EPIDEMIOLOGICAL AND CLINICO-THERAPEUTIC STUDIES ON CANINE DEMODICOSIS

THUSHARA. M. R.

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Department of Veterinary Epidemiology and Preventive Medicine
COLLEGE OF VETERINARY AND ANIMAL SCIENCES
MANNUTHY, THRISSUR - 680 651
KERALA, INDIA

DECLARATION

I hereby declare that this thesis entitled **"EPIDEMIOLOGICAL AND CLINICO-THERAPEUTIC STUDIES ON CANINE DEMODICOSIS"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

Mannuthy
3-11-03

THUSHARA. M.R.

CERTIFICATE

Certified that the thesis, entitled **"EPIDEMIOLOGICAL AND CLINICO-THERAPEUTIC STUDIES ON CANINE DEMODICOSIS"** is a record of research work done independently by **Dr. Thushara. M.R.**, under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.

Mannuthy
3-11-03

Dr. P.V. Tresamol
(Chairperson, Advisory Committee)
Assistant Professor
Department of Veterinary
Epidemiology and Preventive Medicine
College of Veterinary and Animal Sciences
Mannuthy

CERTIFICATE

We, the undersigned members of the Advisory Committee of **Dr. Thushara, M.R.,** a candidate for the degree of Master of Veterinary Science in Preventive Medicine, agree that the thesis entitled **"EPIDEMIOLOGICAL AND CLINICO-THERAPEUTIC STUDIES ON CANINE DEMODICOSIS"** may be submitted by Dr. Thushara, M.R., in partial fulfilment of the requirement for the degree.

3/11/03

Dr. P.V. Tresamol
(Chairperson, Advisory Committee)
Assistant Professor
Department of Veterinary Epidemiology and Preventive Medicine
College of Veterinary and Animal Sciences
Mannuthy

3.11.03

Dr. M.R. Saseendranath
Associate Professor and Head
Department of Veterinary
Epidemiology and Preventive Medicine
(Member)

3/11/03

Dr. P.G. Baby
Professor and Head
Department of Clinical Medicine
(Member)

3.11.03

Dr. K. Devada
Assistant Professor (Senior Scale)
Department of Veterinary Parasitology
(Member)

External Examiner 5/11/03

Dr Manica Vasalaa Dandekaran Ph.
Professor & Head,
Dept. Vet. Epidemiology & Preventive Medicine
VCRI., Namakkal.

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Introduction

1. INTRODUCTION

Skin is the largest organ of the body and forms the anatomical and physiological barrier between the animal and environment. It provides protection from the physical, chemical and microbiological injuries and its sensory components perceive heat, cold, pain, pruritus, touch and pressure. Not only is the skin an organ with its own reaction patterns, but it is also a mirror reflecting the *mileu interieur* and at the same time, the capricious world to which it is exposed. The skin, hair and subcutis of a newborn puppy represent 24 per cent of its body weight. By the time of maturity, these structures compose only 12 per cent of the body weight (Muller *et al.*, 1989).

A good number of dogs and cats suffer from various dermatological cases; those due to parasites making up a major share.

Among the skin diseases due to parasites, demodectic mange may pose a diagnostic problem to the practitioner. Unlike in sarcoptic mange, the clinical signs are variable and may produce traps for the unwary; it is a great imitator of other skin diseases (Baker and Thomsett, 1990).

Demodicosis (red mange, follicular mange or acarus mange) is caused by *Demodex canis,* which is located in the hair follicles and sebaceous glands of the skin. Approximately, 30 to 80 per cent of the normal canine population are asymptomatic carriers of the mites. Although the mite is a normal inhabitant of the skin, it should be noted that a few dogs manifest the disease clinically. A hereditary element and presence of certain stress factors predisposing to the development of generalised demodicosis are evident and have been recognised. This implies the importance of understanding the epidemiological factors associated with the disease occurrence.

Canine demodicosis represents a most perplexing treatment problem. Generalised demodicosis is one of the severe skin diseases, which can often be fatal. More than 75 compounds have been tried for the treatment of demodicosis. They include both topical medicaments from ronnel to amitraz and systemic endectocides from ivermectin to the newly emerged avermectin, milbemycin oxime. Since an immunodeficiency is indicated in the pathogenesis of demodicosis, immunostimulation with levamisole in combination with miticides can be tried to minimise the treatment period. Therefore a combination therapy using these agents becomes worthwhile in canine demodicosis. On the basis of above facts it was decided to undertake a study to illustrate the following.

1. Epidemiology of canine demodicosis
2. Comparison of the efficacy of treatments viz.
    - (i) Ivermectin
    - (ii) Amitraz
    - (iii) Ivermectin + amitraz
    - (iv) Ivermectin + amitraz + levamisole
3. Haematological and biochemical changes in the affected animals, as well as the effect of treatments on these parameters.

Review of Literature

2. REVIEW OF LITERATURE

2.1 PREVALENCE

2.1.1 Global

Abu-Samra *et al.* (1981) reported severe canine demodicosis in two male adult dogs for the first time in Sudan.

Santos-Matos *et al.* (1982) reported *Demodex canis* in 87 (29.5 per cent), *Sarcoptes scabei* in five (1.7 per cent) and *Psoroptes* in one (0.3 per cent) from 294 dogs with skin disease in Salvador, Bahia state, Brazil.

Nolte and Ammelounx (1986) diagnosed demodicosis in 206 dogs out of 30, 272 cases examined from Giessen, Germany.

Raczynski (1996) examined skin scrapings from 20 pure bred dogs with skin lesions in Poland and found that nine (45 per cent) of them were positive for *Demodex canis* and three (15 per cent) for *Sarcoptes scabei* var *canis*. The remaining eight (40 per cent) were positive for fungal spores.

Gallupi *et al.* (2001) examined skin scrapings from 1138 dogs in Bologna, Italy and found that *Demodex canis* was the most frequent ectoparasite in dogs (14.3 per cent) followed by *Sarcoptes scabei*.

2.1.2 India

Sharma *et al.* (1991) examined 66 pet dogs presented for treatment at the division of experimental medicine and surgery IVRI, Izatnagar and found that 28, 24 and 14 dogs were infected with *Sarcoptes scabei, Demodex canis* and *Otodectes cyanotis* respectively.

Sarma *et al.* (1992) examined 134 dogs at the veterinary polyclinic, Visakhapatnam during 1986 to1989 with mange infestation and reported that 64,

58 and 16 dogs were positive for *Sarcoptes scabei, Demodex canis* and *Otodectes cyanotis* respectively.

Kamboj *et al.* (1993a) determined that the overall incidence of dermatitis at the Small Animal Clinic of Ludhiana was 17.05 per cent of which 7.27 per cent was contributed by demodicosis.

Neog *et al.* (1995) reported the incidence of mange in dogs in and around Guwahati as 14.85 per cent out of which *Demodex canis* constituted 14.19 per cent and *Sarcoptes scabei* var *canis,* 0.66 per cent.

Nayak *et al.* (1997) studied the case records maintained at various veterinary hospitals in Bhubaneswar from 1987 to 1992 and found that three per cent of the dogs presented were treated for demodicosis. During this five year period, on examination of skin scrapings of 912 dogs with dermatitis in and around Bhubaneswar, 319 (35 per cent) dogs were found positive for *Demodex canis.*

Aujla *et al.* (2000) reported a prevalence of 6.04 per cent for demodicosis in 281 dogs examined at Small Animal Clinic of Punjab Agricultural University, Ludhiana.

Chhabra *et al.* (2000a) found that the overall prevalence of *Sarcoptes scabei* and *Demodex canis* were 19.0 per cent and 5.2 per cent respectively in the veterinary clinic of Punjab Agricultural University, Ludhiana from January 1996 to December 1996.

In a survey of skin diseases in dogs conducted in Western Uttar Pradesh, Dimri and Sharma (2000) observed that skin ailments constituted 16 per cent of the total cases, out of which mange ranked the highest with 6.22 per cent when compared with ring worm (2.75 per cent), pyoderma (1.25 per cent), lice and ticks (5.71 per cent) and other nonspecific skin ailments.

Roy *et al.* (2000) remarked that demodectic mange was a great problem in India, which was often unnoticed and neglected.

Gupta and Prasad (2001) reported demodicosis in 14 (17.72 per cent) cases out of 79 dogs with dermatitis presented at the clinical complex of College of Veterinary and Animal Sciences, Palampur.

Chakrabarti *et al.* (2002) observed that alopecia due to tick infestation (0.92 per cent) predominated demodectic (0.79 per cent) and sarcoptic alopecia (0.79 per cent) among the ectoparasitic cases of alopecia in dogs at Kolkota metropolis during April to September 1996.

Sreedevi *et al.* (2002) reported 5.6 per cent prevalence of demodectic mange and 10.05 per cent prevalence of sarcoptic mange by examining the skin scrapings from 179 dogs suffering from dermatitis presented at the State Institute of Animal health, Tanuku, Andhra Pradesh.

2.1.3 Kerala

Mathews (1999) observed a prevalence of 23.8 per cent of generalised demodicosis and 19.1 per cent of localised demodicosis as the ectoparasitic cases of dermatitis during 1991 to 1995 in dogs presented at the University Veterinary Hospitals, Mannuthy and Kokkalai of the Kerala Agricultural University.

2.2 PREDISPOSING FACTORS

2.2.1 Age

Canine demodicosis was observed as a disease predominantly of young shorthaired dogs by Baker (1968).

Muller and Kirk (1976) opined that localised demodicosis usually occurred in dogs aged three to six months.

According to Thoday (1980) canine demodicosis was seen rarely in adults and usually occurred at 3 to 15 months of age.

Cannon (1983) observed prevalence of *Demodex canis* as 22 percent, 47 per cent, and 31 per cent in dogs below six months of age, 7 to 12 months and above 12 months of age respectively.

Shirk (1983) reported occurrence of canine demodicosis as 21.1 per cent, 47.5 per cent and 31.4 per cent among dogs below six months, 7 to 12 months and above 12 months of age respectively

Folz *et al.* (1984) found 43.6 per cent, 27 per cent and 29.4 per cent prevalence of localised demodicosis among dogs aged 7 to 12 months, six months or less and older than one year respectively. Among those with generalised demodicosis 35.5 per cent were older than one year and 64.5 per cent less than one year.

Grant (1985) stated that juvenile onset demodicosis was the most common form of generalised demodicosis.

According to Reedy (1986) juvenile onset generalised demodicosis was more common which occurred at 3 to 12 months of age.

Moriello (1987) stated that demodicosis was a disease of young dogs and was most commonly seen in dogs less than one year of age.

According to Henfrey (1990) demodicosis was more commonly seen in purebred dogs under the age of 15 months.

A prevalence rate of 20.8 per cent, 45.8 per cent and 33.4 per cent of *Demodex canis* was observed in dogs below six months, above six months and less than one year and above one year of age respectively (Yathiraj *et al.*, 1990).

Sosna and Medleau (1992b) opined that localised form of demodicosis occurred most often in dogs less than one year of age and juvenile onset generalised demodicosis in 3 to 18 months age group.

Kamboj *et al.* (1993a) noted 34.04 per cent prevalence of canine demodicosis among 6 to 12 months of age.

Nayak *et al.* (1997) observed a prevalence of demodicosis as 60 per cent, 23 per cent and 17 per cent in dogs less than one year of age, one to two years and above two years of age respectively.

In a study conducted by Aujla *et al.* (2000) the dogs at 6 to 12 months of age (50 per cent) were most susceptible to demodicosis.

According to Gupta *et al.* (2000), among the dogs with demodicosis 79 per cent were below one year of age.

Shipstone (2000) stated that juvenile onset demodicosis occurred in dogs up to 18 months of age and adult onset generalised demodicosis in dogs older than four years with no previous history of the disease.

Wagner and Wendlberger (2000) examined 22 cases of generalised demodicosis among which 14 were juvenile onset demodicosis and eight, adult onset demodicosis.

Sreedevi *et al.* (2002) noted that demodicosis was more among two to eight months old dogs whereas zero to two months age group was not affected.

2.2.2 Breed

Cannon (1983) found that out of 131 dogs with demodicosis 73 per cent were purebreds of which Dobermans and German shepherds were the most commonly affected.

Shirk (1983) observed 77.62 per cent of the demodicosis cases among purebreds, which included Doberman pinschers (25 per cent) and German shepherds (13 per cent). In the generalised cases 79.1 per cent were purebreds and 20.9 per cent were crossbreds.

Folz *et al.* (1984) observed 75.8 per cent purebreds among the dogs with localised demodicosis and 79.6 per cent among those with generalised demodicosis.

According to Grant (1985) demodicosis occurred at any age, breed or sex but was more common among purebreds like Doberman pinscher, Staffordshire bullterrier, Boxer, Pug and in some long haired breeds like Old English sheep dog, Afghan hound, German shepherd and Collie.

Breeds that were at increased risk for demodicosis included Doberman pinscher, German shepherd, Great dane, Staffordshire bull terrier, Sharpei, Dalmatian, English bull dog, Boston terrier, Boxer, Dachshund, Old English sheep dog and Beagle (Reedy, 1986).

According to Henfrey (1990) breeds which were more susceptible to demodicosis included Afghan hound, American pit bull terrier, Beagle, Boston terrier, Boxer, Chihuahua, Collie, Dachshund, Dalmatian, Doberman, English bull dog, German shepherd, Great dane, Old English sheep dog, Pug, Pointer, Scottish terrier, Sharpei and Staffordshire bull terrier.

Yathiraj *et al.* (1990) recorded that out of 72 cases of demodicosis 60 (83.3 per cent) were purebreds and 12 (16.7 per cent) were nondescript ones. The different breeds involved were German shepherd (29.1 per cent), Doberman pinscher (16.7 per cent), nondescript (15.3 per cent), Spitz (12.5 per cent), Dachshund (6.9 per cent), Cocker spaniel (6.9 per cent), Boxer (4.2 per cent), Terriers (2.8 per cent), Great dane (2.8 per cent), Lhasa-apso (1.4 per cent) and Rajapalayam (1.4 per cent).

Sosna and Medleau (1992b) opined that although demodicosis occurred in many breeds, there appeared to be a familial predisposition to this condition in Afghan hound, Beagle, Boston terrier, Boxer, Chihuahua, Chinese sharpei, Chow chow, Collie, Dalmatian, Dachshund, Doberman pinscher, English bull dog, German shepherd, Great dane, Old English sheep dog, Pointer, Pit bull terrier, Pug and Staffordshire bull terrier breeds.

According to Kamboj *et al.* (1993a) demodicosis was prevalent in 76.06 per cent purebred dogs with 33.33 per cent prevalence in German shepherd.

Nayak *et al.* (1997) found that among the 319 cases screened, the highest involvement (41 per cent) was noted in Tibetan apso followed by Doberman pinscher (26 per cent), Mongrels (17 per cent) and Alsatian (16 per cent).

Aujla *et al.* (2000) obtained higher prevalence in Spitz and Cocker spaniel (33.33 per cent) among the purebreds.

2.2.3 Sex

Folz *et al.* (1984) observed that out of the 252 cases of localised demodicosis, 138 (54.8 per cent) were females and 114 (45.2 per cent) were males. Of the females, 76.8 per cent and of the males 94.7 per cent were intact. Among 569 dogs with generalised demodicosis, the prevalence in males was 49.0 per cent and females, 51.0 per cent and among the females, 218 (75.2 per cent) were intact and 72 (24.8 per cent) neutered. Of the males 272 (97.5 per cent) were intact and 7 (2.5 per cent) neutered.

It is learnt that bitches were predisposed to demodicosis after oestrus, pregnancy or whelping and that neutering prevented reexacerbration within individuals (Moriello, 1987).

John and Nedunchelliyan (1989) reported that out of the 15 dogs presented with demodicosis, 12 were males and three females.

According to Henfrey (1990) the disease showed no sex predisposition but oestrus in bitches precipitated the clinical disease.

Sosna and Medleau (1992b) opined that adult onset demodicosis showed no sex or breed predisposition.

Ristic *et al.* (1995) reported that out of the 12 dogs with generalised demodicosis, four were sexually intact females, five spayed bitches and three sexually intact males.

Nayak *et al.* (1997) examined the skin scrapings of dogs with dermatitis and found that the prevalence of canine demodicosis in males and females were 49 per cent and 51 per cent respectively.

Aujla *et al.* (2000) concluded that male dogs (70 per cent) were more susceptible to demodicosis when compared with bitches (30 per cent).

Gupta *et al.* (2000) found that among the dogs with demodicosis, 64.29 per cent were females.

2.2.4 Season

Misra *et al.* (1974) observed that the prevalence of *Demodex canis* and *Sarcoptes scabei* was 32 per cent and 68 per cent respectively in the winter season among winter born puppies.

Neog *et al.* (1995) found the highest prevalence of mange (22 per cent) including *Demodex canis* and *Sarcoptes scabei* var *canis* in the post monsoon (October and November).

Aujla *et al.* (2000) observed highest incidence of demodicosis in the month of March followed by November.

According to Dimri and Sharma (2000), the highest prevalence of skin infections in dogs was in September (22.8 per cent) followed by August (19.6 per cent) and October (19.4 per cent).

Sreedevi *et al.* (2002) reported that demodicosis occurred more during the rainy season (6.89 per cent), followed by winter (6.0 per cent) and summer (4.22 per cent).

2.2.5 Others

Greve and Gaafar (1964) reported that hypothyroidism had no effect on the host parasite relationships in dogs.

In an experimental study, Folz *et al.* (1978) observed that dogs stressed by intermittent crowding after being exposed to severely parasitised mongrels, developed generalised form of the disease.

Moriello (1987) stated that there has a clearly recognised hereditary predisposition for the development of generalised demodicosis with certain breeds of purebred dogs seeming to have higher predisposition. The disease was often seen among littermates and particular matings consistently produced affected dogs. Parasitic infestations especially heartworm and hookworm exacerbated the disease.

Adult onset generalised demodicosis might be due to an underlying disease such as heartworm disease, intestinal parasitism, hyperadrenocorticism, immunodeficiency, hypothyroidism, diabetes mellitus, or neoplasia. Unlike juvenile onset demodicosis, familial or breed predisposition has not been reported (Sosna and Medleau, 1992b; Shaw and Foster, 2000).

Duclos *et al.* (1994) reviewed the medical records of 41 dogs with adult onset generalised demodicosis presented between 1979 and 1990 and found that out of 41 dogs, eight had hyperadrenocorticism, five were suspected or confirmed to have hypothyroidism, 10 had allergic disease and had been treated with

corticosteroids and six were receiving chemotherapy, because of a neoplastic or immune mediated condition. In the remaining 12, a concurrent underlying condition was not identified.

Medleau and Willemse (1995) observed that out of the 22 cases of adult onset demodicosis, one was hypothyroid, one had iatrogenic hyperadrenocorticism, and one was both hypothyroid and iatrogenically cushingoid.

Burrows (2000) stated that concurrent bacterial pyoderma was present in most cases of canine generalised demodicosis, which contributed to immunosuppression.

2.3 TRANSMISSION

Greve and Gaafar (1966) found that pups born naturally from bitches with or without clinical evidence of demodicosis and kept with them harboured mites while caesarean derived pups were not harbouring the mites indicating that natural transmission of *Demodex canis* occurred neonatally by contact with the bitch.

Baker (1968) detected that mites were attracted to the warmer skin of the newborn puppies from the infected dam and penetrated those parts of the skin, in intimate contact with the dam viz., muzzle, forehead and limbs.

According to Nutting (1976) who studied the biology of demodectic mites noted that they were slow moving, prone to desiccation and hence required extended contact period for transfer. Once aboard the host, they survived on renewable resources such as yield of cells or glandular products.

Demodex canis, a normal inhabitant of hair follicles in most dogs was believed to be transmitted to nursing pups from their dams during the first two or three days of life. (Reedy, 1986; Henfrey, 1990; Sosna and Medleau, 1992a).

2.4 PATHOGENESIS

Gaafar *et al.* (1958) found that 5.4 per cent of 93 specimens taken from healthy dogs harboured demodectic mites indicating that follicular mange was a complex condition precipitated by many factors.

According to Baker (1968) mites caused follicular rupture giving access to the pathogenic coagulase positive staphylococci, normally found on the dog's skin.

Hirsh *et al.* (1975) found that dogs destined to become affected in a generalised manner contained higher concentrations of a serum factor that suppressed lymphocytoblastogenesis.

Samad and Bhave (1980) could not detect *Demodex* or *Demodex* like mites on examining eyelids from 50 healthy dogs.

According to Reedy (1986) an inherited immunological defect believed to be T-cell mediated allowed the mites to multiply abnormally and to extend to the dermis to induce foreign body reaction with further immunosuppression.

Henfrey (1990) quoted that demodicid mites generated a humoral substance, which caused generalised T-lymphocyte suppression, which further spread the mites and secondary bacterial infection.

Barriga *et al.* (1992) concluded that immunosuppression followed rather than preceded the clinical manifestation of generalised demodicosis.

Immunosuppression due to an inherent immune system defect, immunosuppressive therapy or underlying immunosuppressive process might allow the mites to proliferate uncontrollably within the hair follicles leading to subsequent rupture, alopecia, secondary pyoderma, erythema and some times pruritus (Sosna and Medleau, 1992a).

Caswell *et al.* (1997) found that the clinical severity of infection reflected the intensity of the host inflammatory or immune response rather than being the direct effect of *Demodex* mites or their secretion. The immunohistochemical findings indicated that cells infiltrating the follicular epithelium are CD3+ CD8+ T-cells, which induced apoptosis on target cells.

Toman *et al.* (1997) examined the activity of immune system in 66 dogs with pyoderma and demodicosis and diagnosed immunosuppression in 17 cases. Of these 13 dogs had deep pyoderma and four had superficial pyoderma. It was concluded that pyoderma was associated with immunosuppression more frequently than with demodicosis.

Aujla *et al.* (2000) said that the fragments of extra follicular mites as well as secondary bacterial infection might induce the presence of pyogranulomas in the vicinity of hair follicles and dermal glands.

2.5 CLINICAL SIGNS

Folz *et al.* (1983) described two distinct forms of demodicosis, localised form which was a mild and less severe disease appearing as small patches of partial alopecia and mild erythema, on the facial region, and generalised form which was the most severe skin disease of dogs characterised by erythema, oedema, alopecia, seborrhoea, pyoderma and pruritus, which occurred on the face, trunks and legs of the animal and could be fatal.

Folz *et al.* (1984) observed lymphadenopathy in 19.1 per cent of the localised and 51.8 per cent of the generalised demodicosis cases.

Localised demodicosis was rarely pruritic, but the generalised condition was severely pruritic when associated with secondary pyoderma (Grant, 1987; Medleau, 1990).

Henfrey (1990) opined that the most susceptible site of infection was the head especially around the eyes, mouth and anterior aspect of the forelegs.

Lymphadenopathy was also common and in severe cases, lethargy and inappetence with resultant death. Demodicosis was known to cause interdigital pruritus.

