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Research Article

A Survey for Zoonotic and Other Gastrointestinal Parasites in Pig in Bali Province, Indonesia

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ABSTRACT

Pigs have potentially to transmit zoonotic gastrointestinal parasite disease both caused by protozoa and worm. The aim of this study was to identify gastrointestinal parasites that were potentially zoonotic in pigs in the province of Bali. A total of 100 fresh feces samples was collected from several pig farms in Bali, from Badung and Tabanan districts, each consisted of 50 samples. Pig feces samples were examined for the presence of eggs worms, cysts and oocysts for protozoa based on the morphology and size. Identification for protozoa and worms used native, sedimentation and sucrose flotation methods. Parameters measured were sex, feed and cage management. The result showed that the characteristic parameters for pigs in both district were generally female. Cage management for raising pigs mostly used group cage. Feed that provided in both district mostly used bran and concentrate. All of 100 pig feces samples that examined positive for parasites. There were 8 types of gastrointestinal parasites that have been identified. Four types of protozoa found were Entamoeba sp. (99%), Balantidium sp. (79%), Eimeria sp. (78%), Blastocystis sp. (69%) and four types of worms were Ascaris sp. (20%), Trichuris sp. (20%), Strongyloides sp. (19%), and Oesophagostomum sp. (8%). All pigs were infected with two or more parasites. The prevalence of parasitic gastrointestinal infections was different for each district, six genera (Entamoeba sp., Balantidium sp., Blastocystis sp., Eimeria sp., Oesophagostomum sp. and Trichuris sp.) were higher found in Tabanan district and the two genera (Ascaris sp. and Strongyloides sp.) were higher in Badung district. Oesophagostomum sp. was only found to infect pigs in Tabanan district. The conclusion is gastrointestinal parasites that found in pigs at Badung and Tabanan district Bali Province mostly have zoonotic potential.

Keywords: *Zoonotic parasite, Gastrointestinal parasite, Pig, Bali Indonesia*

ABSTRAK

Babi memiliki potensi untuk menularkan penyakit parasit gastrointestinal zoonotik yang disebabkan oleh protozoa dan cacing. Tujuan dari penelitian ini adalah untuk mengidentifikasi parasit gastrointestinal yang berpotensi zoonosis pada babi di provinsi Bali. Sebanyak 100 sampel feses segar dikumpulkan dari beberapa peternakan babi di Bali, dari kabupaten Badung dan Tabanan masing-masing terdiri dari 50 sampel. Sampel feses babi diperiksa terhadap keberadaan telur cacing, kista dan ookista protozoa berdasarkan morfologi dan ukuran. Identifikasi protozoa dan cacing menggunakan metode natif, sedimentasi dan flotasi sukrosa. Parameter yang diukur adalah jenis kelamin, pakan dan manajemen kandang. Hasil penelitian menunjukkan bahwa karakteristik parameter pada babi di kedua kabupaten umumnya betina. Manajemen kandang untuk beternak babi kebanyakan menggunakan kandang kelompok. Pakan yang disediakan di kedua kabupaten sebagian besar menggunakan dedak dan konsentrat. Dari total 100 sampel feses babi yang diperiksa positif terhadap parasit. Terdapat 8 jenis parasit gastrointestinal yang telah diidentifikasi. Empat jenis protozoa yang ditemukan adalah Entamoeba sp. (99%), Balantidium sp. (79%), Eimeria sp. (78%), Blastocystis sp. (69%) dan empat genus cacing yaitu: Ascaris sp. (20%), Trichuris sp. (20%), Strongyloides

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sp. (19%), and Oesophagostomum sp. (8%). Setiap babi terinfeksi oleh dua atau lebih parasit. Prevalensi infeksi parasit gastrointestinal berbeda untuk tiap kabupaten, enam genus (Entamoeba sp., Balantidium sp., Blastocystis sp., Eimeria sp., Oesophagostomum sp. dan Trichuris sp.) lebih tinggi ditemukan di kabupaten Tabanan dan dua genus (Ascaris sp. dan Strongyloides sp.) lebih tinggi di Kabupaten Badung. Oesophagostomum sp. hanya ditemukan menginfeksi babi di kabupaten Tabanan. Kesimpulannya adalah parasit gastrointestinal yang ditemukan pada babi di Kabupaten Badung dan Tabanan Provinsi Bali sebagian besar memiliki potensi zoonosis.

