CLINICO-THERAPEUTIC STUDIES ON CANINE PYODERMA

UDAYASREE. V. J.

Thesis submitted in partial fulfilment of the requirement for the degree of

Master of Veterinary Science

Faculty of Veterinary and Animal Sciences
Kerala Agricultural University, Thrissur

2004

Department of Clinical Medicine
COLLEGE OF VETERINARY AND ANIMAL SCIENCES
MANNUTHY, THRISSUR-680651
KERALA, INDIA

DECLARATION

I hereby declare that the thesis entitled **"CLINICO-THERAPEUTIC STUDIES ON CANINE PYODERMA"** is a bonafide record of research work done by me during the course of research and that this 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.

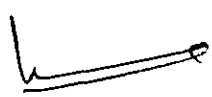
Mannuthy
15.09.2004

Udayasree

UDAYASREE .V.J.

CERTIFICATE

Certified that the thesis entitled **"CLINICO-THERAPEUTIC STUDIES ON CANINE PYODERMA"** is a record of research work done independently by **Dr. Udayasree .V.J.**, 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.



Dr. Usha Narayana Pillai
(Chairperson, Advisory Committee)
Assistant Professor (Sr. Scale)
Department of Clinical Medicine
College of Veterinary and
Animal Sciences, Mannuthy

Mannuthy
15.09.2004

CERTIFICATE

We, the undersigned members of the Advisory Committee of **Dr. Udayasree .V.J.**, a candidate for the degree of Master of Veterinary Science in Clinical Medicine, agree that the thesis entitled **"CLINICO-THERAPEUTIC STUDIES ON CANINE PYODERMA"** may be submitted by Dr. Udayasree .V.J., in partial fulfilment of the requirement for the degree.

Dr. Usha Narayana Pillai
(Chairperson, Advisory Committee)
Assistant Professor (Sr. Scale)
Department of Clinical Medicine
College of Veterinary and Animal Sciences
Kerala Agricultural University
Mannuthy, Thrissur

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

Dr. P.C. Alex
Associate Professor and Head
University Veterinary Hospital
Kokkalai, Thrissur
(Member)

Dr. P.V. Tresamol
Assistant Professor
Department of Veterinary Epidemiology
and Preventive Medicine
(Member)

27/11/04

External Examiner

ACKNOWLEDGEMENT

I wish to express my deep sense of gratitude to Dr. Usha Narayana Pillai, Assistant Professor and Chairperson of the Advisory Committee, Department of Clinical Medicine for her able and patient guidance, personal attention, unceasing encouragement, constant support and timely suggestions throughout the course of this work.

I owe my deep gratitude to Dr. P.G. Baby, Professor and Head, Department of Clinical Medicine and member of the Advisory Committee for his words of inspiration, kindness and professional guidance during the entire period of research.

I am very much thankful to Dr. P.C. Alex, Associate Professor and Head, University Veterinary Hospital, Kokkalai and Dr. P.V. Tresamol, Assistant Professor, Department of Veterinary Epidemiology and Preventive Medicine for the encouragement and valuable suggestions rendered throughout the study period as Advisory Committee members.

I am greatly indebted to Dr. K.M. Jayakumar, Associate Professor, Department of Clinical Medicine for his meticulous guidance, creative suggestions and sustained encouragement throughout my study period.

It is with great pleasure, I would like to thank Dr. M.R. Saseendranath, Associate Professor and Head, Department of Veterinary Epidemiology and Preventive Medicine for the sincere and whole hearted help and valuable suggestions offered to me during the research work.

Co-operations rendered by Dr. S. Ajithkumar, Dr. Premni Elias, Assistant Professors, Department of Clinical Medicine and Dr. V. Vijayakumar, Department of Epidemiology and Veterinary Preventive Medicine are thankfully acknowledged.

I remember with deep sense of gratitude Dr. Nandakumar, Professor and Head (Retd.), Department of Nutrition and Dr. K.M. Syam Mohan, Assistant

Professor, Department of Nutrition for having given the meticulous guidance, technical assistance and for extending facilities for my work.

I sincerely acknowledge the assistance rendered by Dr. Krishnan Nair, Assistant Professor and Dr. P.X. Antony, Ph.D. Scholar, Department of Microbiology.

I owe my sincere thanks to Smt. Sujatha, Assistant Professor and Head, Smt. K.A. Mercy, Assistant Professor, Department of Statistics for their help and whole-hearted suggestions offered in the statistical analysis of the data.

No words can express my deep gratitude to Dr. P.J. Rajkamal, Associate Professor, Department of Extension for his inspiration, encouragement and valuable suggestions offered to me during my study period.

The invaluable help and advise rendered by my friends Dr. Archana, Dr. Seema, Dr. Josemi, Dr. Dhanya, Dr. Ambily, Dr. Bindu, Dr. Sunitha, Dr. Reshma, Dr. Durga, Dr. Preethy, Dr. Indu, Dr. Devi, Dr. Rahul, Dr. Sujith and Dr. Raju is sincerely acknowledged.

I wish to place on record, the invaluable help and understanding rendered to me by my colleagues Dr. Rani Gopinath and Dr. Siby Antony, throughout the course of the academic programme.

I express my heartfelt thanks to Dr. Sindhu .O.K., Dr. Renjith .R. and Dr. Jabeena Martha Philip, without whose help and understanding, it would not have been possible to successfully complete the work.

I do express my sincere thanks to Dr. Siji, Dr. Thushara, Dr. Reena, Dr. Renju, Dr. Prasanna, Dr. Jagaveera Pandian and Naveen.

I sincerely thank other staff members in the Department of Clinical Medicine for their whole hearted co-operation and sincere help during the work.

I am very much thankful to variety pharmaceuticals for providing the 'Ciprowell' samples free of cost for my research.

I also sincerely acknowledge the co-operation and help rendered by Dr. Augustin Antony, College of Horticulture and Dr. N. Viswanathan, Ayurveda College, Thiruvananthapuram.

I sincerely thank Dr. E. Nanu, Dean, College of Veterinary and Animal Sciences, Mannuthy for extending facilities to undertake this study.

I am thankful to KAU for awarding me the fellowship for P.G. study.

I am grateful to Mr. O.K. Ravindran, Peagles, Mannuthy and Mr. George, Platen Printers for their well timed assistance in the preparation of the thesis.

I also thank all my friends and well wishers who helped me directly or indirectly to the completion of this work.

With immense pleasure I would like to acknowledge with gratitude the moral support, encouragement, strength and confidence extended by my best friend Dr. Sudheesh S. Nair for the successful completion of the study.

Words are inadequate to express my profound gratitude to my Achan, Amma, Ammomma, Induchechi, Manuchettan and Kochumol for their moral support, prayers, affection and encouragement during the course of the study, and without which, I could not have completed this course with determination.

Over and above everything, I praise and thank God Almighty for His abundant blessings and grace which enabled me to complete this programme successfully.

UDAYASREE .V.J.

Dedicated to
My Achan and Amma

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF ABBREVIATIONS

g/dl	-	gram per decilitre
g%	-	gram percentage
mg/kg	-	milligram per kilogram
ppm	-	parts per million
µl	-	microlitre
SD	-	Standard deviation

Introduction

1. INTRODUCTION

Dogs are the most loving and loyal companion animals of human-beings and the role of dog as a pet is increasing day by day in our society. Healthy skin and coat greatly contribute to the aesthetic appeal that dogs hold and the pet owners are very particular about the maintenance of healthy coat.

Skin is the largest organ of the body, and act as the anatomic and physiologic barrier between animal and environment. It provides protection from physical, chemical and microbiologic injury and its sensory components perceive heat, cold, pain, pruritus, touch and pressure. In addition, the skin is synergistic with internal organ systems and thus reflects pathologic processes that are either primary elsewhere or shared with other tissues.

Skin, as the outermost integument of body, is the most commonly exposed organ to the adversities of environment and is likely to be affected by various infectious, non-infectious and environmental influences. About 50 to 75 per cent of the patients in small animal practice have skin problems as a chief or concurrent owner complaint and these dermatological disorders continue to be the most difficult problem confronting the practitioner and often warrant our attention in view of their zoonotic, economic and aesthetic importance. Management of dermatological problems is one of the common and daunting tasks encountered by a clinician (Chandler *et al.*, 1991).

Cutaneous bacterial infections or bacterial pyodermas are one of the most common canine skin diseases presented to a small animal practitioner or veterinary dermatologist. The term canine pyoderma covers many clinical pictures, all of which include some degree of pyogenic skin inflammation associated with bacterial infection. It occurs as a result of changes in the skin or immune status of body which facilitate a skin infection and also occurs as a complicating factor in other primary conditions.

Pyoderma manifests itself as a self-limiting condition or as a treatment-resistant, or as a life-threatening infection. Canine pyodermas are classified as surface, superficial, and deep based on the depth of skin involvement.

Diagnosis and treatment of pyoderma is often confusing because the condition can be secondary to a number of other integumentary conditions such as atopy, flea bite allergy, seborrhoea and hormonal imbalances. A careful history and complete physical examination of the dermatologic patient in a systematic fashion is essential to make a correct diagnosis of skin diseases. Appropriate management of pyoderma depends on predisposing causes, pathogenesis, lesion classification, establishing a correct diagnosis, and available treatments. Veterinarians must be familiar with the wide variety of skin lesions that can be confused with pyoderma to avoid misdiagnosis.

Recurrence of pyoderma even after its empirical treatment using a number of oral antibiotics with varying spectrum of activity and efficacy makes the owner frustrated and poses a challenge to the clinician. Hence the present research was undertaken with the following objectives.

(1) To study the epidemiology, clinical signs and clinico-pathological changes in canine pyoderma.

(2) To identify the organisms associated with canine pyoderma and its antibiogram.

(3) To study the clinical response of the cases to the treatment regimen adopted.

Review of Literature

2. REVIEW OF LITERATURE

Cutaneous pyogenic bacterial infections or pyoderma are considered to be important dermatoses affecting dogs. Coagulase positive Staphylococci were reported to be the primary cutaneous pathogens, although various Gram negative organisms were also been incriminated (Ihrke, 1987).

2.1 ETIOLOGY

2.1.1 Normal

Allaker *et al.* (1992) isolated bacteria from the hair and skin of normal dogs and were predominantly *Staphylococci* and aerobic *Corynebacterium*, a small number of *Micrococcus* spp., *Streptococcus* spp., *Bacillus* spp., and aerobic Gram negative bacteria.

Burkett and Frank (1998) isolated *Staphylococcus intermedius* from ten clinically normal dogs.

2.1.2 Primary Causes

Three coagulase-positive staphylococcal species – *Staphylococcus intermedius, Staphylococcus aureus* and *Staphylococcus schleiferi* subspecies *coagulans* could be isolated from the skin of dogs affected with suppurative lesions (Hajek, 1976; Biberstein *et al.*, 1984; Woldehiwet and Jones, 1990).

Bacterial isolates obtained from forty dogs with suppurative skin disorders were *Staphylococcus aureus* 98% (55% pure culture), beta-haemolytic *Streptococci* (30%) gram negative rods (30%), *Staphylococcus epidermidis* (15%) and *Micrococcus* spp. (13%) (Krough and Kristensen, 1981).

Phillips and Kloos (1981) isolated six strains of *Staphylococcus intermedius* from canine clinical specimens, five from pyoderma and one from milk.

Amine-Khodja *et al.* (1983) isolated *Staphylococcus aureus* (84%), *E. coli* (10%), non-haemolytic *Streptococci* (7%), *Pseudomonas* spp. (5%) and *Proteus* spp. (5%) from 493 cases of canine pyodermatitis.

Coagulase-positive Staphylococcus was isolated in pure culture from most dogs with pyodermas (Muller *et al.*, 1989, Slade *et al.*,1984, Cox *et al.*, 1985)

Tissue invasion of *Proteus* spp., *Pseudomonas* spp. or *Escherichia coli* was probably secondary to tissue changes created by *Staphylococcus intermedius* infection (Ihrke, 1983).

Okin (1983) isolated *Staphylococus aureus* from eight cases and *Proteus mirabilis* from three cases of canine pyoderma.

Seventy of the seventy two isolates obtained from the skin of healthy dogs and various surgical and pyogenic lesions were identified as *Staphylococcus intermedius* of seven biotypes and two isolates were identified as *Staphylococcus aureus* of two biotypes (Berg *et al.*, 1984).

Bacteriological examination of 143 cases of pyoderma in dogs revealed *Staphylococcus aureus* as the commonest isolate (Cerri *et al.*, 1984).

Cox *et al.* (1984) identified *Staphylococcus intermedius* as the most frequently cultured staphylococcus in dogs and the most frequent source of *Staphylococcus intermedius* from dogs were infections of the skin, eyes, ears and superficial wounds or incisions.

Staphylococcus intermedius was the most frequently isolated coagulase-positive *Staphylococcus* spp. recovered from pyogenic bacterial skin infections in dogs (Phillips and Williams, 1984).

Vokoun (1985) reported that 306 bacterial isolates were obtained from 203 cases of canine pyoderma. The main pathogen was *Staphylococcus aureus*, found in 65% of cases in pure culture and in further 29% with other bacteria.

Wisselink *et al.* (1985) isolated coagulase-positive *Staphylococci* from 23 German Shepherd dogs with deep pyoderma. In addition to this, hemolytic *Streptococci* were found in eight dogs and *Escherichia coli* in two dogs.

Linda *et al.* (1986) reported the involvement of coagulase negative *Staphylococcus epidermidis, Staphylococcus xylosus, Staphylococcus simulans* and *Staphylococcus hominis* and the involvement of coagulase-positive *Staphylococcus intermedius, Staphylococcus aureus* and *Staphylococcus hyicus* in canine pyoderma.

Medleau *et al.* (1986) reported that out of 201 coagulase positive isolates obtained from pyogenic skin lesions of dogs, 197 were identified as *Staphylococcus intermedius*, three as *Staphylococcus aureus* and one as *Staphylococcus hyicus* and out of fourteen coagulase – negative isolates, five were identified as *Staphylococcus epidermidis*, five as *Staphylococcus xylosus*, three as *Staphylococcus simulans* and one as *Staphylococcus hominis*.

Baker (1987) reported that *Staphylococcus aureus* was generally considered to be the most important primary pathogen of canine bacterial skin disease.

Juntilla *et al.* (1987) identified 99 strains of *Staphylococcus intermedius* among 100 strains of staphylococcus from canine pyoderma.

Reyss-Brion (1987) reported that *Staphylococcus intermedius* was the only bacterial species isolated from canine pyoderma.

Bacteriological study of necrotic material from 461 dogs with pyoderma yielded *Staphylococcus* spp. in 94% of the samples. In 72% of the samples, *Staphylococcus* spp. were isolated in pure culture, and in 22% with *Streptococci*

spp. The remaining 5.9% were various gram negative organisms, such as *Pseudomonas* spp., *Proteus* spp., *Escherichia* spp., *Klebsiella* spp., and *Pasteurella multocida* in pure or mixed culture. 58.5% of the *Staphylococci* behaved like *Staphylococcus intermedius* (Awad-Masalmeh *et al.*, 1988).

Angarano and MacDonald (1989) identified coagulase-positive *Staphylococcus* as a single isolate in 12 of 13 dogs in which bacterial culturing was done and the remaining bacterial culture contained a mixture of a coagulase-positive *Staphylococcus*, a coagulase-negative *Staphylococcus* and a *Streptococcus* spp.

Krick and Scott (1989) isolated three coagulase positive and five coagulase negative haemolytic *Staphylococcus* spp. from eight bacterial cultures obtained from bacterial folliculitis, furunculosis and cellulitis in German Shepherd dogs.

According to Cox (1998) coagulase-positive *Staphylococci* was the primary pathogenic bacteria in skin infections and in deep pyoderma.

Woldehiwet and Jones (1990) reported that *Staphylococcus intermedius* was more frequently isolated from the infected skin of dogs than *Staphylococcus aureus* which was rarely isolated from the skin.

Khosla *et al.* (1991) isolated different species of bacteria from 57 specimens of canine pyoderma. *Staphylococcus aureus* was the principal isolate followed by *Staphylococcus epidermidis*, others were coagulase-negative *Staphylococci* and *Micrococcus* spp.

Samples from 120 cases of canine pyoderma yielded 96 isolates of *Staphylococcus intermedius* and 17 isolates of Gram-negative bacilli and seven gave no aerobic bacterial growth (Noble and Kent, 1992).

Frank and Kunkle (1993) isolated *Staphylococcus intermedius* from 44 dogs with pyoderma. A non- haemolytic *Streptococcus* spp. and beta hemolytic

Streptococcus spp. were isolated in addition to the *Staphylococcus intermedius* from one dog with furunculosis.

Harvey *et al.* (1993) isolated *Staphylococcus intermedius* from pustules of 33 dogs with superficial pyoderma.

Among 229 cases of canine pyoderma in West Bengal, single infections of coagulase positive *Staphylococcus aureus* were found in 101 cases, while the other cases were due to mixed infections of *Staphylococcus aureus, Streptococcus pyogenes, Corynebacterium pyogenes* and *Pseudomonas aeruginosa* (Pal *et al.*, 1993).

Tamura *et al.* (1993) cultured lesions of 62 dogs with pyoderma that resulted in isolation of *Staphylococcus aureus, Staphylococcus inermedius, Staphylococcus hominis, Staphylococcus epidermidis, Staphylococcus hyicus, Staphylococcus simulans* and *Staphylococcus saprophyticus*

Hill and Moriello (1994) stated that *Escherichia coli, Proteus mirabilis* and *Pseudomonas* spp. could exist as concurrent infection with *Staphylococcus intermedius*

Kamboj *et al.* (1995) reported that out of 229 bacterial strains isolated from canine bacterial dermatitis, *Staphylococcus intermedius* was the main organism (82.96%). Other bacterial isolates were *Staphylococcus aureus, Proteus* spp. *E. coli* and *Bacillus* spp. (2.18% each), *Staphylococcus epidermidis* and *Streptococci* spp. (3.49 per cent each) and *Pseudomonas* spp. (1.31 per cent).

Aujla *et al.* (1997) reported that among various bacteria isolated from bacterial dermatitis in dogs, *Staphylococcus* spp. were most commonly (80%) isolated, with *Staphylococcus intermedius, Staphylococcus aureus* and *Staphylococcus epidermidis* being recovered in 45, 22.5 and 12.5% of cases, respectively.

Farca *et al.* (1997) isolated four *Staphylococcus aureus*, one *Escherichia coli* and three *Proteus mirabilis* from five dogs with chronic bacterial dermatitis. In three cases, two different bacterial strains were isolated from the lesions.

Mueller *et al.* (1998) reported that bacterial cultures taken from 65 dogs with clinical and cytological features consistent with bacterial pyoderma in Australia revealed *Staphylococcus intermedius* in 50 dogs (77%). Other bacteria isolated were *Escherichia coli, Proteus* spp., *Pseudomonas aeruginosa* and *Streptococcus faecalis.*

The bacteria isolated from 27 cases of canine dermatitis included *Staphylococcus aureus, Streptococcus pyogenes, Actinomyces pyogenes, Bacillus* spp. and *Pseudomonas aeruginosa* (Batta *et al.*, 1999)

Carlotti *et al.* (1999) isolated 50 strains of bacteria from thirty-six cultures of canine pyoderma. *Staphylococcus intermedius* was the most frequent isolate followed by *Staphylococcus aureus, Staphylococcus hyicus* and *Staphylococcus hominis*. Gram-negative bacteria such as *Proteus* spp., *Pseudomonas* spp. and *Escherichia coli* were isolated from three (8%), five (14%) and four dogs (11%) respectively.

Littlewood *et al.* (1999) obtained cultures from bacterial skin disease of 51 cases and isolated coagulase-positive *Staphylococcus* spp. from the lesions of 46 cases. In 14 cases, other organisms were also isolated, including beta haemolytic *Streptococci*, non-haemolytic *Streptococci.* Coliforms, *Acinetobacter* spp., *Corynebacterium* spp. and a scanty growth of *Pseudomonas* spp. in one case. The lesions of four cases yielded coagulase-negative *Staphylococci*, with other organisms also being isolated from two of them. A heavy, mixed growth of a non-haemolytic *Streptococcus* and *Acinetobacter* spp., but no *Staphylococci* were isolated from one case.

Mathews (1999) isolated *Staphylococcus intermedius* from 21 cases of canine pyoderma.

Patil *et al.* (1999) isolated coagulase positive *Staphylococcus* spp. (82%) and coagulase negative *Staphylococcus* spp. (12%) from fifty dogs showing clinical pyoderma. *Streptococcus* spp. were isolated from 28% of pyodermic dogs of which 20% were beta and 88% were alpha haemolytic *Streptococcus. Micrococcus, Pseudomonas, Proteus* and *Klebsiella* spp. were isolated in 6%,12%, 8% and 6% cases, respectively as a mixed infection along with *Staphylococcus.*

Staphylococcus intermedius was isolated in 15 of 21 dogs with superficial bacterial pyoderma (Bloom and Rosser, 2001)

Paradis *et al.* (2001) performed pre-treatment aerobic bacteriologic cultures of skin lesions in 47 dogs and the predominant pathogen isolated was *Staphylococcus intermedius.*

Bes *et al.* (2002) reported that *Staphylococcus intermedius* was the most common cause of canine skin infections followed by *Staphylococcus aureus Staphylococcus schleiferi* subspecies *coagulans.*

Petersen *et al.* (2002) isolated *Staphylococcus intermedius* (88.6%) and *Pseudomonas aeruginosa* (7.5%) from canine pyoderma cases over a six year period (1992-1997)

Staphylococcus intermedius was commonly isolated from canine pyoderma (Lewis, 2003).

2.1.3 Predisposing Causes

Scott (1981) and Willemse (1986) reported that 33 per cent and 26.5 per cent, respectively, of dogs with atopic dermatitis had concurrent pyoderma.

Pre-existing disease like seborrhoea or allergy, poor grooming, ectoparasites, immune incompetence, endocrinopathies like hypothyroidism and

Cushing's disease and injudicious use of corticosteroids predisposed to pyoderma (Ihrke, 1987).

Pyodermas could be secondary to conditions that increased the bacterial population on the skin such as poor hygiene, seborrhea, pruritus, diseases that broke down the skin's barrier to bacteria as ectoparasites or to diseases that might compromise immune function as endocrine diseases, nutritional abnormalities and metabolic disorders (Stewart, 1988)

Hyperadrenocorticism could cause cutaneous signs like alopecia, hyperpigmentation, thin skin, comedones, calcinosis cutis and pyoderma (Sousa, 1990).

Secondary pyoderma caused by *Staphylococcus intermedius* was common in dogs and cats affected with diabetes mellitus (Campbell *et al.,* 1991).

Higher incidence of canine pyoderma was correlated with rainfall and relative humidity (Pal *et al.,* 1993).

Day (1994) suggested that immune dysfunction was a factor which predisposed German shepherd dogs to deep pyoderma.

Factors that predisposed to development of Staphylococcal pyoderma included immunodeficiency, primary dermatosis caused by parasites or other forms of skin damage and allergy (Gyles and Thoen, 1994).

According to Dowling (1996), canine atopy was the most common cause of recurrent canine pyoderma.

Panciera (1997) stated that hypothyroidism could predispose dogs to recurrent pyoderma.

Cell-mediated hypersensitivity reactions, immune complexes, host aspects including genetic, endocrine and immunological factors might lead to development of canine pyoderma (Biberstein and Hirsh,1999).

2.2 EPIDEMIOLOGY

2.2.1 Incidence of Bacterial Dermatitis or Pyoderma

It has been estimated that 20% to 75% of the cases seen in the average small animal practice had skin problems as a chief or concurrent owner complaint (Nesbitt, 1983).

Sischo *et al.* (1989) reported that pyoderma ranked third among the ten most common skin disorders in dogs in 17 North American Veterinary Teaching Hospitals.

Among dermatological diseases, canine pyoderma represented the second most frequently reported skin disease internationally, after flea allergy dermatitis (Ihrke, 1987).

Scott and Paradis (1990) reported that dermatological disorders accounted for 18.8% of all the dogs examined at the Small Animal Clinic, University of Montreal, Saint-Hyacinthe, during a one-year period. The most common groups of dermatological disorders encountered were bacterial folliculitis and furunculosis, allergic dermatitis, endocrinopathy, neoplasia, ectoparasitism and immune-mediated dermatitis.They diagnosed 141 bacterial folliculitis and furunculosis, one impetigo and one zinc-responsive dermatosis among 558 dermatological disorders in dogs and the most common dermatological disorders seen in dogs were bacterial folliculitis and furunculosis (25.3%).

Pal *et al.* (1993) reported that out of 229 cases of canine pyoderma in West Bengal 157 were superficial pyoderma (of which 94 cases were skin fold pyoderma) and 72 were deep pyoderma.

Overall incidence of bacterial dermatitis from 825 dogs investigated at the small animal clinics of Punjab Agricultural University was found to be 40.24 per cent (Kamboj *et al.*, 1995).

Aujla *et al.* (1997) reported that out of 3075 dogs examined, dermatitis was seen in 281 (9.13%) dogs, of which bacterial dermatitis formed 31.31%.

Of 39 canine pyoderma cases studied, percentage of folliculitis was 23, furunculosis 28, cellulitis 44 and interdigital pyoderma five (Carlotti *et al.*, 1999).

