



Prevalence and Risk Factors of Fasciolosis in Bali Cattle in Ujung Loe Subdistrict, Bulukumba Regency

Eka Anny Sari^a, Hadi Purnama Wirawan^b, Fika Yuliza Purba^{a*}

^aVeterinary Study Program, Faculty of Medicine, Hasanuddin University, Makassar 90245

^bMaros Veterinary Centre, Jl. DR. Ratulangi, Allepolea, Kec. Lau, Kabupaten Maros, Sulawesi Selatan 90514

*corresponding author: fikapurba@med.unhas.ac.id

Abstract

This study aimed to determine the prevalence and risk factors of fasciolosis in Bali cattle in Ujung Loe District, Bulukumba Regency. A total of 157 Balinese cattle fecal samples were collected and selected proportionally from 13 villages in Ujung Loe Subdistrict, Bulukumba Regency. The fecal examination was carried out by the sedimentation method to detect the presence of *Fasciola* sp. eggs based on the morphology. Risk factors of fasciolosis such as animal age, management, cage condition, intermediate host control, and farmer knowledge were analyzed using Chi-square and Odds Ratio. The results of this study indicated that the prevalence of fasciolosis in Ujung Loe District, Bulukumba Regency was 4.4%. The results of the Chi-square analysis showed that age and management system had a relationship with the incidence of fasciolosis, while other factors were not related to fasciolosis.

Keywords: Fasciola sp., Fasciolosis, Bali cattle

Copyright © 2020 JRVI. All rights reserved.

Introduction

Cattle farms in Indonesia continue to develop along with the increase in knowledge and technology in the field of animal husbandry. The high public demand for meat makes the government implement the meat self-sufficiency. Based on the data of the Directorate of Food and Agriculture (2013), the total consumption of beef in the country continues to increase rapidly with an average of 8.11% / year. In 2011, the total consumption of beef was 488.9 thousand tons. This also happened in 2012 which reached around 544.9 thousand tons. Bali cattle are the largest contributor to meat from ruminants to national meat production (Bandini, 2003). Bali cattle have several advantages including good adaptability to poor environments, such as high temperature and low quality of feed. In addition to having these advantages, Bali cattle also have several disadvantages, including being very sensitive to several types of diseases that are not found in other animals, for example, Jembrana and Baliziekte. Bali cattle are also vulnerable to diseases caused by worms, especially if they are kept extensively and semi-intensively (Guntoro, 2002).

Increasing the quality of Bali cattle farms continues to be pursued by the government and the private sector. The aim of the program is the achievement of meat self-sufficiency as

the backbone of national animal food security (Hadi, 2011). Animal husbandry development is faced with various problems that must be anticipated and overcome in order to obtain maximum benefit. Obstacles to animal husbandry development are due to the disease problem which is a factor directly affecting livestock. Disease in livestock can cause considerable economic losses for farmers and also be transmitted to humans (zoonoses).

Liver worm disease (fasciolosis) is often found on Bali cattle farms. Fasciolosis is a disease caused by Trematoda species, *Fasciola hepatica*, and *Fasciola gigantica*. Both of these worms are transmitted to livestock through snails Lymnaeidae. *Fasciola hepatica* is generally found in temperate regions, while *Fasciola gigantica* is found in wet tropical climates (Kaplan, 2001; Loyacano, et al., 1999; Fairweather and Boray, 1999). According to Martindah, et al., (2005), the prevalence of fasciolosis in Indonesian livestock reaches 90%, while cases in humans have not been reported.

The prevalence of fasciolosis in Indonesia varies, depending on the season and the region. The prevalence of fasciolosis in West Java reaches 90% and in the Special Region of Yogyakarta ranges from 40 - 90% (Estuningsih, 1997). Darmawi (2007) showed that 60% of cattle positively infected with *Fasciola gigantica*, were observed in cattle slaughtered in Banda Aceh abattoirs, while 68.18% cattle from Gowa Regency slaughtered in RPH Makassar City were infected with *Fasciola* sp. based on the results of fecal examination (Purwanta, 2006). Animal market survey in Indonesia showed that 90% of cattle originating from smallholder farms are infected with worms, liver, roundworms and hookworms. The infection of worms in cattle, especially *Fasciola* sp. resulting in economic losses for livestock owners and can also infect humans then disrupt the health (Abidin, 2002). Based on the problems described above, research on the prevalence and risk factors causing fasciolosis in cattle is important to be carried out.