Kata kunci: *Parasit zoonotik, Parasit gastrointestinal, Babi, Bali Indonesia*

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INTRODUCTION

Pigs are one of the commodities in the livestock sector, which has great potential to be developed in the recent decades. The pig population in Indonesia continues to increase along with the increasing number of large-scale pig farms and individual pig farmers. One of the regions in Indonesia where most people raise pigs is in Bali Province. Bali Provincial Livestock Service[1] reports that the total pig population in 2016 reached 803,517. In Bali Province, pigs are an important commodity and most people in Bali maintain pigs as their primary and secondary business. In addition, pigs also play an important role in fulfilling daily food needs and as a complement to religious ceremonies.[2]

Generally, pigs in Bali are traditionally raised with low nutritional value and poor hygiene. This condition make pigs are more vulnerable to various diseases and has potential to spread the diseases.[3] The existence of the diseases can cause considerable economic losses for pig farmers. Losses include a decrease in production due to inhibition of livestock growth and increase medical costs.[4] One of the diseases that can infect pig is gastrointestinal parasites. Economic losses caused by gastrointestinal parasites were significant, but farmers may not realize it because the symptoms tend to be subclinical and pigs may still look healthy.[5]

Gastrointestinal parasites in pigs are protozoa and worms. The types of protozoa that can infect gastrointestinal tract of pigs include *Entamoeba* sp.; *Balantidium* sp.; *Eimeria* sp.; and *Isospora* sp.[6] Recent study by Yoshikawa *et al*.,[7] in East Nusa Tenggara found the presence of protozoa *Blastocystis* sp. as much as 87.1%. Research about *Blastocystis* sp. in pigs in Bali Province, previously have not been reported. According to Suryastini *et al*.,[8] several types of gastrointestinal worms that can infect pigs were *Gnathostoma hispidum*, *Hyostrongylus rubidus*, *Macracanthorhyncus hirudinaceus*, *Globocephalus urosubulatus*, *Strongyloides ransomi*, *Ascaris suum*, *Oesophagostomum dentatum* and *Trichuris suis*.

Some gastrointestinal parasites in pigs have potentially to transmit zoonotic diseases to human. According to Schar *et al*.,[9] there are five gastrointestinal parasites that can be detected in pigs with zoonotic potential, were *Ascaris* sp., *Trichuris* sp., *Capillaria* spp., *Balantidium coli* and *Entamoeba* sp. In addition, Wang *et al*.,[10] stated that *Blastocystis* sp. in pigs also had zoonotic potentially. It will certainly have an impact on the animal welfare as well as pig farmers and surrounding communities close to the farm area. Therefore, the aims of this study was to determine zoonotic and other gastrointestinal parasites in pig at Bali province, Indonesia based on fecal examination and discuss their zoonotic potential.

MATERIALS AND METHODS

Study Area

This study was conducted in two district in Bali: Badung and Tabanan districts. In Badung district

Figure 1. Map of Sampling Location. Dark Blue Colour is Badung District and Pink Colour is Tabanan District.

samples were taken in North Kuta sub-district, and in Tabanan district samples were taken in Baturiti sub-district. Geographically, Badung district located between 08˚14'20" - 08˚50'48'' South latitude and 115˚05'00" - 115˚26'16" East longitude. North Kuta sub-district has an area of 33.86 km^2 with an altitude of 0-65 meters above sea level. North Kuta sub-district was located in the lowlands close to urban areas. Geographically, Tabanan district located between 08˚14'30" - 08˚30'07" South latitude and 114˚54'52" East longitude. Baturiti sub-district has an area of 99.17 km^2 with an altitude of 465-2082 meters above sea level. Baturiti sub-district was located in the highlands of rural areas. Dark blue colour is Badung district and pink colour is Tabanan district (**Figure 1**). A total of 100 pig fecal samples were taken randomly, from Badung and Tabanan districts consisted each 50 samples. Samples collection were conducted from 15 - 22 January 2018.