Yathiraj *et al.* (1990) observed that out of a total of 72 cases presented, 59.7 per cent had dry type of lesions, 40.3 per cent had suppurative lesions and generalised demodicosis was observed in 62.5 per cent of the cases.

There were three primary forms of demodicosis, localised disease, generalised disease and pododemodicosis. Localised form occurred most often in dogs less than one year of age with lesions on muzzle, periocular skin, commissures of the mouth, head, pinnae, forelimbs, trunk and most cases resolved spontaneously in four to eight weeks. The condition was not pruritic unless secondary pyoderma was present. There were two categories of generalised demodicosis, juvenile onset, affecting dogs of 3 to 18 months of age and adult onset demodicosis in dogs older than 12 months in smaller breeds and 18 months in larger ones. Signs included erythema and scaling together with secondary pyoderma, pruritus and peripheral lymphadenopathy. Pododemodicosis affected the feet with or without lesions elsewhere on the body and with or without generalised demodicosis. On presentation feet were swollen, erythematous and painful (Sosna and Medleau, 1992b).

Das *et al.* (1995) described squamous and pustular form of demodicosis. Squamous form was characterised by wrinkled skin on the forefeet, around the muzzle and eyes with loss of hair and thickening. The pustular form was generalised and consisted numerous rounded nodules 4 to 8 mm in diameter filled with inspissated pus like material containing large number of mites and their developmental stages.

The affected pups showed signs of patchy alopecia, erythematous plaque development, pustules, thickening of the skin, hyperpigmentation and scales on

the skin. Pruritus was rare and in some cases pyoderma was observed (Bhosale *et al.*, 2000b).

Gupta and Prasad (2001) found that chief lesions in demodicosis were alopecia and erythema (100 per cent), followed by papules (85.7 per cent) and macula (71.43 per cent), mainly affecting the face and labial commissures (78.57 per cent), periorbital area (71.43 per cent) and head (57.14 per cent).

2.6 CLINICAL PATHOLOGY

2.6.1 Haematological Parameters

Pathak and Bhatia (1986) reported decrease in haemoglobin, packed cell volume, TEC and MCH and leucocytosis indicating normocytic hypochromic anaemia in a dog with generalised demodicosis.

In a treatment trial of canine demodicosis, Roy *et al.* (1991) reported that the values of TEC, TLC, haemoglobin and PCV gradually increased in the groups treated with ivermectin at 400 mcg per kg or 600 mcg per kg subcutaneously at weekly intervals compared with untreated control group.

Bhosale *et al.* (2000b) obtained lower TEC and TLC values and higher eosinophil and monocyte counts in dogs with demodicosis.

A slight leucopaenia and lymphopaenia was noticed in *Demodex* infested dogs but no significant differences were noticed, after treatment with moxidectin or ivermectin (Chhabra *et al.*, 2000b).

Deb *et al.* (2000) noted that haemoglobin decreased during the infection period in pups experimentally infested with *Demodex canis*.

Dimri *et al.* (2000) reported reduced haemoglobin, TEC and PCV and increased TLC in *Demodex* infested dogs and pointed out a positive effect of ivermectin (0.4 mg per kg subcutaneously twice at 10 day intervals) in reversing these parameters towards the control group values.

Haematological examination of five dogs with demodicosis revealed low haemoglobin and PCV, leucocytosis and neutrophilia (Wadhwa *et al.*, 2002).

2.6.2 Biochemical Parameters

2.6.2.1 Serum Protein

Chakrabarti *et al.* (1978) reported elevation of both beta and gamma globulin values in dogs with chronic demodicosis.

Hypoproteinemia, hypoalbuminemia, hyperglobulinemia and decrease in albumin globulin ratio was observed in demodicosis whereas AST activity remained unchanged (Pathak and Bhatia, 1986).

Reddy *et al.* (1992) reported that the total proteins were within the normal range in 90 per cent of dogs with localised demodicosis and slightly higher levels of total protein were noticed in five out of the 10 generalised demodicosis cases. Albumin was significantly reduced in localised and generalised demodicosis with significant elevation of total globulins.

Aujla *et al.* (1998) reported significant increase in total protein and circulating immune complexes in sarcoptic and demodectic dermatitis.

According to Chhabra *et al.* (2000b) variations in biochemical profile of *Demodex* infested dogs were insignificant, however treatment with either ivermectin or moxidectin caused elevation of GOT, ALP, arginase and total serum protein.

2.7 DIAGNOSIS

Nutting and Desch (1978) summarised the morphological characters of *Demodex canis* as a medium sized member of the genus, the longest adult specimen being female which measured 246 µm. Male measured 167.8 µm. Four pairs of legs were evenly spaced along the podosoma; ovum, spindle shaped 81.5

µm long and 26.6 µm wide; larva, fusiform 91.0 µm long and 27.2 µm wide with three short pairs of legs projecting laterally from the body wall; protonymph, 130.7 µm long and 29.2 µm wide, with three pairs of legs; nymph, 201.2 µm long and 33 µm wide with four pairs of legs.

According to Thoday (1980) a single mite was sufficient to diagnose the disease in presence of lesions suggestive of demodicosis.

Reedy (1986) opined that the diagnosis of demodicosis was done by finding numerous *Demodex canis* (adult, larvae, nymph or eggs) in the skin scrapings and that finding only a few mites in numerous skin scrapings was normal and could not be regarded as clinically significant.

Moriello (1987) suggested that active waving of mite's legs and movement of the head were helpful in identifying the live ones and that recording representative live to dead mite ratio and numbers of adult, larvae and eggs were useful in studying the progression of disease.

According to Henfrey (1990), a good scraping technique was essential to establish the diagnosis and the skin biopsy could be necessary in extreme thickening of the skin, as observed in pododemodicosis and in Chinese sharpei dogs.

A short form of *Demodex spp.* varying from 90 µm to 148 µm in size from six dogs of age ranging from 13 months to 11 years six months with lesions of demodicosis was observed (Chesney, 1999).

Saridomichelakis *et al.* (1999) observed large number of short tailed demodectic mites with measurements of body ranging from 0.165± 0.019 mm and abdomen 0.08 ± 0.018 mm along with *Demodex canis* in the superficial skin scrapings from two dogs with adult onset demodicosis.

Lewis (2003) enumerated the list of differential diagnosis for canine demodicosis which included colour dilute alopecia, alopecia areata, sebaceous

adenitis, deep or superficial pyoderma, injection site reaction, deep mycotic infection, cutaneous T-cell lymphoma, pemphigus foliaceus, drug eruption, zinc responsive dermatosis, dermatophytosis, *Malassezia* dermatitis and endocrine disorders.

2.8 TREATMENT

2.8.1 Ivermectin

Henfrey (1990) discouraged the increasingly widespread use of ivermectin to treat canine demodicosis since the agent appeared to have no effect on demodicids and also due to the legal difficulties in the usage of an unlicensed product.

Blakley and Rousseaux (1991) demonstrated the immunostimulatory properties of ivermectin at 0.2 mg per kg or higher dose on T- helper lymphocyte response in mice.

Roy *et al.* (1991) compared the efficacy of ivermectin at 400 mcg per kg and 600 mcg per kg weekly as subcutaneous injections, on dogs naturally infested with demodicosis and found that 400 mcg per kg dose rate was as good as 600 mcg per kg in clearing the infection by day 35.

Yathiraj *et al.* (1991) studied the efficacy of ivermectin at 400 mcg per kg body weight given as subcutaneous injections at 14 day intervals and reported that though all the localised cases responded well after three injections, 28.57 per cent of the recovered cases were presented to the clinics with generalised demodicosis two to three months later. In generalised demodicosis 53.85 per cent had clinical recovery after three to five injections while the remaining cases did not respond even after five injections.

Dogs with localised demodicosis and generalised demodicosis were treated with ivermectin at 0.2 mg per kg and 0.4 mg per kg as subcutaneous

injections at 14 day intervals and it was found that both the dose rates were equally effective in clearing the mites by day 42 in localised demodicosis and by day 56 in generalised demodicosis (Sarma *et al.*, 1992).

Sosna and Medleau (1992c) opined that ivermectin was ineffective against *Demodex spp.* when administered on a weekly basis although it was effective against many ectoparasites.

Saseendranath *et al.* (1993) treated a case of demodicosis in an Alsatian dog with ivermectin at 200 mcg per kg subcutaneously twice at monthly intervals along with supportive vitamins and calcium.

Medleau (1994) quoted that ivermectin at 0.6 mg per kg orally daily upto four weeks after recovery was effective in the treatment of chronic canine demodicosis that was refractory to topical amitraz therapy.

Charach (1995) remarked that ivermectin had immunomodulatory effects and probably an anti-inflammatory action that reflected in dogs and acted better prior to elimination of mites.

Ivermectin administered at 0.6 mg per kg orally daily cured 10 out of 12 cases, which were refractory to biweekly or weekly 0.025 per cent topical amitraz therapy with a mean treatment duration of 10 weeks (Ristic *et al.*, 1995).

Vishwakarma *et al.* (1996) reported cent per cent success in treating demodicosis and scabies with ivermectin at 250 mcg per kg subcutaneously at weekly intervals with one to three injections.

Prasad *et al.* (1999) tried benzyl benzoate topically (25 per cent emulsion daily), amitraz topically (250 ppm at weekly intervals) and ivermectin (400 mcg per kg body weight subcutaneously at weekly intervals) for treating canine demodicosis and obtained a cure rate of 85.71 per cent with amitraz and 80 per cent with ivermectin while benzyl benzoate was found to be ineffective.

Dimri *et al.* (2000) reported the successful treatment of canine demodicosis with ivermectin at 400 mcg per kg body weight subcutaneously twice at 10 day intervals in 21 days.

In a study to compare the efficacy of amitraz (300 ppm, weekly intervals five times), deltamethrin (50 ppm weekly intervals, five times) and ivermectin (0.2 mg per kg, subcutaneously, weekly intervals, five weeks) in the treatment of pups experimentally infected with *Demodex canis*, Nayak *et al.* (2000) obtained a clinical cure of cent per cent, 99.33 per cent and 74.03 per cent with amitraz, deltamethrin and ivermectin respectively. Mites were not present in cent per cent, 83 per cent and 50 per cent of the pups treated with these drugs in the same order.

Chhabra *et al.* (2001) found that ivermectin and moxidectin at 200 mcg per kg, weekly (four and six times) and fortnightly (four times) cured localised demodicosis completely but neither of these drugs were effective in generalised demodicosis.

Doramectin at 200 mcg per kg body weight subcutaneously at weekly intervals was found to be cent per cent effective in curing demodicosis with two to three doses as against 77.77 per cent efficacy of ivermectin (Gupta and Prasad, 2001).

Prapasarakul *et al.* (2001) reported cent per cent efficacy of ivermectin injectable formulation (IVOMEC) in curing generalised as well as localised demodicosis when given orally daily at 0.6 mg per kg body weight with a mean treatment duration of five to nine weeks.

In a comparative study of various doses of ivermectin in 35 dogs with generalised demodicosis at 200 mcg per kg, 250 mcg per kg, 333 mcg per kg, 500 mcg per kg, 600 mcg per kg, 700 mcg per kg and 800 mcg per kg subcutaneously at weekly intervals, cent per cent efficacy was recorded with 800 mcg per kg

without any adverse reactions or recurrence and at 200 mcg per kg and 250 mcg per kg, there was not much clinical improvement (Sarma and Sharma, 2002).

2.8.2 Amitraz

Folz *et al.* (1978) evaluated the effect of amitraz in dogs with demodicosis and scabies and found that single dermal treatment with amitraz on all concentrations (2000, 1000, 500, 250 and 125 ppm) indicated activity against both *Demodex canis* and *Sarcoptes scabei*. A single treatment with 250 ppm concentration of active drug was comparable to the multiple applications of standard treatment with ronnel.

Farmer and Seawright (1980) studied the efficacy of amitraz in nine dogs with localised (five) and generalised (four) demodicosis of which three treated with ronnel did not respond. It was concluded that weekly vigorous topical application for atleast eight weeks of a 0.05 per cent aqueous suspension of amitraz was ideal for treating demodectic mange infections.

Cannon (1983) treated 131 cases of demodicosis with amitraz (10.6 ml of a 19.9 per cent Mitaban diluted in two gallon water) and obtained 99 per cent clinical improvement in all cases with 98 per cent of the dogs returning to normal condition after a treatment series consisting of 3 to12 treatments. The remaining two per cent responded to a second treatment series. Supportive antimicrobial therapy was given in severe cases of pyoderma.

Folz *et al.* (1983) evaluated the efficacy and safety of single and multiple topical treatments of 250 ppm solution of amitraz on 52 dogs with generalised demodicosis. They found that a single topical treatment did not significantly reduce the incidence of mites but resulted in significant clinical improvement. Multiple treatment trials at 14 day intervals were shown to be effective with a mean rate of improvement of 99 per cent, by four treatments. Three to six treatments cleared 96.2 per cent of the dogs with demodicosis.

Shirk (1983) treated 299 demodectic dogs with amitraz (Mitaban 19.9 per cent, 10.6 ml per two gallons water) at 14 day interval and obtained a clinical improvement of 93.6 per cent after one treatment series consisting three to six treatments. An average of 4.5 topical applications were required to bring 91.9 per cent of the generalised cases to clinical normalcy.

Amitraz, 250 ppm of the active drug as topical application was used to treat 252 dogs with localised demodicosis and 569 with generalised lesions at 14 day interval. Dogs with localised demodicosis showed a mean clinical improvement of 93.3 per cent, and the mites were cleared after three to six treatments. Six dogs (2.4 per cent) did not show any clinical improvement. More than six treatments were required in 9.7 per cent of the cases, 99.2 per cent of the localised demodicosis returned to clinical normalcy after 3 to18 treatments. In dogs with generalised demodicosis, the mean clinical improvement was 92.1 per cent after six treatments. Mites were cleared in 80 per cent of the dogs after three to six treatments. Twenty per cent of the dogs required more than six treatments, 16.5 per cent required 7 to12 treatments and 3.5 per cent required more than 12 treatments. Even after 18 treatments 0.9 per cent were found to retain mite populations (Folz *et al.*, 1984)

Folz *et al.* (1985) compared the efficacy of amitraz (250 ppm) alone and in combination with a detergent at 14 day interval on 30 dogs with generalised demodicosis. They reported that the combination did not significantly alter the safety or efficacy of the treatment although the addition of the nonionic detergent to the liquid concentrate formulation water mixture grossly enhanced the wetting characteristics of the medication.

Reedy (1986) opined that the treatment of choice for generalised demodicosis was amitraz, which is a formamidine pesticide with pharmacological activities including monoamine oxidase inhibition, α-adrenergic antagonism and prostaglandin synthesis inhibition.

Amitraz (0.0125 per cent) solution applied weekly five times, successfully cured cats with generalised demodicosis (Cowan and Campbell, 1988; Yathiraj *et al.*, 1994).

John and Nedunchelliyan (1989) found that the topical application of 250 ppm solution of amitraz at weekly intervals cured 80 per cent of the dogs with generalised demodicosis and cent per cent of the dogs with localised demodicosis 50 days after the application.

Medleau (1990) advised the application of two to three drops of amitraz in mineral oil (1:9) daily for demodectic otitis until the ear swabs were negative.

In a treatment trial on dogs with localised demodicosis (27) and generalised demodicosis (45) with 250 ppm amitraz at weekly intervals, Yathiraj *et al.* (1990) found that 92.6 per cent of the localised cases responded very well and returned to clinical normalcy after five treatments. Remaining two dogs (7.4 per cent) required eight applications. Six treatments cleared 86.7 per cent of the generalised cases, but 8.9 per cent required 10 treatments whereas 4.4 per cent did not become normal even after 10 treatments.

Tikaram *et al.* (1991) treated nine Doberman pinschers affected with generalised demodicosis with biweekly application of amitraz (0.05 per cent solution) and found that all the nine dogs showed clinical improvement after two applications and five of the eight dogs (one dog was euthanised due to unrelated cause) eliminated the mites after two applications.

A therapeutic response of 86.67 per cent was obtained in dogs with demodicosis when treated with a topical application of 6 ml Ectodex (amitraz five per cent) diluted in one litre water once daily for 15 days (Murthy and Rao, 1992).

Roy *et al.* (1992) assessed the efficacy of amitraz (Ectodex - amitraz, five per cent; 6 ml per litre of water) topically weekly on dogs with localised (eight)

and generalised (five) demodicosis and found that six dogs with localised lesions cured after third application and remaining two after six applications, whereas four out of the five generalised cases required eight applications while reinfection was observed in one dog.

Kamboj *et al.* (1993b) reported that three applications of amitraz (0.05 per cent) at weekly intervals cured 93.33 per cent of the localised cases and seven applications cured 90.47 per cent of the generalised cases.

Murthi *et al.* (1993) reported a cure rate of 86.66 per cent with amitraz (Ectodex five per cent, 6 ml per litre of water, once daily for 15 days) against 80 per cent in dogs treated with ivermectin (200 mcg per kg subcutaneously, weekly intervals) with two injections.

A success rate of 61 per cent was observed in 50 dogs with generalised demodicosis with daily application of 0.125 per cent amitraz solution over half of the body and the next half on the next day. The median treatment duration was 6.5 weeks (Medleau and Willemse, 1995).

Naresh *et al.* (2002) observed that benzoyl peroxide as a follicular flushing agent increased the efficacy of amitraz treatment in a case of pododemodicosis.

2.8.3 Levamisole

Levamisole modulates the immune system by modifying the activities of T-lymphocytes stimulating cell mediated immune reactivity and potentiating the rate of T-lymphocyte differentiation, responsiveness to antigens and mitogens. Approximately one fourth to one third of the anthelmintic dose should be used for immunostimulation (Roberson, 1982).

Reedy (1986) suggested that though demodicosis did not appear to respond to immunostimulants (staphylococcal vaccines or levamisole), recurring concurrent pyoderma often may be reduced by such therapy.

Henfrey (1990) opined that although an immunodeficiency was indicated in the pathogenesis of demodicosis, immunostimulation with levamisole was not effective.

Mojzisova *et al.* (1997) treated four generalised demodicosis cases with amitraz four times at two week intervals and nine dogs with both amitraz topically at two week intervals and levamisole orally at 3.5 mg per kg body weight at two day intervals and found that neutrophil phagocytosis and functional activity of lymphocytes improved earlier, in dogs treated with amitraz and levamisole.

2.8.4 Combination Therapy

Medleau and Ristic (1994) reported a case of generalised demodicosis complicated with pododemodicosis which was cured with 0.125 per cent amitraz solution applied daily to half of its body, alternating half treated next day and sulphadiazine and trimethoprim for eight weeks. Pedal lesions were then cured with a daily oral ivermectin, 0.6 mg per kg for six weeks after stopping amitraz therapy.

Soni *et al.* (1999) compared the efficacy of treatments (1) ivermectin (0.2 mg per kg subcutaneously once a week for four weeks), (2) amitraz (Ectodex, five per cent), 6 ml per litre topically once a week for four weeks) (3) benzyl benzoate (25 per cent topically once daily for four weeks), (4) combination of ivermectin and amitraz (5) combination of ivermectin and benzyl benzoate at the same dose rates to find that none of the individual agents tested were cent per cent successful against *Demodex canis*, while the combination of ivermectin + amitraz and ivermectin + benzyl benzoate exhibited cent per cent efficacy on day 30.

Bhosale *et al.* (2000a) reported maximum cure rate with topical application of amitraz (Ectodex, five per cent, 6 ml per litre) in combination with

levamisole (2.5 mg per kg) orally both at weekly intervals against ivermectin and amitraz singly or with a combination of ivermectin and levamisole

Uysal (2001) obtained a cure rate of cent per cent in dogs with demodicosis treated with ivermectin at 0.4 mg per kg weekly subcutaneously for three weeks and amitraz applied topically at three day intervals.

2.9 CONTROL

Nutting (1976) opined that the best hope for control was in providing measures to break the transference cycle such as avoidance of introduction of overt cases to resident population, isolation of animals with signs of demodectic infestation, mechanical rupture of purulent nodular lesions, treatment with an acaricide, selection of a breeding group of caesarean hand reared young to provide mite free population and selection of best strains which are resistant to overt manifestation of the disease.

The American Academy of Veterinary Dermatology had passed a resolution that all dogs with generalised demodicosis should be neutered. Breeders should be encouraged to remove sire, dam and all littermates from breeding programme (Moriello, 1987).

According to Henfrey (1990) breeders should be advised not to breed the animals with generalised demodicosis or which had produced puppies having the disease.

Sosna and Medleau (1992c) recommended monthly or bimonthly maintenance treatments throughout animal's lifetime to prevent recurring of juvenile onset generalised demodicosis and in adult onset demodicosis, successfully treated patients should never again receive systemic corticosteroid therapy since relapse may occur.

Materials and Methods

3. MATERIALS AND METHODS

The study was carried out in the Department of Veterinary Epidemiology and Preventive Medicine of College of Veterinary and Animal Sciences, Mannuthy during May 2002 to April 2003.

3.1 MATERIALS

3.1.1 Glasswares and Chemicals

In this study Borosil brand of glasswares, Laxbro Plastics and analytical or guaranteed reagent grade chemicals were used. The materials were sterilised either in hot air oven or autoclave, depending upon the materials to be sterilised.

3.1.2 Sources of Clinical Cases

Dogs with dermatological problems presented at the University Veterinary Hospitals, Mannuthy and Kokkalai during May 2002 to April 2003 formed the materials of study. The study was conducted in dogs with symptoms suggestive of demodicosis. A complete dermatological history followed by detailed clinical examination of each case was carried out as per the proforma given in Appendix - I, which was modified from Muller *et al.* (1989).

3.1.3 Collection of Skin Scrapings

Skin scrapings were collected from dogs with lesions suggestive of demodicosis and were subjected to parasitological examination.

3.1.4 Collection of Blood for Haematological and Biochemical Examination

Seven millilitres of blood was collected from dogs positive for demodicosis, before and after the treatment trials and also from six apparently

healthy control dogs. Blood for haematological examination was collected in EDTA vials.

3.1.5 Haematological Examination

3.1.5.1 Haemoglobin

Sahli's haemoglobinometer

O.IN hydrochloric acid.

3.1.5.2 Packed Cell Volume (Wintrobe Method)

Wintrobe's haematocrit tube

2 ml. syringe with long needle

Centrifuge with 3000-rpm capacity

3.1.5.3 Total Leucocyte Count

Haemocytometer

Microscope

W.B.C. diluting fluid (Thomas' fluid)

3.1.5.4 Differential Leucocyte Count

Wright's stain

Microscope

Immersion oil

3.1.6 Biochemical Examination

Total protein and albumin kits from Merck Diagnostics

3.1.7 Therapeutic Agents Used in the Treatment Trial

Inj. Ivermectin[1]

Inj. Levamisole[2]

Amitraz[3]

3.2. METHODS

3.2.1 Collection of Skin Scrapings

Area of active lesion with erythema and pustules were selected and the hair covered areas were carefully clipped. A drop of glycerin was added to facilitate scraping. The area to be scraped was then squeezed between two fingers to express the mites from hair follicles and scraped with a 10 #scalpel blade held at right angles to the skin and scraped until capillary bleeding occurred.