Materials and Methods

This research was conducted in Ujung Loe District, Bulukumba Regency, South Sulawesi province. Bali cattle population in this region according to Animal Husbandry and Animal Health Service in 2013 is 5983. The assumption of fasciolosis prevalence in this study was determined as 11% (Laboratory of Parasitology, Maros Veterinary Centre). With a confidence level of 95% and an error of 5%, the sample size determined based on the Selvin formula (2004) was 157 animals. The sampling technique used was a simple random method by taking samples in all villages in Ujung Loe District, proportionally.

Fasciolosis in this study was determined based on the presence or absence of *Fasciola* sp. eggs in the fecal sample. A total of 157 fecal samples were collected from selected cattle. The collection of feces was performed per rectal and then stored in plastic bags with formalin cotton. The fecal examination was carried out at the Laboratory of Parasitology, Balai Besar Veteriner Maros, using the sedimentation method. Worm egg examination is carried out under the microscope using 10× objective magnification. Worm eggs from *Fasciola* sp. were identified based on the morphology reference (Wirawan, 2011). Questionnaire are used to collect data related to risk factors of fasciolosis. Factors included the age of cattle, management system, cage condition, control of the intermediate host and farmer knowledge. In this study, the independent variables were the risk factors of fasciolosis, while the dependent variable was the prevalence of fasciolosis.

The prevalence of fasciolosis in this study was analyzed descriptively by dividing the number of positive samples to the total of all samples examined. The results of the

questionnaire were analyzed using chi-square (χ^2) to measure the relationship of these factors to the incidence of fasciolosis at a 95% confidence level. The strength magnitude of the relationship was calculated by the odds ratio (OR) test at a 95% confidence level.

Results and Discussion

This study was conducted to determine the prevalence and risk factors causing fasciolosis in Ujung Loe District, Bulukumba Regency. A total of 157 cattle samples were collected proportionally by taking samples in each village. A description of the number of samples in each village is presented in Table.

Table 1. Description of the cattle samples number in each village in Ujung Loe District

No.	Village	Population	Number of samples
1.	Salemba	93	2
2.	Dannuang	208	5
3.	Manjalling	96	3
4.	Padang Loang	188	5
5.	Seppang	891	23
6.	Bijawang	364	10
7.	Lonrong	135	4
8.	Balong	1248	33
9.	Garanta	762	20
10.	Manyampa	896	24
11.	Balleanging	525	14
12.	Tamatto	354	8
13.	Paccaramengan	223	6
	Jumlah	5983	157

Fecal sample examination was carried out at Balai Besar Veteriner Maros (BBVET) using a sedimentation method to collect trematodes worm eggs, especially *Fasciola* sp. The number of worm eggs found in 2 grams of feces was only 1-2 worm eggs. Worm eggs were observed under a microscope at a magnification of 100 \times . Based on observations, the morphology of *Fasciola* sp. had an operculum in one of its poles, it was ovoid-shaped and had a thin eggshell (Figure 1). These results were then compared with references (Tantri, et al., 2013).

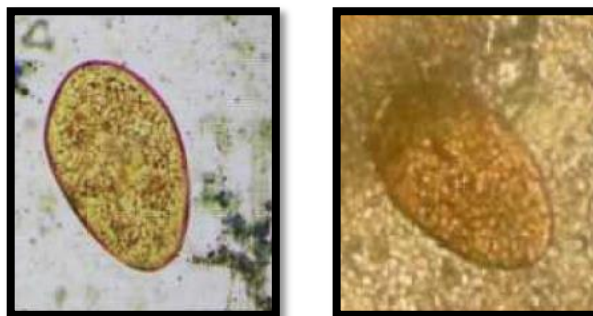


Fig. 1 Egg of *Fasciola* sp. collected from samples (A) and *Fasciola* sp. from reference (B)

The fecal examination resulted in the presence of other trematode worm eggs, such as *Paramphistomum* sp. which had the same morphology with those of *Fasciola* sp. To distinguish between these two eggs, the characteristic of each egg was observed. The egg of *Fasciola* sp. had golden yellow color because it did not absorb the color of methylene blue, it had an operculum in one of its poles and embryonal cells looked less clear. From the examination, the eggs of *Fasciola* sp. was positively found in 7 of 157 samples. From 13 villages, the positive samples were distributed over 4 villages, namely Manyampa (4/24),

