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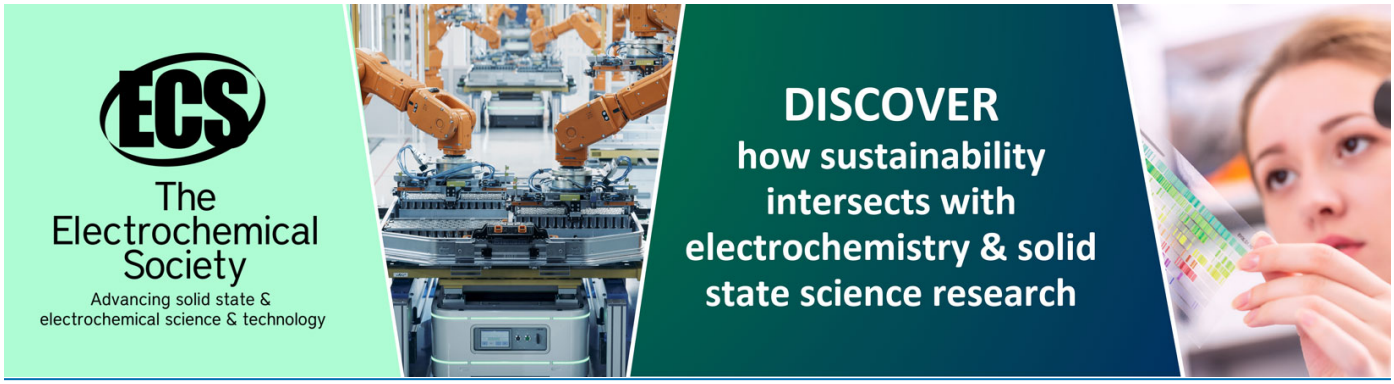

Investigation of causes of neonatal mortality in Bali cattle on Sumbawa Island

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Abstract. There is a desire to increase cattle production on Sumbawa Island but anecdotal reports from farmers indicate that calf mortality can be high. The aim of this paper is to report the occurrence and common causes of calf mortality, as well as to determine if colostral antibody transfer is sufficient in new-born calves. Personal interviews were conducted with 27 farmers. Immunoglobulins were measured in neonatal calves (n=18) using the FASTest IgG Bovine kit. The presence of various pathogens was investigated in fecal samples from calves (n=12) with signs of diarrhea between 1-2 months of age using the FASTest D4T bovine kit and the presence of gastrointestinal parasites was investigated using fecal floatation from pre-weaned calves (3 weeks-3 months of age; n=62). From the questionnaire calf losses ranged from 10–27%, with most losses occurring in older calves. Only one of the 18 calves demonstrated an insufficient concentration of IgG in serum, indicating the possibility of failure of passive transfer from the dam. Of the samples tested from scouring calves, 7 out of 12 samples tested positive for one of the microorganisms causing general diarrhoea in calves. A range of different gastrointestinal nematode parasites were found although very few coccidial oocysts were seen. The results of these studies indicate that calf mortality is high and will be a limitation on the production of beef cattle for slaughter in the Dompu region of Sumbawa Island. Further investigation is required to determine which pathogens are the cause of this calf loss.

1. Introduction

Bali cattle (*Bos javanicus*) is one of Indonesia's native cattle. Bali cattle have an important contribution in achieving food security by providing animal protein from livestock and at the same time improving the welfare of smallholder breeders. However, limited information has been published on cattle farming on Sumbawa Island, especially on the local indigenous Bali cattle. Bali cattle are the most numerous breed type in Sumbawa island but latterly Brahman type cattle and crossbreeds between Bali cattle and Bos taurus beef breeds such as Simmental, Angus and Hereford are now also being farmed.

There is desire to increase cattle production and recent efforts have focused on raising bulls in dry lots using a "cut and carry" feeding regime [1,2,3]. A limitation is the supply of young cattle from breeding herds. Anecdotal reports from local farmers in the Dompu district of Sumbawa indicate that calf mortality can be high (20–30%) [3]. Common causes of neonatal mortality in Australasia include pathogens such as rotavirus, coronavirus, *Escherichia coli* (*E. coli*) and *Cryptosporidium* [4], often exacerbated by poor uptake of colostral antibodies by the new-born calf [5,6]. Older calves can suffer from a different range of pathogens including gastrointestinal nematodes, coccidia, clostridial species of bacteria amongst others [4]. However, it is unknown if these common causes are involved in the high death rates reported in the Dompu district of Sumbawa.