Mathews (1999) reported that the overall prevalence of bacterial dermatitis was 42%. Out of different clinical bacterial dermatitis conditions, superficial bacterial folliculitis was the most prevalent one (38.1%) followed by impetigo (28.6%) and German Shepherd Dog Pyoderma (19.0%). The other clinical bacterial dermatitis were furunculosis (9.5%) and infantile pustular dermatoses (4.8%).

Saridomichelakis *et al.* (1999) reported that otitis externa (43/91) and bacterial pyoderma (30/91) were the most common conditions associated with canine atopic dermatitis in 91 dogs in Greece.

Choi-Won Pil *et al.* (2000) diagnosed bacterial pyoderma in 40.4 per cent of dogs from 70 dogs with dermatitis.

2.2.2 Age

Slade *et al.* (1984) reported that the mean age of 26 dogs with pyoderma was 3.5 years (range, 6 months to 13 years).

The age of 23 German Shepherd dogs with deep pyoderma ranged from four to twelve years with mean of seven years (Wisselink *et al.*, 1985).

Angarano and MacDonald (1989) reported that the age of dogs with bacterial dermatitis, ranged from four months to 16 years.

Retrospective analysis of 17 cases of bacterial folliculitis, furunculosis and cellulitis in German Shepherd dogs revealed that the age of the affected animals ranged from three months to 13 years and the disease seemed to affect primarily middle-aged dogs with mean age of five years (Krick and Scott, 1989).

White *et al.* (1989) reported that age of 15 dogs with juvenile cellulitis ranged from 3 to 12 weeks with a mean age of 6.8 weeks.

Halliwell (1990) stated that Staphylococcal pyoderma had a peak age of onset around puberty and in the young to middle-aged dogs.

Survey of canine and feline skin disorders at Saint-Hyacinthe area revealed that there were no apparent age or sex predilections for dermatological disease as a whole (Scott and Paradis, 1990).

Canine pyoderma due to Gram-positive cocci was more common in animals of one to five years of age (Khosla *et al.*, 1991).

The mean age of dogs affected with pyoderma was 5.2 years (Frank and Kunkle, 1993) and 4.8 years(Harvey *et al.*,1993).

Pal *et al.* (1993) reported that percentage of clinical cases of canine pyoderma was greater in younger and older age groups.

Aujla *et al.* (1997) reported greater prevalence of bacterial dermatitis in dogs upto two years of age (26.48%).

Carlotti *et al.* (1999) reported that the age of the animals affected with pyoderma ranged from one to 14 years with a mean of 5.2 years and their weight varied from nine to 53 kg with a mean of 32 kg.

Age-wise prevalence of bacterial dermatitis revealed that dogs below six months of age were more frequently affected followed by an equal incidence in the age group of one to four years, and above four years group (Mathews, 1999).

Clinical pyoderma was more commonly seen in dogs aged between one and four years (46%) followed by dogs aged between four and eight years (28%) (Patil *et al.*, 1999).

2.2.3 Sex

Slade *et al.* (1984) reported that out of 26 cases of canine pyoderma, 20 were males, five were females and one was a neutered female.

Wisselink *et al.* (1985) reported that out of 23 German Shepherd dogs with deep pyoderma, fifteen were intact male dogs and three of the female dogs had been ovariohysterectomized.

Angarano and MacDonald (1989) stated that out of thirty dogs with bacterial dermatitis, 17 were males and rest were females.

Krick and Scott (1989) reported that out of 17 German Shepherd dogs with bacterial folliculitis, furunculosis and cellulitis, included six intact males, three intact females, two castrated males and six spayed females.

White *et al.* (1989) reported that out of 15 dogs with juvenile cellulitis, seven were females and eight were males.

In a study of pyoderma in 45 dogs by Frank and Kunkle (1993), 22 were males and 23 were females.

According to Harvey *et al.* (1993) sex wise distribution of canine pyoderma in 30 dogs were as follows: seven females, twelve neutered females, ten males and one neutered male.

Pal *et al.* (1993) reported that clinical cases of canine pyoderma were more in males than females.

Kamboj *et al.* (1995) reported that bitches were more susceptible to bacterial dermatitis (70.59%) than males (29.41%).

Carlotti *et al.* (1999) reported that 43.6% of dogs with pyoderma were females and 56.4% were males.

Sex-wise prevalence of bacterial dermatitis showed that 47.6% were females and 52.4% were males (Mathews, 1999).

Incidence of pyoderma was more in male (62%) than in female (38%) (Patil *et al.*, 1999).

Choi-Won Pil (2000) reported that there was no significant difference due to sex or living conditions on canine dermatitis in the Korean Republic.

Of twenty-one dogs with superficial bacterial pyoderma included five males, ten spayed females and six castrated males (Bloom and Rosser, 2001).

2.2.4 Breed

Okin (1983) reported that short haired breeds were at greater risk for juvenile cellulitis.

According to Krick and Scott (1989), German Shepherd Dogs were more prone to recurrent bacterial folliculitis, furunculosis and cellulitis.

Scott and Paradis (1990) reported that Newfoundland, Golden Retriever and Collie were at increased risk to develop bacterial folliculitis and furunculosis. German Shepherd dogs accounted for one-third of cases of recurrent, idiopathic bacterial folliculitis and furunculosis and it was attributed to an autosomal recessive inheritance.

Pal *et al.* (1993) reported that clinical cases of canine pyoderma were more in German Shepherds compared to other breeds.

Aujla *et al.* (1997) reported that pure bred dogs were more susceptible (76.48%) to bacterial dermatitis than mixed breeds (23.52%).

Carlotti *et al.* (1999) observed that 23.1% German Shepherd dogs, 10.3% Labrador Retriever, 7.7% Boxer, 7.7% Cocker Spaniel, 7.7% Cross breeds, 7.7% English setter and 39% others were susceptible to pyoderma.

Mathews (1999) reported that the breed-wise prevalence of bacterial dermatitis indicated Non-descript dogs were more affected (33.3%) followed by German Shepherd (23.8%), Dobermann and Dachshunds (19.1% each) and Labrador (4.8%).

Long haired breeds (86%) were prone to pyoderma than short haired breeds (14%) (Patil *et al.*, 1999).

Choi-Won Pil *et al.* (2000) reported that bacterial pyoderma was common in long haired breeds.

2.3 PATHOGENESIS

Ihrke *et al.* (1978) stated that bacterial infection and pruritus develop from a combination of factors, including response of host, nutritional state, integrity of the cutaneous barrier and toxins produced by the bacteria.

According to White *et al.* (1983), the potential existence of a reservoir of *Staphylococcus aureus* on the hair should be considered in the pathogenesis and therapy of canine skin diseases.

Slade *et al.* (1984) and Halliwell (1990) reported that hypothyroidism might be involved in the pathogenesis of canine pyoderma.

The presence of protein A in *Staphylococcus intermedius* could contribute to the pathogenesis of staphylococcal infections in animals (Cox *et al.*, 1986; Fehrer *et al.*, 1986).

Baker (1987) and Wisselink *et al.* (1988) stated that staphylococcal hypersensitivity might be an important factor in the pathogenesis of canine pyoderma.

Devriese and De Pelsmaecker (1987) suggested that *Staphylococcus intermedius* might be a resident of the mucosae and from mucosae the bacteria

were seeded to the hair and skin during grooming and other activities providing a source of infection in the development of canine pyoderma.

Ihrke (1987) stated that Protein A is a substance, elaborated by certain staphylococcal strains which can prevent access of specific antibody, which prematurely triggers the complement cascade, and acts as a chemo-attractant for neutrophils.

Mason and Lloyd (1989) stated that hypersensitive dogs were shown to have significantly higher surface counts of Staphylococci than normal controls and these bacteria were concentrated in the more superficial layers of the stratum corneum. A major role of hypersensitivity reactions in the pathogenesis of pyoderma might be by an effect on epidermal permeability, promoting penetration of Staphylococcal antigens from the stratum corneum which then caused the lesions of pyoderma.

Muller *et al.* (1989) stated that staphylococcal species were capable of producing many toxins and enzymes with the potential to produce pruritus.

Miller (1991) proposed breed-related immunodeficiency as a contributory factor in the pathogenesis of deep pyoderma in German Shepherd dogs.

The study of Keane and Taylor (1992), demonstrated that Staphylococci isolated from canine pyoderma were capable of producing slimes which enhanced the ability of the organism to adhere to the skin.

Staphylococci obtained from canine pyoderma were documented to contain Protein A that could elicit immediate and delayed hypersensitivity reactions resulted in erythema, pruritus and pustule formation (Hill and Moriello, 1994).

The host's immune status had been implicated as a contributory factor in canine pyoderma but most studies on host factors had been inconclusive (Chabanne *et al.*, 1995; Chammas and Hagiwara, 1998).

Burkett and Frank (1998) reported that production of exotoxin by *Staphylococcus intermedius* did not play a role in the recurrent nature of pyoderma in atopic dogs or on type of lesion or severity of pruritus associated with pyoderma.

McEwan (2000) reported that atopic dermatitis might cause staphylococcal pyoderma in canines due to increased adherence by pathogenic staphylococci to keratinocytes in atopic dermatitis.

Hendricks *et al.* (2002) documented the potential role of staphylococcal superantigens in the pathogenesis of canine pyoderma.

2.4 CLINICAL SIGNS

2.4.1 Surface Pyoderma

Ihrke (1987), Mason (1991) and Hill and Moriello (1994) classified canine pyoderma as surface, superficial and deep on the basis of depth of infection within the skin. They reported that the classic lesion of pyotraumatic dermatitis appeared as a well-demarcated area of alopecia that oozes serum and becomes covered with purulent exudates and matted fur and the lesion had a yellowish center with an erythematous periphery.

Reinke *et al.* (1987) described the typical lesions of hotspots or acute moist pyotraumatic dermatitis as well demarcated areas of alopecia, erythema, exudation, erosion and ulceration.

Codner (1988a) reported that the characteristic lesion of surface pyoderma was a well-demarcated area of alopecia that oozes serum and becomes crusted with exudates or covered with matted hair and it had a yellow center surrounded by an erythematous halo.

The most commonly observed surface pyodermas were classified into acute moist dermatitis and skin-fold pyoderma (Muller *et al.*, 1989).

2.4.2 Superficial Pyoderma

Lesions of superficial pyoderma included erythematous papules, pustules, cysts, folliculitis, furuncles and fistulous tracts and pruritus (Baker, 1987).

Crusted papules, pruritus without marked gross skin changes and collarette were the lesions of superficial pyoderma (Ihrke, 1987).

Codner (1988a) reported that superficial folliculitis was the most common form of pyoderma in dogs and the lesions characterized by papule or pustule at the base of the hair, some time the pustule ruptured and formed a crust. End-stage lesions included epidermal collarettes and circular areas of alopecia that might have an erythematous border or hyperpigmented center. Hemorrhagic bullae and seborrheic plaques were also seen as characteristic lesions of superficial folliculitis. As adjacent hair follicles became infected and hair lost, the coat appeared as "moth-eaten".

Rhodes (1990) reported that the primary lesion of superficial pyoderma was a small inflammatory pustule with a hair protruding from the centre. The staphylococcal folliculitis appeared as a "moth eaten" alopecia if the condition was chronic. Short coated breeds occasionally manifested superficial pyoderma as non-inflammatory alopecia and were often misdiagnosed as having endocrine disorders.

According to Pal *et al.* (1993) canine pyoderma was characterized by hyperkeratinization, acanthosis, papillomatosis, thinning and erosion of epidermis.

Curtis *et al.* (1995) reported three cases of canine eosinophilic folliculitis and furunculosis. The disease was characterized by the rapid development of pruritic, papular, pustular and ulcerative lesions on the dorsum and muzzle. In two cases, skin lesions were confined to the face and the third dog had generalised pustular lesions. Eosinophil infiltration was prominent in these cases.

According to Lloyd *et al.* (1997), folliculitis was characterized by the presence of papules or pustules centred on hair follicles.

Dermatological observations of superficial pyoderma consisted of papule (66.6%), pustule (86.6%) and hyperpigmentation (53.3%). These skin lesions were seen on the back (35.5%), abdomen (29.0%), axilla (6.4%), legs (3.2%), neck (3.6%) and foot (16.1%) (Oh-Taeho and Oh, 1999).

Craig (2003) stated that epidermal collarettes, follicular papules and pustules, round patches of alopecia, erythema, scaling, crusting and hyperpigmentation were highly suggestive lesions of superficial bacterial folliculitis.

Lewis (2003) reported that circular-alopecia, a moth-eaten appearance to the hair coat, epidermal collarettes, honey-coloured crusts, papules, pustules, macules and crusted plaques were typical lesions of superficial pyoderma in the dog.

2.4.3 Deep Pyoderma

The major lesions of deep pyoderma were located in the dermis and the subcutis, resulting in ulceration, fistulation, necrosis and edema (Ihrke, 1987).

According to Lloyd *et al.* (1997), furunculosis was associated with the formation of deep papules, pustules and nodules, with discharging exudates and crust formation.

Craig (2003) stated that clinical features of deep pyoderma included papules and pustules, alopecia, plaques, draining tracts, ulcers, crusting and hyperpigmentation.

2.4.4 Puppy Pyoderma

In juvenile impetigo, the glabrous skin of young dogs was usually affected and the lesions were seen on ventral abdomen, medial thighs and the

axillae with multiple papules, crusting with surrounding erythema with moderate to severe pruritus (Thoday, 1980).

Juvenile cellulitis or juvenile pyoderma was characterized by oedema, cellulitis and alopecia of the face, head and ears and occasionally the preputial and perianal areas (White *et al.*, 1989).

Mason (1991) stated that impetigo or juvenile pustular dermatitis was a benign condition in which subcorneal pustules formed in the inguinal and axillary regions of sexually immature dogs.

Lewis (2003) reported that non-follicular pustules were localized to the sparsely haired skin of the ventral abdomen and occasionally the axilla in puppies aged two to nine months with puppy pyoderma. Ruptured pustules appeared as small yellowish crusts or epidermal collarettes and pruritus might be absent.

2.4.5 German Shepherd Dog Pyoderma

Wisselink *et al.* (1985) reported that the lesions of deep pyoderma in German Shepherd dogs included fistulae, clusters of pustules, ulceration, alopecia, hyperpigmentation and thickening of the skin.

Krick and Scott (1989), observed that the lesions of 17 German Shepherd dogs with bacterial folliculitis, furunculosis and cellulitis consisted of combinations of follicular papules and pustules, furuncles, epidermal collarettes, erosions, ulcers, fistulas, cellulitis, crusts, alopecia, scales, hyperpigmentation and hyperkeratosis and in sixteen dogs pruritus ranged from mild to intense. In thirteen of the seventeen dogs lesions initially developed over the rump and hindquarters and later progressed to more widely distributed lesions.

2.4.6 Zinc Responsive Dermatosis (Dry Pyoderma)

The lesions which consisted of thick keratinous plaques involving the planum nasale, footpads, and pressure points similar to zinc-responsive dermatosis was known as dry pyoderma (Anderson, 1977).

Sanecki *et al.* (1982) and Sousa *et al.* (1988) reported that zinc deficient dogs developed cutaneous lesions consisting of erythematous papules and pustules, crusting, erosions and ulcerations in a bilaterally symmetrical pattern over the distal portions of extremities, muco-cutaneous junctions, perineal area, ventral abdomen and thorax and the condition could be reversed with a zinc-adequate diet.

Most dogs with dry pyoderma had been shown to have a zinc-responsive dermatosis (Ohlen and Scott, 1986).

Codner (1988b) stated that immune-mediated diseases and zinc-responsive dermatitis might affect the footpads, which then become secondarily infected and lead to pododermatitis.

Manifestations of zinc deficiency in small animals included erythema followed by crusting, alopecia, scaling and underlying suppuration primarily on the face, mucocutaneous junctions, pressure points, and extremities including the foot pads (Willemse, 1992).

2.5 CLINICAL PATHOLOGY

2.5.1 Haematological Changes

2.5.1.1 Packed Cell Volume

Wisselink *et al.* (1985) reported slightly decreased PCV of 36 to 39% in five German Shepherd dogs with deep pyoderma

Van den Broek and Thoday (1986) reported that the complete blood count in five dogs with skin disease associated with zinc deficiency were within the normal limits.

White *et al.* (1989) reported normocytic, normochromic anemia (PCV = 27 to 34%) in six dogs with juvenile cellulitis.

Mathews (1999) reported the mean PCV value of 21 dogs with pyoderma as 43.3 ± 7.3 per cent.

2.5.1.2 Total Leukocyte Count

Fadok (1982) reported slight leucocytosis in zinc-responsive dermatosis in canines.

Krick and Scott (1989) reported mild leukocytosis (21.9 x 10^3 to 22 x 10^3) in eight German Shepherd dogs with bacterial folliculitis, furunculosis and cellulitis.

White *et al.* (1989) reported leukocytosis (24,000 to 26,800 WBC/µl) in six dogs with juvenile cellulitis

Aujla *et al.* (1997) reported a marked leucocytosis (TLC – 27.88 thousands/cu. mm) in bacterial dermatitis.

The mean total leukocyte count of 21 dogs with pyoderma was 14926.0 ± 4802/cmm (Mathews, 1999).

2.5.1.3 Differential Leukocyte Count

Wisselink *et al.* (1985) reported leucocytosis varying from 15.6 to 20.2 x 10^9/L due to increased numbers of polymorphonuclear granulocytes in eight German Shepherd dogs with deep pyoderma.

Pyogenic bacteria such as *Staphylococcus*, *Streptococcus* and *Corynebacterium* spp. produced a more marked neutrophilia and left shift and Gram negative bacteria might produce neutropenia (Coles, 1986).

Krick and Scott (1989) reported neutrophilia in four German Shepherd dogs with bacterial folliculitis, furunculosis and cellulitis.

White *et al.* (1989) reported neutrophilia (70 to 78% mature neutrophils) in four dogs with juvenile cellulitis.

Morris and Dunn (1992) reported that leukaemoid response was an intense neutrophilia (greater than 80 x 10^9/litre) with a pronounced regenerative left shift and was most frequently seen with localized infections. In acute infections and inflammations neutrophilia and eosinophilia were seen whereas in pyogranulomatous diseases and tissue necrosis monocytosis were predominant.

Aujla *et al.* (1997) reported absolute neutrophilia (78.20%) with predominance of band cells in bacterial dermatitis.

2.5.2 Biochemical Changes

2.5.2.1 Serum Protein

Total serum protein concentrations in excess of 70 g/L, due to elevations of beta globulins, gamma globulins or both were observed in 23 German Shepherd dogs with deep pyoderma and twenty dogs had concomitant hypoalbuminemia (Wisselink *et al.*, 1985).

Van den Broek and Thoday (1986) reported that serum protein estimation in five dogs with skin disease associated with zinc deficiency gave normal results.

Krick and Scott (1989) reported mildly increased globulin levels of 4.1 to 5.2 g/dl in three German Shepherd dogs with bacterial folliculitis, furunculosis and cellulitis.

Pal *et al.* (1995) reported that the level of serum protein in experimental canine pyoderma was 4.88 ± 0.10 g/100 ml as against the normal value of 5.19 ± 0.12 g/100 ml.

Aujla *et al.* (1997) reported that biochemical studies of canine pyoderma revealed no significant change in total proteins, albumin and total immunoglobulins, whereas circulating immune complex analysis revealed significant increase in pyoderma (3.41 g/dl) as compared to normal (1.67 g/dl).

2.5.2.2 Serum Copper

Fisher (1977) reported that serum copper values were normally distributed, with means of 0.780 µg/ml for male dogs and 0.702 µg/ml for female dogs in a colony of 800 Beagles. However mean serum copper value in dogs with chronic dermatitis (0.729 µg/ml) was within normal range.

Keen *et al.* (1981) reported that seasonal variations were found to have no effect on serum copper and was not affected by environment temperature. Serum copper concentrations in clinically healthy Beagles increased with age up to 5.5 years and then decreased. The author reported that hemolysis and lipemia had no measurable effect on serum copper concentration.

Van den Broek and Thoday (1986) reported serum copper concentration in four dogs with skin disease associated with zinc deficiency as 9.2, 10.9, 9.5 and 14.1 µmol/L.

Willemse (1992) reported that copper was required for melanin production and keratin synthesis, and a deficiency could result in hypopigmentation and a dry, rough coat.

Pal *et al.* (1995) reported that there was significant decrease in level of serum copper (1.83 ± 0.17 mg/100ml) in dogs with experimentally induced pyoderma. The values of serum copper in control dogs were found to be 2.19 ± 0.16 mg/100 ml.

Mathews (1999) reported that the mean serum copper level in 21 dogs with pyoderma was 0.73 ± 0.09 mg%.

2.5.2.3 Serum Zinc

Dietary deficiency of zinc caused dermatoses in dogs characterized by desquamation of the superficial epidermis, erythema, scaling, crusting and focal erosions mainly on the face, abdomen, extremities and areas of contact, friction and stretch (Robertson and Burns, 1963).

According to Riordan (1976) skin lesions were caused when a zinc deficiency existed, as it was a component of over 70 metalloenzymes that affected carbohydrate, lipid, protein and nucleic acid synthesis or degradation.

Fisher (1977) reported that serum zinc values were normally distributed, with means of 0.885µg/ml for male dogs and 0.957µg/ml for female dogs in a colony of 800 Beagles. The author also reported that mean serum zinc value (0.912 µg/ml) in dogs with chronic dermatitis was within normal range.

Keen *et al.* (1981) reported that seasonal variation was found to have a marked effect on serum zinc with the values positively correlated with ambient temperature. Serum zinc concentrations increased with age upto 7.5 years and then began to decrease. Hemolysis had significant effect on serum zinc values, while lipemia had no significant effect on serum zinc level.

Van den Broek and Thoday (1986) reported the serum zinc concentration in five dogs with skin disease associated with zinc deficiency as 5.9, 4.8, 4.8, 5.6 and 5.9 µmol/L. They reported that the value of serum zinc concentration in the diagnosis of zinc-responsive dermatosis was limited. Presence of the appropriate clinical signs and a serum zinc concentration below the mean for normal dogs would support but not confirm a diagnosis of zinc deficiency dermatosis.

Van den Broek and Stafford (1988) reported that the dogs with zinc-responsive dermatosis had significantly lower mean serum zinc concentrations (3.50 to 10.20 µmol/L) than the normal dogs (4.33 to 16.00 µmol/L) and those with dermatitis not associated with zinc deficiency (6.2 to 16.7 µmol/L).

Logas *et al.* (1993) analysed and compared serum zinc levels using AAS in 28 healthy dogs, 28 dogs with non-dermatological diseases, 35 dogs with allergic skin diseases and 32 dogs with other dermatological disorders. No significant differences in the mean serum zinc levels were demonstrated among any of the four groups.

Pal *et al.* (1995) reported that there was significant decrease in level of serum zinc in dogs with experimentally induced pyoderma.

Mathews (1999) reported that the mean serum zinc in 21 dogs with pyoderma was 0.89 ± 0.14 mg%.

2.6 ANTIBIOGRAM

Love *et al.* (1981) reported that forty strains of Staphylococci isolated from infections of dogs and cats including pyoderma were susceptible to erythromycin, kanamycin, neomycin, gentamicin and cloxacillin.

Drug sensitivity tests on 90 strains of bacteria from pyoderma in dogs showed the greatest sensitivity to cefotaxime (63% of isolates), netilmicin (60%) and piperacillin (60%) (Cerri *et al.*, 1984).

According to Cox *et al.* (1984), isolates which were resistant *in vitro* might be sensitive *in vivo* if the infection was in a tissue or body site in which the antimicrobial agent could concentrate.

Vokoun (1985) reported that 69% of *Staphylococci,* 55% of *Streptococci* and 100% of *Coliforms* isolated from canine pyoderma were resistant to penicillin whereas 41% of *Staphylococci,* 58% of *Streptococci* and 83% of *Coliforms* were resistant to tetracycline. Streptomycin became resistant to 31, 77 and 18 percentage of *Staphylococci, Streptococci* and *Coliforms* respectively.

Wisselink *et al.* (1985) stated that Staphylococci cultures of only seven of the 23 German Shepherd dogs with deep pyoderma were sensitive to penicillin

and ampicillin and 16 cultures showed sensitivity to erythromycin. Staphylococci isolated from canine pyoderma were sensitive to several antibiotics *in vitro* but showed poor response to antibiotic treatment *in vivo*.

Staphylococcus intermedius was more resistant to ampicillin and penicillin (83%) and increased resistance of *Staphylococcus epidermidis* to erythromycin was associated with previous antibiotic therapy (Medleau *et al.*, 1986).

Junttila *et al.* (1987) conducted two studies on the sensitivity of *Staphylococcus* strains isolated from canine pyoderma to antimicrobial drugs. Antibiotic sensitivity testing on 407 strains in first study indicated that 63% of the strains were sensitive to trimethoprim-sulfa, 78% to lincomycin, 84% to tylosin and 91% to chloramphenicol. All strains were sensitive to cephalexin. All the 100 strains in second study were sensitive to cephalexin, fucidin, cloxacillin and rifampicin and about 90% to chlormphenicol, tylosin, erythromycin and clindamycin. Sensitivity to trimethoprim sulfa and lincomycin were 86 and 85% respectively.