Balong (1/33), Bijawang (1/10) and Seppang (1/23). Based on these results, the prevalence of fasciolosis in Bali cattle in Ujung Loe Subdistrict, Bulukumba Regency was 4.4% (7/157). The prevalence of fasciolosis in that region is close to that of fasciolosis in Bone Regency in 2011 (Wirawan, 2011), and is much lower than the results of another study in Gowa regency (Purwanta et al., 2009). Other studies reported the prevalence of fasciolosis in Karangasem, Bali by 18.92% (Sayuti, 2007) and Kebumen by 62.74% (Dewi, 2011).

Fasciolosis is distributed all over the world, especially in tropical and subtropical climates. The difference in incidence is generally related to geographical differences that affect the presence of snails as an intermediate host, endurance of metacercariae in the environment and diagnostic techniques (Mage, et al., 2000; Melaku and Addis, 2012). Sayuti (2007) also suggested that the season affected the degree of fasciolosis prevalence in Karangasem Regency, Bali. The occurrence of fasciolosis often occurs at the beginning of the rainy season because of the growth of eggs into miracidium and development in snail reach a complete stage at the end of the rainy season. In addition, the release of cercariae occurs at the beginning of the dry season along with a decrease in rainfall. This research was conducted in the dry season so it can be explained that the low prevalence is also influenced by seasonal factors. Dry season disturbs the life cycle of *Fasciola* sp. because that cycle requires a watery area, where *Lymnea rubiginosa*, as an intermediate host, cannot resist drought and usually died in the absence of watery area. Variables that describe the risk factors causing the occurrence of fasciolosis in Bali cattle in Ujung Loe District, Bulukumba Regency is presented in Table 2.

Table 2. Description of the risk factor variables causing fasciolosis in Balinese cattle in Ujung Loe District, Bulukumba Regency.

No.	Variable	Description	Results
I.	Cases	<i>Fasciola</i> sp.:	
		1. Positive	= 4.4 % (7/157)
		2. Negative	= 95.5% (150/157)
	Farmer Variables		
II.	Basic information		
	II.1	Gender	
		1. Women	= 3.8 % (6/157)
		2. Men	= 96 % (151/157)
	II.2	Farmer's age	
		1. 1-20 years old	= 1.3 % (2/157)
		2. 21-40 years old	= 46.5 % (73/157)
		3. 41-60 years old	= 47.7 % (75/157)
		4. 61-80 years old	= 4.5 % (7/157)
	II.3	Education	
		1. SD	= 60.5 % (95/157)
		2. SMP	= 17.8 % (28/157)
		3. SMA	= 19.1 % (30/157)
		4. PT	= 2.5 % (4/157)
	1.3d	Farming experience:	
		1. 1-10 years	= 50.9 % (80/157)
		2. 11-20 years	= 21 % (33/157)
		3. 21-30 years	= 15.3 % (24/157)

		4. 31-40 years	= 8.3 % (13/157)
		5. 41-50 years	= 4.5 % (7/157)
III.	Number of ewnership	1. < 10 cattle	= 78 % (113/157)
		2. ≥ 10 cattle	= 28 % (44/157)
	Cattle variables		
IV.	Cattle's age	0-6 months	= 27 % (42/157)
		>6-12 months	= 2.5 % (4/157)
		>1-3 months	= 71 % (111/157)
V.	Management system		
	V.1	Rearing system	
		1. Intensive	= 0 % (0/157)
		2. Semi-intensive	= 34.4 % (54/157)
		3. Extensive	= 65.6 % (103/157)
	V.2	Grazing land condition	
		1. Extensive-Dry	= 39.5 % (62/157)
		2. Extensive-Humid	= 26.1 % (41/157)
		3. Semi intensive-Dry	= 20 % (31/157)
		4. Semi intensive-Humid	= 14.6 % (23/157)
	V.3	Caring of cattle	
		1. Bathing everyday	= 10 % (16/157)
		2. Bathing sometimes	= 30 % (47/157)
		3. No bathing	= 60 % (94/157)
	V.4	Healthy condition	
		1. Healthy	= 39.4 % (62/157)
		2. Unhealthy	= 9 % (14/157)
		3. Ectoparasites infestation	= 51.6 % (81/157)
	V.5	Other animals presence	
		1. Only cattle	= 45.2 % (71/157)
		2. With other animals	= 26.1 % (41/157)
		3. With cattle from other farmers	= 28.6 % (45/157)
	V.6	Anti-worm drug administration	
		1. Never	= 49 % (77/157)
		2. Regularly twice a year	= 34.4 % (54/157)
		3. While sick	= 16.5 % (26/157)
	V.7	Whether cattle are unhealthy	
		1. Neglection	= 36,3 % (57/157)
		2. Separation from healthy cattle	= 1.3 % (2/157)
		3. Contact the local veterinarian	= 62.4 % (98/157)
VII.	Cage condition		
	VII.1	Cage location	
		1. Close to the grazing land	= 30 % (47/157)
		2. Close to other cages	= 1.3 % (2/157)
		3. Not caged	= 68.8 % (108/157)
	VII.2	Cage condition:	

