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Epidemiological investigation on swine intestinal parasites in Shaanxi province, China

Qing Lin[1,2], Xing-Ye Wang[1,2], Mei-Mei Cong[1], Wan-Xin Ren[1], Bing Hu[1], Wen-Yu Cheng[1], Hong-Mei Li[1], San-Ke Yu[1] and Guang-Hui Zhao[1,2]*

[1]College of Veterinary Medicine, Northwest A & F University, Yangling, Shaanxi Province 712100, P. R. China.
[2]State Key Laboratory of Veterinary Etiological Biology, Key Laboratory of Veterinary Parasitology of Gansu Province, Lanzhou Veterinary Research Institute, CAAS, Lanzhou, Gansu Province 730046, P. R. China.

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The present investigation was undertaken to determine the prevalence of common intestinal parasites in domestic pigs in Shaanxi province of China between May 2011 and February 2012. A total of 1339 pig fecal samples were collected from pre-weaners (252), growers (360), fatteners (417), breeding sows and boars (310) in 9 farms located in 8 counties/districts. Among them, 387 fecal samples were positive for intestinal parasites. Growers had the highest infection rate (41.4%), while pre-weaners had the lowest (22.2%). But only 39 pigs were infected with multiple parasites. The common intestinal parasites were *Ascaris suum* (10.23%), *Strongyloides* spp. (6.49%), *Eimeria* spp. (6.35%) and *Cryptosporidium* spp. (4.63%). Of the risk factors for intestinal parasite infection investigated in the present study, the farm management system played a remarkable role in the occurrence and intensity of intestine parasite infection. These results suggested that the efficient prevention and control measures should be taken to control intestinal parasites infection in pig in Shaanxi province.

Key words: Intestinal parasites, prevalence, swine, Shaanxi province.

INTRODUCTION

Pig raising is a historical agricultural industry in China, and the pig production here occupies 50% of the total international live pig production (Chen and Huang, 2007). With approximate 10.1 million slaughtered fattened hogs and 11.2 million grower hogs in 2011, Shaanxi province is becoming a novel important pig production region and the representative province in northwestern China because of its suitable geographical conditions and climate. However, swine could carry many intestinal pathogens which would hinder the growth of pigs, leading to significant economic losses to the livestock industries and farming communities (Joachim et al., 2001; Permin et al., 1999; Roepstorff et al., 1998; Weng et al., 2005). Some intestinal parasites, such as *Cryptosporidium*, can be transmitted to other animals even including humans in many parts of the world especially in children and people with immunodeficiency diseases (Xiao et al., 2002; Widmer, 2004; Enemark et al., 2003; Featherstone et al., 2010; Suárez-Luengas et al., 2007), also including some locations of China (Table 1).

The main objective of this study was to investigate the species and prevalence of intestinal parasites of pigs in Shaanxi province, northwestern China, to assess the related risk factors for intestinal parasite infection in intensive pig farms.

*Corresponding author. E-mail: zgh083@163.com or zgh083@nwsuaf.edu.cn. Tel: +86-29-87081762. Fax: +86-29-87081762.

Table 1. The prevalence of *Cryptosporidium* in pigs in China.

Location	Number of sample	Average prevalence (%)	Reference
Hunan	495	19	Liu et al., 1993
Chongqing	1,790	16.9	Zhou et al., 2007
Henan	113	17.7	Zhang et al., 1998
Guangzhou	198	2.53	Zhang and Huang, 2001
Anhui	162	56.8	Zhao and Li, 2003
Anhui	577	10.05	Zhao et al., 2005
Beijing	71	47.9	Jiang et al., 1992
Shanghai	1,488	11.96	Chen and Huang, 2007