Kunkle (1987) reported that the staphylococcal isolates from dogs that had never received antibiotic therapy were more likely to be sensitive to a wider spectrum of drugs than the isolates from dogs that had been given antimicrobial drugs.

Awad-Masalmeh *et al.* (1988) reported that antibiotic tests on 210 *Staphylococci* (140 *Staphylococcus intermedius*, 70 *Staphylococcus aureus*) showed resistance to antibiotics such as gentamicin 4.8%, neomycin 11%, erythromycin 19%, chloramphenicol 28%, tetracycline 39.5% and ampicillin 61.9%.

Antibiotic sensitivity testing of bacterial isolates from canine pyoderma revealed that 9/13 dogs were resistant to ampicillin whereas 5/13 dogs were resistant to erythromycin (Angarano and MacDonald.,1989)

Krick and Scott (1989) reported an unusually high incidence of resistance of *Staphylococcus* to erythromycin.

According to Frank and Kunkle (1993) the antimicrobial resistance and susceptibility patterns of *Staphylococcus intermedius* isolated from 44 dogs with pyoderma revealed that 16 dogs with first-time pyoderma and 28 dogs with recurrent pyoderma were susceptible to enrofloxacin and no dogs with first time pyoderma and recurrent pyoderma were resistant to enrofloxacin.

Kamboj *et al.* (1995) reported that the Staphylococcal isolates (88.63%) obtained from canine bacterial dermatitis were sensitive to cephalexin and amikacin (100%), followed by cloxacillin (93.59%), amoxicillin (91.13%), gentamicin, kanamycin, lincomycin and chloramphenicol (89.65% each).

Staphylococcus intermedius isolated from canine pyoderma were highly resistant to ampicillin and amoxicillin and moderately resistant to erythromycin and sensitive to cloxacillin, amoxicillin/clavulanic acid and enrofloxacin (Dowling, 1996).

Kruse *et al.* (1996) reported that in a retrospective study on the antimicrobial susceptibility pattern of *Staphylococcus* spp. isolated from dermatitis in dogs, all the isolates were sensitive to cloxacillin, cephalexin and quinolones-enrofloxacin and ciprofloxacin.

Aujla *et al.* (1997) reported that antimicrobial drug sensitivity showed gentamicin and doxycycline as the most effective against all strains of Staphylococci and Streptococci isolated from bacterial dermatitis. Erythromycin, chloramphenicol, co-trimoxazole and nalidixic acid were 100% effective against Streptococci but not Staphylococci. In majority of cases the Staphylococci isolated from pyoderma were resistant to ampicillin, penicillin, bacitracin and polymixin – B.

Mueller *et al.* (1998) reported that *Staphylococcus intermedius* strains from canine pyoderma were sensitive to clavulanic acid/amoxicillin (100%), cephalexin (98%), cloxacillin (96%), doxycycline (92%), erythromycin (90%), lincomycin (84%), trimethroprim-sulfonamide (58%) and penicillin (22%).

Antibiogram of the bacterial isolates from canine pyoderma revealed that among 21 *Staphylococcus intermedius* nine showed sensitivity to marbofloxacin and twelve to ciprofloxacin (Carlotti *et al.*, 1999).

Newer broad–spectrum antibiotic such as enrofloxacin was increasingly used for the treatment of companion animals and resistance rates might also increased with their frequent use (Lloyd *et al.* 1999).

Antibiotic resistance and susceptibility patterns for the *Staphylococcus* spp. isolated from 18 dogs with superficial bacterial pyoderma revealed that ampicillin, erythromycin and enrofloxacin were effective to seven, fourteen, and eighteen dogs respectively (Bloom and Rosser, 2001).

The higher rate of resistance of enrofloxacin in adult dogs showed their increased use in veterinary medicine (Schwarz and Chaslus-Dancla, 2001).

Hoekstra and Paulton (2002) explained that the site of isolation of a bacterium might influence its antibiotic susceptibility *in vitro* and that antimicrobial susceptibilities of isolates from dogs would differ with the sex and age of the animal.

Holm *et al.* (2002) reported that Staphylococci isolated from recurrent canine pyoderma were resistant to macrolides, lincosamides, fusidic acid, tetracycline and streptomycin.

Pseudomonas aeruginosa (95.2%) and *Staphylococcus intermedius* (99%) isolated from canine skin were sensitive to ciprofloxacin (Petersen *et al.*, 2002).

2.7 TREATMENT

2.7.1 Antibiotics

Ayliffe (1980) stated that acquired (R plasmid) resistance might develop during therapy of pyoderma with any antibiotic.

Empirical antibiotic selection was justified if the case history, physical findings, and a smear of purulent contents indicate the likelihood of an uncomplicated superficial pyoderma caused by *Staphylococcus* and material from pyodermas that had not responded to empirical therapy should be collected and cultured (Ihrke, 1983). In mixed infections, an antibiotic effective against *Staphylococcus* spp. should be chosen and the elimination of *Staphylococcus* spp. was sufficient, because it created an environment favourable to the growth of other bacteria.

There was little evidence to suggest that in bacterial infections, bactericidal agents were more effective than bacteriostatic drugs (Biberstein *et al.*, 1984).

Skin infections required higher doses of antibiotics for prolonged periods (Ihrke, 1984).

Ihrke (1987) stated that most superficial pyodermas required at least three weeks of systemic antibiotics and antibiotics should be given for five days beyond apparent clinical resolution of the pyoderma

Codner (1988b) reported that superficial folliculitis, the most common superficial pyoderma, should be treated for at least three weeks with an appropriate antibiotic and deep pyodermas should be treated for at least six to twelve weeks and antibiotic therapy to be continued for one to two weeks beyond complete resolution of lesions.

According to Muller *et al.* (1989) narrow spectrum antibiotics should be chosen because pyodermas frequently required long-term therapy.

Dogs with recurrent superficial pyodermas required three to six weeks of antibiotic therapy whereas an antibiotic course of three to nine weeks required to treat deep pyoderma (Frank and Kunkle, 1993).

2.7.1.1 Aminoglycosides

Ciric *et al.* (1977) reported that gentamicin was successfully used to treat severe, deep, generalized pyoderma in a four year old male German Shepherd dog.

2.7.1.2 Penicillins

Piperacillin was an effective penicillin for treating *Pseudomonas* infections (Powers and Garg, 1980).

Ampicillin or amoxycillin should be prescribed in canine pyoderma only if culture and sensitivity test indicated susceptibility and the bioavailability of amoxicillin would be better than ampicillin (Aronson and Kirk, 1983).

Penicillin-G, ampicillin, and amoxicillin were not usually recommended for treating most canine pyodermas because *Staphylococci* isolated from canine pyodermas were often resistant to these antibiotics (Ihrke, 1984).

Bywater *et al.* (1985) reported that clavulanate-potentiated amoxicillin was an effective treatment for Staphylococcal skin infections of dogs.

Codner (1988b) stated that combination of clavulanic acid and amoxicillin was effective in treating coagulase-positive Staphylococcal infections in dogs.

Antimicrobial therapy for initial treatment of superficial pyodermas included amoxycillin/clavulanic acid @ 20 mg/kg body weight, orally at an

interval of 8 hours or cloxacillin @ 20-40 mg/kg body weight, orally at an interval of 8 hours (Dowling, 1996).

Potentiated amoxicillin was effective against *Staphylococcus intermedius* isolated from canine pyoderma (Craig, 2003).

2.7.1.3 Cephalosporins

Okin (1983) observed that cephalexin was an effective antibiotic for gram-positive bacterial infections in dogs.

Davis (1984) reported that all first generation cephalosporins had good activity against most gram-positive bacteria and beta-lactamase producing strains of *Staphylococcus aureus.* Third-generation cephalosporins had a greater activity against resistant gram-negative organisms isolated from canine skin.

According to Ihrke (1984), cephalosporins are bactericidal antibiotics that have a wide spectrum of activity but should not be used as first-choice antibiotics because it will lead to development of cephalosporin-resistant bacteria.

The third-generation cephalosporins have limited activity against gram-positive cocci, but it was effective against many gram-negative bacteria (Papich, 1984).

Ihrke (1987) stated that cephalosporins were most effective antimicrobial agents for the management of canine pyodermas.

Cephalosporins were used more frequently in veterinary medicine to treat skin infections due to *Staphylococcus* spp. of organisms. *Staphylococcus intermedius* isolated from a chronic complicated case of pyoderma in a six year old spayed English Setter and its complete cure was obtained by using cefadroxil (Price, 1989).

According to White *et al.* (1989) 15 cases of juvenile cellulitis were completely cured with antibiotics (Cephalosporins) and prednisolone (2.2 mg/kg/day).

Wustenberg and Rodenbeck (1990) treated 54 cases of canine pyoderma with a new cephalosporin preparation Cephalexin-monohydrate and 31 dogs were cured completely.

Dowling (1996) recommended cephalexin @ 20 mg/kg body weight, per os every 8 to 12 hours for bacterial skin infections in dogs.

Cephalosporins were effective against *Staphylococcus intermedius* isolated from canine pyoderma (Craig, 2003).

2.7.1.4 Macrolides

Okin (1983) observed that the most effective antibiotics for gram-positive bacteria were lincomycin and erythromycin.

According to Ihrke (1987), erythromycin was a useful antibiotic for empirical therapy of pyoderma.

Dowling (1996) reported that lincomycin and erythromycin were reasonable choices for first time treatment of canine pyoderma, because recurrent infections were likely to be resistant.

Bloom and Rosser (2001) reported that fifteen (71.4%) of the 21 dogs with superficial bacterial pyoderma had an excellent response to clindamycin @ 11 mg/kg body weight at an interval of 24 hours orally.

Lincosamides and macrolides were effective against *Staphylococcus intermedius* isolated from canine pyoderma (Craig, 2003).

2.7.1.5 Quinolones

Paradis *et al.* (1990) reported that 93 per cent of dogs showed an excellent response to the treatment of bacterial dermatitis with enrofloxacin, with a varying treatment time of one to twelve weeks without any serious adverse reactions.

Hill and Moriello (1994) stated that quinolone antibiotics were usually recommended for treatment of recurrent pyoderma in dogs. Enrofloxacin and ciprofloxacin were the drugs of choice for severe, deep pyoderma with mixed infections.

Carlotti *et al.* (1995) treated 57 canine pyoderma cases with marbofloxacin orally and another 54 dogs with amoxicillin-clavulanic acid orally and reported that marbofloxacin was much more effective than the amoxicillin formulation (96% vs 74.5%) particularly for superficial skin infections.

Enrofloxacin was the first choice antibiotic for deep pyodermas and short term therapy for recurrent pyodermas. It had an excellent activity against *Staphylococcus intermedius*, *Pseudomonas* spp. and *Proteus* spp. (Dowling, 1996).

Fluoroquinolones were effective in the treatment of inflamed skin, as in cases of severe pyoderma (Carlotti *et al.*, 1999).

Paradis *et al.* (2001) reported that Marbofloxacin was safe and effective for the treatment of superficial and deep pyoderma in dogs at a dose rate of 2.75 mg/kg body weight orally once daily for 21 or 28 days. The study was conducted in sixty-two dogs with superficial pyoderma and ten had deep pyoderma. Treatment was successful in 86.1% dogs, improvement was noted in 8.3% dogs and treatment failed in 5.6% dogs.

Fluoroquinolone antibiotics were effective against *Staphylococcus intermedius* isolated from canine pyoderma (Craig, 2003).

2.7.1.6 Potentiated Sulphonamides

Non potentiated sulfonamides were not usually recommended for treating most canine pyodermas because Staphylococci isolated from canine pyodermas were often resistant to these antibiotics (Ihrke, 1983).

Messinger and Beale (1993) reported that 75 and 100 per cent of canine pyoderma were cured by giving sulfadimethoxine-ormethoprim orally once daily for three and six weeks respectively.

Dowling (1996) recommended trimethoprim sulphonamide combination as effective in most cases of canine pyoderma as they were having the added advantage of high volume of distribution ensuring adequate tissue penetration.

Potentiated sulphonamides were effective against *Staphylococcus intermedius* isolated from canine pyoderma (Craig, 2003).

2.7.1.7 Tetracyclines

Bettenay *et al.* (1998) reported that doxycycline was not recommended for treatment of deep skin infections, but could be recommended for superficial pyoderma in dogs.

2.7.2 Topical Treatment

Saijonmaa-Koulumies *et al.* (1998) suggested that topical treatment of canine mucosae with fusidic acid could offer an additional tool against canine pyoderma, combined with traditional forms of therapy.

Antibacterial shampoos containing either benzoyl peroxide, benzoyl peroxide and sulfur, chlorhexidine, triclosan or ethyl lactate, soaks, rinses, sprays, lotions, gels and ointments containing mupirocin were useful in the management of canine pyoderma (Mason,1991).

Washing the dog once or twice weekly with an antibacterial shampoo might help to prevent recurrent pyoderma in dogs (Craig, 2003).

2.7.3 *Cynadon dactylon*

Chopra *et al.* (1958) reported that *Cynadon dactylon* plant have antiseptic property.

Singh and Khan (1990) reported the medicinal properties and uses of karuka, as juice of whole plant, hysteria, epilepsy, diarrhoeas, catarrhal ophthalmia, dropsy, roots decoction for complaints of uro-genital tract and paste for external application in ulcers and cuts to check bleeding.

The juice of the plant, a popular astringent, commonly used as an application to fresh cuts and wounds (Caius, 1992).

The plant is acrid, sweet, cooling, useful in biliousness, thirst, vomiting, burning sensation, epilepsy, fatigue, scabies, skin diseases, dysentery, fever, erysipelas and epistaxis. The juice is an astringent and used as an application to fresh cuts and wounds (Kirthikar and Basu, 1994).

Three varieties of durva are niladurva, svetadurva and gandadurva but *Cynadon dactylon* locally called karuka or karukappullu is the accepted source of the drug. It is a perennial herb, stem slender, creeping, rooting at all nodes, branches erect, leaves narrowly linear, flat, upto 8x 0.3 cm (Sivarajan and Balachandran, 1994).

Dash and Kashyap (1997) reported that Durva cured a disease characterized by bleeding from different parts of the body, itching and skin disease.

Nadkarni (1998) stated that the creeping root and stock were mainly used for medicinal purpose. The fresh juice of the grass was useful in haematuresis and as an application in catarrhal ophthalmia, cuts and wounds.

According to Singh and Ali (1998) therapeutic actions and uses of *Cynadon dactylon* included roots as diuretic in dropsy, plant as astringent, applied to fresh cuts and wounds. The plant contains antiviral, phenolic phytotoxins and leaves gave flavone glycosides.

According to Nesamony (1999) *Cynadon dactylon* (Bermuda grass) could be used for treating all kinds of ulcers.

Materials and Methods

3. MATERIALS AND METHODS

The present study was carried out in the Department of Clinical Medicine, College of Veterinary and Animal Sciences, Mannuthy during the period from May 2003 to April 2004. Prevalence of pyoderma was studied using records maintained at Veterinary Hospitals Mannuthy and Kokkalai during the period from May 2003 to April 2004.

3.1 MATERIALS FOR THE STUDY

Dogs presented to the University Veterinary Hospitals, Mannuthy and Kokkalai were included in this study. Fifty two dogs with clinical signs suggestive of pyoderma were subjected to detailed anamnesis, clinical and bacteriological examination. Twenty-six confirmed cases with full data were included in the current study. Signalment and the previous history of the cases were recorded. The prescribed proforma (Appendix I) was filled up after collecting detailed information such as the appearance and site of lesion, how did it spread, information regarding the feeding practices, bathing and grooming practices, method of disinfection of kennel, drug used for deworming and previous medication applied etc. as suggested by Muller *et al.* (1989).

Six apparently healthy animals brought for vaccination were selected at random and utilized as control animals.

3.2 CLINICAL EXAMINATION

Thorough clinical examination of all the dogs showing dermatological problems was carried out and examined for the presence of macules, papules, pustules, wheal, plaques, ulcers, scabs, scales, urticarial eruptions, pus, exudates, crusts, scar, alopecia, erythema, epidermal collarette, excoriation, hyperpigmentation, lichenification and also examined for the presence of ectoparasites such as ticks, lice and fleas.

3.3 COLLECTION OF CLINICAL MATERIAL

Pus from pustules, skin swabs and blood samples taken from dogs having clinical signs suggestive of bacterial dermatitis or pyoderma formed the material for laboratory examination.

3.3.1 Method for Collection of Material for Bacterial Culture

In cases of pyoderma, before collecting samples, hair around the lesions were clipped avoiding trauma to pustules. The pustules were gently swabbed with 70% alcohol, air dried and then opened with a sterile scalpel blade or needle.

A touch swab of the exudates, was collected aseptically and placed in a disposable sterile tube. In cases of crusty lesions the hair around the lesions were cut, area over the crust or scab was thoroughly cleaned with 70% alcohol and allowed to air dry. The crust or scab was then lifted aseptically with a sterile forceps and the exudates beneath the crust or scab was collected using sterile swabs and kept in disposable sterile tube (Nesbitt, 1983).

3.4 ISOLATION AND IDENTIFICATION OF THE BACTERIA

3.4.1 Glasswares and Reagents

Borosil brand of glasswares, analytical or guaranteed grade of reagents, chemicals and culture media (Hi-Media) were used for the study.

3.4.2 Preparation of Glasswares and Culture Media

The petridishes and test tubes were kept in 0.1 per cent hydrochloric acid overnight. They were washed in running tap water and immersed in detergent solution for one day. The petridishes and test tubes were washed thoroughly in running tap water followed by distilled water. The glasswares were dried and sterilized in hot air oven at 160°C for one hour.

The culture media was reconstituted in double glass distilled water according to Manufacturer's (Hi-Media) instructions. It was then sterilized by autoclaving at 121°C and 15 lbs of pressure for 15 minutes. It was cooled to 45°C, poured into sterile petridishes and test tubes and incubated at 37°C for 24 hours to test the sterility.

3.4.3 Isolation of Bacteria

The swabs were put in sterile peptone water and incubated at 37°C for 24 hours and then a drop of the inoculum was streaked aseptically on sterile nutrient agar plates. These plates were incubated for 24 to 48 hours at 37°C.

Plates were examined after 24 to 48 hours. Single colonies were selected and a representative sample was streaked on nutrient agar slants for further identification. Slants were preserved by storing in refrigerator at 4°C.

3.4.4 Identification of the Bacterial Organism

The pure cultures were identified upto Genus level as per the Bergey's Manual of Determinative Bacteriology (Holt et al., 1994).

The culture media used in the present study were

Nutrient Agar

Mueller Hinton Agar (MHA)

Peptone water

Cultural examination was carried out as per the method described by Cowan (1974).

3.4.4.1 Gram's Staining Method

A 24 hours old culture was smeared on a clean slide, allowed to air dry and passed over the flame for fixation. The smear was then stained with crystal

violet for one minute followed by Gram's iodine for another minute. The stained smear was decolourized with ethyl alcohol for 15 seconds and then counterstained with dilute carbolfuchsin for 30 seconds. After each step the slide was washed with water. The stained slide was air dried and subjected to microscopic examination under 100X oil immersion objective. The bacteria were studied and each isolate was recorded as gram positive or gram negative, cocci, bacilli or coccobacilli.

A rapid biochemical test kit (Hi-Media) was employed for the identification of Staphylococcal bacteria. The morphological, cultural and biochemical characters of the isolates belonging to different species were determined as per the methods described by Barrow and Feltham (1993).

3.4.4.2 Biochemical Tests

1. Catalase test
2. Oxidase test
3. Oxidation-fermentation test
4. Carbohydrate utilization test
5. Citrate utilization test
6. Coagulase test
7. Gelatin liquifaction
8. *Indole production*
9. Methyl red test
10. Voges-Prauskauer test
11. Urease test

3.4.5 Growth on Selective Media

Growth of the bacterial isolates were observed in the following selective medias

1. Brain Heart Infusion Agar
2. Mac Conkey Agar
3. Eosin Methylene Blue Agar
4. Mannitol Salt Agar

3.5 ANTIBIOGRAM

3.5.1 Procedure

In vitro antibiotic sensitivity of the organisms was studied using Disc Diffusion Technique (Barry, 1976).

Five colonies of each pure culture were picked up with sterile platinum loop and were used as the inoculum in four milliliter of peptone broth. Inoculum was applied uniformly on the surface of MHA, using a sterile cotton swab and the plate was kept covered for 15 minutes at room temperature for drying the inoculum. Antibiotic discs (that correspond to the antibiotics most commonly used to treat dermatological disorders) were then placed on the surface of the agar 20 mm apart and they were gently pressed on to the surface of the agar to ensure contact. The plates were incubated at 37°C for 18 to 24 hours.

3.5.2 Antibiotic Discs

The antibiotic discs used in the present study included

Antibiotic discs (Hi-Media)

a.	Amoxycillin	(Am)	-	30 mcg/disc
b.	Ampicillin	(A)	-	10 mcg/disc
c.	Ciprofloxacin	(Cf)	-	10 mcg/disc
d.	Cloxacillin	(Cx)	-	10 mcg/disc
e.	Cephotaxime	(Ce)	-	10 mcg/disc
f.	*Enrofloxacin*	(Ex)	-	5 mcg/disc
g.	Erythromycin	(E)	-	15 mcg/disc
h.	Sulphadiazine	(Sz)	-	300 mcg/disc

3.5.3 Interpretation

The zone of inhibition of bacterial growth around each disc was measured and interpreted as sensitive(S), moderately sensitive(MS) or resistant(R) by comparing the ranges given by the manufacturer.

3.6 COLLECTION OF BLOOD FOR HAEMATOLOGICAL EXAMINATION

About three milliliter of blood was collected from recurrent tarsal or cephalic vein of affected dogs in dry glass vials containing EDTA as anticoagulant at the rate of 1 mg/ml of blood and the specimen examined within one hour of collection.

A drop of blood was taken on clean grease free glass slide to prepare a blood smear (Benjamin, 1985).

3.6.1 Haematological Parameters

The following haematological parameters were estimated.

3.6.1.1 Haemogram

Haemoglobin (Hb)

Haemoglobin was estimated by acid- haematin method using Sahli's haemoglobinometer and expressed as gram percentage (Jain, 1986).

Packed Cell Volume (PCV)

Packed Cell Volume was estimated by Wintrobe's method as per Coles (1986) and expressed as per cent.

3.6.1.2 Leukogram

Total Leukocyte Count (TLC)

Total leukocyte count was estimated using Thoma's fluid as per Coles (1986) and value expressed as X 10^3 cells/mm^3 of blood.

Differential Leukocyte Count (DLC)

Blood smear was stained by Leishman's stain and 100 leukocytes were counted under oil immersion objective and differential counts were expressed as percentage (Benjamin, 1985).

3.7 METHOD OF COLLECTION OF BLOOD FOR BIOCHEMICAL EXAMINATION

Five milliliter of blood was collected in a test tube for separating serum. The separated serum, after slow centrifugation at 3000 rpm for ten minutes without disruption of clot, was transferred to a serum vial. Sera thus separated were stored at –20°C till further analysis.

Disposable clean plastic micropipette tips were used to draw serum from the vials for various biochemical estimations.

3.7.1 Biochemical Examination

Biochemical estimations of serum total protein, albumin, globulin, albumin globulin ratio, serum copper and serum zinc were carried out on stored serum samples.

3.7.1.1 Total Protein and Albumin

Serum total protein[1] was estimated by modified Biuret method described by Weichselbaum (1946) while albumin[2] was estimated by bromocresol green dye binding method as described by Doumas *et al.* (1971). Total protein and albumin were estimated by spectrophotometry in Merck 200 spectrophotometer using commercially available kits.

3.7.1.2 Serum Copper

Serum copper was estimated using Atomic Absorption Spectrophotometer (AAS). The AAS was set for operation as per the recommendations of the instrument manufacturers (Perkin-Elmer). Copper was estimated at a wavelength of 324.8 with slit 0.7 and air acetylene as the flame gas. Sensitivity check was 4 mg/lit with a linear range of 5 mg/lit, which is the maximum limit, where the absorbance concentration relationship is linear (Beaty and Kerber, 1993).

3.7.1.3 Serum Zinc

Serum zinc was estimated using Atomic Absorption Spectrophotometer (AAS). The AAS was set for operation as per the recommendations of the instrument manufacturers (Perkin-Elmer). Zinc was estimated at a wavelength of 213.9 with slit 0.7 and air acetylene as the flame gas. Sensitivity check was 1 mg/lit with a linear range of 1 mg/lit which is the maximum limit, where the absorbance concentration relationship is linear (Beaty and Kerber, 1993).

Merck Ecoline, Total Protein[1]

Merck Ecoline, Albumin[2]

3.8 THERAPEUTIC TRIALS

Samples were collected from clinical cases of pyoderma and the animals were treated at random with two schedules of treatment (Group I and Group II).

3.8.1 Group I

Animals in this group were included those dogs treated with antibiotics at recommended dose rate based on culture and antibiogram result.

3.8.2 Group II

Six cases of pyoderma were treated with the paste of leaves of *Cynadon dactylon.* Fresh leaves of *Cynadon dactylon* were collected and made into a paste in electric grinder and used luxuriously three times daily externally.

