STUDIES ON THE EPIZOOTIOLOGY, DIAGNOSIS, PATHOGENESIS AND MANAGEMENT OF VIRAL GASTROENTERITIS IN DOGS

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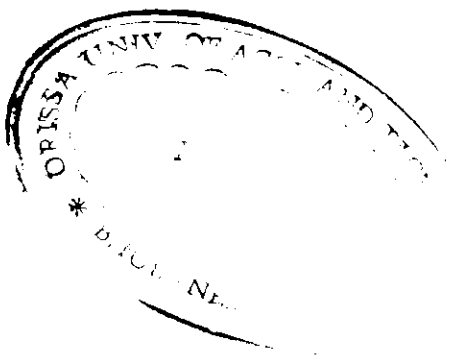
DEDICATED TO
MY ESTEEMED TEACHER

Dr.D.C.Nayak



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CERTIFICATE-I

This is to certify that the thesis entitled " **STUDIES ON THE EPIZOOTIOLOGY, DIAGNOSIS, PATHOGENESIS AND MANAGEMENT OF VIRAL GASTROENTERITIS IN DOGS"** submitted for the degree of **DOCTOR OF PHILOSOPHY** in the subject of **VETERINARY MEDICINE OF THE ORISSA UNIVERSITY OF AGRICULTURE & TECHNOLOGY, BHUBANESWAR,** is a faithful record of bonafide and original research work carried out by **JOGESH CHANDRA JENA** under my guidance and supervision and that no part of the thesis has been submitted for any other degree or diploma.

The assistance and help received during the course of investigation have been fully acknowledged.

07/02/2004

MAJOR ADVISOR

CERTIFICATE-II

This is to certify that the thesis entitled **"STUDIES ON THE EPIZOOTIOLOGY, DIAGNOSIS, PATHOGENESIS AND MANAGEMENT OF VIRAL GASTROENTERITIS IN DOGS"** submitted by **JOGESH CHANDRA JENA** to the **ORISSA UNIVERSITY OF AGRICULTURE & TECHNOLOGY, BHUBANESWAR,** in partial fulfillment of the requirements for the degree of **DOCTOR OF PHILOSOPHY** in the subject of **VETERINARY MEDICINE** has been approved by the student's advisory committee after an oral examination on the same in collaboration with an external examiner.

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CHAPTER - I

INTRODUCTION

INTRODUCTION

Dog is considered as the best companion animal of man and has been domesticated since 12,000-15,000 years in South Eastern Asia (Messent, 1979 and Boorer, 1981). The existence of dog on the earth was experienced about 20 million years ago. From primitive age the dog has proved itself to be a trusted custodian among all steps of lives beginning from the rusty and pastoral communities to the urban and modern societies. The stray dogs play a vital role in maintenance of environmental sanitation with their scavenging activities. The dog is adorned with very unique and impulsive virtues of slumber and sudden alertness extending efficient guardage for human need. The socio-psychic craving of the man for the pet dog has established the reciprocality of man animal bondage. Man fulfills all the basic bare necessities of the pet and creates a strong ring of safety, amiability, amicability, nourishment, care and health measure. The dog repays his master with loyality, faithfulness, keen watchfulness, servility, obedience and detective ability with intelligence. Any illness of the pet draws immediate attention of all the households with emotion and anxiety and the pet owner becomes perturbed for speedy recovery.

Dog suffers from gastroenteritis of various origins with high intensity and morbidity. Viral gastroenteritis is a tenacious ailment comprising of complex enteric syndrome. Canine parvo virus and corona virus are the predominant viral pathogens for manifestation of the symptoms of gastroenteritis. Canine corona virus (CCV) causes mild gastroenteritis whereas canine parvo virus (CPV) is highly pathogenic and causes severe gastroenteritis. CCV was first isolated from sentry dogs in Germany during 1971 (Binnet *et al.*1974). In the United States, during 1978, canine diarrhoea

epizootics occurred in the spring and summer seasons and CCV was isolated frequently from the affected dog (Appeal *et al.*, 1980, Carmichael and Binn, 1981). Even a small description of corona virus CCV became important only after 1977 soon after the association of canine parvo virus with out-breaks of "Contagious vomiting and diarrhoea" in puppies in Texas, USA (Eugster & Nairn, 1977 and Eugster *et al.*, 1978). But parvo virus-like agent was isolated from the faeces of apparently healthy dogs (Binn *et al.*,1970). Since 1977 canine parvo virus infection with enteritis and/or myocarditis has been reported from many countries (Kelly, 1978; Thomson and Gagnon, 1978; Gagnon and Povey, 1979; Johnson and Sparbrow, 1979; Appel *et al.*,1979, Heys *et al.*, 1979; Hitchcock and Scavenell, 1979 Mc Candish *et al.*, 1979; Mann *et al.*, 1980 and Appel *et al.*, 1980). According to Binn *et al.*, (1970) the continuous cell line derived from a subdermoid cyst of an irradiated dog supported the growth of a kind of virus which was subsequently characterized as parvo virus. One isolate (2 x66) was designated as " minute virus of canines" (MVC) which was known as reference strain of this new parvo virus. But the "minute virus of canines" is antigenically distinct from known parvo viruses and canine parvo virus type-2 (Carmichael and Parrish,1984). The second canine parvo virus (CPV-2) was discovered in 1978. There was no serological relationship between the MCV and the CPV-2. The "minute virus of canines" is now referred as canine parvo virus-1 (CPV-1) because it was first recognized as autonomous parvovirus of dog. It could have been assumed that CPV-2 has emerged from another virus through the process of mutation which occurred in tissue culture.

Canine parvoviral gastroenteritis is a fatal disease of dog and first appeared in 1978 in North America, Europe and Australia. By 1980 this disease took panzootic form prevailing in North America, Central America, New Zeeland, Asia, South Africa, Europe, UK, France and Australia (Pollock and Parrish, 1985). Now canine parvo virus is ranked 1st among canine viral gastroenteritis affecting a

sizeable canine population throughout the world. In the recent past, viral gastroenteritis in the pet dog population especially in the pure breeds has created a great concern among the pet owners and veterinary clinicians. A thorough search into literatures of this area of health hazards of canines revealed that canine viral gastroenteritis has a complex nature of viral etiology including corona virus, parvo virus, rota virus, astro virus, calico virus and sometimes canine distemper viruses.

Parvo viruses are best propagated in young and actively dividing cells. The young pups are very susceptible to the disease. In young ones the cardial myelocytes multiply actively which become very suitable for the propagation and multiplication of the parvo viruses. The severity of the infection causes myocarditis and congestive heart failure resulting in sudden death. Mortality rate among the pups aged about 2 to 3 months is more (Meunier *et al.* 1981). According to the observation of Carmichael *et al.* (1984) the new born pups carry the maternal antibodies against parvo virus which confer protection up to 18 weeks. But the majority of cases get affected with CPV-2 and manifest enteritis between 2-3 months of age. The affected pups manifest varied symptoms depending upon the age of the pups. In each and every case fever becomes a constant clinical symptom. In addition to this there will be dullness, general malaise, anorexia, nausea, vomition, rapid dehydration and haemorrhagic foetid watery purgation with dark brown or red flecks of blood. Sometimes there will be slimmy mucus and pus with scanty watery faeces. The main source of infection is the high concentration of the virus in the faeces of the infected dog. Canine parvo virus-2 is extremely resistant to normal environmental condition and may be carried over to a distant place by the dogs, insects and man. In rare cases the infected dogs shed these viruses constantly or periodically. Sometimes any damage to intestinal mucosa caused by the endoparasitic infection like hookworm and coccidia may facilitate the easy onset of parvo virus infection causing severe gastroenteritis.

The contagious nature of the disease urges quick diagnosis and remedial measure to sustain the life of the pet. Basing on the clinical symptoms and differential diagnosis without detection of the virus the diagnosis can not be confirmed for parvo virus infection due to the similar type of symptoms manifested in other viral gastroenteritis. Therefore, other diagnostic methods like detection of virus in the faeces by electron microscopy, virus isolation by tissue culture, enzyme linked immunosorbent assay (ELISA), agar gel immunodiffusion test (AGID), agar gel precipitation technique (AGPT), indirect fluorescent antibody technique, haemagglutination test and PCR etc are being employed for correct diagnosis.

Pathogenesis in canine parvo virus infection has specific feature and is influenced by the age of affected dog. Canine parvo virus depends on cellular DNA replication mechanism and its multiplication takes place only in actively dividing cells. As such the myocardium and intestinal epithelial cells of the puppies are the main target cells for the parvo virus infection and multiplication. Lymphatic infection at the early stage of disease process gives rise to rise of temperature with covert signs of infection. At this stage lymphopenia initiates the disease process in all the affected dogs. The natural route of infection is oral route by ingesting the virus-containing materials from the environment. Pharyngeal lymphoid tissues and the M-cells on the surface of Peyer' patches get infected (Potgierter *et al.*, 1981 and Meunier *et al.*, 1985b). As viraemia and lymphatic infection takes place prior to enteric infection, the intestinal epithelium is not the probable site of entry of the parvo virus. Level of viraemia and lymphatic infection pre-determine the intestinal infection and severity of the overt clinical signs.

The management of viral gastroenteritis poses a great challenge to the veterinarians due its rapid pathogenesis, morbidity and mortality. There are no specific antiviral drugs. The treatment is non-specific and symptomatic. The preventive measures should be taken to save the life of the animal from these refractory diseases

with existing biologicals or by developing new biologicals. No systematic work has been conducted in India against this emerging disease.

In the back drop of the above scenario the present research work, "Studies on the epizootiology, diagnosis, pathogenesis and management of viral gastroenteritis in dogs" has been envisaged for:

- epizootiological status of the viral gastroenteritis with particular reference to parvo virus and corona virus infection in pet dog population in the locality
- diagnosis of different viral association on the basis of examination of faecal samples by
  - Dot-enzyme linked immunosorbent assay (Dot-ELISA)
  - Haemagglutination (HA) test
  - Reverse Passive Haemagglutination (RPHA) test
- clinical symptoms of CPV and CCV infection
- experimental infection
- haematological assay of the infected dogs
- culture and sensitivity test for bacterial isolates
- histopathological changes of the vital organs of the infected animals to assess the pathogenesis of the disease
- therapeutic management of the natural clinical cases.

CHAPTER - II

REVIEW OF LITERATURE

REVIEW OF LITERATURE

EPIDEMIOLOGY

Canine Parvo Virus Infection

Binn *et al.* (1970) reported that in 1967 they recovered small antigenically related viruses from faecal specimens of several normal dogs. The viruses were isolated in a continuous dog cell line (Walter Reed Canine Cell, WRCC) derived from a sub-dermoid cyst of an irradiated dog. One isolate (2 x 66) was designated as the "Minute Virus of Canines" (MVC) which was to be treated as reference strain of this novel parvo virus. As MVC was the first autonomous parvo virus recognized in dogs, it is now referred to as canine parvo virus type I (CPV-I).

Appel *et al.* (1978) reported that a totally new enteric disease in North America and Australia causing sudden death in young puppies due to myocarditis and congestive heart failure. In the tissue culture a parvovirus was isolated from both forms of the disease which was tentatively classified as canine parvovirus Type 2 (CPV-2).

Carmichael (1978) reported that some dogs were found suffering from infectious canine enteritis with the symptoms of diarrhoea, vomition, anorexia and severe weakness. Corona –like virus was recovered from the affected dogs.

Thomson and Gagnon (1978) reported that a serious outbreak of canine gastroenteritis was seen in Ontario and Canada among the population of various age groups ranging from 7 weeks to 11 years of age. They isolated a parvovirus-like agent from faeces of the affected dogs.

Appel *et al.* (1979 a) conducted a study on naturally occurring gastroenteritis in dog population in America. They observed

vomition in the affected dogs to be the first clinical symptom followed by fever and diarrhoea. They recorded that fever ranging from 40° C to 41° C was common in puppies. The faeces were usually loose, pasty, light grey or yellow grey with foetid smell and later flecked with blood or mucus. Some puppies produced only thin watery reddish-brown fluid while in very severe cases of CPV infection the faeces were haemorrhagic. They reported that this type of canine enteritis was due to corona and parvo-like viral enteritis.

Appel *et al.* (1979 b) conducted isolation and immunization studies of a canine parvo-like virus from dogs with haemorhagic enteritis. They stated that CPV shares common antigens with feline parvo virus. However, despite antigenic relationship between CPV and feline parvo virus and common clinical and pathological features for their relevant species, the two viruses are biologically different from one other. Feline parvo virus is only capable of agglutinating pig red blood cells at 40° C. In contrast CPV has a more restricted range of susceptible cells. Besides they found that experimental infection of dogs with FPV did not induce lymphopaenia or fever or result in excretion of virus but it did produce homologous antibodies which protect dog when challenged.

Black *et al.* (1979) reported that the dogs of different age groups from 2 weeks to 1 year of age in Northern and Central America were affected with severe gastroenteritis. These affected dogs exhibited blood tinged diarrhoea, vomition, rise of temperature, anorexia and depression. They observed high morbidity and about 50% mortality in the affected population with canine parvo virus.

Burton and Baker (1979) reported that an outbreak of highly contagious gastroenteritis was observed among the dog population in Australia manifesting profuse bloody purgation and emesis. There was morbidity and fatality among the affected dogs. This infection was diagnosed as canine parvo virus infection.

Burtonboy *et al.* (1979) recorded an occurrence of canine haemorrhagic gastroenteritis in Belgium. They recovered parvo-like virus from the affected dogs which died with haemorrhagic enteritis.

Coignoul *et al.* (1979) studied the aetiological role of a virus causing canine haemorrhagic enteritis in Belgium and reported that CPV was the etiological agent of haemorrhagic enteritis. Their observation included vomition, fever, diarrhoea with blood flecks, anorexia and severe weakness in the affected dogs.

Cooper *et al.* (1979) reported canine viral enteritis in the United States. They recorded morphological lesions in naturally occurring parvo virus infection with symptoms of pyrexia, depression, dyspepsia, vomition and foetid bloody diarrhoea and histological changes in lymphatic tissues, especially in Peyer's patches, lymphnodes, spleen and thymus. They suggested that these histological changes were not pathognomonic in nature but were very helpful in diagnosis of a viral infection. In natural cases of canine gastroenteritis they isolated CPV as etiological agent.

Finnie (1979) recorded the prevalence of canine parvo virus infection in the USA and conducted post-mortem of the victims of canine gastroenteritis and isolated CPV as the causative agent. During post-mortem examinations of puppies which died suddenly, it was found that lungs were firm, gray pink in colour with petechial haemorrhages over pleural surface.

Fletcher *et al.* (1979) reported an outbreak of canine gastro enteritis in the United States of America caused by canine parvo virus and stated that canine parvo virus could be naturally transmitted to the wild animals i.e. maned wolves. They also suggested that natural history and the sudden emergence of pathogenic CPV remained a speculation.

Fritz (1979) reported prevalence of canine enteritis in the state of Illinois, USA. He isolated parvo virus and diagnosed this virus as the causative agent of the canine enteritis.

Gagnon and Povey (1979) reported an epidemic gastro enteritis of dogs in Canada. They isolated the virus and tentatively

diagnosed this virus as canine parvo virus which was the causative agent of the epidemic and suggested that CPV shared common antigens with feline parvo viruses.

Gumbrell (1979) reported prevalence of parvo virus infection in dogs in New-Zealand by isolating CPV from the faeces of dogs suffering from severe gastroenteritis manifesting symptoms of vomition, rise of body temperature and foul smelling bloody diarrhoea.

Hayes *et al.* (1979 a) reported prevalence of canine gastroenteritis in Canada in young dogs and ascertained the cause of death to be CPV. They further recorded that the sudden death of pups aged about 3-10 weeks in this disease episode was myocarditis associated with a parvo virus-like agent.

Hitchcock and Scarnell (1979) recorded canine parvo virus infection in dog population of UK They isolated CPV from the faeces of the dog manifesting severe gastroenteritis.

Horner *et al.* (1979) reported an outbreak of canine gastroenteritis in the dogs of New Zealand exhibiting the symptoms of emesis, fever, foetid diarrhoea and depressed appetite. They isolated the CPV from the faeces of the affected dogs.

Johnson and Spradbrow (1979) reported a severe form of outbreak of canine gastroenteritis in dogs of Australia and isolated CPV from the faeces of affected dogs. They stated that this isolate was antigenically related to feline panleucopenia virus. Besides they documented that CPV and FPV were two distinct and biologically different viruses.

McCandlish *et al.* (1979) reported the prevalence of canine parvo virus gastroenteritis in pedigree dogs in the United Kingdom. He isolated CPV from the faeces of these ailing dogs and labelled it as the causative agent of the disease. They also reported that CPV had an affinity for rapidly dividing myocardium and intestinal cells and was responsible for pathological manifestations of myocarditis and enteritis in pups.

Miscieattelli *et al.* (1979) reported an outbreak of canine gastroenteritis in dogs in four breeding kennels in Italy during the second half of 1979 and they isolated CPV from the faeces of these dogs.

Nelson *et al.* (1979) recorded the prevalence of spontaneous canine viral enteritis due to CPV infection in the puppies in seven kennels in South Dakota, Minnesota and Kansas in the USA. They noted 20-100% morbidity rate and 10-50% mortality rate amongst the affected pups. The highest morbidity and mortality rate was recorded in young weaned pups.

Pollock and Carmichael (1979) reported that CPV was causative agent of canine gastroenteritis. Serologically, they established the antigenic distinction between MVC and CPV and demonstrated the presence of MVC antibodies in the serum of dogs before and after the emergence of canine haemorragic enteritis and myocarditis.

Robinson *et al.* (1979 b) reported an outbreak of canine parvo virus infection in Australia and listed the clinical findings like loss of appetite, fever, vomition and blood tinged diarrhoea. They recorded the rate of morbidity in young pups to range between 20 to 100% and observed that the mortality among the recovered pups was due to heart failure.

Arens and Krauss (1980) reported canine parvo virus infection in German Federal Republic by examining the faeces of pups. They isolated canine parvo virus in 41 out of 71 stool of dogs showing acute gastroenteritis.

Atwell and Kelly (1980) reported prevalence of canine parvo virus infection in dogs in Australia and the mortality was high and sudden due to congestive heart failure.

Becker and Becker (1980) demonstrated prevalence of CPV infection in dogs of East Germany by isolating CPV from the faeces of dogs which clinically manifested vomition, fever and foetid watery bloody diarrhoea.

Bohm (1980) reported occurrence of acute canine gastroenteritis in dogs with high morbidity and mortality in West Germany.

Carpenter *et al.* (1980) reported prevalence of intestinal and cardiopulmonary forms of parvovirus infection in a litter of pups in the U.S.A.

Fluckiger (1980) recorded canine gastroenteritis due to infection of CPV in Switzerland during the winter months of 1979-80. Eighty per cent of infected dogs were below one and half year of age and among them 50% cases were within the age group of 3 months indicating a higher rate of prevalence in younger population. Sex wise males were found more susptible than female pups.

Harcourt *et al.* (1980) reported canine parvo virus infection in a beagle colony. They recorded profuse bloody diarrhoea, fever, emesis, dehydration and weakness in the affected dogs. According to them the clinical manifestation, within a group of puppies, varied considerably with asymptomatic or transient dullness and anorexia to acute haemarrhagic gastroenteritis.

Hornedo (1980) noticed an outbreak of severe gastroenteritis in pups within the age group of six month in Mexico. They isolated CPV as the etiological agent from the faeces of affected pups with symptoms of foetid diarrhoea, vomition, fever and debility.

Jacob *et al.* (1980) recorded epizootic pattern of canine gastroenteritis in the USA. They clinico-pathologically examined 134 affected dogs and incriminated CPV as the causative agent. They also found that young pups were mostly affected although CPV infection occurred in dogs of all ages.

The possibility of introduction of CPV enteritis into Finland was studied by Jalanka (1980) and he found that CPV was responsible for vomition, fever and bloody diarrhoea in dogs.

Jedlizoka (1980) investigated prevalence of canine parvo viral gastroenteritis in dogs in Vienna during 1979-80 and reported 36 cases by isolating CPV from the faeces of affected dogs within the

age group of 7 weeks to 8 years. He found 17 cases to be less than 16 weeks old.

Krohn and Blakstad (1980) reported 5 cases of canine gastroenteritis due to parvo virus in Norway. All these five affected dogs showed almost similar symptoms like vomition, fever and foul smelling bloody diarrhoea.

Niemand *et al.* (1980) reported an epidemic form of gastro enteritis in canines in December, 1979 in Grossraum Mannhium in West Germany. They detected CPV in 62 affected dogs through laboratory examination of faeces.

Olson *et al.* (1980) recorded an outbreak of canine gastroenteritis in Sweden. They detected parvo virus in faeces of affected dogs and identified it as the causative agent.

Osterhaus *et al.* (1980) reported the incidence of CPV infection causing acute diarrhoea and vomition in dogs in Netherland. They isolated a virus closely related to feline panleucopenia virus from the faeces of diarrhoic dogs.

Parrish *et al.* (1980) reported outbreaks of canine gastroenteritis caused by canine parvo virus at five different places in the Wellington region, New Zealand.

Perl *et al.* (1980) reported incidence of acute gastroenteritis in dogs in Israel and isolated CPV from faeces of the affected pups.

Roseto *et al.* (1980) reported epizootical pattern of parvo virus infection in 1979 in Paris and recorded 23.2% incidence of CPV gastroenteritis in dogs.

Smith *et al.* (1980) reported prevalence of the epizootic form of canine gastroenteritis in Australia. They isolated CPV in the faeces of the affected dogs. During serological studies on the epidemiology of parvo virus enteritis of dogs they found that the severity of the clinical manifestation of the disease was closely related to the immune status and responsiveness of individual animal. Besides they observed that in natural cases, secondary bacterial infection or other stress factors could influence the severity and course of the disease.

Touratier (1980) reported parvo virus gastroenteritis and myocarditis in dogs in France.

Walker *et al.* (1980) conducted a serological survey of canine parvo virus infection in New South Wales, Australia and reported that CPV was the etiological agent for causing acute canine gastroenteritis.

Witte *et al.* (1980) reported prevalence of canine parvo virus gastroenteritis in dogs in West Germany. They isolated CPV from faeces of the affected dogs.

Woods *et al.* (1980) recorded the prevalence of canine parvo viral enteritis in two kennels with 31 dogs in the city of Washington, USA. They observed that canine parvo virus infected dogs of all ages but the highest incidence rate and mortality was found among the puppies between 8-16 weeks of age. They reported that the first clinical symptom was manifested only after an incubation period of 7-14 days manifested by vomition followed by fever and then diarrhoea.

Azetaka *et al.* (1981) reported an outbreak of canine gastroenteritis in 52 dogs suspected clinically for canine parvovirus infection in Japan. They isolated CPV from the faeces and tissues of these affected dogs.

Balu and Thangaraj (1981) reported outbreak of canine parvoviral gastroenteritis in Madras city first time in May,1980. Similar outbreaks promptly appeared during the summer of 1981 with a comparatively lower virulent symptoms.

Binn *et al.* (1981) studied the incidence of CPV infection in 26 laboratory Beagles in USA during a natural outbreak of the disease. They recorded the disease in 20 out of 26 Beagles registering an incidence of 78%.

Hinaidy (1981) studied 62 dogs suffering from enteritis to ascertain the etiological agent between spring and November, 1980 in Austria and reported that 17 dogs were suffering from CPV infection to manifest enteritis which accounted an incidence of 27.41%.

Hoffman and Pock (1981) isolated CPV from the faeces of ill dogs aged between 7 weeks to 12 years suffering from gastroenteritis manifesting the symptoms of foetid diarrhoea and vomition in the year 1980 in German Federal Republic. They reported an incidence of 63% of CPV infection among the young ones within an age group of 7-20 weeks during the month of January to May, 1980.

Meunier *et al.* (1981) recorded an outbreak of CPV infection in a commercial kennel of 6000-7000 Beagles in New York, USA. They found that the mortality rate was found highest among the weaned puppies between 9-12 weeks of age.

Neill *et al.* (1981) reported an outbreak of gastroenteritis in dogs in UK and isolated CPV in 41 cases out of 66 dogs registering an incidence of 52 per cent.

Price and Njiro (1981) reported the CPV infection among the dogs of Kenya. They found that the dogs of all ages were affected with the disease but the severity and incidence were recorded more in young dogs.

Sandstedt and Wierup (1981) reported regarding an outbreak of gastroenteritis in dogs in 1979 in Sweden. They isolated CPV from the faeces of 49 dogs out of 77 dogs showing the symptoms of vomition, diarrhoea, anorexia and rise of temperature. They recorded the rate of incidence of CPV infection to be 63. 63%.

Valicek *et al.* (1981) reported outbreak of haemorrhagic enteritis in the dogs in Czechoslovakia. They isolated parvovirus like particles from the faeces of the affected dogs. They recorded 100% morbidity among the affected cases with 20-50% mortality.

Voros *et al.* (1981) recorded an epizootic form of gastroenteritis among a population of 400 dogs in Hungary between May and September, 1980. They isolated CPV from the faeces of affected dogs.

Bucci *et al.* (1982) isolated CPV from the faeces of the dogs of various age groups showing the symptoms of vomition, rise of temperature and haemorrhagic enteritis in Egypt.

Chew-Lim *et al.* (1982) conducted serological tests of 225 dogs for detection of CPV in Singapore and Malaysia in between July, 1981 and September, 1982. The haemagglutination inhibition tests revealed that 170 out of 225 dogs were found seropositive for CPV registering an incidence of 75.5%.

Jones *et al.* (1982) reported that a longitudinal serological survey of parvovirus infection in 106 apparently healthy dogs in New Zealand revealed that 23% of serum samples showed HI titres more than 1:320 which confirmed 24 dogs to be CPV infection.

Knaevelsrud and Moe (1982) recorded canine parvovirus infection in the 24% of the dogs of Kennel in Oslo area of Norway in 1980 which showed the symptoms of vomition, fever and foetid diarrhoea. The morbidity and mortality rates were recorded as 41% and 33.3%, respectively.

Liang and Ho (1982) reported the prevalence of canine parvovirus infection in dogs of various age groups in Northern Taiwan, China.

Mohri *et al.* (1982) reported the prevalence of canine parvo virus infection in the stray dog population in Japan. They detected 133 out of 796 dogs to be seropositive for CPV antibody which recorded an incidence of 16.7%.

Prange *et al.* (1982) conducted a study on clinical aspects of parvovirus enteritis in dogs in German Democratic Republic. They found that the puppies and young dogs were more susceptible for CPV infection than the adults. They recorded 72% of the total mortality to be young male dogs.

Rajaonarison and Rakotondamary (1982) reported outbreak of canine gastroenteritis manifesting the symptoms of vomition, fever, anorexia and foetid bloody diarrhoea which was due to the infection of canine parvo virus in Antanarivo, Madagascar.

Ramadass and Khader (1982) reported that they had confirmed the existence of canine parvo virus infection among the dog of Madras city. A total of 87 dogs showing the symptoms of haemorrhagic enteritis were tested by AGPT and FAT and 45 dogs

were found to be positive for canine parvo virus infection. This disease occurred in all breeds of dogs as well as in non-descript mongrel dogs. Majority of cases occurred in young dogs below 6 months of age. However, significant number of adult dogs were also affected with this disease.

Sabine *et al.* (1982) reported the prevalence of canine parvo virus infection in dogs of all age groups in Australia during 1980 and recorded an over all mortality of 16% in which higher death rate was accounted among young ones.

Tingpalapong *et al.* (1982) reported an epizootic form of viral enteritis in dogs in Thailand. They isolated CPV from 33 of 40 samples of gastroenteritis cases recording an incidence of 82.5%.

Hammond and Timoney (1983) conducted an electron microscopic study of viruses associated with canine gastroenteritis in New York, USA. They found 119 affected dogs out of 247 cases examined to be positive for parvovirus infection indicating 48% incidence rate. Besides they had reported the incidence rate ranged as 11% in 1979, 41% in 1980 and 44% in 1981, during the three years study.

Horner (1983) conducted his study on epidemiological features of canine parvo virus infection and its diagnostic methods in New Zealand. They recorded the highest prevalence rate of the disease in the month of February along with a higher incidence rate in the months of spring and summer. Out of 763 clinical cases of parvo virus infection 526 cases were less than 6 months old indicating 69% of affection in young ones only. They observed the highest morbidity and mortality rates among the puppies aged about 7 weeks or below.

Klunker *et al.* (1983) reported the prevalence of canine parvo virus infection in the Federal Republic of Germany after conducting a serological investigation on 556 serum samples. They found 376 dogs were positive for CPV infection revealing an incidence rate of 67.7%.

Mathys *et al.* (1983 a) conducted a study to detect canine parvo virus through haemagglutination with formalin fixed erythrocytes test from the faeces of the affected dogs showing the symptoms of gastroenteritis in Switzerland. They found 41 out of 72 dogs were positive for CPV infection indicating an incidence rate of 57%.

Rao *et al.* (1983) reported an outbreak of canine gastroenteritis during June-August 1980 in Madras. They examined a total of 292 dogs below 9 months and assessed to be suffering from CPV infection.

Studdert *et al.* (1983) conducted a study on the aspects of the diagnosis, pathogenesis and epidemiology of canine parvo virus in Colorado, USA. They examined 188 cases of gastroenteritis and found 56 dogs positive for CPV infection indicating an incidence rate 30%. Out of 56 affected dogs 44 cases were under six months of age which shared 79% of the total affection. Five affected dogs (5/56) were between the age group of more than six months and less than one year. On the other hand 20% cases were above one year of age and 80% cases were below one year of age.

Cui *et al.* (1984) reported an outbreak of canine parvo viral enteritis in the police dogs in Shenyang District, Liaoning province, China in 1983.

Hernandez *et al.* (1984) reported for the first time an outbreak of acute haemorrhagic gastroenteritis in dogs in Costa Rica originating from canine parvo virus infection.

Nayak *et al.* (1984) reported an enteric disease of dogs simulating parvovirus infection in Orissa recording the clinico pathological features of the disease.

Stann *et al.* (1984) reported clinical and pathogenic features of parvoviral diarrhoea in pound source dogs in Washington, USA. They detected parvovirus in the faecal samples of 40 out of 161 affected dogs registering an incidence rate about 25% among the diarrhoeic dogs.

Ezeokoli *et al.* (1985) reported parvovirus enteritis in Nigerian dogs. Parvo virus was identified in 7 out of 11 dogs with diarrhoea by haemagglutination and haemgglutination inhibition tests. Antibody to canine parvo virus was detected in 24 out of 40 dogs. Antibody prevalence was highest in dogs of 1 year old or younger. They recorded 61% of incidence rate.

Glickman *et al.* (1985) studied on breed related risk factors for canine parvo virus enteritis in USA. They studied the case records of 305 dogs in which 96 cases were of definite CPV infection and observed that Doberman pinchers, RottWeilers were at increased risk of CPV enteritis.

Gordan and Angrick (1985) examined 201 stray dogs in Franklin country, Ohio, USA from January to June 1981 and found 139 dogs to be seropositive for CPV infection and reported an incidence of 69.2%.

Iovane *et al.* (1985) conducted a serological survey on 184 stray dogs for canine parvo virus in Napoli of Southern Italy and reported that 48 stray dogs were found seropositive for canine parvo virus infection indicating an incidence of 26%.

Sherikar and Paranjape (1985) reported an outbreak of canine gastroenteritis in and around Bombay city in 1981. They screened 72 dogs to be positive for CPV infection among 100 dogs showing the symptoms of vomition, fever and haemorrhagic diarrhoea. They could not find any correlation between CPV infection and age/breed/season.

Guo and Xu (1986) conducted a study on epidemiological characteristics of canine parvo virus enteritis in China. They documented ten outbreaks of canine parvo virus infection mainly in cold seasons during 1980 to 1984. German shepherd puppies below six months of age, who were debilitated, were found more susceptible for CPV infection. The puppies below 3 months of age were most vulnerable to this disease. According to their observation the Doberman puppies were found to be resistant to CPV infection.

Herbst and Schliesser (1987) conducted a study for 7 years from 1980-1986 in German Federal Republic. They found 2207 dogs to be affected with canine parvo virus infection while examining a total of 5781 dogs. They reported the rate of incidence of CPV infection as 38.2% registering a variation of 45.2% in 1980 and 29.5% in 1986. The dogs within the age group of six weeks to six months were found to be 78.4% of the total morbidity.

Janthur (1987) conducted a serological study of canine parvo virus infection in 10 districts of Rostock region in German Federal Republic during 1984 and reported that there was no significant difference of incidence in respect of size, breed and keeping methods like kennels or homes.

Mason *et al.* (1987) conducted a study on clinical, pathological and epidemiological aspects of canine parvoviral enteritis in an unvaccinated closed Beagle colony in USA. They examined 1100 unvaccinated Beagles and reported that the dogs below 6 months of age were mostly affected with CPV infection. Out break of the disease gradually occurred in the autumn and early spring in the USA. They found that the susceptibility of the disease had increased correlation between age and ability to produce a litter.

Pospischil and Yamaho (1987) conducted a post-mortem survey for canine parvo virus enteritis for a period of 8 years from 1978-1985, at Munich. They found 654 cases out of 7615 post-mortem examinations to be positive for canine parvo virus infection. They recorded higher incidence rate among German shepherd and York shire terrier breeds in comparison to other breeds. Dogs below six months of age accounted for 80% of the total victims and out of them 60% of the mortality included the dogs below 3 months of age expressing the higher susceptibility of the CPV infection to the young groups of dogs.

Narasimhaswamy (1988) conducted a study on canine parvo virus isolation in Bangalore and reported that 24 cases out of 69

gastroenteritic dogs were detected positive for canine parvo virus infection indicating an incidence rate of 34.7%.

Rao (1988) studied the pathology of canine parvo viral enteritis at University of Agricultural Science, Bangalore. He conducted tests on 39 cases of acute gastroenteritis for detection of CPV and found 15 cases to be positive for CPV infection reporting an incidence of 39.5%.

Wawrzkiewicz *et al.* (1990) conducted seroepidemiological studies of canine parvo virus disease in Poland. He examined 105 serum samples from 105 apparently healthy dogs which included 25 vaccinated dogs with CPV-2 and found all were seropositive for canine parvo virus. They suggested that all these dogs might have been infected with a virulent street strain and/or might have acquired maternal specific antibodies which conferred resistance to infection.

Chang *et al.* (1992) conducted a study during March, 1989-January,1992 in Taiwan on 43 dogs showing the symptoms of vomition, fever and foetid diarrhoea with blood flecks. They found 11 dogs to be positive for canine parvo virus revealing an incidence of 25% over 4 years investigation.

Ernst *et al.* (1992) conducted a study on temporal distribution of clinical parvo virus in canine hospital population of Maldivian, Chile during 1981-1990. They reported that the incidence of CPV infection was influenced by the seasons. This seasonal variation was attributed to the survival and infectivity of the virus, environmental temperature and susceptibility of the host population which was of composite nature in Chile.

Mohan *et al.* (1992) examined 85 faecal samples for isolation of CPV from the dogs showing the symptoms of vomition, fever and haemorrhagic diarrhoea in and around Lothian city and confirmed 78 cases to be positive for canine parvo virus infection recording an incidence of about 92%.

Rai and Nauriyal (1992) reported the prevalence of canine parvo virus infection in dogs in Ludhiana, Punjab showing the

symptoms of vomition, fever, anorexia and haemorrhagic diarrhoea and dehydration.

Saseendranath *et al.* (1992) examined 158 puppies between six and twelve weeks of age showing the symptoms of vomition, diarrhoea, anorexia and fever during June and July, 1991 in Madras and recorded 44 cases as canine parvo virus having an incidence rate of 28%.

Mohan *et al.* (1993) tested faecal samples of 42 dogs showing the symptoms of persistent vomiting and haemorrhagic enteritis in Madras and detected 19 cases to be positive for CPV infection with an incidence rate of 45.2%.

Rao *et al.* (1993) had undertaken a study on 60 suspected clinical cases of gastroenteritis presented in the small animal clinics, PAU, Ludhiana. These were diagnosed as canine parvo virus.

Mizak and Mizak (1994) conducted a study on prevalence of parvoviral antibodies in blood sera in German shepherd dogs aged between 18 and 24 months in Putty, Poland. They detected antibodies in 156 cases but suggested natural infection in 52 dogs which accounted for 33.3% of incidence.

Le *et al.* (1995) examined a total of 135 dogs in Vietnam of which 99 were apparently healthy and 36 were showing clinical symptoms of canine parvo viral gastroenteritis. They detected canine parvo virus antibodies in 58 cases indicating an incidence of 43%.

Vieler and Herbst (1995) conducted a study for detecting viral particles in faeces from dogs aged between 6 and 24 weeks with diarrhoea by electron microscopy in Germany for a period of 5 years. They examined a total case of 4044 and found 696 cases to be positive for CPV antibodies revealing an incidence of the disease as 17.2%.

Gunaseelan *et al.* (1996) assessed 41 faecal samples collected from dogs showing signs of persistent vomition and

haemorrhagic enteritis and of this, 26 were found positive for CPV indicating an incidence of CPV infection as 63% in Madras.

Hirasawa *et al.* (1996) reported the prevalence of canine parvo virus infection as 54.1% after conducting an investigation for a period of 3 years from 1993 to 1995 in Japan.

Houston *et al.* (1996) conducted a study to establish the risk factors associated with parvo virus enteritis in dogs. They observed that German shepherd, Doberman Pinschers, Rottweilers, American Pit Bull terriers were at greater risk of CPV infection followed by Toy Poodles and Cocker spaniels as compared to mixed breed dogs. The dogs of all ages (7 wks-14 yrs) were found to be susceptible to CPV infection with highest incidence among the young ones. The sexually intact dogs above six months of age were found to be prone to the CPV infection than the spayed or neutered dogs. Sexually intact males were two times more in susceptibility as against sexually intact females. They observed the seasonal variation in CPV infection as the number of dogs infected were 3 times more in July, August and September in Canada as compared to the rest of the months of a year.

Hulas *et al.* (1996) reported 41 unvaccinated pups of 7-16 weeks old were found positive for CPV infection out of 50 cases of gastro enteritis in Poland presenting an incidence of 82%.

Meerarani *et al.* (1996) reported 72.9% of incidence of CPV infection after detecting 197 cases as positive for CPV after analysis of 270 faecal samples of the dogs suffering from gastroenteritis.

Udupa and Sastry (1996) studied on the prevalence of canine parvo virus infection among the stray dog and pet population in Bangalore city. They reported an incidence rate of the disease as 91% among the stray dog population and 28.6% among the pet dog population. They also recorded the incidence of the disease as high as 71.4% among the dogs between 7 and 9 months of age.

Lacheretz and Jurin (1997) studied on the epizootiology and diagnosis of canine parvo virus infection during October 1994 to

February 1996 in France. They examined 457 samples and found about 228 (50%) dogs to be positive for canine parvo virus infection.

Subhasini *et al.* (1997) reported an incidence of 56.6% (68/120) of canine parvo virus infection among the dogs in Madras manifesting the symptoms of vomition, fever, malaise and haemorrhagic diarrhoea.

Udupa and Sastry (1997) examined 86 dogs showing symptoms of vomition, rise of temperature up to 104°F, off feed and foetid bloody diarrhoea and isolated CPV from 79 dogs reporting an incidence of 80.3% in Bangalore.

Joshi *et al.* (1998) conducted a study for isolation of canine parvo virus from the clinical cases of canine gastroenteritis in Pantnagar and reported that an incidence of 19.7% (30/152 dogs) during the outbreak of disease.

Meerarani *et al.* (1998) investigated for the prevalence of canine parvo virus infection among the dogs showing the symptoms of gastroenteritis in Chennai and reported an incidence of 64.4% (112/174).

Rodriguez *et al.* (1998) conducted a study on acute disseminated candidiasis in a Rottweilers pups associated with parvo viral infection in Spain and suggested that Rottweilers breed was more susceptible than other breeds due to its predisposed hereditary immunodeficient factor.

Banja (1999) reported an incidence rate of 54.3% for canine parvo virus infection in and around Bhubaneswar city.

Canine Corona Virus Infection

Binn *et al.* (1974) conducted a study on canine diarrhoea in 1971 in Germany to ascertain the etiological agent of the canine gastroenteritis and isolated corona virus from U.S military dogs.

Appel (1978) while engaged in search of the status of an etiological agent responsible for causing canine viral enteritis in the

Baker Research Institute, New York could isolate corona virus from the faeces and intestinal specimens collected from the dogs showing the symptoms of vomition, diarrhoea with occasional bleeding and malaise during an epizootic outbreak of contagious gastroenteritis.

Schnagl and Holmes (1978) reported that 24 out of 58 dogs from three isolated country areas of Australia were found positive for corona virus like particle in their stools indicating the rate of prevalence of corona virus infections as 41.3%.

Arens and Kraws (1980) reported an incidence of 5.6% (4/71) corona virus infection in dogs while examining the faecal samples collected from the dogs suffering from acute gastroenteritis in German Federal Republic.

Hoffmann *et al.* (1980) tested 23 faecal samples collected from the dogs showing symptoms of vomition, fever and diarohhea in German Federal Republic and found 2 samples to be positive for canine corona virus indicating an incidence of 8.6%.

McNutly *et al.* (1980) reported the prevalence of canine corona virus infection in UK after detecting the corona virus from the faeces of the dairrhoeic dogs.

Osterhaus *et al.* (1980) conducted a seroprevalence study of corona virus in dogs in Netherland and found positive for the presence of corona virus antibodies.

Roseto *et al.* (1980) detected canine corona virus from 12 samples out of 56 samples tested from apparently normal dogs collected randomly from the street dogs in Paris, France recording an incidence rate of 21.438%.

Thery (1980) tested 500 serum samples of dogs in Paris, France and detected 73.3% samples to be positive for corona virus indicating a higher rate of incidence.

Vandenberghe *et al.* (1980) reported an outbreak of canine corona virus infection in a litter of poodle pups aged about 10 weeks showing the symptoms of gastroenteritis in Belgium by detecting corona virus in the intestinal contents.

Williams (1980) detected the corona virus-like particles in the diarrhoeal stools of Beagle pups in U.S.A.

Benary *et al.* (1981) conducted a study on the prevalence of corona virus in German Federal Republic by testing 669 faecal samples collected from diarrhoeic dogs. They reported that corona viruses were detected only in 55 samples indicating a prevalence rate of 8.2%.

Binn *et al.* (1981) conducted a serpprevalence study for corona virus infection in laboratory Beagle dogs in Washington, USA affected with diarrhoeal disease and reported the incidence of disease as 24% (6/25).

Neill *et al.* (1981) conducted a microbiological study of the faeces of 66 diarrhoeic dogs and 23 apparently healthy dogs. But curiously canine corona viruses were detected only from 3 healthy samples indicating an incidence of 3.8% (3/89) and infection in a carrier stage.

Danner *et al.* (1982) conducted a study on the epidemiological situation of viral enteritis in dog in the German Federal Republic and reported that 55 (8%) out of 682 dogs were found positive for corona virus infection.

Tingpalapong *et al.* (1982) studied on epizootics of viral enteritis in dogs in Thailand during an outbreak of canine gastroenteritis. They collected 30 samples from the affected dogs with symptoms of diarrhoea vomition and malaise and detected serologically the presence of CCV antibodies in 5 samples suggesting the natural prevalence of CCV in dogs of Thailand with an incidence rate of 16.6%.

Hammond and Timoney (1983) conducted an electron microscopic study of viruses associated with canine gastroenteritis in USA for a period of 3 years from 1979-1981 on 1100 samples collected from the dogs showing symptoms of gastroenteritis. But they recorded only 3 samples to be positive for corona virus infection registering a poor prevalence rate of 0.272% within 3 years.

Studdert *et al.* (1983) tested 150 samples from the dogs showing symptoms of diarrhoea, nausea and deprived appetite in USA and detected corona virus in 12 samples indicating the prevalence rate as 7.9%.

Janthur (1987) conducted serological studies on prevalence of corona virus in the Rostock Region in German Democratic Republic in 1980 and 1984. He documented an increased incidence rate of corona virus infection from 3% in 1980 to 8% in 1984.

Ganesan *et al.* (1990) conducted a study to ascertain the prevalence of corona virus in the canine population of Madras city. They tested 900 faecal samples of the dogs showing the symptoms of gastroenteritis against the corona viral antigen and detected 26 positive cases of corona virus infections which accounted for 2.88% of incidence of the disease. They found 58% of the dogs affected were below 6 months of age. They claimed this to be first report of confirmation for CCV infection in India.