Feces Samples Collection

Feces samples from several pig farmers are taken directly using gloves from the ground and after defecation and accompanied by a veterinarian from the local livestock department. All feces samples were collected in urine steril container and were preserved in 2.0% potassium dichromate for protozoa examinations and 10% formalin for helminths examination, then stored in cool box for transportation. For each animal was recorded with different code. Parameters included sex, feed and cage management.

Examination of Feces Samples

Samples were observed at Veterinary Parasitology Laboratory, Faculty of Veterinary Medicine, Universitas Airlangga, Surabaya Indonesia. Samples were examined for eggs worm, cyst and oocyst for protozoa. Identification for protozoa and egg worm using native, sedimentation and sucrose flotation methods. Feces were diluted with aquadest and then filtered. For native examination, the feces sample is stirred first using a stirring rod and then a small portion of feces sample is taken and placed on the object glass and the lid uses a cover glass after that check under the microscope 400x magnification. For sediment examination, filtrate were centrifugation at 1.500 rpm for 5 minutes (by centrifuge HC 1180T 8 HOLE WITH TIMER, China), then removed supernatant. This step repeated until 3 times. Take the sediment slowly and place it on the object glass then cover with a cover glass. The remaining sediment was added with sucrose solution until complete 12 mL to be centrifuged at 1.500 rpm for 10 min in a 15 mL plastic tube. Floated was added sucrose solution until mouth of tube and was covered by a cover glass. After 5 min, cover glass was transferred to object glass, and the eggs of worm were observed at 100x magnification and the cysts and oocysts of protozoa were observed at 400x magnification for identification by light microscopy. Identification for both protozoa and worm were based on the morphology and size of the eggs, cysts or oocysts.[11,12,13]

Table 1. Characteristic Parameters Pigs for Sampling

Characterictics		Places		Total
		Badung District (n=50)	Tabanan District (n=50)	
Sex	Male	18	16	100
	Female	32	34	
Feed	Bran + Concentrate	35	28	
	Bran + Concentrate + Banana trunk	7	9	
	Bran + Concentrate + Banana trunk + Leftlovers house	5	0	
	Bran + Leftlovers house	1	0	100
	Bran + Consentrate + Banana trunk + Taro stems	0	9	
	Bran + Consentrate + Taro stems	0	3	
	Bran + Chicken innards+ Leftlovers house	2	0	
	Bran + Banana trunk	0	1	
Management	Individual cage	11	8	100
	Group cage	39	42	

RESULTS AND DISCUSSION

A total of 100 pig feces samples from Badung and Tabanan districts Bali province, Indonesia were identified. Information from each pig characteristics were provided in (**Table 1**). **Table 1** shows that the majority of the pig population in Tabanan and Badung districts are female and feed given to almost pigs is bran and concentrate. In Badung district some pigs were fed by leftovers from the kitchen while in Tabanan district some pigs were fed using plant origin ingredients, banana stems and taro leaves. The cage management in both districts mostly pig farmers are using group cages.

The results of identification indicate that the pigs in Bali are infected by 8 genera of parasites: *Entamoeba* sp., *Balantidium* sp., *Eimeria* sp., *Blastocystis* sp., *Strongyloides* sp., *Trichuris* sp., *Ascaris* sp. and *Oesophagostomum* sp. The morphological of the gastrointestinal parasites found in pigs in Bali Province are described in **Figure 2.**

All of the feces samples that have been examined, overall positive for gastrointestinal parasites (**Table 2)**. It means all of pigs were infected with gastrointestinal parasites. The highest prevalence was *Entamoeba* sp. (99%) respectively, was followed by *Balantidium* sp. (79%), *Eimeria* sp. (78%), *Blastocystis* sp. (69%), *Ascaris* sp. (20%), *Trichuris* sp. (20%), *Strongyloides* sp. (19%), and *Oesophagostomum* sp. (8%). The prevalence of parasitic gastrointestinal infections was different for each district, six genera (*Entamoeba* sp. *Balantidium* sp., *Blastocystis* sp., *Eimeria* sp., *Oesophagostomum* sp. and *Trichuris* sp.) were higher found in Tabanan district and the two genera (*Ascaris* sp. and *Strongyloides* sp.) were higher in Badung district. *Oesophagostomum* sp. was only found to infect pigs in Tabanan.

