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Prevalence of Gastrointestinal Parasites in Yellow Cattle between Taiwan and its Offshore Islands

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Cheng-Hung Lai^{1,3*}

Abstract

A total of 310 fecal samples of yellow cattle were collected in Taiwan and its offshore islands Penghu and Kinmen for gastrointestinal parasite examination using coprological techniques. The overall prevalence was 73.2%. The infection rates of protozoa, nematodes, trematodes, and cestodes were 57.7%, 37.7%, 17.1%, and 0.6%, respectively. Among all parasites, *Cryptosporidium* spp. (41.6%) were the most predominant, followed by strongyles (36.1%) and *Eimeria* spp. (11.9%). There were significant differences in the prevalence of protozoa and nematodes between different distributional area groups. The present study demonstrates that gastrointestinal parasitic infections, particularly protozoan infections, occur frequently in yellow cattle in Taiwan and its offshore islands. The results indicate that superior management systems and regular anthelmintic treatments should be performed for the control of parasitic infections on yellow-cattle farms.

Keywords: gastrointestinal parasites, prevalence, Taiwan, yellow cattle

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บทคัดย่อ

ความชุกของปรสิตในทางเดินอาหารโคเหลืองของไต้หวันและนอกชายฝั่งเกาะ

Kwong-Chung Tung¹ Chiu-Chen Huang¹ Chien-Hung Pan¹ Cheng-Hsiung Yang²
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ตัวอย่างอุจจาระของโคเหลืองจำนวน 310 ตัวอย่าง จากประเทศไต้หวันและชายฝั่งหมู่เกาะ Penghu และ Kinmen เพื่อตรวจหาปรสิตในทางเดินอาหาร โดยใช้เทคนิคการตรวจในอุจจาระ พบความชุกโดยรวมเป็นร้อยละ 73.2 โดยมีอัตราการติดเชื้อโปรโตซัว พยาธิตัวกลม พยาธิใบไม้ และพยาธิตัวตัด คิดเป็นร้อยละ 57.7 37.7 17.1 และ 0.6 ตามลำดับ พบ *Cryptosporidium* spp (ร้อยละ 41.6) มากที่สุด ตามด้วยพยาธิ *Strongyles* (ร้อยละ 36.1) และ *Eimeria* spp. (ร้อยละ 11.9) มีความแตกต่างอย่างมีนัยสำคัญในความชุกของโปรโตซัว และพยาธิตัวกลมระหว่างกลุ่มพื้นที่ แสดงให้เห็นว่าการติดเชื้อปรสิตในทางเดินอาหาร โดยเฉพาะโปรโตซัวพบได้มากในโคเหลืองใน ไต้หวัน และนอกชายฝั่งเกาะ ดังนั้นควรใช้ระบบการจัดการที่ดี และถ่ายพยาธิเป็นประจำเพื่อควบคุมการติดเชื้อปรสิตในฟาร์มโคเหลือง

คำสำคัญ: ปรสิตในทางเดินอาหาร ความชุก ไต้หวัน โคเหลือง

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Introduction

Parasitic infection is a primary cause of production losses in most cattle-producing countries of the world (Kaewthamasorn and Wongsamee, 2006; Geurden et al., 2008). Parasites may cause clinical and subclinical diseases according to the severity of infection as well as age and stress level of the animal. In general, younger animals and animals under stress are most likely to show signs of parasitism such as rough coat, anemia, edema, and diarrhea. However, the subclinical effects including decreased milk production, reduction in weight gain, and low conception rate are of major economic importance to the producer (Perry and Randolph, 1999; Sahoo et al., 2002). In raising livestock for food production, studies that help quantify the economic losses caused by parasitism are important, particularly in the smallholder farming systems in developing countries (McDermott et al., 1999). The goal of veterinarians and producers is prevention of parasitism through management, nutrition, and effective treatment, as well as control of relevant epidemiological factors (Kaewthamasorn and Wongsamee, 2006).