Rimmelzwaan *et al.* (1991) conducted a study on the use of enzyme linked immunosorbent assay system for serology and antigen detection in corona virus infection in dogs reared in kennels and open population in Netherlands and reported that 18% of the kennel dogs with diarrhoea were found positive for CCV in contrast to incidence rate of 7% of the dogs in open population without diarrhoea.

Chang *et al.* (1992) conducted a seroprevalence investigation of corona virus among the canine population of Taiwan for a period of 4 years from 1989-1992 and reported that 25 out of 63 serum samples were found positive for corona virus antibodies expressing an incidence rate of the disease as 39.68%.

Tennant *et al.* (1993) conducted studies on the epizootiology of canine corona virus in the UK and reported a prevalence rate of 45% (45/100) in the rescue kennel. They isolated the CCV from 73% of dogs showing symptom of diarrhoea whereas 43% of dogs without diarrhoea were detected positive for CCV infection. They also isolated CCV from 8 out of 32 pet dogs with symptoms of

haemorrhagic diarrhoea. They did not observe any difference between the dogs below or above 4 months of age in seroprevalence study for CCV infection.

Bielsker (1994) investigated the prevalence of corona virus infection among the canine population in USA reared under various condition of keeping systems (Home vs kennel). He recorded a higher rate of corona virus infection of 30% in kennel reared dogs as against the incidence rate of 15-25% among the family pet dogs. He found neonate pups to be more susceptible to CCV infection though the disease affected the dogs of all ages with same peculiarity in pathogenicity among the 6-16 weeks old puppies.

Mostel *et al.* (1994) tested 48 samples from the dogs manifesting symptoms of diarrhoea and /or vomition and found 29 samples positive for corona virus infection indicating an incidence rate of 60%. Likewise they also tested samples of 194 dogs without any symptoms of diarrhoea and/or vomition and recorded 136 dogs to be positive for corona virus infection with an incidence rate of 70% in Australia.

Shaw *et al.* (1995) reported an incidence of 39.5% of CCV infection examining 86 samples from pet dogs in Madras manifesting severe diarrhoea with or without vomition.

Vieler and Herbst (1995) conducted a study on the dogs under and above 6 months of age to ascertain the pattern and rate of prevalence of canine corona virus infection. They examined and found 501 out of 4044 faecal samples positive for CCV infection revealing an incidence rate of 12.4% and even pattern of distribution of disease among all the age groups.

Sekar *et al.* (1998) reported an incidence rate of 15.3% for the CCV infection after examining 851 samples from the dogs manifesting the symptoms of persistent diarrhoea and vomition in Madras.

Banja *et al.* (2002) reported an incidence rate of 24.56% of corona virus infection among the pet dogs showing the symptoms of

gastroenteritis in Bhubaneswar, Orissa after detecting 42 out of 171 affected dogs to be positive for CCV infection.

Mixed Infection of Canine Parvo and Corona Virus

Hoffman *et al.* (1980) conducted a study to find out the etiological pathogen responsible to cause acute gastro intestinal diseases in dogs in the Giessen, Frankfurt region of German Federal Republic in 1980. His finding revealed that 2.8% (1/35) of cases tested carried mixed infection of CPV and CCV at the same time.

Roseto *et al.* (1980 b) recorded that 8.9% of cases manifested the symptoms of gastroenteritis due to mixed infection of CPV and CCV while documenting 23.2% and 21% cases for single infection of CPV and CCV respectively through electron microscopy detection in Paris and France.

Hoffman and Pock (1981) reported the incidence of mixed infection of CPV and CCV in 3.33% of the cases investigated during January-May, 1980 in Giessen, German Federal Republic.

Studdert *et al.* (1983) reported the incidence of mixed infection of CPV and CCV as 4% Colorado, USA whereas the incidence rate for single infection with CPV and CCV were found to be 30% and 8% respectively.

Yasoshima *et al.* (1983) reported the incidence of mixed infection of CPV and CCV in dogs manifesting symptoms of acute vomition, fever and diarrhoea streaked with blood.

Janthur (1987) conducted a virological study of samples collected from the dogs showing symptoms of persistent of diarrhoea and vomition in Rostock region, German Federal Republic during 1984 and reported that 62% of the diagnosed cases were suffering from mixed infection of CPV and CCV and only 38% of the cases were found to be suffering from CCV infection alone.

Mostel *et al.* (1994) reported an incidence rate of 0.826% for mixed infection of CPV and CCV among 264 dogs investigated for gastroenteritis in Australia.

LABORATORY DIAGNOSTIC TESTS

Dot-Enzyme Linked Immunosorbent Assay (Dot-ELISA)

Mathys *et al.* (1983b) compared the haemagglutination and competitive enzyme linked immunosorbent assay procedures for detecting CPV in the faeces of dogs showing symptoms of gastroenteritis. In this study they were able to detect 42 out of 72 (83%) suspected samples to be positive for CPV.

Mildbrand *et al.* (1984) conducted a study for rapid detection of canine parvo virus in the faeces using monoclonal antibodies and enzyme linked immunosorbent assay. They reported the test to be very suitable to detect CPV quickly and reported a correlation up to 95% in ELISA and HA for detection of CPV.

Teramoto *et al.* (1984) conducted a comparative study of enzyme linked immunosorbent assay, DNA hybridization, haemagglutination and electron microscopy for detection of canine parvo virus infections. They recommended ELISA as a sensitive and specific diagnostic test for detection of CPV. The correlation between the result of ELISA and HA was established at 94.4% (67 of 71).

Herbst *et al.*(1986) assessed 65 suspected samples from dogs showing symptoms of gastroenteritis by ELISA test and detected 33 samples (50.7%) as positive cases for CPV.

Kolbl *et al.* (1990) were able to detect CCV antigen in the faeces of 28 out of 79 enteric dogs tested (35.4%) through commercial ELISA.

Rimmelzwaan *et al.*(1990) used enzyme linked immunosorbent assay systems for serology and antigen detection in parvo virus, corona virus and rota virus infections in dogs in Netherlands. They recommended ELISA as an easy and more specific diagnostic method than HA and HI tests.

Sanousi (1990) brought some developments in the Dot-ELISA procedures for direct detection of CPV antigens in the faeces and various affected organs of the canines. His opinion was that the Dot-ELISA method evolved a weak faecal reaction but the result was found almost the same as that of solid phase ELISA. As such he suggested Dot-ELISA as a suitable rapid diagnostic method to detect CPV.

Rimmelzwaan *et al.*(1991) successfully modified double anitibody sandwich ELISA for quick detection of CPV,CCV and rota virus antigens in the faeces of affected dogs.

Tuchiya *et al.* (1991) were able to detect CCV antigen in the faeces of affected dogs within an appreciable short time period.

Mohan *et al.* (1993) used a double antibody canine parvo virus ELISA kit for detection of CPV in the faeces of affected dogs. Of the 42 samples tested with ELISA, 19 were found strong positive, 6 weak positive, one was doubtful and 2 samples were found negative for CPV. They obtained similar results with HA test. They established 100% correlation between the results of ELISA and HA tests and suggested ELISA to be simple, sensitive rapid and suitable diagnostic method for detection of CPV antigen in canine faecal samples.

Drane *et al.* (1994) used CPV ELISA which was produced as prototype kit, was an antibody sandwich ELISA with polyclonal capture antibodies and monoclonal antibody conjugate. The CPV ELISA was compared to the haemagglutination assay (HA) test using electron microscopy and/or virus isolation to confirm infection.

The CPV ELISA had a sensitivity of 87% and specificity of 100% compared to 87% and 63% respectively for HA. The poor specificity of the HA result in a low positive predictive value of 51% compared to 100% of the CPV by Dot-ELISA.

Martinello *et al.* (1996) detected CPV antigen in 19 out of 52 (36.5%) faecal samples from dogs suffering from gastroenteritis by sandwich ELISA.

Ruiz *et al.*(1996) recorded greater sensitivity by developed double antibody sandwich ELISA than HA test. They stated that the Dot-ELISA was found suitable for rapid detection of CPV antigen in the faeces of affected dog with good specificity and sensitivity to CPV.

Zarkov *et al.* (1996) detected CPV antigen in 78 of 104 (75%) faecal samples collected from dogs showing symptoms of gastroenteritis by ELISA and proved this diagnostic method to be simple and rapid.

Banja *et al.* (2002) reported that 93 out of 171 faecal samples of diarrhoeic dogs were found positive for CPV antigen by Dot-ELISA whereas 42 of 171 faecal samples were diagnosed to be positive for CCV antigen.

Haemagglutination test

Appel *et al.* (1979 a) reported that canine parvovirus agglutinated pig and rhesus monkey red blood cells at 4°C and 25°C but not at 37°C.

Appel *et al.* (1980) rapidly detected the CPV from the faeces of the dogs suffering from haemorrhagic gastroenteritis by using the haemagglutination test.

Jacob *et al.*(1980) isolated CPV from the faeces of 96 out of 134 dogs suffering from haemorrhagic gastroenteritis by

haemagglutination test during their studies on clinico pathological features of canine parvo viral enteritis.

Klingeborn and Moreno-Lopez (1980) detected CPV in the faeces of 15 out of 58 dogs (26%) showing symptoms of gastroenteritis by haemagglutination test.

Valicek *et al.* (1981) detected the CPV infection in 9/18 (50%) enteric cases by haemagglutination (HA) test with titres ranging from 5-512.

Rajaonarison and Rakotondamary (1982) confirmed CPV infection in the dogs with enteritis by conducting HA test on the suspected faecal samples.

Danner and Weber (1983) diagnosed 30 of 115 suspected dogs to be suffering from CPV infection by diagnostic HA test of faecal samples.

Studdert *et al.* (1983) detected CPV infection through HA test of faecal samples of 56 out of 188 (30%) dogs showing symptoms of gastroenteritis with fever.

Mochizuki *et al.* (1984) detected 11 of 65 faecal samples from dogs suffering from haemorrhagic gastroenteritis to be positive for CPV by HA test.

Ezeokoli *et al.* (1985) diagnosed 7 out of 11 fecal samples collected from the dogs suffering from gastroenteritis by HA test.

Sherikar and Paranjape (1985) recorded 71 out of 100 faecal samples were positive for CPV from the dogs showing symptoms of gastroenteritis by HA test. They suggested that HA and HI tests in combination were found reliable and rapid.

Szaniszlo and Hovath (1989) detected the CPV infection by HA test and stated that there was no correlation between HA titre and severity of CPV infection.

Mohan *et al.* (1992) conducted microtitre plate HA test on 85 suspected faecal samples for CPV infection and recorded that most of the HA titres were observed between 1:160 and 1:20480 (range 1:40-1:20480) whereas HI was found positive in all the cases.

Rai *et al.* (1994a) reported that 22 of 26 faecal samples collected from the dogs showing symptoms of gastroenteritis were found positive for CPV and CCV infection by HA test with a range of 40-20480 titres. They opined that both HA and HI tests were found cost effective and rapid to diagnose CPV infection.

Gunaseelan *et al.*(1996) reported that only the 4 isolates from 11 faecal samples processed in CRFK showed progressive HA titres assayed after each passage for CPV haemagglutination. They found that HA test was quite dependable.

Meerarani *et al.* (1996) diagnosed 61.1% cases of a total of 270 suspected faecal samples to be positive for CPV infection.

Udupa and Sastry (1997) diagnosed 35 of 86 faecal samples from dogs with enteritis to be positive for CPV infection by HA test.

Meerarani *et al.* (1998) conducted HA test on 174 faecal samples collected from dogs showing symptoms of gastroenteritis and found 90 samples (51.7%) to be positive for CPV.

Joshi *et al.* (2001) detected 8 of 10 faecal samples from CPV infected pups to be positive for CPV by HA test. The HA titres ranged between 64 of 1024 on day 3,4,5 and 6 PI. The HA titre gradually declined and proved negative on day 9 and 10 PI.

Reverse Passive Haemagglutination (RPH) test.

Mochizuki *et al.* (1984) diagnosed CPV infection by RPHA test in the faeces collected from dogs showing symptoms of vomition, fever and perfuse foetid bloody diarrhoea. They stated that faecal RPHA positive cases were above the HA titre of 1:32.

Shaw *et al.* (1995) found 34 of 86 faecal samples (39.5%), from dogs suffering from gastroenteritis to be positive for CCV antigen by RPHA test.

Banja (1999) reported that Reverse Passive Haemagglutination test was performed to detect CCV antigen from faecal samples of dogs with gastroenteritis. The RPHA titre value of $\geq$ 1:8 was taken as positive for CCV infection. Maximum number of faecal samples had titre from 1:32 to 1:64. The RPHA test detected 18.1% CCV infection.

CLINICAL SYMPTOMS

Canine Parvo Virus Infection.

Eugster and Nairn (1977) reported that in parvo virus infection the dogs manifested symptoms of vomition, diarrhoea, fever and dehydration in Texas, USA. They recorded sudden death of puppies due to acute myocarditis.

Appel *et al.* (1978) stated in the status report on canine viral enteritis that the first clinical manifestation was vomiting, followed by fever and then diarrhoea. Fever was common in puppies with temperature ranging from 40-41°C. The faeces was usually loose or pasty, light grey or yellow-grey with foetid smell and later flecked with blood or mucus. Some puppies produced only thin watery reddish brown fluid while in very severe cases the faeces were found haemorrhagic.

Eugster *et al.* (1978) reported the clinical sign as vomition, fever, foetid diarrhoea and dehydration in canine parvo virus

infection in dogs. They recorded the morbidity and mortality rate of CPV enteritis in affected dogs to be from 22-100 and 10 to 50%, respectively, with highest values in young weaned pups.

Thomson and Gagon (1978) observed the clinical symptoms in CPV infection in dogs as vomiting, blood stained diarrhoea with foul smelling and dehydration. They found the affected diarrhoeic dogs to be in moribund and collapsible condition and death within 12 hours to 5 days.

Black *et al.* (1979) recorded the clinical symptoms in canine parvo virus infection like vomition, diarrhoea with blood flacks, rise of temperature, depressed appetite, dehydration, emaciation and depression.

McCandlish *et al.* (1979) recorded sudden vomiting, profused grayish watery diarrhoea with blood flecks, severe dehydration and malaise in dogs affected with canine parvo virus. Other clinical signs included enlargement of lymph nodes.

Nelson *et al.* (1979) reported that canine parvo viral enteritis was frequently encountered as a major problem in large kennel units but individual house hold pups can also become severely ill. They also recorded morbidity rate to be 20-100% and mortality rate as 10-50% in severely affected pups registering highest percentage in young pups. They also recorded death in some cases within 2-3 days.

Pollock and Carmichael (1979) recorded symptoms of canine parvo viral enteritis as vomiting, fever, loose motion sometimes watery/or flaked with blood. In many cases they observed foetid bloody diarrhoea. They observed development of small vesicles in the mouth which ruptured and left ulcers.

Walker *et al.* (1979) while surveying serologically for canine parvo virus infection in New South Wales, Australia, reported clinical symptoms of vomition, diarrhoea, rise of temperature up to 104° F, severe dehydration and death. The mortality rate was highest in young pups below 3 months of age.

Else (1980) observed that dogs suffering from canine parvo virus infection manifested symptoms of vomition, fever, diarrhoea and dehydration. Some puppies produced reddish brown watery faeces, while in severe cases faeces were haemorrhagic. In some cases the diarrhoea lasted for one week. But many animals which were not treated for severe fluid loss died with shock-like syndrome within a few days after onset of illness.

Eugster (1980) in an experimental isolation of CPV in dogs observed that the susceptibility to canine parvo virus and severity of the clinical manifestation of the disease were closely related to the immune status and responsiveness of individual animal.

Fluckiger (1980) observed symptoms of vomition, diarrhoea and death in 25-30% of the cases within the first 5 days of illness. He found blood in the vomit in 18% of the cases and diarrhoea in 40% of the cases.

Groulade (1980) stated that the affected dogs with CPV infection manifested symptoms of emesis, fever, loose motion with blood and mucus, anorexia and dehydration while surveying the kennel and household pups. He recorded that canine parvo virus infection was more frequently encountered in large kennel units although individual household pets were affected severely.

Harcourt *et al.* (1980) observed the clinical manifestation of CPV infection as transient dullness to acute haemorrhagic gastroenteritis. The clinical sign largely included severe emesis and diarrhoea often haemorrhagic.

Jedlizoka (1980) recorded a mortality rate of 53% in parvo viral gastroenteritis cases. He reported symptoms of dullness, depression, anorexia, vomition, reddish brown diarrhoea, dehydration and tachycardia with weak pulse.

Kraft *et al.* (1980) reported that the dogs suffering from parvo virus infection exhibited symptoms of vomition, fever, profuse foetid bloody diarrhoea, anorexia, malaise and severe dehydration.

Niemand *et al.* (1980) reported symptoms of profuse foetid diarrhoea flecked with blood, vomition with froth and /or blood,

anorexia, dehydration and general debility in the dogs suffering from parvo virus infection.

Parrish *et al.* (1980) reported that the dogs affected with parvo viral gastroenteritis exhibited the symptoms of general weakness, malaise, emesis, foetid diarrhoea with blood flecks and severe dehydration and death within 24 hours in acute state.

Smith *et al.* (1980) observed symptoms of vomition, diarrhoea with foul smell and blood flecks, fever and severe dehydration and death. They stated that the severity of clinical manifestation of the disease were closely related to the immune status and responsiveness of the animal.

Woods *et al.* (1980) stated that after an incubation period of 7-14 days in CPV infection the first symptoms manifested was vomition, followed by fever and foetid profuse diarrhoea. They observed that during the first 4-5 days of illness there was leucopenia in parvo viral gastroenteritis and the affected animals became debilitated.

Hoffman and Pock (1981) observed the clinical symptoms of canine parvo viral enteritis in 3 different forms as per the severity. The mild form of disease which prevailed in 30% of cases exhibited symptoms of anorexia, soft faeces leading to slight dehydration and the course of the disease continued for 1-4 days .The acute form of the disease (63%) continued for 5-12 days and manifested the symptoms of frequent vomiting, haemorrhagic profuse diarrhoea leading to severe dehydration and mortality was recorded as 23%.All the cases of peracute form suffered about 2 days and then died.

Panjevic *et al* (1981) stated that the symptoms were severe vomition, fever, depressed appetite, dullness and profuse diarrhoea after an incubation period of 2 to5 days and mortality ranged from 10 to 50%.

Price and Njiro (1981) reported that the dogs suffering from CPV infection manifested symptoms of general malaise, depression, depraved appetite, vomition, rise of temperature, profuse foetid diarrhoea and dehydration. They also observed some mortality among the affected dogs within 2 days of illness.

Balu and Thangaraj (1981) reported outbreak of CPV infection in Madras city in May and June 1980-1981 and suggested that hot tropical climate (100^0F to 110^0F) and high humidity (75%) seemed to favour the onset of outbreak. They classified the symptoms into 4 groups like Gr-I:- marked dullness, nausea, vomition, anorexia and rapid dehydration, Gr-II:- general malaise, vomition, anorexia, rapid dehydration and semisolid to watery loose motion, Gr-III:- general malaise, vomition, anorexia, rapid dehydration, haemorrhagic semisolid or watery loose motion with dark brown or red flecks of blood and foetid odour. The colour of the faeces varied from pinkish or orange to dark brown and Gr-IV:- thick and slimy with pus oozing from the rectum was noticed in addition to the symptoms enumerated in group-II.Fever was a constant feature coupled with ill health which was evidenced by extreme drowsiness and total anorexia in all cases. Frequency of vomiting ranged from 3 to 10 times in a day and colour of the vomitus was either plain watery, yellow, greenish or pinkish and blood stained due to regurgitation of haemorrhagic duodenal content.

Voros *et.al.* (1981) reported the symptoms in CPV infected dogs as anorexia, depression, malaise, frequent vomition (watery/ yellow/ green/ pinkish red), profuse foetid watery diarrhoea with blood and/or flecks of blood. The colour of the faeces varied from yellow to reddish brown colour. There was rapid dehydration of the

affected animals. The temperature rise was observed to be highest (103-104^{0}F) from 3rd to 5th day post infection.

Bucci *et al.* (1982) reported the first incidence of parvo virus infection in March 1981 in 28 German Shepherd puppies of 8-10 weeks old in Egypt and recorded the clinical symptoms manifested by the affected dogs as severe emesis with yellow or pinkish vomitus, fever, anorexia, debility, drowsiness, frequent bloody diarrhoea with reddish brown colour and severe dehydration.

Pollock (1982) conducted a study on experimental canine parvo virus infection in 5 SPF Beagle dogs 2 to 6 months of age at Jamest Baker Institute for Animal Health. He observed symptoms from mild or severe vomition, depression, anorexia, profuse watery diarrhoea with or without blood flecks and fever.

Prange *et al.* (1982) reported that the dogs affected with canine parvo virus infection exhibited the symptoms of depression, off feed, nausea and emesis, fever, severe bloody diarrhoea frequently. They observed that some of the affected dogs were found vacillating convulsant and dead.

Ramadass and Khader (1982) conducted a study for diagnosis of canine parvo virus infection in dogs presented at the Small Animal Unit, Madras Veterinary College Hospital and recorded the symptoms of vomition and haemorrhagic enteritis in 87 cases out of which 45 were positive for CPV infection. Majority of cases occurred in young dogs below 6 months of age not withstanding a significant number of adult dogs.

Stann *et al.* (1984) reported that the dogs suffering from CPV infection manifested symptoms of vomition, anorexia, drowsiness, depression, frequent watery diarrhoea with blood flecks and or mucus and rapid dehydration of various intensity.

Ezeokoli *et al.*(1985) reported that dogs 8 weeks to 3 years old presented to the Small Animal Clinic, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria, manifested symptoms of bloody and watery diarrhoea of greyish/pale, grey/clay coloured, vomiting, anorexia and severe dehydration.

Sherikar and Paranjape (1985) reported an outbreak of viral enteritis in and around Bombay city diagnosing 134 cases as canine parvo virus infection. They recorded vomition stained with blood, profuse watery and bloody diarrhoea with reddish brown colour, debility, anorexia, anemia, subnormal temperature and dehydration presenting high mortality within 24-48 hours.

Rai and Nauriyal (1992) while studying on acid-base status and blood gas dynamics in canine parvo viral gastroenteritis reported that the affected dogs manifested symptoms of fever, anorexia, vomition, haemorrhagic diarrhoea and dehydration of various degrees.

Gunaseelan *et al.* (1993) reported that dogs suffering from CPV infection in Madras city manifested symptoms of persistent vomiting, haemorrhagic enteritis and dehydration.

Mohan *et al.* (1993) reported that 42 clinical cases of dogs suffering from CPV infection in Ludhiana city, Punjab, presented typical symptom of CPV infection like vomition, fever,profuse diarrhoea with blood flecks and rapid dehydration.

Rai *et al* (1994 b) reported that dogs suffering from clinical CPV infection exhibited varying clinical signs viz. malaise (6%) vomition (5%), diarrhoea (6%), vomition and diarrhoea (21%), vomition and haemorrhagic diarrhoea (60%), haemorrhagic vomition and haemorrhagic diarrhoea (2%).

Banja (1999) reported that dogs suffering from CPV infection in Orissa exhibited symptoms of vomition, anorexia, fever, profuse watery diarrhoea and blood flecks and dehydration.

Joshi *et al.* (2001) experimentally produced of canine parvo viral gastroenteritis in Pantnagar,U.P. and reported symptoms of CPV infection to be mild dullness, anorexia, mild to profuse greenish yellow diarrhoea, foul smelling with mucosal shreds and rise of temperature.

Ramprabhu *et al.* (2002) conducted a study in Madras Veterinary College Hospital, Small Animal Clinic on the clinical profile of haemorrhagic gastroenteritis in dogs in clinical cases, due to CPV infection and reported that young pups below the age group of six months old were affected. The clinical symptoms included initial rise of temperature followed by subnormal temperature later, inappetence, polydypsia, frothy yellow vomitus, retching and restlessness. The faeces were brownish, semisolid and mixed with excess mucus and later became foetid diarrhoeic with varying degrees of dehydration and exhaustion.

Canine Corona Virus Infection

Binn *et al.* (1974) reported that symptoms manifested by military dogs suffering from corona virus infection were vomition, yellow-green diarrhoea with foul-smell, anorexia, depression and dehydration. They recorded very low mortality rate among the affected dogs.

Keenan *et al.* (1976) while conducting an experimental corona virus infection in neonatal pups recorded symptoms of moderate to severe diarrhoea of yellow-green colour after an incubation period of 24-48 hours. The affected pups exhibited anorexia, depression, vomition and dehydration and weakness. Most of the pups recovered after 7-10 days of diarrhoea. The recovered pups did not

gain weight. They concluded that the infection in pups was not fatal but self limiting.

Appel *et al.* (1978) reported that the young pups were severely affected with the CCV infection. The incubation period was short and after 1-3 days post infection vomiting and diarrhoea were seen. Faeces were loose and mucoid or watery and were yellow-green or orange in colour, foul smelling and infrequently streaked with blood. Frequent diarrhoea and vomition led to dehydration. Anorexia and depression were the common signs. Most of the affected dogs remained afebrile although elevated body temperature had been recorded in some cases. Vomiting usually subsided after the first day of illness but diarrhoea persisted for several days and even for 3-4 weeks in some affected dogs.

Vadenberghe *et al.*(1980) reported the occurrence of CCV infection in a litter of pups manifesting symptoms of diarrhoea, inappetance, weakness, occasional vomition and dehydration and the mortality rate was considerably low.

Benary *et al.* (1981) recorded mild type of diarrhoea with mucus and rarely with blood and/or flecks of blood in CCV infection. There was dyspepsia and dullness in all affected dogs.

Binn *et al.* (1981) reported that CCV infection though seemed common among the canine population but the disease was not found as highly contagious as CPV infection. The CCV infection exhibited diarrhoea, inappetance, depression and dehydration but was rarely fatal.

Carmichael and Binn (1981) reported CCV infection as a new enteric infection in dogs and recorded symptoms of enteritis, anorexia, dullness, vomition and dehydration. They observed very low mortality rate among the affected dogs.

Tingpalapong *et al.* (1982) observed that the affected dogs with CCV infection exhibited diarrhoea of varied degrees. They observed mild to very profuse diarrhoea with mucus and/or blood. The faeces smelled very pungent, foul odour and looked grayish yellow in colour. The temperature ranged from 38.3 to 39.1°C with progression of the disease.

Ganesan *et al.* (1990) reported that twenty six out of nine hundred faecal samples tested revealed the presence of corona viral antigen. Positive reaction was revealed by single precipitation line in CIEP. Affected dogs showed one or more of the symptoms like inappetance, lethargy, vomiting, mild to severe yellowish diarrhoea with foetid odour which were similar to the symptoms reported by Carmichael and Binn (1981). Five per cent of dogs showed mixed infection with canine parvo virus which showed severe symptoms and mortality. About 58% of the cases occurred in dogs below 6 months of age. They claimed this to be the first confirmation of corona viral infection in dogs in India.

Bielsker (1994) reported that the dogs affected with CCV infection manifested symptoms of watery loose motion with mucus and/or blood. He seldom recorded the mortality in affected dogs.

Banja (1999) reported that the dogs suffering from CCV infection manifested symptoms of gastroenteritis while investigating on viral haemorrhagic gastroenteritis in dogs in Bhubaneswar city during September 1998 to August 1999.

EXPERIMENTAL STUDY

Eugster (1980) could experimentally establish CPV infection in dogs and the symptoms observed were depression, dullness, fever and anorexia.

Pollock (1982) used the Beagle dogs 2-6 months of age in his experimental study. Specific pathogen free dogs were obtained from

colony at the Jems A. Baker Institute, Ithaca, New York. This colony was free from canine distemper, adeno virus, para influenza and rota virus infections. Pups had no hookworm, coccidia or giardia infection. Five dogs were purchased at 8-10 weeks of age from a CPV sero negative colony in Ithaca, New York. Viral suspension containing 10^{62}- 10^{77} $TCID_{50}$/ml were stored at -70°C until used. Oronasal infection was given to some dogs. Eighteen dogs were infected by instilling 2 ml of the virus stock in the nose and mouth. Eight dogs were challenged parenterally with the same dose of virus. Four dogs were infected by I/M and other 4 by I/V routes. Faeces were collected from an experimentally infected pup on the 5^{th} day after oral infection and was found positive for CPV infection.

Azataka *et al.* (1981) conducted study on canine parvo virus isolation, experimental infection and also a serologic survey in Japan and they were successful to establish the infection of CPV. They observed severe heammorrhagic diarrhoea and vomition in experimentally infected pups.

Macartney *et al.* (1984 a) conducted study on experimental canine parvo virus enteritis and successfully established the infection through oral route. They observed severe enteritis, vomition and high rise of temperature in the infected pups and particularly on 4^{th} day post infection symptoms of dullness and anorexia were exhibited followed by severe vomition and diarrhoea from 5^{th} -6^{th} day post infection.

O'sullivan *et al.* (1984) reported that they were able to induce severe canine parvo viral enteritis in experimental dogs in Australia and observed severe foetid diarrhoea with blood flecks, vomition and dehydration.

Appel (1978) successfully produced highly fatal infection in experimental pups infected with oral inoculation of parvo virus on 3^{rd} day post infection of corona virus infection. He observed that all the experimentally infected puppies either with corona virus or with parvo virus established canine gastroenteritis manifesting mild

symptoms of dullness, depression, vomition, diarrhoea and high fever but recovered quickly.

McCandlish *et al.* (1981) conducted experimental study on the CPV infection and reported that the disease was highly contagious and was transmitted easily via infected faeces.

Drane *et al.* (1994) successfully infected 19 experimental dogs with CPV by aerosol method with $10^{5.5}$ medial tissue culture infective dose/ ml {$TCID_{50}$/nu.}

Joshi *et al.* (2001) reported that 10 puppies were infected orally with 2mm of virus (2048 HA units/0.05 ml) inoculum after overnight fasting. The pups were observed for clinical symptoms. Infected pup showed symptoms of mild dullness and anorexia on second day post-infection followed with manifestion of anorexia and mild diarrhoea on fourth day post- infection. They observed yellowish watery diarrhoea in 4 pups on the fifth day onwards. The remaining 4 pups exhibited profuse, greenish yellow foetid diarrhoea with mucus on the sixth day post-infection. They observed moderate rise in temperature between 4^{th} and 5^{th} day post-infection.

HAEMATOLOGICAL PROFILE

Appel *et al.* (1978) obtained white cell count of 500/mm^3 through 2000/mm^3 at the peak of illness. They found leucopaenia during the first 4-5 days of CPV infection.

Black *et al.*(1979) observed planeucopaenia in dogs suffering from CPV enteritis within first 4-5 days of infection with total white cell count of less than 8000/mm^3.

Fluckiger (1980) found less than 1000 leucocytes/ µl during 2^{nd}–4^{th} day of canine parvo virus infection in dogs with the symptoms of severe gastroenteritis.

Jacob *et al.* (1980) tested haematologically 134 dogs for leucocyte count and found leucopaenia in about 50 (37%) cases of canine parvo viral enteritis.

Jedlizoka (1980) conducted leucocyte tests in 36 cases of CPV infection and observed 4000 leucocytes/mm^3 indicating leucopaenia.

Kraft *et al.* (1980) found leucopaenia in 11 out of 15 cases of CPV infection with total white blood cell counts below 4000/mm^3. They stated that this stage of leucopaenia was observed within first 4-5 days of CPV infection.

Wood *et al.* (1980) stated that during the first 4-5 days of canine parvo viral illness there was leucopaenia, with total WBC counts below 3000/m^3, which increased subsequently as result of regenerative leucocytosis.

Neu and Wachhanl (1981) calculated WBC to be less than 200/μl in 5-18% of cases (55) within 3^{rd} – 6^{th} day of CPV infection indicating leucopaenia whereas leucocyte count was found more than 12000/μl in about half of the cases on the seventh day of infection which indicated the state of recovery.

Price and Njiro (1981) conducted haematological test for leucocyte count in 75 cases of CPV infection and found that almost all the cases showed normal to decreased leucocyte count.

Ramadan *et al.* (1981) found leucopaenia in 305 cases of canine parvo virus infection.

Voros *et al.* (1981) conducted haematological test for leucocyte count in 33 affected dogs in between 2^{nd} – 5^{th} day of CPV infection and found all the cases as leucopaenic.

Stann *et al.* (1984) counted WBC to be less than 6000/mm^3 in the dogs affected with CPV infection indicating leucopaenia.

Glickman *et al.* (1985) conducted total leucocyte count in a Doberman pinschers suffering from CPV infection and did not observe leucopaenia.

Ghermai and Kraft (1986) observed leucopaenia in 97 of 290 dogs suffering from CPV infection.

Mohan *et al.* (1993) observed reduced values in Hb, TLC and TEC count in the CPV infections.

Dhanapalan *et al.* (1993) selected 240 dogs showing varying degrees of dehydration from the small animal clinic of Madras Veterinary College Hospital. They found marked increase in PCV in affected dogs indicating dehydration whereas Hb and MCHC were significantly low. However, total erythrocyte count, total leucocyte count and MCV were within the normal range. Reduced haemoglobin and MCHC indicated normocytic hypochromic anemia in the sick animals. Analysis of serum electrolyte revealed hyperkalemia (2.77± 0.06 ME/l.).

Hulas *et al.* (1996) conducted haematological examination in 41 cases of CPV infection and found 40 cases showing leucopaenia, lymphopaenia and neutropaenia.

Ramprabhu *et al.* (2002) conducted haematological and biochemical tests in the cases of haemorrhagic gastroenteritis in dogs including CPV infection. PCV (%) was recorded low ranging from 6-18% in 6 cases of CPV infection. The RBC count was very low (2.3±0.46 million/cmm). The leukogram revealed leukocytosis with related neutrophillia and lymphopaenia in most of the cases. The mean Hb values recorded was 4.25 ± 0.89% and the mean PCV value ranged from 6 to 40% incases of CPV infection.

CULTURE AND SENSITIVITY TEST

Chakrabarti (1977) carried out an *in vitro* sensitivity study on secondary bacterial invaders isolated from the dogs of Bhubaneswar locality. He isolated *Staphylococcus aureus, Streptococcus pyogenes, Pseudomonas aeruginosa, Proteus spp. and Escherichia coli* which were highly sensitive to penicillin, streptomycin and neomycin and moderately sensitive to oxytetracycline, chlorotetracycline, chloramphenicol, erythromycin and tetracycline. These bacteria showed less sensitivity to ampicilin and bacterin.

Reedy (1982) reported that the coagulase positive *Staphylococcus spp.* isolated from dog showed 99%, 89%, 87%, 74% and 59% sensitivity to cephalosporin, chloramphenicol, cloxacillin, erythromycin and lincomycin respectively. He reported that bacterial resistance increased due to the frequent use of the antiobiotics on the same animal.

Muller *et al.*(1983) reported that *Pseudomonas aeruginosa* isolated from the dogs was found to be highly sensitive to gentamycin and carbenicillin.

Nayak (1993) reported that examination of skin swabs from 24 pups having postular lesions yielded 51 isolates. These isolates comprised of *Staphyloccus aureus* (37.2%, *Streptococcus spp.* 21.5%, *Bacillus spp.* 19.6%, *Pseudomonas aeruginia* 5.88%, *Corynebacterium spp.* 5.88% and *Echerichia coli* 9.8%). He reported that most of the isolates were sensitive to gentamicin, chloramphenicol and norfloxacin.

Ramprabhu *et al.*(2002) reported that they identified *E.coli* and *Staphylococcus spp.* after cultural test of the faeces of the dogs suffering from parvovirus infection.

HISTOPATHOLOGY

Keenan *et al.* (1976) observed the pathological in the intestine and mesenteric lymph nodes while conducting the histopathological studies on intestinal infection of neonatal dog with canine corona virus. They also recorded atrophy and fusion of intestinal villi and a deepening of crypts.

Takeuchi *et al.*(1976) conducted an electronic microscope study of experimental enteric infection in neonatal dogs with canine corona virus and reported an increase in cellularity of lamina propria, flattening of epithelial cells and discharged the goblet cells.

Mebus *et al.*(1977) during the study of intestinal lesions induce in gnotobiotic calves by the virus of human infantile gastroenteritis observed the roughening of small intestine and shortening of the villi by scanning electron microscopy.

Eugster *et al.*(1978) while conducting their study on parvovirus infection in dogs observed myocardial and intestinal lesions in the affected dogs. The intestinal crypts showed a higher mitotic index due to the changes in the bacterial flora. He observed characteristic changes in the myocardial region. Degeneration of myocardial fibre was observed.

Black *et al.*(1979) conducted a study on parvoviral enteritis and panleukopaenia in dogs and observed denudation of the epithelial surface of small intestine, shortening of villi and depletion and degeneration of crypts having necrosis. Besides they observed the dilation of some crypts.

Bestetti *et al.*(1979) recorded moderate to severe pulmonary oedema.

Cooper *et al.*(1979) observed marked necrotic changes in the germinal centres of Peyer's patches in addition to destruction of cellular elements in the lymph nodes, bones and spleen. According

to them these are helpful for diagnosis of the viral enteritis in dogs but they were not pathognomonic in nature.

Finnie (1979) reported that the lungs were firm, grey pink with petechial hemorrhage on the pleural surface.

Huxtable *et al.*(1979) observed degeneration of myocardial fibrer with some undergoing necrosis. They also found large elongated basophilic inclusion bodies containing parvoviral particles in some myocardial nuclei.

Pollock and Carmichael (1979) recorded the degenerating changes in myocardium and intestinal epithelium. They observed basophilic intranucluear inclusion bodies.

Robinson *et al.*(1980) recorded the microscopic changes in the affected lungs which were suggestive of diffused interstitial pneumonia. They considered it to be secondary to myocardial dysfunction.

Else (1980) recorded ulceration of the body of stomach and petechiation of its mucosa. He observed that the mesenteric lymph nodes were enlarged and the bones marrow contained more fluid than normal.

Perl (1980) recorded degenerative and necrotic changes of the crypt in the small intestine. He first reported on CPV infection in Israel documented the histopathological findings as atrophy of the crypt epithelium and distention of lumen of the small intestine with necrotic cellular debris.

Cammarata *et al.*(1980) recorded diffused nonsuperative myocarditis by microscopic examination. They observed necrosis and degenerative changes of myocardial fibres.

Frese and Reinacher (1981) studied the pathology of parvovirus enteritis in dogs and noticed atrophy of the crypt epithelium and distended lumen of small intestine with necrotic cellular debris.

McCandlish *et al.*(1981) reported necrosis of lymphatic cells and depletion of lymphocytes in Peyer's patches, lymph nodes, spleen and thymus.

Lenghaus and Studert (1982) studied the generalized parvo virus disease in neonatal pups and reported necrosis of vascular endothelium with haemorrage in brain and meninges. They recorded focal hepatitis, necrosis of epithelial cells and gastro intestinal tract and necrosis of lymphatic cells in spleen and lymph nodes.

Meunier *et al.*(1984) conducted experimental study on parvo virus infection of neonatal pups and recorded myocarditis which was least extensive but about similar with those of naturally occurring parvovirus myocarditis. They conducted post-mortem after 23 days and observed intranuclear inclusion in some myocardiac myosites but at 51th day post-inoculation of parvo virus they observed more extensive lymphocytic infiltration with fragmented myositis and intestinal fibrosis.

O'Sullivan *et al.*(1984) studied experimentally produced severe CPV enteritis in pups and reported that on 3rd day of inoculation there was necrosis of Peyer's patches and on 5th day inoculation they observed oedema of lymphnode and extensive follicular necrosis in Peyer's patches, tonsil and thymic cortex. They observed lymphoid depletion in Payer's patches and mesenteric lymphnode with congestion of intestinal mucosa and severe villous collapse on 7th day post-infection.

Mieura *et al.*(1986) observed giant epithelial cells and intracellular microcytes in the affected mucosae of small intestine in natural cases of parvo viral enteritis. These histopathological characteristics were considered as diagnostic indicator.

Redondo (1989) conducted histopathological study and analytical determination on enteric myocarditis and mixed form of CPV infection and observed necrotic and hemorrhagic gastroenteritis. They recorded hyperplasia of intestinal lymph node. They observed hydro pericardium and intestinal oedema of myocardium.

Lungu *et al.*(1993) recorded varied form of lesions in the myocardium. The thymus was atrophied with an increased number of Hassle's corpuscles. Necrosis was present in white pulp of the

spleen. The gross circulatory lesion of lung were thought to be due to the myocardial lesion. Though foci of intestinal pneumonia were attributed to direct effect of virus in some cases lesions of kidney and liver were not considered specific.

Jarplid (1997) studied on puppy disease caused by infection with canine parvo virus in Sweden. He observed numerous virus particles as intranuclear inclusion of epithelial cells of small intestine.

Joshi *et al.* (2001) reported degeneration, necrosis and sloughing of villus epithelial cells and hyperplasia of goblet cells in the duodenum and jejunum on 4^{th} day post-infection. They also recorded degeneration and necrosis of crypts of leiberkhun and lymphoid cells in Peyer's patches on 6^{th} day post infection. On 8^{th} and 10^{th} day post-infection they recorded degenerative and necrotic changes and proliferation of connective tissues and hypertrophy of capillary epithelial cell with increased cellularity of villi. They noticed severe congestion and depletion of lymphoid cell in the germinal centres of spleen and mesenteric symphonies, destruction of lymphoid cells and hyperplasia of the lymphoid follicles were observed by them.

THERAPEUTICS

Appel *et al.*(1978) suggested that symptomatic treatment of both parvo virus and corona virus infection should be carried out immediately for control of emesis, purgation, dehydration and fever to ensure better recovery and protection from mortality.

Appel *et al.*(1979) observed rapid recovery of the affected dogs which were treated symptomatically and kept quiet and warm under strict managemental procedure. Their observation in case of corona virus enteritis was suggestive of spontaneous recovery within a week or more in some cases.

Pollock and Carmichael (1979) conducting a study on canine viral enteritis observed that both myocarditis and enteritis symptoms were of symptomatic and supportive value. They opined that there was no specific treatment of parvo virus infection and corona virus infection. They suggested that administration of diuretic and cardiac stimulants were found to be beneficial in subacute and mild cases. They advocated rest and nourishment for the patient. They recorded good results by administration of Ringer's lactate solution and such other fluid therapy.

Fluckiger (1980) reported that administration of electrolyte solutions and other fluid therapy for rehydration in CPV enteritis was a judicious therapeutic measure and was quite essential for inclusion in therapeutic regimen against CPV infection. He was in support of antibiotic therapy for control of secondary complication of pneumonia and pleurisy. His prognosis was very doubtful when the rise of temperature was above 40.2 °C.

Groendalen (1980) conducted a study on gastroenteritis in dogs caused by parvo virus- principle of treatment and recommended that parenteral fluid and electrolyte replacement was found very effective to overcome dehydration caused during severe diarrhoea in parvo virus infection and save fatality.

Jedlizoka (1980) carried out a study on symptoms and treatment of parvo virus infection of dogs in Vienna. He designed the therapeutic regimen comprised of antibiotics (chloramphenical and ampicillin), electrolyte solution, charcoal and spasmolytic drugs for successful treatment of CPV infection. He restricted food intake and managed by parenteral dextrose infusion.

Kraft *et al.*(1980) treated parvo virus infection with fluid therapy at dose rate of 40-80 ml /kg body weight in pups for rehydration. They administered ampicillin at a dose rate of 50mg/kg of body weight along with prednisolone at the dose rate of 15-30 mg /kg body weight. Their suggestive therapy was found effective against CPV enteritis.

Krohn and Blaketad (1980) treated 5 cases of gastroenteritis of dog due to parvo virus infection with oxytetracycline, barium sulphate, trimethoprim, sodium chloride and propionyl promazine.

Woods *et al.*(1980) while treating with fluid and electrolyte solution restricted the oral food intake and observed better result.

Anderson (1981) successfully treated clinical cases of canine parvo virus enteritis with dog hypermmune serum preparation available commercially as stabglobal @ 0.2ml/kg body weight intramuscularly in conjuction with of Bayferol and subcutaneously.

Benary *et al.*(1981) while studying on canine corona virus enteritis initiated fluid therapy along with electrolyte and stressed upon the importance of proper and balanced nutritious diet during illness.

