



GOVERNMENT INSTITUTE OF SCIENCE NAGPUR

# INTRODUCTION TO HELMINTHIASIS AND ANTHELMINTICS



PRESENTED BY-

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M.SC. CHEMISTRY 4<sup>TH</sup> SEMESTER

## OUTLINE

- WHAT IS HELMINTHIASIS....?
- TYPES OF WORMS
- CESTODE AND TREMATODE HELMINTHS
- WHAT DOES WHO SAYS ....!
- ANTHELMINTICS DRUGS AND THEIR SYNTHESIS



## WHAT IS HELMINTHIASIS.....?

- Helminth means worm . Their motile activity is accomplished by wriggling movement. The helminth of medical importance belong to 3 classes ; NEMATODA , TREMATODA , CESTODA .
- Helminthology is the study of parasitic worms and their effect on their hosts.
- Geohelminths refer to the helminthes which complete their life cycles not requiring the processes of the development in intermediate hosts .
- They have only one host and a simple life cycle ,such as *ascarid* ,*hookworm* ,*pinworm* etc.



- ▶ **Biohelminths** refers to those that have to undergo the development in intermediate hosts to complete their life cycles , such as *filaria* , *liver fluke* , *pork tapeworm* and so on .
- ▶ In the human body **gastrointestinal tract** is the abode of many helminthes , but some also live in tissues , or their larvae migrate into the tissues .
- ▶ They harm the host by depriving him of food , causing blood loss ,injury to organs , intestinal or lymphatic obstruction and by secreting toxins .
- ▶ Helminthiasis is rarely fatal , but is major cause of ill health .

# Types of worms

## HELMINTHS



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graph TD; HELMINTHS --> PLATYHELMINTHS[Platyhelminths (FLAT WORMS)]; HELMINTHS --> NEMATHELMINTHS[Nemathelminths (ROUND WORMS) NEMATODES]; PLATYHELMINTHS --> CESTODES[Cestodes (TAPE WORM)]; PLATYHELMINTHS --> TREMATODES[Trematodes (FLUKES)]; CESTODES --- CESTODES_BOX[Segmented Separate Sex]; TREMATODES --- TREMATODES_BOX[Un segmented Hermaphroditic]; NEMATHELMINTHS --- NEMATHELMINTHS_BOX[Un segmented Separate Sex];
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The diagram is a hierarchical flowchart. At the top is a green rounded rectangle labeled 'HELMINTHS'. Two arrows point down from it to two more green rounded rectangles: 'Platyhelminths (FLAT WORMS)' on the left and 'Nemathelminths (ROUND WORMS) NEMATODES' on the right. From 'Platyhelminths (FLAT WORMS)', two arrows point down to 'Cestodes (TAPE WORM)' and 'Trematodes (FLUKES)'. Below 'Cestodes (TAPE WORM)' is a white box with 'Segmented Separate Sex'. Below 'Trematodes (FLUKES)' is a white box with 'Un segmented Hermaphroditic'. Below 'Nemathelminths (ROUND WORMS) NEMATODES' is a white box with 'Un segmented Separate Sex'. There are three small worm illustrations: a yellow segmented worm on the left, a yellow flat worm on the right, and a yellow leaf-like flat worm at the bottom right.

Platyhelminths  
(FLAT WORMS)

Nemathelminths  
(ROUND WORMS)  
NEMATODES

Un segmented  
Separate Sex

Cestodes  
(TAPE WORM)

Trematodes  
(FLUKES)

Segmented  
Separate Sex

Un segmented  
Hermaphroditic

## TAXONOMIC CLASSIFICATION OF HELMINTHS

### NEMATODES

- Round worms appear in cross section
- they have body cavities
- a straight alimentary canal and an anus



Ascaris (roundworm)  
Trichuris (whipworm)  
Ancylostoma (hookworm)  
Necator (hookworm)  
Enterobius (pinworm or threadworm)

### PLATYHELMINTHES

- Flat worm
- Dorsoventrally flattened
- No body cavity ,and if present, the alimentary canal is blind ending