		1. Littered garbage around the cage	= 29.7 % (31/157)
		2. Feedlot is separated from cage	= 11.5 % (18/157)
		3. Not caged	= 68.7 % (108/157)
VII.3		Cage floor condition:	
		1. Bedding is available	= 76.4 % (120/157)
		2. No bedding and wet	= 21.6 % (34/157)
		3. Concrete pedestal	= 2 % (3/157)
VII.4		Ideal cage perspective:	
		1. Cleaning regularly	= 77.1 % (121/157)
		2. Cleaning with disinfectant	= 23 % (36/157)
		3. No cleaning	= 0 % (0/157)
VII.5		Close to dam / pond / river / well / rice field	
		1. Yes	= 60 % (94/157)
		2. No	= 40 % (63/157)
		3. No dam / pond / river / well / rice field nearby	= 0 % (0/157)
VIII.	Farmers knowledge		
VIII.1		Knowledge about fasciolosis:	
		1. Yes	= 0 % (0/157)
		2. No	= 91.1 % (143/157)
		3. Doubtful	= 8.9 % (14/157)
VIII.2		Fasciolosis transmission:	
		1. Snail <i>Lymnea rubiginosa</i>	= 0 % (0/157)
		2. Other organisms	= 0 % (0/157)
		3. Do not know	= 100 % (157/157)
VIII.3		Fasciolosis prevention	
		1. Separate healthy and unhealthy cattle	= 0 % (0/157)
		2. Anti-worm administration regularly	= 16.5 % (26/157)
		3. Do not know	= 83.4 % (131/157)
IX.	Intermediate Host Control		
IX.1		Knowledge about the intermediate host	
		1. Yes	= 0 % (0/157)
		2. No	= 91.1 % (143/157)
		3. Doubtful	= 8.9 % (14/157)
IX.2		Molluscicide use	
		1. Yes	= 0 % (0/157)
		2. No	= 100 % (157/157)
		3. Doubtful	= 0 % (0/157)
IX.3		Intermediate host control	
		1. Using of molluscicide	= 0 % (0/157)
		2. Cage cleaning regularly	= 8.9 % (14/157)
		3. Do not know	= 91.1 % (143/157)
IX.4		Pesticide use in the rice field	

1. Regularly	= 100 % (157/157)
2. Never	= 0 % (0/157)
3. Doubtful	= 0 % (0/157)

The farmers were dominated by men, while their ages ranged from 41-60 years old. Overall, the highest education level of the farmers was elementary schools with farming experience of 1-10 years. The age of Bali cattle ranged in the productive age, within 1-3 years old.

The management system was divided into variables management, pasture conditions, cattle care, condition of cattle, presence or absence of other livestock, administration of anti-worm drugs, and treatment of sick cattle. The Bali cattle in Ujung Loe Subdistrict, Bulukumba Regency were kept semi-intensively, while the grazing conditions were most extensive (dry). Most farmers did not bathe their cattle and ectoparasites were found on 51.6% of cattle. In general, farmers did not give anti-worm drugs throughout the year. Cattle were housed without cage and the floor was made of grass/soil which was cleaned regularly. Based on the results, 91.1% of farmers in Ujung Loe Subdistrict, Bulukumba Regency did not know about and how to prevent fasciolosis.