Cynadon dactylon is known as Bermuda grass in English, Karuka in Malayalam and Durwa in Sanskrit (Gurudeva, 2001). It is the common lawn grass and seen in wastelands throughout year (Srivastava, 1989) and is found throughout India (Chopra *et al.*, 1956) (Fig.1).

Response to treatment was assessed by follow up examination at seven, 14 and 21 days by noting clinical improvement of the animals.

3.9 STATISTICAL ANALYSIS

The data obtained in the present study were subjected to statistical analysis as per the procedure described by Snedecor and Cochran (1980).

Fig 1. *Cynadon dactylon*

Results

4. RESULTS

Data on the prevalence of the dermatitis collected from the University Veterinary Hospitals at Mannuthy and Kokkalai from May 2003 to April 2004 are presented in Table 1 and Fig.2.

Age, sex and breed wise prevalence of pyoderma in dogs is presented in Table 2. Prevalence of different forms of canine pyoderma is presented in Table 3 and Fig.3.

4.1 PREVALENCE

Dermatological problems constituted 18.93 per cent of dogs presented to the Veterinary Hospitals.

The overall prevalence of pyoderma in the present study was 12.71 per cent. This accounted for 2.41 per cent of the total canine cases presented in the two hospitals taken up for the study.

4.1.1 Age

Age-wise prevalence of pyoderma revealed that dogs between the age group of one to four years (36.54 per cent) were more frequently affected followed by dogs below six months (26.93 per cent), between six and twelve months (21.15 per cent) and above four-years of age (15.38 per cent).

4.1.2 Sex

The prevalence of canine pyoderma was higher in females (55.77 per cent) than in males (44.23 per cent).

Table 1. Prevalence of dermatological disorders in dogs presented to University Veterinary hospitals during May 2003 to April 2004

	Total number	Per cent incidence out of dermatological cases	Per cent incidence out of total canine cases
Total cases	10,281	--	--
Canine cases presented	2160	--	21.00
Canine cases with dermatological disorders	409	--	18.93
Bacterial dermatitis	52	12.71	2.41
Fungal dermatitis	115	28.12	5.32
Ectoparasitic infestation	184	44.99	8.52
Demodicosis	32	7.82	1.48
Non-specific dermatitis	26	6.36	1.20

Table 2. Age, sex and breedwise occurrence of pyoderma

		Cases with bacterial infection
Age	Below 6 months	14 (26.93)
	Between 6 and 12 months	11 (21.15)
	Between 1 and 4 years	19 (36.54)
	Above 4 years	8 (15.38)
Sex	Female	29 (55.77)
	Male	23 (44.23)
Breed	German Shepherd	17 (32.69)
	Dachshund	3 (5.78)
	Labrador	8 (15.38)
	Non-descript	10 (19.23)
	Others	14 (26.92)

The values given in parenthesis denote the percentage of occurrence

Table 3. Prevalence of different forms of canine pyoderma

	Number	Per cent incidence
1. Total cases of bacterial dermatitis	52	--
a. Surface pyoderma	14	26.92
b. Superficial pyoderma	28	53.85
c. Deep pyoderma	10	19.23

Per cent incidence: Percentage occurrence with relation to total number of cases of pyoderma

Fig. 2 Prevalence of different dermatological disorders in and around Thrissur

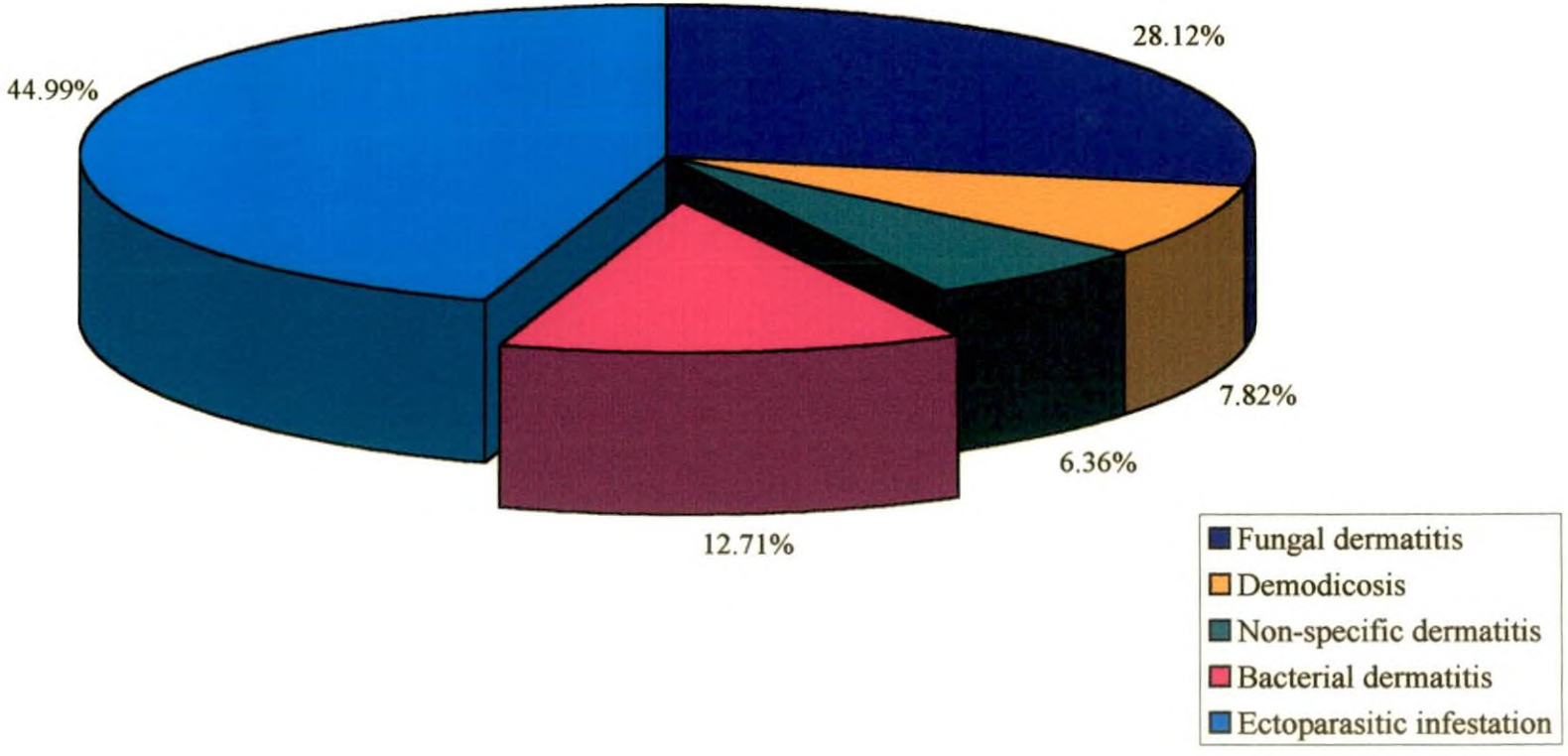
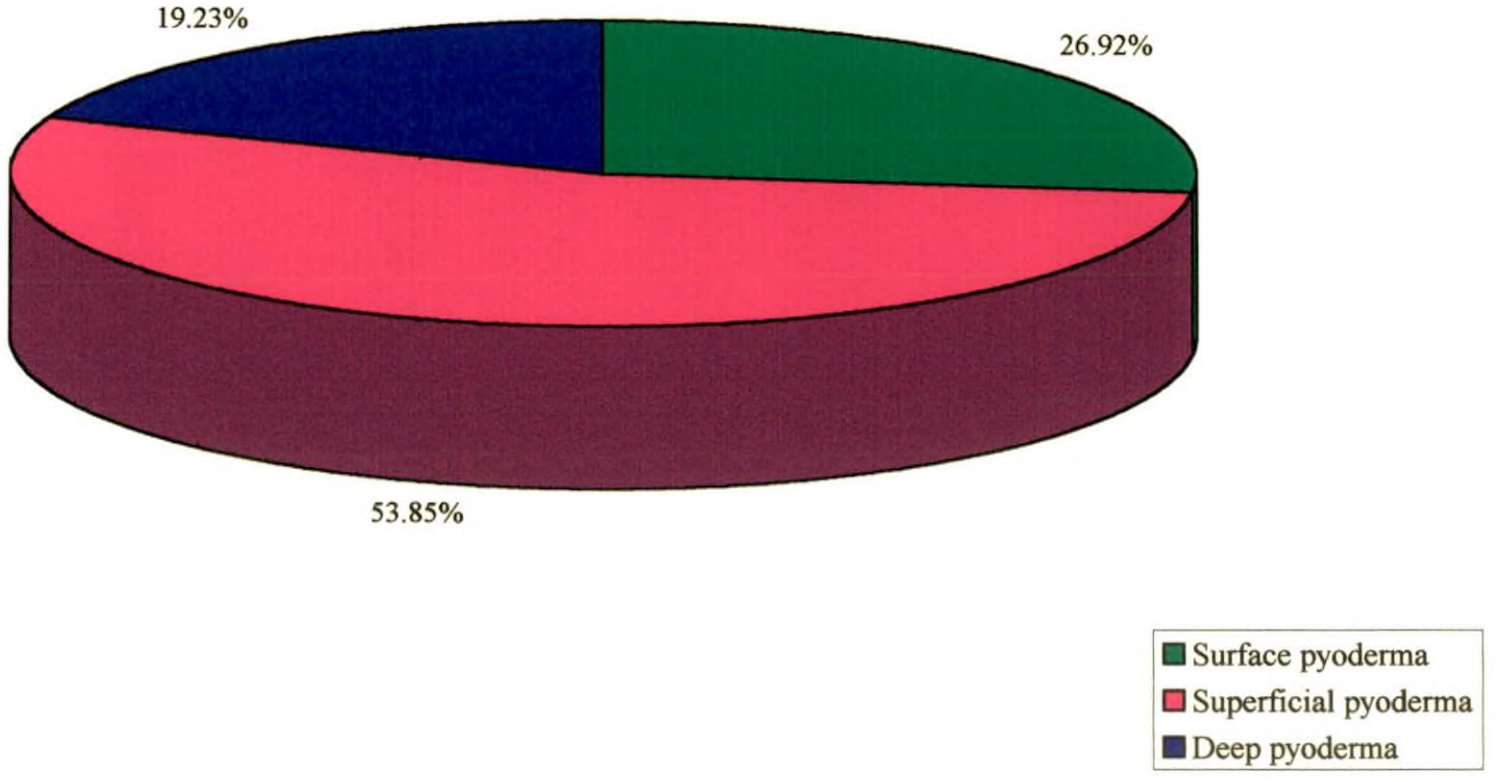


Fig. 3 Prevalence of different forms of canine pyoderma



4.1.3 Breed

The breed-wise prevalence indicated that German Shepherd dogs were more prone to pyoderma (32.69 per cent) followed by Non-descript dogs (19.23 per cent), Labrador (15.38 per cent), Dachshunds (5.78 per cent) and other breeds (26.92 per cent) included Boxer, Rottweiler, Spitz, Cocker Spaniel and Dalmatian (Fig.4).

Out of different clinical pyoderma cases, superficial pyoderma was most prevalent (53.85 per cent) followed by surface pyoderma (26.92 per cent) and deep pyoderma (19.23 per cent).

Though 52 cases were confirmed bacteriologically, only 26 cases with complete data were included for the present study.

4.2 SYMPTOMATOLOGY IN CANINE PYODERMA

4.2.1 Surface Pyoderma

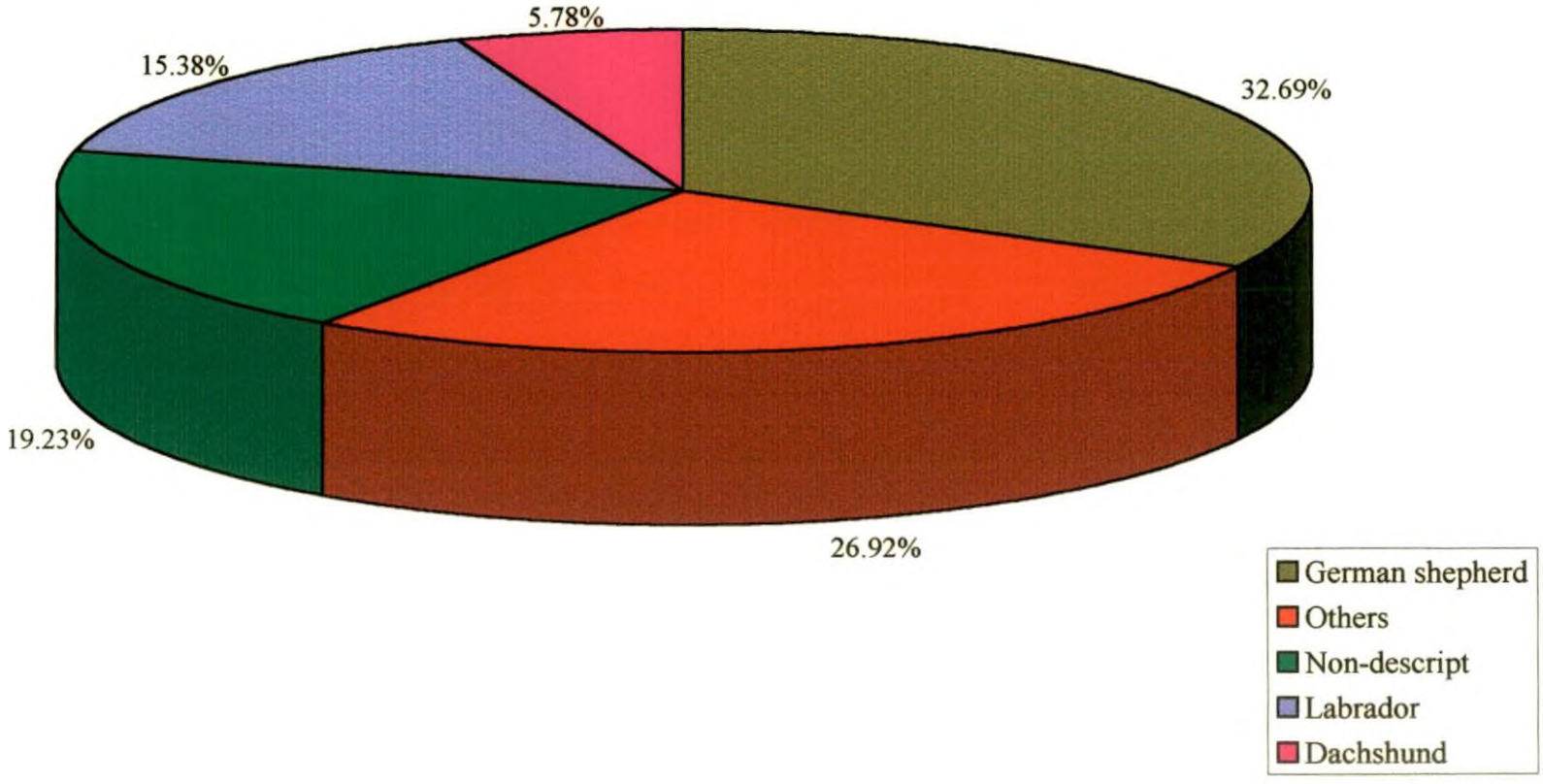
Surface pyoderma was seen more in German Shepherd dogs. It was seen more in age group between one and four years. Majority of dogs with surface pyoderma exhibited lesions such as surface ulceration (33.33 per cent), alopecia (66.66 per cent), serous exudation, erythema (66.66 per cent) and few pustules (33.33 per cent) and pruritus (50 per cent) and the lesions were seen mostly on dorsal thoracic area (16.67 per cent) and also on neck (16.67 per cent) and tail (33.33 per cent) regions (Table 4 and 5).

4.2.2 Superficial Pyoderma

4.2.2.1 Puppy Pyoderma

Three cases of puppy pyoderma were recorded. The breeds affected were German Shepherd, Boxer and Cocker Spaniel. The lesions were pustules and erythema and observed in the glabrous region of skin. The age of the three animals were below six months and all the three were males.

Fig. 4 Breed-wise incidence of canine pyoderma



The other cases of superficial pyoderma revealed symptoms as pustules (73.33 per cent), erythema (66.66 per cent), alopecia (53.33 per cent), epidermal collarette (53.33 per cent) and pruritus (60 per cent). The major locations of lesions were the axilla (38.46 per cent), abdomen (38.46 per cent), flank (38.46 per cent) and dorsal thoracic region (19.23 per cent) (Table 4 and 5).

4.2.3 Deep Pyoderma

Deep pyoderma was seen in three Spitz, one Labrador retriever and one German Shepherd dog. All the dogs exhibited erythema and alopecia and other lesions were pustules (80 per cent), fistulous tracts (60 per cent), hyper pigmentation (80 per cent) and pruritus (80 per cent). The lesions were localized on the ventral part of neck (40 per cent), trunk (40 per cent), hind legs (40 per cent), chin (20 per cent) and nasal area (20 per cent) (Table 4 and 5).

4.3 HAEMATOLOGICAL PARAMETERS

The following haematological parameters were estimated in dogs with pyoderma.

4.3.1 Haemogram

4.3.1.1 Haemoglobin (Hb)

The mean haemoglobin values of normal and diseased groups were 13.083 ± 0.895 g/dl and12.560 ± 0.891 g/dl respectively. The reduction in the haemoglobin concentration obtained in the present study was not statistically significant when compared with normal (Table 6).

4.3.1.2 Packed Cell Volume (PCV)

The mean PCV values of normal and diseased groups were 41.630 ± 1.968 per cent and 36.367 ± 17.371 per cent respectively. Statistical analysis revealed no significant difference in the mean values of diseased group when compared to the mean values of normal animals (Table 6).

Table 4. Primary and secondary lesions in different forms of pyoderma (n = 26)

Forms of pyoderma	Surface	Superficial	Deep
Total number of cases	6	15	5
	No. (%)	No. (%)	No. (%)
Lesions			
1. Primary lesions			
a. Papule	0	4 (26.67)	0
b. Pustule	2 (33.33)	11 (73.33)	4 (80.00)
c. Nodule	0	0	0
d. Fistulous tracts	0	0	3 (60.00)
e. Erythema	4 (66.66)	10 (66.66)	5 (100.00)
f. Alopecia	4(66.66)	8 (53.33)	5 (100.00)
2. Secondary changes			
a. Scale	3 (50.00)	0	0
b. Crust	0	3 (20.00)	2 (40.00)
c. Ulcer	2 (33.33)	0	1 (20.00)
d. Epidermal collarette	0	8 (53.33)	0
e. Erosion	4 (66.66)	0	2 (40.00)
f. Plaque	0	0	0
g. Hyper-pigmentation	0	0	4 (80.00)
h. Lichenification	0	0	0
3. Pruritus	3 (50.00)	9 (60.00)	4 (80.00)
4. Pain	0	0	1 (20.00)
5. Oedema	0	0	3 (60.00)

Table 5. Distribution of lesions in pyoderma (n = 26)

Region	Surface	Superficial	Deep
Head	0	0	0
Ear	1 (16.67)	1 (3.85)	1 (20.00)
Periocular	0	1 (3.85)	1 (20.00)
Nasal area	0	2 (7.69)	1 (20.00)
Chin	0	1 (3.85)	1 (20.00)
Neck	1 (16.67)	4 (15.38)	2 (40.00)
Lower chest	0	1 (3.85)	0
Axilla	0	10 (38.46)	0
Back	1 (16.67)	2 (7.69)	1 (20.00)
Tail	2 (33.33)	2 (7.69)	0
Trunk	1 (16.67)	5 (19.23)	2 (40.00)
Abdomen	0	10 (38.46)	0
Flank	0	10 (38.46)	0
Hind legs	0	4 (15.38)	2 (40.00)
Foreleg	0	1 (3.85)	0
Interdigital	0	2 (7.9)	0
Generalized	0	0	0

4.3.2 Leukogram

4.3.2.1 Total Leukocyte Count (TLC)

The mean total leukocyte count of normal and diseased groups were 11.616 ± 0.391 x 10^3/µl and 11.705 ± 0.610 x 10^3/µl respectively. Statistical analysis showed no significant difference in the mean total leukocyte count of diseased group when compared to normal group (Table 6).

4.3.2.2 Differential Leukocyte Count

Neutrophil count

The mean values of neutrophil count in normal and diseased groups were 70.50 ± 0.84 per cent 71.00 ± 0.86 per cent respectively. Statistical analysis revealed no significant difference in the mean neutrophil count of diseased group when compared to normal group (Table 6).

Lymphocyte count

The mean values of lymphocyte count in normal and diseased groups were 23.50 ± 0.84 per cent and 24.20 ± 2.80 respectively. No statistically significant difference was observed between normal and diseased group (Table 6).

Eosinophil count

The mean values of eosinophil count in normal and diseased groups were 1.67 ± 0.52 per cent and 2.75 ± 2.02 per cent respectively. A statistically significant increase ($P \leq 0.05$) was noticed in the eosinophil count of diseased group when compared to normal value (Table 6).

Monocyte count

The mean values of monocyte counts in normal and diseased groups were 4.30 ± 0.8 per cent and 2.5 ± 1.3 per cent respectively. A statistically

significant decrease ($P \leq 0.01$) was noticed in the monocyte count of diseased group when compared to normal value (Table 6).

4.4 BIOCHEMICAL PARAMETERS

4.4.1 Total Protein

The mean serum protein concentration in animals of normal and diseased groups were 5.450 ± 0.605 g/dl and 5.333 ± 0.816 g/dl respectively. Statistical analysis revealed no significant difference in the mean value of total protein between the normal and diseased groups of animals (Table 7).

4.4.2 Albumin

The mean values of serum albumin in animals of normal and diseased groups were 2.00 ± 0.00 g/dl and 2.251 ± 0.446 respectively. No statistically significant difference was observed in the mean value of albumin between normal and diseased groups (Table 7).

4.4.3 Globulin

The mean value of globulin in animals of normal and diseased groups were 3.33 ± 0.82 g/dl and 3.20 ± 0.52 g/dl respectively. No statistically significant difference was observed in the mean value of globulin between normal and diseased groups (Table 7).

4.4.4 Albumin Globulin Ratio (A:G)

The mean values of albumin globulin ratio in animals of normal and diseased groups were 0.70 ± 0.21 and 0.62 ± 0.19 respectively. No statistically significant difference was observed in the mean value of A:G between normal and diseased groups (Table 7).

Table 6. Haematological values in normal dogs and pyoderma cases (Mean ± SD)

Haematological parameters		Control	Pyoderma
Haemoglobin (g%)		13.083 ± 0.895	12.560 ± 0.891
PCV (%)		41.630 ± 1.968	36.367 ± 17.371
WBC x $10^3/\mu l$		11.616 ± 0.391	11.705 ± 0.610
Differential leukocytes	N (%)	70.50 ± 0.84	71.00 ± 0.86
	L (%)	23.50 ± 0.84	24.20 ± 2.80
	E (%)	1.67 ± 0.52	2.75 ± 2.02*
	M (%)	4.30 ± 0.8	2.5 ± 1.3**
	B (%)	00	00

* Significant at 5% level
** Significant at 1% level

Table 7. Serum biochemical values in normal dogs and pyoderma cases (Mean ± SD)

Biochemical parameters	Control	Pyoderma
Total protein (g/dl)	5.450 ± 0.605	5.333 ± 0.816
Albumin (g/dl)	2.00 ± 0.00	2.251 ± 0.446
Globulin (g/dl)	3.33 ± 0.82	3.20 ± 0.52
Albumin Globulin ratio	0.70 ± 0.21	0.62 ± 0.19
Serum copper (ppm)	0.870 ± 0.084	0.713 ± 0.192
Serum Zn (ppm)	0.957 ± 0.161	0.785 ± 0.163*

* Significant at 5% level

4.4.5 Serum Copper

Mean serum copper levels in animals of normal and diseased groups were 0.870 ± 0.084 ppm and 0.713 ± 0.192 ppm respectively. The reduction in plasma copper level obtained in the present study was not statistically significant when compared to normal values (Table 7).

4.4.6 Serum Zinc

Mean serum zinc levels in animals of normal and diseased groups were 0.957 ± 0.161 ppm and 0.785 ± 0.163 ppm respectively. A statistically significant decrease ($P \leq 0.05$) was obtained in serum zinc value of diseased group when compared to normal value (Table 7).

4.5 CULTURE AND SENSITIVITY

4.5.1 Bacteriological findings

Pus or exudates from lesions of all suspected cases (52) of canine pyoderma were collected on sterile swabs and cultured in nutrient broth for 24 hours at 37°C and stained by Gram's stain (Fig.5). Out of this 52 cases mixed cultures of bacterial isolates were obtained from three cases, 44 were Gram positive and five were Gram negative. Confirmed cases of pyoderma with full details were included in the present study.

Out of 26 bacterial isolates obtained *Staphylococcus* spp. were most commonly isolated viz., *S. intermedius, S. aureus* and *S. epidermidis* in 46.15 per cent, 30.76 per cent and 3.85 per cent of cases respectively. Gram negative organisms included *Escherichia coli* (11.54 per cent), *Pseudomonas aeruginosa* (3.85 per cent) and *Klebsiella* spp. (3.85 per cent) (Table 8 and Fig.6). All the samples yielded single species of bacteria.