3.2.2 Examination of Skin Scrapings

3.2.2.1 Direct Method

The skin scraping material was transferred to a microscopic slide and two to three drops of 10 per cent potassium hydroxide (KOH) was added. Applied a coverslip and examined under low power to observe the mites. Demodecid mites were identified as per Nutting and Desch (1978).

3.2.2.2 Concentration Method

The skin scrapings were transferred to a test tube to which 10 ml of 10 per cent KOH was added and heated to boiling. Centrifuged at 3000-rpm for 10 min

[1] IVECTIN 1%w/v Indian Immunologicals Ltd.
[2] Inj.HELMONIL-C1.5%w/v Alved Pharma&Food Pvt.Ltd.
[3] TAKTIC 5%-Intervet Pvt.Ltd.

and the sediment obtained was examined microscopically to observe the mites (Modified from Bowman and Lynn, 1995).

3.2.3 Extraction of Serum for Biochemical Examination

Five millilitre of blood was collected directly into borosil glass test tubes (boiled and washed with deionised double distilled water and dried in hot air oven). The tubes were kept in slanting position at room temperature and then clotted blood was kept in a refrigerator at 4°C for 30 minutes for separating the serum. The separated serum after slow centrifugation at 3000 rpm was transferred to polypropylene serum vials (washed with deionised double distilled water and dried in hot air oven) and stored at - 20°C. Disposable clean plastic micropipette tips were used to draw the serum from vials for various biochemical examinations.

3.2.4 Haematological Examination

3.2.4.1 Haemoglobin

Haemoglobin content was determined by acid haematin method using Sahli's haemoglobinometer (Benjamin, 1985).

3.2.4.2 Packed Cell Volume (PCV)

Packed cell volume was estimated as per the method described by Wintrobe *et al.* (1981).

3.2.4.3 Total Leucocyte Count (TLC)

Total leucocyte count was determined as per the method by Benjamin (1985).

3.2.4.4 Differential Leucocyte Count (DLC)

Differential leucocyte count (DLC) was carried out as per the method by Meinkoth and Clinkenbeard (2000).

3.2.4.5 Absolute Leucocyte Count

The absolute value for each type of leucocyte was obtained by multiplying the per cent of each type by the total leucocyte count (Benjamin, 1985).

3.2.5 Biochemical Examination

3.2.5.1 Serum Total Protein

The total protein concentration of the serum was determined colourimetrically by direct Biuret method (Gormall *et al.*, 1949). The reagents and standards were supplied by Merck Diagnostics. Values expressed as grams per decilitre.

3.2.5.2 Albumin

Albumin concentration of the samples were determined by Bromocresol green method (Doumas *et al.*, 1971) using the kit from Merck Diagnostics. Values expressed as grams per decilitre.

3.2.5.3 Globulin

Globulin concentrations were derived from the known total protein and albumin values and expressed as grams per deciliter (Benjamin, 1985).

3.2.5.4 Albumin Globulin Ratio

A: G ratio was calculated

3.2.6 Treatment Study

For treatment trial 24 positive cases of demodicosis were randomly grouped into four, each comprising of a minimum of six cases. The treatment was given as per the following table.

Group	Drug	Dose	Route of administration	Treatment interval	No.of animals treated.
I	Inj. Ivermectin	200mcg/kg	S/C	14 days	6
II	Amitraz	0.05%	Topical	7 days	6
III	Inj.Ivermectin + Amitraz	200mcg/kg 0.05%	S/C Topical	14 days 7 days	6
IV	Inj. Ivermectin + Amitraz Inj.Levamisole	200mcg/kg 0.05% 2.5mg/kg	S/C Topical S/C	14 days 7 days 7 days	6

3.2.6.1 Topical Application

Before application of amitraz, the hairs at the lesion site were closely clipped for easy removal of the crusts and scabs. Amitraz liquid concentrate (Taktic-five per cent) was diluted to a therapeutic concentration of 0.05 per cent

by mixing 10 ml of the liquid concentrate in one litre water. The entire body surface of the dog was completely and thoroughly wetted with amitraz solution and allowed to air dry.

Treatment trials were undertaken for a period of minimum eight weeks irrespective of the prognosis or until the skin scrapings were negative.

3.2.7 Assessment of Efficacy of the Treatments

3.2.7.1 Clinical Response to Treatment.

Clinical response to treatment was assessed based on the clinical examination.

3.2.7.2 Examination of Skin Scrapings

The skin scrapings of all the dogs in the treatment groups were examined for the presence of mites at weekly intervals until two consecutive negative results were obtained and the treatment was then considered successful.

3.2.7.3 Determination of Demodicosis Index

The degree of severity of the infection was measured quantitatively in individual dogs of all the treatment groups. The indices were determined as per Folz e*t al.* (1978). The body surface was divided into four quarters. The percentage of each quarter with gross clinical manifestation was recorded. The portion of each quarter, which was infested, was then minutely examined for lesions characteristic of demodicosis. Employing the following index the lesions were scored as

Many lesions = 4

Moderate lesions = 3

Few lesions = 2

No lesions = 1

From the per cent involvements, the mean per cent involvement and from the lesion scores, the mean lesion score was calculated. The pre and post treatment indices were calculated by multiplying the mean lesion score with mean percent involvement.

The indices were determined prior to the treatment and at weekly intervals throughout the treatment period. They were compared to assess the efficacy of the drug used. The indices from all the dogs in a group were also combined to arrive at the mean pre and post treatment index for each group.

The per cent clinical improvement was calculated as

$$\frac{\text{Mean pre treatment index} - \text{Mean post treatment index}}{\text{Mean pre treatment index}} \times 100$$

3.2.8 Statistical Analysis

The data obtained were analysed statistically as per the procedure by Snedecor and Cochran (1980).

Results

4. RESULTS

Prevalence of demodicosis was studied among the dogs with dermatological problems presented at the University Veterinary Hospitals, Mannuthy and Kokkalai during the period from May 2002 to April 2003.

4.1 PREVALENCE

4.1.1 Overall Prevalence

Out of the 9099 canine cases presented during a period of one year from May 2002 to April 2003, 927 were found to have dermatological problems constituting 10.19 per cent of the total canine cases. Fifty four cases (0.59 per cent) of the total canine cases were positive for mange. Demodicosis was diagnosed in 51, 0.56 per cent (Plate 1 and 2) and scabies (*Sarcoptes scabei var canis*) in three, 0.03 per cent of the total canine cases presented. Prevalence of demodicosis over total mite infection was 94.44 per cent (Table 1 and Fig. 1).

Table 1. Prevalence of demodicosis over total mite infections in dogs (May 2002 to April 2003)

	Demodex spp.	*Sarcoptes* spp.	Total
No. positive	51	3	54
% positive	94.44	5.56	-

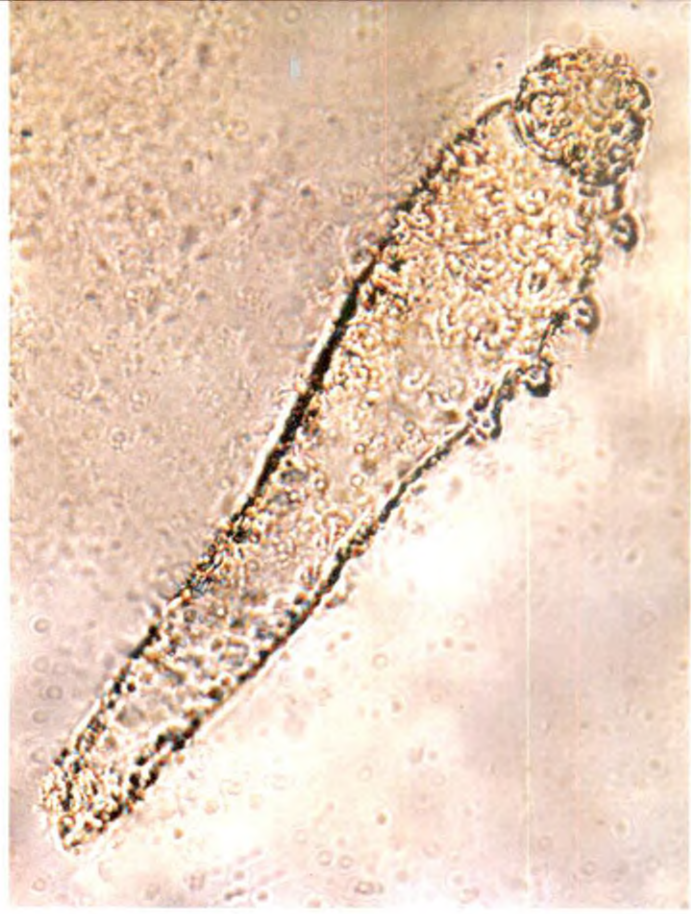
Thus among 927 dermatological cases presented, 51 (5.50 per cent) had demodectic dermatitis and three (0.32 per cent) had sarcoptic dermatitis (Table 2).

Generalised demodicosis was observed in 31 cases and localised in 20.

Plate - 1

Skinscrapings positive for *Demodex* spp. (10 X)

A



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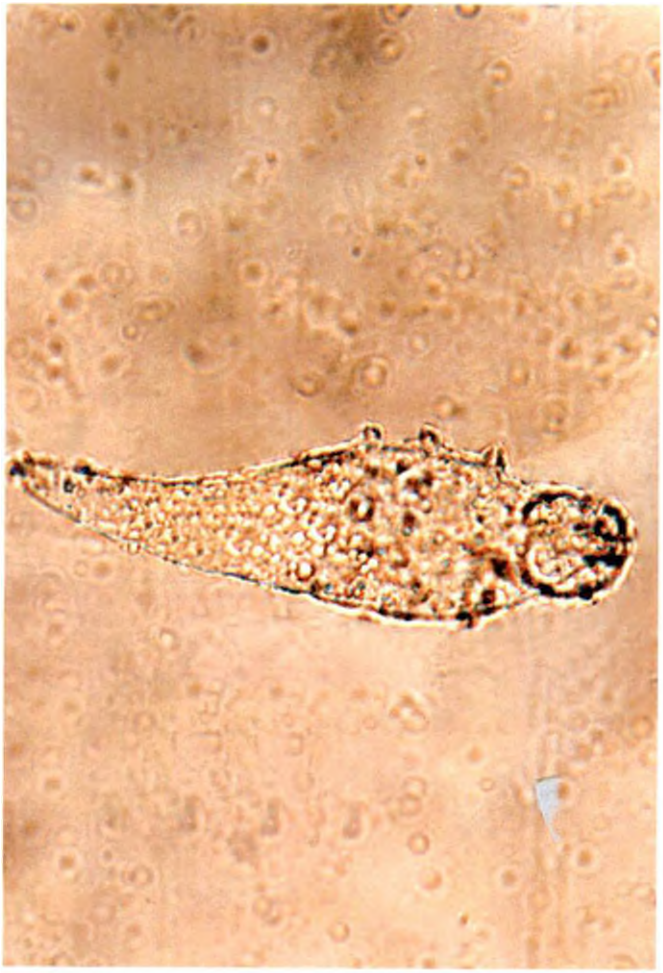

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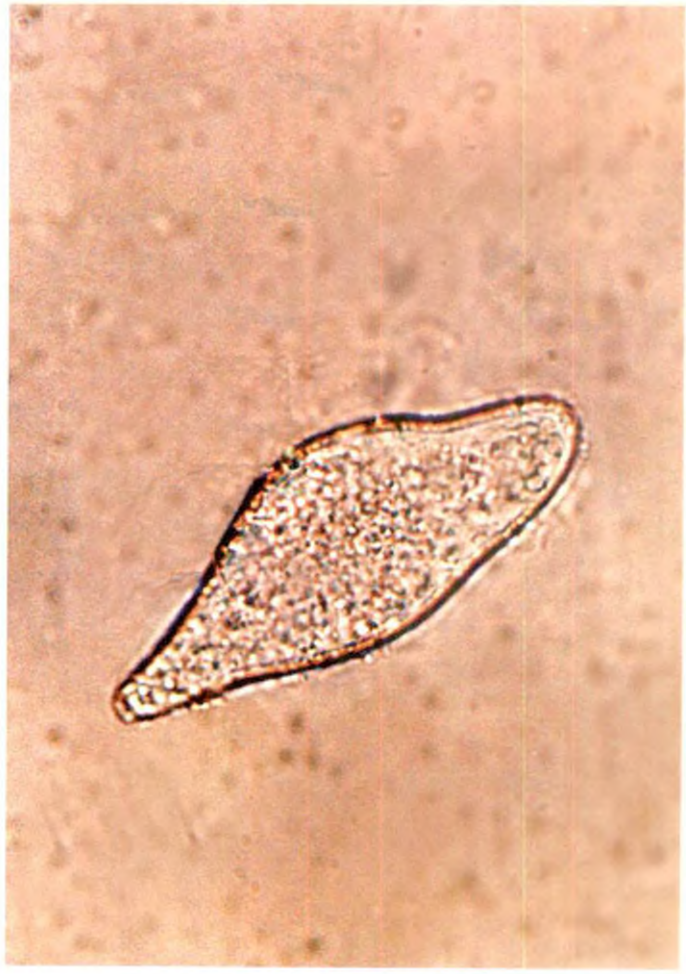


D

Plate - 2 *Demodex canis* (45x)
(A) Adult (B) Nymph (C) Larvae (D) Egg

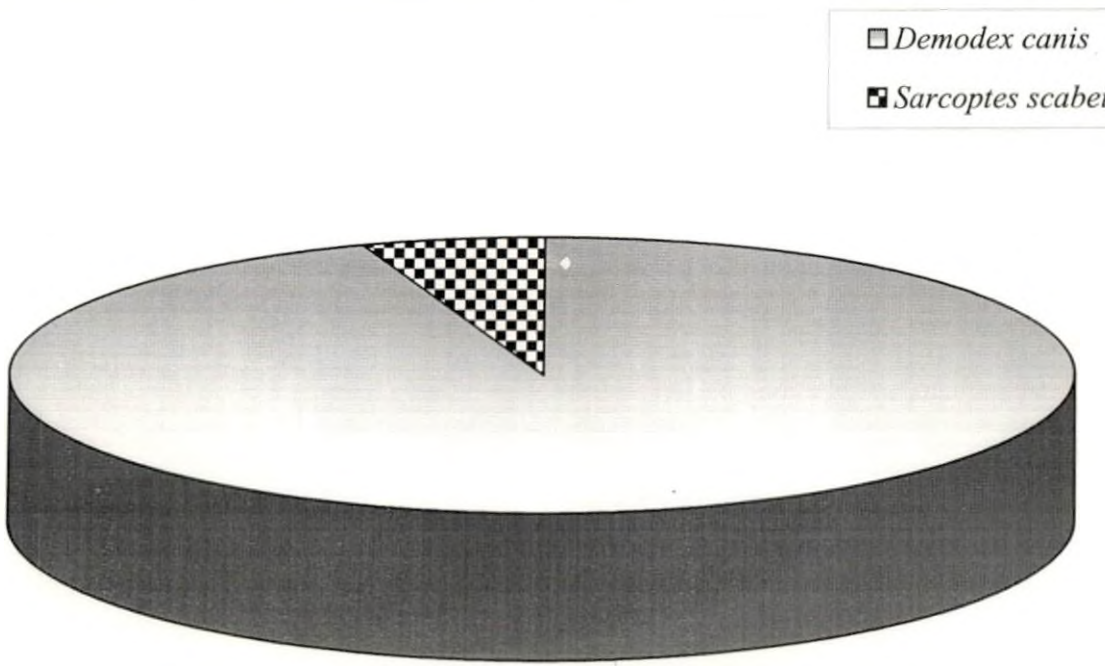


Fig. 1. Prevalence of demodicosis over total mite infections in dogs

Table 2. Monthwise prevalence of mange in dogs

No.	Month	Demodicosis		Scabies		Total number of dermatological cases	Total number of canine cases presented
		No.	%(Among dermatological cases)	No.	%(Among dermatological cases)		
1	May 2002	8	8.16			98	731
2	June 2002	3	4.11			73	756
3	July 2002	3	5.26	1	1.75	57	808
4	August 2002	2	3.18	1	1.59	63	579
5	September 2002	2	3.39			59	718
6	October 2002	3	3.89			77	701
7	November 2002	9	9.68			93	739
8	December 2002	4	6.56			61	754
9	January 2003	3	3.89	1	1.29	77	895
10	February 2003	3	4.76			63	835
11	March 2003	7	6.31			111	885
12	April 2003	4	4.21			95	698
	Total	**51**	**5.50**	**3**	**0.32**	**927**	**9099**

4.1.2 Agewise Prevalence

Age of the dogs affected with demodicosis ranged from two months to five years. Highest rate of infection was noticed in dogs of 6 to 12 months of age (16.13 per cent) followed by those three to six months (11.68 per cent), zero to three months (3.25 per cent), above two years (1.99 per cent) and one to two years (1.88 per cent) (Table 3 and Fig.2).

Statistical analysis showed significant difference ($P<0.05$) in the proportion of positive cases among different age groups.

Among the positive cases, dogs of 6 to 12 months of age contributed 39.22 per cent followed by those of three to six months (31.37 per cent), above two years (13.73 per cent), zero to three months (9.80 per cent) and one to two years (5.88 per cent) (Table 4 and Fig. 3).

4.1.2.1 Localised Demodicosis

Dogs affected with localised demodicosis were between two months to 2.5 years of age. Among the positive cases in localised demodicosis, three to six months age group contributed to 40 per cent followed by 6 to 12 months (30 per cent), below three months (20 per cent), one to two years and above two years (five per cent) (Table 4 and Fig.3).

4.1.2.2 Generalised Demodicosis

Age of the dogs affected with generalised demodicosis ranged from three months to five years. Out of the positive cases, dogs belonging to 6 to 12 months age group contributed to 45.16 per cent followed by those of three to six months (25.81 per cent) and it was the lowest in cases below three months of age (3.23 per cent) (Table 4 and Fig. 3).

4.1.3 Breedwise Prevalence

Demodicosis was observed in different breeds viz., German shepherds, Spitz, Dachshunds, Rottweilers, Boxers, Doberman pinschers, Cocker spaniels, Golden retrievers, Labrador retrievers as well as in non-descripts and crossbreds.

Highest rate of infection was noticed in Boxers where six out of the 14 dogs (42.86 per cent) presented with dermatological problems were positive for demodicosis, followed by Golden retrievers (33.33 per cent) and Rottweilers (30 per cent). Infection rate in Dachshunds was lower (0.69 per cent) compared to other breeds. Infection rate in non-descripts and crossbreds were, 6.29 per cent and 2.41 per cent respectively. Statistical analysis showed significant difference ($P<0.05$) in the proportion of positive cases among different breeds (Table 5 and Fig.4).

Among the total positive cases German shepherds contributed to 43.14 per cent, followed by non-descripts (15.69 per cent), Boxers (11.77 per cent), Doberman pinschers, Rottweilers and Spitz, (5.88 per cent each), crossbreds (3.92 per cent) and Cocker spaniels, Dachshunds, Golden retrievers and Labrador retrievers (1.96 per cent each) (Table 6 and Fig. 5).

4.1.3.1 Localised Demodicosis

Localised demodicosis was observed in German shepherds (50 per cent), non-descripts, Doberman pinschers and Spitz (10 per cent each) and Boxers, Rottweilers, Dachshunds and Golden retrievers (five per cent each) among the total percentage of positives. (Table 6 and Fig. 5)

4.1.3.2 Generalised Demodicosis

Generalised demodicosis was observed in German shepherds, Boxers, Rottweilers, Labrador retrievers, Cocker spaniels, Doberman pinschers, Spitz and also in crossbreds and non-descripts. Among the positive cases, German shepherds contributed to 38.71 per cent followed by non-descripts (19.35 per cent), Boxers (16.12 per cent), Rottweilers and crossbreds (6.45 per cent each) and Doberman pinschers, Spitz, Cocker spaniels and Labrador retrievers (3.23 per cent each) (Table 6 and Fig.5).

Table 3. Agewise prevalence of demodicosis in dogs

Age	No. of dogs presented with dermatological problems	Positive for demodicosis	
		No.	%
0 to 3 months	154	5	3.25
3 to 6 months	137	16	11.68
6 to 12 months	124	20	16.13
1 to 2 years	160	3	1.88
Above 2 years	352	7	1.99
Total	**927**	**51**	**5.50**

The difference in the proportion of different age groups are statistically significant ($P<0.05$).

