EVALUATION OF VARIOUS THERAPEUTIC AGENTS AGAINST *DIPYLIDIUM CANINUM* INFECTION IN DOGS WITH REFERENCE TO HAEMATOBIOCHEMICAL ALTERATION

H. Mehra[1], P. Bhatt, S. K. Shukla[2], S. Shekhar[2] and Satish Kumar
Veterinary Clinics, College of Veterinary and Animal Sciences
Govind Ballabh Pant University of Agriculture and Technology, Pantnagar-263 145, Udham Singh Nagar, Uttarakhand

Received on: 21.09.2017
Accepted on: 23.03.2018

ABSTRACT

The investigation was designed to compare the therapeutic efficacy different drugs against *Dipylidium caninum* infection in dog. Twenty five dogs positive for *Dipylidium caninum* infections were randomly divided in five groups having five dogs each. The dogs of group II, III, IV and V were treated with a combination of Praziquantel and Albendazole (Praziplus), Albendazole alone (Albomar), Homoeopathic medicine Filix mas(ø), and Homoeopathic complex (Filix mas(ø), *Cuprum oxydatum nigrum* (1x), Santonium (3x), *Chelona glabra*(ø)), respectively. The dogs of group I kept as infected control and do not received any medication. In addition group VI comprised of apparently healthy dogs negative for intestinal parasites and haemoprotozoans. Blood samples from different groups were taken at 0, 7 and 14 days interval for haematological and biochemical studies. Haematological and biochemical examination revealed that all the infected dogs had low level of erythrocytic indices, higher leukocyte count, and increase in ALT values as compared to dogs of healthy control group. On coprological examination it was observed that the group II and III dogs stopped shedding the cestode segment after giving the drugs while group IV and V dogs continued to shed cestode segments even after giving the drugs. No side effects were recorded in groups treated with different medicines. Homoeopathic medicines in the present dosage regimen had little effect on haematobiochemical alterations. The drug combination of albendazole with praziquantel and albendazole alone at higher dose showed a good result in eliminating *Dipylidium caninum* infection in dog.

Key words: *Dipylidium caninum,* coprological examination, therapeutic

Introduction

Dipylidium caninum the commonest tapeworm of dogs, also referred as cucumber tapeworm or the double-pored tapeworm, is a cyclophyllid cestode that causes dipylidiasis (Adam *et al*., 2006). The larval fleas (*Ctenocephalides canis, Ctenocephalides felis*, *Pulex irritans*) or a dog's louse (*Trichodectes canis*) act as an intermediate host (Ramana *et al*., 2011). The vertebrate host becomes infected by ingesting the adult flea containing the cysticercoid while grooming, the cysticercoid is stimulated to excyst and to evaginate its hook and suckers. It attaches itself to the dog's mucosa and begins to proliferate proglottids (Silverman, 1961). Gravid proglottids, containing the eggs, detach from the end of the worm and pass out in the faeces, the prepatent period being about 2 weeks. Mammalian hosts infected with *Dipylidium caninum* may have a high worm burden (up to 130 adult worms) because larval fleas typically ingest whole worm packets, resulting in the development of multiple cysticercoids per flea. Infection by *Dipylidium caninum* is generally asymptomatic in dogs. The parasite is not highly pathogenic to dogs but heavy infections in young animals can cause non specific abdominal symptoms and affected animal may have diarrhoea or constipation, unthriftyness or pot bellied appearance. In rare cases obstruction of intestine can occur (Soulsby, 1982). The affected animal become debilitated and experience weight loss. The infected domestic dogs may drag their rump across the floor as a consequence of the perianal pruritis caused by the movement of gravid proglottids in the anus of the host (Dantas, 2008). The tapeworm releases its attachment in the intestines and move into the stomach causing vomition and a worm several inches in length may appear in vomitus. Diagnosis of *Dipylidium caninum* can be done on detection of proglottids wandering out of the anus or proglottids or typical egg packets in stool. The egg shows the characteristic envelope, an embryophore surrounding the oncosphere which has hexacanth along with 2 pairs of hooklet. Many drugs have been used either ayurvedic, homoeopathic or allopathic against the cestodes from ancient times. In addition the effectiveness, economic viability and side effect free treatment of homeopathic anthelmintics as compared to conventional anthelmintics used in dogs is not much understood. Therefore the present investigation was carried out to assess the haematobiochemical alteration and the effectiveness of different anthelmintics against *Dipylidium caninum* in Dog.