One pig could infected with two or more parasites, even, the pigs were infected with seven species of parasites. In detail, the mix infection was presented in **Table 3.** Almost all of mix infections involve *Entamoeba* sp. There is no single infection.

In Indonesia, especially in Bali Province, studies about gastrointestinal parasites have been widely reported. However, most of these studies focus on one type of parasite. There have not been many studies that discuss about mixed infection between protozoa and worms in each pig. From the results of this study showed that gastrointestinal parasites in pigs in Badung and Tabanan districts found several parasites that have zoonotic potential.

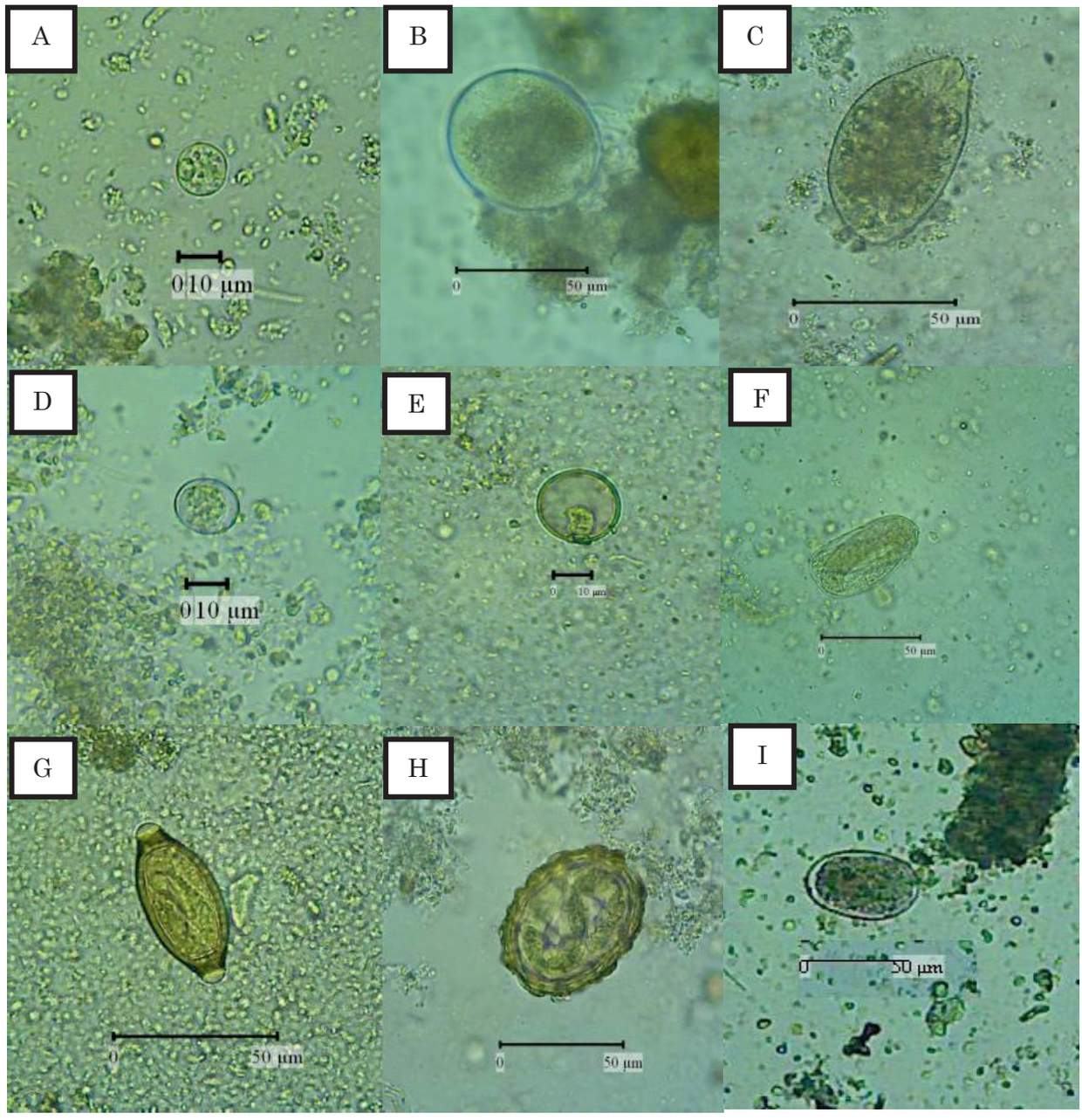

Figure 2. Morphology of Gastrointestinal Parasites in Pig in Bali Province Under Light Microscope. A). *Entamoeba* sp. (Bar: 10µm); B) and C). *Balantidium* sp. Cyst and Tropozoite (Bar: 50µm); D). *Eimeria* sp. (Bar: 10µm); E). *Blastocystis* sp. (Bar: 10µm); F). *Strongyloides* sp. (Bar: 50µm); G). *Trichuris* sp. (Bar: 50µm); H). *Ascaris* sp. (Bar: 50µm); and I). *Oesophagostomum* sp. (Bar: 50µm).

Table 2. Prevalence of Gastrointestinal Parasites Infections in Pig in Bali Province based on Each Genus of Parasite

Places	Samples	Number of Positive (%)							
		En	**Ba**	**Bl**	**Ei**	**As**	**Oe**	**St**	**Tr**
Badung District	50	49(100)	34(76)	35(70)	29(48)	12(24)	0(0)	13(26)	5(10)