Chi-square analysis and Odd Ratio (OR) of the risk factors causing Fasciolosis in Bali cattle in Ujung Loe District, Bulukumba Regency is described in Table 3.

Table 3. Analysis of risk factors causing fasciolosis in Bali Cattle in Ujung Loe subdistrict, Bulukumba district

No.	Variable	Description	Cases		Chi Square (X ²)	Fisher's Test		OR																																																																
			Neg	Pos		2-sided	1-sided																																																																	
1.	Cattle's age	Low risk	43	5	0.016	0.028	0.028	0.161																																																																
		High risk	107	2					2.	Management system	a. Rearing system	Low risk	23	4	0.004	0.017	0.017	0.136	High risk	127	3	b. Grazing land condition	Low risk	25	3	0.077*	0.108	0.108**	-	High risk	125	4	c. Cattle condition	Low risk	59	3	0.852*	1.000	0.572**		High risk	91	4	d. Deworming	Low risk	52	2	0.740*	1.000	0.546**	-	High risk	98	5	3.	Cage condition	a. Cage location	Low risk	46	3	0.496*	0.678	0.380**	-	High risk	104	4	b. Cage condition	Low risk	18	0	0.330*
2.	Management system	a. Rearing system	Low risk	23	4	0.004	0.017	0.017				0.136																																																												
			High risk	127	3					b. Grazing land condition	Low risk		25	3	0.077*	0.108	0.108**	-	High risk	125	4	c. Cattle condition	Low risk	59	3	0.852*	1.000	0.572**		High risk	91	4	d. Deworming	Low risk	52	2	0.740*	1.000	0.546**	-	High risk	98	5	3.	Cage condition	a. Cage location	Low risk	46	3	0.496*	0.678	0.380**	-	High risk		104	4	b. Cage condition	Low risk	18	0	0.330*	1.000	0.419**	-	High risk	132	7				
	b. Grazing land condition	Low risk	25	3	0.077*	0.108	0.108**	-																																																																
		High risk	125	4						c. Cattle condition	Low risk	59	3	0.852*	1.000	0.572**		High risk	91	4	d. Deworming	Low risk	52	2	0.740*	1.000	0.546**	-	High risk	98	5	3.	Cage condition	a. Cage location	Low risk	46	3	0.496*	0.678	0.380**	-	High risk	104		4	b. Cage condition	Low risk	18	0	0.330*	1.000	0.419**	-	High risk	132	7																
	c. Cattle condition	Low risk	59	3	0.852*	1.000	0.572**																																																																	
		High risk	91	4						d. Deworming	Low risk	52	2	0.740*	1.000	0.546**	-	High risk	98	5	3.	Cage condition	a. Cage location	Low risk	46	3	0.496*	0.678	0.380**	-	High risk		104	4	b. Cage condition	Low risk	18	0	0.330*	1.000	0.419**	-	High risk	132	7																											
	d. Deworming	Low risk	52	2	0.740*	1.000	0.546**	-																																																																
		High risk	98	5					3.	Cage condition	a. Cage location	Low risk	46	3	0.496*	0.678	0.380**	-	High risk	104		4	b. Cage condition	Low risk	18	0	0.330*	1.000	0.419**	-	High risk	132	7																																							
3.	Cage condition	a. Cage location	Low risk	46	3	0.496*	0.678	0.380**				-																																																												
			High risk	104	4					b. Cage condition	Low risk		18	0	0.330*	1.000	0.419**	-	High risk	132	7																																																			
	b. Cage condition	Low risk	18	0	0.330*	1.000	0.419**	-																																																																
		High risk	132	7																																																																				