Table 4. Agewise prevalence of demodicosis among total positive cases in dogs

Age	No. of dogs positive for demodicosis			%		
	Localised	Generalised	Total	Localised	Generalised	Total
0 to 3 months	4	1	5	20	3.23	9.80
3 to 6 months	8	8	16	40	25.81	31.37
6 to 12 months	6	14	20	30	45.16	39.22
1 to 2 years	1	2	3	5	6.45	5.88
Above 2 years	1	6	7	5	19.35	13.73
Total	**20**	**31**	**51**	**100**	**100**	**100**

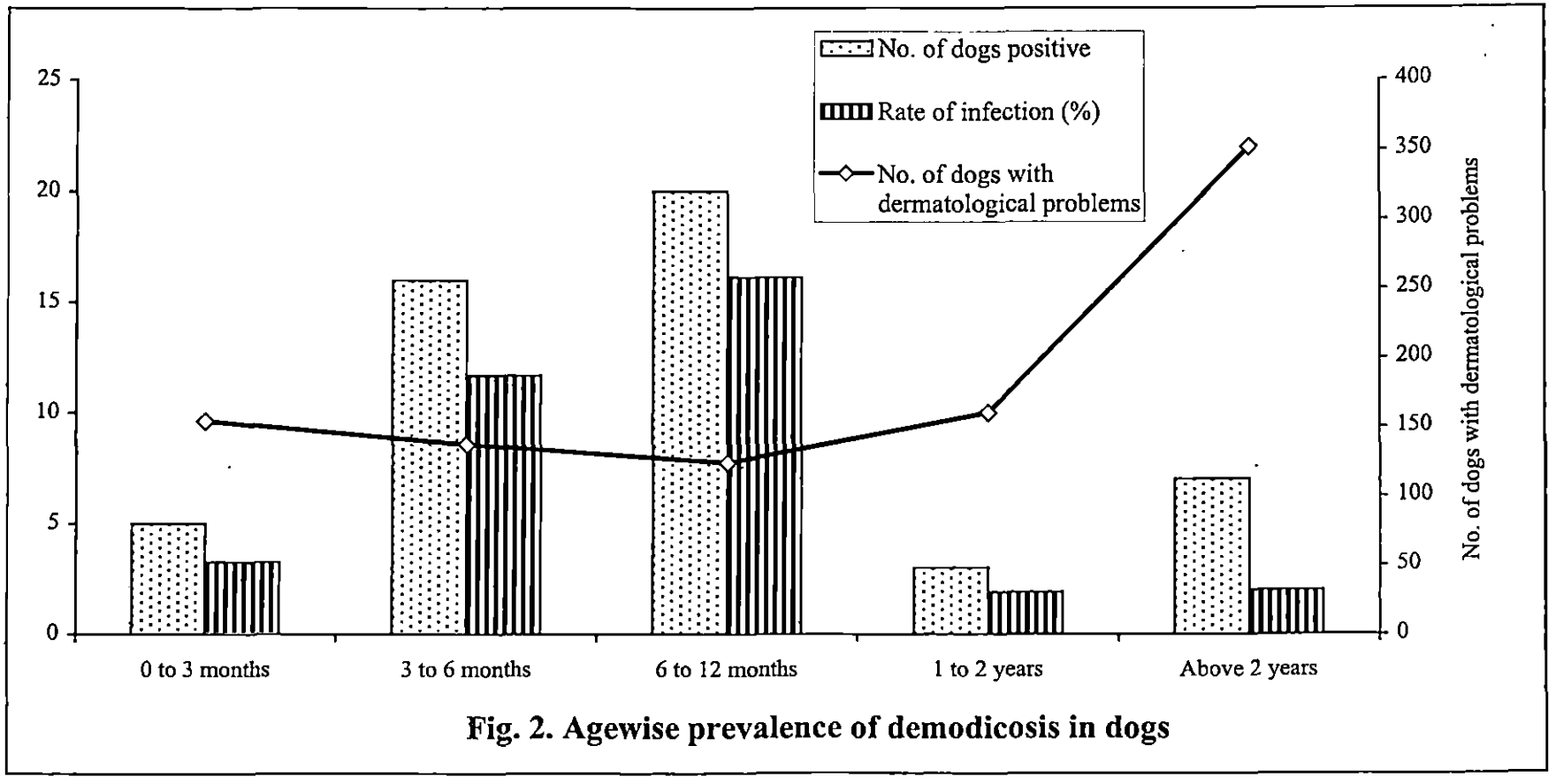


Fig. 2. Agewise prevalence of demodicosis in dogs

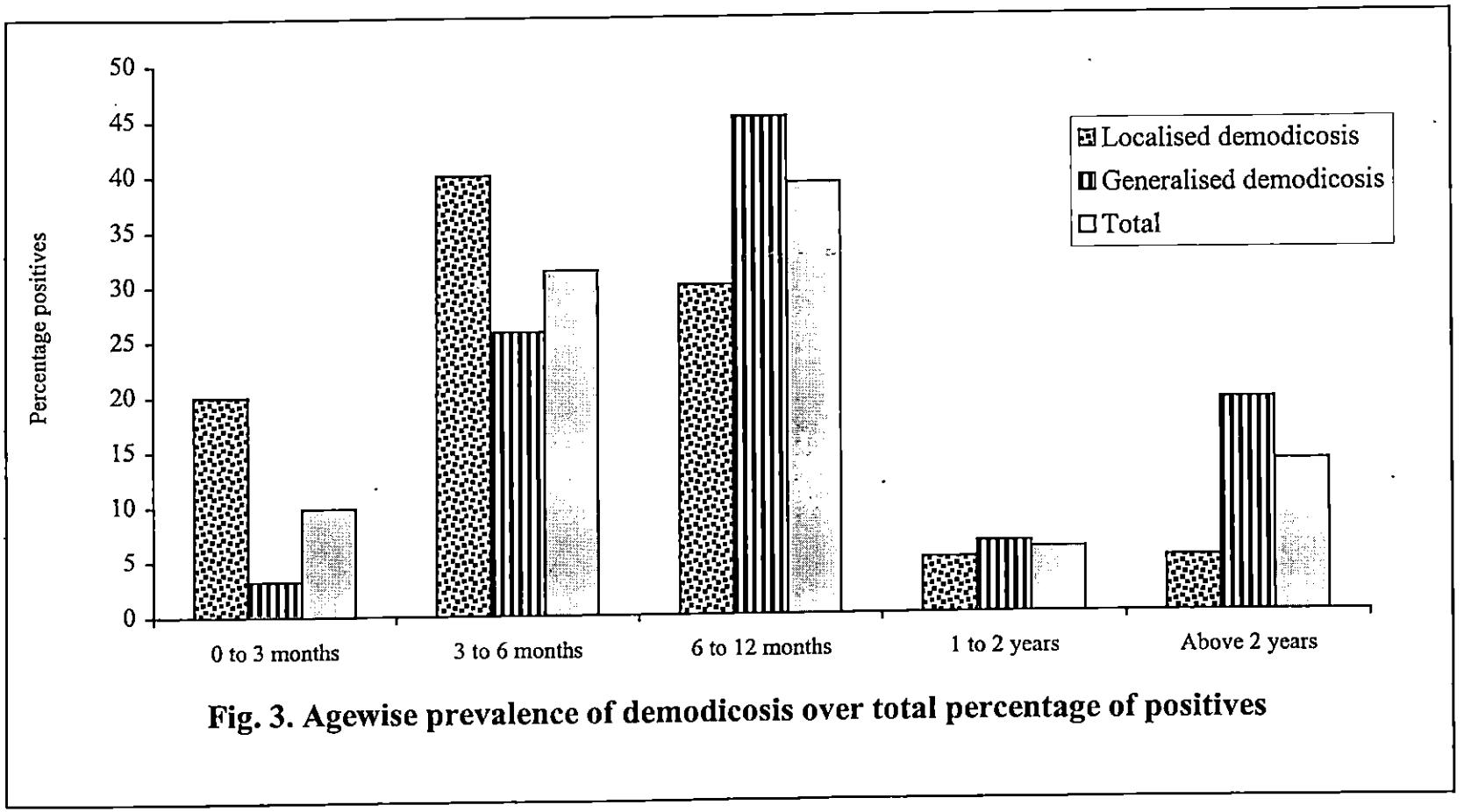


Fig. 3. Agewise prevalence of demodicosis over total percentage of positives

Table 5. Breedwise prevalence of demodicosis in dogs

No.	Breed	No. of dogs presented with dermatological problems	Positive for demodicosis	
			No	%
1	Boxer	14	6	42.86
2	Golden retriever	3	1	33.33
3	Rottweiler	10	3	30.00
4	German shepherd	247	22	8.91
5	Doberman pinscher	34	3	8.82
6	Cocker spaniel	12	1	8.33
7	Non-descript	127	8	6.29
8	Crossbred	83	2	2.41
9	Spitz	131	3	2.29
10	Labrador retriever	70	1	1.43
11	Dachshund	144	1	0.69
12	Others	52	0	0
	Total	**927**	**51**	**5.50**

The difference in the proportion of different breeds are statistically significant ($P<0.05$).

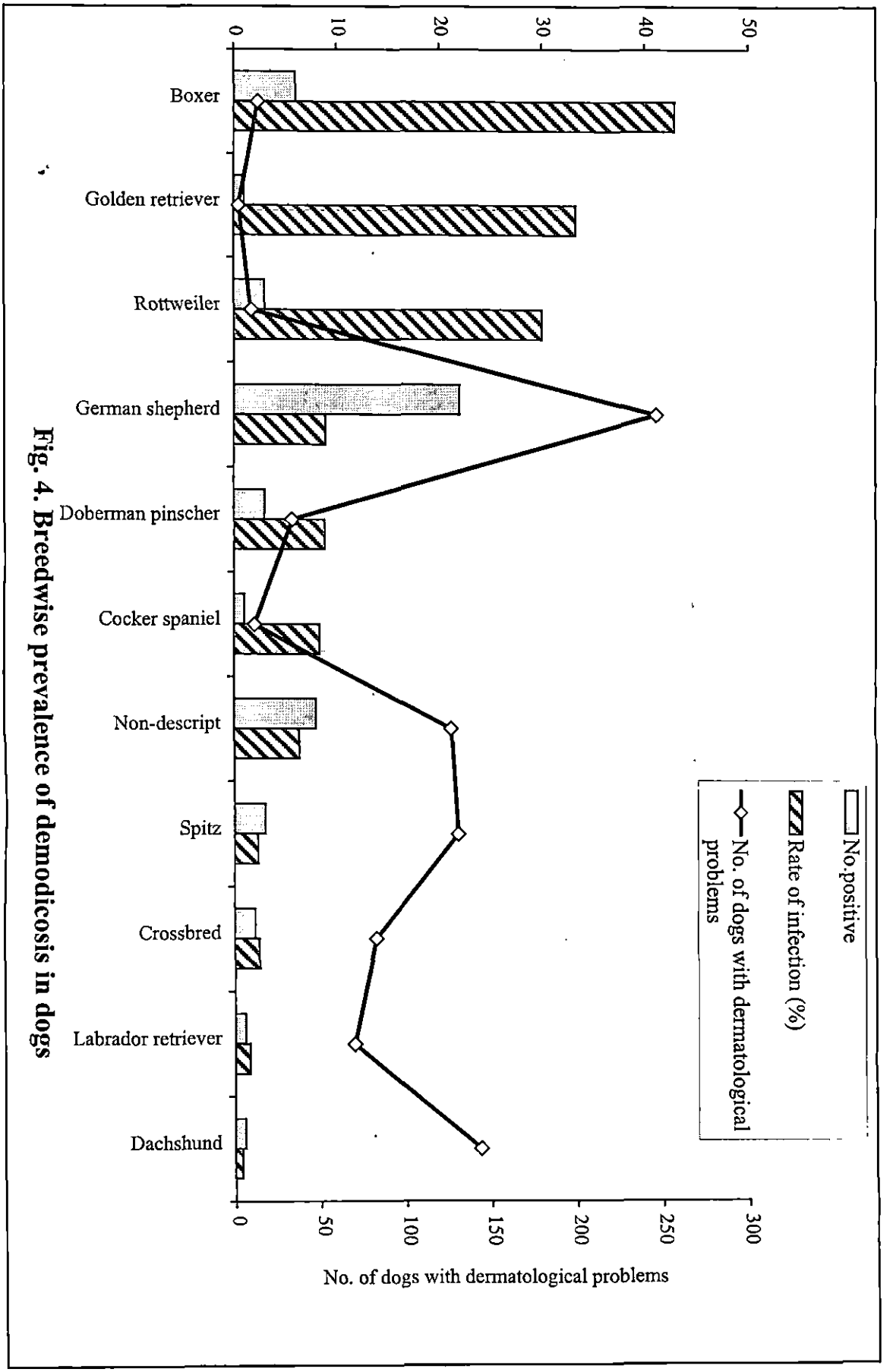


Fig. 4. Breedwise prevalence of demodicosis in dogs

Table 6. Breedwise prevalence of demodicosis among total positive cases in dogs

No.	Breed	No. of dogs positive for demodicosis			%		
		Localised	Generalised	Total	Localised	Generalised	Total
1	German shepherd	10	12	22	50	38.71	43.14
2	Non-descript	2	6	8	10	19.35	15.69
3	Boxer	1	5	6	5	16.12	11.77
4	Doberman pinscher	2	1	3	10	3.23	5.88
5	Rottweiler	1	2	3	5	6.45	5.88
6	Spitz	2	1	3	10	3.23	5.88
7	Crossbred	0	2	2	0	6.45	3.92
8	Cocker spaniel	0	1	1	0	3.23	1.96
9	Dachshund	1	0	1	5	0	1.96
10	Golden retriever	1	0	1	5	0	1.96
11	Labrador retriever	0	1	1	0	3.23	1.96
	TOTAL	**20**	**31**	**51**	**100**	**100**	**100**

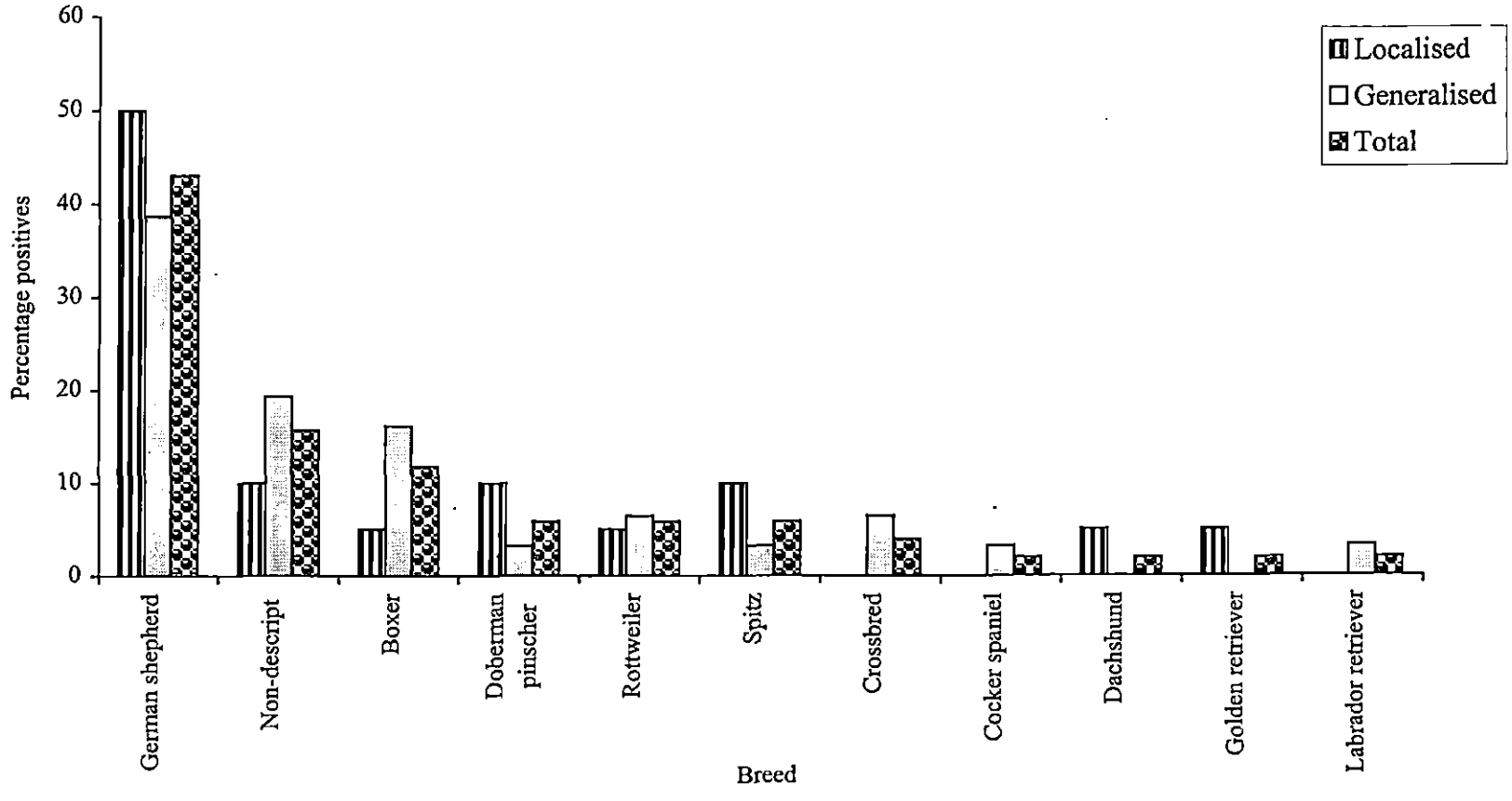


Fig. 5. Breedwise prevalence of demodicocsis over total percentage of positives

4.1.4 Sexwise Prevalence

Among 438 male dogs presented with skin disorders 23 (5.25 per cent) and among 489 female dogs, 28 (5.73 per cent) were positive for demodicosis. The infection rate was found to be high in females, however the difference was not statistically significant (P>0.05) (Table 7 and Fig.6).

Table 7. Sexwise prevalence of demodicosis in dogs

Sex	No. of dogs presented with dermatological problems	Positive for demodicosis	
		No.	%
Male	438	23	5.25
Female	489	28	5.73
Total	**927**	**51**	**5.50**

The difference in the proportion of positives among males and females are not statistically significant (P≥0.05).

Males contributed 45.09 per cent and females 54.90 per cent of the total percentage of positives (Table 8 and Fig. 7).

Table 8. Sexwise prevalence of demodicosis among total positive cases in dogs

Age	No. of dogs positive for demodicosis			%		
	Localised	Generalised	Total	Localised	Generalised	Total
Male	9	14	23	45	45.16	45.09
Female	11	17	28	55	54.84	54.90
Total	**20**	**31**	**51**	**100**	**100.00**	**100.00**

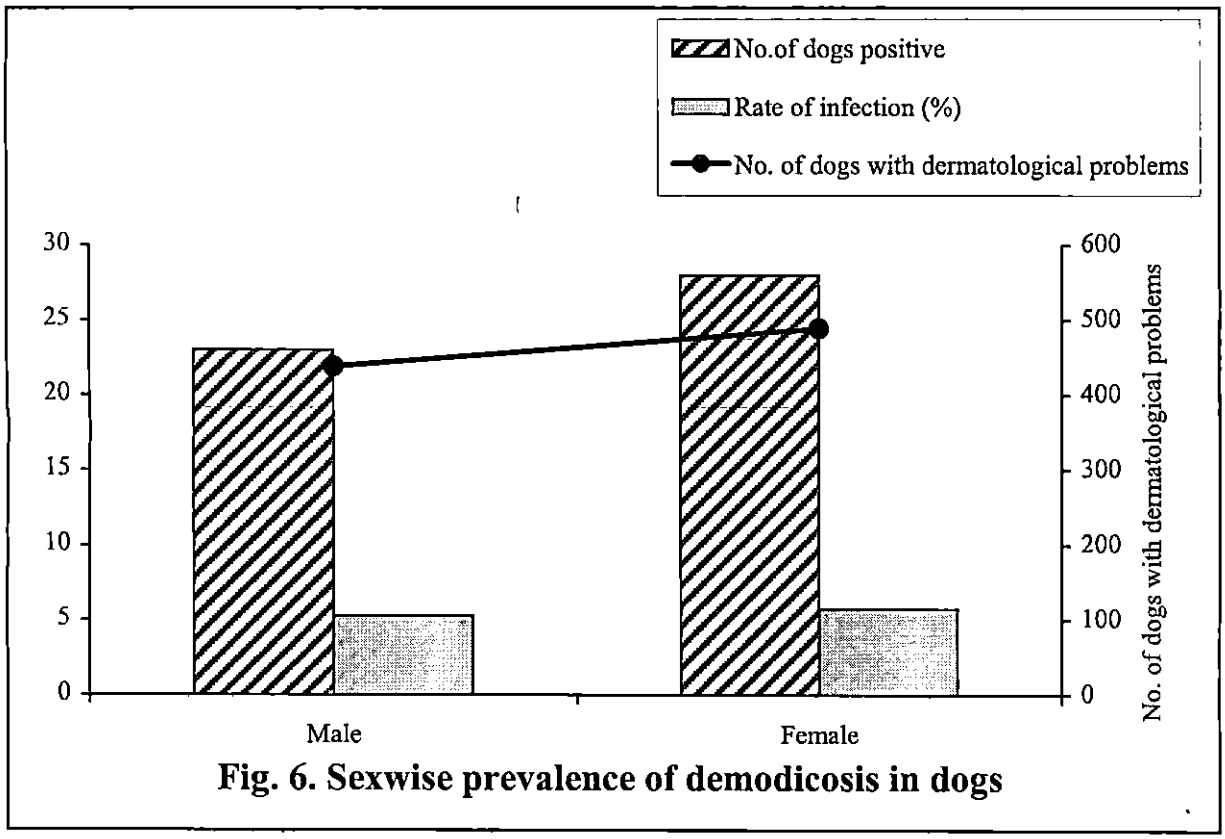


Fig. 6. Sexwise prevalence of demodicosis in dogs

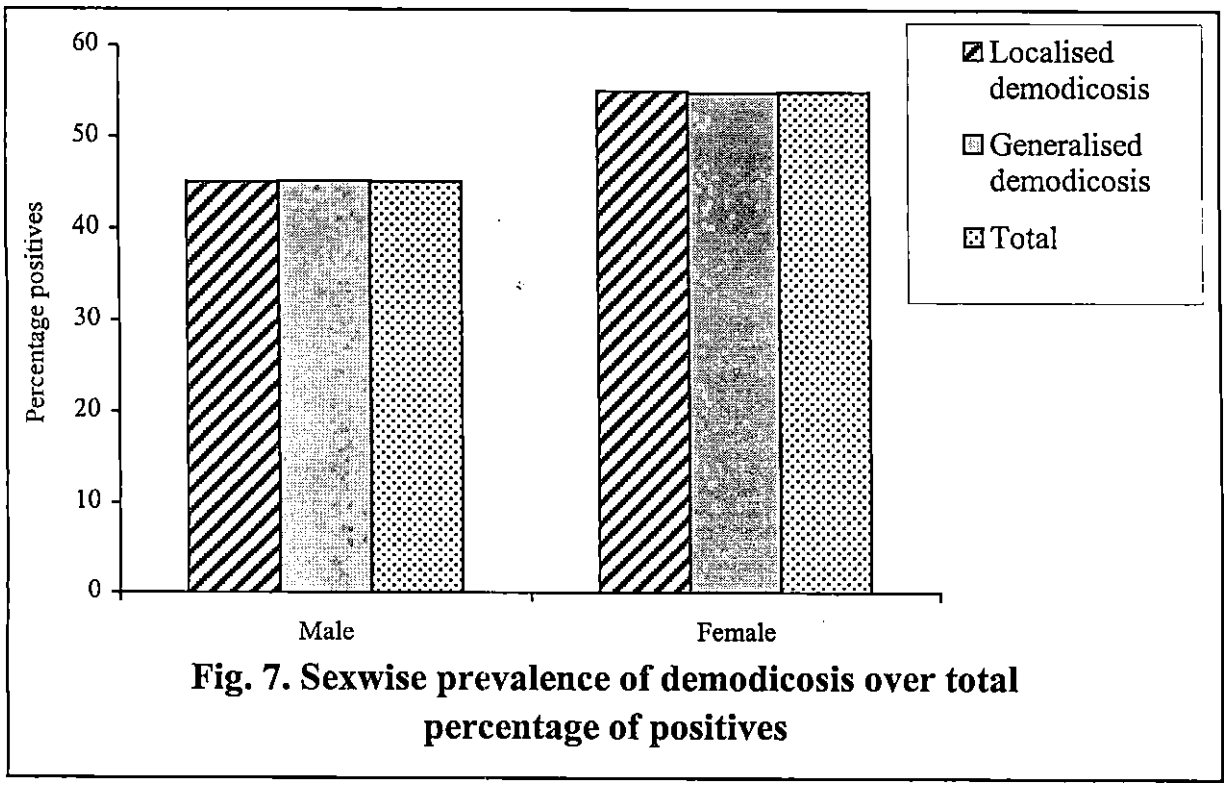


Fig. 7. Sexwise prevalence of demodicosis over total percentage of positives

4.1.4.1 Localised Demodicosis

Localised demodicosis was noted in 45 per cent of the males and 55 per cent of females among the total positive cases (Table 8 and Fig. 7).