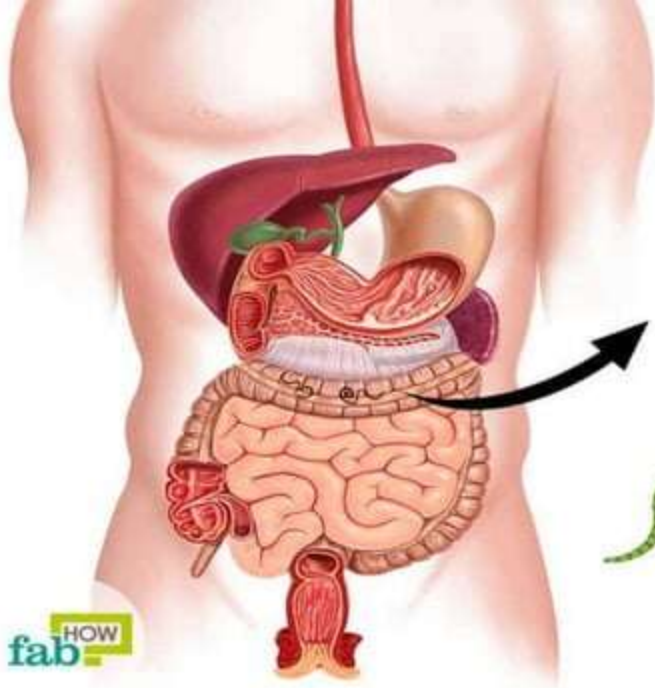


### CESTODES

- Adult tapeworms are found in the intestine of their host
- They have a head with sucking organs
- A segmented body but no alimentary canal
- Each body segment is hermaphrodite , example Taenia (tapeworm)
- Human infection by means of eating partially cooked meat and fish .

### TREMATODES

- Non-segmented ,usually leaf shaped
- With two suckers but no distinct head
- They have an alimentary canal and are usually hermaphrodite
- Transmission through drinking contaminated water
- Example Fasciolops (liver fluke)  
Schistosoma (not leaf shaped)



HUMAN WHIPWORM



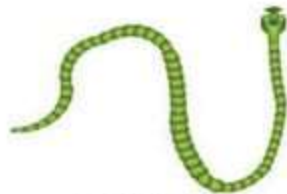
LIVER FLUKE



ASCARIS



PINWORM



PORK TAPEWORM



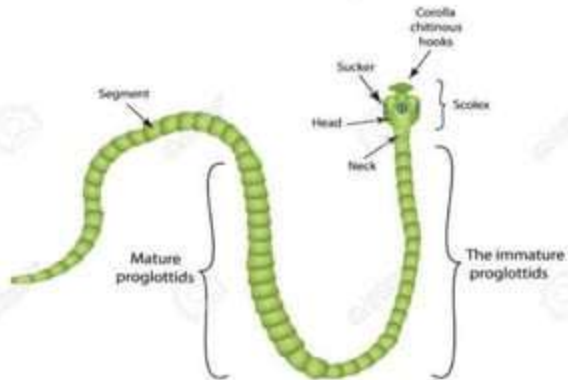
BOVINE TAPEWORM



## CESTODE

- Beef tapeworm - *Taenia saginata*
- Pork tapeworm - *Taenia solium*
- Fish tapeworm - *Diphyllobothrium latum*
- Dwarf tapeworm - *Hymenolepis nana*

### ***The structure of the pork tapeworm***



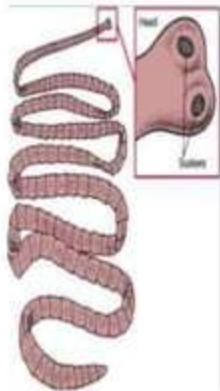
# CESTODES



PORK TAPEWORM



FISH TAPEWORM



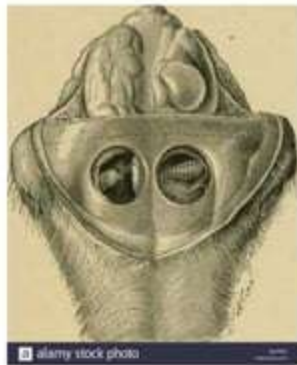
TAPEWORM



ECHINOCOCCOSIS



CYSTICERCOSIS



COENUROSIS PARASITE



HYMENOLEPIS NANA

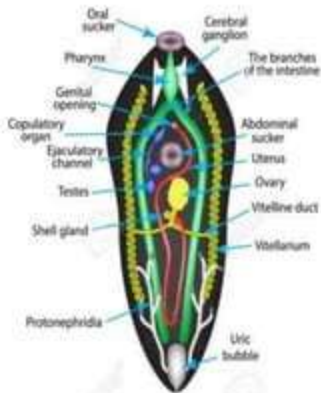


HYMENOLEPIASIS

# TREMATODE

- Body fluke - Schistosomiasis
- Liver fluke - Clonorchiasis
- Intestinal fluke - Fasciolopiasis
- Lung fluke - Paragonimiasis