c.	Cage floor condition	Low risk	117	6	0.628*	1.000	0.529**																																																																																																																																																		
		High risk	33	1				d.	Ideal cage perspective	Low risk	118	6	-	-	-	High risk	32	1				e.	Presence of dam / pond / river / well / rice field	Low risk	61	2	0.523*	0.703	0.414**	High risk	89	5	4. Farmers knowledge								a.	Fasciolosis terminology	Yes	0	0	-	-	-	No	136	7				Doubtful	14	0				b.	Fasciolosis transmission	Low risk	150	7	a	-	-	High risk	0	0				c.	Fasciolosis prevention	Low risk	26	0	0.228*	0.601	0.274**	High risk	124	7	5. Intermediate host control								a.	Host intermediate	Yes	0	0				No	136	7	-	-	-	Doubtful	14	0				b.	Molluscicide use	Yes	0	0				No	150	7	a	-	-	Doubtful	0	0				c.	Control of transmission	Low risk	14	0	0.397*	1.000	0.513**	High risk	136	7	d.	Pesticide use	Low risk	150	7	a	-	-	High risk
d.	Ideal cage perspective	Low risk	118	6	-	-	-																																																																																																																																																		
		High risk	32	1																																																																																																																																																					
e.	Presence of dam / pond / river / well / rice field	Low risk	61	2	0.523*	0.703	0.414**																																																																																																																																																		
		High risk	89	5																																																																																																																																																					
4. Farmers knowledge																																																																																																																																																									
a.	Fasciolosis terminology	Yes	0	0	-	-	-																																																																																																																																																		
		No	136	7																																																																																																																																																					
		Doubtful	14	0																																																																																																																																																					
b.	Fasciolosis transmission	Low risk	150	7	a	-	-																																																																																																																																																		
		High risk	0	0																																																																																																																																																					
c.	Fasciolosis prevention	Low risk	26	0	0.228*	0.601	0.274**																																																																																																																																																		
		High risk	124	7																																																																																																																																																					
5. Intermediate host control																																																																																																																																																									
a.	Host intermediate	Yes	0	0																																																																																																																																																					
		No	136	7	-	-	-																																																																																																																																																		
		Doubtful	14	0																																																																																																																																																					
b.	Molluscicide use	Yes	0	0																																																																																																																																																					
		No	150	7	a	-	-																																																																																																																																																		
		Doubtful	0	0																																																																																																																																																					
c.	Control of transmission	Low risk	14	0	0.397*	1.000	0.513**																																																																																																																																																		
		High risk	136	7																																																																																																																																																					
d.	Pesticide use	Low risk	150	7	a	-	-																																																																																																																																																		
		High risk	0	0																																																																																																																																																					

* untestable *chi-square*, ** not significant ($P > 0.05$), a: constant

Table 3 shows the bivariate analysis of each variable causing fasciolosis. The age of cattle had a significant relationship with fasciolosis incidence. Cattle over 12 months are more susceptible to infection with *Fasciola* sp. compared to those aged between 6-12 months and less than 6 months old. According to Hambal, et al. (2013), the effect of age is closely related to the period of infestation of *Fasciola* sp.

Management system variables had a significant relationship with the incidence of fasciolosis. The extensive and semi-intensive systems had a high tendency for *Fasciola* sp. Infection. These methods are characterized by the release of animals to the grazing land to find their own feed. In the semi-intensive system, animals came back to cage at the end of the day. The intensive system, as described by Tantri et al. (2013), reduced the risk of worm infection because animals are fed in the cage while the extensive system increased the risk of infection.

The expected value of knowledge of fasciolosis and host control was less than five which did not meet the requirements of the 2×2 chi-square test table. Then the variable was tested with Fisher's test ($p \text{ value} > 0.05$). Fisher's test showed that there is no relationship between the condition of the cage, knowledge of Fasciolosis and host control with the incidence of fasciolosis in Ujung Loe District, Bulukumba Regency. A dry and clean

environment for cattle activity can be a factor to inhibit the life cycle of *Fasciola* sp. Bathing cattle every day, separating cattle from other animals and farmer knowledge about infection may reduce the risk of fasciolosis. Furthermore, controlling the intermediate host (*Lymnea rubiginosa*) by administering pesticides to rice fields regularly is necessary to break the life cycle of *Fasciola* sp.

Conclusion

Based on the results of this study it can be concluded that the prevalence of fasciolosis in Bali cattle in Ujung Loe District, Bulukumba Regency is 4.4%. Cattle age and management factors have a relationship with the incidence of fasciolosis in this area.

Acknowledgment

We would like to thank to staff of the Laboratory of Parasitology, Maros Veterinary Centre who helped during the research.