4.1.4.2 Generalised Demodicosis

In generalised demodicosis 14 (45.16 per cent) were males and 17 (54.84 per cent) were females (Table 8 and Fig.7).

4.1.5 Monthwise Prevalence

The results are presented in Table 2 and Fig. 8.

Prevalence of demodicosis was highest in November (9.68 per cent) followed by May (8.16 per cent), December (6.56 per cent) and March (6.31 per cent). Prevalence was above three per cent through out the year.

4.2 CLINICAL SIGNS

4.2.1 Types of Lesions

The distribution of the various types of lesions encountered in canine demodicosis are furnished in detail (Table 9).

4.2.1.1 Localised Demodicosis

The primary lesions noticed were papules (75 per cent) and pustules (33.33 per cent). Secondary lesions noted were erythema and alopecia (100 per cent), scales (66.67 per cent), hyperpigmentation (41.67 per cent), crusts (16.67 per cent) and excoriations (8.33 per cent). Alopecia was localised in cent per cent of the cases (Flow chart 1). Pruritus was observed in 66.67 per cent of the cases with 12.5 per cent having constant pruritus (Flow chart 2).

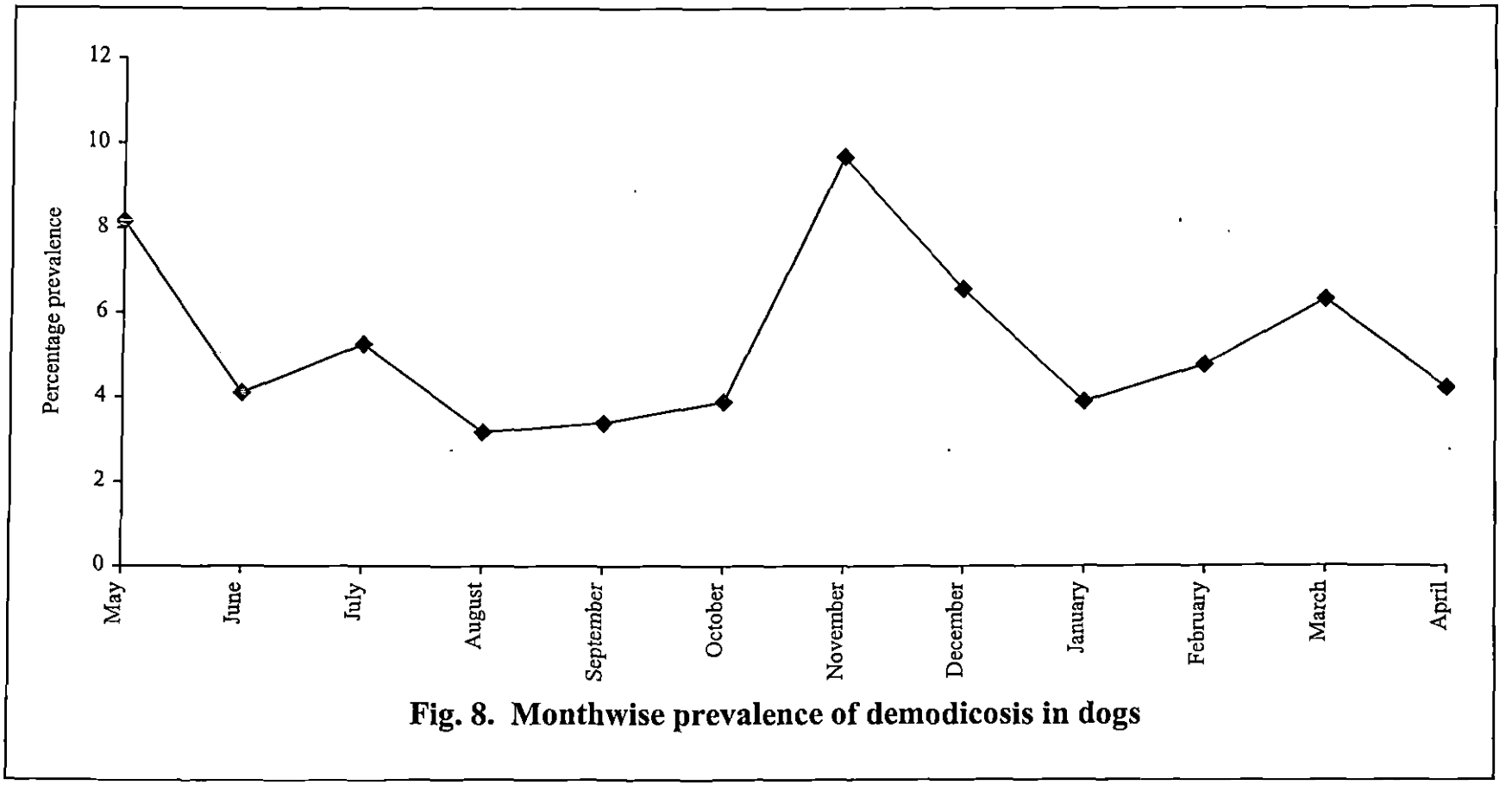


Fig. 8. Monthwise prevalence of demodicosis in dogs

4.2.1.2 Generalised Demodicosis

The primary lesions noted were papules, 93.33 per cent, pustules, 73.33 per cent, macula, 26.67 per cent and patch, 20 per cent. Secondary lesions were erythema and alopecia (100 per cent), crusts (93.33 per cent), scales (80 per cent), excoriations (73.33 per cent), hyperpigmentation (66.67 per cent), hyperkeratosis (33.33 per cent) and erosions (20 per cent).

Alopecia was in diffuse pattern in cent per cent of the cases (Flowchart 1). Pruritus was present in 86.67 per cent of the cases with 8 (61.54 per cent) having constant pruritus and five (38.46 per cent) only occasionally (Flow chart 2).

4.2.2 Sites of Lesions

The various sites of demodectic lesions on the body surface are described in Table 10.

4.2.2.1 Localised Demodicosis

The lesions were distributed on the cheeks (66.67 per cent), commissures of mouth, nasal area, neck, forelimbs and ventral abdomen (33.33 per cent each), periocular skin and head (25 per cent each) and pinnae and trunk (16.67 per cent each).

4.2.2.2 Generalised Demodicosis

The chief sites of lesions were the forelimbs and hindlimbs, cent per cent each, followed by cheeks and neck (93.33 per cent each), nasal area and chin (86.67 per cent each), trunk, commissures of mouth and head (66.67 per cent each), periocular skin and pinnae (60 per cent each) and ventral abdomen and tail (33.33 per cent each).

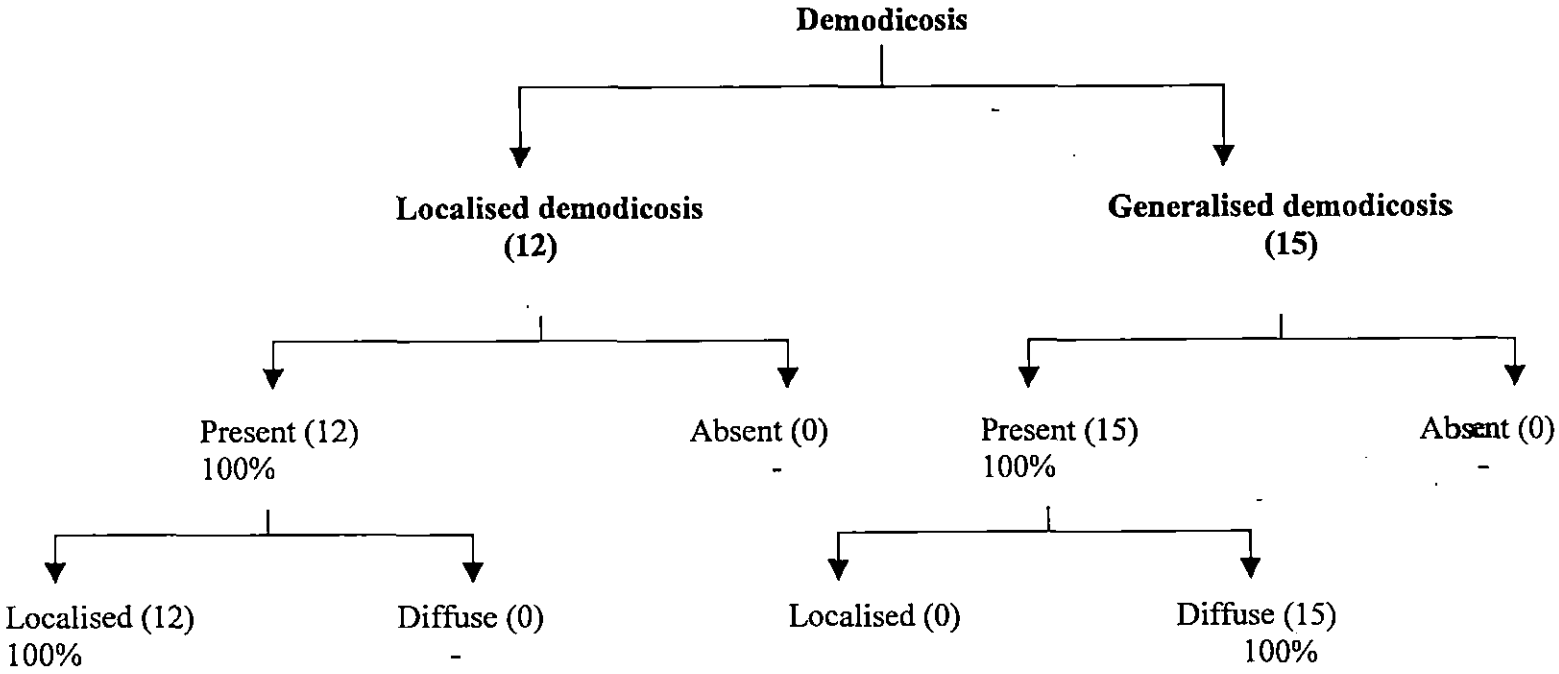
4.3 SYSTEMIC SIGNS

Results are presented in Table 11.

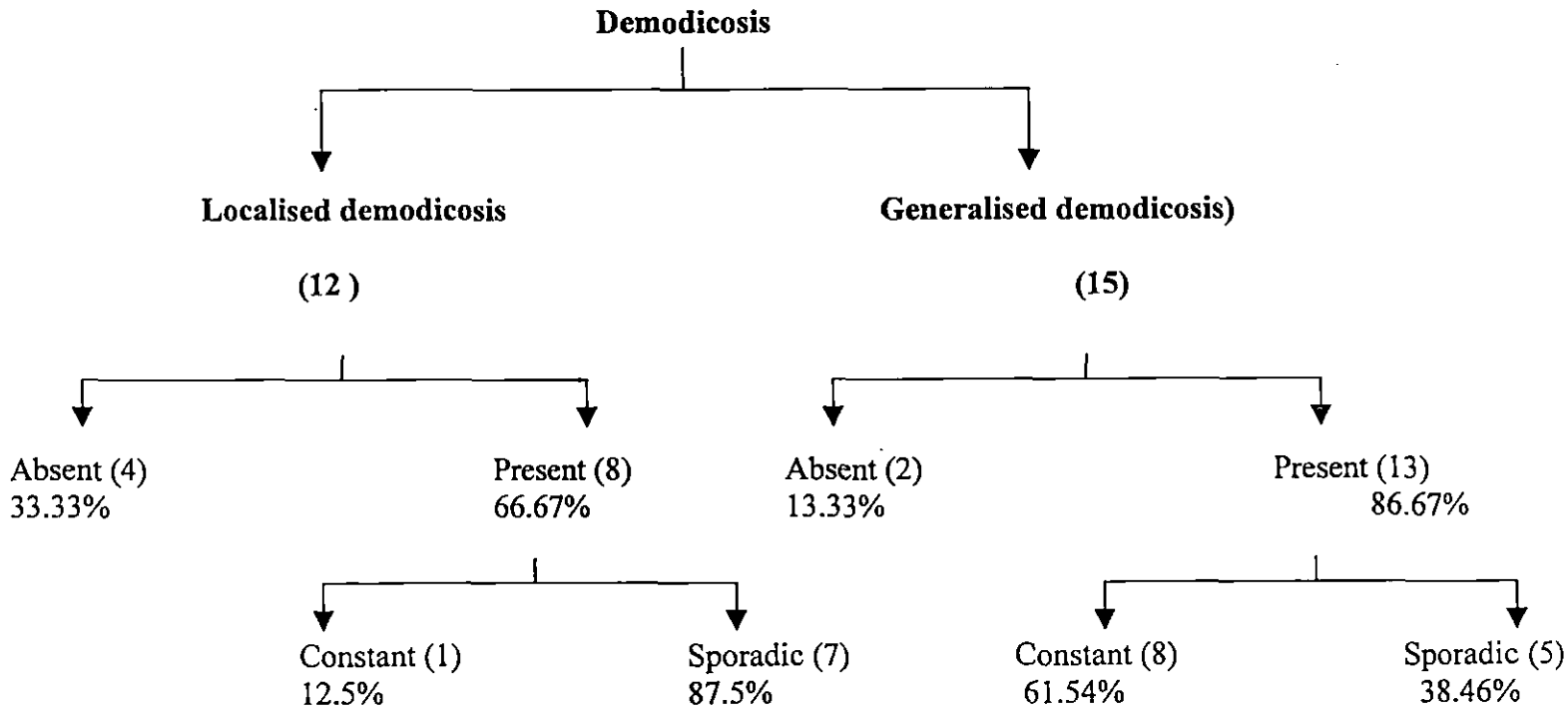
Table 9. Distribution of the types of lesions in canine demodicosis

	Type of lesions	Localised	Generalised	Total
		12	15	27
Primary lesions	Macula	-	4 (26.67)	4 (14.82)
	Plaque	-	-	-
	Vesicle	-	-	-
	Patch	-	3 (20)	3 (11.11)
	Nodule	-	-	-
	Pustule	4 (33.33)	11 (73.33)	15 (55.56)
	Papule	9 (75)	14 (93.33)	23 (85.19)
	Wheal	-	-	-
Secondary lesions	Scales	8 (66.67)	12 (80)	20 (74.07)
	Scars	-	-	-
	Crusts	2 (16.67)	14 (93.33)	16 (59.26)
	Erosions	-	3 (20)	3 (11.11)
	Excoriations	1 (8.33)	11 (73.33)	12 (44.44)
	Ulcers	-	-	-
	Erythema	12 (100)	15 (100)	27 (100)
	Alopecia	12 (100)	15 (100)	27 (100)
	Lichenification	-	-	-
	Hyperpigmentation	5 (41.67	10 (66.67)	15 (55.56)
	Hypopigmentation	-	-	-
	Hyperkeratosis	-	5 (33.33)	5 (18.52)

Figures in parenthesis indicate per cent



Flow chart 1. Distribution pattern of alopecia in canine demodicosis



Flow chart 2.Distribution pattern of pruritus in canine demodicosis

Table 10. Distribution of lesions on the body surface in canine demodicosis

Body regions Affected	Localised (12)	Generalised (15)	Total (27)
Periocular skin	3 (25)	9 (60)	12 (44.44)
Commissures of mouth	4 (33.33)	10 (66.67)	14 (51.85)
Nasal area	4 (33.33)	13 (86.67)	17 (62.96)
Cheeks	8 (66.67)	14 (93.33)	22 (81.48)
Chin	0 -	13 (86.67)	13 (48.15)
Pinnae	2 (16.67)	9 (60)	11 (40.74)
Head	3 (25)	10 (66.67)	13 (48.15)
Neck	4 (33.33)	14 (93.33)	18 (66.67)
Forelimbs	4 (33.33)	15 (100)	19 (70.37)
Trunk	2 (16.67)	10 (66.67)	12 (44.44)
Ventral abdomen	4 (33.33)	5 (33.33)	9 (33.33)
Hindlimbs	0 -	15 (100)	15 (55.56)
Tail	0 -	5 (33.33)	5 (18.52)

Figures in parenthesis indicate per cent

Table 11. Systemic clinical signs in canine demodicosis

		Food intake			Temperature		Lymphadenopathy		Limb oedema		General status	
	n	Normal	Less	Anorexia	Normal	Pyrexia >38.9°C	Present	Absent	Present	Absent	Active	Lethargic
Localised	12	9 (75)	3 (25)	0 -	12 (100)	0 -	0 -	12 (100)	0 -	12 (100)	11 (91.67)	1 (8.33)
Generalised	15	7 (46.67)	7 (46.67)	1 (6.67)	7 (46.67)	8 (53.33)	6 (40)	9 (60)	10 (66.67)	5 (33.33)	8 (53.33)	7 (46.67)
Total	**27**	**16 (59.26)**	**10 (37.04)**	**1 (3.70)**	**19 (70.37)**	**8 (29.63)**	**6 (22.22)**	**21 (77.78)**	**10 (37.04)**	**17 (62.96)**	**19 (70.37)**	**8 29.63)**

Figures in parenthesis indicate per cent

4.3.1 Localised Demodicosis

Food intake was normal in 75 per cent of the cases and less in 25 per cent. One (8.33 per cent) of the dogs was lethargic. Temperature was within the normal range in all the cases and lymphadenopathy was not observed.

4.3.2 Generalised Demodicosis

Food intake was normal in 46.67 per cent, less in 46.67 per cent and one dog (6.67 per cent) was anorexic. Temperature above 38.9°C was noted in 53.33 per cent of the cases and lymphadenopathy in 40 per cent. Limb oedema was observed in 66.67 per cent of the cases and 46.67 per cent of the dogs were lethargic.

4.4 TRANSMISSION

4.4.1 Chance of Disease Transmission to Incontact Animals

Other dogs were reared in the same household in 14 cases out of 27 and 42.86 per cent of the incontact animals were affected with demodicosis (Table12).

Table 12. Chance of disease transmission to incontact animals in canine demodicosis

	n	Incontact animals affected	
		Yes	No
Localised	5	2 (40)	3 (60)
Generalised	9	4 (44.44)	5 (55.55)
Total	**14**	**6** **(42.86)**	**8** **(57.14)**

Figures in parenthesis indicate per cent

4.4.2 Occurrence of Demodicosis in Littermates

Out of the six incontact animals affected with the disease, 4 (66.67 per cent) were from the same litter (Table13).

Table 13. Chance of occurrence of the disease in littermates in canine demodicosis

	n	Littermates	
		Yes	No
Localised	2	1 (50)	1 (50)
Generalised	4	3 (75)	1 (25)
Total	6	**4 (66.67)**	**2 (33.33)**

Figures in parenthesis indicate per cent

4.5 MANAGEMENTAL PRACTICES

4.5.1 Housing Pattern

Demodicosis was noticed in 33.33 per cent of the animals kept indoors, 18.52 per cent kept outdoors and 48.15 per cent reared both indoors and outdoors. Among the 27 cases, 62.96 per cent of the dogs were kept in the kennel and 52.94 per cent of the dogs suffered in the kennels disinfected with chemicals (Table 14).

4.5.2 Bathing

Bathing was practised in all the cases. Dogs were bathed daily (3.70 per cent), once in two days (18.52 per cent), once in a week (48.15 per cent), once in a fortnight (18.52 per cent), once in a month (3.70 per cent) and once in two months in 7.41 per cent of the positive cases (Table 15).

Table 14. Distribution of housing pattern in canine demodicosis

	n	Habit					Kennel		Disinfection of the kennel		
		<50% indoors	50% indoors 50% outdoors	>50% indoors	100% indoors	100% outdoors	Present	Absent	n	Physical washing	Chemical washing
Localised	12	0 -	1 (8.33)	6 (50)	3 (25)	2 (16.67)	6 (50)	6 (50)	6	1 (16.67)	5 (83.33)
Generalised	15	1 (6.67)	1 (6.67)	4 (26.67)	6 (40)	3 (20)	11 (73.33)	4 (26.67)	11	7 (63.64)	4 (36.36)
Total	**27**	**1 (3.70)**	**2 (7.41)**	**10 (37.04)**	**9 (33.33)**	**5 (18.52)**	**17 (62.96)**	**10 (37.04)**	**17**	**8 (47.06)**	**9 (52.94)**

Figures in parenthesis indicate per cent

Table 15. Practice of bathing

	N	Daily	Once in two days	Once in a week	Once in a fortnight	Once in a month	Once in two months
Localised	12	1 (8.33)	1 (8.33)	10 (83.33)	-	-	-
Generalised	15	0 -	4 (26.67)	3 (20)	5 (33.33)	1 (6.67)	2 (13.33)
Total	**27**	**1 (3.70)**	**5 (18.52)**	**13 (48.15)**	**5 (18.52)**	**1 (3.70)**	**2 (7.41)**

4.5.3 Brushing

Brushing was practised in 48.15 per cent of the cases and of these seven (25.93 per cent) were brushed daily (Table 16).

Table 16. Practice of brushing

		Practised		Not practised
	n	Occasionally	Daily	
Localised	12	3 (25)	4 (33.33)	5 (41.67)
Generalised	15	3 (20)	3 (20)	9 (60)
Total	**27**	**6 (22.22)**	**7 (25.93)**	**14 (51.85)**

4.6 TREATMENT

Among the 51 cases found positive for demodicosis, 24 dogs were treated with various drugs viz., 1) ivermectin, 2) amitraz, 3) combination of ivermectin and amitraz, 4) combination of ivermectin, amitraz and levamisole. Efficacy of these drugs against demodicosis was assessed based on the clinical response to treatment, examination of skin scrapings at weekly intervals and determination of demodicosis index.

Blood parameters viz., haemoglobin, packed cell volume, total leucocyte count, differential leucocyte count and biochemical parameters viz., total protein,

albumin, globulin and A: G ratio were studied, before and after the treatment and compared with those of the control group. Six healthy dogs free from skin disorders formed the control group.

4.6.1 Ivermectin

4.6.1.1 Clinical Response to Treatment

All the patients with localised demodicosis showed clinical improvement after two treatments (four weeks), but those with generalised lesions showed no improvement and worsened during the treatment period. The treatment was continued for eight weeks irrespective of the prognosis (Plate 3 and 4).

4.6.1.2 Examination of Skin Scrapings

Mites were not detected in the skin scrapings in 33.33 per cent of the cases with three treatments (six weeks) whereas 66.67 per cent, that is all the localised cases cleared the mites after four treatments (eight weeks), while 33.33 per cent (generalised cases) retained the mite population even after five treatments (10 weeks) (Table 17).

4.6.1.3 Determination of Demodicosis Index

The mean demodicosis index before treatment was 54.17 ± 81.12 and after seven weeks was 103.75 ± 154.53 (Table 18). The mean per cent clinical improvement was –132.5 ± 469.80 per cent after seven weeks (Table 19).

4.6.1.4 Haematological Parameters

The results are presented in Table 20.

Mean haemoglobin value was significantly ($P<0.05$) low in the demodicosis affected dogs before treatment (11.27 ± 2.54 g/dl) and after treatment (12.5±1.93g/dl) compared to that of the control (14.63 ± 1.14 g/dl).

The mean value of the packed cell volume before treatment (34.7 ± 4.29 per cent), after treatment (40.8 ± 3.91 per cent) and those of the control group (47.00 ± 5.55 per cent) differed significantly from each other ($P<0.05$).