Materials and Methods

The dogs found positive for *Dipylidium caninum* infection on coprological examination were divided into five different groups, each consisting of five dogs. A sixth group contains five apparently healthy dogs serve as healthy control. The medication of allopathic and homeopathic complex was started accordingly on following schedule.

Group- I: Infected control not treated with any medicine.
Group-II: Praziplus (Praziquantal-50 mg and Albendazole-150 mg) @ 1 tablet per 10 kg body mass orally once.
Group-III: Albomar (Albendazole) @ 40 mg per kg body mass orally once.
Group- IV: Filix mas (Homoeopathic medicine) @ 2 drops two times a day for two weeks orally.
Group-V: Worm C (Homeopathic complex- containing Filix mas(ø), *Cuprum oxydatum nigrum* (1x), Santonium (3x), *Chelona glabra*(ø)) @ 3 tablets two times a day for two weeks orally.
Group- VI: Apparently healthy dogs negative for intestinal and blood parasites and served as healthy control.

Blood were collected from each group at weekly interval i.e. on day 0, 7, 14-day interval before and after giving the drugs

[1]Teaching Personnel; [2]Present Address – Research Associate, GADVASU, Ludhiana, Punjab

to assess the haemato-biochemical alterations.

Haemoglobin (Hb), packed cell volume (PCV), total erythrocyte count (TEC), total leucocyte count (TLC), differential leucocyte count (DLC) was estimated using methods of (Jain, 1986). Aspartate aminotransferase (AST) and alanine aminotransferase (AST) were estimated help of commercial ERBA diagnostic Kit.

The efficacy of different treatments was evaluated on the basis of coprological examination and restoration of haematobiochemical alterations. Statistical analysis of the data was done using ANOVA technique according to the method described by Snedeor and Cochran (1994). Comparisons among the groups were made and statistical difference between respective mean for various parameters was evaluated.