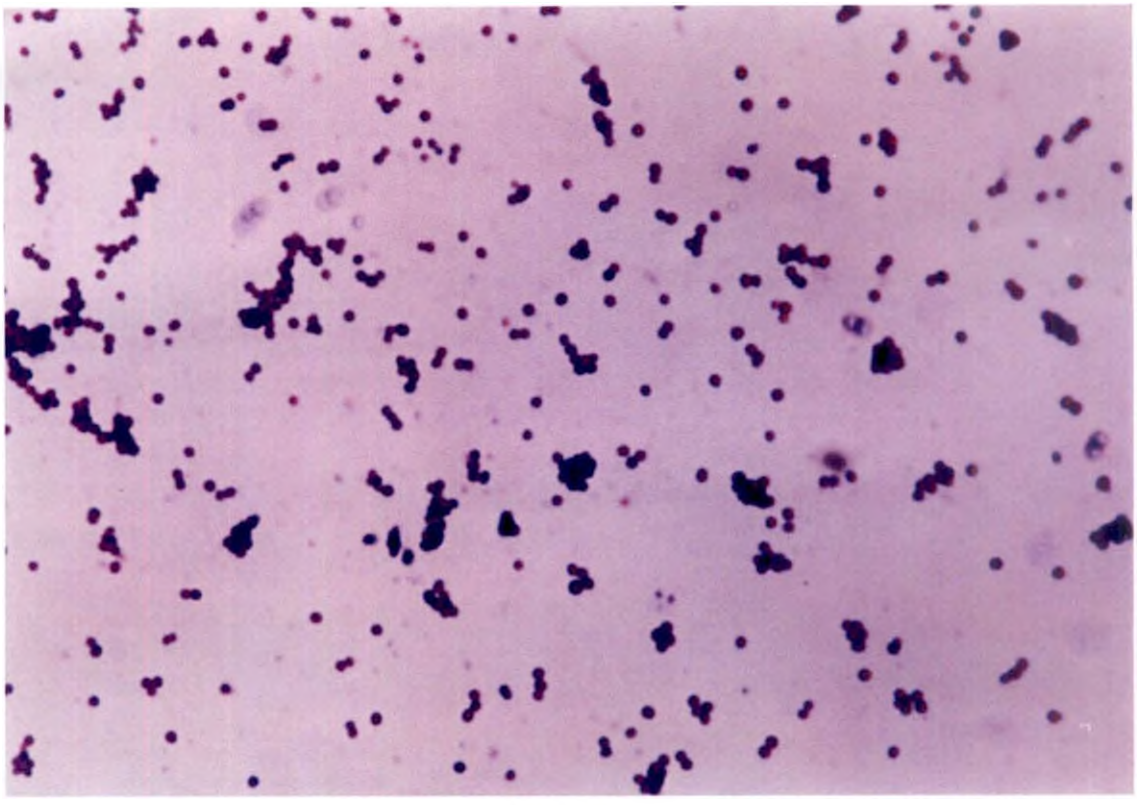
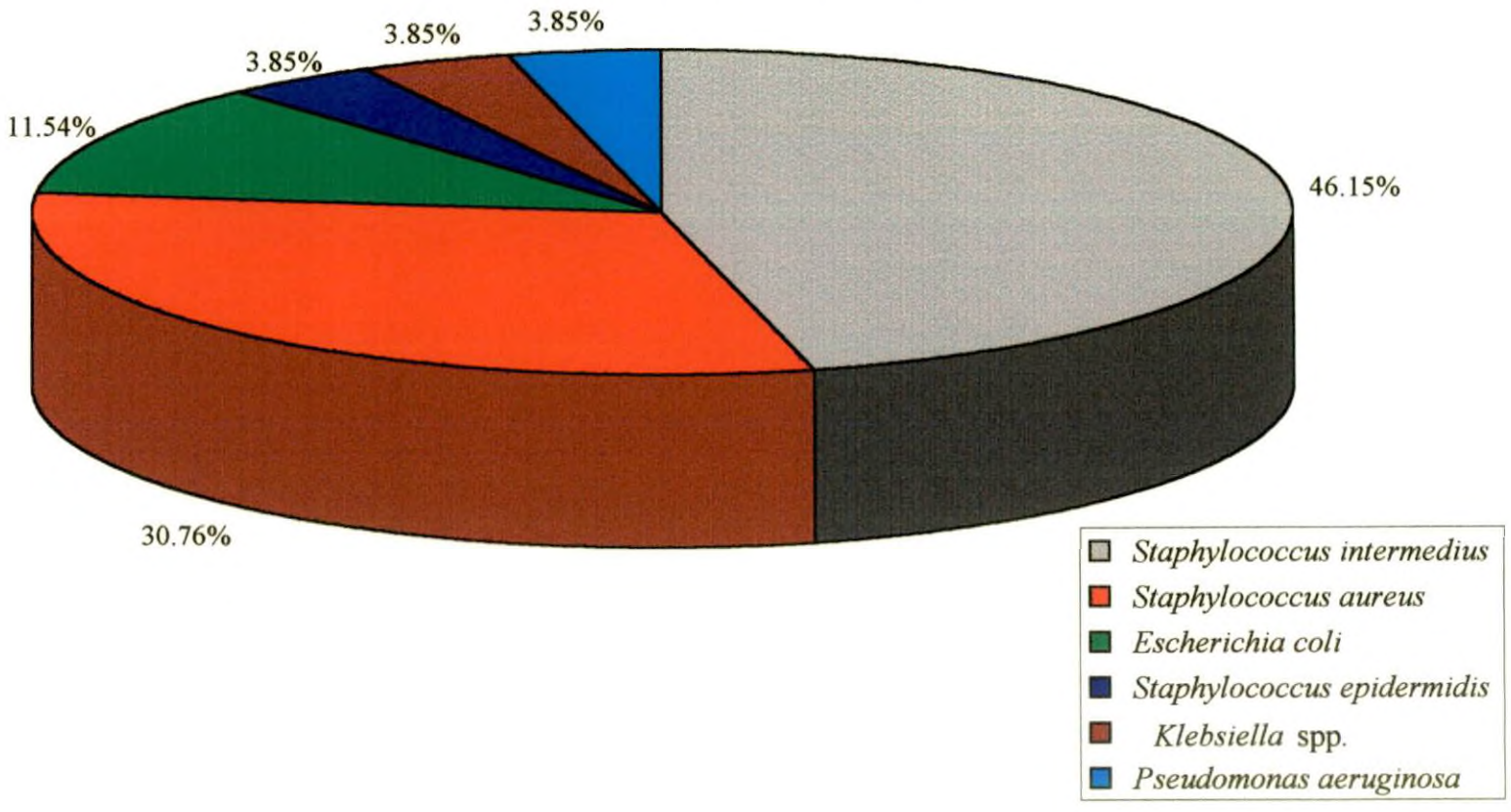


Fig 5.
Microphotograph of
Staphylococcus intermedius (Gram's Staining, X 100)

Table 8. Bacteria isolated from twenty six clinical cases of canine pyoderma

Bacteria	Surface pyoderma	Superficial pyoderma	Deep pyoderma	Per cent
1. *Staphylococcus intermedius*	3	9	0	46.15
2. *Staphylococcus aureus*	2	6	0	30.76
3. *Staphylococcus epidermidis*	1	0	0	3.85
4. *Escherichia coli*	0	0	3	11.54
5. *Pseudomonas aeruginosa*	0	0	1	3.85
6. *Klebsiella* spp.	0	0	1	3.85

Fig. 6 Bacterial isolates from canine pyoderma



Staphylococcus intermedius was grown in nutrient agar (Fig.7). *Staphylococcus aureus* was grown in Mannitol salt agar (Fig.8) and it yielded yellow coloured colonies and the medium changed from pink to yellow. *Pseudomonas aeruginosa* grown in brain heart infusion agar (Fig.9) and *Klebsiella* spp. in Mac Conkey agar (Fig.10). Out of 21 staphylococci isolated, 20 (95.24 per cent) were coagulase positive and one (4.76 per cent) was coagulase negative (Fig.11). The rapid biochemical test kit (Hi-media) was used for the species identification of Staphylococcus (Fig.12).

4.5.1.1 Surface Pyoderma

Among six cases of surface pyoderma, *Staphylococcus intermedius*, *Staphylococcus aureus* and *Staphylococcus epidermidis* were isolated from three, two and one cases of surface pyoderma respectively.

4.5.1.2 Superficial Pyoderma

Staphylococcus intermedius was isolated from nine cases and *Staphylococcus aureus* was isolated from six cases of superficial pyoderma.

4.5.1.3 Deep Pyoderma

Pseudomonas aeruginosa (1), *Escherichia coli* (3) *and Klebsiella* spp. (1) were isolated from five cases of deep pyoderma.

4.5.2 Antibiogram/Sensitivity Test

In vitro antibiotic sensitivity studies of different isolates from twenty clinical cases of canine pyoderma showed that *Staphylococcus intermedius* was sensitive to ciprofloxacin (100 per cent), enrofloxacin (75.00 per cent), erythromycin and amoxycillin (62.50 per cent each), cephotaxime (37.50 per cent) and sulphadiazine (25.00 per cent). All isolates of *Staphylococcus intermedius* were resistant to ampicillin and cloxacillin (Table 9; Fig.13).

Fig 7.
Staphylococcus intermedius
grown in Nutrient Agar

Fig 8.
Staphylococcus aureus
grown in Mannitol Salt Agar

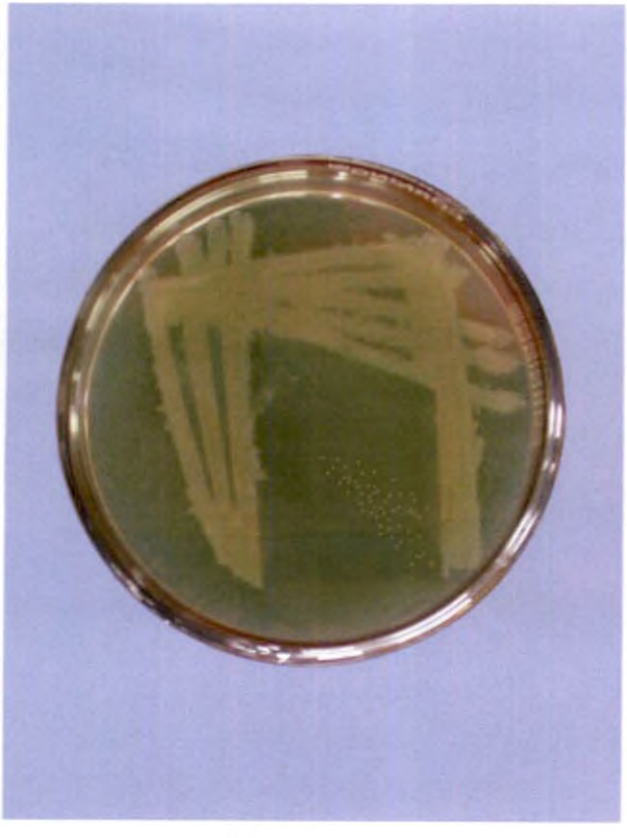


Fig 9.
Pseudomonas aeruginosa
grown in Brain Heart Infusion Agar

Fig 10 .
Klebsiella spp.
grown in Mac Conkey Agar

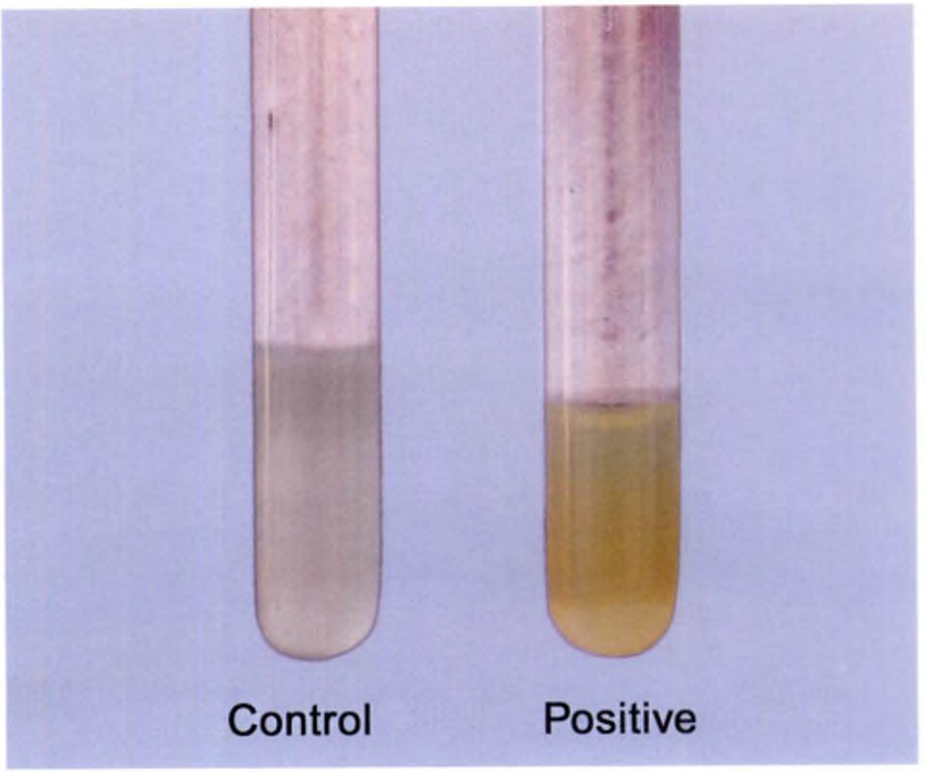


Fig 11.
Coagulase test

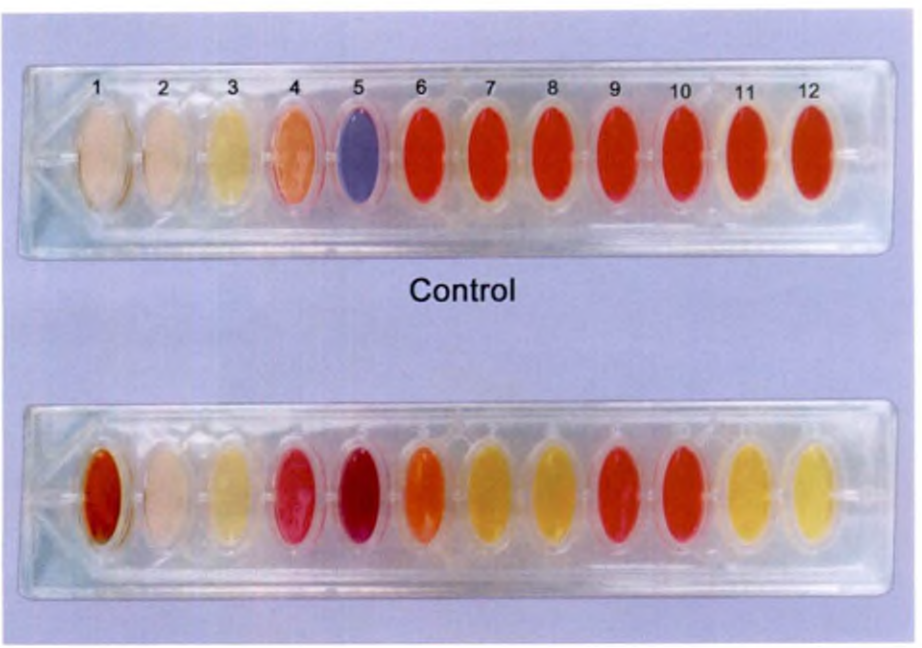


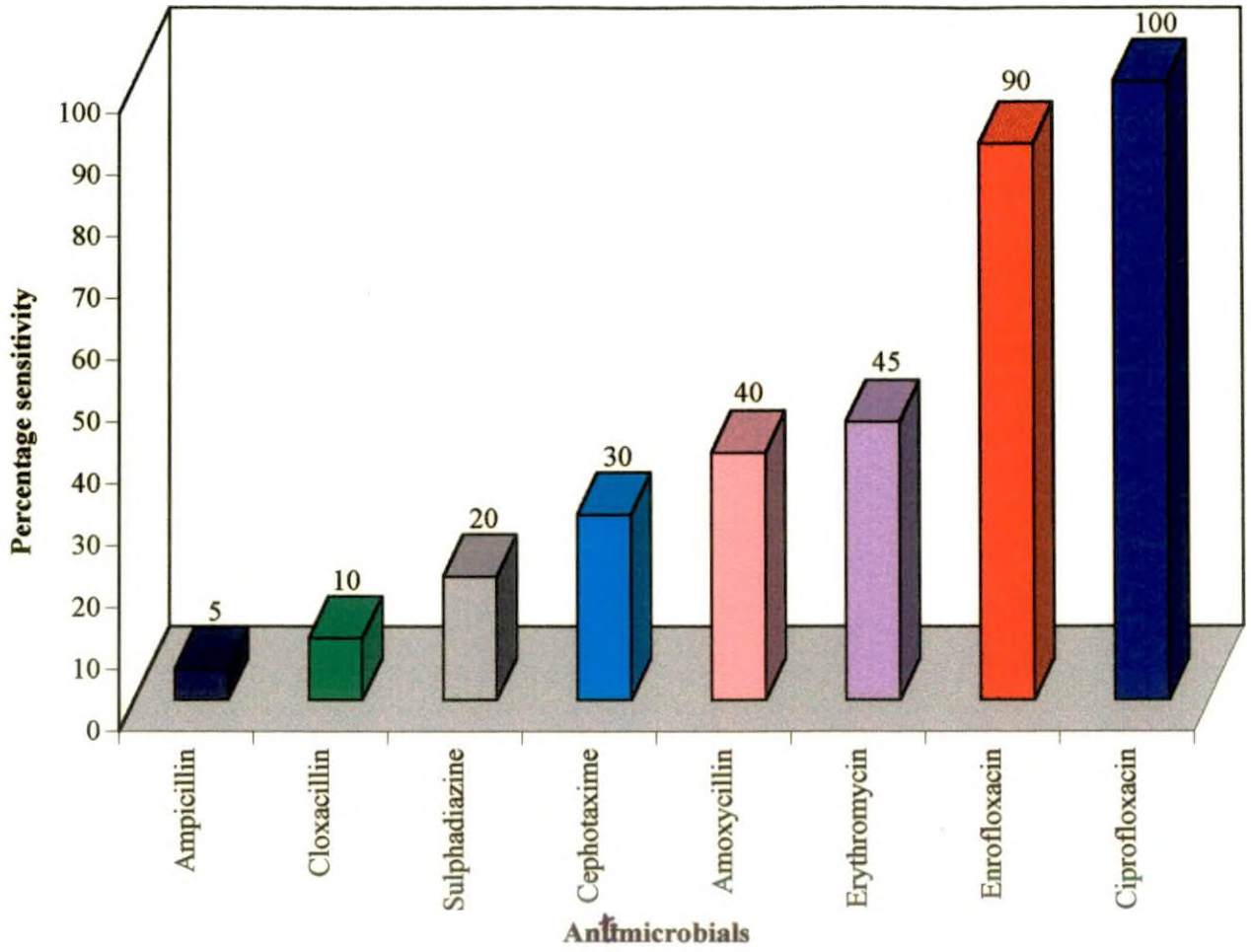
Fig 12.
HiStaph Identification Kit

1. V.P.	+
2. Phosphatase	+
3. ONPG	+
4. Urease	+
5. Arginine dihydrolase	+

Carbohydrate Fermentation

6. Mannitol	+
7. Sucrose	+
8. Lactose	+
9. Arabinose	-
10. Raffinose	-
11. Trehalose	+
12. Maltose	+

Fig. 13 Percentage distribution of antimicrobial sensitivity pattern of 20 bacterial isolates from clinical cases of canine pyoderma



The isolates of *Staphylococcus aureus* were sensitive to ciprofloxacin and enrofloxacin (100 per cent each), amoxycillin and erythromycin (50.00 per cent each), cloxacillin and sulphadiazine (33.33 per cent each) and to ampicillin and cephotaxime (16.67 per cent each) (Table 9).

The single isolate of *Staphylococcus epidermidis* was sensitive to ciprofloxacin, enrofloxacin and erythromycin and resistant to amoxycillin, ampicillin, cephotaxime, cloxacillin and sulphadiazine (Table 9).

Three *Escherichia coli* isolates obtained from deep pyoderma were susceptible to ciprofloxacin and enrofloxacin (100 per cent each) cephotaxime (66.67 per cent). None of the isolates were sensitive to amoxycillin, ampicillin, cloxacillin, erythromycin and sulphadiazine.(Table 9).

Single bacterial isolates of *Klebsiella* spp. and *Pseudomonas aeruginosa* obtained from deep pyoderma were found to be sensitive to ciprofloxacin and enrofloxacin and resistant to amoxycillin, ampicillin, cephotaxime, cloxacillin, erythromycin and sulphadiazine (Table 9).

The *in vitro* antibiotic sensitivity studies of 20 bacterial isolates from canine skin infection revealed that Ciprofloxacin was the most sensitive antibiotic followed by Enrofloxacin, Erythromycin, Amoxycillin and Cephotaxime.

More than seventy five per cent of the isolates were found to be resistant to ampicillin, cloxacillin and sulphadiazine (Table 10 and Fig.14). *Cynadon dactylon* did not show any *in vitro* activity (Fig.15).

4.6 THERAPY

Twenty cases of pyoderma were treated with antibiotics according to the *in vitro* antibiotic sensitivity results (Group I). Antibiotic therapy was continued for one and two weeks beyond the clinical cure in dogs with surface/superficial and deep pyoderma respectively. Six confirmed cases of pyoderma were treated with paste of leaves of *Cynadon dactylon* (Group II).

