Parasites are known to occur in nature as early as the dawn of human history. They have been described in the most ancient literature like Atharvaveda (Jolly, 1951), fossil records (Conway, 1981) and mummies of 1250 B.C. (Ruffer, 1910). However, the importance of diseases caused by these agents was realised much later. This stimulated research on parasites which, at the end of the last century following the development of improved microscope in 1830's and invention of microtome in 1870, gained momentum. Efforts made in this direction resulted in the generation of interesting information on the anatomy, morphology and life cycle of causative agents. Studies on the intricate problems like immunity and physiology, however, began to receive attention during the last few decades only.

The most important parasites are found amongst the protozoa (trichomonads, sarcosporidia, trypanosomes etc.,), the platyhelminths (trematodes and cestodes) and the nematohelminths (nematodes and acanthocephala). Helminths form a very important group of endoparasitic organisms and are ubiquitous in the sense, that they infect not only the human race rather are found in almost all the animals of wild and domestic nature. Apart from being a great threat to the human health directly, they cause a great loss to our health and economy by affecting the animals of veterinary importance.
PATHOGENICITY:

The pathogenicity of parasites varies greatly, depending on their number, habits, nature of migration and especially the degree of adaptation that has developed between the host and the parasite. Parasites may do harm to their hosts in a number of ways, e.g., by absorbing food material intended for the host (tapeworm), by sucking blood or lymph (hookworm), by feeding on the tissues of the host (ascarids), by causing mechanical obstruction or pressure (ascarids, filariae), by causing wounds through which other infections may enter (Ascaris, Demodex) and by irritation (Fasciola). They may also secrete toxins and other harmful substances, e.g., inhibitors to the digestive enzymes (gastrointestinal worms), anticoagulatory and haemolytic substances (hookworm) etc.

Worm parasites frequently cause marked eosinophilia. A typical encapsulation followed by cellular invasion of eosinophils, lymphocytes, plasma cells and few macrophages has been marked in sparganosis (Smyth and Heath, 1970), including swelling, oedema and necrosis on long duration of the infection. Among other common symptoms are the anemia and hemorrhage, which may be due to loss of blood by sucking, the destruction of erythrocytes or the secretion of anticoagulants. Signs of pyrexia, anorexia, muscular weakness and emaciation following death of host tissues are observed in certain infections. Mechanical obstruction of hollow organs has been described as a general feature of helminthiasis,
e.g., of cardiac chambers in dogs by *Dirofilaria immitis*, bile ducts of cattle and sheep by flukes, intestines by *Ascaris* and human lymphatics by filarial parasites.

**DISTRIBUTION AND IMPORTANCE:**

The distribution of parasitic helminths is extremely wide. In 1949, as many as 800 million cases of helminthiasis were reported (Bueding, 1949b), out of which more than 20 million were suffering with *Hymenolepis nana* alone (Stoll, 1947). In 1973, hookworm disease, ancylostomiasis, was reported to occur in 20-25% world population (Davis, 1973). The importance of parasitology in the warm climatic (tropical) countries can not be easily overestimated, where 70-90% population are infected with *Ascaris lumbricoides* (Gentilini *et al.*, 1977). In 1971 (WHO Report), 300 million people were reported to harbour filarial parasites; 150 million among them were only in India (Tech. Rep. ICMR, 1971). In India, like other developing and underdeveloped countries, the cardinal most factor that accounts for poor health status and low level of economic productivity is the unhappy co-existence of innumerable parasitic infections.

Stephenson (1980) stresses on the need for more applied and experimental research to determine more precisely the relationship between nutrition, particularly childhood malnutrition, and intestinal parasitic infections. An important fact that needs to be more generally emphasized
is that the effects of parasitic diseases are often not as striking as those of other infectious diseases. It is the slowly gnawing danger of the parasite that is not realised. For instance, a flock of sheep suffering from worm infection, may be quite passable in appearance, and the owner as well as the veterinarian may become accustomed to this condition, considering it normal for sheep in that area. But these sheep would really be in a much better condition if they had no parasites.

Healthy livestock represents one of man's most valuable renewable resources. They provide high quality of edible protein, fibres of all types and enormous amount of useful by-products, and in the developing countries, motive power and fuel (Kelley and Hall, 1979). In order to maintain an adequate supply of such products against the rate of increase of human population (3.92 billion 1974 to 6.4 billion in 2000 A.D.), it has been estimated that the efficacy of ruminant production will have to be increased by atleast 50% over next two decades (Byerly, 1977). The annual world mortality from various diseases are estimated to exceed 150 million in domestic animals. The effect of nonfatal diseases in terms of production loss are extremely difficult to measure. It is reasonable, however, to assume the production penalties of the order of 20%. Thus, in terms of world ruminant protein output (25 million metric tonnes in 1974) disease induced production losses
conservatively account for at least 5 million metric tonnes.