Tabanan District	50	50(100)	45(90)	34(68)	49(98)	8(16)	8(16)	5(10)	15(30)
Total	100	99(99)	79(79)	69(69)	78(78)	20(20)	8(8)	18(18)	20(20)

En, *Entamoeba* sp.; Ba, *Balantidium* sp.; Bl, *Blastocystis* sp.; Ei, *Eimeria* sp.; As, *Ascaris* sp.; Oe, *Oesophagostomum* sp.; St, *Strongyloides* sp.; Tr, *Trichuris* sp.

Table 3. Prevalence Gastrointestinal Parasites in Pig in Bali Province based on Mix Infection

Parasites	Number of Positive (%)		
	Badung District (n=50)	Tabanan District (n=50)	Total (n=100)
En+Ba	2 (4)	0 (0)	2
En+Bl	4 (8)	0 (0)	4
En+Ba+Bl	7 (14)	1 (2)	8
En+Ba+Ei	7 (14)	5 (10)	12
En+Bl+Ei	4 (8)	0 (0)	4
En+Bl+As	2 (4)	0 (0)	2
En+Ei+Oe	0 (0)	1 (2)	1
En+Ei+St	0 (0)	1(2)	1
En+Ei+Tr	0 (0)	1 (2)	1
En+Ba+Bl+Ei	3 (6)	13 (26)	16
En+Ba+Bl+As	3 (6	0 (0)	3
En+Ba+Bl+St	2 (4)	0 (0)	2
En+Ei+As+St	2 (4)	0 (0)	2
Ba+Bl+Ei+St	1 (2)	0 (0)	1
En+Bl+Ei+St	3 (6)	0 (0)	3
En+Bl+Ei+Tr	0 (0)	1 (2)	1
En+Ba+Ei+As	1 (2)	2 (4)	3
En+Ba+Ei+Oe	0 (0)	3 (6)	3
En+Ba+Ei+Tr	2 (4)	2 (2)	4
En+Ba+Ei+St+Tr	1 (2)	0 (0)	1
En+Ba+Bl+As+St	1 (2)	0 (0)	1
En+Ba+Bl+Ei+As	1 (2)	4 (8)	5
En+Ba+Bl+Ei+Oe	0 (0)	3 (6)	3
En+Ba+Bl+Ei+St	1 (2)	1 (2)	2
En+Ba+Bl+Ei+Tr	1 (2)	9 (18)	10
En+Ba+Ei+As+St+Tr	0 (0)	1 (2)	1
En+Bl+Ei+As+St+Tr	0 (0)	1 (2)	1
En+Ba+Bl+Ei+Oe+St	0 (0)	1 (2)	1
En+Ba+Bl+Ei+As+St	1 (2)	0 (2)	1
En+Ba+Bl+Ei+As+St+Tr	1 (2)	0 (0)	1

En, *Entamoeba* sp.; Ba, *Balantidium* sp.; Bl, *Blastocystis* sp.; Ei, *Eimeria* sp.; As, *Ascaris* sp.; Oe, *Oesophagostomum* sp.; St, *Strongyloides* sp.; Tr, *Trichuris* sp.