## The structure of the liver fluke



# TREMATODE



SCHISTOSOMA



LIVERFLUKE

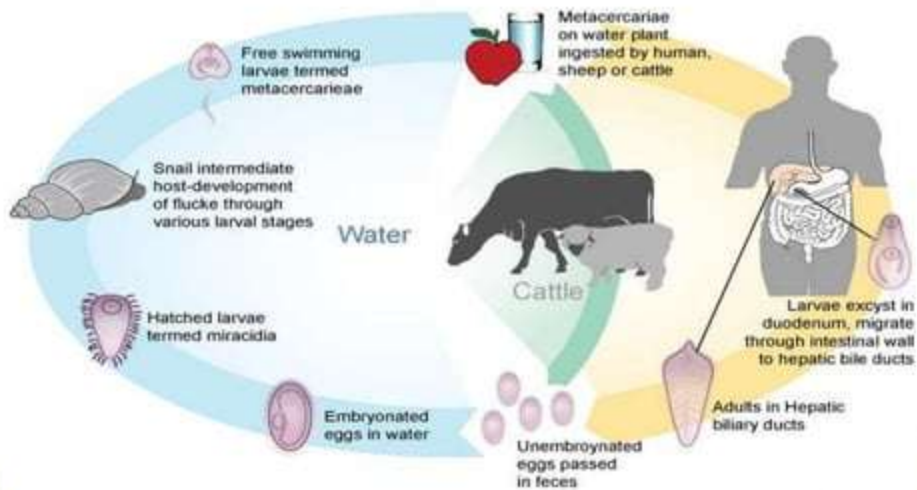


FASCIOLA

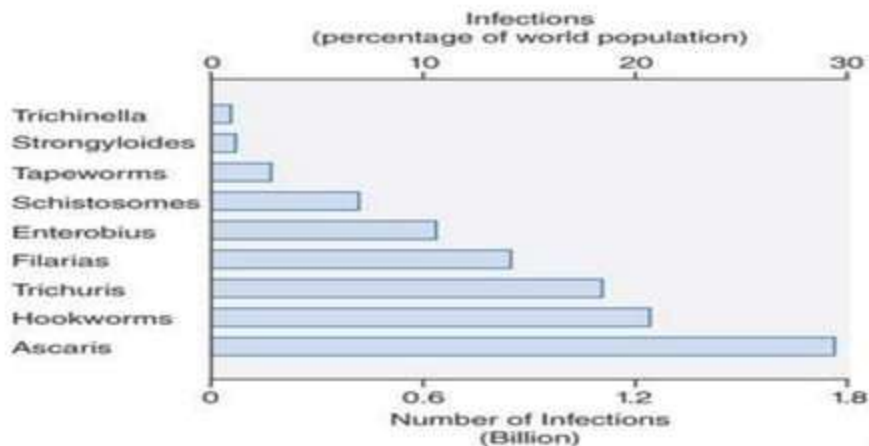


LUNG FLUKE

# Life cycle of fluke



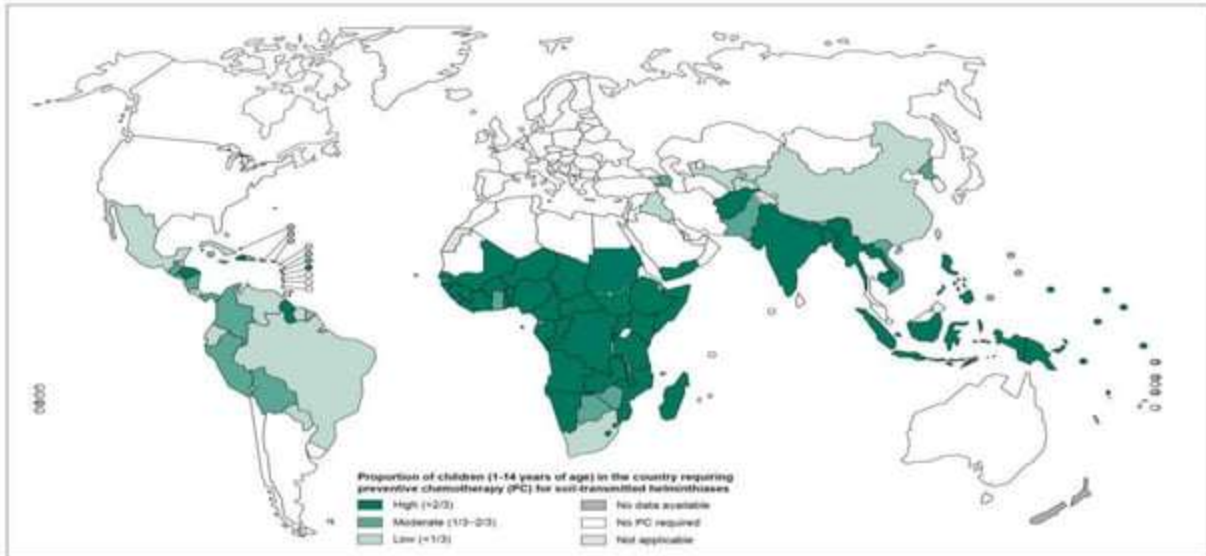
# RELATIVE INCIDENCES OF HELMINTH INFECTION WORLDWIDE



Source: Douglas E. Rollins, Donald K. Blumenthal: Workbook and Casebook for Goodman and Gilman's The Pharmacological Basis of Therapeutics, [www.accesspharmacy.com](http://www.accesspharmacy.com)  
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## Proportion of children (1-14 years of age) in the country requiring preventive chemotherapy (PC) for soil-transmitted helminthiases, worldwide, 2014



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its borders or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement. © WHO 2015. All rights reserved.

Data Source: World Health Organization  
Map Production: Control of Neglected  
Tropical Diseases (NTD)  
World Health Organization



## WHO says...

- In 2014-15 , the WHO estimated that approximately
- 2 billion people were infected with soil transmitted Helminthiasis
- 249 million with Schistosomiasis
- 56 million people with food borne Trematodiasis
- 120 million with Lymphatic Filariasis
- 135 thousands die annually from soil transmitted Helminthiasis



## CAUSES

- Contact with infected animals
- Ingestion of infected meat
- By the animals or human excreta via soil or water
- By means of certain mosquitoes e.g. Filarial worms are transmitted via mosquitoes



## EFFECTS

- Worms may burrow in tissues
- Injury to vessels and organs
- Loss of blood , iron and protein
- Nutritional deficiency
- Malnutrition , anemia
- Can lead to **volvulus, peritonitis and gangrene** of intestine

# ANTHELMINTICS



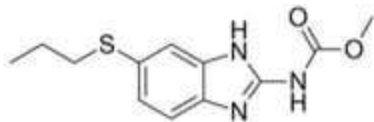
- ▶ Drugs used to kill or remove the parasitic worms .
- ▶ **VERMICIDAL** : which kill the worms .
- ▶ **VERMIFUGES** : helps in expelling them by making the environment uncomfortable for living .
- ▶ Anthelmintic act by causing :
  1. Paralysis of the worm .
  2. Damaging the worm leading to partial digestion or rejection by immune mechanisms .
  3. Interfere with the metabolism of the worm .