Results and Discussion

The mean haemoglobin values before treatment in all the infective groups were significantly decline as comparison to healthy group. On 7 day after treatment an elevated level of mean haemoglobin values were observed in group II, III which were treated with Praziplus, Alomar respectively. On day 14 of treatment the mean haemoglobin values of group II, III moves towards normalcy. A regular decline in mean haemoglobin values in groups I, IV, V was observed on 7 and 14 day of the study as compared to their 0 day values (Table 1). Decrease in haemoglobin values was recorded in affected dogs as compared to healthy dogs, which may be attributed to inappetance, maldigestion, malabsorption caused by parasite in dogs. The effect of parasite on haemogram of dogs have been reported (Ogunkoya *et al.,* 2006; Qadir *et al*., 2011; Mishra *et al.,* 1994; Fan *et al.,* 1998) and it included a significant reduction in levels of haemoglobin. An increase in haemoglobin values was observed in groups II and III animals after one week of drug administration which may be due to the removal of parasites after giving the drugs. Pawar *et al.* (2005) also reported similar increase in haemoglobin levels after drug administration. There was a significant (P< 0.05) decline in the mean PCV values of group I, II, III, IV, V as compared to the value of group VI on 0 day of the study (Table 1). An increase in packed cell volume values was observed in groups II, III on 7 and 14 day as compared to values of 0 day. Also there occurred a decrease in packed cell volume values of group I, IV, V on 7, 14 day as compared to 0 day values. Packed cell volume values have showed an increase in groups II and III after one week of drug administration which is due to the removal of parasites after giving the drugs. Pawar *et al*. (2005) reported that after giving the drugs to dogs there was increase in packed cell volume values. The mean TEC values was a significant (P< 0.05) decline in groups I, II, III, IV, V in compare to group VI on 0 day of the study(Table 1). There was a significant (P< 0.05) decline in the mean TEC values of groups I, II, III, IV, V in compare to group VI on 7th and 14thday of the study. Qadir *et al*. (2011) reported lower level of TEC in parasitized dogs. Fan *et al.* (1998) also reported lower TEC in dogs infected with gastrointestinal parasites. The mean TLC values was significant (P<0.05) increase in the total leucocyte count values of group I, II, III, IV, V as compared to group VI values on 0, 7th and 14th day of the study (Table 1). A continuous increase in total leucocyte values was observed in groups I, IV and V on 7, 14 day as compared to the values of 0 day of the study. Ogunkoya *et al.* (2006) has reported an increase in leucocytes in dogs infected with gastrointestinal parasites. Another investigator reported an increase in leucocytes in infected dogs Qadir *et al.* (2011). An increase in leucocyte count has been observed in infected groups as compared to healthy group due to the activation of host immune response because of the presence of parasite. The mean per cent lymphocyte count values were significant (P< 0.05) increase in groups I, II, III, IV, V as compared to values of group VI on 0 day of the study (Table 1). A significant (P<0.05) decline in mean per cent lymphocyte count values was observed in groups II and III on 7th and 14th day of the study as compared to their values on 0 day of the study. An increase in lymphocyte count in dogs infected with tapeworms was also recorded by Ogunkoya *et al*., (2006) and Qadir *et al.*, (2011). A decline in lymphocyte count in group II and III after 7 days might be related to removal of the parasite after administration of drugs. The mean per cent neutrophil count values was significant (P<0.05) decline in groups I, II, III, IV, V as compared to values of group VI on 0 day of the study (Table 1). A significant (P< 0.05) increase in the mean per cent neutrophil values in all infected group as compared to healthy control group (Table 1). There was a significant (P< 0.05) increase in the mean per cent eosinophil values in all infected group. A significant (P< 0.05) decrease in mean per cent eosinophil values were observed in group II, III on day 7. Ogunkoya *et al.* (2006) found an increase in eosinophil count in dogs infected with tapeworms. It is known that eosinophils play important role mostly during parasitic infections Vegad and Katiyar (2001). In present investigation an increase in eosinophil count in dogs infected with *Dipylidium caninum* was evident. The eosinophil counts came to normal level in the groups II and III as the drugs in these groups caused removal of parasites. There were no significant alterations in values of mean per cent monocyte in all infected groups. Significant (P<0.05) increased in ALT values of group I, II, III, IV, V as compared to group VI. Also a significant decline in ALT values was observed in groups II and III on 7, 14 day (Table 2). The tapeworm releases waste products which results in different clinical signs like indigestion, diarrhoea and loss of appetite (Chapel and Penn, 1990). Molina *et al.* (2003) has also reported that the metabolic waste of tapeworm causes different ill effect on the host. An increase in ALT values of dogs infected with parasite is observed, which might be due to the effect of metabolic wastes released by parasite on liver, liver being the main site for detoxification of any xenobiotic Brunton *et al*. (2006). There was no significant alteration in AST values (Table 2) in different groups at different intervals and were in normal range 23-66 IU/L as mentioned by Kaneko *et al.* (1997). The effectiveness of drugs was evaluated on the basis of shedding of cestode segments at different intervals by the animal after administering the drugs. It was observed that animals in group II and III stopped shedding of segment after receiving the drugs (Table 3). Several workers have also reported the absence of shedding of tapeworms segments after giving the suitable drugs (Gutierrez, 1998; Misraulia *et al.*, 1998; Cristina, 2003; Pawar *et al.*, 2005 and Tuzer *et al.*, 2010). Dogs of group IV and V those treated with homoeopathic drugs, however continued to shed segments even after administration of the drug suggested limited role of homoeopathic medicine in present prescribed doses against the parasite.

Acknowledgement

The authors are thankful to Dean, CVAS, for providing necessary facilities to carry out the investigation.

References

Adam AA, Saeed OM, Ibrahim HM, Malik HY and Ahmed ME (2006) *Dipylidium caninum* infection in a 41 year old Sudanese

Table 1: Effect of different allopathic medicine, homeopathic medicine and Homeopathic complex on haematological parameters in clinical cases of *Dipylidium caninum* infection in dog.

