Endoparasitic helminths fall into two phyla, Platyhelminthes that comprises the cestodes (tapeworms) and trematodes (flukes), and Nematoda that includes the nematodes (roundworms). Their infestations remain a significant biomedical interest because of their high prevalence, adverse effects on nutritional and immune status to their hosts, involving both the livestock and the human population (Crompton, 1999). These helminths, as a matter of fact, currently infect more than a third of human population — approximately 2 billion people (Colley et al., 2001; WHO, 2004) — and continue to be the most substantial cause of economic losses in livestock industry (Perry and Randolph, 1999; Waller, 2003a,b). Gastrointestinal helminths are also the major factors contributing to the debilitating morbidity and mortality in humans, particularly among rural communities in developing countries where health and sanitation amenities are inadequate (WHO, 1987). Moreover, recent information advocate that helminth infections are attributed to amplification of malaria (Nacher et al., 2002), AIDS and tuberculosis (Fincham et al., 2002).

Sustainable control of the parasites is far from being attained albeit discovery of several potent anthelmintic drugs during the last two decades, and heavy reliance on these pharmaceutical anthelmintics brought forth detrimental consequences ever since. This dilemma is largely due to two major contrasting issues: One is the rapid and inexorable widespread evolution of drug resistance in the parasites all over the world, which is arguably the paramount threat to the global animal industries (Sangster, 1999; Geerts and Gryseels, 2000). In some part of the world, the situation is so
alarming that many farmers are compelled to give up animal farming because of such an insurmountable problem (Van Wyk et al., 1999). Moreover, the medical community is intimidated by the notion that resistance in the most prevalent human schistosome such as *Schistosoma mansoni*, and hookworms like *Necator americanus* and *Ancylostoma duodenale*, may soon develop (Geerts and Gryseels, 2001; Doenhoff et al., 2002). Secondly, there is an increasing trend towards organic farming in which there is prohibition of the prophylactic use of all chemical compounds for their potential ecological adverse effects (Waller, 2003a,b). The synthetic anthelmintics are proven to have deleterious effects on the host physiology and non-target organisms (McKeller, 1997). A significant decrease in different insect populations have been accounted as a consequence of anthelmintic excretion from the treated animals, which in turn adversely influences dung degradation and soil recycling (Lumaret and Errouissi, 2002). Therefore, global appreciation of organic farming largely contributes to the hindrance of further dissemination of chemotherapeutics, and the use of drugs already available in the market has to be optimized. Consequently, a general stagnation in the application and development of conventional chemotherapy has led to an increased vigour for research into alternative therapeutic agents to ameliorate the control of unimpeded helminthiasis.

Other hindering drawbacks also compound the use of synthetic chemotherapy, including their expensive cost and limited supply, particularly in remote areas where parasitic infections are generally more prevalent. For these reasons, a vast majority (70-80%) of the world’s population still resort to traditional medicines for primary healthcare (Farnsworth et al., 1985; Ketcha Wanda et al., 2006). Therefore, considering the inevitable problems, there has been renewed attention on the evaluation of traditional phytotherapeutics, and use of the well established medicines
are strongly advocated (WHO, 2000). Use of traditional anthelmintic plants that is cheap, available, sustainable and environmentally acceptable ostensibly offers a veritable candidate as an alternative to commercial drugs (Didier et al., 1988; Robinson et al., 1990; Hammond et al., 1997; Githiori et al., 2006). Thus, an earnest search for prospective phytomedicines has been considerably accelerated in recent years, reviving and assessing many traditional practices in different parts of the world.

Phytomedicines have been used for ages to treat parasitism and to improve the performance of livestock, and many modern commercial anthelmintics are indeed derived from plants. However, scientific evidence on the anti-parasitic efficacy of most plant products is still limited, regardless of their wide ethnomedicinal usage. Empirical validation of their biological effects is, therefore, essential before their actual implementation as therapeutics. Traditional medicines are generally rich in the usage of a variety of plants as anthelmintics in different parts of the world. Based on these traditional knowledge and practice, a number of plants have been experimentally demonstrated as having powerful deworming properties. Moreover, botanical anthelmintics are by and large recognized as having great advantages because of their low toxicity, higher biodegradability and they are easy to use (Hammond et al., 1997). Efforts have been accelerated towards experimental assessments of these traditional anthelmintics since they offer cost-effective, environmentally acceptable and easily accessible means without apparent shortcomings. But it is imperative that credible scientific evidence is required to be accredited before the actual application of botanical ethnomedicines since a number of plants have been revealed to be without desirable effects on the parasites or to cause undesirable effects on the host.
Of a number of traditionally known medicinal plants among the Mizo tribes of north-east India, practically no scientific investigations have been undertaken to validate the use or claims of these plants. Two leguminous shrubs, *Acacia oxyphylla* Graham ex Bentham, known to the Mizo natives as 'khangngo,' and *Millettia pachycarpa* Bentham, 'Rulei' to the natives, are known to have deworming activities on intestinal parasites. Therefore, it is thought worthwhile to perform pioneering experimental study to ascertain whether or not these two plants possess any vermifugal (deworming) and/or vermicidal (killing) effects on the two most abundant intestinal parasites of fowl, the cestode, *Raillietina echinobothrida* and the nematode, *Ascaridia galli*.