In Taiwan, only limited studies were conducted in dairy cattle for the prevalence of gastrointestinal parasites. Various potential parasites including *Haemonchus placei*, *Cooperia punctata*, *Capillaria bovis*, *Strongyloides papillosus*,

Oesophagostomum radiatum, *Fasciola hepatica*, *Eurytrema pancreaticum*, *Paramphistomum* spp., *Moniezia benedeni*, *Buxtonella sulcata*, *Eimeria* spp. had been described (Chang and Wang, 1976; Huang et al., 1979; Shien et al., 1979; Wang, 1979).

Taiwan is located at 23°30'N and 121°00'E. The climate is generally marine, and the annual rainfall is usually more than 2500mm. Kinmen is located at 24°27'N and 118°24'E, and off the southeast coast of Fujian Province in mainland China. It belongs to the subtropical maritime climate, and the average annual rainfall is less than 1100mm. The land of Kinmen is barren, the water holding capacity is very poor. Therefore, many ponds were made to store water. Penghu islands are located at 23°9'~47'N, 119°18'~42'E, off the western coast of Taiwan. It is categorized as sub-tropical marine climate, and its annual average of rainfall is only about 1,000 mm. Being a flat terrain, it is difficult to retain water.

The management of yellow cattle in Taiwan is similar to dairy cattle, but a large playground is provided. However, yellow cattle in offshore islands Kinmen and Penghu are mainly grazing in the field. Therefore, the aims of the present study were to compare the prevalence of gastrointestinal parasites including cestodes, nematodes, trematodes, and protozoa in yellow cattle between Taiwan and its offshore islands.

Materials and Methods

Sample population: Fresh fecal samples of adult yellow cattle aged from 2 to 5 years old were collected once from Taiwan and its offshore islands, Penghu and Kinmen. These cattle had not received any anthelmintics. The fecal samples were kept at 4°C and taken to the laboratory for parasitic examination.

Laboratory examination of specimens: Fecal samples were examined for the presence of helminth ova and protozoan cysts, and oocysts employing the simple floatation procedure using saturated NaCl. A simple sedimentation was used to detect eggs of flukes and some other tapeworms and nematodes whose eggs do not float readily in saturated sodium chloride solution (Zajac, 2006). Direct fecal smears were performed to examine the presence of protozoan trophozoites. Moreover, in order to detect oocysts of *Cryptosporidium*, two smears were made from each fecal sample and stained using the modified Ziehl-Neelsen method (Henriksen and Pohlenz, 1981). The stained fecal smears were observed microscopically under oil immersion at 100x magnification.

Statistics: The Chi-Square test was used to compare the differences between groups. Probability values of below 0.05 were considered significant. The odd ratio was used to assess the risk of endoparasitic infections in different region.

Results and Discussion

To the authors' knowledge, this is the first study on the prevalence of gastrointestinal parasites in yellow cattle between Taiwan and its offshore islands. A total of 310 fecal samples were collected from Taiwan and its offshore islands Penghu and

Kinmen. Among these samples, 70 were collected from Taiwan (27 males, 43 females), 109 from Penghu (41 males, 68 females), and 131 from Kinmen (52 male, 79 females). Of the 310 fecal samples collected, the overall prevalence of gastrointestinal parasitic infection was 73.2%. The highest prevalence was protozoan infection (57.7%), followed by nematodes (37.7%), trematodes (17.1%), and cestodes (0.6%) (Table 1). Risk factor analysis indicated that yellow cattle in Kinmen had significantly higher risk for trematode infections than those in Taiwan and Penghu (Table 2).

Three protozoan trophozoites or cysts/oocysts were identified in cattle fecal specimens, namely *Cryptosporidium* spp. (41.6%), *Eimeria* spp. (11.9%), and *Buxtonella sulcata* (8.4%). There were significant differences in the prevalence of *Cryptosporidium* spp. and *B. sulcata* between different area groups (Table 1).

Identified nematode eggs from fecal samples in the present study included strongyles, *Toxocara vitulorum*, *Trichuris globulosa*, *Strongyloides papillosus*, and *Capillaria bovis*. Strongyle nematodes (36.1%) were the most dominant group in mixed yellow cattle. *Toxocara vitulorum* was detected in 7 animals.