Parameter	Groups	Days of treatment		
		0 Day	7 Day	14 Day
Hb (g/l)	I	93.0 ± 6.10^{Ab}	92.4 ± 5.93^{Ab}	91.2 ± 5.86^{Ab}
	II	84.0 ± 1.58^{Ab}	85.0 ± 1.58^{Ab}	86.0 ± 1.58^{Ab}
	III	82.60 ± 0.92^{Ab}	83.6 ± 0.92^{Ab}	84.6 ± 0.92^{Ab}
	IV	84.80 ± 4.11^{Ab}	84.40 ± 4.24^{Ab}	83.20 ± 4.18^{Ab}
	V	88.40 ± 3.21^{Ab}	88.00 ± 3.30^{Ab}	86.60 ± 3.40^{Ab}
	VI	122.40 ± 0.92^{Aa}	123.00 ± 1.00^{Aa}	123.2 ± 8.60^{Aa}
PCV (l/l)	I	0.27 ± 0.01^{Ab}	0.27 ± 0.01^{Ab}	0.27 ± 0.01^{Ab}
	II	0.24 ± 0.00^{Ab}	0.25 ± 0.00^{Ab}	0.25 ± 0.00^{Ab}
	III	0.24 ± 0.00^{Ab}	0.24 ± 0.00^{Ab}	0.24 ± 0.00^{Ab}
	IV	0.25 ± 0.01^{Ab}	0.24 ± 0.01^{Ab}	0.24 ± 0.01^{Ab}
	V	0.25 ± 0.01^{Ab}	0.25 ± 0.01^{Ab}	0.25 ± 0.01^{Ab}
	VI	0.36 ± 0.00^{Aa}	0.36 ± 0.00^{Aa}	0.36 ± 0.00^{Aa}
TEC($\times10^{12}$/l	I	3.80 ± 0.23^{Ab}	3.68 ± 0.24^{Ab}	3.62 ± 0.22^{Ab}
	II	3.26 ± 0.12^{Acd}	3.34 ± 0.10^{Ab}	3.44 ± 0.10^{Ab}
	III	3.12 ± 0.08^{Ad}	3.24 ± 0.10^{Ab}	3.34 ± 0.08^{Ab}
	IV	3.50 ± 0.20^{Abcd}	3.48 ± 0.21^{Ab}	3.42 ± 0.19^{Ab}
	V	3.64 ± 0.14^{Abc}	3.64 ± 0.14^{Ab}	3.52 ± 0.14^{Ab}
	VI	5.12 ± 0.10^{Aa}	5.18 ± 0.11^{Aa}	5.20 ± 0.14^{Aa}
TLC ($\times 10^9$/l	I	10.20 ± 0.49^{Ab}	10.42 ± 0.50^{Aa}	10.68 ± 0.48^{Aa}
	II	12.20 ± 0.39^{Aa}	12.05 ± 0.41^{Aa}	11.60 ± 0.49^{Aa}
	III	12.21 ± 0.74^{Aa}	11.96 ± 0.75^{Aa}	11.46 ± 0.71^{Aa}
	IV	11.54 ± 0.53^{Aab}	11.86 ± 0.43^{Aa}	12.05 ± 0.53^{Aa}
	V	10.30 ± 0.70^{Ab}	10.47 ± 0.70^{Aa}	10.83 ± 0.69^{Aa}
	VI	8.18 ± 0.25^{Ac}	8.06 ± 0.27^{Ab}	8.07 ± 0.22^{Ab}
Neutrophil (%)	I	58.80 ± 0.37^{Ac}	59.40 ± 0.40^{Ac}	58.60 ± 0.40^{Ab}
	II	59.00 ± 0.31^{Cc}	65.00 ± 0.94^{Bb}	69.80 ± 0.37^{Aa}
	III	60.20 ± 0.37^{Cb}	68.20 ± 1.15^{Ba}	70.60 ± 0.40^{Aa}
	IV	57.80 ± 0.20^{Ac}	58.00 ± 0.31^{Ac}	57.80 ± 0.58^{Ab}
	V	57.80 ± 0.37^{Bc}	59.00 ± 0.31^{Ac}	58.40 ± 0.40^{ABb}
	VI	70.20 ± 0.58^{Aa}	69.80 ± 0.37^{Aa}	70.6 ± 0.24^{Aa}
Monocyte (%)	I	1.40 ± 0.244^{Aa}	1.40 ± 0.244^{Aa}	1.40 ± 0.244^{Aa}
	II	1.40 ± 0.244^{Aa}	1.40 ± 0.244^{Aa}	1.40 ± 0.244^{Aa}
	III	1.40 ± 0.244^{Aa}	1.40 ± 0.244^{Aa}	1.40 ± 0.244^{Aa}
	IV	1.40 ± 0.244^{Aa}	1.40 ± 0.244^{Aa}	1.40 ± 0.244^{Aa}
	V	1.40 ± 0.244^{Aa}	1.40 ± 0.244^{Aa}	1.40 ± 0.244^{Aa}
	VI	1.6 ± 0.244^{Aa}	1.40 ± 0.244^{Aa}	1.40 ± 0.244^{Aa}
Lymphocyte (%)	I	34.00 ± 0.44^{Aa}	33.40 ± 0.67^{Aa}	33.60 ± 0.40^{Aa}
	II	32.60 ± 0.50^{Aab}	30.20 ± 0.80^{Bbc}	26.40 ± 0.40^{Cb}
	III	31.40 ± 0.24^{Ab}	29.00 ± 0.89^{Bb}	26.20 ± 0.48^{Cb}
	IV	33.60 ± 0.50^{Aa}	34.00 ± 0.00^{Aa}	33.80 ± 0.37^{Aa}
	V	34.20 ± 0.37^{Aa}	33.80 ± 0.37^{Aa}	34.20 ± 0.48^{Aa}
	VI	26.8 ± 0.86^{Ac}	27.40 ± 0.60^{Ac}	27.00 ± 0.54^{Ab}
Eosinophil (%)	I	6.00 ± 0.316^{Ab}	6.00 ± 0.44^{Aa}	6.40 ± 0.24^{Aab}
	II	7.00 ± 0.316^{Aa}	2.2 ± 0.20^{Bb}	2.2 ± 0.20^{Bc}
	III	7.00 ± 0.316^{Aa}	1.60 ± 0.24^{Bbc}	1.8 ± 0.20^{Bc}
	IV	7.20 ± 0.374^{Aa}	6.60 ± 0.40^{Aa}	7.00 ± 0.44^{Aa}
	V	6.60 ± 0.24^{Aab}	6.00 ± 0.31^{Aa}	6.00 ± 0.00^{Ab}
	VI	1.40 ± 0.24^{Ac}	1.20 ± 0.20^{Ac}	1.60 ± 0.24^{Ac}