The present investigation of the two plants encompasses fundamental parameters for an *in vitro* assessment of anthelmintic efficacy such as motility and mortality studies, observation on the surface alterations of the body covering and structural changes in the anatomical organization of helminth parasites. A crude alcoholic extract and fractions of the crude extract using different organic solvents were prepared from *A. oxyphylla* stem bark and *M. pachycarpa* root bark. For motility and mortality assays, worms were treated with varying concentrations of the different extracts so that the durability of their physical activity and death were analyzed in comparison with worms treated with standard drugs at similar doses. Changes on the body surface were studied using scanning electron microscopy and those in the internal organs were studied by histology using light microscopy. As a whole, the investigation has been undertaken upon the following objectives:

1. To ascertain the *in vitro* effect of the plant extracts on the motility and survival of commonly found helminthes, such as nematode and cestode.
2. To visualize the alterations on the surface tegument of the parasites.

3. To observe histomorphological and ultrastructural changes induced by the plant extracts in different helminths.

4. To provide plausible clues for a suggestive mode of their action on the parasites based on the aforementioned parameters.
1.2. ENVIRONMENTAL FEATURES OF THE STUDY AREA

Mizoram is the 23rd state of the Indian Union and occupies the remotest part of the north-eastern region of India. It lies between latitude 21° 58' to 24° 34' North and longitude 92° 15' to 93° 25' East, with a total area of 21,081 km² (Fig. 1.1). The state shares national borders with the southern ends of Assam and Manipur, spanning 123 kms and 95 kms, respectively, and north-eastern end of Tripura, extending 66 kms. Majority of its boundary is, however, flanked by Bangladesh on the west and Myanmar on the east and south, stretching 318 kms and 404 kms, respectively; thus, occupying an important strategic position with a long international boundary of 722 kms. The land exhibits a variety of landscape, typically hilly terrains, lined with meandering streams, deep gorges, and lush with natural wealth of flora and fauna. The hills run in ridges from north to south, and the average height of the hills to the west is about 1,000 metres and gradually increases to 1,300 metres to the east.

80% of the total geographical area is covered with forest; out of which 7,909 km² is reserved, 3,568 km² is protected and 5,240 km² is unclassified. Almost all kinds of tropical trees and natural vegetation thrive in Mizoram, but the outstanding group is the bamboos. 30% of the land is covered with wild bamboo forests. In fact, Mizoram harvests 40% of India's 80 million ton annual bamboo production, and remains the unsurpassed revenue of the state.

The region enjoys mild climatic conditions throughout the year. Seasons can be divided broadly into four: summer (March-May), rainy monsoon (June-August), autumn (September-October), and winter (November-February). The average
temperature varies from about 11-26°C in winter to about 15-28°C in summer. During the rainy and autumn months the temperature is usually between 19°C and 25°C. Heavy monsoon rains are more or less evenly distributed throughout the region with an average rainfall of 254 cm per annum.

Aizawl is the capital city and heart of the state, and district centre of the Aizawl district. It occupies the coordinate of 23.73° North and 92.72° East, and situated at an altitude of 3,340 feet above sea level. The Tropic of Cancer runs just south to it. The region is generally cool during the summers with temperatures ranging from 20-30°C and winter temperatures range from 10-20°C. During the last five years the average annual rainfall reached its zenith in 2003 with 281 cm and its nadir in 2005 with 211 cm. The city perches precariously on the steep slopes of a sharp ridge, giving rise to numerous streams in between. Two rivers sandwich the whole area, Tlawng towards the west and Tuirial on the east. Chite, a large stream, also runs on the east, from where the plant materials of the present study were collected. Poultry is by far the most important livestock systems in Mizoram, and the highest production is from Aizawl, as much as 291,856 domestic fowls according to the latest veterinary census of 2003.
Figure 1.1. Geographical location of the study area, Aizawl, Mizoram, from satellite image. Black streaks represent international boundary of India, and blue, interstate boundary of Mizoram.