The prevalence of trematodes (17.1%) was relatively lower than that of protozoa and nematodes. The prevalence in Kinmen was significantly higher than that in Taiwan and Penghu. This study recovered eggs of *Eurytrema pancreaticum*, *Fasciola* spp., and *Paramphistomum* spp. The infection rate of *E. pancreaticum* in Penghu was markedly lower than those in Taiwan and Kinmen. The eggs of *Fasciola* spp. and *Paramphistomum* spp. were only detected in cattle raised in Kinmen (Table 1).

Table 1 Infection rates of gastrointestinal parasites in yellow cattle in Taiwan and its off-shore islands

Species of parasites	% (N0.)			
	Taiwan (n=70)	Kinmen (n=131)	Penghu (n=109)	Total (n=310)
Protozoa	54.3 (38)	65.6 (86)	50.5 (55)	57.7 (179)
<i>Buxtonella sulcata</i>	18.3 (13)	1.5 (2)	10.1 (11)	8.4 (26)
<i>Cryptosporidium</i> spp.	30.0 (21)	57.3 (75)	30.3 (33)	41.6 (129)
<i>Eimeria</i> spp.	5.7 (4)	12.2 (16)	15.6 (17)	11.9 (37)
Nematodes	45.7 (32)	40.5 (53)	29.4 (32)	37.7 (117)
<i>Capillaria bovis</i>	0.0	0.8 (1)	0.9 (1)	0.6 (2)
strongyles	42.9 (30)	38.9 (51)	28.4 (31)	36.1 (112)
<i>Strongyloides papillosus</i>	2.9 (2)	0.8 (1)	0.0	1.0 (3)
<i>Toxocara vitulorum</i>	8.6 (6)	0.8 (1)	0.0 (0)	2.3 (7)
<i>Trichuris globulosa</i>	1.4 (1)	0.8 (1)	0.9 (1)	1.0 (3)
Trematodes	11.4 (8)	32.1 (42)	2.8 (3)	17.1 (53)
<i>Eurytrema pancreaticum</i>	11.4 (8)	13.7 (18)	2.8 (3)	9.4 (29)
<i>Fasciola</i> spp.	0.0	5.3 (7)	0.0	2.3 (7)
<i>Paramphistomum</i> spp.	0.0	20.6 (27)	0.0	8.7 (27)
Cestodes	0.0	0.8 (1)	0.9 (1)	0.6 (2)
<i>Moniezia benedeni</i>	0.0	0.8 (1)	0.9 (1)	0.6 (2)

Table 2 Risk factor analysis for parasites in different areas.

Factor	Protozoa		Trematodes		Cestodes		Nematodes	
	OR (95% CI)	<i>p</i> -value	OR (95% CI)	<i>p</i> -value	OR (95% CI)	<i>p</i> -value	OR (95% CI)	<i>p</i> -value
Area		<i>p</i> <0.05		<i>p</i> <0.001		0.74		0.06
Taiwan	—		—		—		—	
Kinmen	1.61 (0.89-2.91)		3.66 (1.61-8.33)		1.01 (0.99-1.02)		0.81 (0.45-1.45)	
Penghu	0.86 (0.47-1.57)		0.22 (0.06-0.86)		1.01 (0.99-1.03)		0.49 (0.26-0.92)	

OR: odds ratio, CI: confidence interval

Gastrointestinal nematode infections of cattle continue to counter the efficient raising of cattle worldwide. In less developed agricultural systems, parasitic infections may cause severe clinical signs resulting in serious economic losses (Gasbarre et al., 2001). Even in well-managed herds, sub-clinical infections of gastrointestinal parasites hinder growth in young animals (Hawkins, 1993) and decrease milk production in adult cows (Gross et al., 1999). The climate of Southeast Asia is conducive to the transmission of infection, therefore, infections with gastrointestinal parasites are prevalent in cattle (Tum et al., 2004).