Data on calf mortality cow fertility and calf deaths was collected from farmers in the Dompu district on Sumbawa Island that are participating in the "East Indonesia Innovative Farming Systems and Capability for Agribusiness Activity" (IFSCA) project which is being jointly conducted by University of Mataram, Lombok, Indonesia, and Massey University of New Zealand. One element of this project is to develop better farming practices. A sub-group of calves were tested for serum IgG concentration as an indicator of colostral antibody transfer. Fecal samples from other sub-groups of calves were collected and tested to determine the pathogens that might attack young livestock. The aim of this paper is to report the occurrence and common causes of calf mortality, as well as to determine if colostral antibody transfer is sufficient in new-born calves.

2. Materials and methods

Data for analysis in this paper were collected in several ways from different areas in Dompu region, Sumbawa as follows:

2.1. Farmer interviews

Personal interviews were conducted with 27 farmers in 3 villages (Nangatumpu, Simpasai Lepadi) and Doro Ncanga (free grazing area) in the Dompu district. The focus was on cow fertility (as determined by calving rate) and calf mortality.

2.2. Immunoglobulins G (IgG) measurement

Immunoglobulins G (IgG) were measured in neonatal calves (n=18) using the FASTest IgG Bovine (MEGACOR Diagnostik, GmbH, Vorarlberg, Austria) from farms in 8 villages (Soriutu, Nusa Jaya, Lanci jaya, Sukadamai, Doro Melo, Kampasi Meci, Doro Kobo and Anamina) in the Dompu district. Blood samples were collected from calves that were born from October 2018 to January 2019. Blood were taken by jugular venipuncture between 24-48 hours after birth into plain tubes and serum was harvested. The serum sample was then tested for IgG concentration using the FASTest kit which is an immunochromatographic lateral flow test for bovine IgG, where an adequate concentration of IgG is considered to be 12mg/ml. Calves were classified as having failure of passive transfer below this threshold. Birth weight and sex of the calves were recorded at the time of IgG testing. Birth weight was measured using a handheld scale (Zarna Instrument Company, Portable Scale; maximum capacity 40kg with accuracy 0.01kg). Breed type of sire and dam (Bali, Bali cross or Brahman cross) were also recorded if known. Birth weight was analysed using the GLM procedure in SAS (Version 9.4, SAS Institute Inc., Carey, North Carolina, USA) with calf sex and breed type (Bali, Bali cross, Brahman cross) fitted as fixed class variables.

2.3. Scours test and fecal examination

Fecal samples were collected from calves (n=12) with signs of diarrhoea between 1-2 months of age from farms in 6 villages (Sukadamai, Kari Jawa, Kandai 1, Woko, Nusa Jaya and Lanci Jaya) and Doro Ncanga (free grazing area) in the Dompu district between the period of September 2018 and September 2019. The FASTest D4T bovine kit (MEGACOR Diagnostik, GmbH, Vorarlberg, Austria) was used to detect *Cryptosporidium parvum*, rotavirus, bovine coronavirus (BCV) and *E. coli* strain

K-99 (*E. coli*-K99) in the feces of bovines. This is a qualitative test on fresh feces that reports positive or negative samples.

Fecal samples were collected from pre-weaned calves (3 weeks-3 months of age; n=62) from 3 different areas within the Dompu district (Manggelewa, Doro Ncanga, Woko). These were examined using a modified McMaster egg counting technique using saturated sodium chloride as the floatation medium [7] where each egg counted represents 50 eggs/oocysts per gram.