*Values (Mean±SE) having at least one common superscript (Capital letters in rows and small letters in columns) does not differ significantly (P<0.05)

Table 2: Effect of different allopathic medicine, homeopathic medicine and Homeopathic complex on biochemical parameters in clinical cases of *Dipylidium caninum* infection in dog.

Parameter	Groups	Days of treatment		
		0 Day	7 Day	14 Day
AST(IU/L)	I	28.60 ± 0.50^{Aab}	28.00 ± 1.00^{Aab}	29.60 ± 1.07^{Aa}
	II	30.4 ± 0.812^{Aa}	25.60 ± 0.60^{Bb}	25.20 ± 0.48^{Bb}
	III	28.80 ± 0.58^{Aab}	26.20 ± 0.58^{ABab}	25.20 ± 1.39^{Bb}
	IV	28.00 ± 0.70^{Ab}	28.00 ± 0.94^{Aab}	28.80 ± 1.15^{Aa}
	V	28.40 ± 0.67^{Aab}	28.60 ± 0.97^{Aa}	29.80 ± 0.73^{Aa}
	VI	27.40 ± 0.50^{Ab}	27.20 ± 0.58^{Aab}	27.00 ± 0.54^{Aab}
ALT(IU/L)	I	34.60 ± 1.63^{Aa}	35.00 ± 1.09^{Aa}	35.6 ± 1.16^{Aa}
	II	36.60 ± 1.28^{Aa}	27.00 ± 1.61^{Bb}	25.00 ± 1.00^{Bb}
	III	32.60 ± 1.56^{Aa}	25.20 ± 1.57^{Bb}	23.80 ± 0.86^{Bb}
	IV	35.00 ± 1.87^{Aa}	33.20 ± 0.96^{Aa}	34.60 ± 0.97^{Aa}
	V	34.20 ± 1.39^{Aa}	36.00 ± 0.89^{Aa}	36.00 ± 0.70^{Aa}
	VI	25.60 ± 1.39^{Ab}	24.20 ± 0.37^{Ab}	24.60 ± 0.54^{Ab}