# ANTHELMINTICS DRUGS

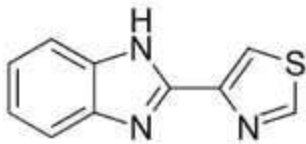
- **BENZIMIDAZOLES** : Albendazole , Thiabendazole , Mebendazole
- **QUINOLINES AND ISOQUINOLINES** : Oxamniquine and Praziquantel
- **PIPERAZINES** : Piperazine citrate and Diethyl carbamazine
- **VINYL PYRIMIDINES** : Pyrantel pamoate
- **AMIDES** : Niclosamide
- **IMIDAZOTHIAZOLES** : Levamisole
- **ORGANOPHOSPHANES** : Metrifonate

M - Mebendazole  
A - Albendazole  
N - Niclosamide  
I - Ivermectin  
P - Praziquantel  
A - Albendazole  
L - Levamisole  
P - Pyrantel  
pamoate  
D - Diethyl  
carbamazine  
Mnemonic :  
MANIPAL PD

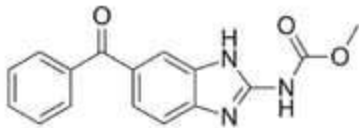
## BENZIMIDAZOLES :



ALBENDAZOLE

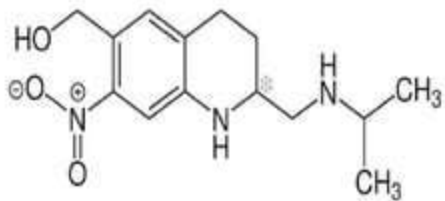


THIABENDAZOLE

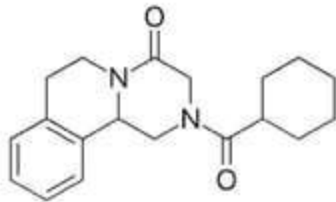


MEBENDAZOLE

## QUINOLINES AND ISOQUINOLINES

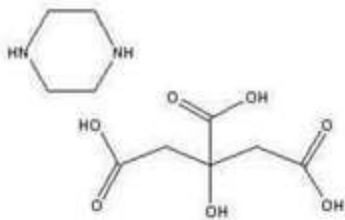


OXAMNIQUINE

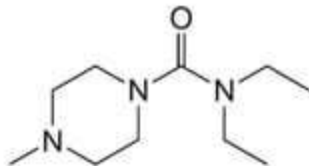


PRAZIQUANTEL

## PIPERAZINES :



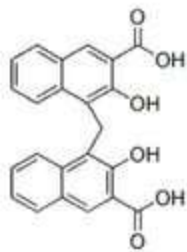
PIPERAZINE CITRATE



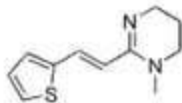
DIETHYL CARBAMAZINE



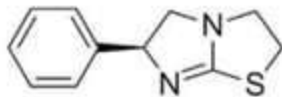
## VINYL PYRIMIDINES



PYRENEL PAMOATE



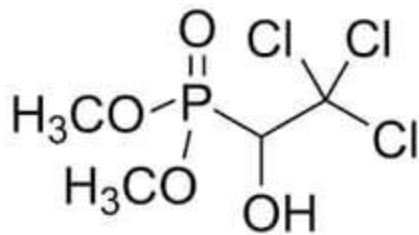
## IMIDAZOTHIAZOLES



H-Cl

LEVAMISOLE

## ORGANOPHOSPHANES

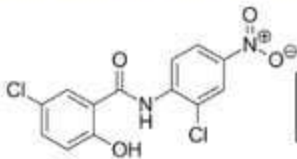


METRIFONATE

# DRUGS USED IN TREATMENT OF CESTODE

## NICLOSAMIDE :

Mechanism of action :



**IUPAC NAME** :5-chloro - N -(2-chloro-4Nitrophenyl)2-hydroxybenzamide

- Inhibiting oxidative phosphorylation in mitochondria and interfering with anaerobic generation of ATP by the tapeworm .
- This is lethal for the cestodes scolex and segments of cestodes but not for the ova .
- A laxative is administered prior to oral administration of Niclosamide .
- Alcohol should be avoided within one day of Niclosamide .
- Can be given in pregnancy .

## PHARMACOKINETIC

- Poorly absorbed from gut
- excreted in urine

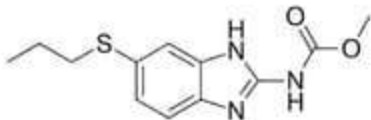
### ADVERSE EFFECT :

- Nausea
- Vomiting
- Abdominal pain
- Dizziness
- Skin rash

### Recommended doses :

- 4 tablets in a single dose (2g) for adults
- 2 tablets (1g) for children 11 to 34 kg
- 3 tablets (1.5 g) for children >34

## ALBENDAZOLE :



**IUPAC NAME:** Methyl [5-(propylthio)-1H-benzimidazol-2-yl]Carbamate

- Albendazole , a broad spectrum oral anthelmintic agent .

