganum harmala</i>    | Seeds       | Alcoholic extract               | <i>F. gigantica</i>                       |
| <i>Nigella sativa</i>     | Seeds       | Essential oil                   | <i>G. crumenifer</i>                      |
| <i>Eucalyptus grandis</i> | Leaves      | Essential oil                   | <i>G. crumenifer</i>                      |
| <i>Cedrus deodara</i>     | Wood        | Essential oil                   | <i>G. crumenifer</i>                      |

# Veterinary Pharmaceuticals dealing with Herbal Drugs

|           |                                  |            |                                       |
|-----------|----------------------------------|------------|---------------------------------------|
| <b>1</b>  | <b>Aamoda, Bangalore</b>         | <b>11.</b> | <b>Cheerans, Thrissur</b>             |
| <b>2</b>  | <b>Alarsin, Mumbai</b>           | <b>12</b>  | <b>Concept, Mumbai</b>                |
| <b>3</b>  | <b>Alembic, Baroda</b>           | <b>13</b>  | <b>Dabur Ayurved, Delhi</b>           |
| <b>4</b>  | <b>AVR, Bangalore</b>            | <b>14</b>  | <b>Guybro, Mumbai</b>                 |
| <b>5</b>  | <b>BE Animal Health</b>          | <b>15</b>  | <b>Herbal Medicaments, Bangalore</b>  |
| <b>6</b>  | <b>Cadila Pharma, Ahmedabad</b>  | <b>16</b>  | <b>Himalaya, Bangalore</b>            |
| <b>7</b>  | <b>Care Tech, Bangalore</b>      | <b>17</b>  | <b>Indian Herbs, Saharanpur</b>       |
| <b>8</b>  | <b>Cattle Remedies, N. Delhi</b> | <b>18</b>  | <b>Indian Pet Products, Bangalore</b> |
| <b>9</b>  | <b>Century, Baroda</b>           | <b>19</b>  | <b>Natural Remedies, Bangalore</b>    |
| <b>10</b> | <b>Charak, Mumbai</b>            | <b>20</b>  | <b>Novartis, Mumbai</b>               |

# Veterinary Pharmaceuticals dealing with Herbal Drugs

|           |                                 |           |                               |
|-----------|---------------------------------|-----------|-------------------------------|
| <b>21</b> | <b>Oriental, Mumbai</b>         | <b>31</b> | <b>Sarabhai Zydus, Baroda</b> |
| <b>22</b> | <b>Pranav, Pune</b>             | <b>32</b> | <b>Theodore, Mehsana</b>      |
| <b>23</b> | <b>Premium, Mumbai</b>          | <b>33</b> | <b>TTK, Chennai</b>           |
| <b>24</b> | <b>Rakesh, Mehsana</b>          | <b>34</b> | <b>VC, Ernakulam</b>          |
| <b>25</b> | <b>Rallis, Mumbai</b>           | <b>35</b> | <b>Venky's, Pune</b>          |
| <b>26</b> | <b>Ranbaxy, New Delhi</b>       | <b>36</b> | <b>Vesper, Bangalore</b>      |
| <b>27</b> | <b>Redeem, Bangalore</b>        | <b>37</b> | <b>Vetchem, Chennai</b>       |
| <b>28</b> | <b>Respel Pharma, Bangalore</b> | <b>38</b> | <b>Vetguard</b>               |
| <b>29</b> | <b>Sai Deep, Bangalore</b>      | <b>39</b> | <b>Vets Farma, Jalandhar</b>  |
| <b>30</b> | <b>Sam Browne</b>               | <b>40</b> | <b>Wockhardt, Mumbai</b>      |

# HERBAL VETERINARY DRUGS MARKETED IN INDIA

| <b>Drug/ Disorder</b>  | <b>Number</b>         |
|--|-----------------------|
| <b>Antihaemorrhagic/haemostatic</b>                                    | <b>1</b>              |
| <b>Anxiolytic/behavioural modifier</b>                                 | <b>1</b>              |
| <b>Herbal ear drops</b>  | <b>1</b>              |
| <b>Herbal performance enhancer</b>                                     | <b>1</b>              |
| <b>Haematinic</b>  | <b>1</b>              |
| <b>Renal disorders</b>   | <b>2</b>              |
| <b>Drugs acting on female genital system-intrauterine formulations</b> | <b>22</b><br><b>2</b> |
| <b>Antifungal/antimange</b>  | <b>3</b>              |
| <b>Appetite stimulant</b>  | <b>4</b>              |
| <b>Anthelmintics</b>   | <b>4</b>              |
| <b>Toxin binders</b>   | <b>4</b>              |

# HERBAL VETERINARY DRUGS MARKETED IN INDIA

| <b>Drug / Disorder</b>                                 | <b>Number</b> |
|--|---------------|
| <b>Anti-inflammatory, antiarthritic, antiflogistic</b> | <b>5</b>      |
| <b>Udder (topical preparations)</b>                    | <b>6</b>      |
| <b>Expectorant/mucolytics</b>                          | <b>7</b>      |
| <b>Tympany/bloat/indigestion/colic</b>                 | <b>8</b>      |
| <b>Anti-stress</b>                                     | <b>8</b>      |
| <b>Ectoparasiticides</b>                               | <b>9</b>      |
| <b>Pain, fever, inflammation</b>                       | <b>13</b>     |
| <b>Acute or chronic diarrhoea/dysentery</b>            | <b>16</b>     |
| <b>Stomachics/rumenotonics</b>                         | <b>16</b>     |
| <b>Galactogogues</b>                                   | <b>20</b>     |
| <b>Hepatobiliary drugs</b>                             | <b>32</b>     |
| <b>Coat conditioner/topical antiseptics</b>            | <b>46</b>     |




# PLANT-BASED ANTHELMINTICS

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- **Narrow and broad spectrum anthelmintic activities**
- **Lower cost**
- **Easy accessibility**
- **No residues in faeces**
- **No environmental problems**

# FUTURE NEEDS

- **Suitable dosage regimens**
- **Improved methods of preparation and uses**
- **Scientific trials in experimentally infected and naturally infected animals**
- **Strategies to enhance therapeutic effects of plant-based anthelmintics**
- **Identification/standardization of active principles**   
**quality control**
- **Biotechnological intervention to increase anthelmintic production by plants**



# Indian Veterinary Research Institute



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