Protozoa are the most common parasites that infect pigs in both districts. The higher prevalence of protozoa is dominated by *Entamoeba* sp. (100%). This result was higher than the study by Suryawan *et al*.,[14], which stated that out of 102 faecal samples of pigs in Papua, 34.2% were infected with *Entamoeba* sp. Research by Agustina *et al*.,[15] in Bali Province found that the prevalence of *Amoeba* sp. in pig fecal samples as much as 82.4%. This is certainly a concern, because all pig samples examined in this study were 100% positive for *Entamoeba* sp.

Entamoeba sp. is a protozoa that can infect human and animals. According to Matsubayashi *et al*.,[16] states that there are 6 species from genus *Entamoeba* that have been identified to infect human and animals, namely *E. histolytica*, *E. polecki*, *E. coli*, *E. dispar*, *E. moshkovskii* and

E. Hartmanni. Research by Gomez *et al.*,[17] from samples of pigs and human on four pig farms in Colombia showed that pig faecal samples were positive for *E. coli*, human faecal samples were also positive for *E. coli* and *E. hystolitica* / *dispar*. The presence of *E. coli* species in pigs and humans in Colombia shows the possibility of zoonotic potential of these parasites, so further molecular identification needs to be done. However, study by Agustina *et al.*,[18] about the incidence of *Entamoebiasis* in pigs in Bali Province showed negative PCR results on *E. polecki*, so the zoonotic potential needs to be studied further.

In this study, another protozoa found was *Balantidium* sp. The prevalence in this study was 83%. In Indonesia, the incidence of *Balantidium* sp. in pigs had been widely studied by Agustina *et al*. and Yuliari *et al.*,[18,19] with a prevalence of 61.2%, and 36.4%, respectively. In Korea[6] was recorded the prevalence of *Balantidium* sp. in pigs was 64.7%, in China[20] was 22.79%, and in Cambodia[9] was 15.8%.

Balantidium sp. is a protozoa that can cause balantidiosis. Balantidiosis is a zoonotic disease that can infect human and animals through the world. Pigs are natural reservoir for *Balantidium* sp. Transmission of the disease by faecal-oral route. In pigs it is usually asymptomatic and these protozoa live in the lumen of the cecum and colon. Transmission between human and animals can occur as well as humans to humans. In human, the incidence of balantidiosis can be asymptomatic. Severe infection can cause diarrhea and abdominal discomfort. Balantidiosis can occur due to several factors, such as sanitation, climate conditions, and community culture. An important factor in the spread of disease to humans is the presence of infected pigs and careless disposal of animal waste. This often occurs in poor rural areas where people tend to live near their livestock, so the disease is easily spread. Some sectors that have a high risk of being infected by *Balantidium* sp. are veterinarians, animal handlers and butchers.[21,22]

Eimeria sp. is a protozoa that can cause coccidiosis. The prevalence of *Eimeria* sp. in this study was 83%, higher than the study Yuliari *et al.*,[19] in pigs in Papua, Indonesia, with an average prevalence was 68.2%. In Bali Province, the prevalence of *Eimeria* sp. in pigs was reported by Agustina *et al.*,[15] as much as 54.8%. The incidence of coccidiosis in several countries has also been reported[13,20,23,24,25] with a prevalence 16.53%, 16.7%, 47%, 89.2% and 3%, respectively. Coccidiosis in young pigs can cause diarrhea and can be predispose to secondary infections by viruses or bacteria. In severe cases, pigs can become dehydrated with a 10-59% chance of death. Animals that have been repeatedly infected have no clinical symptoms, and can transmit to other animals and pollute the surrounding environment.[15]