McCandlish (1981) reported that rehydration with Ringer's lactate solution in severe dehydrated cases of parvo virus infection in dogs brought about cure within shorter duration of treatment.

Meunier *et al.*(1981) successfully treated the cases of parvo virus infection in dogs with intravenous infusion of electrolyte solution and oral therapy of neomycin/ anticholinergic suspension.

Meyer-Engelke (1981) treated the cases of parvo virus gastroenteritis in dogs with antibiotic, analgesics, sulphonamides, corticosteroid and electrolyte solution with an encouraging cure rate.

Neu and Wachhaus (1981), during the study of clinical laboratory diagnosis and treatment of parvo virus infection in dogs, administered fluid with electrolyte solution to overcome dehydration and 8.4% sodium bicarbonate solution to control systemic acidosis. They also administered corticosteroid in severe cases and antibiotic therapy against secondary invasion of pathogens. Besides they used γ-globulins.

Voros *et al.*(1981) treated dogs affected with parvo virus infection by administering electrolyte solution @ 42-80 ml/ kg body weight and were successful in rehydration process with quick infusion rate of 300 to 500 ml in 15 minutes. They also designed the

continuous intravenous infusion with 1500 ml of electrolyte solution in 48 hours.

Pollock (1982) reported that the clinical signs of CPV infection were not exacerbated by steroid treatment. Neither dog treated with corticosteroid exhibited clinical sign of illness and febrile response was similar to untreated dog. Steroid treatment caused a mild neutrophilia and a relative nymphopaenia.

Ishibishi (1983) tried serotherapy for infected dogs with canine parvo virus in Japan. They were able to achieve early recovery and had a control over mortality. Their treatment with immune serum therapy through intravenous route was found effective.

Haeseobrouck *et al.*(1985) studied on serum prophylaxis trial in affected pups aged about 6-11 weeks with parvo virus infection. They administered hyperimmune serum two times at an interval of 7-14 days and recorded 37% mortality in treated pups as against 41% mortality in untreated pups.

Rai *et al.*(1994 b) treated CPV gastroenteritis in 60 dogs. They treated the cases in different groups with ampicillin, chloramphenicol and cotrimazole along with antiemetic like metoclopramide, promethazine hydrochloride and prochlorperazine. They administered anticoagulants like adrenochrome, monosemi carbazone and coagulant venom (Botropase) to check haemorrhage. They preferred intramuscular/ intravenous route followed by oral route according to need of the patient. Vitamin C was tried through IV/ IM route daily for 6-8 days in a group of animals to evaluate its effectivity which was not found in parvo virus infection.

Spielman and Garvey (1993) treated 15 cases of canine parvo viral gastroenteritis with lactated Ringer's solution @ 45-90 ml/kg body weight for a period of 24 hours with I/V administration of ampicillin @ 22 mg/kg body weight 8 hourly.

Bielsker (1994) treated successfully cases of corona virus enteritis with fluid therapy, antibiotics, vitamins for 7-10 days with oral administration of balanced diet. They took care of the affected

animals to overcome stress and provide them a suitable warm environment for speedy recovery. On the whole under such managemental condition and therapeutic measure the animal exhibited quick recovery.

Banja (1999) treated canine parvo virus and corona virus gastroenteritis with gentamicin @ 4mg/kg body weight, Ringer's lactate @ 45-90 ml/kg body weight, metoclopramide @ 1 mg/kg body weight and andrenochrome monosemicarbazone @ 0.1-0.2 mg/kg body weight. He continued treatment for a period 3-5 days or more and restricted oral feeding during the course of treatment. He saved 90.1% cases of CPV single infection, 100% cases of CCV single infection and 80.9% cases of mixed infection of CPV and CCV infection. He reported an overall recovery of 87.5% of dogs in Bhubaneswar city.

Otto (2001) evaluated the ability of an antimicrobial and endotoxin neutralizing agent the recombinant aminoreminal effect of bacterial permeability – increasing protein to decrease plasma endotoxin concentration and severity of clinical sign of canine parvo virus and to improve survival of animals. Plasma endotoxin concentration was found significantly higher in dogs with parvo virus than normal or recovered dogs. Despite 90% survival rate this treatment did not have a significant effect on duration of hospitalization or plasma endotoxin concentration. However, there was improved survival rate but resulted in a significantly increased duration of hospitalization.

CHAPTER - III

MATERIALS AND METHODS

MATERIALS AND METHODS

The present research work on the epizootoology, diagnosis, pathogenesis and management of viral gastro enteritis in dogs was ransacked in the Department of Medicine of the Faculty of Veterinary Science and Animal Husbandry, Orissa University of Agriculture & Technology, Bhubaneswar from 1990 onwards.

EPIZOOTIOLOGY

Source of Information

The epizootics of this emerging dreadful ailment was based on information of prevalence from different sources within the state of Orissa. In this regard many case records and natural clinical cases were brought into the sphere of investigation.

Case Record

Primarily the patient records of Central Clinic of Orissa Veterinary College and out-patient treatment records of principal Veterinary hospitals (25) of the state of Orissa and a leading private canine clinics in the city of Bhubaneswar were meticulously persued for gastroenteritis in dogs with particular reference to corona and parvo viral infection from 1990 and onwards.

Clinical Cases

The clinical cases of gastroenteritis were clinico pathologically examined for natural infection of corona and parvo virus among

different breeds of dog population irrespective of age group and sex.

Detailed history of each case was obtained before clinico pathological examination to attribute, ascertain and correlate the etiological agents as corona and /or parvo virus.

Examination of Animals

All animals manifesting symptoms of vomition, diarrhoea with rise of body temperature were examined for clinical symptoms and history of the ailment. The clinical examination included recording of rectal temperature, body condition, degree of dehydration by skin fold test, palor of visible mucous membrane, conjuctiva and tongue. The consistency, volume, type, frequency and odour of the faeces and vomitus were the other criteria of clinical examination. Besides gait, demeanour, posture and expression of the animal were recorded. The history included the duration of illness, appetite, feeding habit, management and care, immune status particularly against parvo and corona viruses, history of disease outbreak in the past and present in the dog population of the locality.

Collection of Faecal Samples

Viral gastroenteritis of this type being highly contagious and easily transmissible via infected faeces (McCandlish *et al.*, 1981), diagnosis, therefore, was based on the exclusive demonstration and confirmation of canine corona and parvo virus antigen in faecal samples.

A total of 592 faecal samples were collected from dogs of the different breeds, sexes and age groups manifesting symptoms of rise of temperature, persistent vomition, foetid profuse diarrhoea flecked with blood, mucus and mucosal shreds. A sterile cotton swab was at first soaked in previously prepared Hank's Balanced

Salt Solution (HBSS). This cotton swab was introduced into the rectum of the dog, under investigation, to collect the faecal sample.

The impregnated swab containing faecal sample was immersed into an appendorf tube containing 0.75ml. HBSS and was cleared off the faecal material by vigorous shaking. Then it was allowed to mix thoroughly in the solution. Some time later it was squeezed on the inner side of the tube and removed out. The above solution containing the faecal matter was centrifuged at 10,000 rpm for 10 minutes. The faecal supernatant was pipetted into a sterile specimen vial and stored at 4°C for future analysis.

For detection of other endoparasitic ova/oocyst about one gram of faeces was collected in a dry clean glass vial from the same animal.

Preparation of Hank's Balanced Salt Solution.

Hank's balanced salt without $NaHCO_3$ (1 unit vial) of 9.76 g was added with triple distilled water to make 1000 ml and pH was adjusted at 7.4. The solution was autoclaved. Then penicillin @ 1000 I.U./ml and streptomycin @ 1000 mg/ml were added to the solution and was stored at 4°C for use in the test.

Parasitic Examination of Faecal Sample

The parasitological examination of faecal samples was conducted to detect the presence of eggs, larvae or oocyst of different endoparasites as per the method described by Soulsby (1982).

Preparation of Antisera

Anticanine Parvo virus (anti CPV) and anticanine corona virus (anti-CCV) hyperimmune sera were prepared in the rabbits and were

used as positive control sera for screening of the faecal samples against CPV and CCV.

Anti-CPV Hyperimmunesera

Canine parvo virus vaccine (parvocine, Serum Institute of India Ltd.) was utilized as antigen for preparation of antisera in rabbits (Ramadass and Kahder,1982). Five apparently healthy adult rabbits were used for the purpose of raising hyper immune anti-CPV sera. For the first injection, an emulsion was prepared with 1 dose of parvocine in 1 ml of distilled water and 1 ml of Freund's complete adjuvant (FCA) Sigma, USA. One millilitre of the reconstituted emulsion was injected subcutaneously to each rabbit. A repetition was made at 15 days interval for the second and third injections with freshly prepared above emulsion. The rabbits were test bled from the ear vein after 7 days of the last injection for assessment of antibody titre against parvovirus. When the antibody levels in the test sera were found to be sufficient to meet the requirement of the tests to be done, the rabbits were bled from the heart and 7ml of heart blood was collected and allowed to clot at room temperature and later kept overnight at 4°C for separation of serum. Due care was taken to follow statutory provisions for management and maintenance of the animals used during the experiment in order to prevent cruelty. The collected antisera were stored in small aliquots at -20°C along with merthiolate (1:10,000) and treated as positive control sera to be used in the subsequent tests.

Anti-CCV Hyperimmune Sera

Anti CCV hyper immune sera raised in the test rabbits were procured from the department of Preventive Medicine, Madras Veterinary College, Chennai. The procedure of Ramadass and Khader (1982) was followed for this purpose also. The sera were used as positive control in subsequent tests.

Vaccine virus (Novivac-C), manufactured by M/s Intervet International B.V Boxmeer-Holland which contains freeze dried, live attenuated tissue culture (CPV strain 154) vaccine not less than 10^{70} $TCID_{50}$ CPV virus was treated as positive control antigen to be used in different tests contemplated in future for the purpose.

Dogs and rabbits, upon their procurement locally, were assessed to be seronagative for CPV and CCV and were kept as donor for collection of sera. The serum samples collected from them were used as negative control in different tests.

Test Sera Samples

Two hundred ten sera samples were collected from apparently healthy dogs from different localities in Orissa like Bhubaneswar, Cuttack, Puri, Khurdha, Nayagarh, Rourkela, Balasore, Bhadrak, Sambalpur, Dhenkanal, Bhawanipatna Jajpur and Baripada to detect the parvo and corona virus antibodies. Blood was collected in test tubes from each animal and allowed to clot at room temperature for 1 hour and then stored at 4°C for 10-12 hours. The separated serum samples were pooled in small homoeopathic vials with the caps strapped with adhesive cellophone tape with proper labelling and stored at -20°C until used in the test.

Detection of Parvo Virus and Corona Virus Antigens in Faecal Samples

Dot-Enzyme Linked Immunosorbent Assay (Dot-ELISA)

The viral antigens from the faecal samples of dogs were detected through dot-enzyme linked immunosorbent assay as described by Ramadass *et al.* (1996) for Ranikhet disease virus.

Materials required:

I. Phosphate buffered saline (PBS) pH 7.2

II. Phosphate buffered saline wash solution pH 7.2

(a) Phosphate buffered saline 100ml

(b) Tween 20 0.5ml

(c) Distilled water added to make 1000ml

III. Conjugate:

Goat- anti rabbit IgH- horse reddish peroxidase (HRP) conjugate (Ganei,Bangalore, India).

IV. Substrate:

The enzyme substrate diamine benzidine tetrahydrochloride (DAB) was used at the rate of 0.5mg per ml of PBST to which 30µl./10.0 ml of 30% hydrogen peroxide was added (Chand *et al.*, 1988).

V. Nitro cellulose membrane (Sigma,USA).

Standardization of Dot-ELISA

Various serum dilution like 1:50,1:100,1:200,1:400 and 1:800 and conjugate dilution of 1:1000, 1:2000,1:3000, 1:4000 and 1:5000 were screened and determination of the optimum dilution resulted in standardization.

Procedure of Dot-ELISA for Detection of Viral Antigen.

The nitrocellulose membrane (NCM) pieces served as dipsticks. These pieces were of the size of 0.5 x 0.5 cm with 0.45µm. Pore size bound to one end of plastic strip (7.0 x 0.5cm) and were washed with sterile distilled water and air dried at room temperature. Approximately 1µl. of supernatant each of the test faecal sample was dotted separately in the centre of the nitrocellulose membrane pieces. These pieces were kept for drying at room temperature for one hour. The uncoated sites of the NCM

were blocked by 0.5% skimmed milk powder in PSBT for 10 minutes under room temperature. The NCM strips were subjected to two minutes each for 5 minutes. After final wash, these strips were incubated at 37°C for 10 minutes with 1:50 dilution of hyperimmune serum in PBST. After incubation the strips were washed in PBST for 5 times as before. Then the strips were treated with goat anti rabbit HRP conjugate having concentration of 1 in 2000 and were incubated for 10 minutes at room temperature. Thereafter the strips were washed in PBST for several times and were immersed in freshly prepared substrate solution for 2-3 minutes containing 0.5mg of diaminobenzidine tetrahydrochloride and 1µl of 30% hydrogen peroxide per ml until a positive reaction was indicated by development of brown dot. The substrate solution was discarded and NCM strips were washed with distilled water and air dried. Development of light to dark brown dots against a white background indicated positive reaction.

Haemagglutination (HA) test

Haemagglutination test was conducted for detection of parvo virus from faecal samples of naturally and experimentally infected pups. The test was carried out to detect the virus from cell culture fluid. Haemagglutination assay was done as per the method described by Carmichael et al.,(1980). Ninety well U- bottom microtitte plates (Greiner) was used.

Reagents required for H.A.Test.

Phosphate Buffered Saline (PBS)

Disodium hydrogen phosphate	-	1.15g.
Potassium hydrogen phosphate	-	0.20g.
Sodium Chloride	-	8.00g
Potassium Chloride	-	0.20g.
Triple distilled water to make	-	1000ml.

The pH of the buffer saline was adjusted at 7.2 and was autoclaved for 15 minutes at 15lb pressure (at 121°C).

PBS-BSA diluent.

Bovine Serum Albumin (BSA) Fraction-V (Sigma) -0.1g.

Phosphate Buffered Solution -100ml.

The above PBS-BSA diluent was stored at 4°C until use in the (HA) test.

Alsever's solution

Citric acid	-	0.28g
Sodium Choride	-	2.10g
Trisodium Citrate	-	4.00g
Dextrose	-	10.25g

Triple distilled water was added to make the solution 500ml.

The pH of Alsever's solution was adjusted to 7.2 The solution was autoclaved at 115^0C for 30 minutes and was kept in refrigerator at 4^0C until use in the test.

Preparation of Pig-red Blood Cell (PRBC) suspension.

Fresh blood was collected from the indigenous breeds of pig in an equal volume of Alsever's solution taking care to avoid clotting and was centrifuged at 3000 rpm. The plasma portion and buffy coat were siphoned off. Then the red blood cells were washed with ice-cold- PBS-BSA diluents thrice. After the final wash 1% PRBC suspension was prepared in PBS –BSA solution and was used in HA test. Fresh PRBC (1%) suspension was prepared when haemolysis occurred on any occasion.

Procedure of HA test.

The haemagglutination test was conducted in U bottom microtitre plates (Tarsons). A two serial dilution (0.05ml) of the test faecal sample starting from an initial 1:10 dilution in ice-cold-PBS-BSA was made in the 96 wells of the U bottom microtitre plate. To each one of these wells 0.05ml of one per cent PRBC suspension was added and mixed. Controls were included with positive control antigen and a cell control was done in a separate row of the microtitre plate. The plate was incubated at 4^0C for 2-16 hours. The result was read only after the pig erythrocytes control had settled completely. The end point was considered to be the highest dilution of virus producing maximal agglutination. The highest dilution of the antigen that agglutinated pig RBC forming a uniform mat was considered as the end point of titre. This was recorded and the titre value of more than 1:64 was considered HA positive.

The faecal samples found positive for HA test were simultaneously assessed for specific inhibition of CPV haemagglutinine using 1:20 and CPV reference serum as described by Carmichael *et al.*(1980). In the two rows of microtitre plate, 0.05ml of chilled SPB was added to each well. Two fold dilution series were kept at room temperature for a period of one hour. Then 0.05 ml of 0.5-1% procine erythrocytes were mixed in each well and the plates were kept at 4^0C for 2-16 hours. The haemoinhibition (HI) titre was taken as the reciprocal of the highest dilution of serum showing inhibition of aggulutination of the procine erythrocytes.

Reserve Passive Haemagglutination (RPHA) test.

The RPHA test was conducted according to the method described for rinderpest (Scott,1991).

Preparation of Antibody Labeled Erythrocytes

Fresh sheep bloods was collected from local breeds of sheep in an equal volume of Alsever's solution. This mixture was washed in PBS for three times. After the final wash, a 2.5% sheep red blood cells (SRBC) suspension was prepared in PBS. These erythrocytes were fixed with glutraldehyde (Sigma) by mixing 15ml of 2.5% of SRBC suspension with 3ml. of 2.5% glutraldehyde in PBS. Then the suspension was gently stirred at 37^0C for one hour till the RBCs changed from red to brown colour. The fixed RBCs were washed at 1500rpm for 15 minutes in PBS for three times. A stock of 2.5% concentration of packed fixed RBCs was obtained. To this sodium azide (0.2%) was added as preservative and was kept at 4^0C.

In order to perform antibody labelling, 1ml of 1:10 dilution of known antisera was added to 3ml of phosphate buffered saline and to it 1 ml of 2.5% fixed SRBCs was added. All these allowed to mix thoroughly at 37^0C for 30 minutes. This antibody labelled fixed RBCs were washed in PBS three times and then were suspended in 5ml of PBS.

Procedure of RPHA test.

U bottom plates were used for this test and PBS was taken as diluent. Two-fold serial dilution of the test antigen (0.05ml) was made. To the dilution of each well, 0.05ml of antibody labelled fixed RBCs was added. These were thoroughly mixed and incubated at 37^0C for 30 minutes and thereafter the plates were examined for haemagglutination. The RPHA titre was expressed as the reciprocal of the highest dilution giving haemagglutination. A RPHA titre of 1:8 was considered to be positive.

EXPERIMENTAL INFECTION IN PUPS

A total of 12, one month-old, apparently healthy indigenous breed pups were collected from the locality and hygienically reared with artificial feeding with milk and bread. Water was provided ad libidum. Calcium and vitamins were supplemented in their diets and deworming was done as a routine. At about 2 months of age these pups were divided into 3 groups having four pups in each. Each group of pups were kept with 2-3 month old pups naturally infected (clinically diagnosed) with parvo and corona virus. These pups were allowed to mix freely with the experimentally pups. All the pups were kept under close observation and monitored for a period of about one month. On establishment of the infection in the experimental pups necessary pathological materials were collected for examination. Six pups of 2-3 months of age were kept as non-infected control group.

The following examinations and clinical observation were made regularly.

(i) Daily recording of temperature, pulse and respiration daily.

(ii) Recording of clinical symptoms manifested by the experimental pups.

(iii) Examination of faecal samples of experimental pups to detect viral antigen by Dot-ELISA test before and after the experimental infection.

(iv) Collection of blood samples at regular intervals for haematology.

HAEMATOLOGY

For haematological studies about 5ml of blood was collected from cephalic/recurrent tarsal vein in clean sterilized vials containing EDTA (1mg/ml of blood) as anticoagulant. The

haematological studies included determination of haemoglobin (Hb%) packed cell volume (PCV), total erythrocyte count (TEC), total leucocyte count (TLC) and differential leucocyte count (DLC) as per the method described by Schalm *et al.* (1975).

Haemoglobin Estimation (Hb)

Haemoglobin was estimated by Sahl's haemometer and was presented in gm per cent of blood.

Packed Cell Volume (PCV)

Estimation of PCV was done by "Wintrobe tube method". The RBCs were packed by centrifugation at 3000 rpm for 30 minutes and the findings were presented by percentage.

Total Erythrocyte Count (TEC)

Total erythrocyte count was performed by means of double Neuber's counting chamber using Gower's solution. The calculation was transformed to million/cubic millimeter (10^6/Cmm) to present the result.

Total Leucocyte Count (TLC)

Total leucocyte count (TLC) was done by means of haemocytometer and Neuber's counting chamber using leucocyte diluting fluid. The calculated value was transformed to thousands/cubic millmeters (10^3 x Cmm) of blood.

Differential Leucocyte Count (DLC).

Fresh blood smears on grease free new glass slides were taken and dried. These were stained with Giemsa stain. Counting of different components like neutrophil, basophil, eosinophil, monocytes and lymphocytes was done under oil immersion lens. The results were presented in percentage.

CULTURE AND ANTIBIOGRAM OF BACTERIAL ISOLATES

Thirty faecal samples of clinical viral gastroenteritis of CPV,CCV and mixed infection of CPV+CCV (10 each) were examined for the presence of different types of secondary bacterial invaders of gastro-intestinal tract and tested for their sensitivity to different antimicrobial drugs by disc diffusion method (Cruickshank *et al. 1965*). The primary cultural test was conducted in nutrient broth and isolation of different colonies was done on ox blood agar plates. The organisims were identified by colony character. The *in vitro* sensitivity was conducted using the ready made sensitive discs manufactured by M/s Himedia Laboratory Private Limited, Bombay on Muller Hinton agar plates. The sensitivity was graded as per the measurement of zone of inhibition (Baucer,1982)

HISTOPATHOLOGICAL STUDIES

The tissues from intestine, mesenteric lymphnodes, spleen, heart, lung, liver, kidney were collected for histopathological studies after sacrificing the infected pups and gross necropsy findings were recorded in different organs simultaneously during post-mortem.

Collected tissues were fixed in 10% formal saline for histopathological examination. The pieces of fixed tissues were washed over night in running tap water and subjected to dehydration through ascending grades of alcohol. The tissues were then cleared in xylene and embedded in paraffin. Microsection of 5µ thickness were stained with haematoxylene and eosin (H&E) as per the method described by Lillie (1965). After mounting with DPX the tissues were examined under microscope to note the micro tissue changes.

THERAPEUTIC MANAGEMENT

There is no specific therapy for treatment of gastroenteritis caused by canine parvo virus and canine corona virus. By and large symptomatic therapeutic measures consisting of fluid therapy, antiemetic and haemostatic preparations are always designed and employed for curative management. In addition to this antimicrobial drugs are judiciously administered to check the secondary bacterial infections which usually complicate the course of the disease.

Thus three types of treatment regimen were adopted as follows

Group-I

- Ciplox inj. was administered at the dose rate of 10mg/kg of body weight intravenously 12 hourly.
- Ringer's Lactate (RL) solution was administered at the dose rate of 30-80 ml/kg of body weight as per the requirement.
- Perinorm injection was administered at a dose rate of 1.5 mg/kg of body weight intravenously at 12 hourly interval as per the requirement until vomition was controlled.
- Dicynene was administered intravenously at the dose rate of 50 mg/kg body weight at 8 hourly interval until the bleeding subsided.

- *Ciplox Inj. Containing 200 mg of ciprofloxacin per 100ml of injectable solution along with sodium chloride IP 0.9% w.v, water for injection I.P Q.S. manufactured by CIPLA Ltd. Plot No-139-146, Verna Salcette, Goa-403722.*
- *Ringer's Lactate solution (RL). Each 100 ml contains sodium lactate-0.320 gm, sodium chloride-0.600 gm, Potassium chloride-0.040 gm and calcium chloride- 0.027 gm. manufactured by COREHEALTH CARE LTD., Sachana, Gujurat-382150.*
- *Perinorm inj.: containing 5 mg of metoclopramide per ml. of injectable solution in the pack of 2ml. ampoules manufactured by IPCA laboratories Limited, 63-E IPCA house, Kandivial Industrial estate, Mumbai-400067.*

Group-II

- Gentamicin injection was administered at the dose rate of 3mg/kg of body weight intravenously 12 hourly.
- Ringer's Lactate (RL) solution was administered at the dose rate of 30-80 ml/kg body weight as per the requirement.
- Perinorm injection was administered at a dose rate of 1.5 mg/kg of body weight intravenously 8 hourly interval as per the requirement until vomition was controlled.
- Dicynene was administered intravenously at the dose rate of 50 mg/kg body weight at 8 hourly interval until stoppage of bleeding.

iroup-III

- Kemicetine injection was administered at the dose rate of 50mg/kg of body weight intravenously 12 hourly.
- Ringer's Lactate (RL) solution and DNS 5% were administered at the dose rate of 30-80 ml/kg body weight as per the requirement.
- Perinorm injection was administered at a dose rate of 1.5 mg/kg of body weight intravenously 8 hourly as per the requirement till vomition was controlled.
- Dicynene was administered intravenously at the dose rate of 50 mg/kg body weight at 8 hourly till the bleeding was stopped.

- Dicynene inj.: containing 125 mg of ethamsylate per ml. of injectable solution in the pack of 2 ml. ampule manufactured by Dr. Reddy's Labs., 7-1-27/1, 203-II floor, Block-C, Srinivas complex, Ameerpit, Hyderabad-500016.
- *Gentamicin inj.: containing 40 mg of gentamicin/ml and presented in a pack of 2ml vial manufactured by Centaur Laboratories Pvt.Ltd, 279, Ashirwad No.5, Goregaon (W), Mumbai-4000104.*
- Kemicetine inj.: Each vial of 1 gm Kemicetine inj. contains chloramphenicol sodium succenate equivalent to 1 gm of chloramphenicol, manufactured by MAC Laboratories Limited, Vidya Vihar, Mumbai-400086.

The duration of treatment was for 4-5 days or till recovery. Therapeutic trials were carried out in clinical cases only. Eighteen animals were included for each group of therapeutic trial (viz. Gr-I/Gr-II/Gr-III). Out of 18 cases under each group 6 animals were selected from each of CPV infection, CCV infection and CPV and CCV mixed infections. Over all, 54 clinical cases of canine viral gastroenteritis comprising of CPV and CCV and mixed infection of CCV infections were included in the therapeutic trials in this study.

STATISTICAL ANALYSIS

Statistical analysis of the results was done as per the method described by Snedecor and Cochran (1994). Duncan's Multiple Range Test was applied to establish the significant differences between the normal control and infected animals.

CHAPTER - IV

RESULTS

RESULTS

EPIZOOTIOLOGICAL STATUS OF GASTROENTERITIS

During the perusal of case records and investigations thereof through 1990-91-1994-95 a total of 5282, 4987, 6963, 9832 and 7537 were presented in the veterinary hospitals/ dispensaries /central clinic of O.V.C, Bhubaneswar/ private clinics of Bhubaneswar city for treatment of various ailments. Out of these 20.95% (1109/5282), 21.99% (1097/4987), 21.49% (1497/6363), 22.49% (2212/9832) and 21.99% (1658/7537) were dogs treated for canine gastroenteritis in the respective years (Table-1). The overall incidence rate was recorded to be 21.88% (7573/34601). Among the positive cases for canine gastroenteritis 565(50.94%), 561 (51.13%), 762 (50.90%), 1132 (51.17%) and 848 (51.14%) were male with an overall number of 3868 (51.07%) and 544 (49.05%), 536 (48.86%), 735 (49.09%), 1080 (48.82%) and 810 (48.85%) were found to be females with an overall number of 3705 (48.92%) during the year 1990-91, 1991-92, 1992-93, 1993-94 and 1994-95 respectively. The mean incidence rate among male and female was found to be 51.07% and 48.92% in order indicating that there was slight difference in susceptibility between sexes (Table-1, Fig.1).

Canine gastroenteritis (Fig.2) was observed in 465 (41.93%), 460 (41.93%), 628 (41.95%), 929 (41.99%) and 696 (41.97%) cases upto three months of age; 310 (27.95%); 307 (27.98%), 421 (28.11%), 622 (28.11%) and 464 (27.98%) cases up to 4-6 months; 199 (17.94%), 198 (18.04%), 270 (18.03%), 401 (18.12%), 299 (18.03%) cases up to 7-9 months;100 (9.01%), 99 (9.02%), 135 (9.01%), 199 (8.99%) and 149 (8.98%) cases in 10months-1 year

TABLE 1. PREVALENCE OF GASTROENTERITIS IN DOGS BASED ON CASE RECORDS OF VETERINARY HOSPITALS/DISPENSARIES/CLINICS OF ORISSA

YEAR	TOTAL NO. OF DOGS PRESENTED IN THE HOSPITALS/ DISPENSARIES AND CLINICS (27)	TOTALNO. OF DOGS FOUND SUFFERING FROM GASTRO-ENTERITIS	SEX		AGE GROUP					BREED			
			MALE	FEMALE	UPTO 3 MTH.	4-6 MTH.	7-9 MTH	10M-1 YEAR	ABOVE ONE YEAR	DOBER-MAN	ALSA-TIAN	TIBE-TAN APSO	OTHERS
1990-91	5282	1109 (20 95)	565 (50.94)	544 (49 05)	465 (41.93)	310 (27.95)	199 (17 94)	100 (9.01)	35 (3.15)	399 (35.97)	312 (28 13)	288 (25 96)	110 (9.91)
1991-92	4987	1097 (21.99)	561 (51.13)	536 (48.86)	460 (41.93)	307 (27.98)	198 (18 04)	99 (9.02)	33 (3.00)	395 (36.00)	307 (27 98)	285 (25 98)	110 (10.02)
1992-93	6963	1497 (21.49)	762 (50.90)	735 (49.09)	628 (41.95)	421 (28.11)	270 (18 03)	135 (9.01)	43 (2.87)	539 (36.00)	419 (27 99)	390 (26 05)	149 (9.95)
1993-94	9832	2212 (22 49)	1132 (51.17)	1080 (48.82)	929 (41.99)	622 (28.11)	401 (18.12)	199 (8.99)	61 (2.75)	796 (35.98)	619 (27.98)	575 (25 99)	222 (10.03)
1994-95	7537	1658 (21 99)	848 (51.14)	810 (48.85)	696 (41 97)	464 (27.98)	299 (18.03)	149 (8.98)	50 (3.01)	597 (36.00)	464 (27 98)	431 (25.99)	166 (10.01)
TOTAL	34601	7573 (21.88)	3868 (51 07)	3705 (48.92)	3178 (41 96)	2124 (28.04)	1367 (18.05)	682 (9.00)	222 (2 93)	2726 (35.99)	2121 (28.00)	1969 (26.00)	757 (9 99)

- Figures in parentheses indicate percentage

FIG 1. SEX WISE PREVALENCE OF CANINE GASTROENTERITIS DURING DIFFERENT YEARS

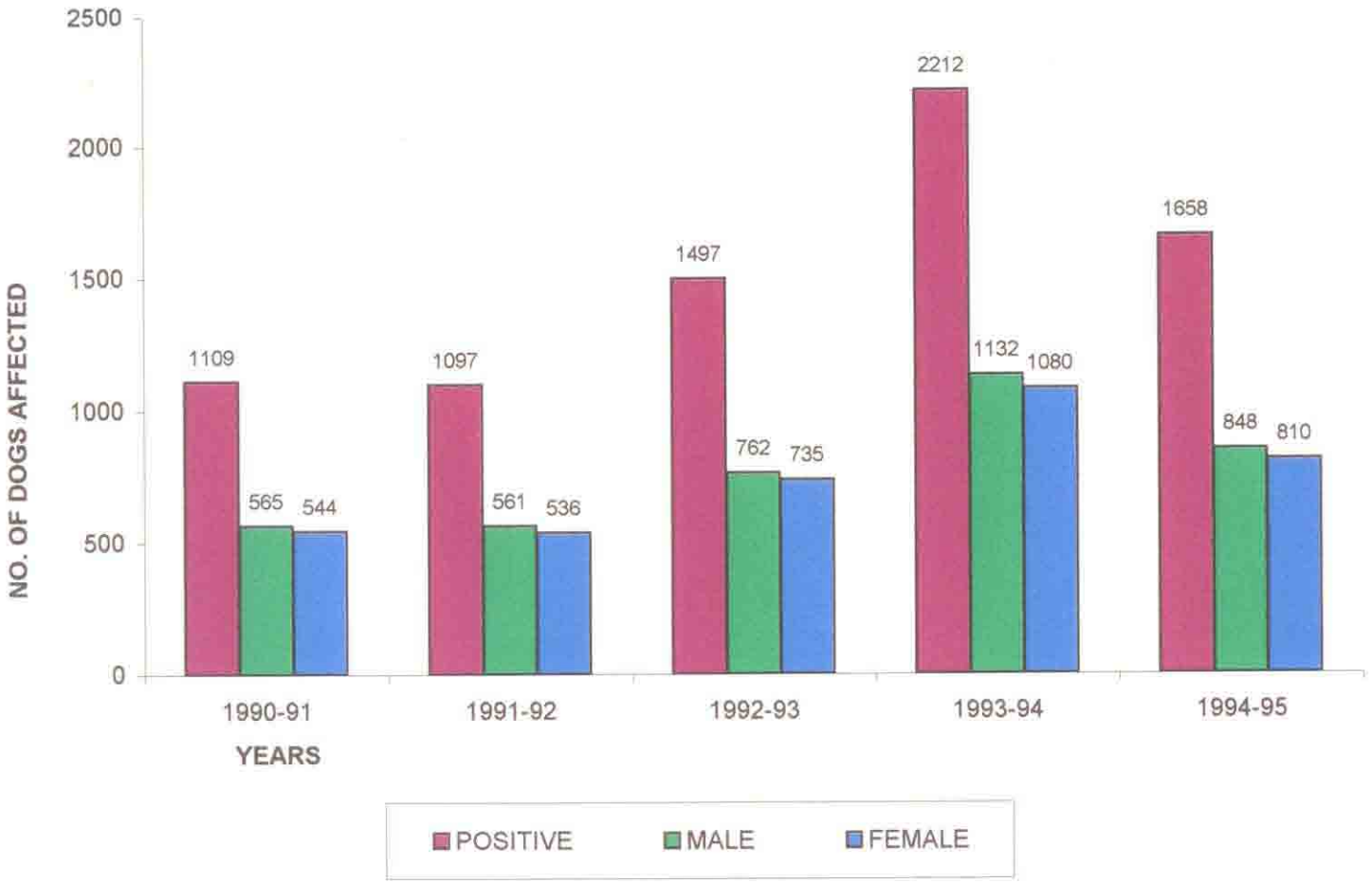
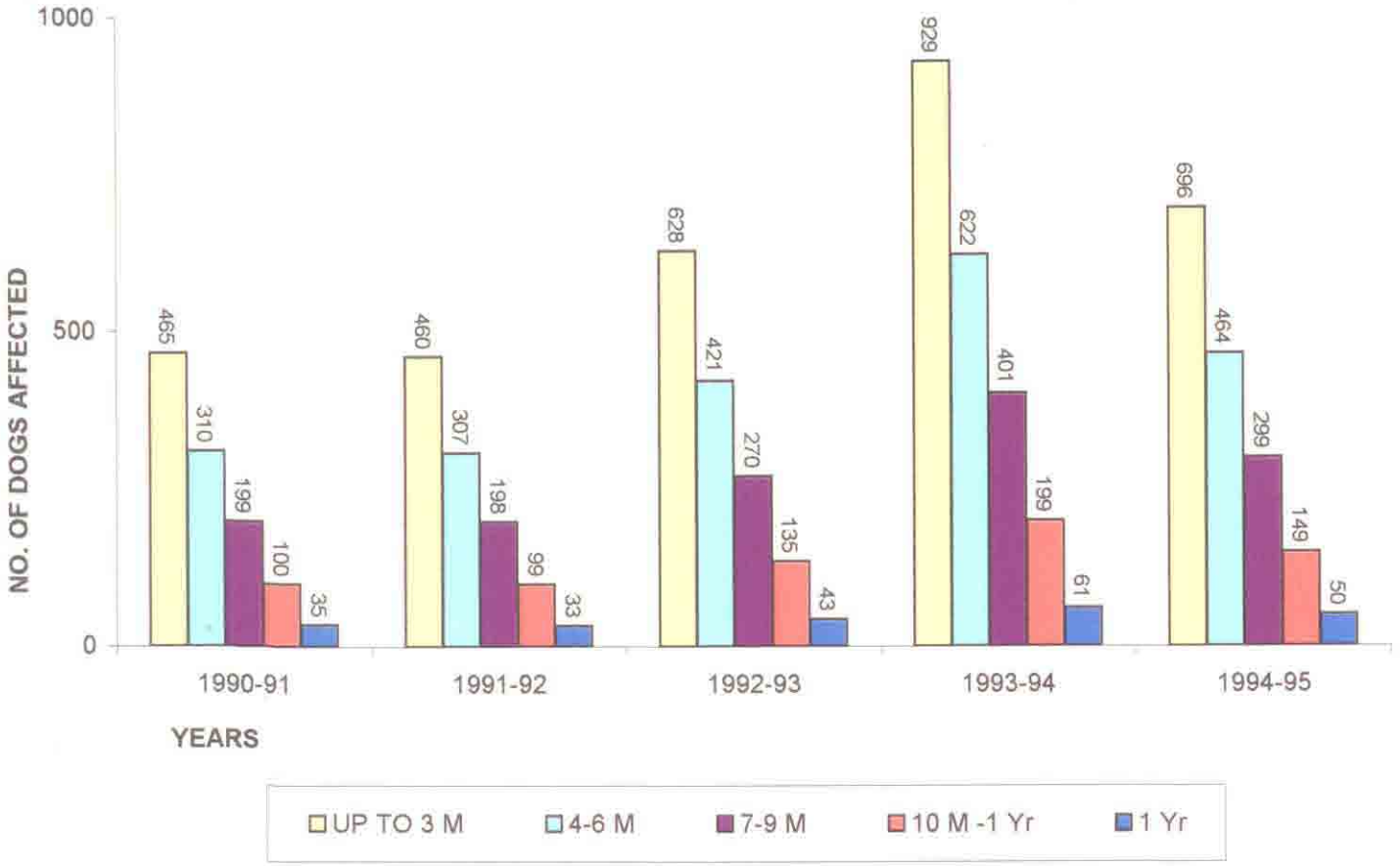


FIG 2. AGEWISE PREVALENCE OF CANINE GASTROENTERITIS DURING DIFFERENT YEARS



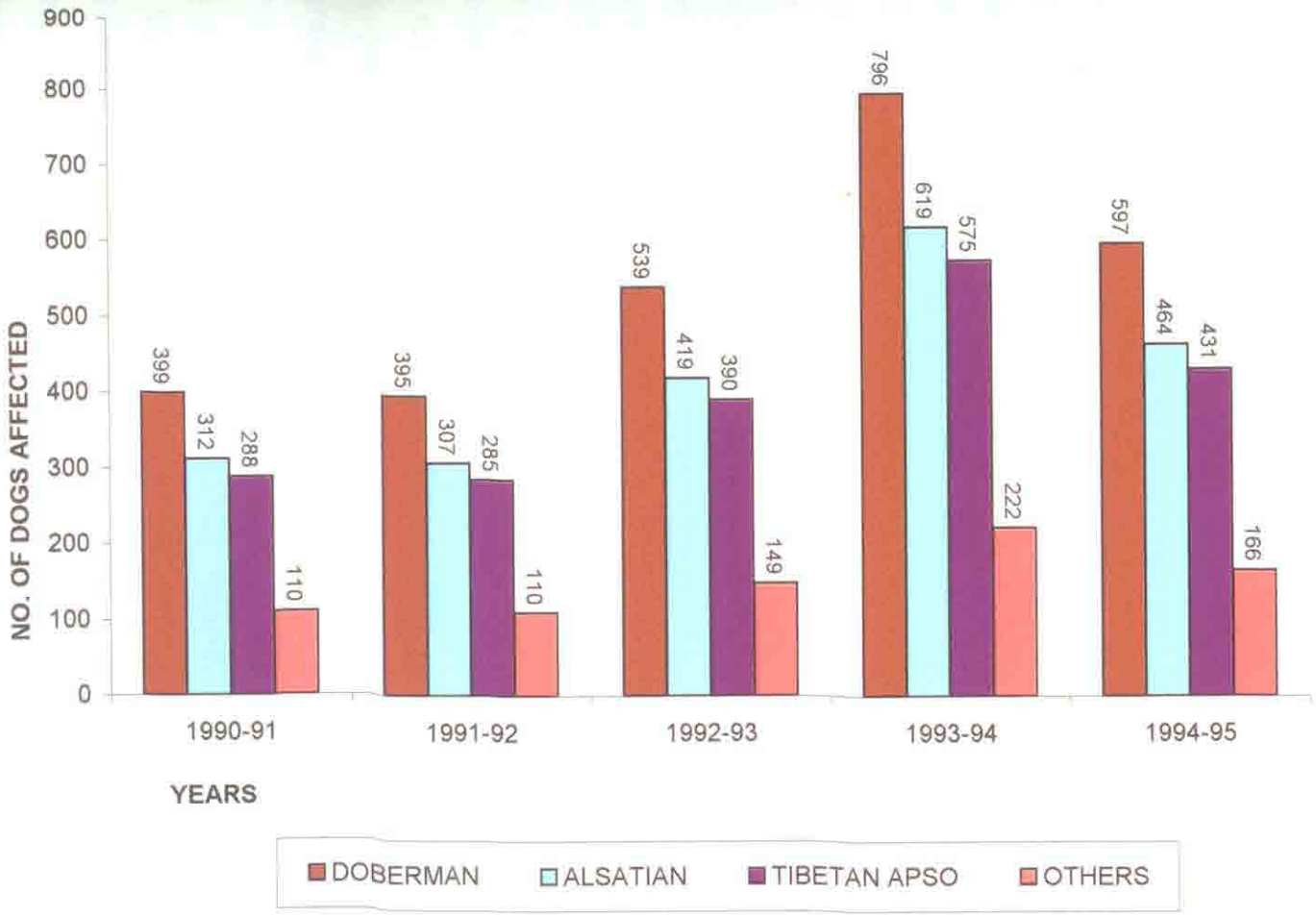
age group; 35(3.15%), 33 (3.00%), 43 (2.87%), 61 (2.75%), 50 (3.01%) cases above 1 year age group through 1990-91, 1991-92, 1992-93, 1993-94 and 1994-95 respectively. The mean incidence rate was found to be 41.96%, 28.04%, 18.05%, 9.00% and 2.93% in 3 months, 4-6 months, 7-9 months, 10m-1 year and above 1 year age groups respectively indicating that the young pups were more susceptible to canine gastroenteritis (Table-1 and Figure-2). Besides reduced rate of incidence was observed with the advancement of the age.

The breed wise investigation for prevalence revealed that 35.97% (399/1109), 36.00% (395/1097), 36.00% (539/1497), 35.98% (796/2212) and 36.00% (597/1658) of cases were Doberman; 28.13% (312/1109), 27.98% (307/1097), 27.99% (419/1497), 27.98% (619/2212) and 27.98% (464/1656) were Alsatian, 25.96% (228/1109), 25.98% (285/1097), 26.05% (390/1497), 25.99% (575/2212) and 25.99% (431/1658) cases were Tibetan Apso and 9.91% (110/1109), 10.02% (110/1097), 9.95% (149/1497), 10.03% (222/2212) and 10.01% (166/1658) were other canine breeds during 1991-92, 1992-93, 1993-94 and 1994-95 respectively. (Table-1 and Fig.3). The incidence rate varies as 35.99% in Doberman, 28.00% in Alsatian, 26.00% in Tibetan apso and 9.99% in others indicating that highest incidence rate was found among Doberman breeds followed by Alsatian and Tibetan apso and lowest was recorded in non-descript pups.