Table 9. *In vitro* antibiotic sensitivity pattern of different bacterial isolates obtained from 20 clinical cases of canine pyoderma

Sl. No.	Antibiotic	*S. intermedius*	*S. aureus*	*S. epidermidis*	*E. coli*	*Klebsiella*	*P. aeruginosa*
1	Amoxycillin (Am)	5 (62.50)	3 (50.00)	0	0	0	0
2	Ampicillin (A)	0	1 (16.67)	0	0	0	0
3	Cephotaxime (Ce)	3 (37.50)	1 (16.67)	0	2 (66.67)	0	0
4	Ciprofloxacin (Cf)	8 (100)	6 (100)	1 (100)	3 (100)	1 (100)	1 (100)
5	Cloxacillin (Cx)	0	2 (33.33)	0	0	0	0
6	Enrofloxacin (Ex)	6 (75.00)	6 (100)	1 (100)	3 (100)	1 (100)	1 (100)
7	Erythromycin (E)	5 (62.50)	3 (50.00)	1 (100)	0	0	0
8	Sulphadiazine (Sz)	2 (25.00)	2 (33.33)	0	0	0	0

Figures in parenthesis indicate percentage

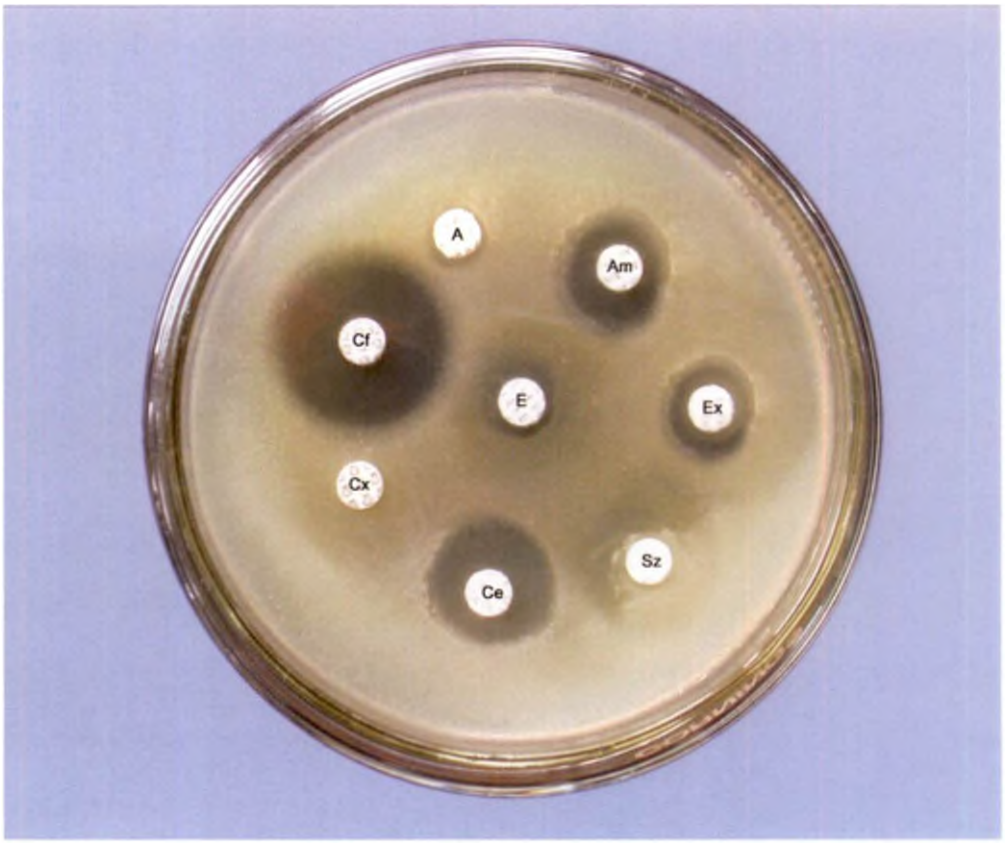


Fig 14.
Antibiogram of
Staphylococcus intermedius

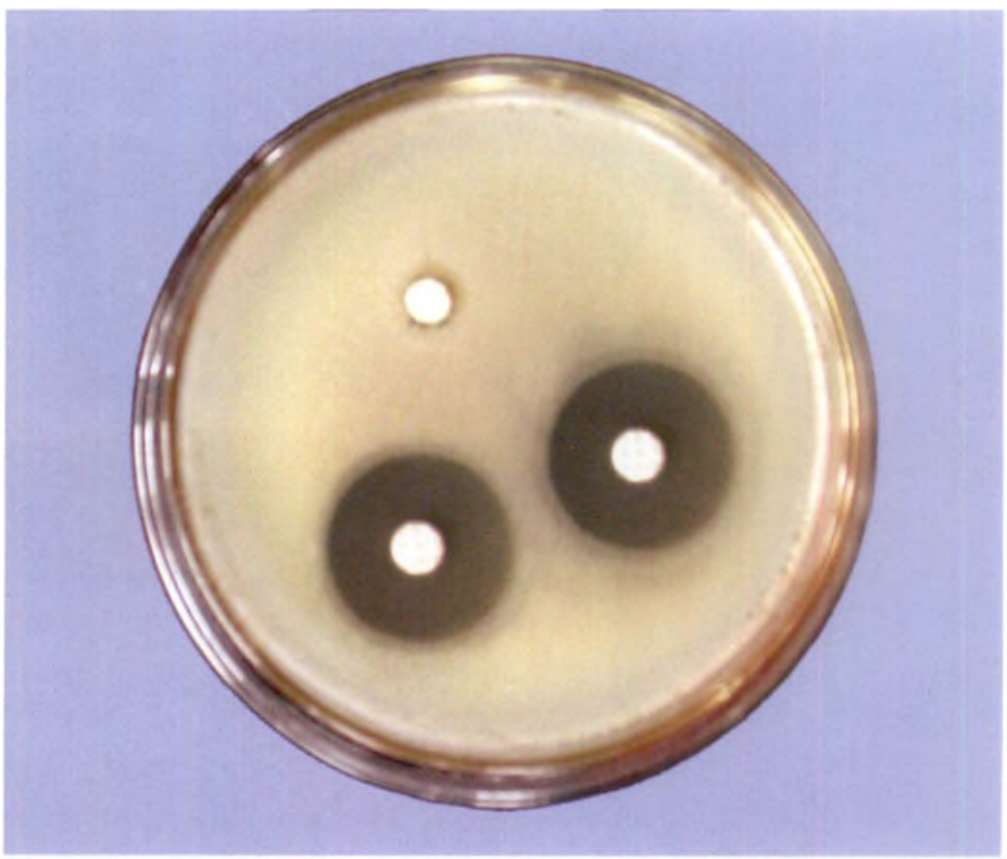


Fig 15.
In vitro antibacterial activity of *Cynadon dactylon*

4.6.1 Group I

4.6.1.1 Ciprofloxacin

Ten dogs were treated for canine pyoderma with Ciprofloxacin @ 10 mg/kg body weight orally once daily. All the ten dogs recovered completely and no treatment failure occurred. Ciprofloxacin was used for the treatment of three, five and two cases of surface, superficial and deep pyoderma respectively. While one case (10 per cent) of superficial pyoderma showed good improvement by the first week (7 days) of treatment, three cases showed excellent response by the second week (14 days).

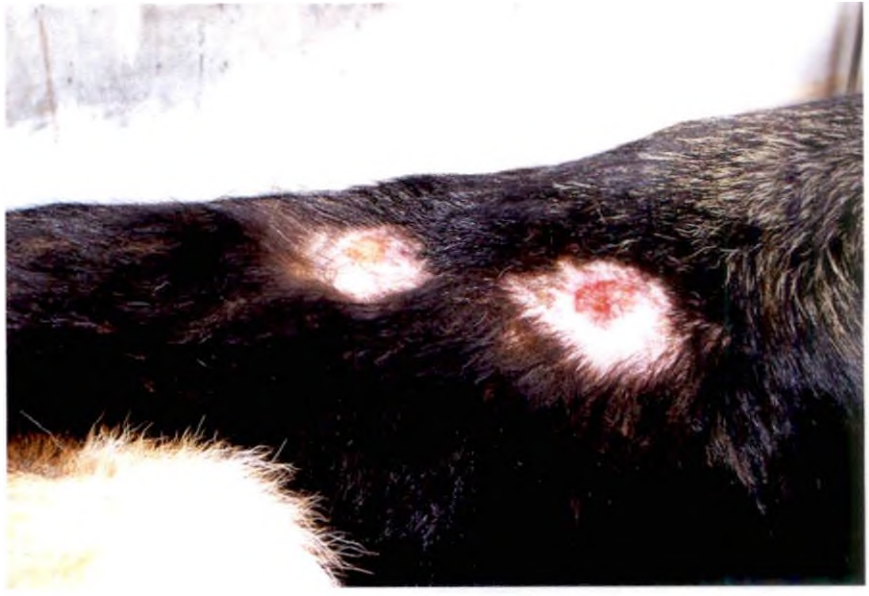
Two cases of deep pyoderma, one case of superficial pyoderma and three cases of surface pyoderma required 21 days (three weeks) for complete recovery (Plate 1). Two dogs suffering from deep pyoderma showed fair response by the first week of treatment. After three weeks of treatment, the dogs showed excellent response and the lesions of pyoderma had completely healed.

4.6.1.2 Enrofloxacin

Nine cases of canine pyoderma were treated with enrofloxacin @ 5 mg/kg body weight orally once daily recovered completely indicating that the efficacy of this antibiotic was 100 per cent in the present study. Enrofloxacin was used for the treatment of two, five and two cases of surface, superficial and deep pyoderma respectively.

One case of surface pyoderma recovered in 7 days (one week) whereas five cases of superficial pyoderma and one case of surface pyoderma required 14 days (2 weeks) and two cases of deep pyoderma required 21 days (three weeks) for complete recovery.

Two cases of deep pyoderma treated with enrofloxacin did not show favourable response by the end of first week of treatment, but lesions such as



A

B

C

Plate 1.Group -I Treated with Ciprofloxacin

A. Before treatment B. During treatment

C. After treatment

fissure and ulcerations healed by the second week, and complete recovery was evident by 21 days.

4.6.1.3 Erythromycin

One case of surface pyoderma recovered completely after 2 weeks (14 days) of treatment with erythromycin at a dose rate of 10 mg/kg body weight orally once daily.

The three antibiotics which showed *in vitro* antibiotic sensitivity were effective *in vivo* also.

4.6.2 Group II

Six confirmed cases of pyoderma in different breeds of dogs were treated with the paste of leaves of *Cynadon dactylon* for seven to 21 days. It was used for the treatment of five cases of superficial pyoderma and one case of deep pyoderma. Twenty one days were required for the complete disappearance of all lesions in case of deep pyoderma whereas 14 days were required for the complete disappearance of all lesions in three cases of superficial pyoderma. Two cases of superficial pyoderma showed good clinical improvement after 7 days of treatment (Table11 and 12).

Cynadon dactylon did not show any *in vitro* activity but it was effective *in vivo* (Plate 2).

Table 10. Percentage distribution of antimicrobial sensitivity pattern of 20 bacterial isolates from clinical cases of canine pyoderma

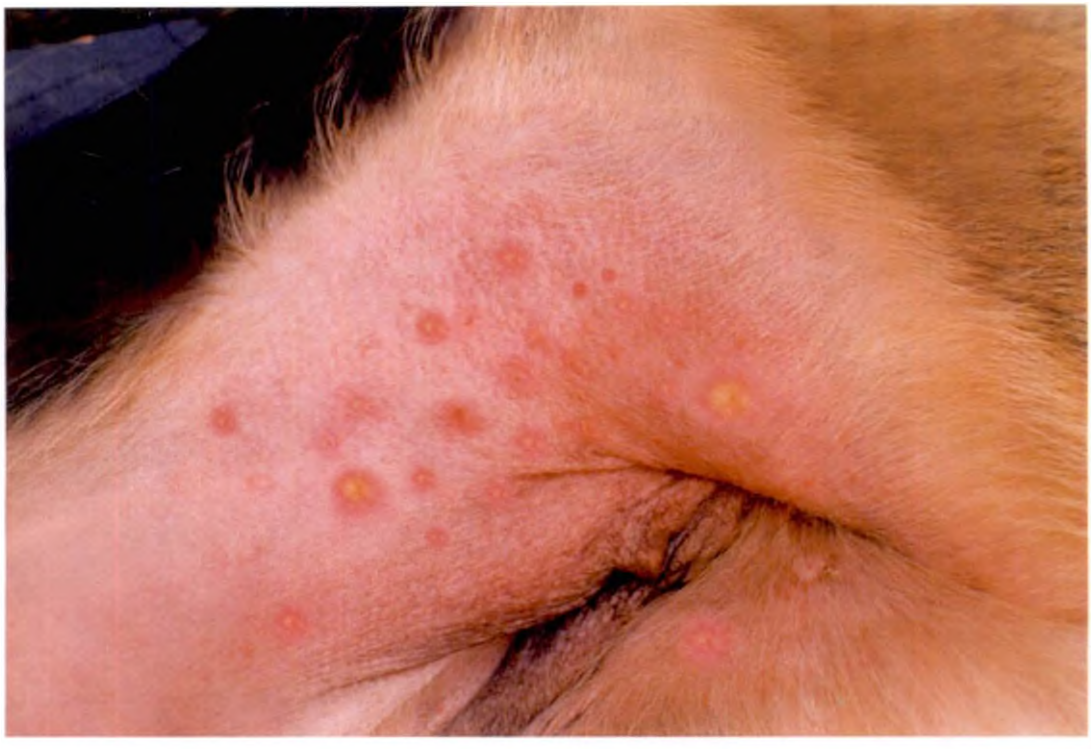
Sl. No.	Antimicrobial agents	Sensitive		Resistant	
		Number	Per cent	Number	Per cent
1.	Amoxycillin (Am)	8	40	12	60
2	Ampicillin (A)	1	5	19	95
3	Cephotaxime (Ce)	6	30	14	70
4	Ciprofloxacin (Cf)	20	100	0	0
5	Cloxacillin (Cx)	2	10	18	90
6	Enrofloxacin (Ex)	18	90	2	10
7	Erythromycin (E)	9	45	11	55
8	Sulphadiazine (Sz)	4	20	16	80

Table 11. Clinical response in dogs of Group II treated with paste of leaves of *Cynadon dactylon*

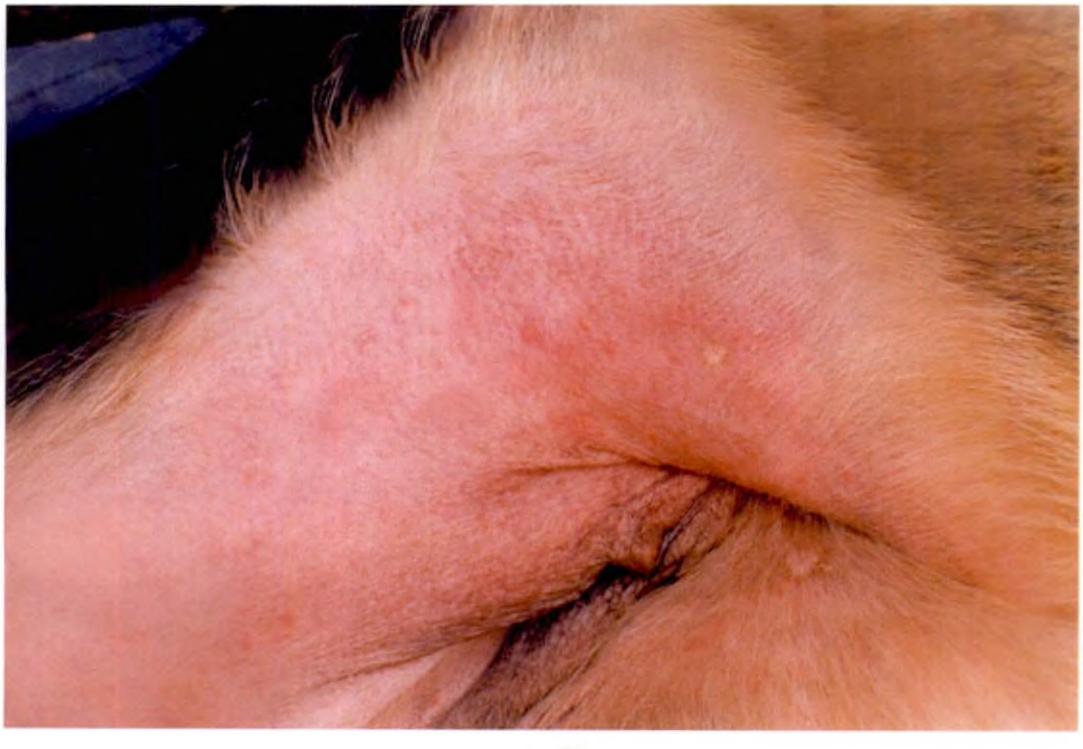
Sl. No.	Case and type of pyoderma	Number of days treated	Clinical improvement
1	German Shepherd Deep pyoderma	21	Yes
2	Labrador Superficial pyoderma	14	Yes
3	German Shepherd Superficial pyoderma	14	Yes
4	Spitz Superficial pyoderma	7	Yes
5	Cocker Spaniel Puppy pyoderma	14	Yes
6	German Shepherd Puppy pyoderma	7	Yes

Table 12. Therapeutic response in Group I and Group II

Group	Number of cases	Treatment response in percentage		
		1st week	2nd week	3rd week
I	20	10.00	50.00	100.00
II	6	33.33	83.33	100.00



A



B

Plate 2. *Group -II Treated with Cynadon dactylon*

A. Before treatment
B. After treatment

Discussion

5. DISCUSSION

Dermatological disorders constitute a major problem in canine practice and usually caused by various etiological factors. Pyoderma are considered to be an important dermatitis affecting dogs.

Staphylococcus intermedius was present on the haired skin of healthy dogs (Ihrke, 1987) and pyodermatitis could be developed in a dog under the influence of underlying causes like allergy, ectoparasites, defective keratinization, immunodeficiency and endocrinopathy (Mason, 1991).

Dogs presented to Veterinary Hospitals with clinical signs suggestive of pyoderma were subjected to detailed anamnesis, clinical examination and laboratory investigations.

5.1 PREVALENCE

The overall prevalence of dermatological disorders in the canine population as per the hospital records, during the study period was 18.93 per cent. This is in agreement with Sischo *et al.* (1989) and Scott and Paradis (1990) who reported that skin diseases represent 20 per cent of small animal cases in the United States and 18.8 per cent in Canada respectively.

Kamboj *et al.* (1995) reported a comparable incidence of 24.45 per cent of dermatological disorders in the small animal clinics of the Punjab Agricultural University and Jafri *et al.* (1999) also reported 22 per cent incidence of skin diseases in canines in Lahore. Aujla *et al.* (1997) reported a lower incidence of 9.3 per cent in Punjab.

Among different dermatological disorders the incidence of bacterial dermatitis was found to be 12.71 per cent and it was the third most frequently diagnosed skin disorder. Sischo *et al.* (1989) also reported similar observations.

The incidence of bacterial dermatitis as revealed in the present study was in close accordance with that reported by Nagata and Sakai (1999) but lesser than that reported by Kamboj *et al.* (1995); Aujla *et al.* (1997) and Mathews (1999). This difference might be due to difference in the type and size of canine population studied.

5.1.1 Age

Analysis of the percentage of dogs suffering from pyoderma in various age groups revealed that age group between one and four years (36.54 per cent) had the highest incidence followed by age group below six months (26.93 per cent).

Krick and Scott (1989), Bloom and Rosser (2001) also reported similar observations while Halliwell (1990) reported that staphylococcal pyoderma had a peak age of onset around puberty and in the young to middle aged dogs.

Mathews (1999) reported that dogs below six months of age are more frequently affected by bacterial skin infection followed by an equal incidence in the age group of one to four years, and above four year group.

5.1.2 Sex

Sex-wise prevalence of pyoderma showed that 55.77 per cent were females and 44.23 per cent were males. The findings in the present study was in agreement with Aujla *et al.* (1997) and Harvey *et al.* (1993) who reported that females were more significantly affected with bacterial dermatitis than males. But Mathews (1999) reported that prevalence of bacterial dermatitis in females was 47.6 per cent and males was 52.4 per cent. But, Krick and Scott (1989) and Choi-Won Pil (2000) did not find any significant sex predilection. Stress associated with oestrus, pregnancy, whelping and nursing might be responsible for higher incidence in females (Hill and Moriello, 1994).

5.1.3 Breed

In the present study, pyoderma had the highest occurrence in German Shepherd dogs (32.69 per cent) followed by other breeds which included Rottweiler, Boxer, Spitz, Cocker Spaniel and Dalmatian (26.92 per cent) and Non-descript (19.23 per cent), Labrador (15.38 per cent) and Dachshund (5.78 per cent). Mathews (1999) reported that Non-descript dogs were more affected (33.3 per cent) followed by German Shepherd (23.8 per cent).

Scott and Paradis (1990) observed that Dobermann pinschers and German Shepherd dogs had a predilection for folliculitis and furunculosis. But in the present study, less incidence of bacterial dermatitis was noticed in Dobermann pinschers and high incidence noticed in German Shepherd dogs and a comparatively high incidence noticed in Labrador Retriever breed. A detailed demographic study involving a wide range of breeds would be required for a proper conclusion to be made.

The higher incidence of pyoderma in the German Shepherd dog found in the present study is in accordance with the reports of previous workers – Scott and Paradis (1990), Pal *et al.* (1993) and Carlotti *et al.* (1999). The higher incidence of recurrent pyoderma in German Shepherd dogs might be due to an autosomal recessive gene, as this leads to a cell mediated immunodeficiency and therefore more incidence of recurrent, idiopathic bacterial folliculitis and furunculosis (Wisselink *et al.*, 1988).

5.2 CLINICAL SIGNS

Ihrke (1987), Hill and Moriello (1994) have classified canine pyoderma as surface, superficial and deep pyoderma.

Surface pyoderma constituted 26.92 per cent of bacterial dermatitis. German Shepherd dogs between the age group of one and four years were more

prone to surface pyoderma. Nagata and Sakai (1999) reported that acute moist dermatitis was recorded in 47.2 per cent of dogs.

In the present study superficial pyoderma constituted 53.85 per cent of total pyoderma cases in dogs. Mathews (1999) reported 38.09 per cent of superficial pyoderma in canines. Pal *et al.* (1993) carried out epidemiological studies on canine pyoderma in West Bengal and reported that 68.56 per cent of the cases were of superficial pyoderma. Frank and Kunkle (1993) reported that 33 dogs out of 44 (75 per cent) under their treatment trial for pyoderma had superficial pyoderma whereas 63.30 per cent of the dogs suffered from superficial pyoderma in a clinical trial on bacterial dermatitis by Angarano and MacDonald (1989). In the present study, superficial pyoderma was seen more in German Shepherd and Dachshunds below six months of age. Overcrowding before weaning (Nesbitt, 1983), dirty coats, faulty brushing and bathing practices and use of local irritants like washing soap and defective immune system (Muller *et al.*, 1989) were reported as predisposing factors for superficial bacterial folliculitis in young age. Superficial bacterial folliculitis could be seen in any breed but, breed predilections might be parallel to those of the predisposing factors (Ihrke, 1987).

Deep pyoderma constituted 19.23 per cent of the cases of canine pyoderma in the present study. Ihrke (1987) stated that deep pyodermas were considerably less common than superficial pyodermas. This proved to be true in the present study. German Shepherd, Irish Setter and Dobermann were more prone to furunculosis (Nesbitt (1983). This is not in agreement with the findings of present study. In the present study, five cases of deep pyoderma were recorded and they were in German Shepherd, Labrador and three cases in Spitz. Pal *et al.* (1993) reported a higher incidence of 31.4 per cent of deep pyoderma in West Bengal.

The lesions observed in canine pyoderma were categorized into primary and secondary skin lesions. Papules, pustules, nodules or vesicles were

considered as primary lesions (Scott and Paradis, 1990). Secondary lesions in pyoderma included epidermal collarette, excoriation, erosion or ulceration, lichenification, callus formation, alopecia, scaling, follicular crusts and also pruritus.

In the present study, the lesions recorded in surface pyoderma were erythema, alopecia, pruritus and pustule. Main lesions in superficial pyoderma were pustules, papules, epidermal collarette and erythema. In deep pyoderma, the lesions were fistulous tracts, erythema, alopecia and hyperpigmentation. Majority of lesions in surface pyoderma were in tail region, in superficial pyoderma lesions were more in axilla, abdomen and flank region whereas in deep pyoderma lesions seen more in neck, trunk and hind legs.

These findings were similar to those reported by Ihrke (1987), Mason (1991), Hill and Moriello (1994). Clinical signs and lesions like pustules, papules, erythema, epidermal collarettes, crust and distribution pattern in the area of abdomen agree with the observation of Nesbitt (1983), Muller *et al.* (1989) and Yager andScott (1993). Oh-Taeho and Oh (1999) reported skin lesions on the back (35.5 per cent), abdomen (20.0 per cent), axillary region (6.4 per cent), legs (3.2 per cent), neck (3.6 per cent) and foot (16.1 per cent). Krick and Scott (1989) reported distribution of lesions from most common to least common sites as rump, ventral abdomen, medial thighs, ventral thorax, back, lateral surface of rear legs, medial aspect of front legs, axilla, pinna, neck, inguinal area and lateral surface of legs. Similar findings were observed in the present study also. Back, hindlegs and abdomen had greater predilection for bacterial dermatitis, the areas being more prone to injuries during fighting and running (Aujla *et al.*, 1997).

5.3 CLINICAL PATHOLOGY

5.3.1 Haemogram

The mean value of haemoglobin and packed cell volume of dogs with bacterial dermatitis in the present study were found to be 12.560 ± 0.891g per

cent and 36.367 ± 17.371 per cent respectively. These values did not show any significant difference from the values obtained in control group. Mathews (1999) recorded normal values of haemoglobin and packed cell volume in 21 dogs with pyoderma.

5.3.2 Leuokogram

In the present study, the mean value of total leukocyte count of dogs with pyoderma was 11.705 ± 0.610 x 10^3/µl. It was slightly elevated due to bacterial infection but was not significant. Mathews (1999) reported that the mean value of total leukocyte count in 21 dogs with pyoderma was 14.926 ± 4802/cmm.

White *et al.* (1989) reported leukocytosis (24,000 to 26,800/µl) in six dogs with juvenile cellulitis. Aujla *et al.* (1997) reported marked leukocytosis (TLC 27.88 thousands/cu.mm) in bacterial dermatitis. The variation observed in the present study might be due to less severe form of infection.

Percentage of neutrophils and lymphocytes in the present study were found to be in the normal range.

The eosinophil percentage was significantly high in the present study (2.75 ± 2.02) and it could be due to staphylococcal hypersensitivity. Hypersensitivity reactions release more histamine from the mast cells and it might be the reason for increased level of eosinophils in the present study.

The monocyte percentage (2.5 ± 1.3) was significantly reduced in the present study.

Wisselink *et al.* (1985) reported leukocytosis varying from 15.6 to 20.2 x 10^9/L due to increased numbers of polymorphonuclear granulocytes in eight German Shepherd dogs with deep pyoderma.

Krick and Scott (1989) reported neutrophilia in four German Shepherd dogs with bacterial folliculitis, furunculosis and cellulitis and Aujla *et al.* (1997)

reported absolute neutrophilia with predominance of band cells in bacterial dermatitis.

5.3.3 Biochemical Changes

5.3.3.1 Total Protein, Albumin, Globulin, Albumin Globulin Ratio

In the present study, the mean value of total protein, albumin, globulin and A:G were 5.333 ± 0.816 g/dl, 2.251 ± 0.446 g/dl, 3.20 ± 0.52 g/dl and 0.62 ± 0.19 respectively. These values were not statistically significant when compared to normal animals. The observation in the present study agree with findings of Aujla *et al.* (1997) who reported no significant change in total proteins, albumin and total immunoglobulins, with increase in circulating immune complex in pyoderma.

Pal *et al.* (1995) observed hypoproteinemia in canine pyoderma and this might be due to more weeping nature of the condition.

5.3.3.2 Serum Copper

Mean value of serum copper obtained in the present study was 0.713 ± 0.192 ppm as against the normal value of 0.870 ± 0.084 ppm. The reduction in the copper level observed in the present study was not significant. This is in agreement with Mathews (1999) who reported non significant changes in serum copper level (0.73 ± 0.09 ppm) in 21 dogs with pyoderma. But Pal *et al.* (1995) reported that there was significant decrease in level of serum copper in dogs with experimentally induced pyoderma. The results ruled out the possibility of copper playing a role in the etiopathogenesis of canine pyoderma.