There was no significant difference ($P\geq0.05$) between the mean values of total leucocyte count, absolute neutrophil count, absolute lymphocyte count, and absolute monocyte count of demodicosis affected dogs before treatment and after treatment when compared to the control group.

The mean absolute eosinophil count before treatment (0.33 ± 0.12 x $10^3/mm^3$) differed significantly from that of the control group (0.13 ± 0.12 x 10^3 x mm^3).

4.6.1.5 Biochemical Parameters

The results are presented in Table 21.

Mean value of albumin of the demodicosis affected dogs before treatment was 2.35 ± 0.80 g/dl and after treatment was 2.58 ± 0.86 g/dl. The values were significantly different ($p<0.05$) from each other but both showed nonsignificant variation ($p\geq0.05$) from the control group values.

The mean globulin values of the dogs before treatment and after treatment were 5.87 ± 1.64 g/dl and 5.65 ± 1.79 g/dl respectively and both showed significant difference ($P<0.05$) from that of the control group (3.81 ± 0.73 g/dl).

The mean A:G ratio before treatment (0.45 ±0.24) was significantly ($P<0.05$) lower than that of the control group (0.72 ± 0.11), while those after treatment(0.52 ± 0.27) showed nonsignificant variation from the control group.

The mean total protein values of demodicosis affected dogs before treatment (8.23 ± 1.25 g/dl) and after treatment (8.24 ± 1.29 g/dl) were significantly higher ($p<0.05$) from that of the control group (6.50±0.85g/dl).

A

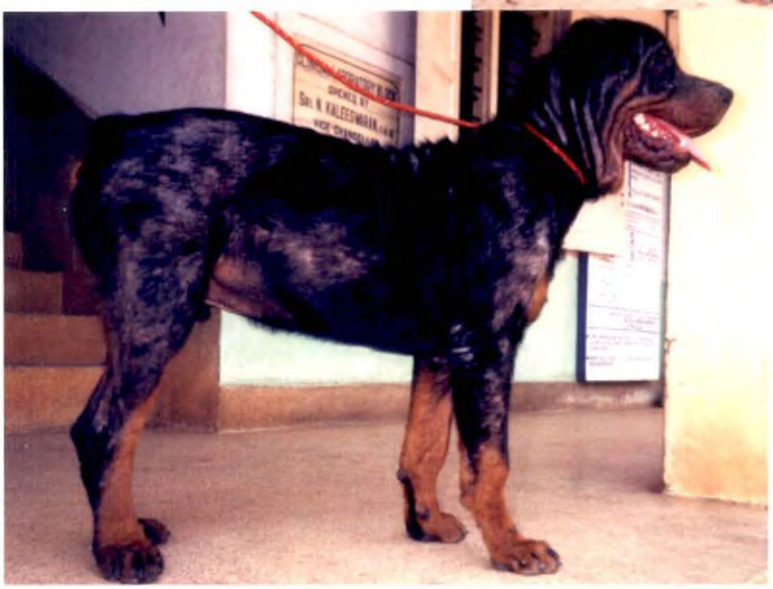
B

C

Plate -3 Group I Ivermectin
(A) Before treatment (B) During treatment (four weeks)
(C) After treatment (nine weeks)

A

B



C

Plate -4 Group I Ivermectin
(A) Before treatment (B) During treatment (four weeks)
(C) After treatment (eight weeks)

Table 17. Clearance percentage of mites from dogs

	0 week	1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week	9th week	10th week
I											
No. of dogs positive	6	6	6	6	6	6	4	3	2	2	2
No. of dogs negative	0	0	0	0	0	0	2	3	4	4	4
% negative	(0)	(0)	(0)	(0)	(0)	(0)	(33.33)	(50)	(66.67)	(66.67)	(66.67)
A											
No. of dogs positive	6	6	6	6	6	6	3	3	2	0	0
No. of dogs negative	0	0	0	0	0	0	3	3	4	6	6
% negative	(0)	(0)	(0)	(0)	(0)	(0)	(50)	(50)	(66.67)	(100)	(100)
I+A											
No. of dogs positive	6	6	6	6	6	5	4	2	1	1	0
No. of dogs negative	0	0	0	0	0	1	2	4	5	5	6
% negative	(0)	(0)	(0)	(0)	(0)	(16.67)	(33.33)	(66.67)	(83.33)	(83.33)	(100)
I+A+L											
No. of dogs positive	6	6	6	6	5	5	4	1	1	1	0
No. of dogs negative	0	0	0	0	1	1	2	5	5	5	6
% negative	(0)	(0)	(0)	(0)	(16.67)	(16.67)	(33.33)	(83.33)	(83.33)	(83.33)	(100)

I – Ivermectin, A – Amitraz, L – Levamisole
Figures in parenthesis indicate per cent

Table 18. Effect of treatments on canine demodicosis in terms of demodicosis index

Treatment group	No. of dogs	Drugs used	Pretreatment Demodicosis Index (Mean ± SD)	Weekly post treatment demodicosis index (Mean ± SD)						
				1st	2nd	3rd	4th	5th	6th	7th
I	6	Ivermectin	54.17 ± 81.12	70.63 ± 90.94	69.79 ± 91.32	102.08 ± 162.98	105.94 ± 167.69	105.32 ± 168.13	104.38 ± 168.83	103.75 ± 154.53
II	6	Amitraz	167.19 ± 154.18	139.79 ± 155.97	100.21 ± 105.21	76.72 ± 113.92	52.14 ± 77.99	39.90 ± 79.88	13.44 ± 25.83	6.25 ± 9.35
III	6	Ivermectin + Amitraz	215.63 ± 82.61	174.73 ± 83.48	124.09 ± 59.02	96.89 ± 69.57	60.26 ± 81.98	33.02 ± 57.84	18.65 ± 36.95	8.96 ± 18.41
IV	6	Ivermectin + Amitraz + Levamisole	279.17 ± 132.68	201.04 ± 114.66	133.54 ± 128.43	91.88 ± 108.47	55.42 ± 81.61	19.38 ± 24.93	8.33 ± 13.36	0.63 ± 1.39

Table 19. Effect of treatments on canine demodicosis in terms of per cent improvement

Treatment group	No. of dogs	Drugs used	Weekly clinical improvement (%) (Mean ± SD)						
			1st	2nd	3rd	4th	5th	6th	7th
I	6	Ivermectin	-48.33 ± 163.51	-55.12 ± 218.68	-155.54 ± 505.56	-147.52 ± 506.77	-144.39 ± 508.38	-135.63 ± 513.00	-132.5 ± 469.80
II	6	Amitraz	24.13 ± 17.73	35.93 ± 15.42	65.23 ± 20.35	80.07 ± 16.32	85.08 ± 17.89	96.13 ± 6.39	97.98 ± 2.54
III	6	Ivermectin + Amitraz	20.27 ± 11.51	40.79 ± 14.78	57.35 ± 17.05	76.39 ± 25.40	88.29 ± 19.03	93.52 ± 12.21	96.94 ± 6.12
IV	6	Ivermectin + Amitraz + Levamisole	30.12 ± 16.49	60.38 ± 27.69	72.57 ± 24.69	83.79 ± 19.48	93.86 ± 6.01	97.72 ± 3.29	99.84 ± 0.35

Table 20. Haematological parameters of demodicosis affected dogs before and after treatment with ivermectin.

Haematological parameters	Mean Haematological values (Mean±SD)		
	Before treatment	After treatment	Control
Haemoglobin (g/dl)	11.27 ± 2.54^{a}	12.5 ± 1.93^{b}	14.63 ± 1.14^{ab}
Packed cell volume (%)	34.7 ± 4.29^{a}	40.8 ± 3.91^{a}	47.00 ± 5.55^{a}
Total leucocyte count ($10^3/mm^3$)	12.84 ± 1.57	12.54 ± 1.97	13.13 ± 1.88
Neutrophils ($10^3/mm^3$)	8.96 ± 1.99	8.85 ± 1.24	8.52 ± 1.73
Lymphocytes ($10^3/mm^3$)	3.36 ± 0.64	3.15 ± 0.85	4.25 ± 0.89
Monocytes ($10^3/mm^3$)	0.19 ± 0.18	0.17 ± 0.19	0.22 ± 0.16
Eosinophils ($10^3/mm^3$)	0.33 ± 0.12^{a}	0.37 ± 0.40	0.13 ± 0.12^{a}
Basophils	--	--	--

Values bearing the same superscripts in a row are statistically significant ($P<0.05$)

Table 21. Biochemical parameters of demodicosis affected dogs before and after treatment with ivermectin.

Biochemical parameters	Mean values (Mean ± SD)		
	Before treatment	After treatment	Control
Albumin (g/dl)	2.35 ± 0.80^{a}	2.58 ± 0.86^{a}	2.69 ± 0.12
Globulin (g/dl)	5.87 ± 1.64^{a}	5.65 ± 1.79^{b}	3.81 ± 0.73^{ab}
A:G ratio	0.45 ± 0.24^{a}	0.52 ± 0.27	0.72 ± 0.11^{a}
Total protein (g/dl)	8.23 ± 1.25^{a}	8.24 ± 1.29^{b}	6.50 ± 0.85^{ab}

Values bearing the same superscripts in a row are statistically significant ($P<0.05$).

4.6.2 Amitraz

4.6.2.1 Clinical Response to Treatment

The patients showed clinical improvement with three to five weekly treatments of amitraz (Plate 5).

4.6.2.2 Examination of Skin Scrapings

The dogs were cleared of the mites in 50 per cent of the cases by six weekly treatments. Skin scrapings were negative in 66.67 per cent of the cases after eight weeks and cent per cent of the dogs cleared the mites after nine treatments (nine weeks) (Table 17).

4.6.2.3 Determination of Demodicosis Index

The mean demodicosis index before treatment was 167.19 ± 154.18 which lowered to 6.25 ± 9.35 after seven weekly treatments (Table 18).

The mean per cent clinical improvement was 24.13 ± 17.73 per cent after one week and 97.98 ± 2.54 per cent after seven weeks (Table 19).

4.6.2.4 Haematological Parameters

Results are presented in Table 22.

Mean haemoglobin content of control animals, 14.63 ± 1.14 g/dl was significantly higher ($P<0.05$) than that of demodicosis affected dogs, before treatment with amitraz (11.37 ± 0.94 g/dl). The values before and after treatment (12.95 ± 1.68 g/dl) showed nonsignificant variation ($P\geq0.05$). Mean value of packed cell volume also showed a similar trend.

There was no significant difference ($P\geq0.05$) between the mean values of total leucocyte count, absolute neutrophil count, absolute lymphocyte count and absolute monocyte count of demodicosis affected dogs before treatment, after

treatment and the control group where as the mean value of absolute eosinophil count before treatment 0.53 ± 0.22 x $10^3/mm^3$ was significantly higher ($P<0.05$) from that of the control group (0.13 ± 0.12 x $10^3/mm^3$) and after treatment value (0.16 ± 0.07 x $10^3/mm^3$).

4.6.2.5 Biochemical Parameters

Results are presented in Table 23.

The mean albumin value before treatment (2.30 ± 0.70 g/dl), after treatment (2.56 ± 0.25 g/dl) and that of the control group (2.69 ± 0.12 g/dl) showed nonsignificant ($P\geq0.05$) variation.

The mean globulin values before treatment (5.23 ± 0.66 g/dl) and after treatment (4.89 ± 0.28 g/dl) were significantly higher ($P<0.05$) from that of the control group (3.81 ± 0.73 g/dl). The before and after treatment values between themselves showed nonsignificant variation.

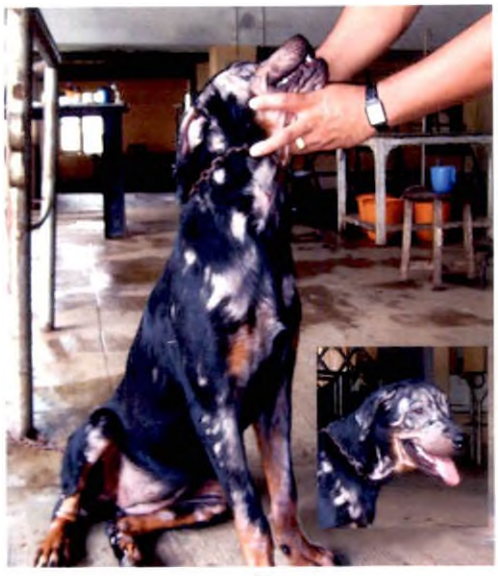
The mean A:G ratio before treatment (0.45 ± 0.21) showed non significant variation from the after treatment value (0.52 ± 0.25) but both were significantly lower ($P<0.05$) compared to the control group value (0.72 ± 0.11).

The difference between the mean values of total protein before treatment (7.36 ± 0.83 g/dl), after treatment (7.43 ± 0.50 g/dl) and that of the control group (6.50 ± 0.35 g/dl) were non significant ($P\geq0.05$)

4.6.3 Ivermectin + Amitraz

4.6.3.1 Clinical Response to Treatment

All the patients showed clinical improvement after three to five weeks of treatment but were positive for demodecid mites on examination of skin scrapings (Plate 6).



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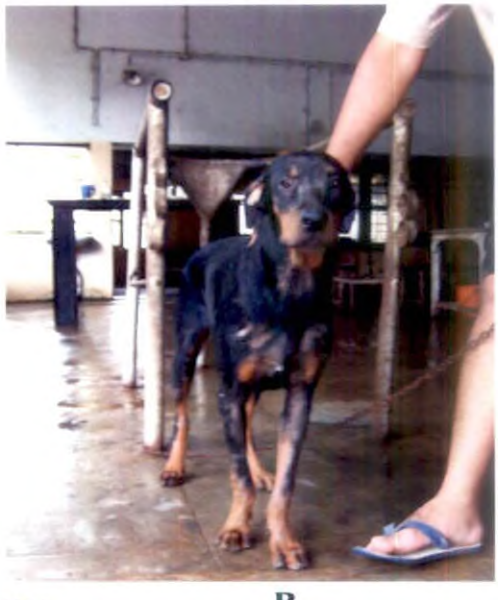


B

C

Plate -5 Group II Amitraz
(A) Before treatment (B) During treatment (four weeks)
(C) After treatment (seven weeks)

Table 22. Haematological parameters of demodicosis affected dogs before and after treatment with amitraz

Haematological parameters	Mean haematological values (Mean±SD)		
	Before treatment	After treatment	Control
Haemoglobin (g/dl)	11.37 ± 0.94^{a}	12.95 ± 1.68	14.63 ± 1.14^{a}
Packed cell volume (%)	34.17 ± 5.19^{a}	41.33 ± 6.62	47.00 ± 5.55^{a}
Total leucocyte count ($10^3/mm^3$)	13.11 ± 0.99	13.20 ± 1.44	13.13 ± 1.88
Neutrophils ($10^3/mm^3$)	8.96 ± 1.99	8.85 ± 1.24	8.52 ± 1.73
Lymphocytes ($10^3/mm^3$)	3.52 ± 0.70	3.71 ± 0.97	4.25 ± 0.89
Monocytes ($10^3/mm^3$)	0.18 ± 0.18	0.25 ± 0.16	0.22 ± 0.16
Eosinophils ($10^3/mm^3$)	0.53 ± 0.22^{ab}	0.16 ± 0.07^{a}	0.13 ± 0.12^{b}
Basophils	--	--	--

Values bearing the same superscripts in a row are statistically significant ($P<0.05$)

Table 23. Biochemical parameters of demodicosis affected dogs before and after treatment with amitraz.

Biochemical parameters	Mean values (Mean ± SD)		
	Before treatment	After treatment	Control
Albumin (g/dl)	2.30 ± 0.70	2.56 ± 0.25	2.69 ± 0.12
Globulin (g/dl)	5.23 ± 0.66^{a}	4.89 ± 0.28^{b}	3.81 ± 0.73^{ab}
A: G ratio	0.45 ± 0.21^{a}	0.52 ± 0.25^{b}	0.72 ± 0.11^{ab}
Total protein (g/dl)	7.36 ± 0.83	7.43 ± 0.50	6.50 ± 0.85

Values bearing the same superscripts in a row are statistically significant ($P<0.05$).

4.6.3.2 Examination of Skin Scrapings

In this group 16.67 per cent of the cases were cleared of the mites by five weeks and 33.33 per cent by six weeks while at seven weeks 66.67 per cent were free from the mites. All the dogs cleared the mites after ten weeks. (Table 17)

4.6.3.3 Determination of Demodicosis Index

The mean demodicosis indices before treatment and after seven weeks were 215.63 ± 82.61 and 8.96 + 18.41 respectively (Table 18). The dogs showed a clinical improvement of 96.94 ± 6.12 per cent after seven weeks (Table 19).

4.6.3.4 Haematological Parameters

Results are presented in Table 24.

Mean haemoglobin value of the dogs before treatment (11.61 ± 0.87 g/dl) was significantly different ($P<0.05$) from the after treatment value (13.23 ± 0.71 g/dl). These values also showed a significant difference ($P<0.05$) from those of the control group (14.6 ± 1.14 g/dl).

Mean value of packed cell volume before treatment (36.67 ± 3.33 per cent) was significantly lower than that of after treatment (43.50 ± 2.17 per cent) and control group (47.0 ± 5.55 per cent). The difference in the after treatment value and control group value was nonsignificant.

There was no significant difference in the mean values of total leucocyte count, absolute neutrophil count, absolute lymphocyte count and absolute monocyte count of the dogs before treatment, after treatment and those of the control group.

Mean value of absolute eosinophil count before treatment in demodicosis affected group (0.86 ± 0.24 x $10^3/mm^3$) was significantly higher ($P<0.05$) compared to the after treatment value (0.15 ± 0.07 x $10^3/mm^3$) and the control group value (0.13 ± 0.12 x $10^3/mm^3$).

4.6.3.5 Biochemical Parameters

Results are presented in Table 25.

The mean value of albumin before treatment (1.56 ± 0.56 g/dl) was significantly lower ($p<0.05$) from that of the control group (2.69 ± 0.12 g/dl) while mean albumin value after treatment (2.16 ± 0.69 g/dl) showed nonsignificant variation from the control group value. The mean globulin value (6.66 ±2.47 g/dl) and A:G ratio, (0.28 ± 0.17), both before treatment was significantly ($P<0.05$) different from that of the control, while mean globulin values (5.77 ± 2.08 g/dl) and A:G ratio (0.47 ± 0.37) after treatment showed no significant difference from the control. The mean value of total protein before treatment (8.23 ± 2.29 g/dl), after treatment (7.93 ± 1.76 g/dl) and that of the control group (6.50 ± 0.85 g/dl) differed nonsignificantly.

4.6.4 Ivermectin + Amitraz + Levamisole

4.6.4.1 Clinical Response to Treatment

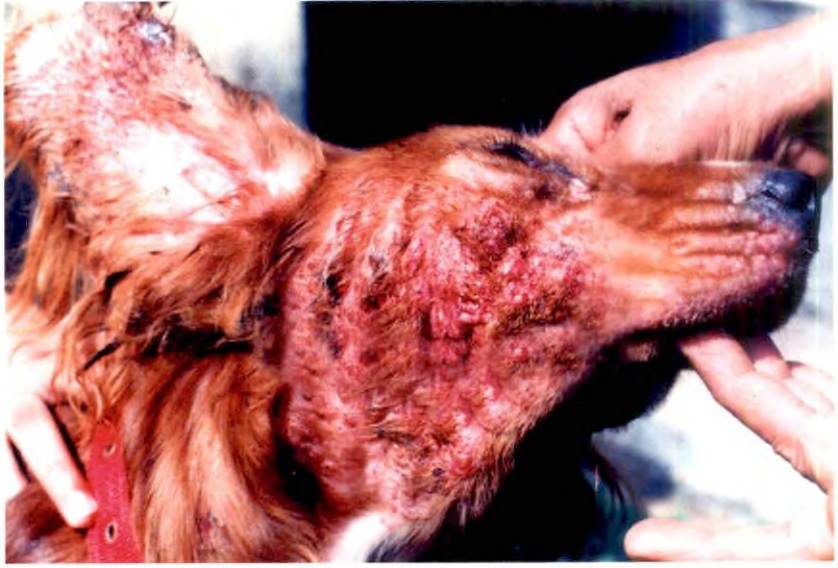
All the patients showed clinical improvement by three to five weeks (Plate 7).

4.6.4.2 Examination of Skin Scrapings

Skin scrapings were negative for the mites in 16.67 per cent of the cases by four weeks of treatment, 33.33 per cent of the cases by five weeks and 83.33 per cent of the cases by seven weeks. All the dogs cleared the mites after ten weeks (Table 17).

4.6.4.3 Determination of Demodicosis Index

Pretreatment demodicosis index was 279.17 ± 132.68 which reduced to 0.63 ± 1.39 after seven weeks (Table 18).