Prevalence of Canine Parvovirus (CPV) and /or Canine Corona Virus (CCV) infections in clinical cases of gastroenteritis

To study the prevalence of CPV and CCV infections in clinical cases of canine gastroenteritis investigation was carried out meticulously in the vicinity of Bhubaneswar city and its outskirts for

FIG 3. BREEDWISE PREVALENCE OF CANINE GASTROENTERITIS DURING DIFFERENT YEARS



a period of 5 years (1990-91 to 1994-95). Canine parvo virus and canine corona virus were detected by Dot-ELISA and findings were presented in Table-2. One hundred thirty two faecal samples collected from the clinical cases of canine gastroenteritis during 1990-91 were examined by Dot-ELISA for CPV and CCV. Besides parasitological examinations were conducted for endoparasites. Out of 132 clinical gastroenteritis cases 82 (62.12%) were found positive for CPV,CCV and mixed infections of both. CPV alone numbered 42 (31.81%), CCV singly accounted for 10 (7.57%) cases while the remaining 30 (22.72%) occurred as mixed infections. A total number of 72 cases signifying 54.54% (single and mixed) were detected for CPV infection and 40 cases denoting 30.30% (single and mixed) for CCV infection other than CPV and CCV exclusive infections. 22.72% of cases (30/132) and 15.15% (20/132) of cases were found positive for endoparasitic infection and other infections representing 37.87% (50/132) in totality. In the year 1991-92, a total number of 122 clinical gastroenteritis cases were screened for aetiological agents. Out of 122 cases 39 cases (31.96%), 9 cases (7.37%), 28 cases (22.95%), 67 cases (54.91%), 37 cases (30.32%) and 76 cases (62.29%) were found positive for single infection of CPV, CCV, Mixed infection of CPV and CCV, total number of cases of CCV (single and mixed), total number of cases of CCV (single and mixed) and total number of cases of CPV and CCV (single and mixed) respectively. Other than CPV and CCV infections there was 37.79% (46/122) of cases in total for other infections like of endoparasitic infection (22.95%) and non-specific infections (14.75%). During 1992-93 out 112 clinical gastroenteritis cases 32.14% (36/112) cases, 7.14% (8/112) cases, 23.21% (26/112) cases, 55. 35% (62/112) cases, 30.35% (34/112) cases and 62.5% (70/112) were found positive for CPV single infection, CCV single infection, CPV and CCV mixed infection, total CPV infection (single and mixed), total CCV infection (single and mixed) and total CPV and CCV infection (single and mixed) respectively.

TABLE 2. YEAR WISE PREVALENCE OF CANINE PARVOVIRUS (CPV) AND/OR CANINE CORONA VIRUS (CCV) INFECTIONS IN DOGS IN CLINICAL CASES OF GASTROENTERITIS

(DETECTION BY Dot-ELISA)

YEAR	NO.OF FAECAL SAMPLES EXAMINED	CPV (SINGLE INFEC-TION)	CCV (SINGLE INFEC-TION)	CPV+CCV (MIXED INFECT-ION)	TOTALCPV (SINGLE+ CPV WITH CCV MIXED INFEC-TION)	TOTALCCV (SINGLE + CCV WITH CPV INFECT-ION)	TOTAL CPV AND CCV INFECT-IONS (SINGLE AND MIXED)	OTHER THAN CPV AND CCV INFECTION		
								ENDO-PARASITIC INFECT-ION	OTHER INFECT-IONS	TOTAL
1990-91	132	42 (31.81)	10 (7.57)	30 (22.72)	72 (54.54)	40 (30.30)	82 (62.12)	30 (22.72)	20 (15.15)	50 (37.87)
1991-92	122	39 (31.96)	9 (7.37)	28 (22.95)	67 (54.91)	37 (30.32)	76 (62.29)	28 (22.95)	18 (14.75)	46 (37.70)
1992-93	112	36 (32.14)	8 (7.14)	26 (23.21)	62 (55.35)	34 (30.35)	70 (62.5)	26 (23.21)	16 (14.28)	42 (37.50)
1993-94	125	40 (32.00)	9 (7.20)	28 (22.4)	68 (54.4)	37 (29.6)	77 (61.6)	29 (23.2)	19 (15.2)	48 (38.40)
1994-95	101	32 (31.68)	8 (7.92)	24 (23.76)	56 (55.44)	32 (31.68)	64 (63.36)	24 (23.76)	13 (12.87)	37 (36.63)
TOTAL	592	189 (31.92)	44 (7.43)	136 (22.97)	325 (54.89)	180 (30.40)	369 (62.33)	137 (23.14)	86 (14.52)	223 (37.66)

- Figures in parentheses indicate percentage

Endoparasitic infection was found to be 23.21% (26/112) whereas other infections numbered 14.28% (16/112). The total number of clinical gastroenteritis cases were found to be 42 cases (37.50%) due to other infections than CPV and CCV (single and mixed). Investigations during the year 1993-94 included 125 clinical cases of gastroenteritis in pups. The faecal samples of these cases were subjected to Dot-ELISA test and endoparasitic infections. Detection by Dot-ELISA revealed that out of 125 cases 40 cases (32%), 9 cases (7.20%), 28 cases (22.4%), 68 cases (54.4%), 37 cases (29.6%) and 77 cases (61.60%) were positive for CPV infection (single), CCV infection (single), CPV and CCV infection (mixed), total CPV infections (single and mixed), total CCV infection (single and mixed) and CPV and CCV (single and mixed) respectively (Table-2). Endoparasitic infection and other infection than CPV and CCV were found to be 23.20% (29/125) and 15.2% (19/125) accordingly. A total number of 38.4% (48/125) cases were found to be due to other infections than those of CPV and CCV. A total number of 101 faecal samples from clinical cases of canine gastroenteritis were screened by Dot-ELISA. It was found out that 32 cases (31.68%), 8 cases (7.92%), 24 cases (23.76%), 56 cases (55.44%), 32 cases (31. 68%) and 64 cases (55.44%), 64 cases (63. 36%) were positive for CPV infection (single) CCV infection (single), CPV and CCV infection (single and mixed) and total number of CPV and CCV infections (single and mixed), respectively. Endoparasitic infection was 23.76% (24/101) whereas other infections were 12.87% (13/101) with a total number of 37 cases (36.63%) other than CPV and CCV infections.

The Investigation during 1990-91 through 1994-95 included 592 clinical cases of gastroenteritis out of which 189 cases (31.92%) were for CPV single infection, 44 cases (7.43%) were for CCV single infection, 136 cases (22.97%) were for CPV and CCV mixed infections, 325 cases (54.89%) were for CPV infections (single and mixed), 180 cases (30.40%) were for CCV infections

(single and mixed) and 369 (62.33%) cases were positive for single and mixed total CPV and CCV infections (Table-2, Fig. 4 & 5). The total number of cases of endoparasitic infection was found to be 137 (23.14%) and other infections were 86 cases (14.52%). On the whole the total number of other infections except CPV and CCV infections were found to be 223 cases (37.66%). The overall assessment during these years revealed that canine gastroenteritis due to CPV infection had gone up to 54.89% as against the 30.40% of CCV infection. More over it was observed that 62.33% of canine gastroenteritis cases were found to be of CPV and CCV infections.

Number of faecal samples found positive for different parasites without CPV and/ or CCV infection and with CPV and /or CCV infections have been presented in Table-2. Out of 137 (23.14%) positive cases of endoparasitic infections, 47 cases (7.93%) were for ascarids (*Toxocaracanis*), 41 cases (6.92%) for *Ancylostoma caninum*, 9 cases (1.52%) for *Strongyloides*, 5 cases (0.84%), 6 cases (1.01%) and 29 cases (4.89%) were mixed infections (Table-3 & Fig. 6). Besides 59 cases (9.96%) were found positive for endoparasitic infections along with CPV and/or CCV infections (Table-3 and Fig. 7, 8).

Faecal samples of 132,122,112,125 and 101 numbers were assessed for CPV by haemagglutination (HA) titre during the investigation through 1990-91,1991-92, 1992-93, 1993-94 and 1994-95 respectively. Haemagglutination titres of faecal samples up to 1:40 was taken as a negative value and was not considered to be positive for CPV infection. The values of haemagglutination titres of faecal samples at 1:80, 1:160, 1:320, 1:640 and 1:1280 were found to be positive for CPV infection. Total number of faecal samples found positive for CPV infection were 66 (50%), 74 (66.65%), 66 (50%), 54 (43.2%) and 42 (41.58%) in the year 1990-91, 1991-92, 1992-93, 1993-94 and 1994-95 respectively. Five hundred ninety two faecal samples from canine gastroenteritis cases during five years assessed through haemagglutination (HA)

FIG. 4. PREVALENCE OF CPV AND / OR CCV, ENDOPARASITES AND OTHER INFECTIONS IN CLINICAL CASES OF CANINE GASTROENTERITIS

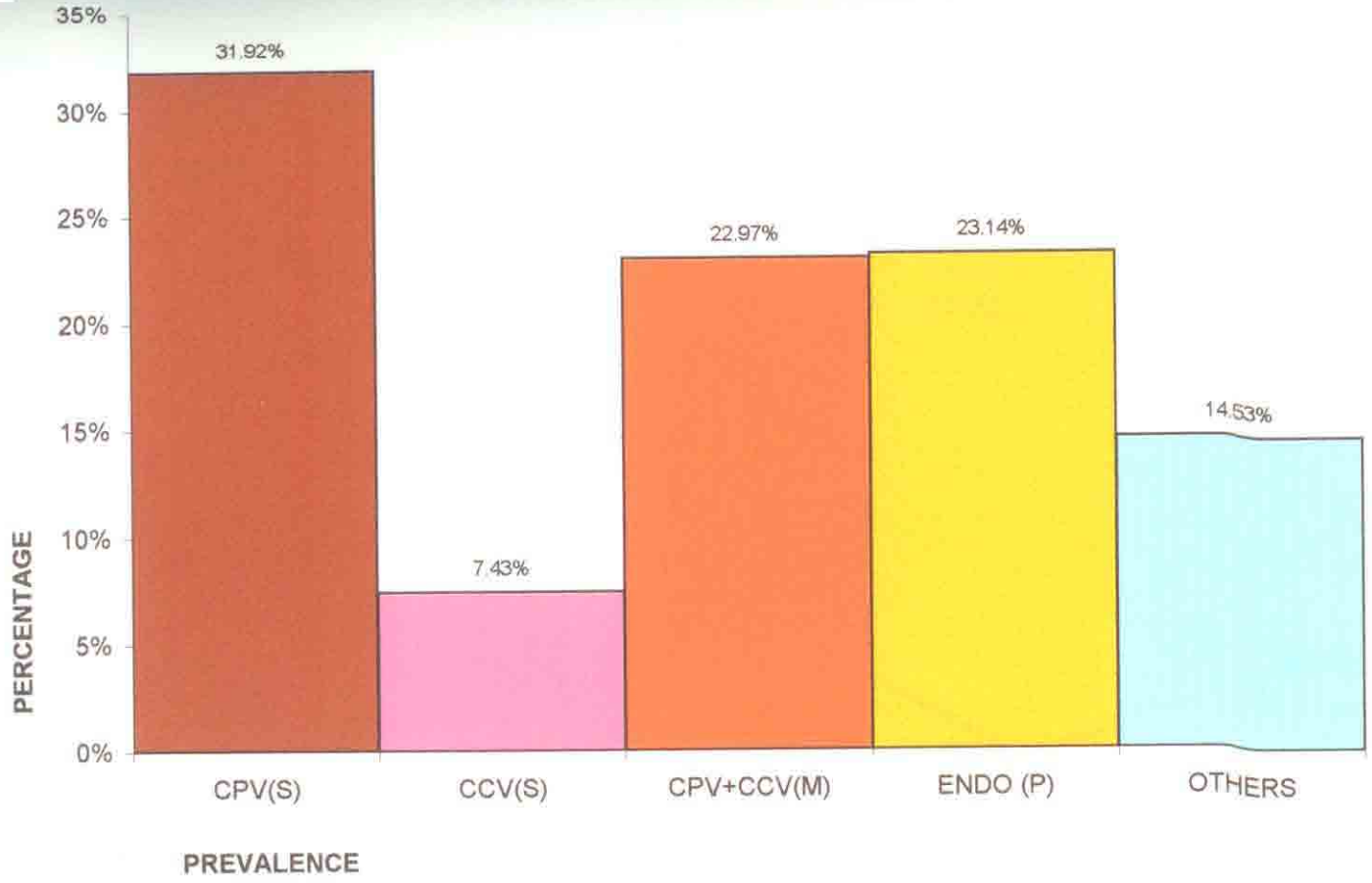


FIG 5. GRAPHICAL REPRESENTATION OF PREVALENCE OF CPV AND CCV DURING 1990-95

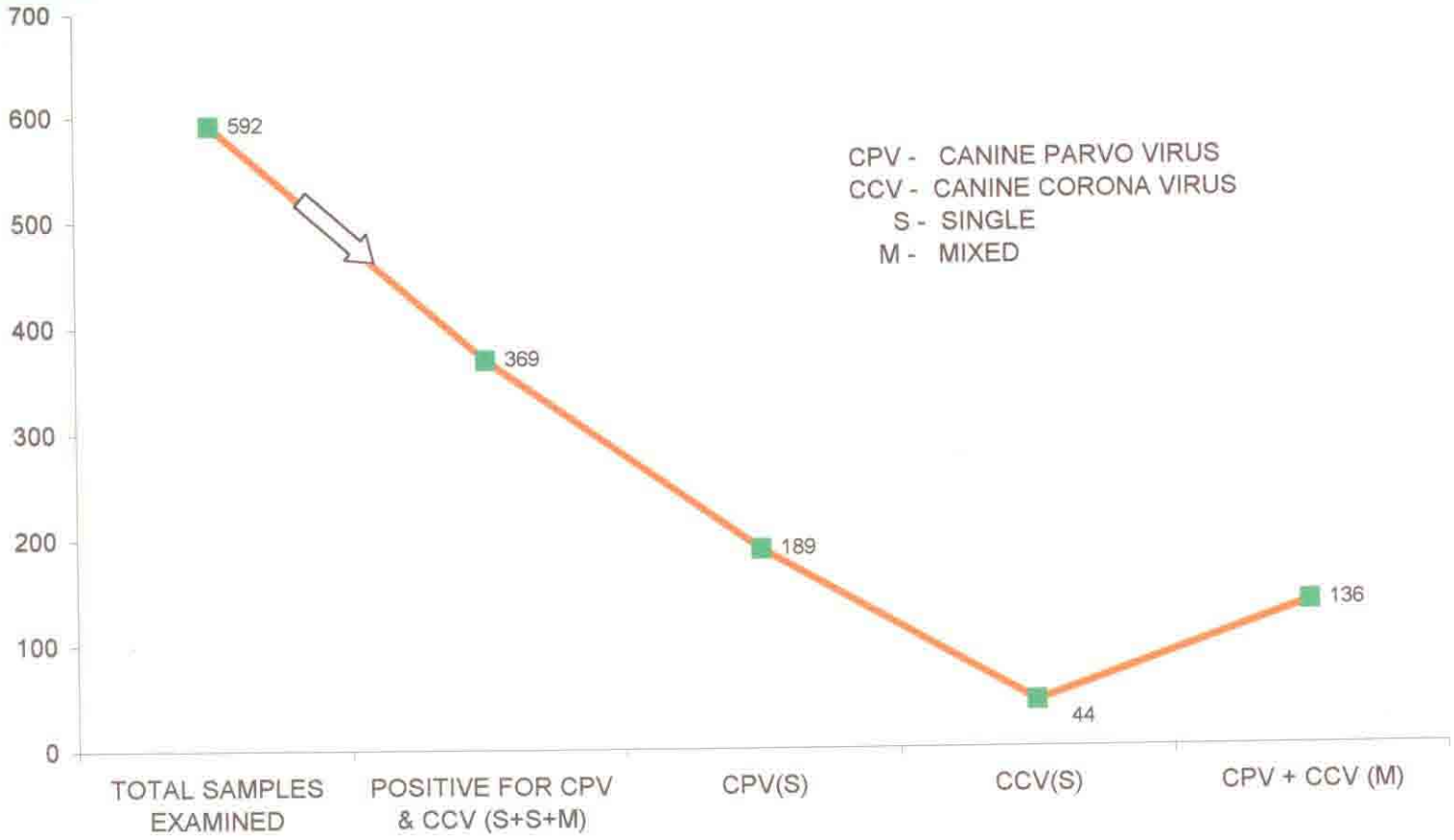


TABLE 3. DETECTION OF ENDOPARASITIC INFECTIONS IN THE FAECAL SAMPLES OF THE DOGS AFFECTED WITH GASTROENTERITIS.

YEAR	NO.OF FAECAL SAMPLES EXAMIN-ED	NO OF FAECAL SAMPLEs FOUND POSITIVE	NO OF FAECAL SAMPLES FOUND POSITIVE FOR DIFFERENT ENDO PARASITIES.						TOTAL NO.OF FAECAL SAMPLES POSITIVE FOR ENDO PARASITES WITH CPV AND/ OR CCV INFECTION
			ASCARIS	ANCYLO-STOMA	STRONGY-LOIDES	DIPYLIDIUM CANINUM	COCCIDIA	MIXED	
1990-91	132	30 (22.72)	11 (8.33)	9 (6.81)	2 (1.51)	2 (1.515)	-	6 (4.54)	13 (9.84)
1991-92	122	28 (22.95)	10 (8.19)	8 (6.55)	1 (0.81)	1 (0.81)	2 (1.63)	6 (4.91)	12 (9.83)
1992-93	112	26 (23.21)	9 (8.03)	8 (7.14)	2 (1.78)	1 (0.89)	1 (0.89)	5 (4.46)	11 (9.82)
1993-94	125	29 (23.20)	9 (7.20)	8 (6.40)	2 (1.60)	1 (0.8)	2 (1.6)	7 (5.6)	14 (11.2)
1994-95	101	24 (23.76)	8 (7.92)	8 (7.92)	2 (1.98)	-	1 (0.99)	5 (4.95)	9 (8.91)
TOTAL	592	137 (23.14)	47 (7.93)	41 (6.92)	9 (1.52)	5 (0.84)	6 (1.01)	29 (4.89)	59 (9.96)

- Figures in parentheses indicate percentage

FIG 6. PREVALENCE OF CPV,CCV(SINGLE AND MIXED) ENDO PARASITIC AND OTHER INFECTIONS IN CLINICAL CASES OF GASTROENTERITIS

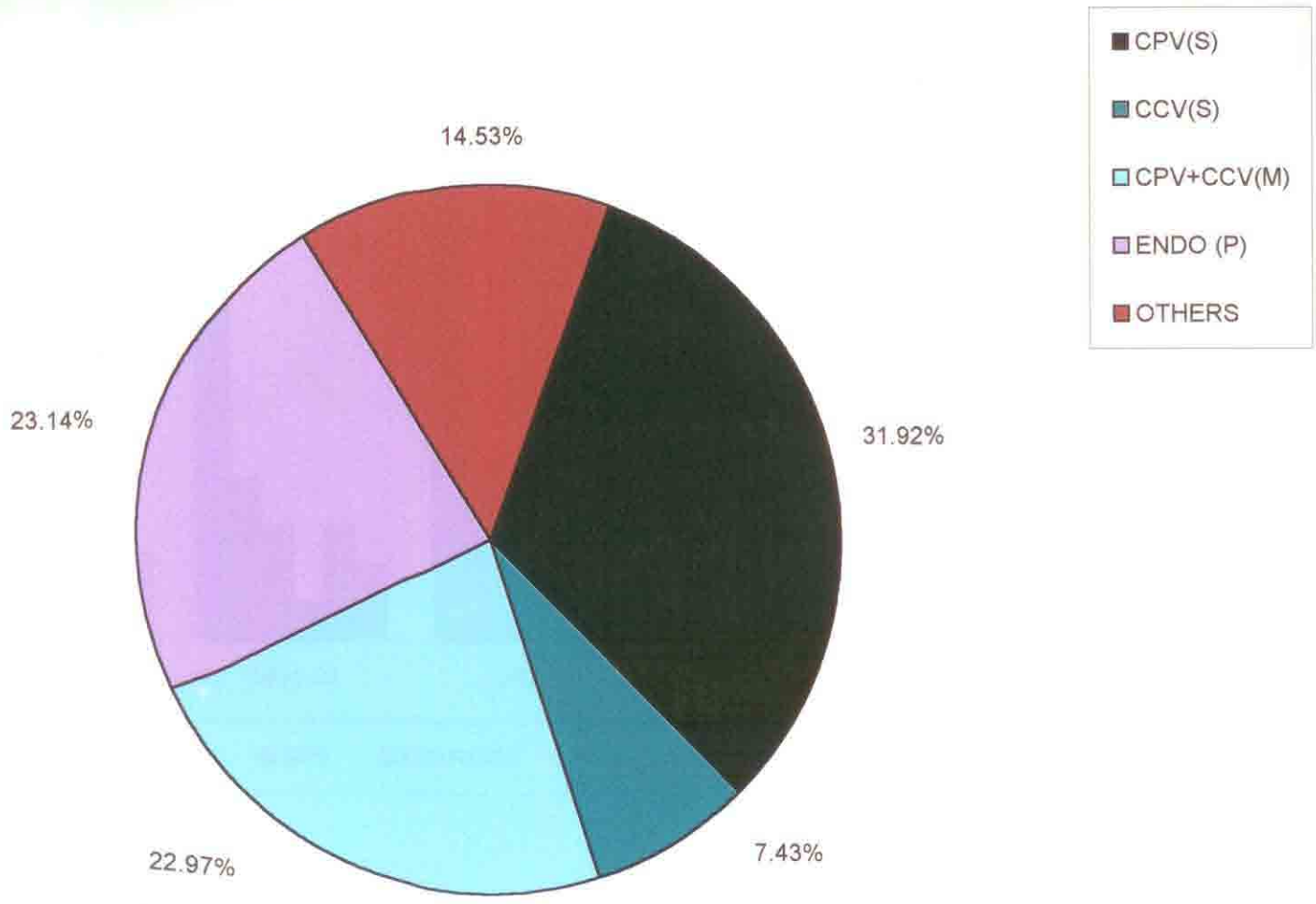


FIG 7. PREVALENCE OF CPV,CPV+CCV, CCV, ENDOPARASITIC AND OTHER INFECTIONS IN CLINICAL CASES OF GASTROENTERITIS DURING DIFFERENT YEARS

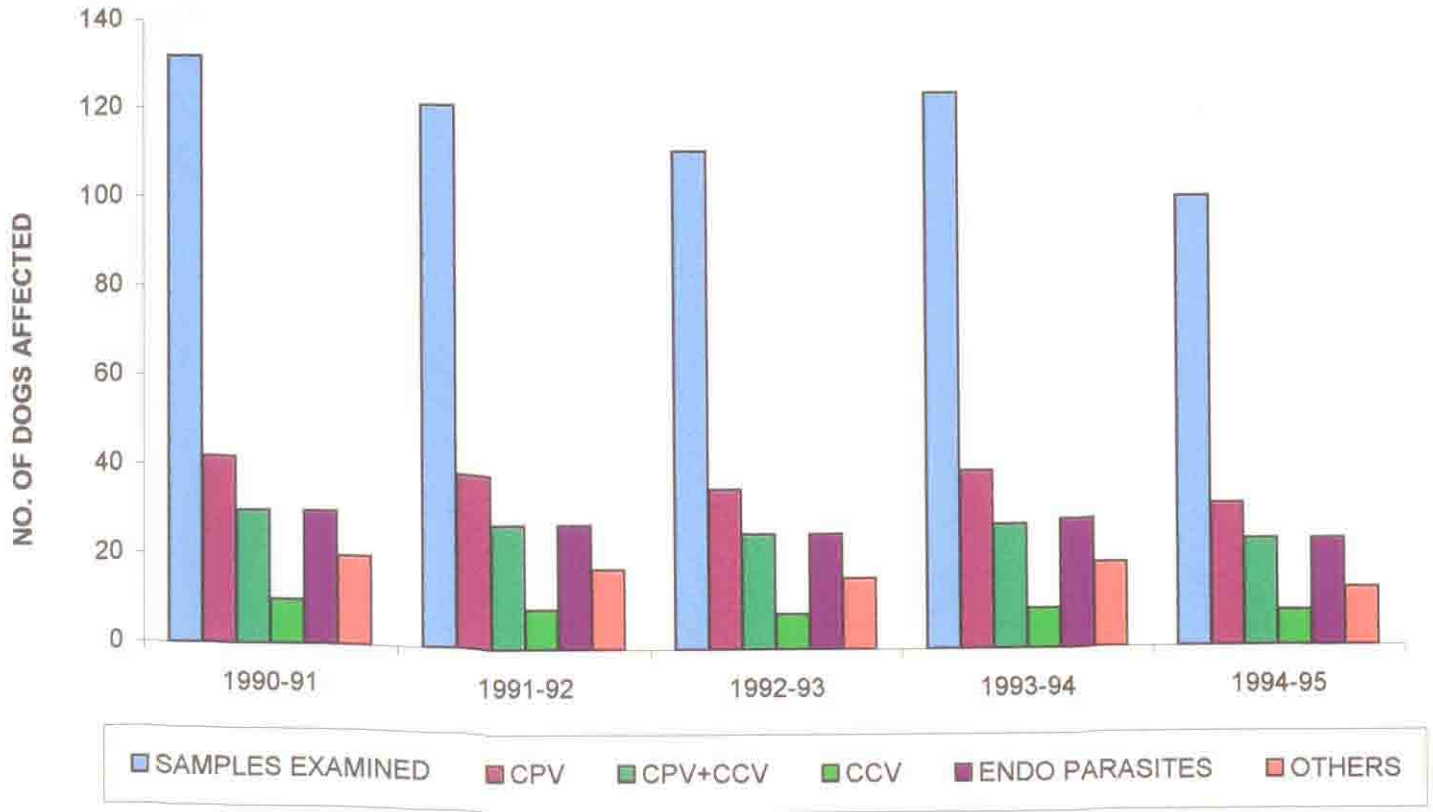
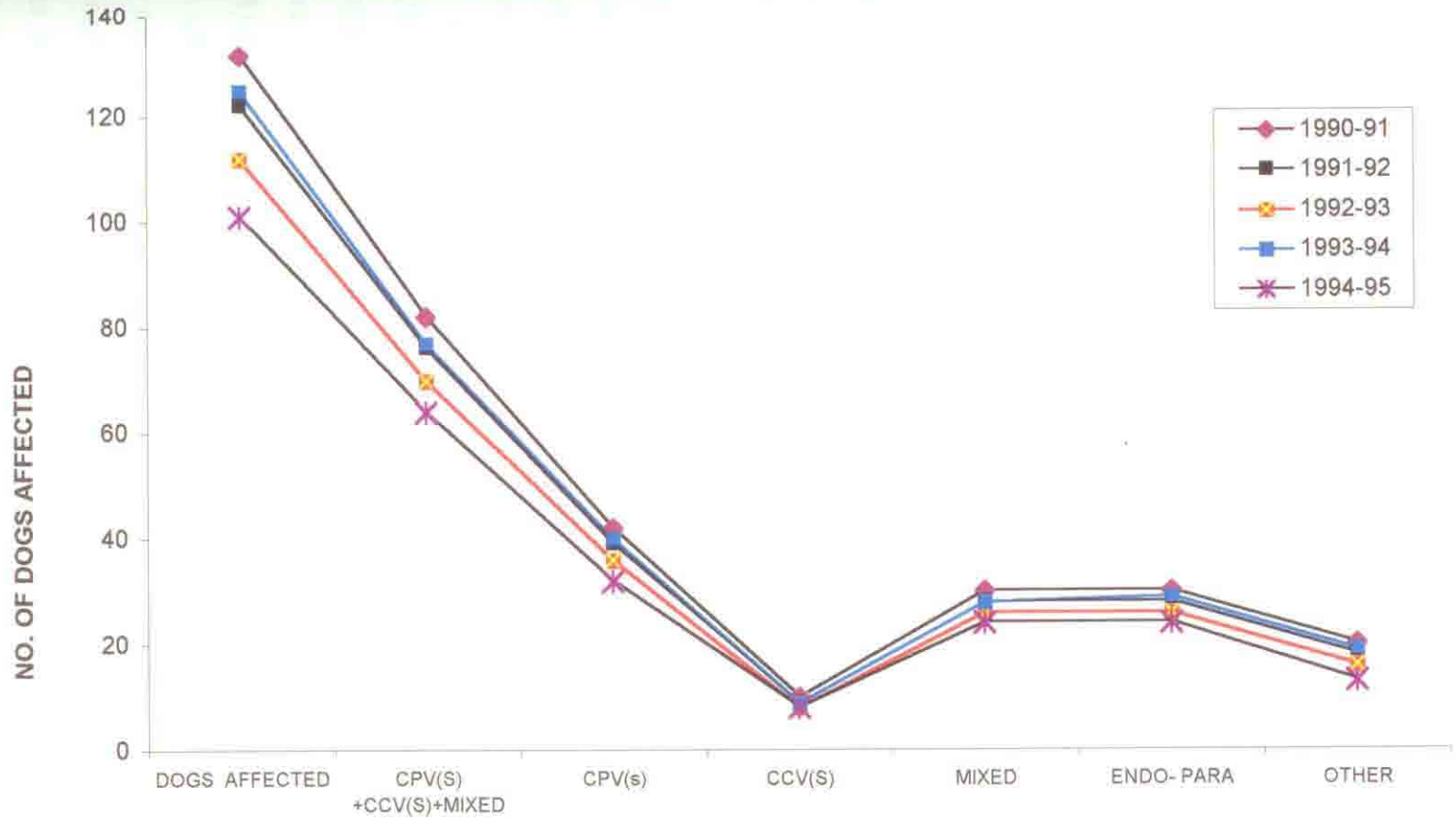


FIG 8. GRAPHICAL REPRESENTATION OF PREVALENCE OF CPV, CCV, ENDOPARASITES AND OTHERS IN CLINICAL CASES OF GASTROENTERITIS DURING DIFFERENT YEARS



test revealed that 302 cases (51.01%) suffered from canine parvo virus infection. It indicated that more than 50% canine gastroenteritis were found due to the infection of canine parvo virus. Haemagglutination titre at 1:640 detected the highest number of cases (94/302) positive for CPV infection followed by the titre of 1:320 (77/302), 1:1280 (57/302), 1:160 (45/302) and 1:80 (27/302) presented in Table-4.

The results of Reverse Passive Haemagglutination (RPHA) titres of faecal samples of dogs affected with gastroenteritis to detect the presence of canine corona virus (CCV) as the causative agent have been presented in the Table-5. One hundred thirty two faecal samples, 122, 112, 125 & 101 faecal samples collected from the canine gastroenteritis cases were subjected to RPHA tests for creening of CCV in the years 1990-91, 1991-92, 1992-93, 1993-94 nd 1994-95 respectively. The total number of faecal samples creened during these years summed up to 592 and RPHA test onfirmed 104 samples to be positive for canine corona virus nfection which was encountered at a lower percentage (17.568%) mong canine gastroenteritis cases. Reverse Passive laemagglutination titres of faecal samples at 1:4 were taken as egative for canine corona virus (CCV) infection and RPHA titres 1:8 were taken as positive for CCV. Total number of faecal mples were found positive at the titres 1:8, 1:16, 1:32 and 1:64 uring the year 1990-91 through 1994-95 as 24 (18.18%), (17.21%), 19(16.96%), 22(17.60%) and 18 (17.82%), spectively. The RPHA titres at 1:64 detected the highest number cases (47/104) to be positive for CCV followed by the titres 1:32 2/104) cases, 1:16 (8/104) cases and 1:8 (7/104) cases (Table-5).

A comparative statement of different diagnostic test results for nine parvo virus and canine corona virus have been presented in Table-6. Dot-ELISA detected 189,44,136, 325 and 180 faceal mples to be positive for single infection of CPV, single infection CV, mixed infection of CPV and CCV, single and mixed infection

TABLE 4. DETECTION OF CPV BY HAEMAGGLUTINATION (HA) TEST OF FAECAL SAMPLES OF DOGS AFFECTED WITH GASTROENTERITIS

YEAR	NO.OF FAECAL SAMPLES EXAMINED	HAEMAGGLUTINATION TITRES OF FAECAL SAMPLES.						TOTAL NO.OF FAECAL SAMPLES FOUND POSITIVE FOR CPV
		UPTO 1:40* (-)	1:80** (+)	1:160 (+)	1:320 (+)	1:640 (+)	1:1280 (+)	
1990-91	132	66 (50.00)	6 (9.09)	10 (15.15)	17 (25.75)	20 (30.30)	13 (19.69)	66 (50.00)
1991-92	122	48 (39.34)	7 (9.45)	11 (14.86)	20 (27.02)	23 (31.08)	13 (17.056)	74 (60.65)
1992-93	112	46 (41.07)	6 (9.09)	10 (15.15)	16 (24.24)	22 (33.33)	12 (18.18)	66 (50.00)
1993-94	125	71 (56.8)	5 (9.25)	8 (14.81)	15 (27.77)	17 (31.48)	9 (16.66)	54 (43.2)
1994-95	101	59 (58.41)	3 (7.14)	6 (14.28)	11 (26.19)	12 (28.57)	10 (23.80)	42 (41.58)
TOTAL	592	290 (48.98)	27 (8.94)	45 (14.90	79 (26.15)	94 (31.12)	57 (18.87)	302 (51.01)

Figures in parentheses indicate percentage

* HA titre at 1:40 was taken as negative for CPV

** HA titre ≥1:80 and onward were taken as positive for CPV

TABLE 5. DETECTION OF CCV BY REVERSE PASSIVE HAEMAGGLUTINATION (RPHA) TEST OF FAECAL SAMPLES OF DOGS AFFECTED WITH GASTROENTERITIS

YEAR	NO.OF FAECAL SAMPLES EXAMINED	REVERSE PASSIVE HAEMAGGLUTINATION TITRES OF FAECAL SAMPLES.					TOTAL NO.OF FAECAL SAMPLES FOUND POSITIVE FOR CCV
		UPTO 1:4 (-)	1:8 (+)	1:16 (+)	1:32 (+)	1:64 (+)	
1990-91	132	108 (81.81)	2 (8.33)	2 (8.33)	10 (41.66)	10 (41.66)	24 (18.18)
1991-92	122	101 (82.78)	2 (9.52)	1 (4.76)	8 (38.09)	10 (47.61)	21 (17.21)
1992-93	112	93 (83.03)	1 (5.26)	2 (10.52)	8 (42.10)	8 (42.10)	19 (16.96)
1993-94	125	103 (82.4)	1 (4.54)	2 (9.09)	8 (36.36)	11 (50.00)	22 (17.60)
1994-95	101	83 (82.17)	1 (5.55)	1 (5.55)	8 (44.44)	8 (44.44)	18 (17.82)
TOTAL	592	488 (82.43)	7 (6.73)	8 (7.69)	42 (40.38)	47 (45.19)	104 (17.56)

Figures in parentheses indicate percentage

* RPHA titre at 1:4was taken as negative for CCV infection

** RPHA titres ≥1:8 and onward were taken as positive for CCV infection

TABLE 6. COMPARISON OF DIFFERENT DIAGNOSTIC TEST RESULTS FOR CPV AND CCV

TESTS	NUMBER OF FAECAL SAMPLES FOUND POSITIVE FOR					SENSITIVITY (%)
	CPV (S)	CCV (S)	CPV AND CCV MIXED (M)	CPV (S+M)	CCV (S+M)	
Dot-ELISA (592)	189 (31.92)	44 (7.43)	136 (22.97)	325 (54.89)	180 (30.10)	100***
HA (592)	-	-	-	302 (51.01)	-	92.92
RPHA (592)	-	-	-	-	104 (17.56)	57.77

Figures in the parentheses indicate percentage
S- single
M- mixed

of CPV, and single and mixed infection of CCV, respectively out of 592 samples collected from canine gastroenteritis cases (Table-6). Haemagglutination test detected 302/592 positive cases for CPV infection (single and mixed) whereas Reverse Passive Haemagglutination test confirmed 104/592 CCV infection (single and mixed). Dot-ELISA test was considered as a standard test because of 100% sensitivity followed by Haemagglutination test at 92.92% and Reverse passive haemagglutination test at 57.77% levels.

During the study of clinical cases of canine gastroenteritis age-wise prevalence of single infection of canine parvo virus (CPV) infection, canine corona virus (CCV) and mixed infection of CPV and CCV, total CPV (single and mixed) infections, total CCV (single and mixed) infection and total CPV and CCV (single and mixed) infection have been presented in the Table-7. Out of 592 canine cases of gastroenteritis 249 cases (42.06%) were found to be within months of age during the study period of 5 years. Of 249 astroenteritis cases 79 cases (31.72%) for CPV single infection, 18 ases (7.22%) for CCV single infection, 57 cases (22. 89%) for CPV nd CCV mixed infection, 136 cases (54. 61%) for total CPV (single nd mixed), 75 cases (30.12%) for total CCV (single and mixed) and 4 cases (61.84%) for viral gastroenteritis due to CPV and CCV fections were found to prevailed in and around Bhubaneswar ong pups within 3 months of age. Out of 592 gastroenteritis es 166 cases (28.04%) belonged to the age group of 4-6 nths. Of these 166 cases 102 cases (61.44%) were due to CPV CCV infections (single and mixed). On the whole 61.44% cases astroenteritis cases were due to CPV and CCV infections in the of 4 to 6 months of age. Among 102 viral gastroenteritis cases 31.92%), 12 (7.22%), 37 (22.28%), 37(22.28), 90 (54.21%) and 29.51%) cases suffered from CPV single infection, CCV single tion, mixed infection of CPV and CCV, total CPV infection e and mixed) and total CCV (single and mixed) infection.

TABLE 7. AGE WISE PREVALENCE OF CPV(S), CCV(S), CPV AND CCV MIXED, TOTAL CPV AND TOTAL CCV AND TOTAL CPV AND CCV (SINGLE AND MIXED) INFECTIONS DURING STUDY OF CLINICAL CASES

Age group of dogs	Total no. of dogs examined	FOUND POSITIVE FOR					Total cpv(s)+ccv(s) +cpv and ccv mixed
		CPV single	CCV single	CPV and CCV mixed	Total CPV (cpv(s) +cpv and ccv mixed)	Total CCV (CCV(s)+ CCV and CPV Mixed)	
Up to 3 months	249 (42.06)	79 (31.72)	18 (7.22)	57 (22.89)	136 (54.61)	75 (30.12)	154 (61.84)
4-6th months	166 (28.04)	53 (31.92)	12 (7.22)	37 (22.28)	90 (54.21)	49 (29.51)	102 (61.44)
7-9th months	106 (17.90)	34 (32.07)	8 (7.54)	23 (21.69)	57 (53.77)	31 (29.24)	65 (61.32)
10^{th} moth-1 yr.	53 (8.95)	17 (32.07)	4 (7.54)	11 (20.75)	28 (52.83)	15 (28.30)	32 (60.37)
Above 1 year	18 (3.04)	5 (27.77)	1 (5.55)	4 (22.22)	9 (50.00)	5 (27.77)	10 (55.55)
Total	592	188 (31.75)	43 (7.26)	132 (22.29)	320 (54.05)	175 (29.56)	363 (61.31)

Figures in parentheses indicate percentage

A total of 106 pups (17.90%) within 7-9 months of age suffered from gastroenteritis which subsequently revealed 65 cases (61.32%) to be due to CPV and CCV infection out of 65 positive cases of CPV and CCV 34 (32.07%), 8 (7.54%), 23 (21.69%), 57 (53.77%) and 31 (29.24%) cases were screened to be of CPV single infection, CCV single infection, mixed infections of CPV and CCV, total CPV (single and mixed) infections and total CCV (single and mixed) respectively. Thirty two of 53 pups (60.37%) within the age group of 10 months-1 year suffered from gastroenteritis due to CPV and CCV infections. Out of these 32 cases of viral gastroenteritis 17 cases (32.07%) were of single CPV infection, 4 cases (7.54%) were due to single CCV infections, 11 cases (20.75%) were of mixed infection of CPV and CCV, 28 cases (52.83%) were due to CPV single and mixed infection and 15 cases (28.30%) were due to CCV single and mixed infections. Eighteen of 592 cases of canine gastroenteritis belonged to the age group above one year. Ten of 18(55.55%) of gastroenteritis were found to be due to CPV and CCV infections. Out of these 10 cases 5 (27.77%), one case (5.55%), 4 cases (22.22%)and 9 cases (50%) and 5(27.77%) cases were found positive for single infection of CPV, single infection of CCV, mixed infections of CPV and CCV, single and mixed infections of CPV and single and mixed infections of CCV respectively. The study on age wise prevalence of CPV and CCV infection revealed that incidence rate of canine gastroenteritis reduced gradually with the advancement of age. The incidence 61.84% among the pups within 3 months of age reduced to 55.55% among the dogs of 1 year and above indicating that the young pups were more susceptible to CPV and CCV infections (Table-7 and Fig. 8, 9 and 10).