3. Results and discussion

3.1. Farmer interviews

Results from the farmer survey are in table 1. Farmers interviewed indicated that the cows calving ranged from 82% to 100% of cows owned, with lower calving success rates tending to be in herds with greater numbers. The survey of farmers shows that calf mortality can be high but varies from farmer to farmer, and between areas. Questionnaire results indicate that most deaths occur in 2–4 months old animals that may die suddenly, suffer from scours over a short period of time and some have haemorrhagic scours. Anecdotally, the farmers attributed a large number of these deaths to a 'poisonous green grasshopper', of which the authors have not been able to prove the existence of.

Table 1. Survey data from farmers interviewed from four different area of Dompu, Sumbawa Island, Indonesia

Area	Number of farmers	Cows/farmer	Total cows	Calves born (calving %)	Calf deaths	Comments on cause of calf death
Nangatumpu village	14	2-10	77	73 (95%)	9 (12%)	Farmers reported deaths occurring between 4-6 months of age
Simpasai village	8	2-5	20	20 (100%)	2 (10%)	1 abortion, 1 trauma
Doro Ncanga Grazing area	4	10- 100	180	147 (82%)	40 (27%)	Deaths occurred predominantly between 2 – 4 months of age
Lepadi village	1	1	1	0	-	-

3.2. *Immunoglobulins G (IgG) measurement*

Table 2 shows breed, birth weight and colostral antibody transfer results from calves tested using the IgG kit. The serum tested for IgG status was from a mixture of Bali, Bali cross and Brahman cross calves. The crossbred calves included various European breeds such as Angus, Simmental and Limousin in their makeup. Of the 18 calves tested, only one demonstrated an insufficient concentration of IgG in serum indicating the possibility of failure of passive transfer from the dam. Passive transfer of colostral antibodies within 24-48 hours after birth appears to be at a sufficient level. Thus, absence of antibodies does not explain calf mortality.

Calf live weights ranged between breed type as shown in table 2 but the level of cross breeding and inaccurate recording made it difficult to ascertain the breed mix of the calves and test for an effect of breed. There was no difference (P=0.14) in birth weight between heifer and bull calves (24.1 ± 1.6 kg vs 27.4 ± 1.4 kg).

Table 2. Calf breed, birth weight and colostral antibody (IgG) status 24-48 hours after birth on farms in the Dompu district, Sumbawa Island, Indonesia.

Calf breed	Birth weight (kg)		IgG test results
	Male	Female	Pass/fail
Bali	-	n = 2	All passed
(n = 2)		21.7	
		(18.9 – 24.4)	
Bali cross	n = 6	n = 5	All passed
(n = 11)	24.8	25.0	
	(22.0 – 27.4)	(20 – 27.4)	
Brahman cross	n = 4	n = 1	4 passed / 1 fail
(n = 5)	31.2	24.0	
	(26 – 38.7)		

Note: Values in parentheses indicate range of birth weights

3.3. Scours test and fecal examination

Samples from 12 scouring calves were tested using the FASTest D4T bovine kit. Of the samples tested, 7 out of 12 samples tested positive for one of the microorganisms causing general diarrhoea in calves. One sample was positive for rotavirus, three for coronavirus, two for *E. coli* and one for *Cryptosporidium*. No cause was identified for the remaining five samples. The limited number of neonatal pathogen test samples suggests a low prevalence of the pathogens tested for (*Cryptosporidium parvum*, rotavirus, BCV and *E. coli*-K99) and it is unclear what is responsible for causing scouring in calves. Several studies have reported that the pathogenic microorganisms most often found as a cause of scours in calves are rotavirus, coronavirus, *Cryptosporidum parvum*, enterotoxigenic *E. coli* K99 and *Salmonella spp* [8,9,10,11,12]. However, success in detecting the presence of these pathogens does not prove causality because all of the pathogens were also identified in both diarrhoea and normal calves [13]. Therefore, it is necessary to consider other factors, apart from disease-causing microorganisms, such as specific management factors that include hygiene and nutrition as well as animal factors such as parity and host's resistance [14,9,10] to determine preventative measures for scours.

A total of 62 fecal samples from calves were collected (table 3). A range of different gastrointestinal parasites were found although very few coccidial oocysts were seen. The overall prevalence of gastrointestinal parasites in calves in this study was recorded to the extent of Strongyle 32.25%, *Strongyloides* 25.80%, *Toxocara* 8.06%, *Trichuris* 9.45%, and *Eimeria* 1.61%.