*Values (Mean±SE) having at least one common superscript (Capital letters in rows and small letters in columns) does not differ significantly (P< 0.05)

Table 3: Shedding of tapeworm segments at different intervals

Groups	0 Day					7 Day					14 Day				
	D1	D2	D3	D4	D5	D1	D2	D3	D4	D5	D1	D2	D3	D4	D5
I	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
II	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-
III	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-
IV	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
V	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
VI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

man in Nyala, Sudan: The First Reported Case in Sudan in 2006. *Al Neelain Med. J.* **2**(6): 37-42.

Brunton LL, Lazo SJ and Parker LK (2006) The Pharmacological basis of therapeutics. 11th ed., Mc Graw Hill medical publishing division.

Chapel CL and Penn HM (1990) *Dipylidium caninum* an underrecognised infection in infants and children. *Pediatr. Infect. Dis. J*. **9**: 745-747.

Cristina RT (2003) Efficiency study of an anthelmintic association in dog. *Revista Romana de Medicina Veterinara.* **13**(2): 168-174.

Dantas T (2008) Canine vector-borne diseases in Brazil. *Parasites and Vectors*. **1**: *25.*

Fan C, Kue E, Chung W, Tsai Y, Chang M and Chao P (1998) A parasitological survey among stray dogs in Tapei city with haematological findings. *J. Chinese Soc. Vet. Sci*. **24**(4): 288-294.

Gutierrez VAF (1998) Efficacy of albendazole against *Dipylidium caninum*. *Veterinaria Mexico*. **29**(3): 303-305.

Jain NC (1986) Schalm's Veterinary Haematology. 5th ed., Lea and Febiger, Philadelphia. pp: 1221.

Kaneko JJ, Harvey JW and Bruss ML (1997) Clinical biochemistry of domestic animals. 5th ed., Academic Press, USA. pp: 895.

Mishra UK, Das RK, Panda MR and Swain P (1994) Histopathological and haematological studies in mixed helminthic infection of stray dogs. *Indian J. Vet. Res.* **3**(2): 38-41.

Misraulia KS, Pandey SS, Reddy AG and Sharma RK (1998) Efficacy of Droncit against *Dipylidium caninum* in dogs. *Indian Vet. J.* 75(3): 247-248.

Molina CP, Ogburn J and Adegboyega P (2003) Infection by *Dipylidium caninum* in an infant. *Arch. Pathol. Lab. Med*. **127**: 157-159.

Ogunkoya AB, Useh NM and Esievo KAN (2006) The haemogram of dogs with gastrointestinal parasites in Zaria, Nigeria. *J. Anim. Vet. Adv.* **5**(9): 782-785.

Pawar SP, Raote YV, Bharkad GP, Khillare BS and Bhonsle AV (2005) Efficacy of anthelmintics against *Ancylostoma caninum and Dipylidium caninum* in pet dogs. *Intas Polivet.* **6**(2): 240-242.

Qadir S, Dixit AK, Dixit P and Sharma RL (2011) Intestinal helminths induce haematological changes in dogs from Jabalpur, India. *J. Helminthol.* **85**(4): 401-403.

Ramana KV, Rao SD, Mohanty SK and Wilson CG (2011) Human dipylidiasis*: A* case report of *Dipylidium caninum* infection from Karimnagar. *Int. J. Health Allied Sci.* **10**(2): 28.

Silverman PH (1961) The Life cycles and host relations of some tapeworms of dogs. *Adv. Small Anim. Pract*. 26-31.

Snedeor and Cochran (1994) Statistical methods. 8th ed., Calcutta, India: Oxford & IBH Publishing Co.

Soulsby EJL (1982) Eggs of worm parasites helminths, arthropods and protozoa of domesticated animals. 7th ed., Bailliere Tindal, London.

Tuzer E, Bilgin Z, Oter K, Ercin S and Tnar R (2010) Efficacy of praziquantel injectable solution against feline and canine tapeworms. *Turkiye Parazitoloji Dergisi*. **34**(1): 17-20.

Vegad JL and Katyar AK (2001) A Textbook of Veterinary Special Pathology. Ist edn. International book distributing cooperation.