Prevalence of canine parvo virus and corona virus infection in male and female dogs has been presented in Table- 8. During the study period a total number of 592 clinical cases

FIG 9. AGEWISE PREVALENCE OF CPV (S), CCV(S) AND CPV + CCV (MIXED) INFECTIONS FROM CLINICAL CASES

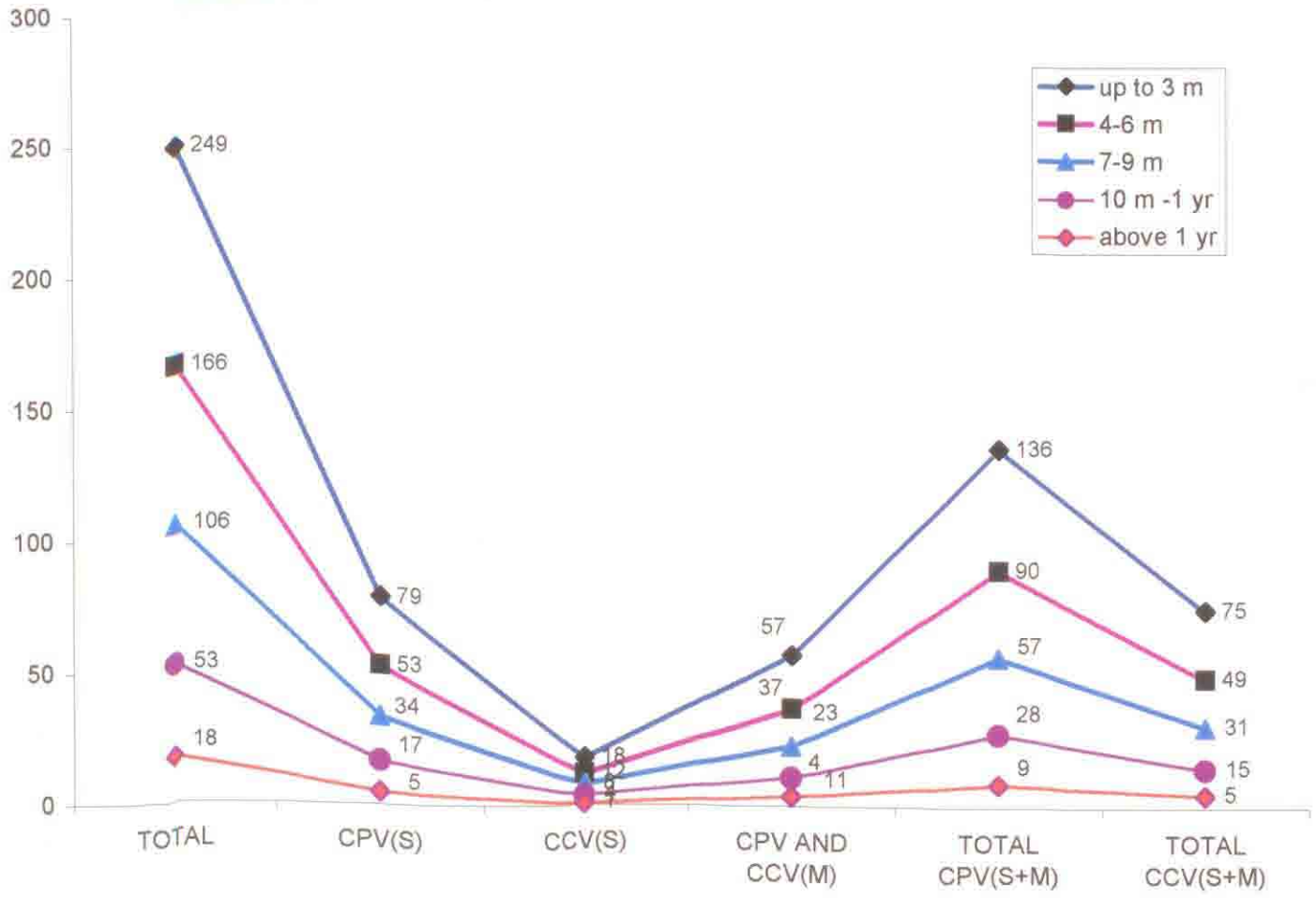


FIG 10. AGEWISE PREVALENCE OF CPV(S), CCV(S), CPV AND CCV MIXED, TOTAL CPV AND TOTAL CCV FROM CLINICAL CASES

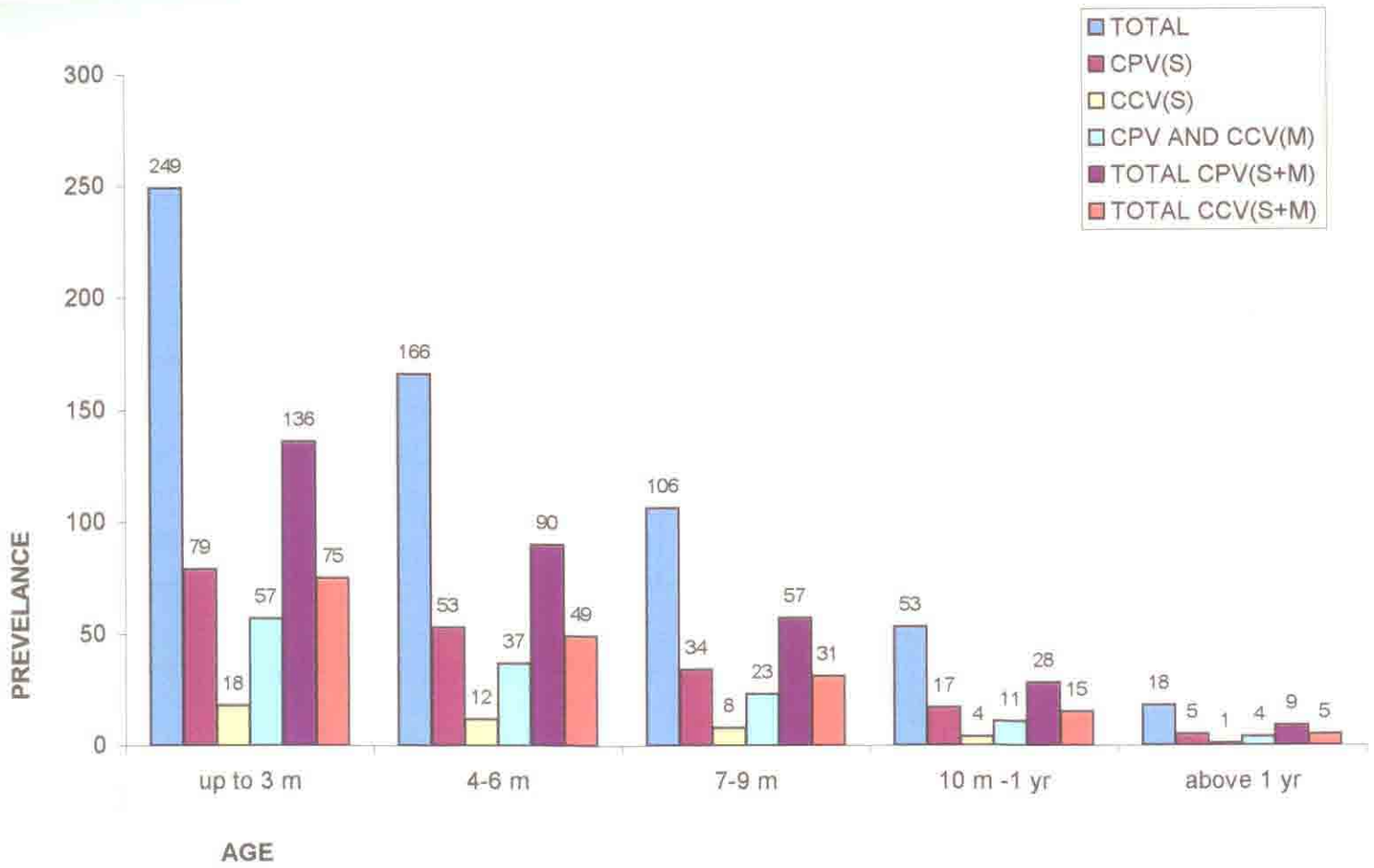


TABLE 8. SEX WISE PREVALENCE OF CPV(S), CCV(S) AND CPV AND CCV MIXED INFECTIONS IN DOGS DURING STUDY OF CLINICAL CASES

SEX	NO OF DOGS EXAMINED	No/of Dogs Found +VE for CPV and CCV (single& mixed)	DOGS FOUND POSITIVE FOR					INCIDENCE RATE AMONG +VE CASES (%)	INCIDENCE RATE AMONG TOTAL POPULATION OF 592 DOGS (%)
			CPV SINGLE(S)	CCV SINGLE(S)	CPV& CCV MIXED (M)	TOTAL CPV (CPV(S)+CPV AND CCV MIXED(M)	TOTAL CCV (S)+CCV AND CPV (M) MIXED		
MALE	302	188	96 (16.21)	23 (3.88)	69 (11.65)	165 (27.87)	92 (15.54)	188/369 (50.94)	188/592 (31.75)
FEMALE	290	181	93 (15.70)	21 (3.54)	67 (11.31)	160 (27.02)	88 (14.86)	181/369 (49.05)	181/592 (30.57)
TOTAL	592	369	189 (31.92)	44 (7.43)	136 (22.97)	325 (54.89)	180 (30.40)	369/369 (100)	369/592 (62.33)

Figures in parentheses indicate percentage

of canine gastroenteritis have been recorded and a total number of 369 clinical cases were found positive for CPV and/or CCV infections among male and female dogs. Out of 369 cases 188 were males and 181 were females with a ratio of 1:0.962 among male and female. Among a total population of 592 dogs 96 (16.21%), 23 (3.88%), 69 (11.65%), 165 (27.87%) and 92 (15.54%) male dogs were found to be affected with CPV single infection, CCV single infection, CPV and CCV mixed infections, total CPV infection (single and mixed) and total CCV infection (single and mixed) respectively. The incidence rate among the positive cases of 369 cases was 50.94% in males whereas 31.75% of incidence rate was encountered among the total population of 592 dogs. Among 181 positive cases of CPV and CCV infections in females 93 cases (15.70%) of CPV single infection cases of CCV single infections, 21 (3.54%) cases, 67 cases (11.31%) of CPV and CCV mixed infection, 160 cases (27.02%) of total CPV infection (single and mixed) and 88 cases (14.86%) of total CCV infection (single and mixed) were encountered among females during study (Table-8). The incidence rate of 49.05% CPV and CCV infections in females was recorded among the positive cases of 369 dogs and an incidence rate of 30.57% (181/592) was observed among the total population of clinical cases of gastroenteritis. The sex-wise prevalence study of CPV and CCV infection revealed a very little difference between male and female susceptibility for CPV and CCV infection.

Breed-wise prevalence of CPV and CCV infection has been presented in Table-9. The study on clinical cases of canine parvo virus and corona virus infections included 213 (35.97%) Doberman, 166 Alsatian (28.04%), 154 Tibetan (26.01%) and 59 (9.96%) non descriptive breeds of dog suffering from gastroenteritis. Positive cases for CPV and CCV infection were found to be 133 for Doberman, 103 for Alsatian, 96 for Tibetan and 37 for other non-descript breeds of dog. The incidence rates were 11.48% for CPV single infection, 2.70% for CCV single infection, 8.27% for CPV and CCV mixed infection, 19.76% for CPV single and mixed infections

[redacted] WISE PREVALENCE OF CPV(S), CCV(S), CPV AND CCV MIXED, TOTAL CPV AND TOTAL CCV INFECTIONS DURING STUDY OF CLINICAL CASES

BREED	NO OF DOGS EXAMINED	NO.OF DOGS FOUND +VE FOR CPV AND/OR CCV	DOGS FOUND POSITIVE FOR					
			CPV SINGLE (S)	CCV SINGLE (S)	CPV & CCV MIXED (M)	TOTAL CPV (CPV(S)+CPV AND CCV MIXED(M)	TOTAL CCV (S)+ CCV AND CPV (M) MIXED	INCIDENCE RATE AMONG TOTAL POPULATION (%)
DOBERMAN	213 (35.97)	133	68 (11.48)	16 (2.70)	49 (8.27)	117 (19.76)	65 (10.97)	133/592 (22.46)
ALSATIAN	166 (28.04)	103	53 (8.95)	12 (2.02)	38 (6.41)	91 (15.37)	50 (8.44)	103/592 (17.39)
TIBETAN APSO	154 (26.01)	96	49 (8.27)	12 (2.02)	35 (5.91)	84 (14.18)	47 (7.93)	96/592 (16.21)
OTHERS (NON DESCRIPT)	59 (9.96)	37	19 (3.20)	4 (0.67)	14 (2.36)	33 (5.57)	18 (3.04)	37/592 (6.25)
TOTAL	592	369	189 (31.92)	44 (7.43)	136 (22.97)	325 (54.89)	180 (30.40)	369 (62.31)

Figures in parentheses indicate percentage

and 10.97% for CCV single and mixed infections among Doberman breeds. The incidence rate for CPV and CCV single and mixed infections was recorded as 22.46% in Doberman. Among Alsatian breed the incidence rates were found to be 8.95% for CPV single infection, 2.02% for CCV single infection, 6.41% for CPV and CCV mixed infections, 15.37% for CPV single and mixed infection and 8.44% for CCV single and mixed infections. The incidence rate among total population of dogs examined was observed to be 17.39% in Alsatian breed. The incidence rates were found to be 8.27% for CPV single infection, 2.02% for CCV single infection, 5.91% for CPV and CCV mixed infection, 14.18% for CPV single and mixed infections and 7.93% for CCV single and mixed infection among Tibetan apso breed.

The incidence rate of CPV and CCV single and mixed infections was recorded to be 16.21% in Tibetan apso. The incidence rates encountered during study in non descript breeds were found to be 3.20% for CPV single infection, 0.67% for CCV single infection, 2.36% for CPV and CCV mixed infection, 5.57% for CPV single and mixed infections and 3.04% for CCV single and mixed infections. The over all incidence rate of CPV and CCV single and mixed infections was observed to be 6.25% in non-descript breeds of dog. From the present study it was observed that higher incidence rate 22.46% of CPV and CCV infections occurred in Doberman breed followed by 17.39% in Alsatian, 16.21% in Tibetan apso and 6.25% in other non-descript breeds. These findings revealed that Dobermans were found to be most susceptible breed in the locality of Bhubaneswar city and indigenous local breeds of dogs were comparatively more resistant to CPV and CCV infection than the pure breeds.

Major diagnostic clinical manifestations of CPV and CCV infections (single and mixed) have been presented in the Table-10. The clinical symptoms in 189 cases of CPV single infection were recorded for vomition in 98.42% cases, fever (Temp 104°F-105°F) in 88% cases, diarrhoea without blood flecks in 70.89% cases,

TABLE 10. CLINICAL MANIFESTATIONS OF CANINE PARVO AND CORONA VIRUS INFECTIONS (SINGLE AND MIXED) IN DOGS

Sl .No	Infections	Clinical Manifestations in Number of Dogs Affected								Mortality Rate.
		Vomition	Fever	Diarrhoea With blood flecks	Diarrhoea Without blood flecks	Haema-temesis	Depressed appetite	Dehyd-ration	Anae mia	
1	Canine parvovirus (CPV) infection (single) (n=189)	186 (98.42)	185 (97.88)	134 (70.89)	48 (25.39)	36 (19.04)	184 (97.35)	76 (40.21)	64 (33)	89 (47.08)
2	Canine coronavirus (CCV) infection (single) (n=44)	41 (93.18)	5 (11.36)	37 (84.09)	7 (15.90)	-	40 (90.90)	4 (9.09)	5 (11.36)	5 (11.36)
3	Canine parvovirus (CPV) and Canine corona virus (CCV) infection (mixed) (n=136)	134 (98.52)	125 (91.91)	103 (75.73)	32 (23.52)	25 (18.38)	135 (99.26)	62 (45.58)	60 (44.11)	75 (55.14)

Figures in parentheses indicate percentage
n- Number

diarrhoea with blood flecks in 25.39% cases, haematemesis in 19.04% cases, depressed appetite in 97.35% cases, dehydration in 40.21% cases and anaemia in 33% cases (Table-10 and Fig. 11). The mortality rate ranged to 47.08% cases of canine parvo virus infection. Among 44 cases of canine corona virus single infection the clinical manifestations were observed in 93.18% cases for vomition, 11.36% cases for fever, 84.09% for diarrhoea without blood flecks, 18.18% cases for diarrhoea with blood flecks,90.90% cases for depressed appetite, 9.09% cases for dehydration and 11.36% cases for anaemia. The mortality rate observed in corona virus single infection to be 11.36% (Fig.12). During the study of viral gastroenteritis 136 cases of mixed infections of CPV and CCV were encountered which manifested the symptoms of vomition in 98.52% cases, fever in 91.91% cases, diarrhoea without blood flecks in 75.73% cases, diarrhoea with blood flecks in 23.52% cases haematemesis in 18.38% cases, dyspepsia in 99.26% cases, dehydration in 45.58% cases and anaemia in 44.11% cases (Table-10, Fig. 13).

The mortality rate was observed to be 55.14% during the mixed infection of CPV and CCV in dogs. The observations of mortality rates in different types of infections with CPV and CCV revealed that mortality rate was found to be highest 55.14% in CPV and CCV mixed infections (Table-10) followed by (47.08%) in CPV single infection (Fig.13). But a lower rate of mortality (11.36%) was observed in pure corona virus infection. On the whole fatality and mortality were more pronounced in the canine parvo virus infection. In addition to this it was observed that in CPV single CCV single and CPV and CCV mixed infections vomition, fever, diarrhoea, dyspepsia and dehydration were very common diagnostic clinical symptoms. Anaemia was observed in 44.11% cases in mixed infections of CPV and CCV and 33% cases in CPV single infection whereas only 11.36% cases were noticed in CCV single infections. One out of 44 cases of CCV infection manifested haematemesis during our present study. The predominant clinical symptoms in

FIG 11. CLINICAL MANIFESTATIONS OF CANINE PARVO VIRUS INFECTION IN DOGS

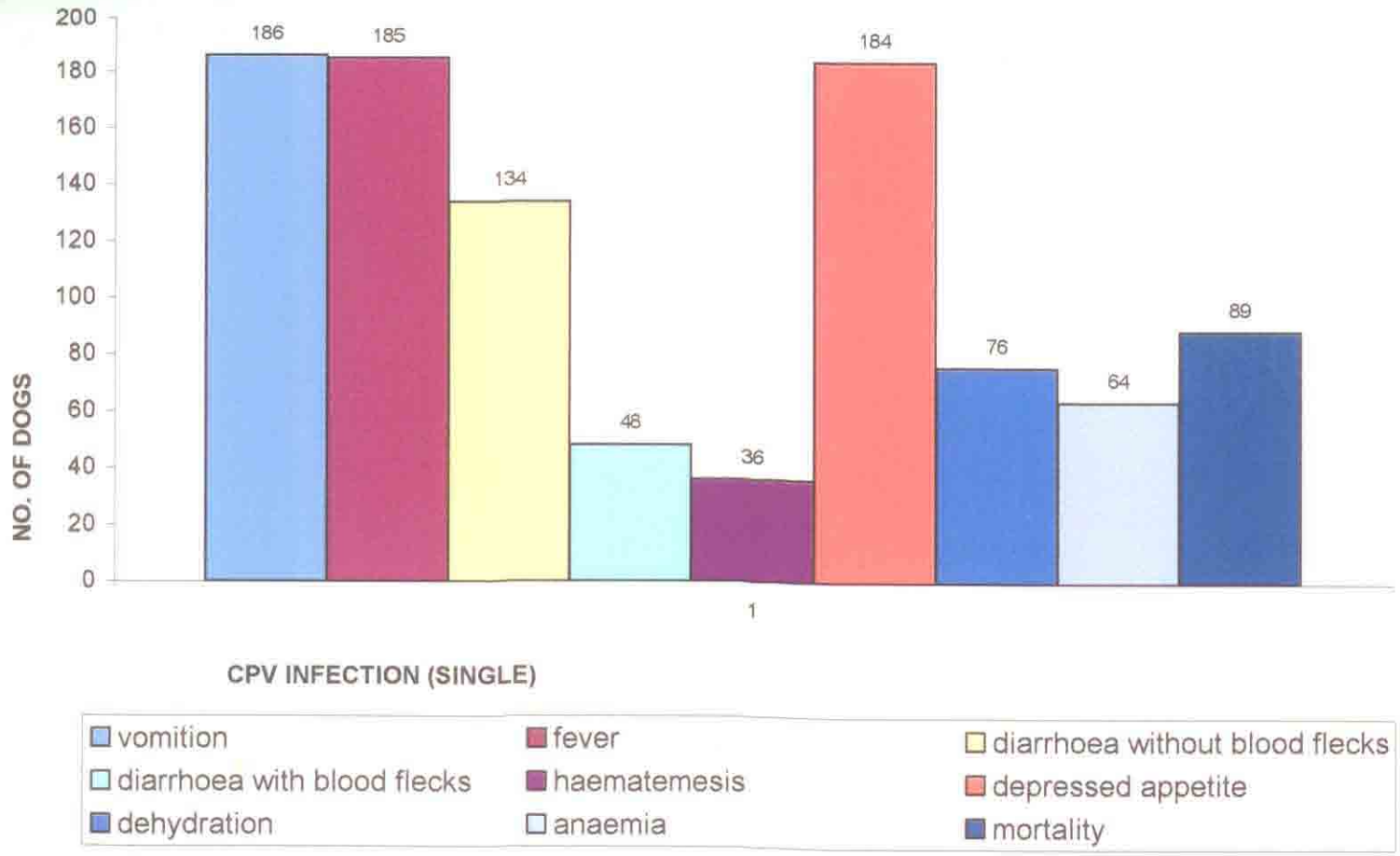


FIG 12. CLINICAL MANIFESTATIONS OF CANINE CORONA VIRUS INFECTION IN DOGS

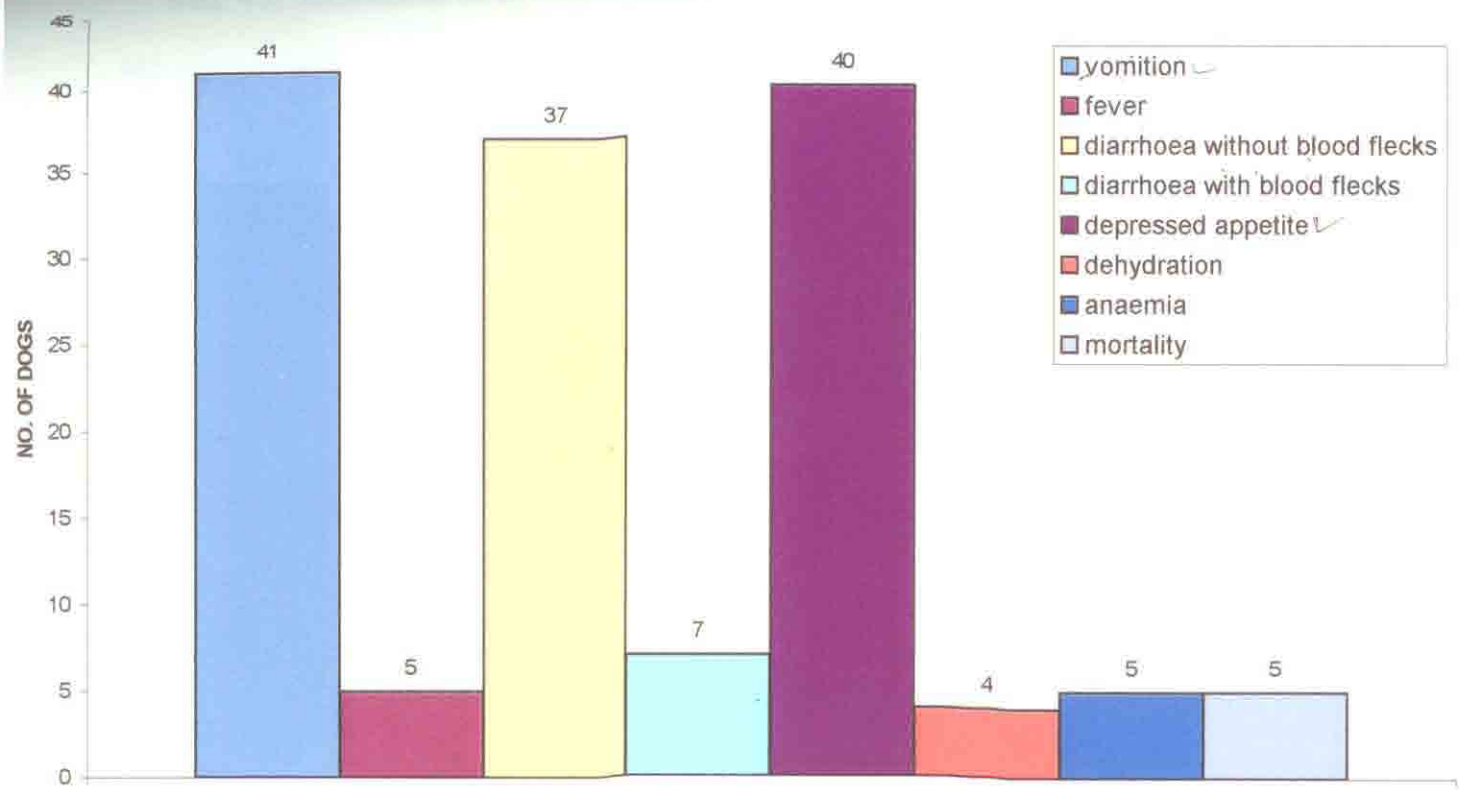
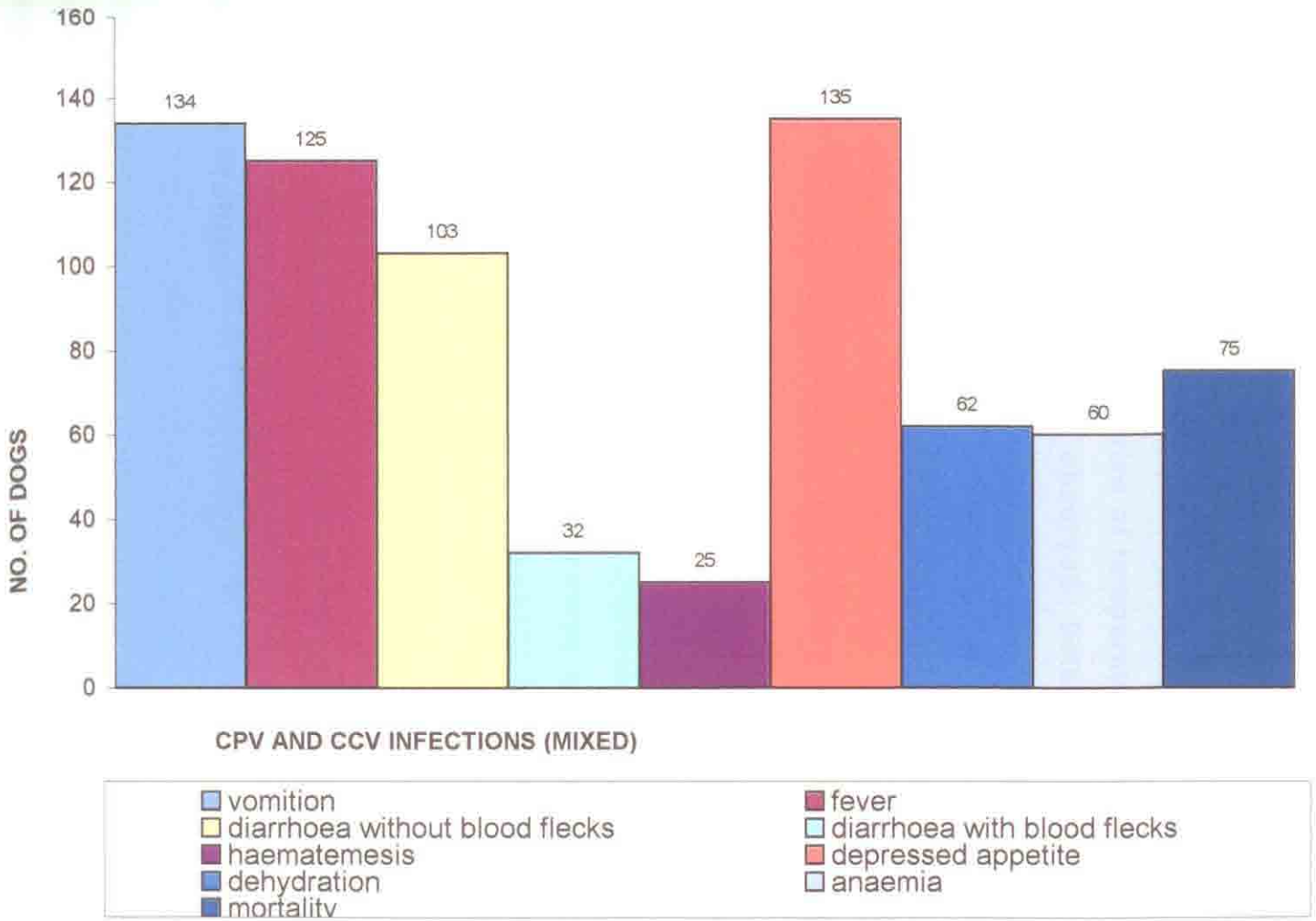


FIG 13. CLINICAL MANIFESTATIONS OF CPV AND CCV INFECTIONS (MIXED)



CCV single infection were observed to be vomition, dyspepsia and diarrhoea without blood flecks.

Experimental Infection in Pups

Ten out of 12 experimental pups in three groups (4 in each group) manifested symptoms whereas 2 pups (one each of 2 groups) did not develop the symptoms. After seven days these ten pups developed symptoms of high rise of temperature from 103°F to 104.6°F. The temperature was observed between 102.8°F to 103.6°F on day8, 9 10 and 11 in infected pups. The pulse rates were recorded between 92-99 per minute on the 7^{th} day and 90-98 per minute from 8^{th} to 11^{th} days. The respiration rate was recorded on the corresponding days to be from 33 to 39 per minute and 32-37 per minute in the infected pups. On the 7^{th} day the infected pups exhibited vomition and yellowish foetid diarrhoea with blood which continued for day 8, 9 and 10. These pups were found dull, anorectic and moderately dehydrated.

The faecal samples of these experimental pups were examined by Dot-ELISA and were found positive for CPV and CCV. These pups at pre-infection stage were assessed to be negative for CPV and CCV infection by Dot-ELISA test. This established the infection of CPV and CCV in experimental pups.

Six pups (apparently healthy) kept as non infected control did not develop any symptom and were found to be apparently healthy.

Hematological Profile:

The hematological findings of the infected pups with CPV and CCV and non-infected pups (apparently healthy control groups) have been presented in Table-11. The hematological mean values with SE in CPV infected pups were found to be hemoglobin (Hb) 8.58±0.077 gm/dl, total erythrocyte count (TEC)- 4.21±0.06 10^6/Cmm, total leucocyte count (TLC) 6.32±0.07 x 10^3/Cmm,

packed cell volume (PCV) 58±0.88%, differential count (DC) neutrophils 78.4±0.4%, Lymphocytes 12.8±0.38%, Eosinophils 3.4±0.33%, monocytes 2±0.21% and Basophils 1.1±0.1 % (Table-11).

In case of CCV infected pups the hematological mean values with SE were recorded as Hb 10.80±0.03 g/dl, TEC-4.80±0.01x 10^6/Cmm, TLC 7.40±0.07 x 10^3/Cmm, PCV- 53±1.33%, DC: N-77.6±0.54%, L- 18.2±0.41%, E-3.1±0.27%, M-2.4±0.16%, B-0±0% (Table-11).

The corresponding haematological mean values with SE in apparently healthy control pups were found to be 12.40±0.02g/dl for Hb, 5.37±0.05 x 10^6/Cmm for TEC, 8.60±0.02 x 10^3/Cmm for TLC, 42.4±0.99% for PCV, DC:N-69.2±0.92%, L-26.1±0.82%, E-4.1±0.52%, M-1.9±0.27% and B-1.2±0.13% (Table-11).

The present findings for hematological values were found to be low in respect of Hb, TEC, TLC and Lymphocytes in case of CPV and CCV infections as compared to the healthy control group. But the values for PCV and lymphocytes were found higher as against the corresponding values of control pups. The above hematological values in CPV and CCV infected pups were a pointer towards an acute pathological impact on haemopoeitic system (Table-11, Fig.13,14,15, 16 and 17).

Culture and Antibiogram Studies of Bacterial Isolates.

During the course of study period of 5 years faecal samples from 369 clinical cases of CPV, CCV (single and mixed) were subjected to test to identify the bacterial isolates and their involvement in the diarrhoeic faeces of CPV and CCV infected dogs and to determine their frequency of occurrence. The findings have been presented in Table-12. The cultural test revealed that out of faecal samples 74.79%, 35.23%, 29.81%, 22.22% and 21.13% were found to be *Escherichia coli*, *Campylobacter jejunis*

TABLE 11. HAEMATOLOGICAL PROFILE OF CPV AND CCV INFECTED PUPS

Sl.No	Haematological Parameters		Canine Parvo Virus Infection (cpv) n=10 Mean±SE	Canine Corona Virus Infection (ccv) n=10 Mean±SE	Apparently Healthy Control Group, n=10 Mean±SE
1	Haemoglobin (Hb) (gm %)		8.58±0.07	10.80±0.03	12.40±0.02
2	Total Erythrocyte Count (TEC) (Million/Cmm)		4.21±0.06	4.80±0.01	5.37±0.05
3	Total Leucocyte Count (TLC) (Thousands/Cmm)		6.32±0.07	7.40±0.07	8.60±0.02
4	Packed Cell Volume (PCV) percent		58±0.88	53±1.33	42.4.±0.99
5	Differential Leucocyte Count	Neutrophils %	78.4±0.4	77.6±0.54	69.2±0.92
		Eosinophils %	3.4±0.33	3.1±0.27	4.1±0.52
		Basophils %	1.1±0.1	0	1.2±0.13
		Lymphocytes %	12.8±0.38	18.2±0.41	26.1±0.82
		Monocytes %	2±0.21	2.4±0.16	1.9±0.27

FIG 14. HAEMATOLOGICAL PROFILE OF CPV AND CCV INFECTED PUPS AND HEALTHY CONTROL

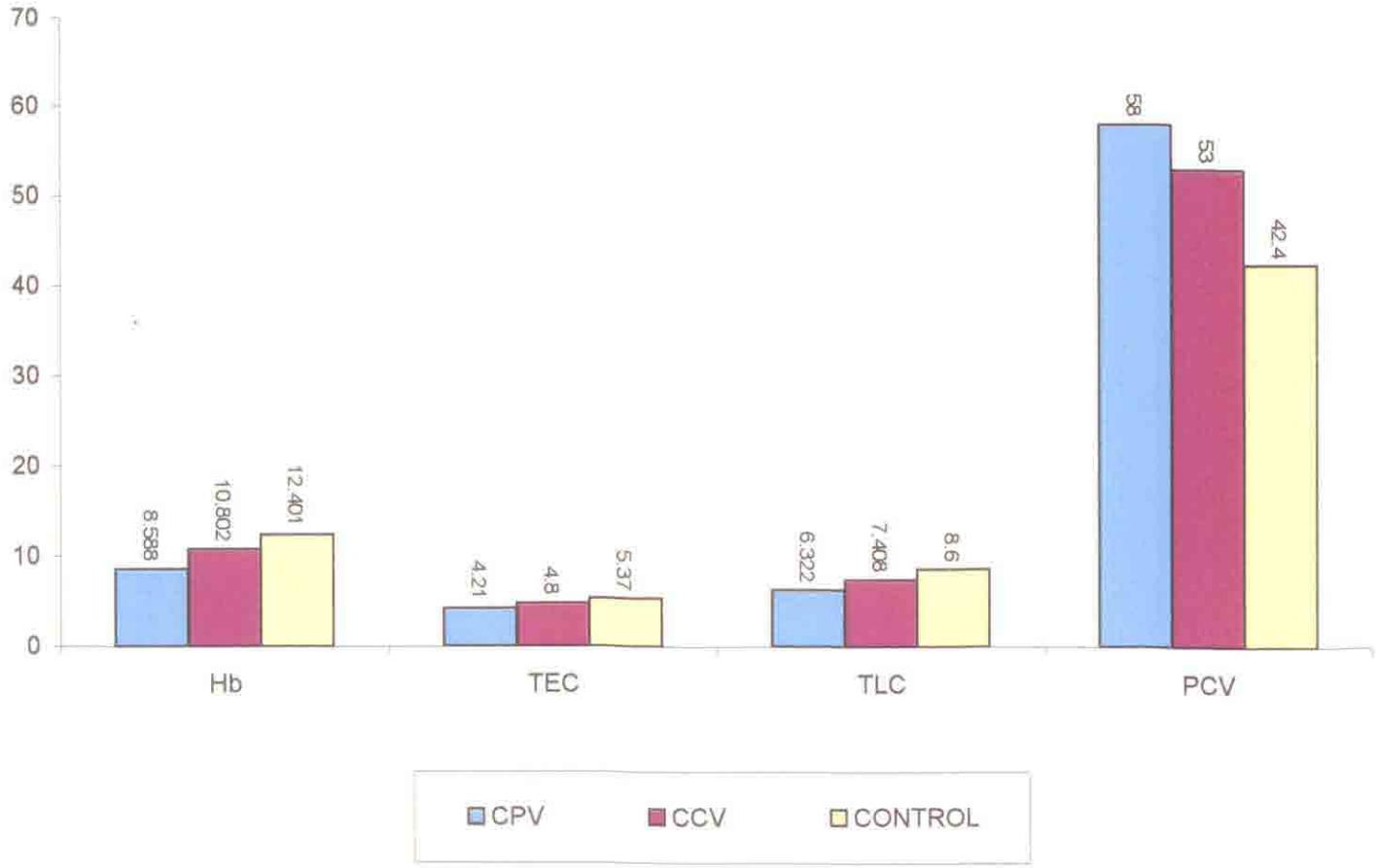


FIG 15. HAEMATOLOGICAL PROFILE OF CPV AND CCV INFECTED PUPS

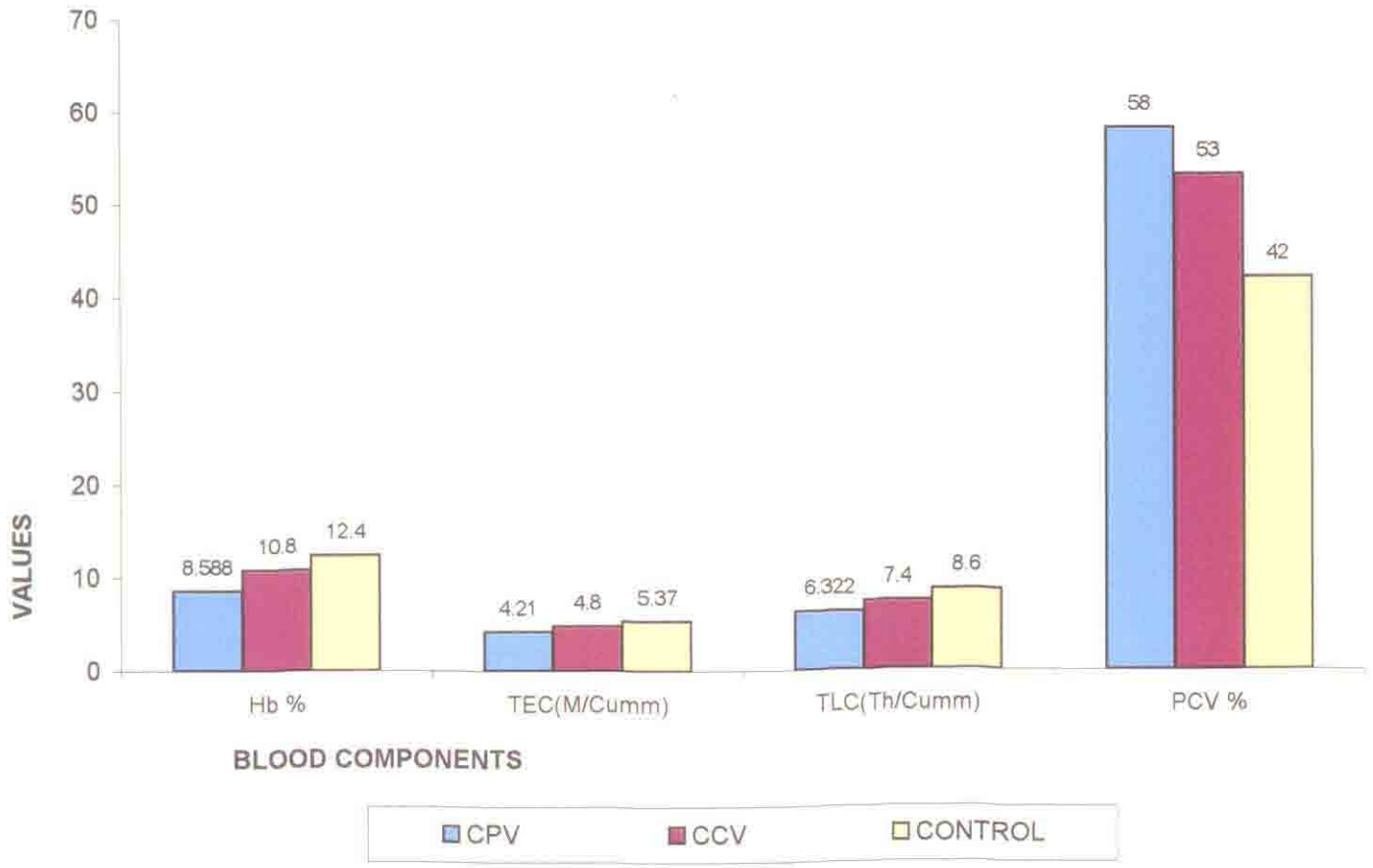


FIG 16. DIFFERNTIAL LEUCOCYTE COUNT OF INFECTED PUPS

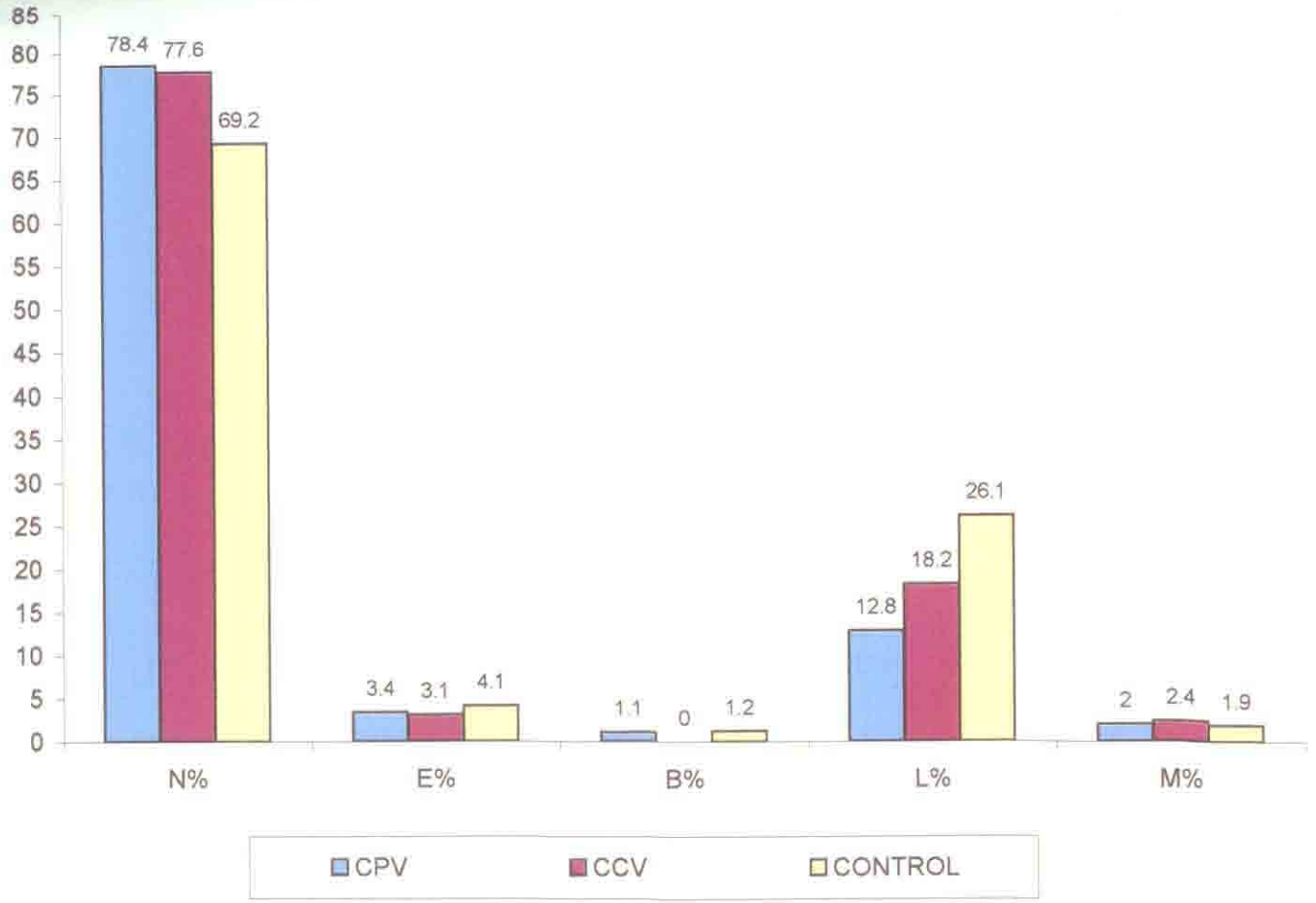


FIG 17. DIFFERENTIAL LEUCOCYTE COUNT OF CPV AND CCV INFECTED PUPS

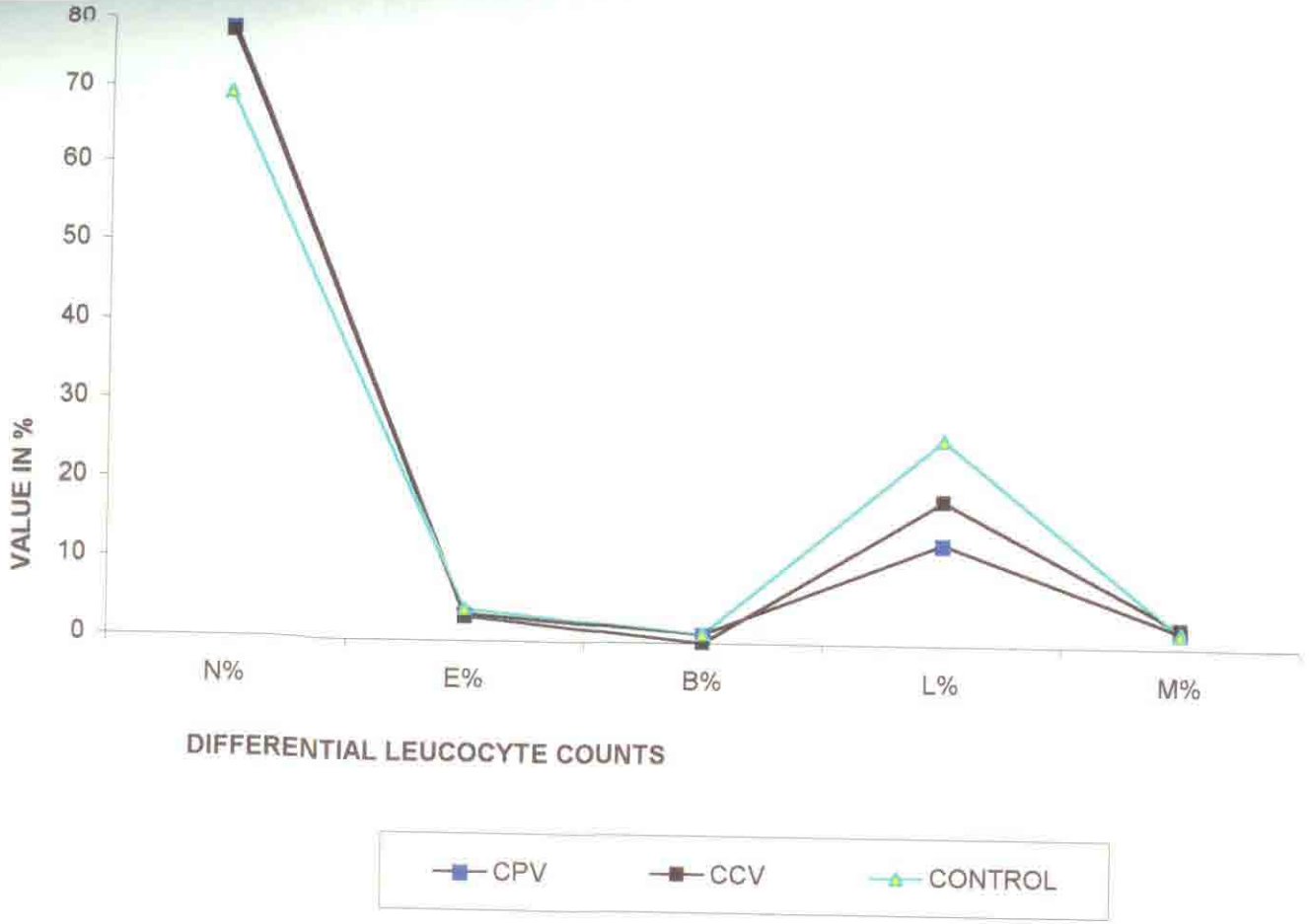


TABLE 12. BACTERIAL SPECIES ISOLATED FROM THE DIARRHOEIC FAECES AND THEIR FREQUENCY OF OCCURRENCE

Sl.No	No. of dogs with clinical CPV, CCV infections examined	Bacterial Species Isolated	Frequency of Isolation		
			No. of dogs harbouring bacteria	% of total dogs +ve.	% of total isolates
1	369	*Escherichia coli*	276	74.79	40.82(276/676)
2		*Campylobacter jejunis varintestinalis*	130	35.23	19.23(130/676)
3		*Staphylococcus aureus*	110	29.81	16.27(110/676)
4		*Proteus vulgaris*	82	22.22	12.13(82/676)
5		*Klebsiella aerogenes*	78	21.13	11.53(78/676)

varintestinalis, Staphylococcus aureus, Proteus vulgaris and Klebsiella aerogenes, respectively (Table-12).