### MECHANISM OF ACTION :

- Blocks glucose uptake and deplets its glycogen stores .
- Binds with beta-tubulin and inhibits microtubules polymerization .

### ADVERSE EFFECT :

- Well tolerated
- **G.I.** side effects
- Dizziness
- Headache , fever , jaundice if used for prolonged period of time .

## PHARMACOKINETICS

- Albendazole is erratically absorbed after oral administration, but absorption is enhanced by a high fat meal.
- Its metabolized in liver and primarily excreted in urine.
- $T_{1/2}$  = approx. 8.5 hours
- It enters brain

**Recommended doses :** adult - 400 mg/kg  
children -200 mg/kg in single dose

For Eradication of

Endoparasitic Worms

**WORNO™**

Albendazole 200mg      SUSPENSION  
Albendazole 400mg      CHEWABLE TABLETS



### USEFUL IN

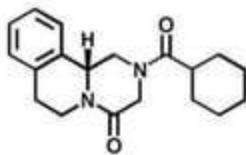
Echinococcosis  
Neurocysticercosis  
Ascariasis  
Enterobiasis  
Trichuriasis  
Strongyloidiasis  
Giardiasis

"Say NO to worms by WORNO"



# DRUGS USED IN TREATMENT OF TREMATODE

## PRAZIQUANTEL :



**IUPAC NAME:** (R*S*)-2-(cyclohexyl carbonyl)-1,2,3,6,7,11b-hexahydro-4*H*-pyrazino [2,1-*a*]isoquinolin 4-one

- Trematode infections are generally treated with Praziquantel .
- It is a drug of choice to treat Schistosmiais and cestode infections like Cysticercosis .

## MECHANISM OF ACTION :

- Permeability of the cell membrane to calcium ion is increased .
- This leads to contraction and so paralysis of the parasite occurs .
- Worm loses its grip in GIT and expelled out .

## PHARMACOKINETIC

- Rapidly absorbed from intestine ,  $t_{1/2}$  - 1.5 hours .
- Excreted in urine .

Recommended doses : 20 mg/kg /dose · 2-3 doses

## ADVERSE EFFECTS :

- Dizziness , GI upset , Drowsiness .
- Bitter in taste - nausea and abdominal pain .



# SYNTHESIS :

## NICLOSAMIDE :

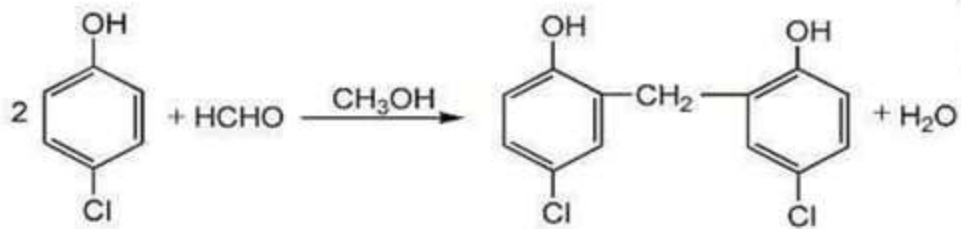


5-Chlorosalicylic acid

2-Chloro-4-nitroaniline

Niclosamide

## DICHLORPHEN :



Parachlorophenol

Formaldehyde

Dichlorophen

## REFERENCES :

- Synthetic drugs by G.R. Chatwal (page no. 279 -293 )
- Medicinal chemistry by A. Kar (page no. 652-664 )
- Medicinal chemistry by Yogeshwari and D. Shriram (page no. 546 -551 )
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- <https://www.fabhow.com/wp-content/uploads/2017/07/intro-parasites-in-humans.jpg>

**Any queries....**



THANK  
YOU

A decorative illustration featuring a central branch with several leaves in shades of red, pink, and light green. Small clusters of dark berries are interspersed among the leaves. The words "THANK" and "YOU" are written in a black, serif font, with "THANK" on the top line and "YOU" on the bottom line. The text is partially overlaid by the branch and leaves. Small decorative marks resembling three radiating lines are placed at the beginning of "THANK" and the end of "YOU".