5.3.3.3 Serum Zinc

Significant decrease ($P \leq 0.05$) was obtained in the mean serum zinc value (0.785 ± 0.163 ppm) in pyodermic dogs when compared to normal dogs. This

finding in the present study agree with the observation made by Van den Broek and Stafford (1988) and Pal *et al.* (1995).

Decrease in the serum zinc level obtained in the present study might be due to binding of zinc by phytate and phosphorus or competition for intestinal absorption site by calcium, copper, iron, cadmium from other dietary component or by inherent defect in zinc absorption (Sanecki *et al.*, 1982). Most of the pet owners feed their dogs with commercial dry dog foods that are rich source of calcium, as this might interfere with absorption of zinc from intestine. Zinc modulate many phases of the immune and inflammatory responses and has influence on keratogenesis and wound healing. Riordan (1976) reported that skin lesions were caused when a zinc deficiency existed as it was a component of over 70 metalloenzymes that affected carbohydrate, lipid, protein and nucleic acid synthesis or degradation. This might be one of the reason for the higher incidence of dermatological problems in canine practice.

5.4 ISOLATION OF BACTERIA

The cases of pyoderma in dogs were diagnosed by examination of Gram's stained smears of cultures obtained from the pus or exudates of the lesions. Identification of bacteria was made on the basis of cultural, morphological and biochemical characteristics.

Out of the 52 cases recorded during one year study period, 26 cases were taken up for detailed study.

In the present study, the bacterial isolates obtained from canine pyoderma included gram positive and gram negative organisms. Among various gram positive organisms *Staphylococcus intermedius* (46.15 per cent) were most commonly isolated followed by *Staphylococcus aureus* (30.76 per cent) and *Staphylococcus epidermidis* (3.85 per cent). Gram-negative organisms such as *Escherichia coli, Pseudomonas aeruginosa* and *Klebsiella* spp. were cultured from 11.54 per cent, 3.85 per cent, and 3.85 per cent cases respectively. This

confirms that *Staphylococcus intermedius* was the major skin pathogen in dogs as implicated by Hill and Moriello (1994), Ihrke (1987) and Carlotti *et al.* (1999). Wisselink *et al.* (1985), Angarano and MacDonald (1989) and Mathews (1999) isolated *Staphylococcus intermedius* from all cases of canine bacterial dermatitis.

Aujla *et al.* (1997), Barrs *et al.* (1995) and Carlotti *et al.* (1999) isolated *Staphylococcus aureus* from 22.5, 10 and six per cent of pyoderma cases respectively. In the present study 30.76 per cent of bacterial isolates obtained from canine pyoderma was *Staphylococcus aureus.* Mason and Lloyd (1989) reported that hypersensitive dogs were shown to have significantly higher surface counts of staphylococci than normal animals and these bacteria were concentrated in the more superficial layers of the stratum corneum. As a result of hypersensitivity reactions protective mechanism of skin are compromised and changes in the surface microclimate occur, rendering the skin surface more susceptible to colonization by staphylococci and allows pyoderma to develop.

Pseudomonas aeruginosa was obtained from deep pyoderma in a Labrador. Pal *et al.* (1993), Bettenay *et al.* (1998), Petersen *et al.* (2002) also isolated Pseudomonas from dogs affected with pyodermatitis.

Klebsiella spp. was isolated from one case of deep pyoderma in a German Shepherd dog. Presence of a gram negative organism along with pyogenic *Staphylococci* was considered to be due to secondary invasion (Ihrke, 1987).

5.5 ANTIBIOGRAM

It is of paramount importance to conduct *in vitro* antibiotic sensitivity test to help the clinician for the appropriate selection of antibiotic because many bacterial species have become highly resistant to antimicrobials through their inappropriate and indiscriminate use. Multiple drug resistance was shown by many organisms. The results of *in vitro* antibiotic sensitivity tests were suggestive of an internal genetic structure of each organism.

Variations occurred in the antibiotic sensitivity of different species of organisms from place to place. Antibiotic sensitivity to *Staphylococcus intermedius* isolated from canine pyodermas varies depending upon the use of antibiotics in the region (Ihrke, 1984). Following antimicrobial therapy, bacteria might develop resistance by the change in a bacterial gene or by conjugation or by transfer of R-plasmids between the bacteria. Most of the bacteria isolated in the present study also showed resistance to many of the antibiotics. Muller *et al.* (1989) suggested that culturing and sensitivity tests be performed in chronic, refractory cases of pyoderma to guide the selection of the most effective drug.

Antimicrobial drug sensitivity showed that ciprofloxacin (100 per cent) and enrofloxacin (90 per cent) were most effective against all strains of gram positive and gram negative bacteria isolated from canine pyoderma followed by erythromycin (45 per cent), amoxycillin (40 per cent) and cephotaxime (30 per cent). This is in agreement with the findings of Frank and Kunkle (1993) who reported that the antimicrobial resistance and susceptibility patterns of *Staphylococcus intermedius* isolated from 44 dogs with pyoderma showed that all bacteria were sensitive to enrofloxacin.

The present study revealed that all the bacteria isolated were highly sensitive to ciprofloxacin (100 per cent) and 90 per cent were sensitive to enrofloxacin. This is in agreement with the report of antibiotic susceptibility test of Kruse *et al.* (1996). They reported that all isolates of *Staphylococcus* spp. from dermatitis in dogs were sensitive to quinolones such as enrofloxacin and ciprofloxacin. Bloom and Rosser (2001) reported that *Staphylococcus* spp. isolated from 18 dogs with superficial bacterial pyoderma was cent per cent sensitive to enrofloxacin. Petersen *et al.* (2002) reported that 95.2 per cent of *Pseudomonas aeruginosa* and 99 per cent of *Staphylococcus intermedius* isolated from canine skin were sensitive to ciprofloxacin.

More than seventy five per cent of the isolates showed resistance to sulphadiazine (80 per cent), cloxacillin (90 per cent) and ampicillin (95 per cent).

This finding in the present study is not in agreement with the observations of Kruse *et al.* (1996) who reported that all the isolates of *Staphylococcus* spp. from dermatitis in dogs were sensitive to cloxacillin. Kamboj *et al.* (1995) reported that sensitivity of cloxacillin to staphylococcal isolates from canine bacterial dermatitis was 93.59 per cent and Mueller *et al.* (1998) reported sensitivity of cloxacillin was 96 per cent. The high resistance to ampicillin, cloxacillin and sulphadiazine in the present study was probably due to the continuous use of these drugs over a long period in the clinic

5.6 RESPONSE TO THERAPY

The basic principles of antibiotic therapy include the selection of a proper antibiotic, establishment of an optimum dosage and continuing the therapy for the proper duration to ensure a complete cure (Ihrke, 1987). Most of the superficial pyodermas and all deep pyodermas required systemic antibiotic therapy. The skin infection should be treated with an appropriate antibiotic, preferably bactericidal with good cutaneous penetration and active against *Staphylococcus intermedius* (Carlotti *et al.*, 1999) In the present study, oral administration of ciprofloxacin, enrofloxacin and erythromycin were used to treat different forms of bacterial dermatitis according to the antibiogram result. After achieving the clinical cure, the respective antibiotics were continued for one more week in surface and superficial pyodermas and two more weeks in deep pyoderma as per the recommendation of Ihrke (1984).

5.6.1 Ciprofloxacin

Ciprofloxacin was used for the treatment of three, five and two cases of surface, superficial and deep pyoderma respectively. One case of superficial pyoderma showed good improvement by the first week of treatment. Three cases of superficial pyoderma showed excellent response by the second week. Two cases of deep pyoderma, one case of superficial pyoderma and three cases of surface pyoderma required 21 days for complete recovery.

5.6.2 Enrofloxacin

Enrofloxacin was used for the treatment of two, five and two cases of surface, superficial and deep pyoderma respectively. One case of surface pyoderma recovered in seven days whereas five cases of superficial pyoderma and one case of surface pyoderma required 14 days and two cases of deep pyoderma required 21 days for complete recovery.

5.6.3 Erythromycin

Erythromycin was used for the treatment of a single case of surface pyoderma and it showed improvement after two weeks.

In the present study the three antibiotics which showed *in vitro* antibiotic sensitivity were effective *in vivo* also. The findings in the present study partially agreed with Ihrke (1984 and 1987) who stated that most superficial pyoderma require at least three weeks of systemic antibiotics while the duration of antibiotic therapy for deep pyodermas was highly variable and they required long term therapy. Findings of the present study agree with Craig (2003) who stated that fluroquinolone antibiotics were effective against *Staphylococcus intermedius* isolated from canine pyoderma. Fluroquinolones had well- known good cutaneous diffusion and may be particularly effective in the treatment of inflamed skin, as in cases of severe pyoderma, because of their capacity to accumulate in leukocytes with a high cellular and extracellular ratio and an intracellular fraction highly active in the cytosol (Carlotti *et al.*, 1999).

5.6.4 *Cynadon dactylon*

Six confirmed cases of pyoderma in different breeds of dogs were treated with the paste of leaves of *Cynadon dactylon* for seven to 21 days. It was used for the treatment of five cases of superficial pyoderma and one case of deep pyoderma. Two cases of superficial pyoderma showed good clinical improvement after seven days of treatment whereas 14 days were required for the

complete recovery in three cases of superficial pyoderma. Three weeks of treatment was needed for the recovery of deep pyoderma. This is in accordance with Nesamony (1999) who reported that *Cynadon dactylon* could be used for treating all kinds of ulcers. Chopra *et al.* (1958) reported that *Cynadon dactylon* plant had antiseptic property. Dash and Kashyap (1997) also reported that *Cynadon dactylon* cured a disease characterized by bleeding from different parts of the body, itching and skin diseases.

Based on the present study, it is concluded that quinolone antibiotics such as ciprofloxacin and enrofloxacin could be used for the treatment of all forms of canine pyodermas. Erythromycin could be used as a second choice in the treatment of pyoderma. *Cynadon dactylon* is a cheap and effective indigenous medicine for canine bacterial skin infections and can be used in field conditions.

No recurrence could be observed in any of the treated cases during the period of study.

5.7 ECONOMY OF TREATMENT

Based on the sensitivity test, antibiotics used in the present study were ciprofloxacin, enrofloxacin and erythromycin. These antibiotics were used for a period of seven to 21 days. The cost of treatment with these drugs were Rs.85, Rs.125 and Rs.75 respectively.

Indigenous medicine *Cynadon dactylon* was also used for the same period for which no cost is incurred as it is freely available in Kerala and can be prepared domestically without any expenditure. So this drug can be recommended for all forms of pyoderma.

Summary

6. SUMMARY

The present study "Clinico-therapeutic studies on canine pyoderma" was conducted to know the epidemiology, bacterial etiology, antibiogram, haematological and biochemical parameters of canine pyoderma and to evaluate the efficacy of *Cynadon dactylon* in the treatment of canine pyoderma. Prevalence of bacterial dermatitis was studied among the dogs presented with dermatological problems at the University Veterinary Hospitals, Mannuthy and Kokkalai during the period from May 2003 to April 2004.

Analysis of the prevalence of dermatological disorders revealed that the overall prevalence was 18.93 per cent among 2160 canine cases presented during the study period. Among the 409 dermatological cases presented 52 (12.71 per cent) had bacterial dermatitis (2.41 per cent of the total canine population). Out of the 52 pyoderma cases, 26 cases with full data were selected for detailed study.

Classification of cases of pyoderma based on depth of infection as evident from lesions and clinical symptoms, the cases of superficial pyoderma (53.85 per cent) were found to be considerably more than that of surface pyoderma (26.92 per cent) and deep pyoderma (19.23 per cent).

Surface pyoderma was recorded more in German Shepherd breed in the age group between one and four years. No sex predilection was observed in this case. Superficial pyoderma was more in German Shepherd and Dachshunds in age group below six months. Females were more affected with superficial pyoderma. Deep pyoderma was more seen in Spitz in age group between one and four years and in females.

The lesions in surface pyoderma were alopecia, erythema and pruritus and the lesions were predominant in tail, trunk and ear region. The lesions in superficial pyoderma consisted of pustules, papules, erythema and alopecia and

seen more over axilla, abdomen and flank. The lesions in deep pyoderma were pustules, fisulous tracts, ulcer and pruritus. These were seen mainly on trunk and hind legs.

Haematological parameters revealed significant increase in the eosinophil count and significant reduction in the mean values of monocyte count in dogs affected with pyoderma when compared to normal animals.

Statistical analysis of biochemical parameters such as total protein, albumin, globulin, albumin globulin ratio and serum copper did not show any significant difference. A significant decrease was obtained in serum zinc level.

Diagnosis of pyoderma was arrived by the presence of bacteria on preliminary cultural examination of pus or exudates from the lesions on canine skin.

From the twenty six cases of bacterial dermatitis taken up for detailed study 21 (80.76 per cent) were Gram positive organisms and five (19.24 per cent) were Gram negative organisms. Bacterial isolates obtained were *Staphylococcus intermedius* (12), *Staphylococcus aureus* (8), *Staphylococcus epidermidis* (1), *Escherichia coli* (3), *Pseudomonas aeruginosa* (1) and *Klebsiella* spp. (1).

Overall antibiotic sensitivity pattern of the 20 isolates showed maximum sensitivity to ciprofloxacin (100 per cent) followed by enrofloxacin (90 per cent), erythromycin (45 per cent), amoxycillin (40 per cent), cephotaxime (30 per cent), sulphadiazine (20 per cent), cloxacillin (10 per cent) and ampicillin (five per cent).

Twenty confirmed cases of pyoderma were treated with the most appropriate antibiotic based on antibiogram result. Ciprofloxacin was used for the treatment of three, five and two cases of surface, superficial and deep pyoderma respectively. Enrofloxacin was used for the treatment of two cases of

surface pyoderma, five cases of superficial pyoderma and two cases of deep pyoderma. A single case of surface pyoderma was treated using erythromycin.

Monitoring of response to therapy was carried out on days seven, 14 and 21. The treatment was advised to be continued upto one week and two weeks in cases of surface/superficial and deep pyoderma respectively, beyond the point of clinical recovery. All animals responded well to the treatment adopted.

Six confirmed cases of canine pyoderma were treated with the paste of leaves of *Cynadon dactylon* for a variable period of time from seven to 21 days depending on the severity of lesions. All six cases showed good clinical improvement and recovered.

Based on the findings of the present study, it was concluded that the most effective antibiotics in the treatment of canine pyoderma were ciprofloxacin and enrofloxacin and erythromycin could be used as a second choice. *Cynadon dactylon* is also effective in the treatment of bacterial skin diseases in canines when used externally. A course of antibiotic along with oral administration of skin tonic containing zinc as an adjuvant might enhance speedy recovery of canine pyoderma cases.

References

REFERENCES

Allaker, R.P., Lloyd, D.H. and Simpson, A.I. 1992. Occurrence of *Staphylococcus intermedius* on the hair and skin of normal dogs. *Res. Vet. Sci.* 52: 174-176

Amine-Khodja, L.A., Pellerin, J.L., Chandal, J. and Milon, A. 1983. Microflora of suppurative dermatitis and otitis in dog. *Reveu. Med. Vet.* 134: 307-312

Anderson, R.K. 1977. A crusted skin disease resembling dry juvenile pyoderma case report. *J. Am. Anim. Hosp. Assoc.* 13: 701-703

Angarano, D.W. and MacDonald, J.M. 1989. Efficacy of cefadroxil in the treatment of bacterial dermatitis in dogs. *J. Am. Vet. Med. Assoc.* 194: 57-59

Aronson, A.L., Kirk, R.W. 1983. Antimicrobial Drugs. *Textbook of Veterinary Internal Medicine*. (Ed. Ettinger, S.J.). W.B. Saunders Co. Philadelphia, pp. 338-366

Aujla, R.S., Singh, N., Sood, N., Gupta, P.P. and Sodhi, S. 1997. Bacterial dermatitis in dogs in Punjab – Prevalence and clinico pathological studies. *Indian Vet. J.* 74:837-840

*Awad-Masalmeh, M., Jurinka, A. and Willinger, H. 1988. Bacteriological studies on pyoderma in dogs. Therapeutic use of an autogenous vaccine. *Wiener Tierarztliche Monatsschrift.* 75: 232-234

Ayliffe, T.R. 1980. Penetration of tissue by antibiotics. *Vet. Dermatol. Newsletter* 2: 33-37

Baker, B.B. 1987. Bacterial dermatitis in dogs. *Mod. Vet. Pract.* 68: 472-476

Barrow, C.I. and Feltham, R.K.A. 1993. *Cowan and Steels Manual for the Identification of Medical Bacteria.* Third edition. Cambridge University Press, Great Britain, 331 p.

Barrs, V.R., Malik, R. and Love, D.N. 1995. Susceptibility of Staphylococci isolated from various disease conditions in dogs a further survey. *Aust. Vet. Pract.* 25: 37-42

Barry, A.L. 1976. *The Antimicrobial Sensitivity Test Principles and Practices.* Lea and Febiger, Philadelphia, 210 p.

Batta, M.K., Katoch, R.C., Verma, S., Sharma, M. and Nagal, K.B. 1999. Microbiological investigations on canine dermatitis in Himachal Pradesh. *Indian Vet. J.* 76: 357-358

Beaty, R.D. and Kerber, J.D. 1993. *Concepts, Instrumentation and Techniques in Atomic Absorption Spectrophotometry.* The Perkin-Elmer Corporation, Norwalk, C.T., U.S.A., 421 p.

Benjamin, M.M. 1985. *Outline of Veterinary Clinical Pathology.* Third edition. Kalyani Publishers, New Delhi, 351 p.

Berg, J.N., Wendell, D.E., Vogelweid, C. and Fales, W.H. 1984. Identification of the major coagulase positive staphylococcus species of dogs as *Staphylococcus intermedius. Am. J. Vet. Res.* 45: 1307-1310

Bes, M., Faublee, V.G., Freney, J. and Etienne, J. 2002. Isolation of *Staphylococcus schleiferi* subspecies *coagulans* from two cases of canine pyoderma. *Vet. Rec.* 150: 487-488

Bettenay, S.V., Mueller, R.S. and Dell'Osa-D. 1998. Doxycycline hydrochloride in the treatment of canine pyoderma. *Aust. Vet. Pract.* 28: 14-19

Biberstein, E.L. and Hirsh, D.C. 1999. Staphylococci. *Veterinary Microbiology* (Eds. Hirsh, D.C. and Zee, Y.C.) Blackwell Science, Inc, USA, pp. 479-481

Biberstein, E.L., Jang, S.S. and Hirsh, D.C. 1984. Species distribution of coagulase positive Staphylococcus in animals. *J. Clin. Microbiol.* 18: 610-615

Bloom, P.B. and Rosser, E.J. 2001. Efficacy of once-daily clindamycin hydrochloride in the treatment of superficial bacterial pyoderma in dogs. *J. Am. Anim. Hosp. Assoc.* 37: 537-542

Burkett, G. and Frank, L.A.1998. Comparison of production of *Staphylococcus intermedius* exotoxin among clinically normal dogs, atopic dogs with recurrent pyoderma, and dogs with a single episode of pyoderma. *J. Am. Vet. Med. Assoc.* 213: 232-234

Bywater, R.J., Hewett, G.R., Marshall, A.B. and West, B. 1985. Efficacy of clavulanate potentiated amoxycillin in experimental and clinical skin infections. *Vet. Rec.* 116: 177-179

Caius, J.F. 1992. *The Medicinal and Poisonous Plants of India.* Scientific Publishers, Jodhpur, 226 p.

Campbell, K.L., Neitzel, C. and Zuckermann, F.A. 1991. Immunoglobulin A deficiency in the dog. *Canine Pract.* 16: 7-11

Carlotti, D.N., Guaguere, E.P.D., Jasmin, P., Thomas, E. and Guiral, V. 1999. Therapy of difficult cases of canine pyoderma with marbofloxacin a report of 39 dogs. *J. Small Anim. Pract.* 40: 265-270

*Carlotti, D.N., Jasmin, P., Guaguere, E. and Thomas, E. 1995. Use of marbofloxacin in the treatment of canine pyoderma. *Pratique-*

Medicale and Chirurgicale de-l' Animal-de-Compagnie 30: 281-293

*Cerri, D., Bizzeti, M. and Balestri, L. 1984. Pyoderma in dogs. Characterization of the bacterial isolates and their antibiotic sensitivity. *Annali-della-Facolta-di-Medicina-Veterinaria – di- Pisa.* 37: 129-140

Chabanne, L., Marchal, T., Denerolle, P., Magnol, J.P., Fournel, C., Monier, J.C. and Rigal, D.1995. Lymphocyte subset abnormalities in German shepherd dog pyoderma (GSP). *Vet. Immunol. Immunopathol.* 49: 189-198

Chammas, P.P.C. and Hagiwara, M.K. 1998. Evaluation of neutrophilic function (Chemotaxis, phagocytosis and microbial activity) in healthy dogs and in dogs suffering from recurrent deep pyoderma. *Vet. Immunol. Immunopathol.* 64: 123-131

Chandler, E.A., Thompson, D.J., Sutton, J.B. and Price, C.J. 1991. *Canine Medicine and Therapeutics*. Third edition. Blackwell Scientific Publications, Oxford, 450 p.

Choi-Won Pil, Lee-Soon II, Lee Kenn Woo, Choi, W.P., Lee, S.I. and Lee, K.W. 2000. Aetiological and epidemiological features of canine dermatitis. *Korean J. Vet. Res.* 40: 94-100

Chopra, R.N., Chopra, I.C., Handa, K.L. and Kapur, L.D. 1958. *Indigenous Drugs of India*. Second edition. Dhur and Sons Private Ltd., Calcutta, 596 p.

Chopra, R.N., Nayar, S.L. and Chopra, I.C. 1956. *Glossary of Indian Medicinal Plants.* Council of Scientific and Industrial Research, New Delhi, India, 140 p.

*Ciric,V., Stojkovic, M. and Marjanovic, D. 1977. Generalized pyoderma in dogs, and gentamicin sulphate treatment. *Veterinarski-Glasnik.* 31: 531-537

Codner, E.C. 1988a. Classifying and diagnosing cases of canine pyoderma. *Vet. Med.* 80: 984-994

Codner, E.C. 1988b. Choosing a treatment course for dogs with pyoderma. *Vet. Med.* 80: 995-1003

Coles, E.H. 1986. *Veterinary Clinical Pathology.* Fourth edition. W.B. Saunders Company, Philadelphia, 486 p.

Cowan, S.T. 1974. *Cowan and Steels Manual for the Identification of Medical Bacteria.* Second edition. Cambridge University Press, New York, 416 p.

Cox, H.U. 1998. Staphylococcal Infections. *Infectious Diseases of the Dog and Cat.* Second edition. (Ed. Greene, C.E.). W.B. Saunders Company, London, pp. 214-216

Cox, H.U., Newman, S.S., Roy, A.F. and Hoskins, J.D. 1984. Species of Staphylococcus isolated from animal infections. *Cornell Vet.* 74: 124-135

Cox, H.U., Newman, S.S., Roy, A.F., Hoskins, J.D. and Foil, C.S. 1985. Comparison of coagulase test methods for identification of *Staphylococcus intermedius* from dogs. *Am. J. Vet. Res.* 46: 1522-1525

Cox, H.U., Schmeer, N. and Newman, S.S. 1986. Protein A in *Staphylococcus intermedius* isolates in dogs and cats. *Am. J. Vet. Res.* 48: 1881-1884

Craig, M. 2003. Diagnosis and management of pyoderma in the dog. *In Pract.* 418-425

Curtis, C.F., Bond, R., Blunden, A.S., Thomson, D.G., Mc Neil, P.E. and Whitbread, T.W. 1995. Canine eosinophilic folliculitis and furunculosis in three cases. *J. Small Anim. Pract.* 36: 119-123

Dash, B. and Kashyap, L. 1997. *Materia Medica of Ayurveda.* Concept Publishing Company, New Delhi, 460 p.

Davis, L.E. 1984. Clinical pharmacology of cephalosporin antibiotics. *J. Am. Vet. Med. Assoc.* 184:344-347

Day, M.J. 1994. An immunopathological study of deep pyoderma in the dog. *Res. Vet. Sci.* 56:18-23

Devriese, L.A. and De Pelsmaecker, K.1987. The anal region as a main carrier site of *Staphylococcus intermedius* and *Streptococcus canis* in dogs. *Vet. Rec.* 121: 302-303

*Doumas, B., Waston, W.A. and Higgs, H.G. 1971. *Clin. Chim. Acta* 31: 87-96 cited in the Operation Manual of Merck Ecoline Albumin.

Dowling, PM. 1996. Antimicrobial therapy of skin and ear infections. *Can. Vet. J.* 37: 695-699

Fadok, V.A. 1982. Zinc responsive dermatosis in a Great Dane: a case report. *J. Am. Anim. Hosp. Assoc.* 18: 409

Farca, A.M., Piromalli, G., Maffei, F. and Re, G. 1997. Potentiating effect of EDTA-Tris on the activity of antibiotics against resistant bacteria associated with otitis, dermatitis and cystitis. *J. Small Anim. Pract.* 38: 243-245

Fehrer, S.L., Boyle, M.D.P. and Halliwell, R.E.W. 1986. Identification of protein A from *Staphylococcus intermedius* isolated from canine skin. *Am. J. Vet. Res.* 49: 697-701

Fisher, G.L. 1977. Effects of disease on serum copper and zinc values in the Beagle. *Am. J. Vet. Res.* 38: 935-940

Frank, L.A. and Kunkle, G.A. 1993. Comparison of the efficacy of cefadroxil and generic and proprietary cephalexin in the treatment of pyoderma in dogs. *J. Am.Vet. Med. Assoc.* 203: 530-532

Gurudeva, M.R. 2001. *Botanical and Vernacular Names of South Indian Plants.* Divyachandra Prakashana Bangalore, 280 p.