The detail findings of antibiogram studies of different bacterial isolates have been presented in the Table-13. A total of 98.91%, 100%, 99.27%, 57.97%, 59.42% and 54.34% isolates of *Escherichia coli;* 98.46%, 99.23%, 96.92%, 57.69%, 58.461%, and 52.30% isolates of *Campylobacter jejuni var intestinalis;* 91.81%, 98.18%, 81.81%, 10.90%, 63.63% and 59.09% isolates of *Staphylococcus aureus;* 98.78%, 81.48%, 70.37%, 71.60% and 51.85% of isolates of *Proteus vulgaris* and 97.43%, 98.71%, 82.05%, 76.92%, 73.07% and 52.57% isolates of *Klebsiella aerogenis* were found to be sensitive to Gentamicin, Ciprofloxacin Chloramphenicol, Streptomycin, Kanamycin and Tetracyclin (Table-13),respectively. Except 51.81% isolates of *Staphylococcus aureus,* all other four types of bacterial species were found to be resistant to penicillin. The spectrum of sensitivity to various antibiotics revealed that Ciprofloxacin, Gentamicin and Chloramphemicol were found to be the drug of choice for inclusion in the treatment of clinical cases of CPV and CCV infections.

HISTOPATHOLOGICAL CHANGES

During post-mortem examinations of canine parvo virus and/or corona viral enteritis cases the gross pathological changes were recorded in various organs viz. duodenum, mesenteric lymph nodes, jejunum, ileum, spleen, heart, lungs, liver and thymus. The dogs were grossly found dehydrated. Thymus was found to be atrophied in some cases. Jejunum and ileum were enlarged and distended. Haemorrhagic patches were observed at different portions of the intestine. The mesenteric lymph nodes and spleen were found to be markedly enlarged. Haemorrhagic lesions were seen in Peyer's patches. The intestine contained hemorrhagic fluid. Hydrothorax, pulmonary oedema and hydropericadium were the prominent gross

TABLE 13. ANTIBIOGRAM OF DIFFERENT ISOLATES

Sl .No	Bacterial Isolates	No. of Isolates Sensitive to Different Antibiotics						
		Genta-micin	Ciproflo-xacin	Chloramph-enicol	Strepto mycin	Peni-cillin	Kanam-ycin	Tetrac-yclin
1	*E. coli* 276	273 (98.91)	276 (100.00)	274 (99.27)	160 (57.97)		164 (59.42)	150 (54.34)
2	*C. jejunis varintestinalis* 130	128 (98.46)	129 (99.23)	126 (96.92)	75 (57.69)		76 (58.46)	68 (52.30)
3	*S. aureus* 10	101 (91.81)	108 (98.18)	90 (81.81)	12 (10.90)	143 (51.81)	70 (63.63)	65 (59.09)
4	*P. vulgaris* 20	81 (98.78)	81 (98.78)	66 (81.48)	57 (70.37)		58 (71.60)	42 (51.85)
5	*K. aerogenis* 78	76 (97.43)	77 (98.71)	64 (82.05)	60 (76.92)		57 (73.07)	41 (52.57)

Numbers in parentheses against bacterial species indicate the numbers of isolates.
Numbers in parentheses against the numbers of isolates indicate the percentage of sensitivity.

lesions in many cases. The liver was invariably found to be congested.

The tissue samples collected from different parts of small intestine, mesenteric lymph nodes, spleen, heart and lungs were examined histopathologically. The epithelial cell linings of the crypts were found desquamated and some crypts contained necrotic cellular debries (Fig.18). The glandular cells showed goblet cell hyperplasia, necrosis and denudation (Fig.19). The villi and the mucosa in certain cases displayed proliferation of connective tissue capillary endothelium and increased cellularity (Fig-20). Hyperplastic changes of the duodenum and jejunum were observed in many cases. However, the regenerative hyperplasia was encountered in some crypts. There was inflammatory cell infiltrations in the laminapropria. The intestine was found congested and thickened and the submucosa and stratum muscularis were oedematous in many cases (Fig-21). Peyer's patches of the small intestine and lymphnodes commonly showed marked washed-away-appearance indicating depletion of lymphoid cells (Fig-22).

The intestinal villi were found to have undergone necrotic and degenerative changes. Desquamation of the epithelial cells on the tips of the villi was observed at many places. Hypertrophy of the endothelial cells of the capillaries of the villi and proliferative changes of the connective tissue cells were pronounced. There was destruction of cellular elements in the lymph nodes and thymus.

In some cases the histopathological examination of mesenteric lymph nodes revealed mild congestion and moderate nuclear changes in the lymphoid cells whereas in other cases, there were necrotic areas within germinal centres in the lymphoid cells. There was also observed hyperplasia in moderate degrees in the lymphoid follicles.

The spleen showed congestion of sinusoids and blood vessels. The sinusoids at the red pulp were found to be lined with reticulo-endothelial cells and macrophages. Hyperplasia of reticulo-endothelial cells in the red pulp areas were well noticed. The

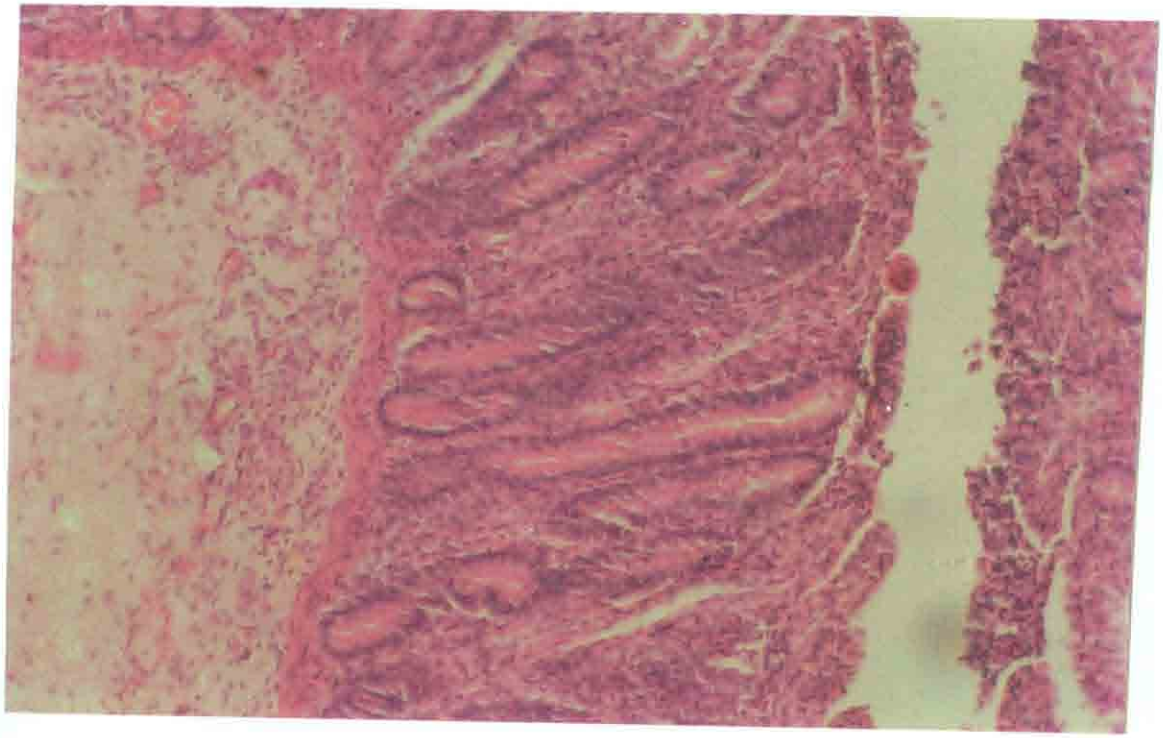


FIG.18. Photomicrograph showing desquamation of the epithelial cell lining of the crypts with necrotic cellular debries. HE x 35

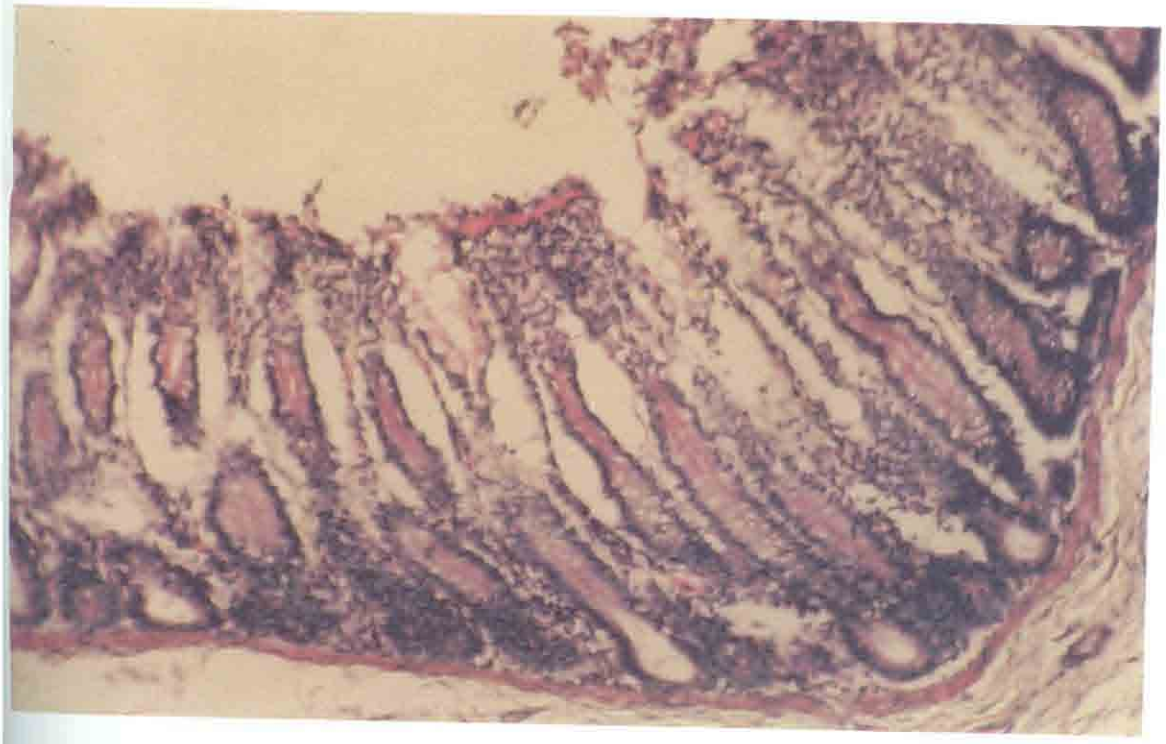


FIG.19. Photomicrograph showing goblet cell hyperplasia of intestine. HE x 35

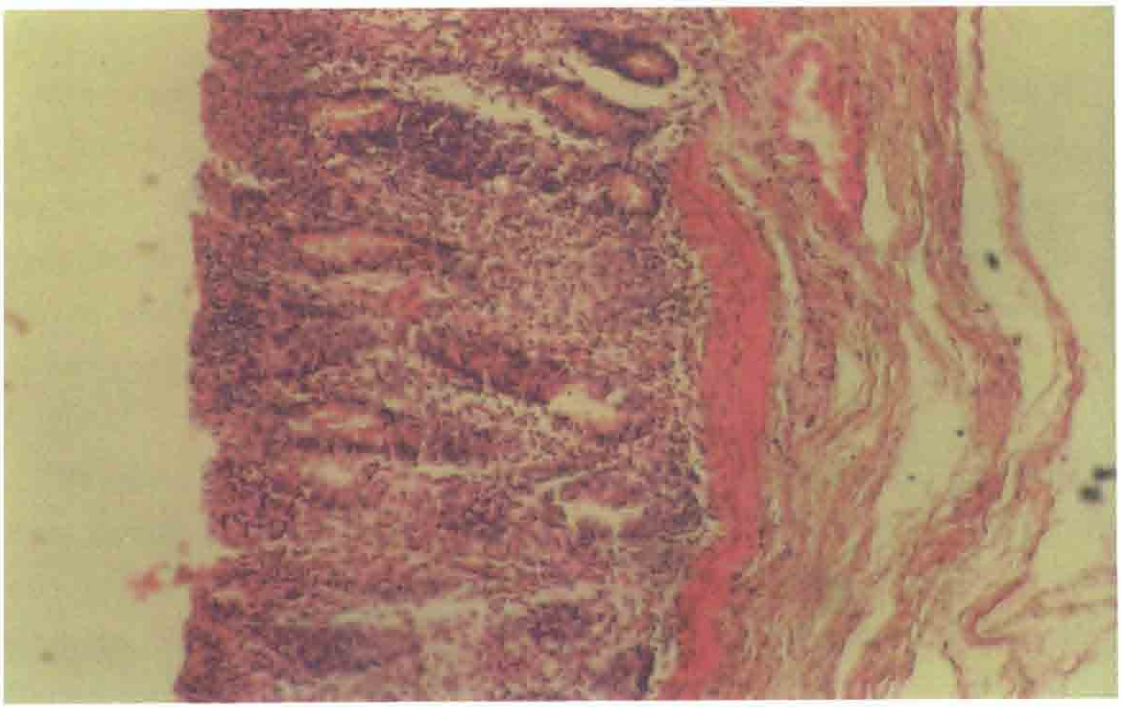


FIG.20. Photomicrograph showing increased cellularity in the villi and mucosa of intestine. *HE* x 35

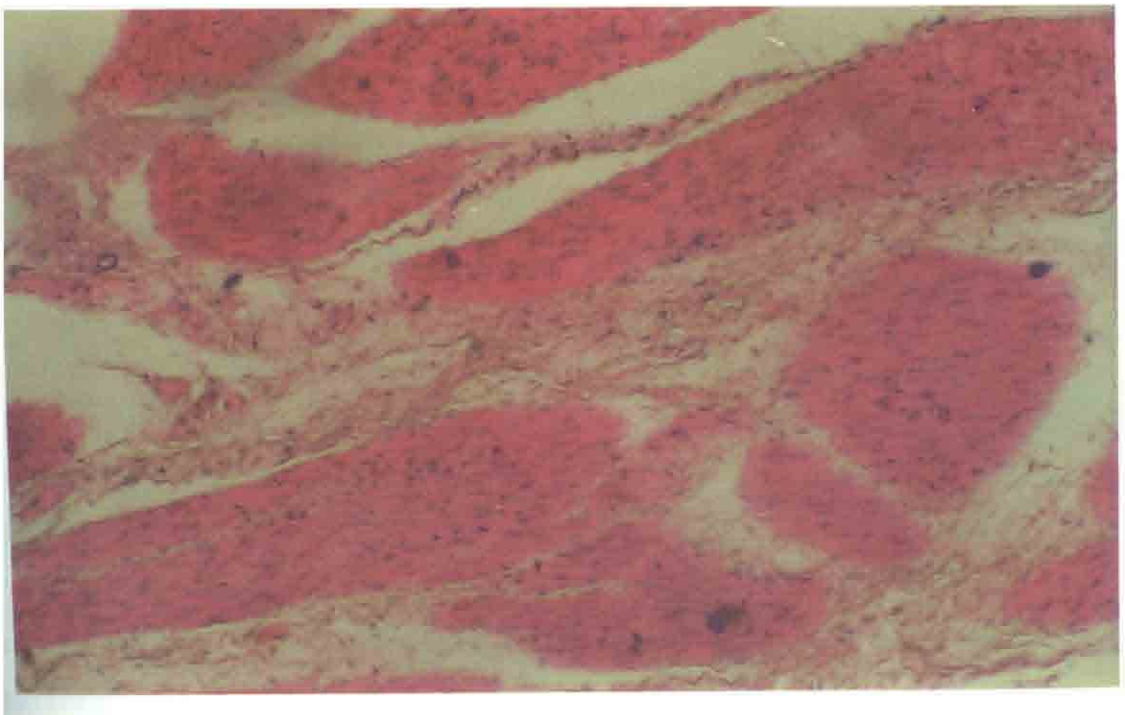


FIG.21. Photomicrograph showing congestion and thickening with oedema of the stratum muscularis of the intestine. HE x 35

corpuscles invariably showed marked depletion of the lymphatic cells (Fig-23).

Non-suppurative and diffused myocarditis was evident in some cases. Some areas of necrosis and degeneration of myocardial fibres were observed (Fig-24). Proliferative and inflammatory changes were not discernible in the myocardial tissues although interstitial oedema was evident. The myocardial blood vessels were highly congested.

The lung tissues showed marked thickening of the inter alveolar septa and accumulation of serous exudates in the lungs alveoli. There was also hyperplasia of the epithelial cells of the bronchioles. In some cases there was congestion of blood capillaries and hyperplasia of endothelial cells in the areas of inter alveolar septa. The bronchioles were mostly distended with degenerated and desquamated the epithelium (Fig-25). The urinary space was distended and contained fibrinous exudates in some cases (Fig-26). Only mild congestion was noticed in the kidney. Mild to severe congestion of sinusoid, acute cell swelling and pericentral necrosis were frequently observed in liver. (Fig-27)

THERAPEUTICS

Fifty four clinical cases comprising of CPV and CCV infection nd mixed infection of CPV and CCV were subjected to trials gainst different therapeutic regimens in three groups viz. Gr-I,Gr-II d Gr-III (18 clinical cases for each group). Six clinical cases of V, 6 clinical cases of CCV and 6 clinical cases of CPV and CCV ed infection were treated under each treatment group erately. The results of each therapeutic trial have been ented in tabular form.

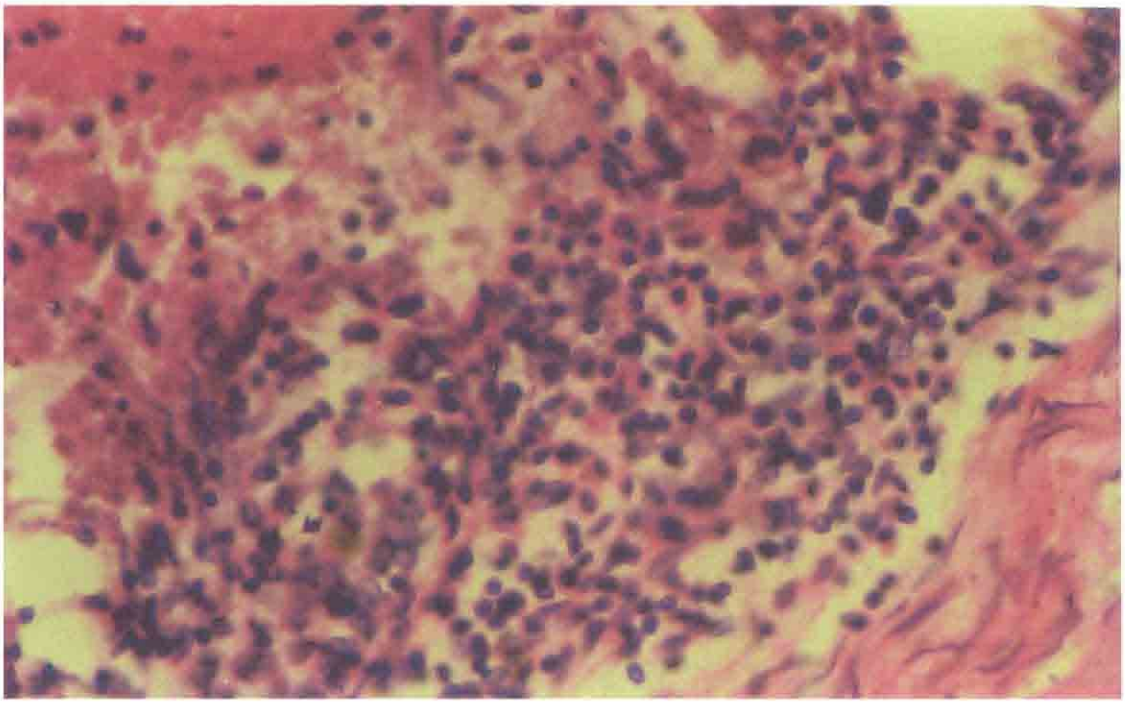


FIG.22. Photomicrograph showing marked depletion of lymphoid cells in the Peyer's patches of the small intestine. HE x 125

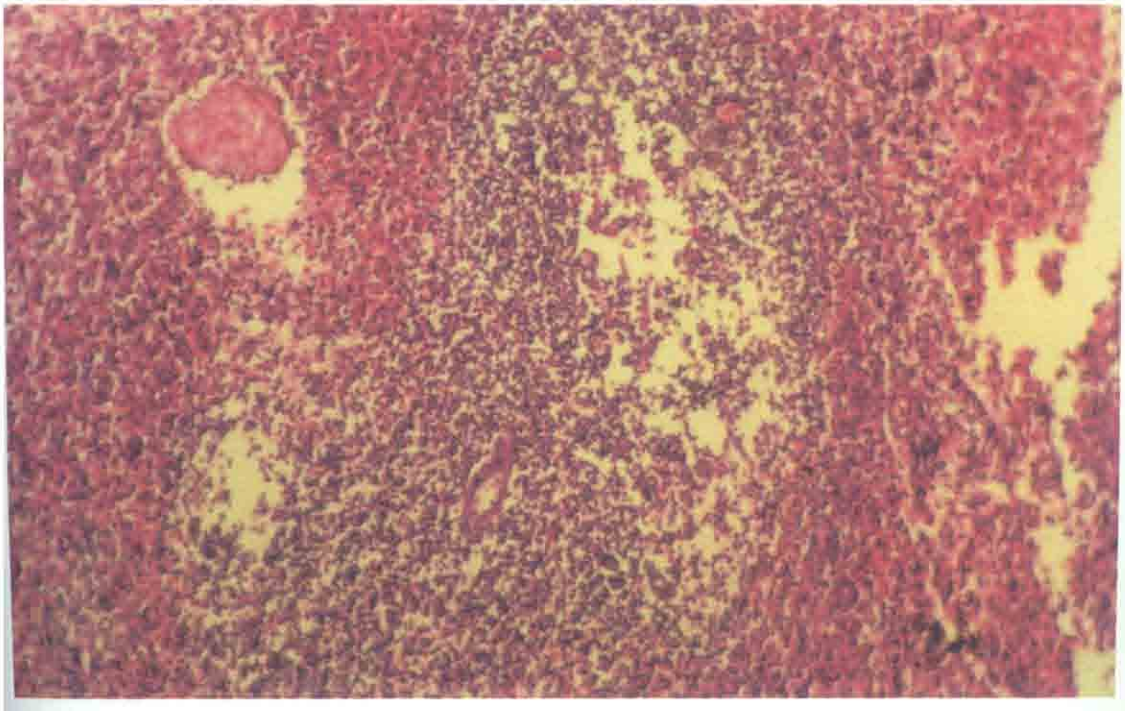


FIG.23. Photomicrograph showing the marked depletion of the lymphatic cells in the germinal centre of the spleen. HE x 35

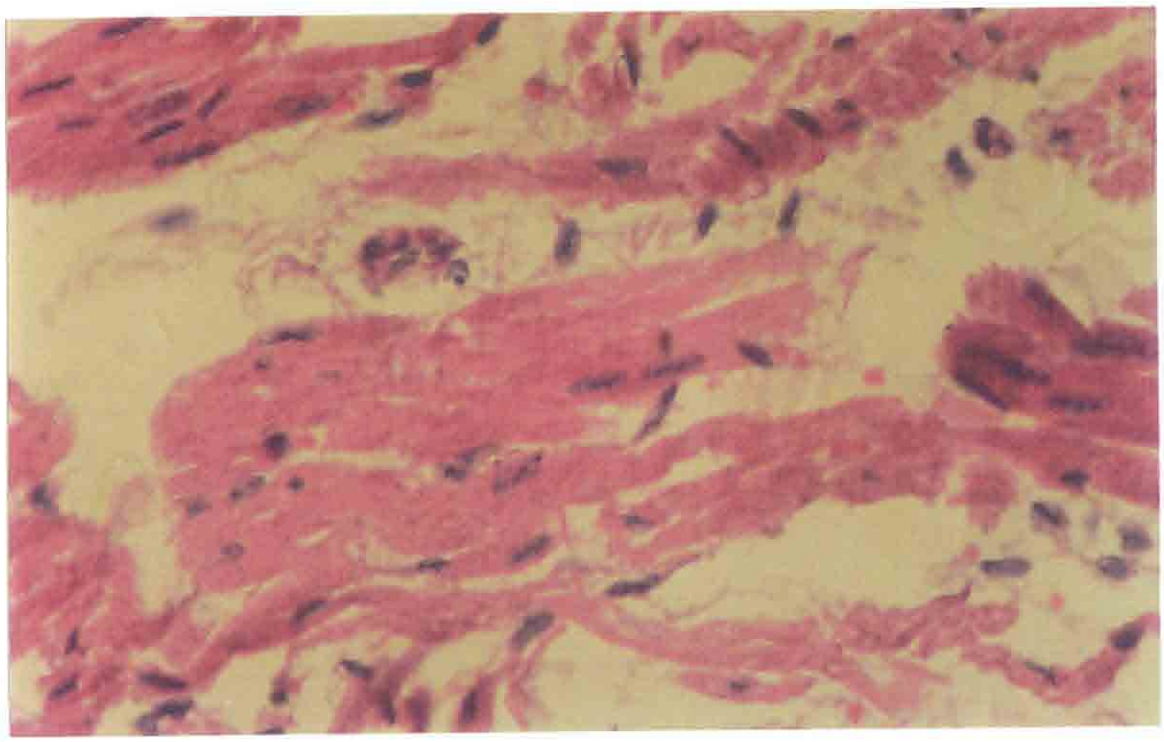


FIG.24. Photomicrograph showing degenerative changes and necrosis of myocardial fibers.HE x 125

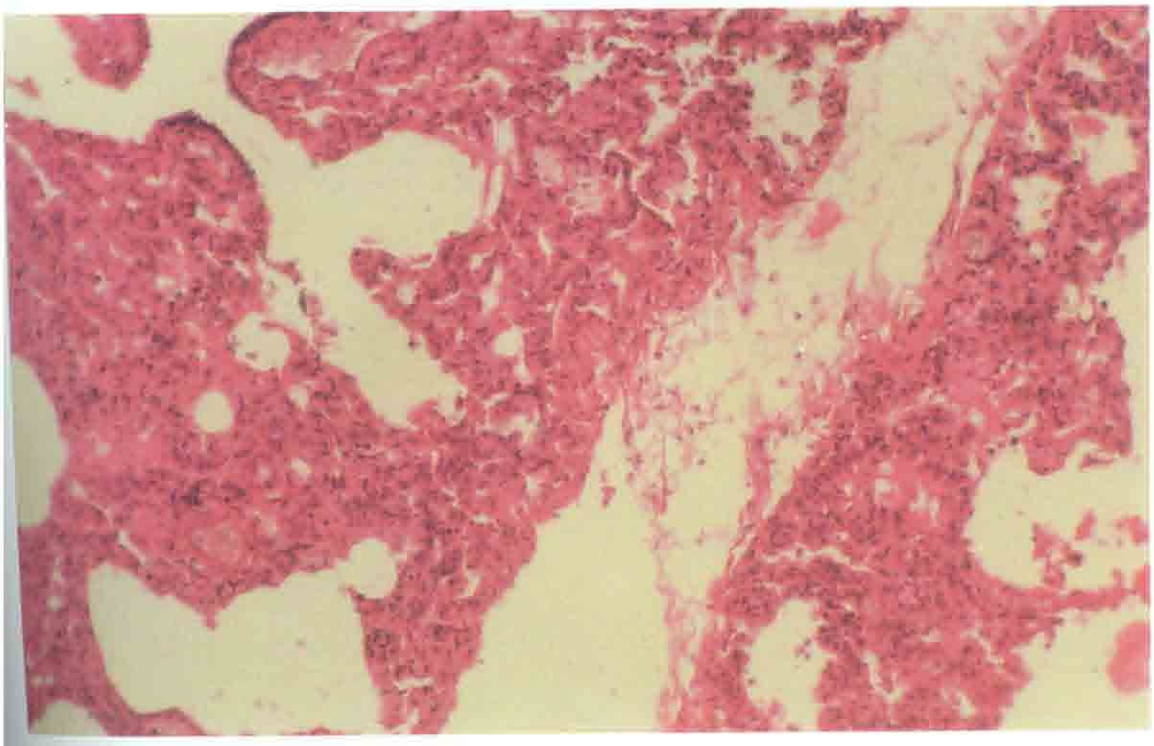


FIG.25. Photomicrograph showing degeneration and desquamation of the epithelium of the bronchioles. HE x 35

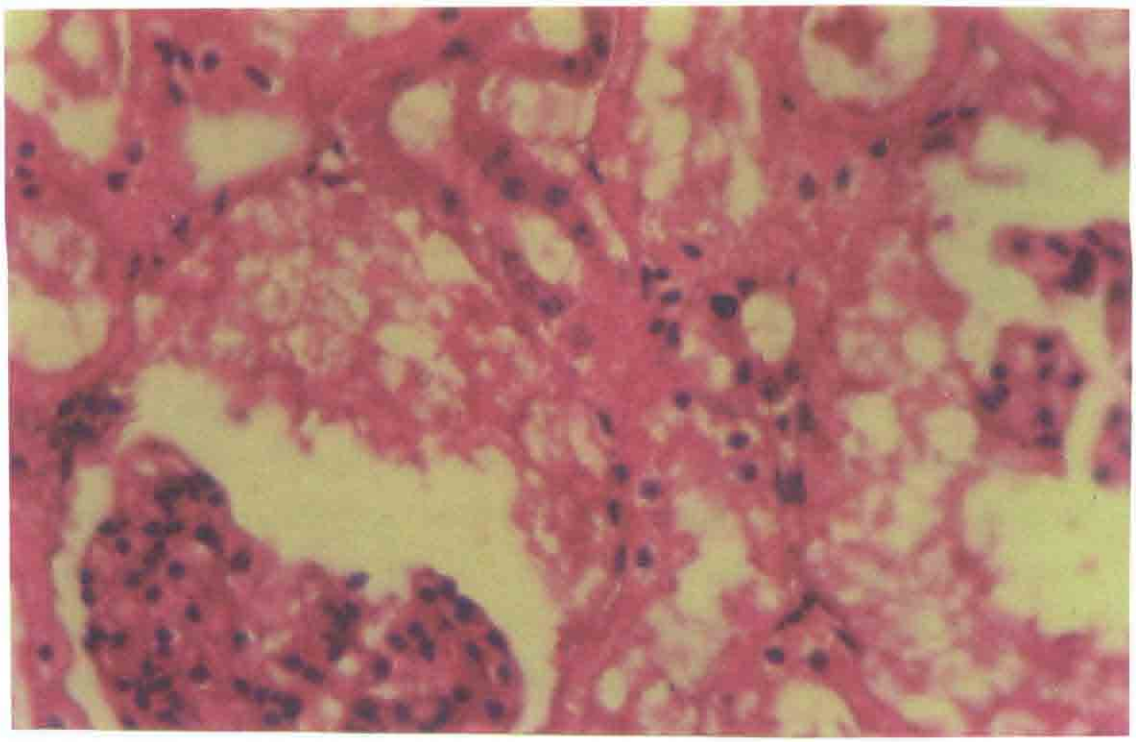


FIG. 26. Photomichrograph showing distended urinary space in the kidney containing fibrinous exudates. HE x 125

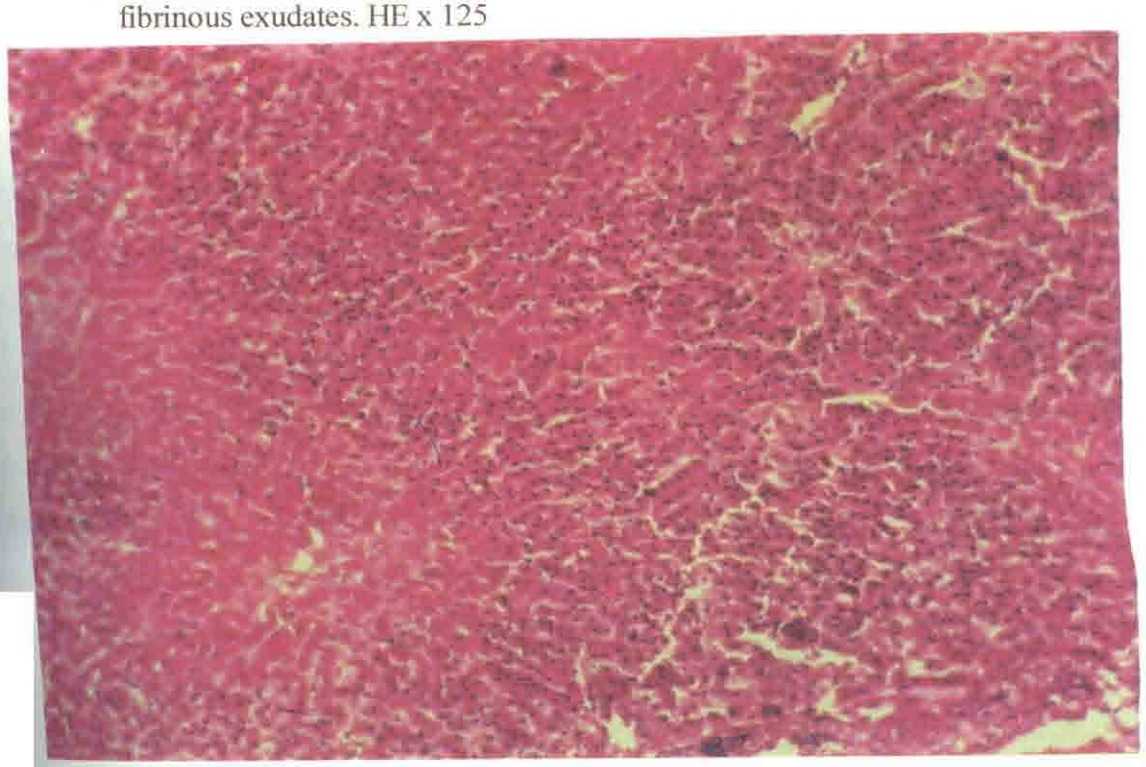


FIG. 27. Photomichrograph showing pericentral necrosis of the liver. HE x 35

The Gr.I therapeutic regimen consisted of ciplox infusion, Ringer's Lactate solution, Perinorm and Dicynene injection. The result of the trial has been documented in the table-14. All the six CPV infected animals showed slight reduction in temperature, vomition and diarrhoea but without improvement in appetite and depression on the first day post treatment. The observation on 2nd day post treatment showed moderate reduction in temperature, vomition and diarrhoea but no improvement in depression. However 50% (3/6) animals showed slight improvement in appetite. Thereafter all the treated animals showed gradual improvement in ever, vomition, diarrhoea, anorexia and depression on 3rd and 4th lay post treatments. On the 4th day post-treatment all the treated inimals were found to approach normalcy except one whose omition was not fully controlled. All the treated animals were found ured on the 5th day post treatment. Evidently the Gr-I therapeutic egimen was found to be effective against the CPV infection.

Day one post treatment observation revealed that all six CCV nfected animals showed slight improvement in fever, vomition and iarrhoea with no improvement in anorexia and depression with Gr-I therapeutic regimen. All the treated animals showed gradual improvement (from slight to moderate and moderate to better) in obatement of fever, vomition, anorexia and depression on 3rd and 4th day post-treatments. On 5th day post treatment 50% animals ere found to be cured. Two animals were cured of fever, vomition nd diarrhoea with apparently normal appetite and alertness. Only e animal was cured of fever and vomition but there was slight nifestation in diarrhoea, anorexia and depression. On the 5th day observation full recovery was observed in all animals treated nst CCV with Gr-I therapy.

After one day treatment with Gr-I medicament all the animals ed with CPV and CCV mixed infections, exhibited slight vement in fever, vomition and diarrhoea. But there was no vement in appetite and depression in these treated animals. 2nd day post treatment all the animals were found to have

[redacted] EFFICACY OF Gr.I THERAPEUTIC REGIMEN AGAINST THE CLINICAL CASES OF CPV, CCV AND CPV+CCV MIXED INFECTIONS

Daily Post Treatment Clinical Improvements.

Disease	Sl.No.	Pre-treatment	Day-1					Day-2					Day-3					Day-4					Day-5				
		T (°F)	T (°F)	V	D	A	Dp	T (°F)	V	D	A	Dp	T (°F)	V	D	A	Dp	T (°F)	V	D	A	Dp	T (°F)	V	D	A	Dp
CPV Infection	1	105.2	104.8	-	-	-	-	104.6	+	+	-	-	103.2	++	++	+	+	102	+++	+++	++	++	101.8	++++	++++	+++	+++
	2	105	104.6	-	-	-	-	104.2	+	+	-	-	103	++	++	+	+	102.4	+++	+++	++	++	102	++++	++++	+++	+++
	3	105	104.4	-	-	-	-	104	+	+	-	-	103	++	++	+	+	102	+++	+++	++	++	101.6	++++	++++	++++	++++
	4	105	104.6	+	+	-	-	103.8	++	++	+	+	103	+++	+++	++	++	102	++++	++++	++++	++++	101.4	√	√	√	√
	5	104.8	104	+	+	-	-	103.4	+	+	-	-	103	+++	+++	++	++	101.8	++++	++++	++++	++++	101.2	√	√	√	√
	6	104.6	103.8	+	+	-	-	103	+	+	-	-	102.8	+++	+++	++	++	101.6	++++	++++	++++	++++	101	√	√	√	√
CCV Infection	1	105	104.8	-	-	-	-	104	+	+	-	-	103	+++	+++	+++	+++	102	++++	++++	++++	++++	101.2	√	√	√	√
	2	104	104.2	+	+	-	-	103.8	+	+	-	-	103	+++	+++	+++	+++	102.8	++++	++++	++++	++++	101.4	++++	++++	++++	√
	3	105.4	105	-	-	-	-	104.4	+	+	-	-	103	++	++	+	+	102.2	+++	+++	++	++	101.6	++++	++++	++++	++++
	4	104.8	104.6	+	+	-	-	103.8	+	+	-	-	103	++	++	+	+	102.4	++++	++++	++++	+++	101	√	√	√	√
	5	104	103.6	+	+	-	-	103	+	+	-	-	102.6	+++	+++	+++	+++	102	++++	++++	++++	++++	101	√	√	√	√
	6	105.6	105	-	-	-	-	104.6	+	+	-	-	102.8	++	++	+	+	102	+++	+++	++	++	101.8	++++	++++	++++	++++
CPV+ CCV Infection	1	105.2	104.8	-	-	-	-	104.2	-	-	-	-	103	+	+	+	+	102.6	++	++	++	++	102	+++	+++	++++	++++
	2	105	104.8	-	-	-	-	104	+	+	-	-	103	++	++	++	++	102.4	+++	+++	+++	+++	102	++++	++++	++++	++++
	3	104	103.8	+	+	-	-	103	+	+	-	-	102.6	+++	+++	+++	++++	102	++++	++++	++++	√	101.8	√	√	√	√
	4	105	104.6	-	-	-	-	104	+	+	-	-	103	+++	+++	+++	++++	102.2	++++	++++	++++	√	102	√	√	√	√
	5	104.8	104.2	+	+	-	-	103.6	+	+	-	-	103	++	++	++	++	102.4	+++	+++	+++	+++	101.8	++++	++++	++++	++++
	6	105	104.4	-	-	-	-	104	-	-	-	-	103	++	++	++	++	102.8	+++	+++	+++	+++	102	++++	++++	++++	++++

slightly improved: +, moderately improved : ++, better improved : +++, approaching to normalcy: ++++, cured (100%) : √, T:Temperature, V:Vomition, D: Diarrhoea, A: Anorexia, Dp: Depression.

improved moderately in fever, vomition and diarrhoea though they were found somewhat depressed. In 50% cases there was slight improvement in appetite but others were found to be completely anorectic. All the treated animals showed gradual improvement on 3rd and 4th day post treatment in fever, vomition, diarrhoea, anorexia and depression. On the 5th day post-treatment all the animals were found to be cured of fever, vomition, diarrhoea, with return of appetite and alertness. From the 5th day post-treatment observation it was concluded that the Gr-I therapy was found efficacious against mixed infection of CPV and CCV.

The Gr-II therapeutic regimen comprising Gentamicin injection, Ringer's Lactate solution, Perinorm and Dicynene injection was tried against CPV,CCV and CPV+CCV infection. The details of the daily post-treatment improvements have been presented in the table-15. On first day post-treatment all the treated animals showed improvement in remission of temperature and reduction in vomition. Five out of six treated animals showed slight reduction in the volume and frequency of diarrhoea whereas one animal did not show any improvement. Two animals were found to show slight improvement in appetite and alertness whereas the rest four treated animals did not show any improvement in anorexia and depression. The day-2 post treatment improvement showed that all the treated animals exhibited moderate clinical improvement in fever and emesis. Four animals manifested moderate improvement in diarrhoea whereas two showed only slight reduction. Four animals were found to be completely anoretic and depressed but two exhibited moderate improvement in appetite and alertness. On 3rd day post treatment results revealed that all the treated animals were in better condition with reduction in temperature and vomition. Five out of six animals showed much better improvement in diarrhoea whereas one manifested moderate improvement. Two animals were found to present better improvement in appetite and alertness whereas the rest four exhibited slight improvement only. The temperature and vomition in all treated animals approached to

[redacted] EFFICACY OF GR.II THERAPEUTIC REGIMEN AGAINST THE CLINICAL CASES OF CPV, CCV ANDCPV+CCV MIXED INFECTIONS.