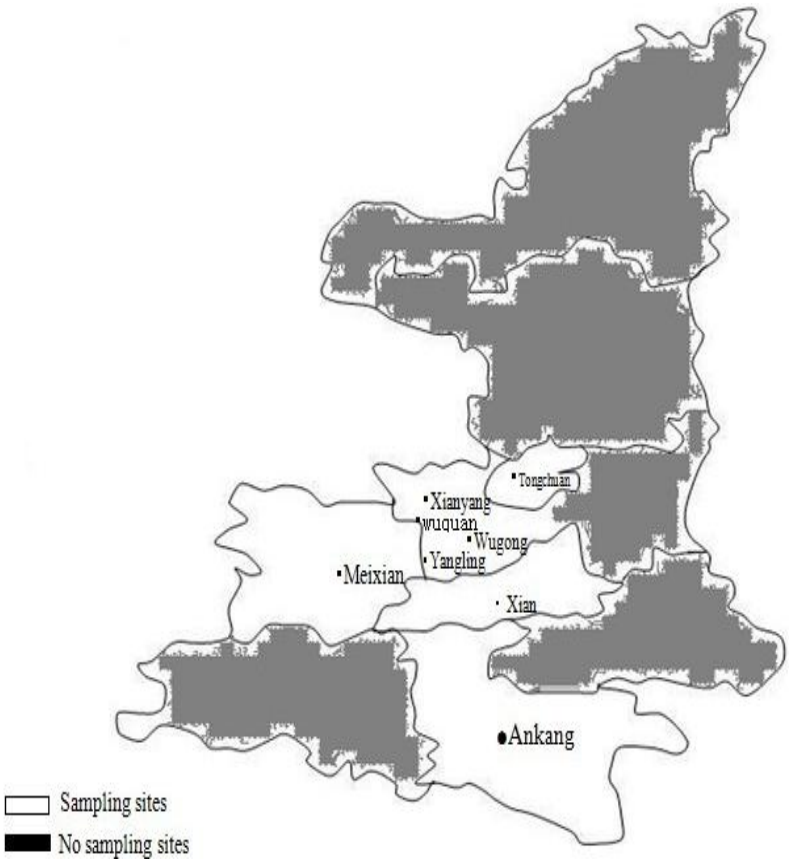

Figure 1. The sampling locations for pig intestinal parasites in different regions of Shaanxi, north western, China.

MATERIALS AND METHODS

The study site

The study was conducted in Shaanxi province, northwestern China, which is located in the middle Yellow River between northern latitudes 31°42′ to 39°35′ and eastern longitudes 105°29′ to 111°15′, sharing borders with Shanxi and Henan provinces in the east, Ningxia autonomous region and Gansu province in the west, Sichuan province, Hubei province, and Chongqing city in the south, and the Inner Mongolian autonomous region in the north. The whole region belongs to continental monsoon climate with an average annual temperature ranging from 7 to 16°C and average annual rainfall of 576.9 mm.

Samples collection

Between May 2011 and February 2012, a total of 1339 fresh fecal samples were collected from 9 pig farms randomly selected from 8 counties/districts in Shaanxi province (Figure 1). Samples were obtained directly from the rectum of each animal and marked with

age, date, management, physical condition and vaccination. Four age categories were defined, namely <1 month, 1-2 month, 2-6 month and >6 month. Four seasons were specified as spring (February to April), summer (May to July), autumn (August to October), and winter (November to January). All the samples were transported to laboratory and stored at 4°C for further detection.

Parasite detection

Samples were processed by filtration to remove impurities, and concentrated through the Sheather's sugar flotation technique and saturated saline flotation method. The fat in fecal samples collected from less than 3 months old pigs was removed using formalin-ethylacetate sedimentation method. The presence of helminth eggs and protozoan cysts, oocysts and/or trophozoites was determined by microscopy from a direct surface layer fecal smear. Each observed egg or cyst/oocyst was identified by their morphological characteristics (Wade and Gaafar, 1991).

Data analysis

The sample was defined as positive when one or more parasite eggs, oocysts, cysts or trophozoites were found. The overall herd infection rate was calculated by positive samples with the whole number of samples evaluated and expressed as a percentage. The mean prevalence rate for each pig farms and age category were counted by dividing the number of positive numbers with the total number of animals in that farm and category, then also was expressed as a percentage. The same data analysis was used for the season. Data was analyzed using SPSS17.0 (Statistical Pac kage for the Social Sciences) and Microsoft Excel 2003. The SPSS software was also used to evaluate the differences in prevalence of intestinal parasites between different groups of swine, with values of $p<0.05$ and $p<0.01$ considered to be statistically significant and highly significant. The differences in prevalence were evaluated using Pearson's Chi-Square test (X^2-test) for comparing multitude risk factors.