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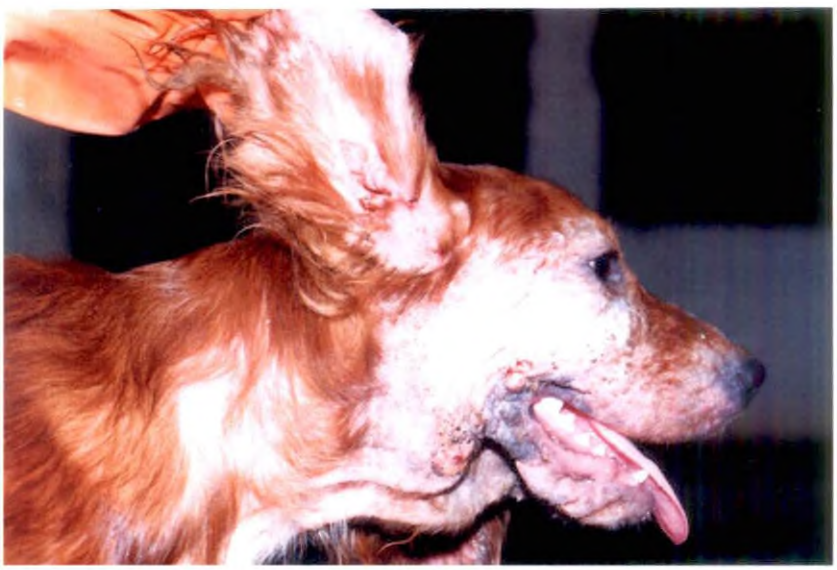

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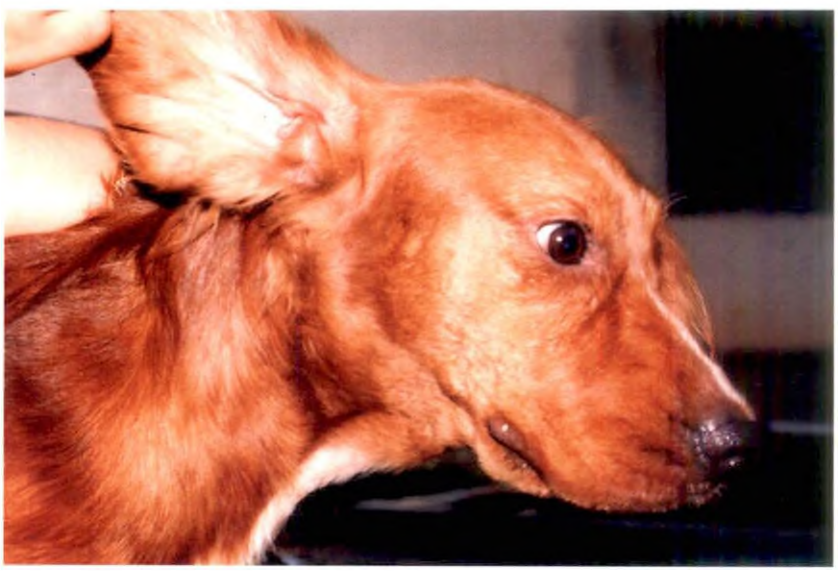


C

Plate -6 Group III Amitraz+Ivermectin
(A) Before treatment (B) During treatment (four weeks)
(C) After treatment (nine weeks)

Table 24. *Haematological parameters of demodicosis affected dogs before and after treatment with a combination of ivermectin and amitraz*

Haematological parameters	Mean Haematological values (Mean±SD)		
	Before treatment	After treatment	Control
Haemoglobin (g%)	11.61 ± 0.87^{a}	13.23 ± 0.71^{a}	14.6 ± 1.14^{a}
Packed cell volume (%)	36.67 ± 3.33^{ab}	43.50 ± 2.17^{a}	47.00 ± 5.55^{b}
Total leucocyte count ($10^3/mm^3$)	12.83 ± 2.75	12.66 ± 2.51	13.12 ± 1.88
Neutrophils ($10^3/mm^3$)	8.49 ± 2.00	8.65 ± 1.49	8.52 ± 1.73
Lymphocytes ($10^3/mm^3$)	3.36 ± 0.64	3.15 ± 0.85	4.25 ± 0.89
Monocytes ($10^3/mm^3$)	0.11 ± 0.13	0.13 ± 0.09	0.22 ± 0.16
Eosinophils ($10^3/mm^3$)	0.86 ± 0.24^{ab}	0.15 ± 0.07^{a}	0.13 ± 0.12^{b}

Values bearing the same superscripts in a row are statistically significant ($P<0.05$).

Table 25. *Biochemical parameters of demodicosis affected dogs before and after treatment with a combination of ivermectin and amitraz.*

Biochemical parameters	Mean values (Mean ± SD)		
	Before treatment	After treatment	Control
Albumin (g/dl)	1.56 ± 0.56^{a}	2.16 ± 0.69	2.69 ± 0.12^{a}
Globulin (g/dl)	6.66 ± 2.47^{a}	5.77 ± 2.08	3.81 ± 0.73^{a}
A:G ratio	0.28 ± 0.17^{a}	0.47 ± 0.37	0.72 ± 0.11^{a}
Total protein (g/dl)	8.23 ± 2.29	7.93 ± 1.76	6.50 ± 0.85

Values bearing the same superscripts in a row are statistically significant ($P<0.05$)

The mean clinical improvement after seven weeks was 99.84 ± 0.35 per cent (Table 19).

4.6.4.4 Haematological Parameters

Results are presented in Table 26.

The mean haemoglobin value before treatment (11.75 ± 0.87 g/dl) was significantly lower ($P<0.05$) from that of the control (14.16 ± 1.14 g/dl), while the after treatment value (13.20 ± 1.17 g/dl) showed nonsignificant variation from the control.

The mean value of packed cell volume showed significant difference ($P<0.05$) between those before treatment (34.33 ± 7.74 per cent) and after treatment (39.67 ± 5.89 per cent); significant difference ($P<0.05$) was also noted between the control group value (47 ± 5.55 per cent) and before treatment value (34.33 ± 7.74 per cent). The difference between the after treatment value and control group value was nonsignificant.

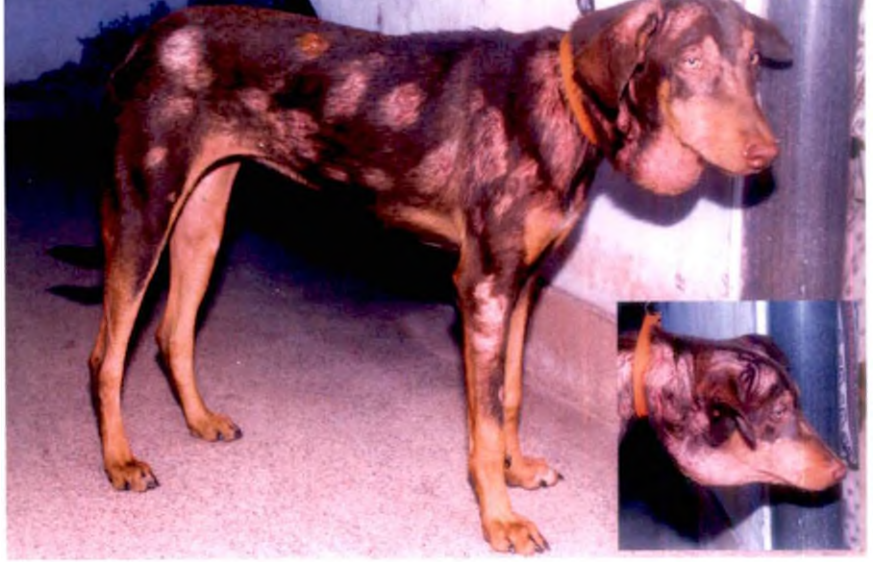
There was no significant difference between the mean values of total leucocyte count, absolute neutrophil count, absolute lymphocyte count, and absolute monocyte count.

Mean value of eosinophil count before treatment (0.67 ± 0.39 $x10^3$ /mm3) was significantly different from those of the control group (0.13 ± 0.12 x $10^3/mm^3$) and after treatment value (0.16 ± 0.16 x $10^3/mm^3$). After treatment value and control group value showed nonsignificant variation.

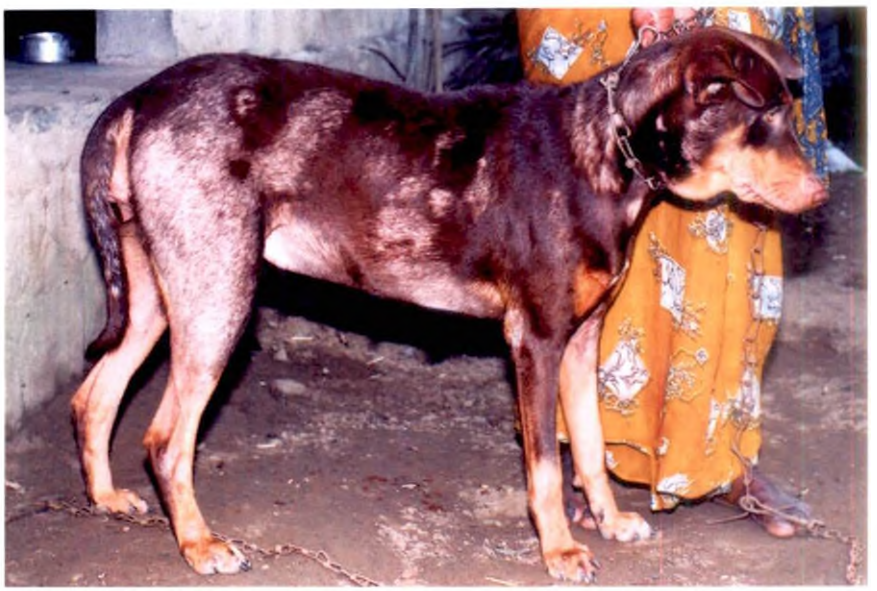
4.6.4.5 Biochemical Parameters

The results are presented in Table 27.

The difference in the mean albumin value before treatment (2.68 ± 0.68 g/dl), after treatment (3.44 ± 0.86 g/dl) and that of the control group (2.69 ± 0.12 g/dl) was nonsignificant ($P\geq0.05$).



A



B

C

Plate -7 Group IV Amitraz+Ivermectin+ Levamisole
(A) Before treatment (B) During treatment (four weeks)
(C) After treatment (eleven weeks)

Table 26. Haematological parameters of demodicosis affected dogs before and after treatment with a combination of ivermectin, amitraz and levamisole.

Haematological parameters	Mean Haematological values (Mean±SD)		
	Before treatment	After treatment	Control
Haemoglobin (g%)	11.75 ± 0.87^{a}	13.20 ± 1.17	14.6 ± 1.14^{a}
Packed cell volume (%)	34.33 ± 7.74^{ab}	39.67 ± 5.89^{a}	47.00 ± 5.55^{b}
Total leucocyte count ($10^3/mm^3$)	12.47 ± 2.99	13.89 ± 2.79	13.13 ± 1.88
Neutrophils ($10^3/mm^3$)	8.99 ± 2.18	8.73 ± 1.69	8.52 ± 1.73
Lymphocytes ($10^3/mm^3$)	3.25 ± 1.49	3.42 ± 1.21	4.25 ± 0.89
Monocytes ($10^3/mm^3$)	0.23 ± 0.17	0.12 ± 0.09	0.22 ± 0.16
Eosinophils ($10^3/mm^3$)	0.67 ± 0.39^{ab}	0.16 ± 0.16^{a}	0.13 ± 0.12^{b}

Values bearing the same superscripts in a row are statistically significant ($P<0.05$)

Table 27. Biochemical parameters of demodicosis affected dogs before and after treatment with a combination of ivermectin, amitraz and levamisole.

Biochemical parameters	Mean values (Mean ± SD)		
	Before treatment	After treatment	Control
Albumin (g/dl)	2.68 ± 0.68	3.44 ± 0.86	2.69 ± 0.12
Globulin (g/dl)	5.80 ± 1.20^{ab}	4.28 ± 1.42^{a}	3.81 ± 0.73^{b}
A: G ratio	0.50 ± 0.16^{ab}	0.88 ± 0.35^{a}	0.73 ± 0.11^{b}
Total protein (g/dl)	8.59 ± 1.31^{a}	7.71 ± 1.58	6.50 ± 0.85^{a}

Values bearing the same superscripts in a row are statistically significant ($P<0.05$).

The mean globulin value before treatment (5.80 ± 1.20 g/dl) was significantly higher ($P<0.05$) from that of the control group (3.81 ± 0.73 g/dl) and from the after treatment value (4.28 ± 1.42 g/dl).

Mean A:G ratio before treatment (0.50 ± 0.16) was significantly different ($P<0.05$) from those after treatment (0.88 ± 0.35) and control group value (0.73 ± 0.11).

Mean values of total protein showed significant difference between the values before treatment (8.59 ± 1.31 g/dl) and that of the control group (6.50 ± 0.85g/dl). The after treatment value (7.71 ± 1.58 g/dl) was nonsignificantly different when compared with the before treatment value and control group value.

4.7 COMPARISON BETWEEN FOUR TREATMENTS

Due to high variation within the group treated with ivermectin, statistical analysis was not justified in this group. The variation was due to the improvement observed in localised demodicosis and worsening of generalised demodicosis.

The other three groups when compared by ANOVA showed no statistical difference both in terms of demodicosis index and per cent improvement ($P\geq0.05$).

Discussion

5. DISCUSSION

5.1 PREVALENCE

The prevalence of canine demodicosis was studied among the dogs presented with dermatological disorders at the University Veterinary hospitals, Mannuthy and Kokkalai during the period from May 2002 to April 2003.

5.1.1 Overall Prevalence

Dermatological problems constituted 10.19 per cent of the total canine cases and out of this 54 cases (0.59 per cent of the total canine cases) were those with mange. Dimri and Sharma (2000) observed a prevalence of 16.0 per cent for skin infections in Western Uttar Pradesh and Kamboj *et al.* (1993a) reported the overall prevalence of dermatitis as 17.05 per cent in the Small animal clinic of Ludhiana. Nayak *et al.* (1997) observed a prevalence of 3.5 per cent for demodicosis over the total canine cases presented in Bhubaneswar. The above reports indicated higher values compared to the present study. The lesser incidence of skin infections in the present study may be explained by more number of people rearing purebred dogs with a good knowledge in pet care and ectoparasite control in the locality.

Out of the total dermatological cases, 5.50 per cent suffered from demodectic mange while a much lower prevalence, 0.32 per cent was noted for sarcoptic mange. The prevalence of demodicosis as observed in the present study agrees with Aujla *et al.* (2000) with 6.04 per cent, Chhabra *et al.* (2000a) with 5.2 per cent and Sreedevi *et al.* (2002) with 5.6 per cent, but all of the above reports detected a much higher prevalence for *Sarcoptes scabei.* A higher prevalence of *Demodex canis* (14.19 per cent) compared to *Sarcoptes scabei* (0.66 per cent) was observed by Neog *et al.* (1995).

Higher incidence of demodicosis compared to scabies might be due to the fact that *Demodex canis* being the normal inhabitant of the skin of the dogs could

flare up and cause the disease whenever a breakdown in immunity is encountered. Secondly since scabies responds effectively to most of the topical acaricides compared to demodicosis (Reedy, 1986), many of the cases might not have been brought to the hospital, since the owners themselves could treat the disease without detailed investigation.

5.1.2 Agewise Prevalence

Highest rate of infection was observed in dogs of 6 to 12 months age followed by three to six months, the difference being statistically significant (Table 3). Among the total per cent positives also, 6 to 12 months age group ranked highest with 39.22 per cent (Fig. 3). This is in agreement with the observation of Cannon (1983), Shirk (1983), Kamboj *et al.* (1993a), Yathiraj *et al.* (1990) and Aujla *et al.* (2000) who reported higher prevalence among 6 to 12 months age group. In generalised demodicosis, out of the total per cent positives higher prevalence was observed among 6 to 12 months age group followed by three to six months. This finding agrees with Folz *et al.* (1984) who observed 50.6 per cent prevalence for generalised demodicosis in 7 to 12 months age group. In localised demodicosis highest prevalence was noted in three to six months age group. According to Grant and Thoday (1991), localised cases occurred mostly in three to six months age group. The reason for the higher prevalence in younger age group might be due to the lowered immune status of young animals attributed to various stress factors like inadequate diet, rapid growth, vaccinations, endoparasitism and separation anxiety, all of which allowed the proliferation of mites (Mundell, 2000). The disease probably might have started as a localised form, which manifested between zero to three months of age as exemplified by the higher occurrence of localised form in this age group in the present study. Some might have healed spontaneously while others progressed to the generalised form precipitated by secondary bacterial infection, further depressing the immune status and allowing the extensive multiplication of mites, manifested at 6 to 12 months of age.

5.1.3 Breedwise Prevalence

Among the total per cent positives purebreds constituted 80.39 per cent, crossbreds, 3.92 per cent and non-descripts, 15.69 per cent (Table 6). This is in agreement with Canon (1983), Folz *et al.* (1984), Yathiraj *et al.* (1990) and Kamboj *et al.* (1993a).

Higher rate of infection was observed in Boxers, followed by Golden retrievers and Rottweilers (Table 5). Infection rates in Dachshunds, Labrador retrievers and spitz were less. This is in disagreement with Aujla et al. (2000) who observed higher prevalence in Spitz and Cocker spaniel and Nayak et al. (1997) observed higher prevalence in Tibetan apso, a long haired breed. According to Gross and Ihrke (1992) juvenile onset demodicosis occurred in any breed but was more common among purebreds like Doberman pinscher, Staffordshire terrier, Bullterrier, Boxer, Pug and in some long haired breeds like Old English sheep dog, German shepherd, Afghan hound and Collie.

Observations made in the present study agree with this statement, except that high prevalence was noted in Rottweiler breeds. Baker (1968) opined that demodicosis was a disease mainly affecting young shorthaired breeds and Day (1999) suggested a possible immunodeficiency in Rottweiler breeds, which might have precipitated the clinical disease.

5.1.4 Sexwise Prevalence

The difference between the rate of occurrence of the disease in male dogs (5.25 per cent) and female dogs (5.73 per cent) was not statistically significant implying that both sexes were equally susceptible to the disease (Table 7). This agrees well with the findings of Nayak *et al.* (1997). On the other hand Aujla *et al.* (2000) observed demodicosis to be more frequent in male dogs (70 per cent) compared to the females. Gupta *et al.* (2000) reported high prevalence in females (64.29 per cent) and suggested that the factors like oestrus, whelping, nursing of young ones and confinement with pups lowered the immunity in females and

made them temporarily susceptible to the disease. This may be the reason for the high rate of infection in females.

5.1.5 Monthwise Prevalence

High prevalence was reported in November (9.68 per cent) followed May (8.16 per cent), December (6.56 per cent) and March (6.31 per cent) (Fig.8). This is in partial agreement with the report of Neog *et al.* (1995) who observed high prevalence of mange in October and November and Aujla *et al.* (2000) in March and November. Dimri and Sharma (2000) reported high prevalence of skin infections in September, August and October and Sreedevi *et al.* (2002) in the rainy season followed by winter and summer months. The high prevalence observed in November, May, December and March in the present study might be due to the hot and humid climatic condition during these months, which might have acted as a stress factor in dogs predisposing to demodicosis.

5.2 CLINICAL SIGNS

The clinical signs included both cutaneous manifestations and systemic signs.

5.2.1 Lesions

5.2.1.1 Types of Lesions

Papules and pustules were observed as the most frequent primary lesions while erythema, alopecia, crusts, scales, excoriations, hyperpigmentation, hyperkeratosis and erosions formed the secondary lesions. In localised demodicosis, all these lesions except erosions were encountered, though to a less severe degree. Papules were the most frequent primary lesion while erythema and alopecia were the most observed secondary lesions. Gupta and Prasad (2001) also observed erythema and alopecia as the most prominent skin lesion in demodicosis.

Mites infected the primary hair follicles of the neonate to infect the numerous hair follicles arising from the triad of these primary follicles. Proliferation of mites within the follicles, ruptured the follicles, released the mites and hairs to the skin surface, which acted as a foreign body and evoked the inflammatory reaction that gave the erythematous appearance to the skin Destruction of the hair follicles caused alopecia, and though there was new hair formation at the base of the hyperkeratinised follicle, replacement was slow. The inflammatory process in the skin also gave access to the pathogenic coagulase positive staphylococci, normally found on the dog's skin that gave rise to pustular reactions, which might become extensive (Baker, 1968).

Pruritus was observed in 66.67 per cent of the localised cases and 86.67 per cent of the generalised cases. Pruritus was seen occasionally in 87.5 per cent of the localised cases, whereas constant pruritus was observed in 61.54 per cent of the generalised cases. According to Sosna and Medleau (1992b), demodicosis was not pruritic unless secondary pyoderma was present. Pyoderma along with self-inflicted trauma due to pruritus might have given rise to other secondary lesions like crusts, scabs, excoriations and erosions. In many cases sebaceous glands were destroyed and follicles were occluded with hyperkeratinised plugs. Scales observed in demodicosis might be due to the increased rate of keratinisation (Moriello, 1987).

5.2.1.2 Distribution of the Lesions

The face (cheeks, commissures of mouth, nasal area, periocular skin) head, neck, forelimbs and ventral abdomen were the most frequently affected sites in localised demodicosis. Hind limbs were seldom affected. Generalised demodicosis followed a more extensive distribution of the lesion, but the lesions were more numerous on the face, chin, head, neck and extremities. Trunk was also affected. According to Muller *et al.* (1989) the most common sites of occurrence were the face and forelegs, which was observed in the present study

also but they stated that abdomen was the least affected part. In the present study abdominal area was also found to be affected in a localised manner.

The head and forelimbs of the pups were in most intimate contact with the bitch while suckling during which time, the transmission of *Demodex canis* occurred and hence the mites and lesions were found to appear first in these areas (Greve and Gaafar, 1966).

5.2.2 Systemic Signs

Pyrexia, lymphadenopathy, reduced food intake and lethargy were observed in generalised demodicosis. In localised demodicosis systemic signs were less frequent. Folz *et al.* (1984) reported lymphadenopathy in 19.1 per cent of the localised demodicosis and 51.8 per cent of the generalised demodicosis. Sosna and Medleau (1992b) and Moriello (1987) observed generalised lymphadenopathy, septicaemia, anorexia, pyrexia and lethargy in dogs affected with demodicosis complicated by secondary pyoderma. Toxaemia produced by large number of mites and their products and secondary pyoderma might have contributed to the systemic clinical signs observed in generalised demodicosis as in the present study.

5.3 TRANSMISSION

Incontact animals were affected in 42.86 per cent of the cases and out of the incontact animals affected 66.67 per cent were littermates. Mites were transmitted from bitches to the puppies during the first few days of life and except for this transmission, the mites spend their entire life cycle on the host (Moriello, 1987). According to Nutting (1976) adult to adult transfer occurred only rarely since the demodicid mites were slow moving and killed by desiccation within 45 to 60 minutes. At the time of suckling since the hair of the puppies were short and that about the mammary gland was sparse, mechanical barrier was not great and the mites were attracted to the warm skin of the new born puppies (Baker, 1968). The humidity during the confinement after the first

few days of whelping also increased the survival period of mites. This type of transfer might be the reason for the high per cent of occurrence among littermates compared to the incontacts. Secondly there has a clearly recognised hereditary predisposition for the development of generalised demodicosis (Moriello, 1987), which also contributed to the high per cent of occurrence among littermates.

5.4 MANAGEMENTAL PRACTICES

5.4.1 Housing

The prevalence of demodicosis was 33.33 per cent in animals kept indoors and 18.52 per cent in animals kept outdoors, while the rest were reared in both indoors and outdoors. Thus the disease was rare in free roaming dogs compared to the confined ones indicating that stress due to confinement played an important role in lowering the immunity. According to Nutting (1976) stress provided commonly under domestication of a physical or biochemical nature or even from other disease causing organisms produced changes in the normal mite population.

Among the 27 affected dogs, 62.96 per cent of the cases in the kennel indicate that dogs confined in the cages were more susceptible. Physical washing of the kennel was resorted in 47.06 per cent of the cases, while chemical washing was done in 52.96 per cent of the cases. The corrosive effect of the chemicals like dettol and phenol used for washing the cages might have damaged the skin of the dogs predisposing them to secondary bacterial infections lowering the immune status and thence to clinical demodicosis.

5.4.2 Bathing

Bathing was practised in all the demodicosis affected dogs with 70.37 per cent of the dogs being given a bath at an interval of one week or less. Thus it can be inferred that frequent bathing increased the susceptibility to the disease. According to Muller and Kirk (1976), water absorbed on to the skin softened the

keratin, which was the main protective barrier. Thus frequent contact with water made the skin prone to fungal, bacterial and ectoparasitic infections, which normally colonise the skin. Soulsby (1982) mentioned that undue use of alkaline soap or shampoo acted as a predisposing factor to the clinical demodicosis.