Daily Post Treatment Clinical Improvements.																										
		Pre-treatment	Day-1					Day-2					Day-3					Day-4					Day-5				
Disease	Sl.No.	T (°F)	T (°F)	V	D	A	Dp	T (°F)	V	D	A	Dp	T (°F)	V	D	A	Dp	T (°F)	V	D	A	Dp	T (°F)	V	D	A	Dp
CPV Infection	1	104	103.4	+	+	+	+	103	++	++	++	++	102.8	+++	+++	+++	+++	102	++++	++++	+++	++++	101	√	√	√	√
	2	104.8	104	+	+	+	+	103.4	++	++	++	++	103.8	+++	+++	+++	+++	102.2	++++	++++	+++	++++	101	√	√	√	√
	3	105.4	105	+	+	-	-	104	++	++	-	-	103	+++	+++	+	+	102	++++	++++	++	++	101	√	√	+++	+++
	4	104	103.8	+	+	-	-	103	++	++	-	-	102.8	+++	+++	+	+	101.8	++++	++++	++	++	101	√	√	++++	++++
	5	104.8	104.2	+	+	-	-	103.8	++	+	-	-	103	+++	+++	+	+	102	++++	++++	++	++	101.2	√	√	++++	++++
	6	105.6	105.2	+	-	-	-	103.8	++	+	-	-	103	+++	+++	+	+	102	++++	+++	++	++	101	√	++++	++++	++++
CCV Infection	1	105	104.6	+	+	-	-	102.8	++	++	+	+	101.8	+++	+++	++	++	101.2	++++	++++	+++	+++	101	√	√	√	√
	2	105.4	105.2	+	+	-	-	103	++	++	-	-	102	+++	+++	+	+	101.6	++++	++++	++	++	101	√	√	√	√
	3	104	103.8	+	+	-	-	102.4	++	++	+	+	101.4	+++	+++	++	++	101.4	++++	++++	+++	+++	101	√	√	√	√
	4	104.8	104.2	+	+	-	-	103	++	++	+	+	102	+++	+++	++	++	101.6	++++	++++	+++	+++	101	√	√	√	√
	5	105	104.8	+	+	-	-	103.6	++	++	-	-	102.2	+++	+++	+	+	101.8	++++	++++	++	++	101	√	√	√	√
	6	105	104.8	+	+	-	-	103	++	++	+	+	102	+++	+++	++	++	101.6	++++	++++	+++	+++	101	√	√	√	√
CPV + CCV Infection	1	104	103.6	+	+	-	-	103	++	++	+	+	102.4	+++	+++	++	++	101.8	++++	++++	+++	+++	101	√	√	++++	++++
	2	104.6	104	+	+	-	-	103	++	++	-	-	102.2	+++	+++	+	+	101.6	++++	++++	++	++	101	√	√	√	√
	3	105	104.6	+	+	-	-	103.2	++	++	-	-	102.4	+++	+++	+	+	101.8	++++	++++	++	++	101	√	√	++++	++++
	4	105	104.8	+	+	-	-	104	++	++	-	-	103	+++	+++	+	+	101.6	++++	++++	++	++	101	√	√	√	√
	5	105	104.8	+	+	-	-	104	++	++	+	+	102.8	+++	+++	++	++	101.8	++++	++++	+++	+++	101	√	√	√	√
	6	105	104.8	-	-	-	-	104.2	++	++	-	-	103	+++	+++	+	+	101.6	++++	++++	++	++	101	√	√	++++	++++

slightly improved: +, moderately improved : ++, better improved : +++, approaching to normalcy: ++++, cured (100%) : √
T: Temperaturer, V: Vomition, D: Diarrhoea, A: Anorexia, Dp: Depression.

normalcy after 4-day-treatment period. One animal was found to be improved better whereas the rest five were found to be about normal in defaecation. Two animals exhibited improvement in appetite and alertness towards normalcy bur the rest four were found to be improved moderately.

After 5th day treatment all the animals were found to be normal in temperature without vomition. Five out of six animals were cured of diarrhoea but one had slight loose motion. Two animals regained normal appetite and alertness whereas four animals were found to be near normal. Thus it was seen that adoption of Gr-II therapeutic regimen could lead to cure the CPV infected animals in about 5-day-treatment schedule.

All the CCV infected animals treated with Gr-II therapy showed slight improvement in fever, vomition and diarrhoea but without improvement in appetite and alertness after the first day post-treatment. On the second day post treatment all the treated animals improved moderately with reduction of temperature, vomition and diarrhoea. Four out of six animals manifested slight improvement in appetite and alertness whereas other two did not exhibit any improvement in aneroxia and depression. The third day post-treatment observation revealed that all the treated animals were found clinically better with regard to fever, vomition and diarrhoea. Two animals showed slight improvement in appetite and depression whereas other 4 exhibited moderate improvement in appetite and alertness. After 4 days of treatment all the animals were found to approach the normalcy in temperature, vomition and diarrhoea. Four out of six animals were better in appetite and alertness whereas other two exhibited moderate improvement. The result of individual treatment profile on the fifth day post treatment showed that all the treated animals were normal in all respects indicating that the regimen was efficacious against the treatment of CCV infection.

Four out of six animals infected with the mixed infection of CPV and CCV exhibited slight improvement in fever, vomition,

diarrhoea without any improvement in anorexia and depression. Two animals did not show any improvement in fever, vomition, diarrhoea, anorexia and depression on first day post treatment. On the second day post treatment all the treated animals were found to have improved moderately in fever, vomition and diarrhoea. Two animals improved slightly in appetite and alertness whereas other four did not exhibit any improvement. The third day post treatment observation revealed that all the treated animals were found to be improved better in fever, vomition and diarrhoea. There was slight improvement in four animals in respect of anorexia and depression whereas moderate improvement was noticed in anorexia and depression in two animals. On fourth day post treatment all the animals approached to normalcy in fever, vomition and diarrhoea. Only two animals improved better in appetite and alertness whereas other four animals were found to have moderate improvement. All the animals treated with Gr-II therapy were found to be cured of fever, vomition and diarrhoea fully. Fifty per cent of the treated animals resumed normal appetite and alertness whereas the rest were observed to approach near normalcy in these respect.

The therapeutic efficacy of Gr-III therapy against the clinical cases of CPV, CCV and mixed infection of CPV and CCV comprising of Ringer's Lactate, Dicynene and Perinorm injection has been presented in Table-16. Day one post treatment observation showed that 50% of the treated animals did not show any clinical improvement in vomition, diarrhoea, anorexia and depression. In these animals there was slight reduction in temperature. The rest three animals showed slight improvement in reduction of temperature, vomition and diarrhoea without manifesting any clinical improvement in anorexia and depression. Five out of six treated animals exhibited slight improvement in reduction of temperature, vomition and diarrhoea without any improvement in anorexia and depression. Only one animal showed moderate improvement in fever, vomition and diarrhoea with slight improvement in appetite and alertness. On the third day post treatment 50% of the animals

[redacted] OF Gr.III THERAPEUTIC REGIMEN AGAINST THE CLINICAL CASES OF CPV, CCV AND CPV+CCV MIXED INFECTIONS

Daily Post Treatment Clinical Improvements

Disease	Sl.No.	Pretreatment	Day-1					Day-2					Day-3					Day-4					Day-5				
		T (°F)	T (°F)	V	D	A	Dp	T (°F)	V	D	A	Dp	T (°F)	V	D	A	Dp	T (°F)	V	D	A	Dp	T (°F)	V	D	A	Dp
CPV Infection	1	105.2	104.8	-	-	-	-	104.6	+	+	-	-	103.2	++	++	+	+	102	+++	+++	++	++	101.8	++++	++++	+++	+++
	2	105	104.6	-	-	-	-	104.2	+	+	-	-	103	++	++	+	+	102.4	+++	+++	++	++	102	++++	++++	+++	+++
	3	105	104.4	-	-	-	-	104	+	+	-	-	103	++	++	+	+	102	+++	+++	++	++	101.6	++++	++++	++++	++++
	4	105	104.6	+	+	-	-	103.8	++	++	+	+	103	+++	+++	++	++	102	++++	++++	++++	++++	101.4	√	√	√	√
	5	104.8	104	+	+	-	-	103.4	+	+	-	-	103	+++	+++	++	++	101.8	++++	++++	++++	++++	101.2	√	√	√	√
	6	104.6	103.8	+	+	-	-	103	+	+	-	-	102.8	+++	+++	++	++	101.6	++++	++++	++++	++++	101	√	√	√	√
CCV Infection	1	105	104.8	-	-	-	-	104	+	+	-	-	103	+++	+++	+++	+++	102	++++	++++	++++	++++	101.2	√	√	√	√
	2	104	104.2	+	+	-	-	103.8	+	+	-	-	103	+++	+++	+++	+++	102.8	++++	++++	++++	++++	101.4	++++	++++	++++	√
	3	105.4	105	-	-	-	-	104.4	+	+	-	-	103	++	++	+	+	102.2	+++	+++	++	++	101.6	++++	++++	++++	++++
	4	104.8	104.6	+	+	-	-	103.8	+	+	-	-	103	++	++	+	+	102.4	++++	++++	++++	+++	101	√	√	√	√
	5	104	103.6	+	+	-	-	103	+	+	-	-	102.6	+++	+++	+++	+++	102	++++	++++	++++	++++	101	√	√	√	√
	6	105.6	105	-	-	-	-	104.6	+	+	-	-	102.8	++	++	+	+	102	+++	+++	++	++	101.8	++++	++++	++++	++++
CPV + CCV Infection	1	105.2	104.8	-	-	-	-	104.2	-	-	-	-	103	+	+	+	+	102.6	++	++	++	++	102	+++	+++	++++	++++
	2	105	104.8	-	-	-	-	104	+	+	-	-	103	++	++	++	++	102.4	+++	+++	+++	+++	102	++++	++++	++++	++++
	3	104	103.8	+	+	-	-	103	+	+	-	-	102.6	+++	+++	+++	++++	102	++++	++++	++++	√	101.8	√	√	√	√
	4	105	104.6	-	-	-	-	104	+	+	-	-	103	+++	+++	+++	++++	102.2	++++	++++	++++	√	102	√	√	√	√
	5	104.8	104.2	+	+	-	-	103.6	+	+	-	-	103	++	++	++	++	102.4	+++	+++	+++	+++	101.8	++++	++++	++++	++++
	6	105	104.4	-	-	-	-	104	-	-	-	-	103	++	++	++	++	102.8	+++	+++	+++	+++	102	++++	++++	++++	++++

slightly improved: +, moderately improved : ++, better improved : +++, approaching to normalcy: ++++, cured (100%) : √
T: Temperature, V: Vomition, D: Diarrhoea, A: Anorexia, Dp: Depression.

were found to be improved moderately in fever, vomition and diarrhoea but slightly improvement in appetite and alertness. The rest 50% showed better improvement in fever, vomition and diarrhoea with moderate improvement in anorexia and depression. On the fourth day post treatment three out of six animals were found to be improved better in fever, vomition and diarrhoea with moderate improvement in anorexia and depression. The rest three animals were found to be apparently normal in temperature, vomition, diarrhoea, anorexia and depression. Fifty per cent of the treated animals were found to be cured on the fifth day post treatment. One animal was observed to be apparently normal. Two animals showed better improvement in appetite and alertness but diarrhoea, vomition and fever were almost at a normal state in these two animals. On the first day post treatment all the CCV infection showed slight reduction in temperature. Fifty per cent of the animals did not show any improvement in vomition, diarrhoea, anorexia and depression. Three animals showed slight improvement in vomition and diarrhoea but did not show any improvement in anorexia and depression. On the second day post treatment all the treated animals showed slight improvement in fever, vomition and diarrhoea but these animals did not show any improvement in appetite and alertness. After three days of treatment 50% of the animals showed better improvement in fever, vomition, diarrhoea, anorexia and depression. The rest three animals were moderately improved from [redacted]ever, vomition and diarrhoea with slight improvement in anorexia [redacted]nd depression.

[redacted] The fourth day post treatment observation indicated that three [redacted]t of six animals were found to be apparently normal from fever, [redacted]nition, diarrhoea , anorexia and depression. The rest of the [redacted]nals were found to be improved better from fever, vomition and [redacted]rhoea with moderate clinical improvement in appetite and [redacted]ness. On the fifth day post treatment 50% of the animals were [redacted] to be cured of fever, vomition, diarrhoea, anorexia and [redacted]ssion. But two animals were found to be apparently normal.

Only one animal showed apparent normalcy in temperature, vomition, diarrhoea and appetite with complete alertness. All the animals infected with mixed infection of CPV and CCV showed slight reduction in temperature on the first day post treatment. Four out of six animals did not show any improvement in vomition, diarrhoea, anorexia and depression. Two animals showed slight reduction in vomition and diarrhoea without any improvement in appetite and alertness. On the second day post-treatment two animals did not show any improvement in vomition, diarrhoea, anorexia and depression except moderate improvement in fever. Four animals showed moderate improvement in temperature and reduction in vomition and diarrhoea. But these four animals did not show any improvement in appetite and alertness. On the third day post-treatment improvement was better with reduction in temperature in case of all treated animals. One animal showed slight reduction in vomition, diarrhoea, anorexia and depression. Three animals were found to manifest moderate improvement in vomition, diarrhoea, anorexia and depression, whereas three animals were found to be improved better in vomition, diarrhoea, anorexia and depression. After four days of treatment all the animals were found to tend to normalcy in temperature. Fifty per cent of the animals were found to be improved better in vomition, diarrhoea, anorexia and depression. One animal was found to show moderate improvement in emesis, loose motion, appetite and alertness. The rest two animals were found to be apparently normal in vomition, diarrhoea, and appetite with complete alertness. On fifth day post treatment two animals were found to be cured completely whereas four animals were found to be apparently normal in temperature, vomition, diarrhoea, anorexia and depression but one animal was found to exhibit the clinical improvements in vomition, diarrhoea, anorexia and depression to be better than the fourth day post treatment findings.

STATISTICAL INTERPRETATION OF THE RESULTS FOR THERAUPETIC TRIALS

The efficacies of different drug combinations in treatment groups have been assessed by degrees of manifestations of different clinical symptoms (Table-17,18,19,20 and 21). The mean values for improvements in temperature, vomition, diarrhoea, anorexia and depression between groups of drug combinations have been presented in table-17. Statistical analysis revealed that the effects of the Gr-I and Gr-II treatments are at par but they are significantly better than Gr-III treatment in bringing down the temperature to normalcy. The effect of Gr-I medicament was found to be the best for control of vomition and diarrhoea in shorter duration followed by the Gr-II and Gr-III treatments. The effect of Gr-I treatment was found to be most efficacious for improvement of appetite and also bringing the appetite to normalcy at the end of treatment period as compared to the Gr-II and Gr-III treatment. The efficacy of Gr-II and Gr-III was found to be the same as there was no significant difference between the Gr-III and Gr-II treatments. No significant difference was noticed among Gr-I, Gr-II and Gr-III treatments in recovering from the depression (Table-17). Better curative effect of different treatments was observed on CCV infection as compared to CPV infection alone and mixed infection of CPV and CCV (Table-18). On the whole CPV infection responded better to different treatment groups than the mixed infection of CPV and CCV.

The interaction between treatments and disease presented in [illegible]le-19 indicated that Gr-I treatment was found to be the most [illegible]cacious against the CCV infection. Gr-I and Gr-II treatments [illegible]nst CCV infection found to the most efficacious in bringing the [illegible]erature to normal. The effect of Gr-I, Gr-II and Gr-III [illegible]ments against CPV infection were found to be the same in [illegible]ng the temperature to normalcy. The effect of Gr-I and Gr-II [illegible]nts against the mixed infection of CPV and CCV was the

[redacted] VALUES FOR DECREASE IN TEMPERATURE, VOMITION, DIARRHOEA, ANOREXIA AND DEPRESSION BETWEEN GROUPS

Treatment group	Temperature °C	Vomition %	Diarrhoea %	Anorexia %	Depression %
Group-I	2.287[a]	61.55[b]	58.01[a]	43.42[a]	42.28[b]
Group-II	2.193[a]	53.41[c]	52.56[c]	34.88[b]	34.73[b]
Group-III	1.851[b]	42.16[b]	42.16[b]	32.46[b]	33.96[b]

Same superscripts within a column do not differ significantly (P<0.05)

TABLE 18. MEAN VALUES FOR DECREASE IN TEMPERATURE, VOMITION, DIARRHOEA,ANOREXIA AND DEPRESSION BETWEEN DISEASES

Name of the disease	Temperature °C	Vomition %	Diarrhoea %	Anorexia %	Depression %
CPV	2.056[b]	53.04[a]	50.72[b]	35.64[b]	34.29[b]
CCV	2.284[a]	54.18[a]	53.89[a]	39.92[a]	40.62[a]
CPV+CCV	1.991[b]	49.90[b]	48.13[c]	35.20[b]	36.06[b]

Same superscripts within a column do not differ significantly (P<0.05)

TABLE 19. MEAN VALUES FOR DECREASE IN TEMPERATURE, VOMITION, DIARRHOEA, ANOREXIA AND DEPRESSION BETWEEN GROUPS AND DISEASES

Treatment Group and Disease	Temperature °C	Vomition %	Diarrhoea %	Anorexia %	Depression %
Group-I -CPV	2.173^{b}	60.96^{bb}	56.53^{b}	41.07^{b}	36.69^{bc}
Group-I -CCV	2.547^{a}	64.39^{a}	63.50^{a}	48.84^{a}	49.31^{b}
Group-I -(CPV+CCV)	2.140^{b}	59.31^{b}	54.00^{bc}	40.34^{b}	40.84^{a}
Group-II -CPV	1.993^{bc}	54.00^{c}	51.46^{c}	33.96^{cd}	34.39^{b}
Group-II -CCV	2.487^{a}	54.00^{c}	54.00^{bc}	37.92^{bc}	39.93^{c}
Group-II -(CPV+CCV)	2.100^{b}	52.13^{c}	52.23^{c}	32.77^{cd}	31.89^{bc}
Group-III -CPV	2.000^{bc}	44.16^{d}	44.16^{d}	31.88^{d}	31.81^{c}
Group-III -CCV	1.820^{cd}	44.16^{d}	44.16^{d}	32.99^{cd}	34.61^{bc}
Group-III -(CPV+CCV)	1.733^{d}	38.16^{e}	38.16^{e}	32.49^{d}	35.46^{bc}

Same superscripts within columns do not differ significantly ($P<0.05$)

TABLE 20. MEAN VALUES FOR DECREASE IN TEMPERATURE, VOMITION, DIARRHOEA, ANOREXIA AND DEPRESSION IN DIFFERENT DAYS

Days	Temperature °C	Vomition %	Diarrhoea %	Anorexia %	Depression %
Day - 1	0.425^{e}	20.66^{e}	20.66^{e}	0.984^{e}	0.98^{e}
Day - 2	1.341^{d}	34.69^{d}	34.22^{d}	11.78^{d}	8.78^{d}
Day - 3	2.152^{c}	52.20^{c}	51.98^{c}	37.84^{c}	40.69^{c}
Day - 4	2.989^{b}	69.48^{b}	63.34^{b}	52.60^{b}	56.64^{b}
Day-5	3.644^{a}	84.85^{a}	84.35^{a}	81.40^{a}	77.86^{a}

Same superscripts within columns do not differ significantly ($P<0.05$)

TABLE 21. MEAN VALUES FOR DECREASE IN TEMPERATURE, VOMITION, DIARRHOEA, ANOREXIA AND DEPRESSION BETWEEN GROUPS AND DAYS

Treatment groups and days	Temperature °C	Vomition %	Diarrhoea %	Anorexia %	Depression %
Group-I - Day-1	0.466^{h}	26.56^{g}	26.56^{h}	0.00^{g}	0.00^{h}
- Day-2	1.567^{f}	40.51^{f}	40.51^{fg}	17.70^{f}	11.67^{g}
- Day-3	2.278^{d}	62.17^{c}	62.17^{c}	46.47^{d}	50.38^{cd}
- Day-4	3.244^{b}	88.52^{a}	70.82^{b}	62.93^{c}	69.34^{b}
- Day-5	3.878^{a}	90.00^{a}	90.00^{a}	90.00^{a}	80.00^{a}
Group-II - Day-1	0.388^{h}	23.61^{g}	23.61^{h}	2.95^{g}	2.95^{h}
- Day-2	1.456^{f}	39.23^{f}	37.82^{g}	14.68^{f}	13.21^{g}
- Day-3	2.267^{d}	50.77^{e}	50.13^{e}	33.47^{e}	33.47^{f}
- Day-4	3.067^{b}	63.44^{c}	62.74^{c}	44.35^{d}	45.06^{de}
- Day-5	3.789^{a}	90.00^{a}	88.52^{a}	78.96^{b}	78.97^{a}
Group-III - Day-1	0.422^{h}	11.80^{h}	11.80^{i}	0.00^{g}	0.00^{h}
-Day-2	1.000^{g}	24.31^{g}	24.31^{h}	2.95^{g}	1.47^{h}
- Day-3	1.911^{e}	43.65^{f}	43.65^{f}	33.59^{e}	38.21^{ef}
- Day-4	2.656^{c}	56.46^{d}	56.46^{d}	50.50^{d}	55.51^{c}
- Day-5	3.267^{b}	74.54^{b}	74.54^{b}	75.24^{b}	74.61^{ab}

Same superscripts within columns do not differ significantly ($P<0.05$)

TABLE 22. MEAN VALUES FOR DECREASE IN TEMPERATURE, VOMITION, DIARRHOEA, ANOREXIA AND DEPRESSION BETWEEN DISEASE AND DAYS

Disease and Days	Temperature °C	Vomition %	Diarrhoea %	Anorexia %	Depression %
CPV - Day-1	0.52^{h}	22.13^{f}	22.13^{g}	2.95^{gh}	2.95^{f}
- Day-2	1.24^{g}	35.71^{e}	34.30^{f}	11.73^{f}	8.65^{ef}
- Day-3	1.87^{e}	53.07^{c}	52.43^{de}	36.80^{e}	38.21^{d}
- Day-4	2.92^{bc}	68.71^{b}	60.62^{c}	47.75^{d}	54.80^{c}
- Day-5	3.71^{a}	85.57^{a}	84.10^{a}	78.96^{b}	66.86^{b}
CCV - Day-1	0.41^{h}	22.13^{f}	22.13^{g}	0.00^{h}	0.00^{f}
- Day-2	1.54^{f}	36.29^{e}	36.29^{f}	14.75^{f}	14.76^{e}
- Day-3	2.56^{d}	56.02^{c}	56.02^{cd}	41.02^{e}	42.31^{d}
- Day-4	3.16^{b}	70.89^{b}	69.41^{b}	58.26^{c}	58.97^{bc}
- Day-5	3.73^{a}	85.57^{a}	85.57^{a}	85.57^{a}	87.05^{a}
CPV + CCV - Day-1 (MIXED)	0.34^{h}	17.71^{f}	17.71^{g}	0.00^{h}	0.00^{f}
-Day-2	1.23^{g}	32.06^{e}	32.06^{f}	8.85^{fg}	2.95^{f}
- Day-3	2.01^{e}	47.50^{d}	47.50^{e}	35.71^{e}	41.54^{d}
- Day-4	2.87^{c}	68.84^{b}	59.98^{c}	51.78^{d}	56.15^{c}
- Day-5	3.48^{a}	83.39^{a}	83.39^{a}	79.67^{ab}	79.67^{a}

Same superscripts within columns do not differ significantly ($P<0.05$)

same as against the single infection of CPV. The effect of Gr-I, Gr-II and Gr-III treatments are the same against the CPV infection as there was no significant difference among the treatment groups for temperature ($P<0.05$). The Gr-I treatment brought better clinical cure to control vomition, diarrhoea, anorexia and depression.

The Gr-I treatment was found to be the most efficacious as compared to Gr-II and Gr-III treatments against the mixed infection of CPV and CCV.

There was significant decrease in temperature, vomition, diarrhoea and depression in successive days indicating normalcy at the end of fifth day treatment (Table-20,21,22).

CHAPTER - V

DISCUSSION

DISCUSSION

Canine gastroenteritis is caused by various aetiological agents with varied intensity and morbidity. The viral gastroenteritis in dogs is a dreadful ailment exhibiting a complex nature of enteric syndrome. Canine parvo virus and corona virus, either single or in association, are the predominant viral pathogens to augment the intense clinical pathogenesis of gastroenteritis. The first autonomous parvo virus recognized in dog was "minute virus of canines (MVC) (Binn *et al.*, 1970). The minute virus of canine is now referred as canine parvo virus-1 (CPV-1). The canine parvo virus-2 (CPV-2) was discovered in 1978 (Appel *et al.*, 1978). Now canine parvovirus gastroenteritis prevails world wide in distribution affecting a sizeable canine population.

The data obtained from the case records of some important veterinary hospitals/dispensaries and private clinics in Orissa over a period of 5 years from 1990-91 to 1994-95 revealed that the prevalence of canine gastroenteritis was 21.88% (7573 out of 34601 cases).

Similar data are not available in Orissa. But the clinical experiences during past few years indicated an increased incidence of gastroenteritis in dog population in urban and rural areas as well. This may be attributed to the factors like poor management practice, inadequate housing space, unhygienic environmental condition and careless feeding with indigestible food of poor quality and excess quantity. The drinking water of pet dog might be contaminated. This may be added by very poor attention of the pet owners for routine and required feeding and to refrain the pets from willful access to any type of unnecessary food stuffs.

Search through the records of veterinary hospitals/ dispensaries/ clinics revealed the incidence of gastroenteritis in dogs as 51.07% in male and 48.92% in females. From this observation it was concluded that in Orissa the prevalence of canine gastroenteritis was found to be little higher in male dogs than in females. A search through literatures did not accord similar findings from case records of a region/ locality. How ever, Fluckiger (1980) recorded gastroenteritis due to CPV infection to be more prevalent in males as compared to the females. Banja (1999) studied a viral haemorrhagic gastroenteritis due to CPV and CCV in dogs in Orissa in clinical cases and observed that incidence rate was 46.1% in males and 53.8% in females which was in contrast to the findings of Fluckiger (1980). From this it might be assumed that the prevalence of canine gastro- enteritis might not be influenced by sex factor, rather it might be attributed to the managemental and hygienic factors for individual dog.

Observation from the records reviewed for the study indicated that out of 7537 clinical gastroenteritis cases 41.96%, 28.04%, 18.05%, 9.00% and 2.93% cases were recorded in the age group of 3 months, 4-6 months, 7-9 months, 10m-1 year and above 1 year respectively. No such study has been conducted on the incidence of gastroenteritis of various aetiological factors in Orissa. The study on viral gastroenteritis in dogs due to CPV and CCV infection in Orissa showed that out of 171 natural clinical cases of gastroenteritis due to CPV and CCV infection only 28 cases, 40 cases, 29 cases and 74 cases were found to be in the age group of $\leq$ 3 months, > 3-6 months, > 6-12 months and > 12 months respectively indicating that such type of gastroenteritis occurred more frequently in the young canine population in Orissa. But our present findings indicated that comparatively higher incidence rates of gastroenteritis were encountered in younger pups. No other similar literature are available for discuss. Such type of work is quite new in the state of Orissa.

In the present study the breed wise prevalence of canine gastroenteritis obtained from the records indicated that 35.99% cases, 28.00% cases, 26.00% cases and 9.99% cases were encountered in Doberman, Alsatian, Tibetan apso and other non-descriptive breeds of the dog in order. This overted that Doberman was the most susceptible breed to gastroenteritis followed by Alsatian, Tibatan apso and other indigenous breeds in the locality of the state of Orissa. Similar findings are not available through literature for comparison and discussion. The overall scenario of observation from the records of different veterinary hospitals /dispensaries /clinics of Orissa indicated that gastroenteritis in canine population shares about 22% of the total ailments.

During the study period from 1990-91 to 1994-95, 592 faecal samples were examined out of which 189 samples (31.92%), 44 samples (7.43%), 136 sample (22.97%), 325 samples (54.89) and 130 samples (30.40%) were detected by Dot-ELISA to be positive for single infection of CPV, single infection of CCV, mixed infection of CPV and CCV, total CPV (single and mixed) and total CCV (single and mixed) infections respectively. Roseto *et al.* (1980) reported 23.2% incidence of CPV infection in Paris during 1979. Bill *et al.* (1981) recorded the incidence of CPV infection as 78% in the USA. Hinaidy (1981) reported an incidence of 27.41% for CPV infection in Australia whereas an incidence of 52% infection for CPV was reported by Neill *et al.* (1981) in the UK A higher percentage of incidence (63.63%) of CPV infection was recorded by Sandstedt and Wierup (1981) in Sweden; Chew-Lim *et al.* (1982) reported a still higher percentage of incidence (75.5%) of CPV infection in Singapore and Malaysia in between July 1981 to September 1982. Mohri *et al.* (1982) reported an incidence of 16.7% of CPV infection in Japan. Hammond and Timoney (1983) reported an incidence of 48% of canine parvo virus infection in NewYork and the USA. They also reported the incidence as 11% in 1979, 41% in 1980 and 44% in 1981 during their 3 years study.

Mizak and Mizak (1994) reported an incidence of 33.3% of CPV infection in Putty, Poland which is in approximate agreement with our present finding of 31.92% of CPV infection.

Narasimhaswamy (1988) recorded an incidence rate of 34.7% for CPV infection in Bangalore (India) whereas Rao in 1988 reported the incidence of CPV to be 39.5% in Bangalore. Mohan *et al.* (1992) recorded an incidence of about 92% in and around Ludhiana city while examining the cases of canine gastro enteritis. Saseendranath *et al.*(1992) reported an incidence of 28% of CPV infection in Madras. Joshi *et al.* (1998) reported an incidence of 19.7% of CPV infection in Panthanagar, U.P.

Banja (1999) during his studies on viral haemorrhagic gastroenteritis in dogs reported an incidence of 29.80% of CPV single infection, 6.4% for CCV single and 24.5% for mixed infection of CPV and CCV in and around Bhubaneswar, Orissa.

The variation in incidence of CPV infection ranging from a low incidence of 16.7% to a high of 92% in different parts of the world may be attributed to the propensity of the virus in the endemic areas and preventive vaccination measures. In Orissa, the incidence does not make much difference as incidence recorded in our study and the incidence reported by Banja swings in between 30 and 32%. This might be explained due to the same locality and alike population with approximately the same preventive health care measure, sanitation and care and management system adopted by the pet owners.

As regards to the prevalence of corona virus infection in dogs the literatures revealed a varied range of incidence rate of CCV in different parts of the world as well as in India. Schnagl and Holmes (1978) reported an incidence of 41.3% of corona virus infection from 3 (three) isolated country areas of Australia. Arens and Krauss (1980) noted an incidence of 5.6% of CCV infection in German Federal Republic whereas Hoffmann *et al.* (1980) reported the incidence rate to be 8.6% in the same year, Benary *et al.* (1981) recorded an incidence of 8.2% and Roseto *et al.* (1980) recorded an

incidence of 21.42% of CCV infection in Paris, France whereas 73.3% of incidence of CCV infection was documented by Thery (1980) in the same city indicating a very high incidence rate. In contrast to these incidence report Hammond and Timoney (1983) in USA investigating for a period of 3 years from 1979-1981 registered a very low prevalence rate of 0.27% of CCV infection screening 1100 samples from the dogs showing gastroenteritis.

Ganesan *et al.* (1990) reported prevalence of CCV infection to be 2.88% in Madras city. An incidence rate of 7.43% of CCV (single) infection in Orissa was recorded during the present investigation in contrast to the incidence rate of 24.56 % recorded by Banja (1999).

The above fact sheet providing the background information of incidence rate of CCV infections in different parts of the world projected that such wide variation of CCV infection might be attributed to the local factors among pet dog population. The present findings is in approximate agreement with the findings of Hoffman *et al.* (1980) who reported the incidence of 8.6% from German Federal Republic.

In the present study of detection of mixed infection of CPV and CCV by Dot-ELISA revealed an incidence rate of 22.97% among the dog population in Orissa. But Banja (1999) detected the mixed infection of CPV and CCV infection in dogs of Bhubaneswar, Orissa to be 40.3% in prevalence.

The prevalence of mixed infection of CPV and CCV had been recorded by Mostel *et al.* (1994) as 0.82% in Australia, by Hoffmann *et al.*(1980) as 2.8% in German Federal Republic, by Roseto *et al.* (1980) as 8.9% in Paris, France, Hoffmann and Pock (1981) as 3.33% in German Federal Republic and by Studdert *et al.* (1983) as 4% in USA.

A low incidence rate of mixed infection of CPV and CCV in Australia, German, France and USA might be due to better management systems of dog owners under good hygienic condition as compared to those in Orissa. Therefore, a comparatively higher incidence rate was encountered in the state of Orissa, India.

In the present study the prevalence of canine parvovirus infection (single and mixed) in totality in the state of Orissa as registered in the records of different hospital / dispensaries was found to be 54.89%. In the same locality of Orissa, Banja (1999) recorded an incidence rate of 54.3% of CPV infection. Ramadass and Khader (1982) reported the incidence of parvovirus infection in dog to be 51.72% in city of Madras, India. Sherikar and Paranjape (1985) reported an incidence of 72% of canine parvovirus infection in and around Bombay city. Narasimhaswamy (1988) reported the incidence of parvovirus infection in dogs in Bangalore as 34.7% whereas Rao (1988) reported the incidence to be 39.5% in the same city, but Udupa & Sastry (1996) reported the incidence of CPV infection as 28.6% among pet dogs and 91% among stray dog population in Bangalore city. Mohan *et al.* (1992) reported from Ludhiana city the incidence of canine parvovirus infection to be as high as 92% whereas Mohan *et al.* (1993) also reported the incidence of CPV as 45% in the same area. Gunaseelan *et al* (1993) reported the incidence of CPV infection to be 63% in Madras. Subhashini *et al.* (1997) reported the incidence of CPV infection to be 56.6% in and around Madras city. Hoffman *et al.*(1980) recorded the incidence of mixed infection of canine parvo and corona virus to be 2.8% in Frankfurt region of German Federal Republic. Present finding of incidence rate of 54.89% of CPV infection is in agreement with the findings of Banja (1999) who recorded approximately the same incidence rate of 54.3%. The varied incidence rate of canine parvovirus infection in India and abroad may be attributed to the local factors of management, hygiene and prevalent agro climatic conditions of the locality.

As regards to prevalence of canine corona virus infection (single and mixed) the present study revealed an incidence of 0.10%. Tennant *et al.* (1993) reported a prevalence rate of 45% in e rescue kennel in UK. Bielsker (1994) recorded the incidence of rona virus infection of 30% in kennel reared dogs which proximates the present findings in our study. Mostel *et al.* 994) ,Shaw *et al.* (1995) , Vieler and Herbst (1995) and Sekar

In the present study the prevalence of canine parvovirus infection (single and mixed) in totality in the state of Orissa as registered in the records of different hospital / dispensaries was found to be 54.89%. In the same locality of Orissa, Banja (1999) recorded an incidence rate of 54.3% of CPV infection. Ramadass and Khader (1982) reported the incidence of parvovirus infection in dog to be 51.72% in city of Madras, India. Sherikar and Paranjape (1985) reported an incidence of 72% of canine parvovirus infection in and around Bombay city. Narasimhaswamy (1988) reported the incidence of parvovirus infection in dogs in Bangalore as 34.7% whereas Rao (1988) reported the incidence to be 39.5% in the same city, but Udupa & Sastry (1996) reported the incidence of CPV infection as 28.6% among pet dogs and 91% among stray dog population in Bangalore city. Mohan *et al.* (1992) reported from Ludhiana city the incidence of canine parvovirus infection to be as high as 92% whereas Mohan *et al.* (1993) also reported the incidence of CPV as 45% in the same area. Gunaseelan *et al* (1993) reported the incidence of CPV infection to be 63% in Madras. Subhashini *et al.* (1997) reported the incidence of CPV infection to be 56.6% in and around Madras city. Hoffman *et al.*(1980) recorded the incidence of mixed infection of canine parvo and corona virus to be 2.8% in Frankfurt region of German Federal Republic. Present finding of incidence rate of 54.89% of CPV infection is in agreement with the findings of Banja (1999) who recorded approximately the same incidence rate of 54.3%. The varied incidence rate of canine parvovirus infection in India and abroad may be attributed to the local factors of management, hygiene and prevalent agro climatic conditions of the locality.

As regards to prevalence of canine corona virus infection (single and mixed) the present study revealed an incidence of 30.10%. Tennant *et al.* (1993) reported a prevalence rate of 45% in the rescue kennel in UK. Bielsker (1994) recorded the incidence of corona virus infection of 30% in kennel reared dogs which approximates the present findings in our study. Mostel *et al.* (1994) ,Shaw *et al.* (1995) , Vieler and Herbst (1995) and Sekar

et al (1998) reported incidence rate of CCV infection as 60% in Australia, 39.5%, 13.4% and 15.3% in Madras respectively. Banja *et al.* (2002) reported an incidence rate of 24.56% of corona virus infection in Orissa. This pattern of variation ranging from 12.4 to 60% might be attributed to the factors of management, hygiene and local agro-climatic conditions. Besides the variation might have emanated from the rearing process of the dogs in different localities of world, being closely associated with the endemic pockets of CCV infection at different places.

The prevalence of canine parvovirus and corona virus altogether revealed an incidence rate of 62.33% in the state of Orissa. Banja *et al.* (1999) reported a higher rate of incidence of canine viral gastroenteritis due to CPV and CCV infection altogether in state of Orissa. This higher rate of incidence as compared to present finding might be due to lack of preventive control measure especially in practicing preventive vaccination measure in Orissa during these years. The gradual awareness of this dreadful viral gastroenteritis has developed consciousness among the pet owners of Orissa to adopt the preventive vaccination measure regularly. Janthur (1987) reported from German Federal Republic an incidence of 62% of CPV and 38% of CCV infection. Mohan *et al.* (1992) reported an incidence of 92% of canine viral gastroenteritis in and around Ludhiana. Mizak and Mizak (1994) reported an incidence of 33.3% of canine viral gastroenteritis in Poland. Though these finding are in contrast to our present findings yet it indicates that a higher percentage of canine gastroenteritis is due to CPV and CCV infection with the increased replacement of indigenous dog population with the susceptible exotic breeds in the localities of the state of Orissa. During the present investigation of canine gastroenteritis 37.66% of cases are screened aetiologically to be due to other agents than CPV and CCV infection . Out of these 23.14% was due to endoparasitic infection which is in agreement with Banja *et al.* (1999) who reported the incidence as 23.3% in Orissa.

During the present investigation the detection of endoparasites in the faecal sample of dogs affected with gastroenteritis amounted to 23.14% which was comprised of 7.93% for *Ascaris*, 6.92% for *Ancylostoma* spp., 1.52% *Strongyloids*, 0.84% for *Dipylidium caninum*, 1.01% for Coccidia and 4.89 % for mixed infection. The total number of faecal samples found positive for endoparasite with CPV and/ or CCV infection were 9.96%. Similar observation was recorded by Banja (1999) who found the total number of samples positive for parasitic ova to be 23.3% and for CPV and/ or CCV with parasitic infection to be 9.3%.

In the present study the detection of viral antigen of CPV and CCV (single and mixed) from faecal materials was carried out by Dot-ELISA and HA for CPV and Dot-ELISA and RPHA for CCV. Dot-ELISA detected 31.92% cases of single infection of CPV., 7.43% of single infection of CCV, 22.97% of mixed infection of CPV & CCV, 54.89% of total CPV infection (single and mixed) and 30.15% of total CCV infection (single and mixed). Dot-ELISA test was found to be a standard test for detection of parvovirus and considered as 100% sensitive. At present many diagnostic tests are used for detection of CPV and CCV but Dot-ELISA which is a modification of standard ELISA is a very sensitive solid phase immunosorbent assay of antigen and antibody reaction, (Boctor *et al.* 1987). Mathys *et al.* (1983 b) used the faecal material of dog for screening parvo virus and opined that faeces is a standard source for detecting parvovirus. Mildbrand *et al.* (1984) also considered faecal material of dog was a standard and major source of parvovirus. Bielsker (1994) considered faecal material to be the major source of corona virus antigen. Mathys *et al.* (1983) reported that $>10^9$ $TCID_{50}$/gm of faeces were shed at the acute stage of infection. Appel *et al.* (1980), Jacob *et al.* (1980) Valicek *et al.* (1981),Danner and Weber (1983) and Ezeokoli *et al.* (1985) considered faecal material of dogs as a very good source of canine parvo virus.

On the above backdrop, the faeces of the dog affected with CPV and CCV was taken as a standard test material for diagnosis of canine parvo and corona virus. Mathys *et al.* (1983b) were able to detect CPV antigen in 83% of samples of affected dogs. Mildbrand *et al.* (1984) reported that Dot-ELISA test was found very suitable to detect the CPV antigen quickly. Teramoto *et al.* (1984) recommended ELISA as a sensitive and specific diagnostic test for detection of CPV antigen. Herbst *et al.* (1986), Martinello *et al.* (1996), Zarkov *et al.* (1996) and Banja *et al.* (2002) reported that Dot-ELISA test detected 50.7%, 36.5%, 75% and 54.4% of faecal samples to be positive for CPV antigen respectively. The present finding in our study approximates to the findings of Banja *et al.* (2002). Banja (1999) detected 24.5% of CCV infection by Dot-ELISA whereas the present finding was of 30.10%. Kolbl *et al.* (1990) detected CCV antigen in 35.4% of faecal samples through commercial Elisa. Rimmelzwaan *et al.*(1991) successfully modified W-Antibody sandwich Elisa for quick estimation of CCV in faeces of affected dog. Tuchiya *et al.* (1991) were able to detect CCV antigen in faeces of affected dog with in an appreciably short time. The sensitivity of Dot-ELISA was found to be 100% reliable and is considered as a most suitable standard method for detection of parvo and corona virus infection.

Out of 592 faecal samples 302 samples were detected for CPV antigen through haemagglutination test. In the present study Dot-ELISA and haemagglutination tests were equally sensitive in detection of canine parvovirus antigen in the faecal material. Haemagglutination test was not able to detect the corona virus antigen in single and mixed infection of parvo and corona virus faecal materials.

Jacob *et al.* (1980) detected CPV from the faeces of 96 out of 134 (71.6%) dogs suffering from canine gastroenteritis by haemagglutination test. Klingeborn and Lopez (1980) detected CPV in faeces of 26% of dogs with gastroenteritis through HA test. Valicek *et al.* (1981) detected CPV antigen in 50% of the faecal

materials by haemagglutination test which is nearly in agreement with our findings in present study. Meerarani *et al.*(1998) reported 51.7% of canine parvovirus antigen through HA test in the faecal samples of the dogs showing the symptoms of gastroenteritis. This finding of Meerarani is in agreement with the findings of the present study. Banja (1999) detected 50.2% CPV antigen in the faecal samples of dogs showing the symptoms of gastroenteritis through HA test in the same locality of Orissa where the present study was carried out revealing an incidence of 51.013% assessed through HA test. This similarity in the findings through HA test for CPV antigen might be attributed to almost the same climatic condition and managemental practices of pet dog rearing . On the contrary Joshi *et al.* (2001) detected 80% of canine parvovirus antigen through HA test. The H.A. titre value of $\geq$1:64 was considered as a safe margin of titre value at 1% concentration of Porcine Erythrocyte (Carmichael *et al.* 1980). Celer *et al.* (1984), Ezeokoli *et al.* (1985), Szaniszlo & Horvath (1989), Mohan *et al.* (1992), Udupa & Sastry (1997), Meerarani *et al.* (1998), Joshi *et al.* (2001) and Banja *et al.* (2002) have taken this value as a standard for HA test to detect CPV antigen. In the present study haemagglutination titre of faecal samples were taken as positive for CPV antigen at $\geq$ 1.:80 HA titre. This has been found to be a very useful diagnostic test for canine parvovirus infection.

In the present study RPHA titre was considered negative at 1:4 and positive at $\geq$ 1:8 for CCV infection. Scott. (1991) described this method to be suitable for detection of CCV at faecal titre $\geq$ 1:8. But RPHA was not able to detect CPV infection. It was only able to detect 17.56% of fecal materials to be positive for CCV as compared to 30.10% of faecal samples detected positive for CCV by Dot-ELISA. The present observation indicated that RPHA was found inferior to Dot-ELISA test. Banja (1999) detected 18.1% samples positive for CCV antigen through RPHA test as compared to 30.9% of faecal samples detected positive through Dot-ELISA. The

findings of Banja (1999) is in agreement with the present finding However Shaw *et al.* (1995) found 39.5% of faecal samples from the dogs affected with gastroenteritis to be positive for CCV antigen by RPHA test.

The comparison of sensitivity of Dot-ELISA, HA test and RPHA test indicated that Dot-ELISA was found as a standard diagnostic test for detection of CPV and CCV faecal antigens and was considered as 100% sensitive followed by 92.92% sensitive for HA and 57.77% sensitive for RPHA. On comparison of the above tests Dot-ELISA was credited to be the best for detection of CPV and CCV infections.

Out of 592 cases 42.06% 31.72%n, 7.22%, 22.89%, 54.61%, 30.12% and 61.84% cases were under the age group of 3 months for CPV single infection, CCV single infection, CPV and CCV mixed infection, total CPV infection, total CCV infection and total canine viral gastroenteritis cases due to CPV infection and CCV infection respectively indicating more than 61% of cases were within the age group of 3 months. Fluckiger (1980) reported 50% of cases were within the age groups of 3 months whereas in the present study the higher rate of prevalence was recorded within the age group of 3 months. Bielsker (1994) recorded a higher rate of corona virus infection of 30% in kennel reared dogs within the age group of 6-16 weeks. Jacob *et al.* (1980) reported that the young pups were mostly affected with CPV infection. Banja (1999) recorded 28.5%, 3.5%, 46.4%, 75%, 50% and 78.5% of cases below 3 months of age for single infection of CPV , single infection of CCV, mixed infection of CPV and CCV, total infection of CPV, total infection of CCV and total infection of CPV and CCV (single and mixed) respectively. He registered 78.5% of cases within the age group of 3 moths as against our present finding of 61% .This variation, in the state of Orissa, more or less in the same locality may be explained for rearing practice of pups in a better hygienic way as compared to the

previous years and vaccinations of adult dogs against CPV and CCV.