RESULTS AND DISCUSSION

In the present study, a total of 1339 fecal samples were collected from 8 representative intensive pig farms with different antiparasite management practices during May 2011 and February 2012. Among them, 387 fecal samples were positive for intestinal parasites with overall infection rate of 28.90% (Table 2), which is much lower than that in other places of China, for example, 95.9% in Hunan and 68.0% in Guangdong (Boes et al., 2000; Weng et al., 2005). The prevalence here was also lower than that in Korea (73.5%) and Uganda (91%) (Ismail et al., 2010; Nissen et al., 2011). The common parasites were *Ascaris suum*, *Strongyloides*, *Eimeria* spp. and *Cryptosporidium* spp. in Shaanxi, but with *Oesophagostomum* spp. and *A. suum* in Hunan, *Balantidium coli* and *Eimeria* spp. in Guangdong, while with *Balantidium coli, A. suum*, and *Entamoeba* spp. in Korea, and strongyles*, A. suum, Trichuris suis* in Uganda.

Of all the samples examined in this study, the prevalence were 23.2, 31.1, 26.9 and 18.8% for breeding pigs, fatteners, growers and weaners, respectively (Table 3). The growers had the highest infection rate, while pre-weaners had the lowest among the four age categories. The difference of infection rates for intestinal parasites between different age categories was statistically highly significant ($P < 0.01$).

The average prevalence among each pig farms ranged from 6.54 to 62.43%. The infection rates between different pig farms fluctuated greatly ($P < 0.01$). For example, the prevalence of *Cryptosporidium* spp. ranged from 0 to 23.8%, and that of nematodes ranged from 1.90 to 38.6%. In this study, all the samples were collected from intensive system since this raising mode is widely used by farmers in Shaanxi. As is known, pigs can get infected with parasites by ingesting infective egg and oocyst/cyst from environment (feces, contaminated food and water). However, regular cleaning and disinfection of pig farms and food/water, scientifically antiparasitic regimens and animal welfare play positive role in reducing infection rate during farms. Periodical anthelmintic practices were carried out in YanglingB pig farm which enjoyed a low infection rate. These results revealed the importance of farm management system in the prevalence of intestinal parasites.

The prevalence of intestinal parasites in different seasons (spring, summer, autumn, winter) was statistically highly significant ($P < 0.01$). The prevalence of *Cryptosporidium* spp. infection rate ranged from 1.24 to 11.1%, with the highest in autumn and the lowest in summer (Table 4). These results were not consistent with the previous report in Shanghai province of China that the highest percentage was found in the winter and lowest in summer (Chen et al., 2011). But the highest infection rate for coocidian oocysts appeared in winter and lowest in autumn.

The present investigation showed that intestinal parasites in swines were considerably serious in Shaanxi province. The average herd prevalence of each pig farms was significantly different, indicating that farm management system and parasites control practice played an important role on the occurrence and intensity of intestinal parasites among numerous risk factors. Since pigs can be infected with intestinal parasites by ingesting infective eggs and/or oocyst/cyst from surrounding environment, the suitable farm management strategies, regular disinfection and periodical anthelmintic practices will be useful to lower the infection rate of these parasites. Previous studies also reported that pigs with suitable daily diets would play a potential role in acquisition of immunity to parasites (Bundy and Golden, 1987; Coop and Holmes, 1996; Wan et al., 1989). Meanwhile, another feasible preventive measure is affirmed to hire a veterinarian who is responsible for management (Theodoropoulos et al., 2009; Polson et al., 1992; Ingwersen, 1995).

Of the 9 pig farms, nematode was the most common parasite, including *A. suum* (10.23%), *Strongyloides* spp.

Table 2. The prevalence of intestinal parasites of 9 pig farms in Shaanxi province.

Collection site	Sample size	*Cryptosporidium* spp. prevalence (Positive sample)	Nematode prevalence (Positive sample)	*Eimeria* spp. prevalence (Positive sample)	*Isopora suis* prevalence (Positive sample)	Tapeworm prevalence (Positive sample)	Positive number prevalence (Positive sample)
Ankang	76	0	7.89% (6)	1.31% (1)	2.63% (2)	0	11.84% (9)
Wugong	189	23.8% (45)	38.6% (73)	2.65% (5)	0.53% (1)	0	62.43% (118)
YanglingA	81	6.17% (5)	7.40%(6)	1.23%(1)	2.47%(2)	0	13.58%(11)
Wuquan	185	3.24% (6)	31.4% (58)	6.49% (12)	2.70% (5)	0	41.08% (76)
YanglingB	367	0.54% (2)	1.90% (7)	2.18% (8)	2.18% (9)	0.82% (3)	6.54% (24)
Xianyang	92	1.08% (1)	17.4% (16)	6.52% (6)	6.52% (4)	0	25.00% (23)
Meixian	121	3.31% (4)	16.5% (20)	4.96% (6)	2.48% (3)	0	23.97% (29)
Tongchuan	124	2.42% (3)	16.1% (20)	19.4% (24)	10.5% (13)	0.81% (1)	42.74% (53)
Xi'an	104	0.96% (1)	17.3% (18)	21.2% (22)	11.5% (12)	0	42.31% (44)
Total	1339	4.63% (62)	16.72% (224)	6.35% (85)	3.81% (51)	0.29% (4)	28.90% (387)