Gyles, C.L. and Thoen, C.O. 1994. *Pathogenesis of Bacterial Infections in Animals*. Second edition. International Book Distributing Co:, New Delhi, 312 p.

Hajek, V. 1976. *Staphylococcus intermedius*, a new species isolated from animals. *Int. J. Syst. Bacteriol.* 26: 401-408

Halliwell, R.E.W. 1990. Skin diseases of old dogs and cats. *Vet. Rec.* 132: 389-394

Harvey, R.G., Noble, W.C. and Ferguson, E.A. 1993. A comparison of lincomycin hydrochloride and clindamycin hydrochloride in the treatment of superficial pyoderma in dogs. *Vet. Rec.* 132: 351-353

Hendricks, A., Schuberth, H.J., Schueler, K. and Lloyd, D.H. 2002. Frequency of superantigen-producing *Staphylococcus intermedius* isolates from canine pyoderma and proliferation-inducing potential of superantigens in dogs. *Res. Vet. Sci.* 73: 273-277

Hill, P.B. and Moriello, K.A. 1994. Canine pyoderma. *J. Am.Vet. Med. Assoc.* 204: 334-339

Hoekstra, K.A. and Paulton, R.J.L. 2002. Clinical prevalence and antimicrobial susceptibility of *S. aureus* and *S. intermedius* in dogs. *J. Appl. Microbiol.* 93: 406-413

Holm, B.R., Petersson, U., Morner, A., Bergstrom, K., Franklin, A. and Greko, C. 2002. Antimicrobial resistance in staphylococci from canine pyoderma: a prospective study of first time and recurrent cases in Sweden. *Vet. Rec.*151: 600-605

Holt, I.G., Krieg, N.R., Sneathm, P.H.A., Staley, J.T. and Williams, S.T. 1994. *Bergeys Manual of Determinative Bacteriology*. Ninth edition. Baltimore, M.D. Williams and Williams, 525 p.

Ihrke, P.J. 1983. The Management of Canine Pyodermas. *Current Veterinary Therapy VIII. Small Animal Practice*. W.B. Saunders Co., Philadelphia, pp. 505-517

Ihrke, P.J. 1984.Therapeutic strategies involving antimicrobial treatment of the skin in small animals. *J. Vet. Med. Assoc.*185: 1165-1168

Ihrke, P.J. 1987. An overview of bacterial skin disease in the dog. *Br. Vet. J.* 143: 112-117

Ihrke, P.J., Schwrtzman, R.M., McGinley, K., Horwitz, L.N. and Marples, R.R. 1978. Microbiology of normal and seborrheic canine skin. *Am. J. Vet. Res.* 39: 1487-1489

Jafri, S.A, Masood Rabbani and Rabbani, M. 1999. Prevalence of canine diseases in Lahore area. *Pak. Vet. J.* 19: 40-42

Jain, N.C. 1986. *Schalm's Veterinary Haematology*. Fourth edition. Lea and Febiger, Philadelphia, 361 p.

*Junttila, J., Schildt, R. and Hintikka, E.L. 1987. Sensitivity to antimicrobial drugs of Staphylococcus strains isolated in canine pyoderma. *Suomen Elain Laakarilehti* 93: 263-267

Kamboj, D.S., Singh, K.B., Sharma, D.K., Nauriyal, D.C. and Baxi, K.K. 1995. Characterisation and antimicrobial profile of bacterial isolates from canine bacterial dermatitis. *Indian Vet. J.* 72: 671-674

Keane, K.A. and Taylor, D.J. 1992. Slime-producing Staphylococcus species in canine pyoderma. *Vet. Rec.* 130: 75

Keen, C.L., Lonnerdal, B. and Fisher, G.L. 1981. Seasonal variations and the effects of age on serum copper and zinc values in the dog. *Am. J. Vet. Res.* 42: 347-350

Khosla, R., Dwivedi, P.N. and Verma, H.K. 1991. Aerobic microbiology of canine pyoderma. *Indian J. Anim. Sci.* 61: 1287-1288

Kirthikar, K.R. and Basu, B.D. 1994. *Indian Medicinal Plants*. Second edition. Lalit Mohan Basu, Dehradun, India, 2720 p.

Krick, S.A. and Scott, D.W. 1989. Bacterial folliculitis and Furunculosis and Cellulitis in the German Shepherd Dog. A Retrospective Analysis of 17 cases. *J. Am. Anim. Hosp. Assoc.* 25: 23-29

Krough, H.V. and Kristensen, S. 1981. A study of skin diseases in dogs and cats VI. Microflora of the major canine pyodermas. *Vet. Bull.* 51: 5772

*Kruse, H., Hofshagen, M., Thoresen, S.I., Beedal, W.P., Vollset, I. and Sole, N.E. 1996. Staphylococci from dogs with dermatitis. Antibiotic resistance and recommendations for treatment. *Norsk-Veterinaertidsskrift*. 108: 307-312

Kunkle, G.E. 1987. New consideration for rational antibiotic therapy of cutaneous staphylococcal infection in the dog. *Vet. Bull.* 58: 682

Lewis, D.T. 2003. Dermatologic Disorders. *Clinical Medicine of the Dog and Cat* (Ed. Schaer, M.). Manson Publishing Ltd., USA, pp. 576-582

Linda, M., Long, R.E., Brown, J. and Miller, W.H. 1986. Frequency and anti-microbial susceptibility of Staphylococcus species isolated from canine pyodermas. *Am. J. Vet. Res.* 47: 229-231

Littlewood, J.D., Lakhani, K.H., Paterson, S., Wood, J.L.N. and Chanter, N. 1999. Clindamycin hydrochloride and clavulanate-amoxycillin in the treatment of canine superficial pyoderma. *Vet. Rec.* 662-665

Lloyd, D.H., Carlotti, D.N., Koch, H.J. and Van Den Broek, A.H. 1997. Treatment of canine pyoderma with co-amoxyclav a comparison of two dose rates. *Vet. Rec.* 141: 439-441

Lloyd, D.H., Lamport, A.I., Noble W.C. and Howell, S.A. 1999. Fluoroquinolone resistance in *Staphylococcus intermedius. Vet. Dermatol.* 10: 249-252

Logas, D., Kunkle, G.A. and Mc Dowell, L. 1993. Comparison of serum zinc levels in healthy, systemically ill and dermatologically diseased dogs. *Vet. Dermatol.* 4: 61-64

Love, D.N., Lomas, G., Bailey, M., Jones, R.F. and Weston, I. 1981. Characterization of strains of Staphylococci from infections in dogs and cats. *J. Small Anim. Pract.* 22: 195-199

Mason, I.S. 1991. Canine pyoderma. *J. Small. Anim. Pract.* 32: 381-386

Mason, I.S. and Lloyd, D.H. 1989. The role of allergy in the development of canine pyoderma. *J. Small Anim. Pract.* 30: 216-218

Mathews, M.R. 1999. Dermatologic disorders in dogs. M.V.Sc. thesis. Kerala Agricultural University, Thrissur, 118 p.

Mc Ewan, N.A. 2000. Adherence by *Staphylococcus intermedius* to canine keratinocytes in atopic dermatitis. *Res. Vet. Sci.* 68: 279-283

Medleau, L., Long, R.E., Brown, J. and Miller, W.H. 1986. Frequency and antimicorbial susceptibility of Staphylococcus species isolated from canine pyodermas. *Am. J. Vet. Res.* 47: 229-231

Messinger, L.M. and Beale, K.M. 1993. A blinded comparison of the efficacy of daily and twice daily trimethoprim-sulfadiazine and daily sulfadimethoxine-ormethoprim therapy in the treatment of canine pyoderma. *Vet. Dermatol.* 4: 13-18

Miller, W.H. 1991. Deep pyoderma in two German Shepherd dogs associated with a cell-mediated immunodeficiency. *J. Am. Anim. Hosp. Assoc.* 27: 513-517

Morris, J.S. and Dunn, J.K. 1992. Haematology getting the best from the laboratory. *In Practice* : 67-72

Mueller, R.S., Bettenay, S.V., Lording, P. and Dell'Osa-D. 1998. Antibiotic sensitivity of *Staphylococcus intermedius* isolated from canine pyoderma. *Aust. Vet. Practitioner* 28: 10-13

Muller, G.H., Kirk, R.W. and Scott, D.W. 1989. *Small Animal Dermatology.* Fourth edition. W.B. Saunders Company, Philadelphia, 810 p.

Nadkarni, K.M. 1998. *Indian Plants and Drugs with Their Medical Properties and Uses.* Asiatic Publishing House, Delhi, 420 p.

Nagata, M. and Sakai, T. 1999. Clinical Survey of canine dermatosis in Japan. *J. Japan Vet. Medical Assoc.* 52: 775-779

Nesamony, S. 1999. *Oushadhasasyangal.* Ninth edition. State Institute of Language, Nalanda, Thiruvananthapuram, 300 p.

Nesbitt, G.H. 1983. *Canine and Feline Dermatology: A Systematic Approach.* Lea and Febiger, Philadelphia, 620 p.

Noble, W.C. and Kent, L.E. 1992. Antibiotic resistance in *Staphylococcus intermedius* isolated from cases of pyoderma in the dog. *Vet. Dermatol.* 3: 71-74

Ohlen, B. and Scott, D.W. 1986. Zinc responsive dermatitis in puppies. *Canine Pract.* 13: 6-10

Oh-Taeho and Oh, T.H. 1999. Clinical investigations of canine superficial pyoderma. *Korean J. Vet. Res. 39*: 1017-1020

Okin, R.E. 1983. Canine bacterial dermatitis. *Canine Pract.* 10: 39-41

Pal, A., Basak, D.N. and Chakrabarti, A. 1993. Epidemiological studies on canine pyoderma in West Bengal. *Indian J. Anim. Hlth.* 32: 121-125

Pal, A., Basak, D.N. and Chakrabarti, A. 1995. Biochemical studies of serum and hair in experimental canine pyoderma. *Indian Vet. J.* 72: 481-484

Panciera, D.L. 1997. Clinical manifestations of canine hypothyroidism. *Vet. Med.* 92: 44-67

Papich, M.G. 1984. Clinical Pharmacology of cephalosporin antibiotics. *J. Am. Vet. Med. Assoc.* 184: 344-347

Paradis, M., Abbey, L., Baber, B., Coyne, M., Hannigan, M., Joffe, D., Pukay, B., Trettien, A., Waisglass, S. and Wellington, J. 2001. Evaluation of the clinical efficacy of marbofloxacin (Zeniquin) tablets for the treatment of canine pyoderma: an open clinical trial. *Vet. Dermatol.* 12: 163-169

Paradis, M., Lemay, S., Scott, D.W., Miller, W.H., Willington, J. and Paich, R. 1990. Efficacy of enrofloxacin in the treatment of canine bacterial pyoderma. *Vet. Dermatol.* 1: 123-127

Patil, S.S., Madhava Rao, P. and Patil, N.A. 1999. Epidemiology and bacterial isolates in canine pyoderma. *Indian J. Vet. Med.* 19: 39-40

Petersen, A.D., Walker, R.D., Bowman, M.M., Schott, H.C. and Rosser, E.J. 2002. Frequency of isolation and antimicrobial susceptibility patterns of *Staphylococcus intermedius* and *Pseudomonas acruginosa* isolates from canine skin and ear samples over a six year period (1992-1997). *J. Am. Anim. Hosp. Assoc.* 38: 407-413

Phillips, W.E. and Kloos, W.L. 1981. Identification of coagulase positive *Staphylococcus intermedius* and *Staphylococcus hyicus* subspecies *hyicus* isolates from veterinary clinical specimens. *J. Clin. Microbiol.* 14:671-673

Phillips, W.E. and Williams, B.J. 1984. Antimicrobial susceptibility patterns of canine *Staphylococcus intermedius* isolates from veterinary clinical specimens. *Am. J. Vet. Res.* 45: 2376-2379

Powers, T.E. and Garg, R.C. 1980. Pharmacotherapeutics of Newer Penicillins and Cephalosporins. *J. Am. Vet. Med. Assoc.* 176: 1054-1059

Price, P.M. 1989. Using cefadroxil to treat a chronic complicated case of canine pyoderma. *Vet. Med.* 82: 1106-1109

Reinke, S.I., Stannard, A.A., Ihrke, P.J. and Reinke, J.D. 1987. Histopathologic features of pyotraumatic dermatitis. *J. Vet. Med. Assoc.* 190: 57-59

Reyss-Brion, D.A. 1987. Benzoyl peroxide (oxydex) therapy of canine pyoderma. *Vet. Dermatol. Newsletter* 11: 5-8

Rhodes, K.H. 1990. Recognizing cutaneous diseases that mimics endocrine dermatoses. *Vet. Med.* 85: 1290-1293

Riordan, J.F. 1976. Biochemistry of zinc. *Med. Clin. North Am.* 60: 661-674

Robertson, B.T. and Burns, M.J. 1963. Zinc metabolism and the Zinc-Deficiency Syndrome in the Dog. *Am. J. Vet. Res.* 24: 997-1002

Saijonmaa-Koulumies, L., Passons, E. and Lloyd, D.H. 1998. Elimination of *Staphylococcus intermedius* in healthy dogs by topical treatment with fusidic acid. *J. Small Anim. Pract.* 39: 341-347

Sanecki, R.K., Corbin, J.E. and Forbes, R.M. 1982. Tissue changes in dogs fed a zinc-deficient ration. *Am. J. Vet. Res.* 43: 1642-1646

Saridomichelakis, M.N., Koutinas, A.F., Gioulekas, D. and Leontidis, L. 1999. Canine atopic dermatitis in Greece clinical observations and the prevalence of positive intradermal test reactions in 91 spontaneous cases. *Vet. Immunol. Immunopathol.* 69: 61-73

Schwarz, S. and Chaslus Dancla, E. 2001. Use of antimicrobials in veterinary medicine and mechanisms of resistance. *Vet. Res.* 32:201-225

Scott, D.W. 1981. Observations on canine atopy. *J. Am. Anim. Hosp. Assoc.* 10: 233-244

Scott, D.W. and Paradis, M. 1990. A survey of canine and feline skin disorders seen in university practice small animal clinic University of Montreal Saint Hyacinthe Quebec (1987-1988). *Can. Vet. J.* 31: 830-839

Singh, V.K. and Ali, Z.A. 1998. *Herbal Drugs of Himalya.* Today and Tomorrows Publishers, New Delhi, 220 p.

Singh, V.K. and Khan, A.M. 1990. *Medicinal Plants and Folklores*. Today and Tomorrows Publishers, New Delhi, 520 p.

Sischo, W.M., Ihrke, P.J. and Franti, C.E. 1989. Regional distribution of ten common skin diseases in dogs. *J. Vet. Med. Assoc.* 195: 752-756

Sivarajan, V.V. and Balachandran, I. 1994. *Ayurvedic Plants and Their Plant Sources*. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 414 p.

Slade, E.A., Thompson, F.N., Lorenz, M.D. and Kemppaainen, R.J. 1984. Serum thyroxine and tri iodothyronine concentrations in canine pyoderma. *J. Am. Vet. Med. Assoc.* 185: 216-218

Snedecor, G.W. and Cochran, W.G. 1980. *Statistical Methods*. Ninth edition. Oxford IBH Publishing Company, Calcutta, 584 p.

Sousa, C.A., Stannard, A., Ihrke, P.J., Reinke, S.I. and Schmeitzel, L.P. 1988. Dermatotis associated with feeding generic dog food 13 cases (1981-1982). *J. Am. Vet. Med. Assoc.* 192: 676-680

Sousa, C.A.1990. The cutaneous features, diagnostic tests, and therapies for hyperadrenocorticism. *Vet. Med.* 85: 1310-1316

Srivastava, R.C. 1989. *Drug-Plant Resources of Central India.* Today and Tomorrows Publishers, New Delhi, 350 p.

Stewart, L.J. 1988. The role of pyoderma in pruritus. *Small Anim. Pract.* 18: 1013-1021

Tamura, Y., Takahashi, H., Ookubo, T. and Wantanabe, A. 1993. Bacteria isolated from dogs with pyoderma. *J. Jap. Vet. med. Assoc.* 46: 54-46

Thoday, K.L. 1980. Canine pruritus an approach to diagnosis stage II infestations and infections. *J. Small. Anim. Pract.* 21:449-458

Van den Broek, A.H.M. and Stafford, W.L. 1988. Diagnostic value of zinc concentrations in serum, leucocytes and hair of dogs with zinc-responsive dermatosis. *Res. Vet. Sci.* 44: 41-44

Van den Broek, A.H.M. and Thoday, K.L. 1986. Skin disease in dogs associated with zinc deficiency: a report of five cases. *J. Small Anim. Pract.* 27:313-323

*Vokoun, P. 1985. Antibiograms of the most frequent microflora in canine pyoderma. *Veterinarstvi* 35: 515-517

Weichselbaum, T.E. 1946. *Am. J. Clin. Pathol.* 16: 40. Cited in operation manual of Merck Ecoline Total Protein

White, S.D., Ihrke, P.J., Stannard, A.A., Sousa, C., Reinke, S., Rosser, E.J. and Jang, S. 1983. Occurrence of *Staphylococcus aureus* on the clinically normal canine hair coat. *Am. J. Vet. Res.* 44:332-334

White, S.D., Rosychuk, R.A.W., Stewart, L.J., Cape, L. and Hughes, B.J. 1989. Juvenile cellulitis in dogs: 15 cases (1979-1988). *J. Am. Vet. Med. Assoc.* 195: 1609-1611

Willemse, T. 1986. Atopic skin disease: a review and a reconsideration of diagnostic criteria. *J. Small Anim. Pract.* 27: 771-778

Wisselink, M.A., Bernadina, W.E., Willemse, A. and Noordzij, A. 1988. Immunologic aspects of German Shepherd dog pyoderma (GSP). *Vet. Immunol. Immunopathol.* 19: 67-77

Wisselink, M.A., Willemse, Akoeman, J.P. 1985. Deep pyoderma in the German Shepherd dog. *J. Am. Anim. Hosp. Assoc.* 21: 773-776

Woldehiwet, Z. and Jones, J.J. 1990. Species distribution of coagulase positive staphylococci isolated from dogs. *Vet. Rec.* 126: 485

*Wustenberg, T. and Rodenbeck, H. 1990. Canine pyoderma: symptomatology and therapy with special regard to a new cephalosporin preparation (Cephalexin-monohydrate). *Kleintierpraus* 35: 483-492

Yager, J.A. and Scott, D.W. 1993. The Skin and Appendages. *Pathology of Domestic Animals.* (Eds. Jubh, K.V., Kennedy, P.C. and Pulmer, N.) Fourth Edition. Academic Press, London. pp. 531-737

* Originals not consulted

Appendix

Appendix I

DERMATOLOGICAL INVESTIGATION PROFORMA

1. Date Case No. Hospital

2. Owner's name and address

3. Patient's name: Age: Breed: Sex : M/F

Chief complaint:

History

1. Castrated/spayed/Not

2. Parity / NA

3. Date of last whelping / NA

4. Mating History

5. Active/Lethargic

6. Feed consumption

7. Frequency of feeding
Time of feeding
List of suspected foods

☐ Cow's milk ☐Beef ☐ Mutton ☐ Pork ☐ Chicken ☐ Rabbit
☐ Fish (variety) ☐ Egg ☐ Oatmeal ☐Corn ☐ Soy
☐ Wheat ☐ Rice ☐ Potatoes ☐ Canned food
☐ Dog biscuits (name)

8. Normal/Less Anorectic

9. History of vaccination

10. History of deworming

Parasites present: Flea/Lice/Ticks/Sarcoptes/Demodex/Other mites

11. Bath
Frequency of bathing: Daily/once in two days/once in a week/Once in a fortnight/Once in a month/Once in two months/Nil

Soap : Used / Not used
If used Name of soap

12. Practice of brushing : Yes / No
If Yes when? Occasionally / Just before bath / Just after bath

13. Type of kennel : Floor / Roof / Side walls

14. Type of Breeding

15. Mode of disinfection of kennel : Just washing
If chemical disinfectant used (soap/detergent)
Name of chemical

16. Age of purchase of the dog
From where purchased/kennel/petshop/private
If private from whom

17. Type of lesion

Primary

- ☐ Macule
- ☐ Plaque
- ☐ Vesicle
- ☐ Tumour
- ☐ Patch
- ☐ Nodule
- ☐ Bulla
- ☐ Papule
- ☐ Pustule
- ☐ Wheal

Secondary

1. Scale
2. Scars
3. Crusts
4. Erosion
5. Ulcers
6. Excoriation
7. Erythema
8. Alopecia
9. Lichenification
10. Hyperpigmentation
11. Hypopigmentation
12. Patches of hyperpigmentation
13. Hyperkeratosis
14. Epidermal collarette
15. Callus

Colour of the lesion

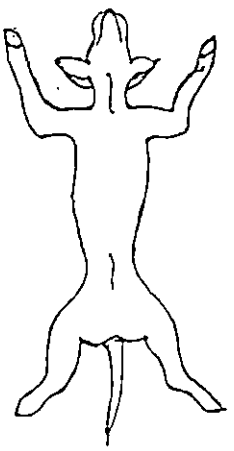
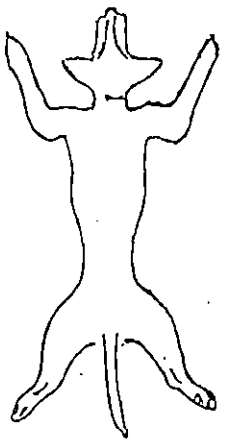
Alopecia present / absent

If present localised / diffused / assymetrical / Symmetrical

Pruritis Present / absent

If present constant / sporadic / only at night

Distribution of lesion

Ventral View	Dorsal view	Lesion – Many / Moderate / Few / No
		

Skin changes

Elasticity Extensibility Thickness

Quality of haircoat Other factors

Epilation

Pilage in : Dry Brittle Dull oily Nail

Configuration Area

Linear Angular (target) Grouped

Where did the problem began

What did it look like then

How has it changed or spread

Whether the colour of hair changes or not

Change / No change

Whether any incontact animals affected : Yes / No

Whether any incontact humans affected : Yes / No

19. Medications

Previously applied / Not applied / Not known

Name of the drug

Duration of treatment

Last date of previous treatment

Other diseases for which treated previously

Name of disease *condition*	Drug used	Duration of treatment		Effect of treatment
		Start	End	

20. Diagnosis

Results of laboratory examination

1. Cultural examination
2. Antibiotic sensitivity pattern
3. Haematology
   i) Haemogram
   ii) Serum parameters

21. Therapy

22. Remarks

CLINICO-THERAPEUTIC STUDIES ON CANINE PYODERMA

UDAYASREE. V. J.

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

Master of Veterinary Science

Faculty of Veterinary and Animal Sciences
Kerala Agricultural University, Thrissur

2004

Department of Clinical Medicine
COLLEGE OF VETERINARY AND ANIMAL SCIENCES
MANNUTHY, THRISSUR-680651
KERALA, INDIA

ABSTRACT

Prevalence of pyoderma was studied among the dogs presented with dermatological problems at the University Veterinary Hospitals, Mannuthy and Kokkalai during the period from May 2003 to April 2004. Among the 409 dermatological problems in canines, bacterial dermatitis was 12.71 per cent (52 cases).

Incidence of surface pyoderma, superficial pyoderma and deep pyoderma were 26.92, 53.85 and 19.23 per cent respectively. Surface pyoderma were more in age groups between one and four years, superficial pyoderma were more in age group below six months and deep pyoderma was more in age group between six and 12 months.

The most frequent lesions were pustules, papules, erythema, alopecia and epidermal collarette and distributed mostly on axilla, abdomen, flank and trunk region.

A significant increase in eosinophil count, with decrease in monocytic count and serum zinc level was observed in the affected dogs.

Out of the 26 bacterial isolates 21 (80.77 per cent) were gram positive and five (19.23 per cent) were gram negative. *Staphylococcus intermedius* (12) was the major pathogen isolated from canine pyoderma followed by *Staphylococcus aureus* (8), *Staphylococcus epidermidis* (1), *Escherichia coli* (3), *Pseudomonas aeruginosa* (1) and *Klebsiella* spp. (1).

Ciprofloxacin, enrofloxacin and erythromycin were found to be the most effective antibiotics against bacterial isolates of canine pyoderma, ampicillin and cloxacillin the least effective.

Based on the antibiogram result, ciprofloxacin was used to treat ten cases of pyoderma, enrofloxacin for nine cases and erythromycin was used to treat a single case of pyoderma. All the cases recovered within a period of three weeks.

Six confirmed cases of pyoderma were treated with the paste of leaves of *Cynadon dactylon* and all six cases shown good clinical improvement.