Age wise prevalence from 4-6 months of age groups was recorded in present study as 31.92% for single infection of CPV, 7.22% for single infection of CCV, 22.28% for mixed infection of CPV and CCV, 54.21% for total CPV infection, 29.51 for total CCV infection and 61.44% for total viral gastroenteritis due to CPV and CCV infection. In the same age group Banja (1999) recorded the incidence of 34.5% for single CPV infection, 6.8% single CCV infection, 17.2% for mixed infection of CPV and CCV, 30% for mixed CPV and CCV infection, 57.5% for CPV (single and mixed) infection, 47.5% for CCV (single and mixed) infection and 75% for total canine viral gastroenteritis due to CPV and CCV infections.

The present investigation revealed that the total incidence of canine gastroenteritis of CPV and CCV infection has reduced remarkably in the recent years in the same locality of Bhubaneswar which may be again attributed to the hygienic rearing of the pet dog with good nutrition and better health care measures. Ramadass and Khader (1982) reported that majority of gastroenteritis cases due to CPV and CCV infection were observed in young dogs below 6 months of age in Madras city. Horner (1983) reported 69% of cases of parvo viral gastroenteritis were within the age group of 6 months in New Zealand. Studdert *et al.* (1983) recorded an incidence of CPV infection as 79% of the total cases in Colorado, USA. Ganesan *et al.* (1990) reported the prevalence of parvo viral canine gastroenteritis as 58% among the affected dogs within the age groups of 6 months of age. The variation in the rate of incidence of canine gastroenteritis due to CPV and CCV infection recorded by various workers in different parts of the world may be due to variation in health care measures as regards the preventive vaccination and managemental practice, nutrition, care and housing of the pups. It is evident from the above data that the

younger dogs within the age groups of 6 moths throughout the world are most susceptible victims for CPV and CCV infection.

The present observation on age wise prevalence of canine parvo virus and corona virus infection revealed that single CPV infection, single CCV infection, mixed CPV and CCV infection, total CPV infection (mixed and single), total CCV infection (mixed and single) and total CPV and CCV (mixed and single) infection were recorded as 32.07%, 7.54%, 21.69%, 53.77%, 29.24% and 61.32% of incidence rate respectively among the dogs within the age group of 7-9 months. Banja *et al.* (1999) reported the incidence rate of 34.4%, 6.8%, 17.2%, 51.7%, 24.1% and 58.6% for single infection of CPV, singe CPV infection, single CCV infection, mixed CPV and CCV infection, total CPV infection (mixed and single), total CCV infection (mixed and single) and total CPV and CCV (mixed and single) respectively. Both the findings of present study and earlier study of Banja (1999) indicated that the incidence rate of canine gastroenteritis due to CPV and CCV infection was reduced with the advancement of the age of dog. Udupa and Sastry (1996) recorded the incidence of canine parvoviral gastroenteritis as high as 71.4% among the dogs between 7-9 months of age in Bangalore city. Rao *et al.* (1983) reported high incidence of canine parvovirus infection in the dogs of Madras city below 9 months. From the available literature it is overted that older dogs are comparatively less susceptible to parvoviral gastroenteritis.

In the age groups of 10 months to 1 year the incidence rate was recorded as 32.07% for CPV infection alone, 7.54% for CCV infection alone, 20.75% for CPV and CCV mixed infection, 52.83% for total CPV infection (single and mixed). 28.30% in total CCV infection (single and mixed) and 60.37% of total CPV and CCV infection (single and mixed). Ezeokoli *et al.* (1985) reported 61% of incidence rate of canine gastro- enteritis due to parvo virus infection in dogs of 1 year old. This finding is similar to the findings in the present study for prevalence of canine gastroenteritis among the dogs of 1 year of age.

Among the dogs above 1 year of age the prevalence of canine parvo virus single infection, canine corona virus single infection, CPV and CCV mixed infection, total CPV infection (single and mixed), total CCV infection (single and mixed) and total incidence rate of canine gastroenteritis due to parvo virus and corona virus were recorded as 27.77%, 5.55%, 22.22%, 50%, 27.77% and 55.55% respectively in the city of Bhubaneswar, Orissa. Banja (1999) recorded the rate of incidence among the dogs above 1 year as 29.7% for single CPV infection, 1.3% for single CCV infection, 16.2% of mixed infection of CPV and CCV, 45.9% for mixed and single infection of CPV , 17.5% of mixed and single infection of CCV, 47.2% single and mixed infection of CPV and CCV. The present work has covered many urban and rural parts of state of Orissa which gave an idea of different types of managemental, hygienic and preventive measures for the health of the pet dogs under varied agro climatic zones of the state. Generally the urban pet owners are more conscious for health measure of the pet dogs than those in rural areas. Banja (1999) though worked in recent past, his study was only confined to the city of Bhubaneswar where the pet owners were very conscious for the health of their pets. This might be the reason for lower incidence rate of canine parvo viral gastroenteritis. Mizak and Mizak (1994) reported a comparatively low incidence of 33.3% of parvo viral gastroenteritis in Putty, Poland where the pets were reared under better hygienic care and managemental practices.

The present investigation of clinical cases of canine parvo and corona viral gastroenteritis revealed the sex wise prevalence of CPV and CCV infections as 16.21% /15.70% for CPV single, 3.88% /3.54 for CCV (single), 11.65%/11.31% for CPV and CCV (mixed), 27.87%/ 27.02% for total CPV (single and mixed) infection, 15.54%/14.89% for total CCV (mixed and single) infection and 31.75%/ 30.57% of total incidence rate of male/ female dogs. Banja (1999) recorded the incidence rate of male/ female as 41.1% /58.8% in single CPV infection, 54.5%/ 45.4% in single CCV infection, 50%/

50% in mixed infection of CPV and CCV, 45.1%/ 54% in total CPV (single and mixed) infection, 50.9% / 49% in total CCV infection (single and mixed) and 46.1%/ 53.8% in total CPV and CCV infection (single and mixed). The overall scenario of the present study indicated that the male dogs were comparatively more susceptible than female dogs to all types of CPV and CCV infections. The findings of Banja (1999) indicated female dogs were more susceptible than male for CCV infection (single and /or mixed infection). But male dogs were found to be more susceptible for CCV infection. He recorded an equal ratio of male and female to be affected with CPV and CCV (mixed) infection whereas the present finding revealed a higher side in prevalence rate in male for CPV and CCV (mixed) infection). Fluckiger (1980) reported that the sex wise prevalence of canine parvo virus was found more in males as compared to female pups. This is in agreement with our present findings. Besides, Prange *et al.* (1982) recorded 72% of total mortality in young male dogs as compared to females and observed also a higher incidence of CPV gastroenteritis in male as compared to female dogs.

The breed wise prevalence of CPV and CCV infections (mixed and single) during the study of clinical cases of canine gastro enteritis revealed an incidence rate of 11.48%, 8.95%, 8.27% and 3.20% of CPV single infection in Doberman, German shepherd. Tibetan apso and other non descript breed respectively. Banja *et al.* (1999) recorded CPV infection as 28.5% in Doberman, 40.9% in German shepherd and 16.6% in non descript breed in the locality of Bhubaneswar. The variation in these two types of study may be due to greater population of Doberman breed throughout Orissa in comparison to German shepherd precipitating more number of cases among Doberman breed throughout Orissa. In the present study also more number of Doberman (213) were screened as against German shepherd (166) for canine gastroenteritis out of which 133 Doberman dogs were found to be affected with gastroenteritis as against 103 German shepherd dogs. In contrast to

this observation Guo and Xu (1986) reported that the Doberman puppies were found to be resistant to CPV infection. Pospischil and Yamaho (1987) recorded higher incidence rate among German shepherd breed in comparison to other breeds. Houston *et al.* (1996) observed that Doberman and German shepherd breeds were at greater risk of CPV infection as compared to mixed breed dogs. Rodriguez *et al.* (1998) reported that Rottweilers breed was more susceptible than other breeds for CCV infection in Spain. The breed susceptibility expressed by various workers might be attributed to predisposed hereditary immune deficient factor.

The incidence rate of CCV single infection was recorded in the present study, as 2.70% in Doberman, 2.02% in German shepherd, 2.02 in Tibetan apso and 0.67% in non descript breed. Banja (1999) recorded an incidence of CCV infection as 14% in Doberman, 4.5% in German shepherd and 5.5% in non descript type indicating that indigenous breeds were more susceptible than pure breed like Doberman and German shepherd. Our findings recorded a very low incidence of CPV infection in indigenous breed as compared to pure breed like Doberman, German shepherd and Tibetan apso. This low incidence rate of CPV infection in non descript breeds might be explained as indigenous breeds are more resistant to CCV infection than pure breeds which are often considered susceptible to so many infections. In contrast to these findings many other workers like Janthur (1985), Ramadass and Khader (1982), Sherikar and Paranjape (1985) had observed no breed wise variation in prevalence of canine parvo virus and canine corona virus infection.

The incidence of CPV and CCV mixed infection was found in the present investigation to be 8.27% in Doberman, 6.48% in German shepherd, 5.91% in Tibetan apso and 2.36% in indigenous breeds of dog indicating a higher incidence rate in Doberman breed followed by Alsatian, Tibetan apso and non descript breed. This incidence pattern also was observed in single infection of CPV and CCV in these breeds. The incidence of total CPV infection (single and mixed) was recorded in present study as 19.76% in Doberman,

15.37% in Alsatian, 14.19% in Tibetan apso, 5.57% in indigenous breed depicting a higher rate of incidence in Doberman breed which is in agreement with the findings of Banja *et al.* (1999). The incidence rate of total CCV infection was recorded as 10.97% in Doberman, 8.44% in Alsatian, 7.93% in Tibetan apso and 3.04% in non descript breed which indicated the lowest prevalence rate in the indigenous breed as compared to Doberman, Alsatian and Tibetan apso. Banja also reported the incidence rate of CCV infection in non descript breed to be lower in comparison to Doberman and German shepherd. The available literature is devoid of information for such type of comparative study among different breeds for prevalence of corona virus. On the whole the prevalence of gastroenteritis in dogs due to CPV and CCV infection was found to be 22.46% in Doberman, 17.69% in Alsatian, 16.21% in Tibetan apso and 6.25% in indigenous breeds indicating that the disease was more prevalent in Doberman followed by Alsatian, Tibetan apso and other non descript breeds. The present study revealed that all the breeds of dog were found to be suffering from canine gastroenteritis due to CPV and CCV infection. Despite the variation in incidence rate, Banja (1999) suggested that all types of breeds are susceptible for canine gastroenteritis due to CPV and CCV infection which is in agreement with the present findings.

The dogs affected with parvo and corona viral gastroenteritis exhibited varied symptoms of dullness, depression, vomition, fever, diarrhoea, haematemesis, anorexia, dehydration and anaemia. One hundred eighty six (98.42%) out of 189 affected dogs manifested severe vomition in canine parvo virus infection. The affected dogs manifested the symptoms of fever, diarrhoea without blood flecks, foetid diarrhoea with blood flecks, haematemesis, anorexia, dehydration and anaemia as 97.88%, 70.89%, 25.39%, 19.04%, 97.36%, 40.21% and 33% respectively. From this observation it was evident that vomition, fever, diarrhoea, depression and dehydration were found to be most predominant diagnostic symptom. Severe anaemia and haematemesis were other relevant signs causing

mortality. The present study recorded the mortality rate above 47% which demonstrated the severe form of fatality. Eugster and Nairn (1977) reported that the dogs affected with CPV infection manifested vomition, diarrhoea, haematemesis in Texas, V.A. They recorded sudden death in puppies due to acute myocarditis. Appel (1978), Thomson and Gagon (1978), Mc Candlish *et al.* (1979), Pollock and Carmichael (1979), Walker *et al.* (1979), Groulade (1980), Hoffman and Pock (1981), Ramadass and Khader (1983), Stan *et al.* (1984), Joshi *et al.* (2001) and Ramprabbu *et al.* (2002) also recorded same type of clinical manifestations in parvo viral gastroenteritis. The present findings is in agreement with the findings of previous workers.

In parvovirus infection Nelson *et al.* (1979) recorded morbidity to be 100% and mortality rate to be 10 to 50% in severely affected pups. Panjevic *et al.* (1981) recorded the mortality ranged from 10 to 50% as against our present finding of 47.08%. Jedlizoka (1980) reported a mortality rate of 53% in parvo viral gastroenteritis cases whereas Hoffman and Pock (1981) recorded a mortality rate of 23%.

The dogs affected with canine corona virus manifested vomition in 93.18% of cases, fever in 11.36%, diarrhoea without blood flecks in 15.90%, depressed appetite in 90.90%, dehydration in 9.09% and anaemia in 11.36% of cases. From the present findings it was evident that diarrhoea,vomition and anorexia were the common predominant symptoms in corona viral gastroenteritis. The mortality per cent in this disease was observed to be low as compared to parvo viral infection. Binn *et al.*(1974), Keenan *et al.* (1976), Appel *et al.* (1978), Vandenberghe *et al.* (1980), Charmichael and Binn (1981), Ganesan *et al.* (1990) and Banja (1999) also recorded the similar symptom in the dogs affected with canine corona virus. Binn *et al.* (1974), Vandenberghe *et al.* (1980), Carmichael and Binn (1981) and Bielsker (1994) recorded very low mortality in affected dogs. The findings of the above workers were almost in agreement with the findings of present study.

The mixed infection of CPV and CCV manifested the symptoms of vomition as 98.52%, fever as 91.91%, diarrhoea without blood flecks as 75.73%, diarrhoea with blood flecks as 23.52%, haematemesis as 18.38%, depressed appetite as 99.26%, dehydration as 45.58% and anaemia as 44.11%. Vomition, fever, foetid diarrhoea with or without blood flecks, anorexia, dehydration and anaemia were encountered as predominant diagnostic clinical symptoms of CPV infection. In case of mixed canine parvo and corona viral gastroenteritis the higher rate of mortality suggested unfavorable prognosis.

Hoffmann *et al.*(1980) reported diarrhoea, vomition and fever as important clinical manifestations in mixed infection of CPV and CCV infection. Roseto *et al.* (1980), Hoffmann and Pock, (1981), Studdert *et al.* (1983), Janthur (1987) and Banja (1999) observed vomition, diarrhoea and fever as predominant clinical signs in mixed infection of CPV and CCV infection.

The findings for clinical symptoms are in agreement with the findings of Yasoshima *et al.* (1983) and Janthur (1987) who observed the symptoms of acute vomition, fever and diarrhoea streaked with blood.

The parvo and corona virus infection was established experimentally in pups by keeping them in close contact with the naturally infected pups under close observation and constant monitoring for a period of 1 month. Ten out of 12 experimental pups were found to develop the symptoms of fever (103°-104.6° F), increased pulse rate i.e. 92-99/ min, vomition, dehydration, yellowish foetid diarrhoea with blood flecks and anorexia within seven days. The faecal samples of these experimental pups were assessed by Dot-ELISA confirming the infection as CPV and CCV in experimental pups. Eugster (1980) conducted a study on experimentally CPV infected dogs and reported that the infections were established and the symptoms of depression, dullness, fever, anorexia, vomition and diarrhoea were exhibited. Azetaka *et al.* (1981) observed vomition and haemorrhagic diarrhoea in

experimentally infected pups. Joshi *et al.* (2001) observed the symptoms of diarrhoea, vomition, mild dullness and anorexia from 6^{th} day post infection and onwards. They observed also moderate rise of temperature on 5^{th} day of post infection. This finding is nearly in agreement with present findings in experimentally infected pups. McCandlish *et al.* (1981) conducted experimental study on CPV infection and reported that disease was highly contagious and was transmitted easily via faeces. This is similar to our present experimental study.

During the study of heamatological profile of infected pups in CPV and CCV infection it was observed that mean haemoglobin value with standard error was found to be 8.58±0.07 g% in canine parvo virus infection, 10.80±0.03 g% in canine corona virus infection and 12.40±0.02 g% in apparently healthy pups indicating that a lower haemoglobin value was recorded in parvovirus infection comparison to the haemoglobin value in corona virus infection. In both the infections haemoglobin value was found remarkably lower as compared to the value recorded in apparently healthy control pups. This indicated that the pups infected with canine parvo virus were found to be more anaemic due to presence of severe haemorrhagic diarrhoea and the pups affected with corona virus exhibited comparatively less anaemic condition. In canine corona viral diarrhea the quantity of blood voided was moderate. The haemoglobin % was limited to a apparently moderate level as compared to healthy control group. Mohan *et al.* (1993) reported a decreased level of haemoglobin in the parvo virus infection, Dhanapalan *et al.* (1993) and Rai *et al.* (1994 b) also recorded reduced value of haemoglobin in parvo viral enteritis. Ramprabhu *et al.* (2002) recorded the mean haemoglobin value as 4.25±0.89 g% in canine parvo virus infection. The present finding of the mean haemoglobin value in parvo virus infections is in agreement with the findings of Mohan *et al.* (1993), Dhanapalan *et al.* (1993) and Rai *et al.* (1994 b). Reduced haemoglobin value in parvo virus infection indicated normocytic, hypochromic anaemia in sick animal. The

mean value of total leucocyte count was recorded as 4.21±0.06 (10^6/Cmm) in CPV infection, 4.80±0.01 (10^6/Cmm) in CCV infection as against the control value of 5.37±0.05 (10^6/Cmm). The comparatively lower value in parvo virus and corona virus infection was indicative of severe viral enteritis. Mohan *et al.* (1993) and Rai *et al.* (1994 b) recorded reduced total erythrocyte count (TEC) in the CPV infection which support the present findings. But Ramprabhu *et al.* (2002) recorded a very low value of RBC count as 2.3±0.46 (10^6/Cmm).

The mean TLC values recorded in the present study was found to be 6.32±0.07 (10^3/Cmm) in CPV infection, 7.48±0.07(10^3/Cmm) in CCV infection and 8.60±0.02 (10^3/Cmm) in apparently healthy control pups. A lower TLC value was observed in CPV and CCV infections indicating leucopaenia in parvo viral and corona viral gastroenteritis which may be explained as the virus induced myeloid degeneration of bone marrow with depletion of circulating matured neutrophils. The extensive loss of neutrophils has been observed through the damaged intestinal wall (Ettinger and Feldman, 1995; Appel 1978; Black *et al.* 1979; Jacob *et al.* 1980; Jedlijoka. 1980, Kraft *et al.* 1980). Dhanapalan *et al.* (1993) also observed leucopaenia in canine parvo virus infection. Stann *et al.* (1984) counted WBC to be less than 6000/Cmm in the dogs affected with CPV infection indicating leucopaenia. This observation is in agreement with the present observation in CPV infection.

In the present study the mean value of packed cell volume (PCV) was recorded as 58±0.88% in canine parvo virus and 53±1.33% in CCV infection as against the control value of 42.4±0.99%. The PCV value in both the viral gastroenteritis cases were found to be increased in comparison to the value recorded for apparently healthy control pups. This higher value of haemoconcentration due to dehydration caused by profuse vomition and diarrhoea seen in parvo virus and corona virus infection. In contrast, Ramprabhu *et al.* (2002) reported a varied PCV value ranging from 6% to 40% in cases of CPV infection.

The differential leucocyte count revealed the mean value of lymphocyte to be 12.8±0.38% in CPV infection and 18.2±0.41% in CCV infection as against the normal value in control group as 26.1±0.82%. This observation indicated lymphopaenia which is in agreement to the findings of Ramprabhu *et al.* (2002).

The mean value of neutrophil, eosinophil, monocyte and basophil were recorded as 78.4±0.4%, 3.4±0.33%, 2±0.21% and 1.1±0.1% in CPV infection and 77.6±0.54%, 3.1±0.27%, 2.4±0.16% and 0% in CCV infection respectively. The corresponding value in apparently healthy control group was found to be 69.2±0.92%, 4.1±0.52%, 1.9±0.27%, 1.2±0.13%. These findings in the present study indicated neutrophilia and monocytosis in parvo and corona virus infections. The mean value of eosinophil was reduced as compared to the control group. No remarkable alteration was observed in basophilic value in CPV and CCV infection. The present finding is in agreement with the findings of Ramprabhu *et al.* (2002) who reported neutrophilia and lymphopaenia. McCartiney *et al.* (1984) also reported similar observation.

The culture test of the faecal material collected from the dogs suffering from parvo viral and corona viral gastroenteritis revealed that 74.79%, 35.23%, 29.81%, 22.22% and 21.13% of cases were found to be *Escherchiia coli, campylobacter jejunis varintestinalis, Staphylococcus aureus, Proteius vulgaris, Klebsiella aerogenies* respectively. Chakrabarti (1977) recorded *E. coli and S. aureus* in the culture test of the faeces from dogs of Bhubaneswar locality suffering from gastroenteritis. Reddy (1982) reported that coagulase positive *Staphylococcus spp.* were isolated from faecal material of dogs suffering from parvo viral gastroenteritis. From the present findings it is suggested that the parvo viral enteritis cases are being complicated due to presence of bacterial pathogens. Such type of secondary bacterial invasion could have accentuated the pathogenic lesions produced by parvo virus in the intestinal villi. The intestinal villi are quickly destroyed by the canine parvo virus infection. This massive destruction of intestinal villi perhaps helped gram negative

bacteria and the lipopolysacharides to enter into the general circulation of the affected dog causing toxaemia due to endotoxins (Jones *et al.*,1982). The severity of symptoms in canine parvo viral gastroenteritis may be due to the combined effect of viruses and bacteria. Hence the culture test of faecal materials in the parvo viral cases and their sensitivity may be practiced for an effective and specific treatment as a routine.

In the present study the antibiogram of different isolates revealed that all the isolates (*E.coli, Campylobactor jejunis varintestinalis, S. aureus, Proteius vulgaris, Klebsiella aerogexies)* were found to be highly sensitive to ciprofloxacin followed by gentamicin and chloramphenicol. Except *S. aureus* all other isolates manifested moderate sensitivity to streptomycin only. *S. aureus* was found to be moderately sensitive to penicillin. All the isolates showed moderate sensitivity to kanamicin and tetracycline. The present finding was in agreement with the findings of Ramprabhu (2002) who suggested that the gentamicin would be the drug of choice for treating gastroenteritis due to gram negative bacteria and to check bacterial invasion in canine parvo viral enteritis. Nayak (1993) found S. *aureus and E.coli* to be highly sensitive to gentamicin and chloramphenicaol in *in vitro* sensitivity test. Besides, Chakrabarti *et al.* (1977) reported that S. *aureus and E.coli* were found highly sensitive to chloroemphenicol in *in vitro* sensitivity study. Reddy (1982) reported that *S. spp.* from dog suffering from gastroenteritis was highly sensitive to chloramphenicol and cephalosporin in *in vitro*. Our findings of antibiogram for *S. aureus and E.coli* were in agreement with the findings of these workers. Kirk (1992) stated that *E.coli, Klebsiella spp., Proteus spp. and S. spp.* were found to be sensitive to gentamicin and chloramphenicol whereas *Staphylococcus* was found to be highly sensitive to chlormphenicol.

The histopathology of tissue collected from the dogs suffering from parvo virus and/or corona virus infection revealed typical pathological lesions in duodenum, mesenteric lymphnode, jejunum,

spleen, heart, lungs, liver and thymus. The epithelial cell linings of the crypts were found to be desquamated and some crypts contained necrotic debris. The glandular cells exhibited hyperplasia and necrosis of duodenum.

The villi and mucosa manifested increased cellularity and proliferation of connective tissue in the capillary endothelium. The submucosa and stratum muscularies of intestine were found to be oedematous and Peyer's patches of small intestine and lymphnodes had depletion of lymphoid cells. The corpuscles of the spleen invariably showed marked depletion of lymphatic cells. Non suppurative and defused myocarditis were predominant histopatholigical findings with necrosis and degeneration of myocardial fibres. The lung tissues were found thickened at the interalveolar septa with the accumulation of serous exudates in the alveoli. Epethelial cell of bronchus were found to be hyperplastic. In some cases there was congestion of capillaries. The bronchioles were found distended with degenerated and desquamated epithelium. The urinary space showed fibrinous exudates and distention. Only mild congestion was noticed in kidney and liver tissues. These significant histopathological changes seen in the present work were in agreement with the findings of Josi *et al.* (2001), O' Sullivan *et al.* (1984), Meunier *et al.*(1984), Mieura *et al.* (1986), Perl *et al.*(1980), Pollock and Carmichel (1979), Eugster *et al.* (1978), Black *et al.* (1979), Cooper *et al.* (1979) and Keenan *et al.* (1976) who in their histological study on intestinal infection of neonatal dogs with canine corona virus recorded the atrophy and fusion of intestinal villi and deepening of crypts. Takeuchi *et al.* (1976) conducted histological study on experimental enteric infection of CCV in neonatal dogs and reported that lamina propria was found to have increased cellularity, flattened of endothelial cells and goblet cells. These two above findings support the present pathological changes in the intestine. Joshi *et al.* (2001) reported that degeneration, necrosis and sloughing of villus epithelial cell were prominent histopathological changes. They recorded goblet

cell hyperplasia in duodenum and jejunum, degeneration and necrosis of crypt of leibarkuhn and lymphoid cell in Peyer's patches. They also observed the hyperplasia of lymphoid follicles and their findings of histopathological changes in spleen and masenteric lymphonodes consisted of congestion and severe depletion of lympoid cells in germinal centres of spleen. The present findings are in agreement with the findings of Joshi *et al.* (2001).

Three groups of therapeutic regimen were designed for the treatment of clinical cases comprising of CPV and CCV infection and mixed infection of CPV and CCV. The Gr-I treatment included Ciplox infusion, Ringer's lactate solution, Perinorm and Dicynene injection. All the treated animals of these groups were cured from the ailments of CPV infection, CCV infection and mixed infection of CPV and CCV. From the above observation, it was evident that the group I therapeutic regimen was found to be very effective within a period of 5 days.

Ciprofloxacin (Ciplox) included in the Gr-I therapeutic regimen was proved very effective against 3 types of canine viral gastroenteritis i.e. due to CPV infection, CCV infection and mixed infection of CPV and CCV to bring the temperature to normalcy after 3 days of treatment period.

The anti-emetic metoclopramide (Perinorm) was found to be very efficacious to control the vomition fully on the third day of treatment. It was observed that administration of metoclopramide intramuscularly was found efficacious to control the vomition on the day-1 treatment in CPV infection, CCV infection and mixed infection of CPV and CCV.

Ringer's lactate containing sodium lactate, sodium chloride, potassium chloride and calcium chloride was found very effective to control the loss of electrolyte and dehydration during the profuse diarrhoea caused by CPV infection, CCV infection and mixed infection of CPV and CCV.

Ethamsylate (Dicynene) in the injectable form when administered intravenously checked bleeding in purgation due to

CPV infection, CCV infection and mixed infection of CPV and CCV. Hence the combined effect of ciprofloxacin, Ringer's lactate solution, metoclopramide and ethamsylate brought quick recovery of the patient from parvo viral and corona viral diarrhoea in mixed and single infection in a short period of 4 days treatment.

Banja (1999) adopted the same treatment with metoclopramide to control the vomition in parvo viral gastroenteritis and Ringer's lactate to control dehydration and loss of electrolytes during canine gastroenteritis of CPV and CCV infection.

During severe vomition in canine parvo and corona viral infection depletion of potassium in mild quantity occurs in the vomitus and diarrhoeic faeces. There might be respiratory and metabolic alkalosis due to hypokalaemia which was due to loss of hydrogen ion in urine. During parvo viral vomition perigastric disorders occurs which reduces the oral intake of fluid and the consequent dehydration is the result of obligatory loss of water and electrolyte solution. In order to overcome such embarrassment, Ringer's lactate was an essential fluid therapy for restoration of serum electrolyte and normalcy in body fluid because Ringer's lactate was found effective for replacement of potassium and fluid in required doses. Therefore, many workers had used Ringer's lactate solution during severe dehydration resulting from vomition and diarrhoea as encountered in parvo and corona viral infection. (Pollock and Carmichael ; 1979, Fluckiger, 1980, Groendalen, 1980, Jedlizoka, 1980, Benary *et al.*1981, Meunier *et al.*, 1981, Voros *et al.*, 1981). Rai *et al.* (1993) successfully treated vomition with metaclopramide caused during CPV gastroenteritis. Otto *et al.* (2001) opined that antimicrobial drug should be included in therapeutic regimen for control of secondary bacterial invasion. Bielsker (1994) successfully treated cases of corona virus enteritis with fluid therapy, antibiotic and other preparations which hold good in support of the present therapeutic regimen to treat the canine gastroenteritis due to CPV and CCV infection.

The Gr-II therapeutic regimen comprised of Gentamicin (injectable), Ringer's lactate solution, Perinorm (metoclopramide) and ethamsylate. The treatment continued for 5 days. All the animals were found to be cured of fever, vomition and diarrhoea. Fifty per cent of animals resumed normal appetite and alertness whereas rest were observed to approach to normalcy. This group of therapeutic regimen were found effective in 5 days to cure the patient suffering from CCV infection whereas little bit more time was required to cure the patient suffering from CPV infection and mixed infection of CPV and CCV. Summarising the effect of therapeutic regimen of Gr-II, it was observed that this therapy was also found effective to cure the CPV infected animals in 5 days or slightly more. Banja (1999) used gentamicin, Ringer's lactate and metoclopramide for the treatment of canine gastro enteritis of CPV and CCV infection and was successful to cure the disease within a period of 5-8 days. The supportive therapy and symptomatic treatment have been advocated by Rai *et al.* (1994) and Ettinger and Feldman (1995) for effective curative measure against canine gastroenteritis due to parvo virus and corona virus infection. Ramprabhu *et al.* (2002) reported that gentamicin was an effective antimicrobial drug which needed inclusion in therapeutic regimen for treatment of canine parvo viral diarrhoea. Meyer-Engelke (1981) recorded the encouraging result when treated with antibiotics along with other supportive treatment. Krohn and Blakstad (1980) reported that fluid therapy, antiemeitic and antimicrobial drugs were found effective against parvo viral gastroenteritis. Therefore, the present therapeutic design in Gr-II were well supported by the findings of other workers for the treatment of parvo viral gastroenteritis.

The Gr-III therapeutic regimen comprising of chloramphenicol in addition to the same anti emetic, electrolyte solution and anticoagulant preparations as designed for other 2 groups. This group of treatment brought about cure in all the treated animals on the fifth day of treatment. Only in some animals slight depression

was observed which warranted a slightly more time than 5-day-treatment for full recovery.

It might be suggested that the inclusion of ciprofloxacin as a broad spectrum antibiotic brought quick recovery within a period of 4 days whereas gentamicin inclusion in the therapeutic regimen brought about cure within 5 days of treatment and inclusion of chloramphenicol required some more time to bring about total cure. The statistical analysis of the efficacy of these three therapeutic regimens revealed that Gr-I treatment was more efficacious therapeutic regimen than Gr-II and Gr-III treatment against mixed infection of CPV and CCV. There was significant relief in temperature, diarrhoea, vomition and depression in successive days indicating normalcy at the end of five day treatment. Statistical analysis revealed that Gr-I and Gr-II therapeutic regimens were significantly better than Gr-III treatment but the Gr-I and Gr-II treatments were at par in efficacy against canine gastroenteritis due to CPV and CCV infection.

CHAPTER - VI

SUMMARY

SUMMARY

A study on epizootiology, diagnosis, clinical symptoms, experimental infection, haematological profile, culture and sensitivity test for bacterial isolates, histopathological changes and therapeutic management of clinical cases of viral gastroenteritis in dogs due to canine parvo virus and canine corona virus infection was conducted in the Department of Medicine, Faculty of Veterinary Science and Animal Husbandry, Bhubaneswar, Orissa from 1990 and onwards.

During the investigation the out patient treatment records of Central Clinic of Orissa Veterinary College and 26 important veterinary hospitals and dispensaries of Orissa were meticulously scrutinized for canine viral gastroenteritis with particular reference to canine parvo virus and corona virus infection and an overall incidence rate of canine gastroenteritis was recorded to be 21.88% out of which male dogs were 51.07% and females were 48.92%. There was no significant difference in incidence rate among male and female. The age wise incidence rate was found to be 41.96% within < 3 months, 28.04% in 4-6 months, 18.05% in 7-9 months, 9.00% in 10m-1 year and 2.93% in >1 year of age group indicating that the young pups were more susceptible to canine gastroenteritis. The breed wise prevalence rate was distributed as 35.99% for Doberman, 28.00% for Alsatian, 26% for Tibetan apso and 9.99% for other indigenous breeds. These findings revealed that indigenous local breeds were found less susceptible to CPV and CCV infection as compared to pure breeds. The year wise prevalence of canine parvo virus and/or canine corona virus (CCV) infections in dogs in 592 clinical cases of gastroenteritis was recorded as 31.92% in single infection of CPV, 7.43% in single infection in CCV, 22.97% of CPV and CCV mixed infections, 54.89%

in total CPV infections (single + mixed), 30.10% in total CCV infections (single+mixed) and 62.33% in total CPV and CCV infections (single +mixed). The canine gastroenteritis caused due to other infections than CPV and CCV infections during the study was screened as 23.14% for endoparasites and 14.52% for other causes out of 37.66% cases. Out of 23.14% of endo-parasitic infections, 7.95%, 6.92%, 1.52%, 0.84%, 1.01% and 4.89% were for *Ascaris, Ancylostoma spp.*, *Strongyloides*, tapeworm, coccidian and mixed infection of endoparasites. The total number of faecal samples positive for endoparasites with CPV and / or CCV infections were found to be 9.96%.

Comparison between different diagnostic test results for CPV and CCV antigens revealed that Dot-ELISA detected faecal antigens in 31.92% for CPV (single), 7.43% for CCV (single), 22.97% for mixed infection of CPV and CCV, 51.01% for total CPV (single and mixed) infection, 30.10% for total CCV (single and mixed) infection and was considered as a standard diagnostic test with 100% sensitivity. The Haemagglutination test detected only CPV infections (single and mixed) in 51.01% with 92.92% of sensitivity. The Reverse Passive Haemagglutination test also detected only 17.56% of CCV antigens at 57.77% of sensitivity. Therefore, it is suggested that Dot-ELISA is the most suitable diagnostic test for both CPV and CCV infections due to 100% sensitivity.

Age wise prevalence of CPV (single), CCV (single), CPV and CCV (mixed), total CPV and total CCV infection, total CPV and CCV (single and mixed) during the study of clinical cases were recorded among the age group of up to 3 months as 31.72%, 7.22, 22.89%, 54.61% and 30.12% respectively expressing a total incidence rate of 61.84%; in 4-6 months of age group as 31.92%, 7.22%, 22.28%, 54.21% and 29.51% expressing an overall incidence rate of 61.44%; in the age group of 7-9 months as 32.07%, 7.54%, 21.69%, 53.77% and 29.24% expressing an overall incidence rate of 61.32%; in the age group of 10m-1 year as 32.07%, 7.54%, 20.75%, 52.83% and 28.30% expressing an overall incidence rate of 60.37% and in the

age group of above 1 year as 27.77%, 5.55%, 22.22%, 50% and 27.77% expressing an overall percentage of 55.55%.

Sex wise prevalence of CPV, CCV, CPV and CCV (mixed), total CPV infection (single and mixed) and total CCV infection (single and mixed) during study of clinical cases were recorded for male dogs as 16.21%, 3.88%, 11.65%, 27.87% and 15.54% expressing an overall incidence of 31.76% of males and in the female dogs as 15.70%, 3.54%, 11.31%, 27.02% and 14.86% expressing an overall incidence rate of 30.57% among total population of 592 clinical cases of gastro- enteritis.

Breed wise prevalence of CPV (single), CCV single, CPV and CCV (mixed), total CPV (single and mixed) and total CCV (single and mixed) were found to be 11.48%, 2.70%, 8.27%, 19.76% and 10.97% expressing an overall incidence of 22.46% in Doberman breed and 8.95%, 2.02%, 6.41%, 15.37% and 8.44% in Alsatian breed expressing an overall incidence rate of 17.39%, 8.27%, 0.27%, 5.91%, 14.18% and 7.93% in Tibetan apso expressing an overall incidence of 16.21%; 3.20%, 0.67%, 2.36%, 5.57% and 3.04% in indigenous breeds expressing an overall incidence of 6.25% among total population.

Clinical manifestations recorded in CPV, CCV and mixed infections of CPV and CCV were almost the same whereas no hematemesis was encountered in single infection of CCV. The predominant symptoms in order of severity were encountered as vomition, fever, diarrhoea without blood flecks, diarrhoea with blood flecks, hematemesis, anorexia, dehydration, anaemia and depression. Most of the dogs manifested symptoms of vomition, fever, diarrhoea and anorexia in CPV and CCV infection but fever was observed only in 11.36% of cases of corona virus infection. Most of the mixed infections of CPV and CCV exhibited the symptoms of vomition, fever, diarrhoea, anorexia, dehydration and anaemia. The mortality rate was 47.9% in single infection of CPV as 47.9%, 11.36% in single infection of CCV and 35.15% in the mixed infection of CPV and CCV.

Experimental infection by intimate contact was found to be successful in 80% of cases both in CPV and CCV infection within 1 month of time and infected pups on seventh day post infection and onwards exhibited vomition, yellowish foetid diarrhoea with blood flecks. These pups were found to be dull, depressed, anorectic and moderately dehydrated. Faecal samples of these experimental dogs through Dot-ELISA was found positive for CPV and CCV infection.

Haematological profile of infected pups revealed of haemoglobin value was 8.58±0.07g% for single infection of CPV, 10.80±0.03 g% for single infection of CCV. Total erythrocyte count was recorded as 4.21±0.06 (10^6/Cmm) for CPV infection (single) and 4.80±0.01 (10^6/Cmm) for CCV (single) infection. Total leucocyte count was estimated to be 6.32±0.78 (10^3/Cmm) for CPV infection (single) and 7.40±0.07 (10^3/Cmm) for CCV infection (single). The corresponding values in healthy control group were recorded as 12.40±0.02g%, 5.37±0.05 (10^3/Cmm) and 8.60±0.021 (10^3/Cmm). The PCV was recorded as 58.88% for CPV infection and 53.±1.33% for CCV infection whereas healthy control group revealed the corresponding value as 8.60±0.02%. The differential leucocyte count consisted of lymphocytes- 12.3±0.38% and 18.2±0.41%, nuotrophil-78.4±0.4 and 77.6±0.54%, eosinophil-3.4±0.33% and 3.1±0.27%, monocyte-2.0±0.210% and 2.4±0.163% and basophil-1.1±0.01 and 0% in CPV and CCV infection respectively. In healthy control group the Differential leucocyte count revealed lymphocyte-26.1±0.82%, nutrophil- 69.2±0.92, esonophils- 4.1±0.52%, monocyte- 1.9±0.27 and basophil- 1.2±0.13%.

Cultural examination of faecal material revealed *E. coli, C.jejunis varintestinalis, S. aureus, P. vulgaris and K. aerogenes* in 74.79%, 35.23%, 29.81%, 22.22% and 21.18% cases respectively.

Antibiogram study of bacterial isolates showed that the *E.coli, C. jejunum varintestinalis, S. aureus, P. vulgaris and K. aerogenes* were found to be highly sensitive to ciprofloxacin followed by gentamicin and chloramphenicol.

The predominant histopathological findings were confined to small intestine, mesenteric lymphnode, spleen, heart and lungs. Hyperplastic changes of duodenum and jejunum in most of cases were found to be proliferative with connective tissue and the capillary endothelium were found to be increased with cellularity. Many crypts were found necrotic and glandular cell showed goblet cell hyperplasia, necrosis and denudation. Peyer's patches of the small intestine and lymphnodes were commonly marked with depletion of lymphoid cells. The stratum muscularis were found oedematous in many cases. The corpuscles invariably showed marked depletion of lymphatic cells. Leucopaenia and diffused myocarditis were evident in some cases. There was degeneration of myocardial cells. There was mild congestion in kidney and liver tissue. Urinary space contained fibrinous exudates in some cases.

Three groups of therapeutic regimens were tried against the canine parvo and corona virus infections and their efficacy was assessed. The Gr-I therapeutic regimen comprising of Ciplox injection, RL solution, Perinorm injection and Dicynene injection and Gr-II therapeutic regimen comprising of Gentamycine, RL solution, Perinorm and Dycinene injection were found to be equally efficacious to bring the temperature, vomition, diarrhoea, anorexia, dehydration and depression to normalcy and were observed significantly superior to Gr-III therapeutics. The Gr-III therapeutic regimen comprising of Kemicetin, RL solution, Perinorm and Dycinene was found effective to bring the temperature into normalcy but could not restore the manifested symptoms into normalcy during the same treatment period. Through statistical analysis Gr-I therapeutic regimen was found to be the most efficacious followed by Gr-II and Gr-III treatments against CPV and CCV infections.

CHAPTER - VII

CONCLUSION

CONCLUSION

- Incidence rate of gastroenteritis in dogs in the state of Orissa found from the patient records of different hospitals and private clinics was recorded as 21.86% out of which 41.07% were male dogs and 48.92% were female dogs. The pups below 3 months of age were found to be most susceptible with affecting 41.96% of pups. Doberman breed was found to be most susceptible breed followed by Alsatian and Tibetan apso among the pure breeds whereas the local indigenous breeds were comparatively less susceptible to gastroenteritis.
- Agewise epizootic pattern of canine parvo and corona virus was recorded during the investigation of clinical cases with an incidence rate of 61.84% in the pups up to 3 months of age, 61.44% in 4-6 months of age group, 61.32% among 7-9 months of age group, 60.37% in 10 months to 1 year of age group and 55.55% of dogs above 1 year of age. The overall incidence rate for canine viral gastroenteritis due to CPV and CCV was 61.31%. The sex wise prevalence of canine parvo viral and corona viral gastroenteritis was recorded to be 31.75% in males as against 30.57% in females. Doberman breed was found to be most susceptible followed by Alsatian, Tibetan apso and non descript breeds of Orissa indicating that the indigenous breeds of dogs were found to be resistant to the parvo and corona viral gastroenteritis.
- Demonstration of CPV and CCV antigen in the faecal materials is found to be standard method of diagnosis through Dot-ELISA, HA and RPHA tests. Dot-ELISA was considered to be the most efficient diagnostic test for parvo

viral and corona viral antigens in single and mixed infection and was also considered as a standard test at 100% sensitivity. Haemagglutination test was able to detect only canine parvo virus antigen at a comparatively lower percentage with Dot-ELISA. Reverse Passive Haemagglutination test was able to detect only CPV faecal antigen at a very lower rate of 17.56%.

- Though clinical symptoms of fever, vomition, and diarrhoea with blood flecks and diarrhoea without blood flecks, anorexia, depression and dehydration were encountered during the mixed infection of parvo and corona viral diarrhoea yet it was observed that fever, vomition, haemorrhagic foetid diarrhoea and anorexia were the diagnostic clinical symptoms in CPV infection and diarrhoea, vomition and anorexia were predominant infection in CCV infection.

- Experimental infection by direct contact was established successfully within 7-10 days as evident from the manifested clinical symptoms of CPV and CCV and antigens detected from faecal materials.

- Haematological profile revealed that leucopaenia, lymphopenia, neutrophilia, lower erythrocyte count and haemoglobin value indicating anaemia were observed in CPV infection.

- Marked depletion of lymphoid cells in Peyer's patches in small intestine, myocarditis, degeneration and desquamation of epithelium of bronchioles, congestion and thickening of mucosa and stratum muscularis were the predominant histopathological changes in canine parvo and corona viral gastroenteritis.

- Early symptomatic treatment for vomition, diarrhoea and fever should be instituted to reduce morbidity and mortality.

- Considering the gravity of high rate of morbidity and mortality in parvo and corona viral gastroenteritis for which there is no specific curative antiviral treatment, it is recommended that all the pet dogs should undergo annual preventive vaccination against parvo and corona virus.

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