5.4.3 Brushing

Brushing was not practised in 51.85 per cent of the demodicosis affected dogs while 22.23 per cent were brushed only occasionally. Thus it can be inferred that regular brushing had a positive effect in reducing the incidence of the disease. This may be due to the fact that brushing stimulated the anagen stage by removal of dead shedding hairs and by removal of dirt and discharge and contributed towards animal health and wellbeing (Van der Heiden, 1994)

5.5 TREATMENT

Treatment trials were conducted in 24 dogs diagnosed of having demodicosis. The response to the treatments was assessed on the basis of clinical response to treatments, examination of skin scrapings at weekly intervals and determination of demodicosis index and per cent improvement. Haematological and biochemical parameters were assessed before treatment and after treatment and compared with the control.

5.5.1 Ivermectin

Ivermectin was found to be effective in only those cases with localised lesions. After six weeks of treatment, 33.33 per cent (localised) of the dogs cleared the mites, and after eight weeks, 66.67 per cent (localised) were free from mite infection. This is contradictory to the finding by Sarma *et al.* (1992) who reported recovery in all the cases of localised and generalised demodicosis with three to four injections ivermectin at 200 mcg per kg fortnightly. Vishwakarma *et al.* (1996) reported cent per cent recovery using one to three treatments with ivermectin at 250 mcg per kg dose rate at weekly intervals while Gupta and

Prasad (2001) reported 77.71 per cent efficacy for ivermectin at 200 mcg per kg subcutaneously weekly. The observation made in present study is in agreement with Chhabra *et al.* (2001) who observed that ivermectin at 200 mcg per kg fortnightly, four times was effective only in curing localised demodicosis, and not generalised ones. Sarma and Sharma (2002) noted no significant clinical improvement when treated with ivermectin at 200 mcg per kg at seven day intervals while cent per cent efficacy was obtained with 800 mcg per kg dose rate.

The ivermectin acted by enhancing the GABA mediated transmission causing the neurological paralysis of the mites. It does not kill the parasites and hence the success of ivermectin treatment could be achieved only by its prolonged usage and increasing the frequency (Sarma and Sharma, 2002).

5.5.2 Amitraz

In the group treated with 0.05 per cent amitraz, 50 per cent of the dogs recovered by six treatments (six weeks) and 100 per cent by nine treatments (nine weeks). Similar observation was made by Kraiss and Gothe (1983) who reported cent per cent efficacy with 0.05 per cent amitraz weekly in 8 to12 weeks. Observations made in the present study were a bit higher compared to Bussieras and Chermette (1980) who reported 65 per cent recovery with 0.05 per cent amitraz in 4 to 12 weeks. While efficacies higher than the present study with lower concentration was reported by Cannon (1983), John and Nedunchelliyan (1989), Roy *et al.* (1992) and Yathiraj *et al.* (1990) who reported 95.6 per cent recovery with weekly application of 0.025 per cent amitraz by 10 treatments. Folz *et al.* (1984) observed that 80 per cent of the dogs showed clinical improvement by three to six treatments and obtained a per cent improvement of 92.1 in generalised demodicosis by three to six treatments while cent per cent of the dogs in the present study showed clinical improvement, with a per cent improvement of 96.13 ± 6.39 by six treatments (Table 19). The higher efficacy observed in the present study might be due to the higher concentration of the drug

used and the increased frequency of application adopted. The mean post treatment index observed at the end of six treatments in the present study (13.44 ± 25.83) is in well agreement with Folz *et al.* (1983) who got the post treatment index as 11.3.

Temporary side effects such as pruritus, and sedation were also observed in this group as described by Folz *et al.* (1983). The topical application of amitraz was non-irritant to the eyes and was safe when applied on severely infected and inflamed skin as observed by Shirk (1983).

5.5.3 Ivermectin + Amitraz

The combination of ivermectin and amitraz cured cent per cent of the dogs by 10 treatments (ten weeks). Soni *et al.* (1999) reported cent per cent cure rate in the dogs by day 35 with combination of ivermectin (200 mcg per kg) and amitraz (0.03 per cent) weekly. The lower efficacy of improvement noted in the present study might be due to the variation in the severity of the lesions, pedal involvement of the cases which delayed the treatment response and the stress and hormonal changes associated with oestrus causing exacerbation of the lesions and delay in healing as one of the cases in the present study had pedal involvement and two were in oestrus while undergoing treatment.

5.5.4 Ivermectin + Amitraz + Levamisole

Bhosale *et al.* (2000a) observed 66.67 per cent cure rate in 40 days with a combination of amitraz (0.03 per cent) weekly and levamisole (2.5 mg per kg orally weekly) while in the present study, 83.33 per cent cure rate was obtained with the combination of three drugs. The higher efficacy noted in the present study might be due to the high concentration of amitraz (0.05 per cent) and also due to the immunomodulatory effect of levamisole on T-lymphocytes (Roberson, 1982) and anti parasitic effect of ivermectin.

5.6 HAEMATOLOGICAL PARAMETERS

The mean value of haemoglobin and PCV in the demodicosis affected group was significantly different ($P<0.05$) from those of the control group. This is in agreement with Pathak and Bhatia (1986) and Dimri *et al.* (2000). The reduced haemoglobin concentration in demodicosis affected dogs indicated by decrease in haemoglobin content and packed cell volume may be due to the deteriorated condition of the affected dogs owing to reduced food intake, systemic illness, toxaemia and septicaemia caused by the mites as well as by secondary bacterial infection. All the four treatments increased the values of haemoglobin and packed cell volume towards that of the control group. The difference in the mean values of packed cell volume before and after treatment was significant ($P<0.05$) in groups resorted to ivermectin treatment and combination therapy (III and IV). Mean PCV values before and after treatment showed nonsignificant variation ($P\geq0.05$) in the amitraz treated group and though this difference was significant ($P<0.05$) in the ivermectin treated group, the after treatment values were still significantly lower ($P<0.05$) than the control group. This indicates the higher efficacy of combination therapy in improving the general health status which is in agreement with Uysal (2001) who reported significant difference ($P<0.05$) in the mean haematocrit values before and after treatment with combination of amitraz and ivermectin.

Total leucocyte count, absolute neutrophil count, absolute lymphocyte count and absolute monocyte count revealed nonsignificant variation. This is in agreement with Chhabra *et al.* (2000b) while Pathak and Bhatia (1986) reported leucocytosis and Dimri *et al.* (2000) reported leucocytosis and lymphopaenia in the affected dogs. Aujla *et al.* (2000) observed neutrophilia and lymphocytopaenia in demodicosis affected dogs compared with the control.

In dogs with demodicosis, no neutrophil deficiency or abnormality was detected, as also was the case with humoral immunodeficiency, and in fact their B-cell responses appeared to be higher as in chronic generalised demodicosis. In

terms of cellular immunity, these dogs rarely have lymphopaenia and have no hypocellularity of the T-cell areas and the T-cell defect appeared to be suppression rather than deficiency. The defect was seen in lymphocytic blastogenesis to mitogens (Muller *et al.*, 1989) and this may be the reason for the normal leucocytic count and lymphocytic count observed in the present study.

The absolute eosinophil count was significantly higher ($P<0.05$) in the affected dogs compared to the control group. Except in the ivermectin treated group the difference between the before and after treatment values were also significant indicating the effect of treatments in reducing the count towards its normal value. This is in agreement with Dimri *et al.* (2000) and Aujla *et al.* (2000) who reported increased eosinophil count in the demodicosis affected dogs. Chhabra *et al.* (2000b) reported nonsignificant variation. The high eosinophil count as observed in the present study might be due to the allergic reaction towards the mites and their products, which represented a highly significant antigen concentration. The restoration of the values towards the control group indicated the efficacy of treatments in clearing the mites. The inefficacy of ivermectin may be due to the worsening of generalised demodicosis cases.

5.7 BIOCHEMICAL PARAMETERS

Total serum protein before treatment was higher compared to the control in all the groups, although statistical difference ($P<0.05$) was observed in the ivermectin treated group, and in the group treated with combination of ivermectin, amitraz and levamisole. This is in partial agreement with Gupta and Prasad (2001) who reported significantly higher total protein and globulin ($P<0.05$) in demodicosis affected dogs.

Mean value of albumin was lower in all the treatment groups before treatment compared to the after treatment value and control group value. The difference between the before treatment value and control group value was significant ($P<0.05$) in the group treated with the combination of ivermectin and

amitraz. Hypoalbuminaemia may be attributed for the limb oedema in the affected dogs. Reddy *et al.* (1992) reported significantly lower albumin values in dogs with demodicosis. Shakir *et al.* (1996) observed decreased albumin in dogs with skin disorders. The decreased albumin as observed in the present study might be due to the reduced food intake and deteriorated condition in the demodicosis affected dogs.

The globulin values were significantly ($P<0.05$) higher in the affected dogs compared to the control. This in agreement with Reddy *et al.* (1992) and Shakir *et al.* (1996) who observed significantly higher ($P<0.01$) globulin. Muller *et al.* (1989) reported consistent elevation in the $\alpha 2$ and β-globulin fractions in dogs with generalised demodicosis, while the elevation in γ-globulin fraction was less consistent, but usually accompanied secondary pyoderma. The immunosuppressive factor in demodicosis appeared to be in the β-globulin fraction of the serum and thus the demonstrated immunodeficiency is secondary to the disease and not the cause. The serum immunosuppressive factor also disappeared as the mites were eradicated. The decreased albumin and increased globulin in the affected dogs contributed towards the decreased albumin globulin ratio as observed in the present study. The treatments brought the values towards the control group indicating the efficacy of the treatments in clearing the infection. Significantly ($P<0.05$) higher A:G ratio was observed in the group treated with the combination of ivermectin, amitraz and levamisole after treatment compared to the value before treatment. This may be due to the immunostimulatory effect of both levamisole (Roberson, 1982) and ivermectin (Blakley and Rousseaux, 1991; Charach, 1995) on T-lymphocytes, which aided in a faster response and caused reduction in B-cell hyper reactivity.

5.8 COMPARISON BETWEEN THE FOUR TREATMENTS

Ivermectin given at 200 mcg per kg fortnightly subcutaneously was observed to cure only localised cases. The low efficacy of ivermectin may be due

to low dose rate and lesser frequency of administration. Burrows (2000) opined that ivermectin given at weekly intervals was ineffective against demodicosis.

The per cent improvements in other three treatment groups when compared by ANOVA showed no significant difference indicating that three of them were equally effective. But higher per cent improvement, was observed in the group treated with ivermectin, amitraz and levamisole, even though the difference was not significant statistically. Higher efficacy and faster healing observed in the group treated with the combination of three drugs might be due to the ability of levamisole to stimulate cell mediated immunity by potentiating the rate of T-lymphocyte differentiation (Roberson, 1982), as defect in the cell mediated immunity and blastogenesis of T-lymphocytes (Muller *et al.*, 1989) was observed in demodicosis. When the treatment group II (amitraz) and group III (ivermectin + amitraz) was compared, high per cent improvement (97.98 ± 2.54 per cent) was noted in the amitraz treated group compared to the two drugs in combination (96.94 ± 6.12 per cent) after seven weeks of treatment. The low per cent improvement in group III compared to group II may be due to inclusion of one case of generalised demodicosis complicated with pododemodicosis and one animal in oestrus which delayed the treatment response and variation in the severity of the lesions.

It can be concluded that amitraz is highly effective in clearing the infection and can be recommended for treatment in all cases of demodicosis since it was safe, nontoxic, nonirritant to the eyes and can be easily administered even by the clients (Shirk, 1983). But combination of amitraz with ivermectin and levamisole can be advised for a faster response as the immunostimulatory effects of ivermectin (Blakley and Rousseaux, 1991; Charach, 1995) and levamisole (Roberson, 1982) improves the general health status of the affected dogs thus increasing the efficacy of amitraz treatment especially in case of generalised demodicosis.

Summary

6. SUMMARY

Prevalence of demodicosis was studied among the dogs presented with dermatological problems at the University Veterinary Hospitals, Mannuthy and Kokkalai during the period from May 2002 to April 2003.

Out of the 9099 canine cases presented 927 (10.19 per cent) were having dermatological problems. Among the 927 dermatological cases presented 51 (5.50 per cent) had demodectic dermatitis and three (0.32 per cent) had sarcoptic dermatitis. Prevalence of demodicosis over total mite infection was 94.44 per cent. There was significant difference between the proportion of positive cases among different age groups of dogs with highest rate of infection in those of 6 to 12 months of age (16.13 per cent) followed by three to six months age group (11.68 per cent) and the lowest in one to two years of age (1.88 per cent). Among the total positives also 6 to 12 months age group contributed more (39.22 per cent). In generalised demodicosis dogs of 6 to 12 months age group contributed the maximum with 45.16 per cent and in localised demodicosis, three to six months age group ranked highest with 40 per cent among the total positive cases. Stress factors like rapid growth, vaccinations, parasitic load and inadequate diet might have contributed towards the high rate of infection in younger age group.

Among different breeds highest rate of infection was observed in Boxers (42.86 per cent) followed by Golden retrievers and Rottweilers and lowest in Dachshunds, the difference being statistically significant. Among the total positive cases, German shepherds contributed highest with 43.13 per cent. No influence of sex was observed on the prevalence of demodicosis. Highest prevalence of demodicosis was observed in November (9.68 per cent) followed by May (8.16 per cent).

Papules, pustules, macula and patch were the primary lesions. Erythema and alopecia were the most frequent secondary lesions observed in cent per cent of the cases. Face and extremities were more frequently affected with occasional lesions on the trunk and ventral abdomen. Constant pruritus was noted in 12.5 per cent of the localised cases and 61.54 per cent of the generalised cases. Pyrexia was observed in 53.33 per cent, lymphadenopathy in 40 per cent and limb oedema in 66.67 per cent of the generalised demodicosis, while these signs were absent in localised demodicosis. Reduced food intake was observed in more than 50 per cent of the generalised demodicosis and it was less than 25 per cent in the localised demodicosis.

Out of the incontact animals affected, 66.67 per cent were littermates indicating the transmission of the disease from mother to neonate at the time of suckling. Prevalence of demodicosis was more in dogs kept indoors when compared to those kept outdoors.

Among the 51 cases found positive for demodicosis, 24 dogs were divided into four equal groups and were treated with various drugs viz., 1) ivermectin, 2) amitraz, 3) combination of ivermectin and amitraz and 4) combination of ivermectin, amitraz and levamisole. Efficacy of these drugs against demodicosis was assessed based on the clinical response to treatment, examination of skin scrapings and determination of demodicosis index.

Ivermectin at 200 mcg per kg, administered subcutaneously, fortnightly was found to cure localised demodicosis cases while ineffective in generalised form. In the other three groups cent per cent of the dogs cleared the mites by nine to ten weeks. Weekly per cent improvement and demodicosis index analysed statistically showed no significant difference between these three treatment groups.

Haematological parameters revealed significant reduction ($P<0.05$) in the mean values of haemoglobin and packed cell volume and significant increase

($P<0.05$) in the absolute eosinophil count of the demodicosis affected dogs compared to the control. All the four treatments were having a positive effect in bringing these parameters towards their normal level of the control group after treatment. No significant difference was observed between the control animals and the demodicosis affected dogs before and after treatments on the mean values of TLC, absolute neutrophil count, absolute lymphocyte count and absolute monocyte count.

Biochemical parameters revealed significant reduction ($p<0.05$) in the albumin globulin ratio in demodicosis affected dogs before treatment compared to the control. Albumin was lower while globulin and total protein were higher in the affected dogs. All the four treatments were effective in increasing the albumin globulin ratio, albumin content and reducing the globulin content after treatment. But significant difference in the mean value of A : G ratio before and after treatment was observed in the group treated with the combination of ivermectin, amitraz and levamisole. Although not statistically significant, higher per cent improvement (99.84 ± 0.35 per cent) and faster healing was observed in the group treated with the combination of ivermectin, amitraz and levamisole compared to the amitraz treated group (97.98 ± 2.54 per cent) and the group treated with the combination of ivermectin and amitraz (96.94 ± 6.12 per cent) by seven weeks of treatment.

To conclude the treatment of choice in generalised demodicosis is amitraz in combination with ivermectin and levamisole. The immunostimulatory effects of ivermectin and levamisole improves the general health status of the affected dogs and hence increases the efficacy of amitraz treatment in clearing the infection.

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* Originals not consulted

Appendix

Appendix – I

DERMATOLOGICAL INVESTIGATION PROFORMA

I. Date ..... Case No. ..... Hospital .....
II. Owner's name and address
III. Patient's name ..... Age ..... Breed Sex M/F Colour

Chief complaint

IV. History

(i) 1. When did the problem begin?
2. How did it look like then?
3. How has it changed or spread?
4. Whether the colour of hair changes ☐ change ☐ no change

(ii) Previous history of any skin lesion ☐ Yes ☐ No
If yes

Name of drug used	Duration of treatment		Effect of treatment
	Start	End	

(iii) Other diseases for which treated previously

Name of disease condition
Drug used
Duration of treatment
Effect of treatment
History of vaccination

(iv) Dewormed/Not dewormed

Date of last deworming
Name of the drug used for last deworming

(v) Castrated/Spayed/Not
Parity /NA
Date of last whelping /NA
Mating history

Active/lethargic

(vi) Feed consumption Normal / Less / Anorectic
Diet given usually ☐ Vegetarian ☐ Non-vegetarian

(vii) Season of occurrence :Year round / Seasonal / No seasonality

If seasonal : Summer / Rainy / Winter
Kept : Indoor / Outdoor
Time indoor ..... % Time outdoor .....%

(viii) Whether any in contact animals affected Yes / No
Whether in contact human affected Yes / No

(ix) Bath
Frequency of bathing : Daily / once in two days / once in a week / Once in a fortnight / once in two months / Nil

Soap : Used / Not

If used name of soap :
Practice of brushing : Yes / No
If Yes when : Occasionally / Just before bath / just after bath

Type of kennel : Floor
Roof
Sidewalls

Mode of disinfection of kennel : Just washing / chemical / physical

If chemical disinfectant used (soap / detergent)
Name of chemical

Type of collar used

V. OBSERVATIONS

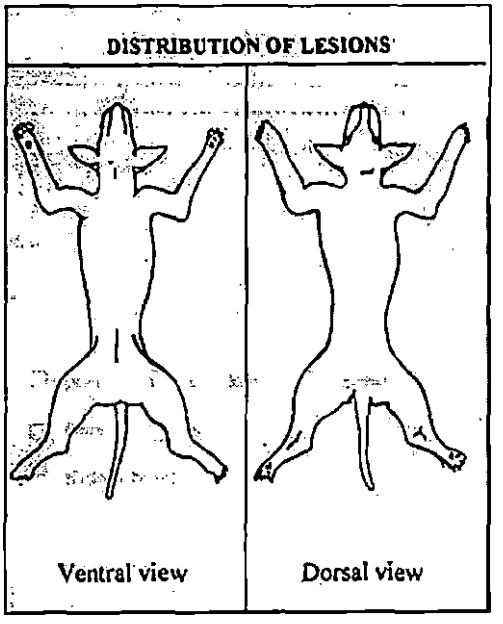
Type of lesion : Primary

☐ Macule	☐ Patch	☐ Papule
☐ Plaque	☐ Nodule	☐ Wheal
☐ Vesicle	☐ Pustule	

Secondary

☐ Scales	☐ Ulcers	☐ Hypopigmentation
☐ Scars	☐ Erythema	☐ Patches of hyperpigmentation
☐ Crusts	☐ Alopecia	☐ Hyperkeratosis
☐ Erosions	☐ Lichenification	
☐ Excoriations	☐ Hyperpigmentation	

Colour of the lesion		Odour of the lesion
Alopecia	:	Present / Absent
If present	:	Localised / Diffuse / Assymetric / Symmetric
Pruritus	:	Present / Absent
If present	:	Constant / Sporadic / only at night



Lesion	:	Many / Moderate / Few / No
Score	:	4 / 3 / 2 / 1

% area of involvement

Skin changes

Elasticity	Extensibility	Thickness
Quality of hair coat	Other factors	
Epilation		
Pelage is	: Dry / Brittle	Dull / oily
Parasites present	: Fleas / Lice / Tick / Sarcoptes / Demodex / Others	

VI. **Laboratory Examination**

1. Wet film examination

2. Faecal sample examination

3. Others

Result of examination of skin scrapings
Direct method :
KOH :

Examination if conducted
Fungus
Bacteria
Result of histopathological sections

VII. TREATMENT

VIII. FOLLOW-UP

	Result of examination of skin scrapings	Lesions				Score				Area involved
		Many	Moderate	Few	No	1	2	3	4	
7th day										
14th day										
21st day										
28th day										

EPIDEMIOLOGICAL AND CLINICO-THERAPEUTIC STUDIES ON CANINE DEMODICOSIS

THUSHARA. M. R.

Abstract of the thesis submitted in partial fulfilment of the requirement for the degree of

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Kerala Agricultural University, Thrissur

2003

Department of Veterinary Epidemiology and Preventive Medicine
COLLEGE OF VETERINARY AND ANIMAL SCIENCES
MANNUTHY, THRISSUR - 680 651
KERALA, INDIA

ABSTRACT

Prevalence of demodicosis was studied among the dogs presented with dermatological problems at the University Veterinary Hospitals, Mannuthy and Kokkalai during the period from May 2002 to April 2003. Among the 927 dermatological problems in canines, demodicosis was diagnosed in 51 (5.50 per cent) and scabies (*Sarcoptes scabei* var *canis)* in three (0.03 per cent) cases.

Significant difference ($P<0.05$) in the proportion of positive cases was noted among different age groups of dogs with the highest rate of infection in 6 to 12 months age group followed by three to six months. Highest rate of infection was observed in Boxers followed by Golden retrievers and Rotteweilers and lowest in Dachshunds, the difference being statistically significant ($P<0.05$). No influence of sex was observed on the prevalence of demodicosis.

Papules and pustules were the most frequent primary lesions and erythema and alopecia, the predominant secondary lesions distributed mostly on the face, neck and extremities with occasional lesions on the trunk of the affected dogs. Constant pruritus with diffuse pattern of alopecia was observed in most of the generalised demodicosis while the pruritus was absent or occasional and rarely constant in localised demodicosis. Out of six incontact animals affected, four were from the same litter indicating the transmission of the disease from the mother to neonate at the time of suckling. Dogs kept outdoors were less frequently affected.

A significant reduction in the haemoglobin, PCV and albumin globulin ratio and an elevation in absolute eosinophil count and globulin content ($P<0.05$) was observed in the affected dogs. All the treatments were effective in bringing these values towards their normal level in the control group.

Ivermectin at 200 mcg per kg, subcutaneously, fortnightly was found to cure only localised cases while it was seem to be ineffective in generalised demodicosis. Weekly per cent improvement and demodicosis index analysed statistically showed no significant difference between the other three treatment groups (1) amitraz, (2) amitraz + ivermectin and (3) amitraz + ivermectin + levamisole. Although not statistically significant ($P<0.05$) faster healing, greater per cent improvement and significant improvement in the haematological and biochemical parameters was observed in the group treated with the combination of ivermectin, levamisole and amitraz. Clinical improvement was observed within three to five treatments and cent per cent of the dogs cleared the mites by 10 treatments.