Table 3. The prevalence of intestinal parasites in pigs by age.

Age group	Sample size	*Cryptosporidium* spp. Positive sample (prevalence)	Nematode Positive sample (prevalence)	*Eimeria* spp. Positive sample (prevalence)	*Isopora suis* Positive sample (prevalence)	Tapeworm Positive sample (prevalence)	Positive number Positive sample (prevalence)
<1 month	252(18.8%)	9(3.57%)	23(9.12%)	18(7.14%)	13(5.16%)	0	56(22.2%)
1–2 month	360(26.9%)	45(12.5%)	81(22.5%)	18(5.00%)	6(1.67%)	0	149(41.4%)
2–6 month	417(31.1%)	6(1.44%)	61(14.63%)	24(5.76%)	14(3.36%)	2 (0.48%)	93(22.3%)
>6 month	310(23.2%)	2(0.65%)	59(19.0%)	25(8.06%)	18(5.81%)	2 (0.65%)	89(28.7%)
Total	1339	62(4.63%)	224(16.7%)	85(6.35%)	51(3.81%)	4(0.29%)	387(28.90%)

Table 4. The prevalence of intestinal parasites in pigs by season.

Season	No. of sample	*Cryptosporidium* spp. Positive sample (prevalence)	Nematode Positive sample (prevalence)	*Eimeria* spp Positive sample (prevalence)	*Isopora suis* Positive sample (prevalence)	Tapeworm Positive sample (prevalence)
Spring	148	2(1.35%)	2(1.35%)	3(2.03%)	6(4.05%)	1(0.68%)
Summer	404	5(1.24%)	63(15.6%)	17(4.20%)	8(1.98%)	2(0.50%)
Autumn	440	49(11.1%)	103(23.4%)	15(3.41%)	11(2.50%)	0
Winter	347	6(1.73%)	56(16.1%)	50(14.4%)	26(7.49%)	1(0.29%)
Total	1339	62(4.63%)	224(16.7%)	85(6.35%)	51(3.81%)	4(0.29%)

(6.49%), while in Chongqing and Guangdong provinces, the prevalence of *Balantidium* sp. were prevalence of 22.79 and 47.2%, respectively (Weng et al., 2005; Lai et al., 2011). *Cryptosporidium* oocysts were found in 8 pig farms with infection rates of 4.63%, which is much lower than that reported in Henan and other eastern provinces of China (Wang et al., 2010; Chen and Huang, 2007). *Eimeria* spp. and *Isopora suis* were the most widespread intestinal coccidian, which were found in all pig farms with prevalence of 6.35% and 3.81%, respectively. But their prevalence were lower than that in Chongqing province (Lai et al., 2011). Moreover, the prevalence of intestinal parasites in intensive swine farms in Shaanxi province is much lower than those reported in Guizhou and Guangxi in China (Hong et al., 2000; Liu and Lu, 2002). In Kabale District of Uganda, the prevalence of several nematodes was recorded, namely strongyles (89%), *A. suum* (40%), *T. suis* (17%) and spiruroid eggs (48%) (Nissen et al., 2011). These differences may be due to the distinct climatic conditions and pig management systems in different locations.

The disparity of infection rates of intestinal parasites between different age categories was significant. The growers had the highest infection rate while pre-weaners had the lowest, which were consistent with previous studies in Henan and Hunan Provinces of China (Chou et al., 2008; Huang et al., 2008). This uneven age-specific herd prevalence of pig intestinal parasite is a common phenomenon that may be due to different host-parasite interactions, especially immunity to the parasite (Roepstorff and Nansen, 1994; Damriyasa and Bauer, 2006).