Research about *Blastocystis* sp. in pigs in Bali Province, previously have not been reported. In this study, the prevalence of *Blastocystis* sp. in pigs was 60%. In Indonesia, research on *Blastocystis* sp. was reported for the first time[7] and *Blastocystis* sp. was found in humans, pigs, chickens and rodents in the Winyapu area, Southwest Sumba District, East Nusa Tenggara Province, and evidenced by PCR methods. So far, there are 17 *Blastocystis* sp. subtypes that have been identified based on gen analysis of small subunits ribosomal RNA (SSU rRNA).[26] Humans can be infected by 9 subtypes (ST1-ST9).[27] In China[28] was reported that there were 3 zoonotic subtypes in pigs, namely ST1, ST3 and ST5, which showed that *Blastocystis* sp. in pigs could be zoonotic.

Several factors that related to the emergence of *Blastocystis* sp. infection are lack of the environmental hygiene, poor community sanitation, socio-economic status and lifestyle. *Blastocystis* sp. can infect humans and some animals including pigs, cows, monkeys and chickens. Some zoonotic subtypes of these animals have been isolated, therefore, they can act as reservoir hosts. Transmission can occur from human to human, from human to animal and from animal to human by faecal-oral route.[29,30]

In this study found various types of nematode worms namely *Strongyloides* sp., *Trichuris* sp., *Ascaris* sp. and *Oesophagostomum* sp. This result is also evidenced by the existence of investigations in Indonesia found various types of worms that often infect pigs. Study by Agustina[31]

in pigs in Bali found *Oesophagostomum* sp. with the prevalence of 47.5%. In addition, research by Fendryanto *et al*.,[3] on piglets in Bali found the prevalence of *Ascaris* sp., *Trichuris* sp. and *Strongyloides* sp. with the prevalence of 33.2%, 14.0% and 57.6%, respectively. In Poland, study by Wictor and Jarosz[32] noted the prevalence of worms in pigs was found *Ascaris* sp. (22.2%), *Trichuris* sp. (5.6%), *Strongyloides* sp. (36.1%) and *Oesophagostomum* sp. (36.1%). In Malaysia[25] noted the prevalence of *Strongyloides* sp. (45.6%) and *Trichuris* sp. (8.7%). In Cambodia, Inpankaew *et al*.,[33] noted the prevalence of *Oesophagostomum* sp. (76.6%), *Strongyloides ransomi* (23.3%), *Ascaris suum* (13.3%) and *Trichuris suis* (6.6%). Research by Nonga and Paulo[34] in Tanzania showed that differences in the prevalence of gastrointestinal worms in some areas may arise due to differences in environmental conditions that are conducive to the parasite survival, the number of definitive hosts infected, type of feed and animal diet and the hosts immune system.

Strongyloides sp. is an important parasite that can be infected most of the suckling piglets. The worms predilection is in the small intestine. Common clinical symptoms that may occur are diarrhea followed by progressive dehydration. In severe infections, death usually occurs before piglets are between 10 and 14 days old, but if piglets can survive, dwarfism can occur. Recent research by Giang *et al*.,[35] states that the type of *Strongyloides* sp. in pigs in Vietnam based on molecular identification is *S. ransomi*. *S. ransomi* has a similar morphology to *S. papillosus*, but in molecular analysis based on 18S rDNA, *S. ransomi* is close to *S. venezuelensis*. The zoonotic aspect and importance of *Strongyloides* sp. in veterinary medicine are discussed more detail in Thamsborg *et al*.,[36] which states that until now *S. ransomi* in pigs has not been zoonotic, but there are other species such as *S. stercoralis* in dogs have zoonotic potential to humans.

Trichuris sp. is a type of worm that commonly infect pigs and live in the large intestine. Pigs are considered as the natural host of *Trichuris* sp, although primates and humans may be infected. *Trichuris* sp. infection can cause ulceration in the lining of the intestinal mucosa, damage to blood capillaries and secondary infections can occur by bacteria. Clinical symptoms in pigs include anorexia, slimy and bloody diarrhea, dehydration and death occur in severe cases. *Trichuris* sp. can survive for several years outside the hosts. So far, it is still a question of whether or not *Trichuris* sp. is zoonotic. According to Nejsum *et al*.,[37] stated that the species *Trichuris trichiura* in humans can be found in pigs, but until now most worms did not survive. This shows that human cross-infection can occur with *T. suis* in pigs under experimental conditions.