It should be realised further that animals compared to man live under very unhygienic conditions, as their faeces and urine are voided on the pastures on which they feed. Certain animals due to their habits are more prone to such infections. For example, swine, on account of its scavenging habits, is more liable to become infected with tapeworm. It is pertinent to mention here that attention has been drawn (2nd International Congress of Parasitology, 1970) towards the economics and other aspects of parasitic diseases among domestic animals. The existence of the problem has been given recognition and two points were considered of main importance: method of diagnosis, particularly at subclinical levels of parasitism; and the economic benefits of antiparasitic treatment. Therefore, from the veterinary point of view also the chemotherapeutic and immunotherapeutic measures are most important.

In the absence of effective immunotherapeutic remedies the only available course of treatment of helminth disorders is by the use of suitable chemotherapeutic agents. As a result of revolutionary progress over the last few decades, a few good broad spectrum anthelmintics, such as, benzimidazole group of compounds have been brought into use. Thiabendazole, as the first compound of this group was introduced in 1961 and, in addition to other related compounds, proved to be highly effective and extra
ordinarily safe. But, unfortunately their excessive use for the last two decades has led to the emergence of an increasing number of resistant helminths (Kelley and Hall, 1979) and poses an important problem to chemotherapists. Hence the search for an ideal drug is still in progress.

**SCOPE OF BIOCHEMICAL STUDIES:**

For the development of better drugs on rational basis it should be kept in mind that chemotherapeutic agents exert their effects by interference with physiological or biochemical mechanisms essential for the functional integrity or the reproduction of the invading organism (Saz and Bueding, 1966). If studied in detail, many such compounds are capable of altering a multitude of enzyme systems or physiological responses, especially when applied in concentration far above those which are chemotherapeutically effective. Furthermore, one of the primary requisite for a chemotherapeutic agent is its selective toxicity for the parasite against none or very low toxicity for the host. One should also bear in mind that a compound inhibiting a vital reaction in homogenates can be without practical importance if it is not absorbed by the parasite in vivo. Therefore, an understanding of the physiological and biochemical differences between the host and the parasite is of utmost importance.

Anaerobic helminths are obviously biochemically different from the host tissue in which they reside. Such
differences, concerning either metabolic pathways or, more subtly, kinetics and structure of enzymes or of receptors, can make the parasite susceptible to specific chemotherapeutic attack. Bueding (1959) described the possibility of relating a drug action to an enzyme system. These include a quantitative elucidation of inhibition pattern of drug on enzyme involved in a vital step of metabolism.

Phylogenetically, parasitic helminths are a diverse group of organisms, all of which have adapted for a specialized mode of life by losing unnecessary organs and developing the others. Very striking of these is the loss of certain sense organs, like photoreceptors in internal parasites, wings in certain external parasites and even of alimentary canal in tapeworms and acanthocephala. Special development is seen in organs of adhesion such as hooks and suckers, and the organs of reproduction. This adaptation is ought to be reflected at the biochemical and genetic level, offering an interesting site for the wanted specificity to chemotherapeutic agents. Much of the intrinsic interest in parasitic biochemistry comes from the ways in which metabolic pathways have been modified to suit their highly specialized mode of life.

The limited information available suggests that, except for carbohydrates, the nutritional requirements may not be much more complicated from those of vertebrates.
Extensive investigations carried out on carbohydrate metabolism have revealed that helminth parasites do not completely oxidize sugars into $\text{CO}_2$ and water even in the presence of adequate supply of oxygen. Studies from various schools, especially from the University of Notre Dame (USA), have shown that worms obtain their energy anaerobically from a route different to other organisms. This pathway (Row and Saz, 1974) is of particular interest from the chemotherapeutic point of view.

Many more pathways and sites need extensive digging in order to approach chemotherapy in a rational way instead of making hit and miss trials. It would be pertinent to mention here the view of Baldwin (1948), who has commented on the disproportionality between the existing knowledge concerning the biochemistry of vertebrates and bacteria on one hand and that of invertebrate metazoa on the other. Although the comparative biochemistry of parasites has emerged from its infancy, it still lags well behind the study of the biochemistry of vertebrates, for example.

Technical problems arising while conducting the studies with parasitic helminths have been pointed out by Barrett (1981). They include conditions provided during the process of study; *in vitro* situation is far away or at least not close to the *in vivo* environment. This is, in particular, true with the cestodes, which live in a state of dynamic equilibrium with their hosts, and loose this
balance when studied in vitro.

In spite of the fact that there are obvious deficiencies in our approach, it would be trite to say that integrated efforts need to be carried out for generating more basic information on the subject. Mansour (1979) in his recent review on 'Chemotherapy of parasitic worms: New biochemical strategies' has advised many facets of biochemical and enzymatic approaches which may directly be exploited in the development of new drugs. He has also stressed the need for putting more impetus on the metabolic regulation.

*Goeppalia digonopora*, a cyclophyllidean cestode, apart from being of economic importance to domestic livestock of fowls (fowl population corresponds to 95.7% of the total 6.819 million world domestic birds - Crompton and Neshem, 1976), and being partially characterised for its highly parasitic existence (Nadakal et al., 1970), provides a conveniently excellent model for studies needed in placing cestodes in a proper perspective of comparative biochemistry and physiology. The initiation of systematic biochemical investigations might afford a better comprehension of mode of parasitism of this parasite. Since *Ascaridia galli*, a coparasitic nematode, has been comparatively better studied for its biochemical nature, present investigation would be confined to *G. digonopora* only.