Gastrointestinal parasitic infections are highly influenced by age [15]. The results of the present study (table 3) indicate a high prevalence (65.38-90.99%) of gastrointestinal parasites in calves in all areas covered. Calves are more vulnerable to parasitic infections than adults [16,17] for several reasons, including naive immunity, high responsiveness and high nutritional requirements for growth that may compete with the available nutrients for the development of an immune response [19]. The vulnerability could also be due to farmers not adopting recommended calf management strategies.

Gastrointestinal parasites were present, but infection levels do not appear excessive. Nevertheless, the burdens noted are likely to reduce weight gains and lead to some ill thrift. Although some Toxocara egg counts were high (31125±11706.01) this may not mean the individual calves had substantial worm burdens as this is a very fecund species. The highest prevalence of gastrointestinal parasites was in Strongyle (32.25%) followed by Strongyloides with a prevalence rate of 25.80%. Strongyle was the most prevalent helminths in cattle irrespective of age groups [15,19]. Strongyle infection in calves may be associated with confinement of calves in small areas of pasture resulting in infective larval concentrations [15]. Strongyloides is a relatively non-pathogenic species so these figures are unlikely to indicate a sub-clinical problem [20]. It was somewhat surprising that few coccidial oocysts were noted in these calves.

Table 3. Prevalence and mean count (mean ± SE) of gastrointestinal parasites in calves.

Species	Areas			GI parasites prevalence
	Manggelewa (n=25)	Woko (n=11)	Doro Ncanga (n=26)	
Toxocara				
EPG	31125±11706.01	10650±0.00	25500±0.00	
(range values)	(3300-60600)	(10650)	(25500)	
NP (prevalence)	3 (12%)	1 (9.09%)	1 (3.80%)	5 (8.06%)
Strongyle				
EPG	50±0.00	412.50±89.51	220.83±52.74	
(range values)	(50)	(50-750)	(50-700)	
NP (prevalence)	1 (4%)	7 (63.63%)	12 (46.10%)	20 (32.25%)
Strongyloides				
EPG	486.36±144.29	100±28.86	495±126.58	
(range values)	(50-1300)	(50-150)	(350-1000)	
NP (prevalence)	10 (40%)	2 (18.18%)	4 (15.30%)	16 (25.80%)
Trichuris				
EPG	80±30.00			
(range values)	(50-200)			
NP (prevalence)	4 (16%)	0	0	4 (6.45%)
Eimeria				
OPG	50±0.00			
(range values)	(50)			
NP (prevalence)	1 (4%)	0	0	1 (1.61%)
Area wise prevalence	19 (76%)	10 (90.90%)	17 (65.38%)	

Note: EPG = eggs/grams; OPG = oocysts/gram; NP = number positive

Given that calf mortality seems to occur over a defined age range, this would likely rule out ingestion of toxic plants and other toxins (e.g. pesticides) as it would be expected that older cattle would also suffer, and this was idea was not supported by the farmer survey responses. Consequently, an infectious agent is suspected. Further investigation is required to determine which pathogens, such as *Clostridium perfringens,* are involved.

4. Conclusion

The calf mortality ranged from 10–27% with most deaths occurring in 2–4 months old calves. Passive transfer of colostral antibodies within 24-48 hours after calf birth appears to be at a sufficient level. Therefore, absence of antibodies does not explain calf mortality. A low prevalence of the pathogens causing common general diarrhea was observed suggesting that it is unclear what is responsible for incidence of scouring observed. The prevalence of gastrointestinal parasitic infections in calves was high ranging from 65.38 to 90.99%. Gastrointestinal parasites found include Strongyle, *Strongyloides*, *Toxocara*, *Trichuris* and *Eimeria*, but their infection levels do not appear excessive. The presence of pathogenic microorganisms and gastrointestinal parasites will contaminate the environment, especially grazing areas, and become a source of disease transmission. Calf mortality is a limitation on the production of beef cattle for slaughter in the Dompu region of Sumbawa Island, thus further investigation is required to determine which pathogens are the cause of this calf loss.

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