In conclusion, age categories and pig farm control strategies were the main aspects that affect infection rates among the related risks factors. Our investigation here provided basic data on the prevalence of intestinal parasites and related factors in Shaanxi province. The prevalence of intestinal parasites in pigs in Shaanxi was severe and the infection of intestinal parasites is still an important factor that hinders the development of the pig farming industry as well as affects human health in Shaanxi province. Therefore, the findings here would have important implications to control and prevent intestinal parasite infection in pigs in Shaanxi province.

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REFERENCES

Boes J, Willingham AL, Fuhui S, Xuguang H, Eriksen L, Nansen P, Stewart TB (2000). Prevalence and distribution of pig helminths in the Dongting Lake Region (Hunan Province) of the People's Republic of China. J. Helminthol. 74: 45-52.

Bundy DA, Golden MH (1987). The impact of host nutrition on gastrointestinal helminth populations. Parasitology 95: 623-635.

Chen F, Huang K (2007). Prevalence and phylogenetic analysis of *Cryptosporidium* in pigs in Eastern China. Zoonoses Public Health, 54: 393-400.

Chen Z, Mi R, Yu H, Shi Y, Huang Y, Chen Y, Zhou P, Cai Y, Lin J (2011). Prevalence of *Cryptosporidium* spp. in pigs in Shanghai, China. Vet. Parasitol. 181: 113-119.

Chou SX, Jian FC, Ren GZ, Ning CS, Lu XY, Shi K, Zhang LX (2008). Investigation of intestinal parasites in intensive pig farms in Henan Province. Anim. Husb. Vet. Med. 40: 39-42 (in Chinese).

Coop RL, Holmes PH (1996). Nutrition and parasite interaction. Int. J. Parasitol. 26: 951-962.

Damriyasa IM, Bauer C (2006). Prevalence and age-dependent occurrence of intestinal protozoan infections in suckling piglets. Berl. Munch. Tierarztl. Wochenschr., 119: 287-290.

Enemark HL, Ahrens P, Bille-Hansen V, Heegaard PM, Vigre H, Thamsborg SM, Lind P (2003). *Cryptosporidium parvum*: infectivity and pathogenicity of the 'porcine' genotype. Parasitology 126: 407-416.

Featherstone CA, Marshall JA, Giles M, Sayers AR, Pritchard GC (2010). *Cryptosporidium* species infection in pigs in East Anglia. Vet. Rec. 166: 51-52.

Hong M, Wang CJ, Zhang YZ, Xia BY, Wang WD (2000). Investigation on the prevalence of parasites in pigs in Tongren Administrative Region, Guizhou Province, People's Republic of China. Chin. J. Vet. Parasitol. 8: 28 (in Chinese).

Huang JH, Chen SM, Deng FQ (2008). Investigation of intestinal parasites in intensive pig farms in Yongzhou, Hunan Province. Anim. Husb. 1: 67-68 (in Chinese).

Ingwersen J (1995). Inclusion of veterinarians in the structure of swine production. Dtsch. Tierarztl. Wochenschr. 102: 269-271.

Ismail HA, Jeon HK, Yu YM, Do C, Lee YH (2010). Intestinal Parasite Infections in Pigs and Beef Cattle in Rural Areas of Chungcheongnam-do, Korea. Korean J. Parasitol. 48: 347-349.

Jiang JS, Bi KX, Xu YQ, Zhao YR (1992). Survey on the prevalence of *Cryptosporidium* spp. in pigs in Beijing area. Chin. J. Vet. Med. 18: 3-4 (in Chinese).

Joachim A, Dülmer N, Daugschies A, Roepstorff A (2001). Occurrence of helminthes in pig fattening units with different management systems in Northern Germany. Vet. Parasitol. 96: 135-146.

Lai M, Zhou RQ, Huang HC, Hu SJ (2011). Prevalence and risk factors associated with intestinal parasites in pigs in Chongqing, China. Res. Vet. Sci. 91: 121-124.

Liu CQ, Lu J (2002). Investigation on the prevalence of parasites in intensively raised pigs in Yulin Administrative Region, Guangxi Zhuang Nationality Autonomous Region, People's Republic of China. Guangxi J. Anim. Sci. Vet. Med. 18: 11-12 (in Chinese).

Liu Y, Liu ZN, Li DX, Cao XM, Li JF (1993). Investigation on the prevalence of *Cryptosporidium* in pigs. Chin. J. Vet. Med. 19: 5-6 (In Chinese).