Ascaris sp. is disease that can cause ascariasis and commonly found in pigs. This typical worm species also found in wild pigs. If pig infected with a severe infection, intestinal obstruction can occur, loss of appetite, vomiting, jaundice and death. In the case of moderate infection can occur low appetite, low food efficiency and slow growth. *Ascaris* sp. is zoonotic and can infect humans and other mammals by consuming food or water contaminated by infective eggs. *Ascaris* sp. eggs in a dry environment can last 2 to 4 weeks, while in a humid and cold environment they can survive eight weeks and become an infective stage in the environment. After ingestion, eggs hatch into larvae through the intestinal wall, pass through the liver and migrate to the lungs, and adult worms have a predilection in the small intestine.[38] The occurrence of zoonosis *Ascaris* sp. has been reported[39] which identified 14 cases of ascariasis in humans in contact with pigs in Maine, USA. In addition, research conducted by Nejsum *et al*.,[40] stated that ascariasis is a case of zoonosis in Denmark, where humans are in direct contact with pigs and pig feces.

In this study, the prevalence of *Oesophagostomum* sp. only found in Tabanan district. *Oesophagostomum* sp. is known as a worm nodule that has predilection in the large intestine in cecum and colon. *Oesophagostomum* sp. worm infection occurs when pigs eat plants or foods that contaminated by infective larvae[31]. *Oesophagostomum* sp. infection in pigs can cause lack of appetite, poor growth rates, easy secondary infection and can cause death[41]. So far there have been no studies that discuss the

possibility of zoonosis of *Oesophagostomum* sp. in pigs.

In this study, all pig were infected with mixed parasite protozoa and worms. According to Tolistiawaty *et al*.,[42] parasitic infections generally occur due to the weakness resistance of the animal to parasites. Mixed infections often occur, and making it difficult to know the specific symptoms that seen. Infection that occurs is usually caused by several types of worms in the intestine and other organs. The way of animal treatment also very influential on the incidence of gastrointestinal parasitic infections. This is supported by research from Supriadi *et al*.,[43] which was stated that gastrointestinal parasitic infections in pigs can be caused by poor management. Poor cage sanitation is also a factor that increases the risk of parasitic infection and does not rule out the possibility of transmission to humans, especially for pig owners (zoonosis). In addition, according to Roesel *et al*.,[44] stated that the most important factors associated with gastrointestinal parasitic infections in pigs are related to sanitation, especially cleaning of pig stool regularly from the cage and the use of disinfectants.

In Badung and Tabanan districts, most people use group cages to raising pigs. This type of maintenance system includes intensive maintenance where the pig is caged in a cage. According to Lai *et al*.,[20] raised pigs traditionally have a higher prevalence of the disease, this is because intensive pig farming has better maintenance management. Although intensive maintenance implements better management, it seems that it cannot help reduce the incidence of disease infection effectively. The possibility of a parasitic infection occurs due to a lack of public awareness about the good sanitation, besides that habit from pigs by eat in soil contaminated with faeces can be predispose to infection. Research by Mutua *et al*.,[45] stated that pig needs energy, amino acids, minerals, vitamins and water. These elements are needed for the process of growth, reproduction and lactation.

CONCLUSION

Gastrointestinal parasites that found in pigs in Badung and Tabanan districts Bali Province mostly have zoonotic potential. These parasites included *Entamoeba* sp., *Balantidium* sp., *Eimeria* sp., *Blastocystis* sp., *Strongyloides* sp., *Trichuris* sp., *Ascaris* sp. and *Oesophagostomum* sp. This study is expected to provide information to improve the hygiene and sanitation in terms of raising pigs, to provide a basis for further control and treatment in pigs that infected with gastrointestinal parasites as well as providing information about zoonotic potential that can arise.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest for this research.

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