The results of the present study indicate a high prevalence of protozoan infection in yellow cattle. *Cryptosporidium* spp. infection was found in 41.6% of all yellow cattle, and cattle raised in Kinmen had significantly higher prevalence than those in Taiwan and Penghu. Calves are most vulnerable to infection and act as reservoirs (Roy et al., 2006), and a high level of *Cryptosporidium*-shedding calves in a herd is associated with an increased risk of diarrhea (Uhde et al., 2008; Gulliksen et al., 2009). Previous studies indicated that *C. parvum* infection played an important pathogenic role in neonatal calf diarrhea syndrome in southern Taiwan (Wu et al., 2010) and that *Cryptosporidium* infections led to poor health and significant economic loss in farm animals (Xiao et al., 1999). Because grazing cattle in Kinmen mainly drink water from ponds near the pasture, the primary cause of infection might have been water contaminated with *Cryptosporidium* oocysts. *Cryptosporidium* spp. have been shown to have zoonotic potential (Reif et al., 1989; Okhuysen et al., 1999); therefore, the importance of *Cryptosporidium* spp. in public health should be concerned.

Buxtonella sulcata is a commensal protozoan of the alimentary tract of ruminants and participates in the digestion of plant aliment (Al-Saffar et al., 2010). Buxtonellosis has not been considered of importance in ruminants yet; however, previous investigations reported that *B. sulcata* might be a causative agent of diarrhea in ruminants (Tomczuk et al., 2005; Al-Saffar et al., 2010). Fox and Jacobs (1986) indicated that a change in diet from fresh to

conserved grass coupled with an increase in supplementary concentrate feeding resulted in an increase in carbohydrate intake by the host which might affect the population dynamics of *B. sulcata*. In the present study, the prevalence of *B. sulcata* in Taiwan was significantly higher than that in Penghu and Kinmen. This was mainly associated with the supplementation of concentrated feed on yellow-cattle farms in Taiwan.

Nematodes infected 37.7% of yellow cattle, the prevalence in Taiwan was higher than those in the offshore islands. Among the identified nematodes, strongyles were most abundant. Strongyles are nematodes with roughly cylindrical bodies that are round in cross-section. The adults are equipped with well-defined buccal capsules with teeth adapted to latch onto the intestinal wall. When strongyle eggs are passed in manure, they hatch in the fecal pile and develop to infective third-stage larvae under appropriate environmental temperatures. Cattle ingest strongyle larvae through the normal process of grazing as L3 larvae crawl up blades of grass. Irregular anthelmintic administration and poor management might increase the risk of nematode infection in yellow cattle.

Fifty-three yellow cattle (17.1%) were infected with trematodes, and animals located in Kinmen were significantly associated with increased risk of trematode infection (*p*<0.05). The prevalences of *Fasciola* spp. and *Paramphistomum* spp. infections were 2.3% and 8.7%, respectively, and the infections were only found in Kinmen. Chang and Wang (1976) indicated that *Fasciola hepatica* infected 30.89% of cattle in southern Taiwan. Previous studies indicated that the prevalence of *Paramphistomum* spp. was 24.6%–67.92% (Chang and Wang, 1976; Wang, 1979). *Fasciola* spp. and *Paramphistomum* spp. have similar life cycles, which involve a mammalian definitive host and a snail intermediate host. Increase in environmental pollutants considerably decreases the number of the intermediate hosts thereby significantly reducing the prevalence of trematodes in Taiwan. A decrease in industrial pollution in Kinmen resulted in constant snail populations in ponds near pastures and, therefore, increased the risk of trematode infection.

Cestode infection was very rare, and only 2 yellow cattle were found to be infected with *Moniezia benedeni*. The low proportion of infected calves could be due to minimal exposure to the intermediate hosts-free-living soil mites on the pasture (Cox and Todd, 1962). *M. benedeni* can infect goats, sheep, and cattle, but it is more common in cattle (Mohanta et al., 2007; Nguyen et al., 2011). Although no significant problem was detected regarding *Moniezia* spp. infection, it is well known that they cause indigestion and diarrhea and are associated with the poor absorption of ready-made nutrients resulting in malnutrition (Mohanta et al., 2007).

Gastrointestinal parasites of cattle remain a serious impediment to the efficient production of milk and meat worldwide. Climatic conditions determine which parasites occur in a given region, and the nutritional status of the livestock influences the severity with which an individual is affected by acquired parasites (Kaewthamasorn and Wongsamee, 2006). This survey based on fecal examination in yellow cattle provides insight into the current prevalence of gastrointestinal parasites in Taiwan and its offshore islands.

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