Nissen S, Poulsen IH, Nejsum P, Olsen A, Roepstorff A, Rubaire-Akiiki C, Thamsborg SM (2011). Prevalence of gastrointestinal nematodes in growing pigs in Kabale District in Uganda. Trop. Anim. Health Prod. 43: 567-572.

Permin A, Yelifari L, Bloch P, Steenhard N, Hansen NP, Nansen P (1999). Parasites in cross-bred pigs in the Upper East Region of Ghana. Vet. Parasitol. 87: 63-71.

Polson DD, Marsh WE, Dial GD (1992). Financial evaluation and decision making in the swine breeding herd. Vet. Clin. North Am. Food Anim. Pract. 8: 725-747.

Roepstorff A, Nilsson O, Oksanen A, Gjerde B, Richter SH, Ortenberg E, Christensson D, Martinsson KB, Bartlett PC, Nansen P, Eriksen L, Helle O, Nikander S, Larsen K (1998). Intestinal parasites in swine in

the Nordic countries: prevalence and geographical distribution. Vet. Parasitol. 76: 305-319.
Roepstorff A, Nansen P (1994). Epidemiology and control of helminth infections in pigs under intensive and non-intensive production systems. Vet. Parasitol. 54: 69-85.
Suárez-Luengas L, Clavel A, Quílez J, Goñi-Cepero MP, Torres E, Sánchez-Acedo C, del Cacho E (2007). Molecular characterization of *Cryptosporidium* isolates from pigs in Zaragoza (northeastern Spain). Vet. Parasitol. 148: 231-235.
Theodoropoulos G, Stevens KB, Hartsa A, Theodoropoulou H, Pfeiffer DU (2009). Farm-level factors associated with above-average production on pig farms in Evia, Greece**.** Prev. Vet. Med. 89: 163-166.
Wade WF, Gaafar SM (1991). Common laboratory procedures for diagnosing parasitism. In: Colville, J. (Ed.) Diagnostic Parasitology for Veterinary Technicians. American Veterinary Publications Inc., St. Louis, pp. 7-50.
Wan JM, Haw MP, Blackburn GL (1989). Nutrition, immune function, and inflammation: an overview. Proc. Nutr. Soc. 48: 315-335.
Wang R, Qiu S, Jian F, Zhang S, Shen Y, Zhang L, Ning C, Cao J, Qi M, Xiao L (2010). Prevalence and molecular identification of *Cryptosporidium* spp. in pigs in Henan, China. Parasitol. Res. 107: 1489-1494.
Weng YB, Hu YJ, Li Y, Li BS, Lin RQ, Xie DH, Gasser RB, Zhu XQ (2005). Survey of intestinal parasites in pigs from intensive farms in Guangdong Province, People's Republic of China. Vet. Parasitol. 127: 333-336.
Widmer G (2004). Population genetics of *Cryptosporidium parvum*. Trends Parasitol. 20: 3-6.
Xiao L, Bern C, Arrowood M, Sulaiman I, Zhou L, Kawai V, Vivar A, Lal AA, Gilman RH (2002). Identification of the *Cryptosporidium* pig genotype in a human patient. J. Infect. Dis. 185: 1846-1848.
Zhang DM, Huang JG (2001). Investigation on the prevalence of *Cryptosporidium* spp. in pig and dairy cattle in Guangzhou city. Chin. J. Zoonoses. 17: 100-101 (in Chinese).
Zhang LX, Ning CS, Jiang YF, Xu ZM (1998). Prevalence of *Cryptosporidium* spp. in pigs in the suburban areas of Zhengzhou city. Chin J. Vet. Parasitol. 6: 19-20 (in Chinese).
Zhao CC, Li PY (2003). Epidemiologic survey on pig cryptosporidiosis in Fengtai county in Anhui province. Chin. J. Vet. Parasitol. 11: 42-44 (in Chinese).
Zhao CC, Li PY, Wu L, Chen LZ, Yu WY (2005). Epidemiological survey on swine cryptosporidiosis in Anhui province. Anim. Husb. Vet. Med. 37: 18-20 (in Chinese).
Zhou RQ, Huang HC, Wei GH, Liu P, Li Q, Wang RH, Nie K (2007). Epidemiology survey of pig *Cryptosporidium* in Chongqing and identification of *Cryptosporidium* species. J. Southwest China Norm. Univ. 32: 82-84 (in Chinese).