Reference

- Abidin, Z. 2002. *Penggemukan Sapi Potong*. Agro Media Pustaka, Jakarta.
- Bandini. 2003. *Sapi Bali*. Swadaya, Jakarta.
- Darmawi, Hambal, M., Estuningsih, S. E. 2007. *Produksi, Aplikasi, dan Evaluasi Imunoglobulin Yolk Antiidiotipe Fasciola gigantica Sebagai Kandidat Vaksin Terhadap Fasciolosis Pada Domba*. Laporan Akhir Pelaksanaan Riset Insentif. Kementerian Negara Riset dan Teknologi Republik Indonesia.
- Dewi, P. A., Ani F., dan Edy S. 2012. Kejadian Infeksi Cacing Hati (*Fasciola spp.*) Pada Sapi Potong di Kabupaten Kebumen Tahun 2011. *Buletin Laboratorium Veteriner*, 12(1), 11-15.
- Estuningsih, S.E., Adiwinata, G., Widjajanti, S., dan Piedrafita, D., 1997. Evaluation of Antigens of *Fasciola gigantica* as Vaccines Against Tropical Fasciolosis in Cattle. *Int. J. Par.*, 27, 1419 – 1428.
- Fairweather, I., and Boray, J.C. 1999. Fasciolicides: efficacy, actions, resistance and its management. *Vet. J.*, 158, 81–112.
- Guntoro, S. 2002. *Membudidayakan Sapi Bali*. Kanisius. Yogyakarta.
- Hadi, P. U. 2011. *Kebijakan dan Strategi Pemasaran Ternak dan Daging Sapi Bali untuk Menjaga Kesejahteraan Peternak*. Pusat Sosial Ekonomi dan Kebijakan Pertanian. Semiloka Nasional PKSB Universitas Udayana, Denpasar.
- Hambal, M., Arman, S., dan Agus, D. 2013. Tingkat Kerentanan *Fasciola gigantica* pada Sapi dan Kerbau di Kecamatan Lhoong, Kabupaten Aceh Besar. *Jurnal Medika Veterinaria*, 7, 52.
- Kaplan, R. M., 2001. *Fasciola hepatica*: a review of the economic impact in cattle and considerations for control. *Vet. Therapeutics*, 2(1), 1-11.
- Loyacano, A., Williams, J. C., and Gurie, J. 1999. *Effect of internal parasites on replacement heifers*. Baton Rouge. Louisiana State University, Dean Lee Research Station.
- Magé, C., Bourgne, C., Toullieu, J. M., Rondelaud, D., and Dreyfuss, G. 2000. *Fasciola hepatica* dan *Paramphistomum daubneyi*: changes in prevalences of natural infections in cattle and in *Lymnea truncatula* from central France over the past 12 years. *Vet Res.*, 33: 439-447.
- Martindah, E., Widjajanti, S., Estuningsih, S. E., dan Suhardono. 2005. Meningkatkan kesadaran dan kepedulian masyarakat terhadap fasciolosis sebagai penyakit infeksius. *Wartazoa*, 15.
- Melaku, S., and Addis, M. 2012. Prevalence and Intensity of Paramphistomum in Ruminants slaughtered at Debre Zeit Industrial Abattoir, Ethiopia. *Glob Vet.*, (8)3, 315-319.

- Purwanta, Ismaya N. R. P. dan Burhan. 2006. Penyakit cacing hati (fascioliasis) pada sapi bali di perusahaan daerah rumah potong hewan (RPH) kota Makassar. *Journal agrisistem*, 2 (2).
- Sayuti, L. 2007. Kejadian infeksi cacing hati (*Fasciola sp.*) pada sapi Bali di Kabupaten Karangasem, Bali. Fakultas Kedokteran Hewan. Institut Pertanian Bogor. Skripsi.
- Selvin, S. 2004. *Statistical analysis of epidemiology data*. London (UK): Oxford University Press.
- Tantri, N., Tri Rima Setyawati, dan Siti Khotimah. 2013. Prevalensi dan intensitas telur cacing parasit pada feses sapi (*Bos Sp.*) Rumah Potong Hewan (RPH) Kota Pontianak Kalimantan Barat. *Jurnal Protobiont*, 2(2), 102 - 106
- Wirawan, H. P. dan Tim Laboratorium Parasitologi BBVET MAROS. 2011. Survey Internal dan Eksternal Parasit. Maros: Direktorat Jenderal Peternakan dan Kesehatan Hewan Balai Besar Veteriner.