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PROBIOTIC FEED PROCESSING AND ENDOMETRITIS MANAGEMENT IN BALI CATTLE IN KUPANG, EAST NUSA TENGGARA: A REVIEW

Herry Agoes Hermadi [1], Nanik Hidayatik [1,*], Mirni Lamid [1], Sunaryo Hadi Warsito [1], Mohammad Anam Al 'Arif [1], Eka Pramyrtha Hestianah [1], Zulfi Nur Amrina Rosyada [1], Elisabet Tangkonda [2], Tarsisius Considus Tophianong [2] and Fhady Riskhy Loe [2]

[1] Department of Veterinary Science, Faculty of Veterinary Medicine, Universitas Airlangga, Surabaya, Indonesia.
[2] Study Program of Veterinary Medicine, Faculty Medicine and Veterinary Medicine, Universitas Nusa Cendana, Kupang, Indonesia.
* Corresponding Author

ORCID Details
Herry Agoes Hermadi: https://orcid.org/0000-0003-2337-6716
Nanik Hidayatik : https://orcid.org/0000-0002-7812-8368
Mirni Lamid: https://orcid.org/0000-0001-6539-4571
Sunaryo Hadi Warsito: https://orcid.org/0000-0002-6280-0631
Mohammad Anam Al 'Arif: https://orcid.org/0000-0002-5220-9311
Eka Pramyrtha Hestianah: https://orcid.org/0000-0001-8679-040X
Zulfi Nur Amrina Rosyada: https://orcid.org/0000-0002-0080-5066
Elisabet Tangkonda: https://orcid.org/0000-0002-5811-7696
Tarsisius Considus Tophianong: https://orcid.org/0009-0000-8625-1238
Fhady Riskhy Loe: https://orcid.org/0009-0000-1969-1399

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ABSTRACT

Background: Bali cattle are the backbone of smallholder beef production in Kupang, East Nusa Tenggara (NTT), Indonesia, yet their reproductive efficiency is constrained by long dry seasons, poor-quality forage and postpartum uterine disease.

Objective: This review synthesises published evidence on two linked interventions: probiotic-based feed processing and the management of endometritis in Bali cattle under Kupang conditions.

Methods: A narrative literature review was conducted using Indonesian and international journals, proceedings and theses indexed in Garuda, DOAJ, PubMed Central and university repositories. Sources were screened for relevance to Bali cattle, dryland NTT production systems and bovine endometritis, and findings were synthesised qualitatively.

Results: Probiotic fermentation of local fibrous feeds (kume grass, rice straw, crop residues) consistently raised crude protein and lowered crude fibre. In a Kupang feeding trial, hydrolysed kume hay with probiotic additives raised daily

gain from 0.38 to 0.70 kg/head. Field data from Kupang Regency show a pregnancy rate of only 45%; reproductive disorders affected 58% of Bali cows in a large field survey, and endometritis accounted for about 8% of disorder cases in another. Standard therapy relies on intrauterine antibiotics, povidone-iodine or Lugol's solution, and PGF2α, while lactic acid bacteria (LAB) given intravaginally or intrauterine are an emerging, antibiotic-sparing option.

Conclusion: Combining probiotic-fermented dry-season feed with early postpartum examination and PGF2α-based endometritis therapy is the most practical path to shorter calving intervals in Kupang. Controlled trials of probiotics and uterine LAB in Bali cows are still lacking.

Keywords: Bali Cattle; Probiotic; Fermented Feed; Endometritis; Reproductive Efficiency; Kupang; East Nusa Tenggara

1 INTRODUCTION

Bali cattle (*Bos javanicus domesticus*) are the dominant beef breed of East Nusa Tenggara (NTT), and Kupang Regency holds the province's largest Bali cattle population. The breed is valued for high fertility, adaptation to hot dryland conditions and lean carcasses. Most herds, however, are kept by smallholders under extensive or semi-intensive systems, typically without records or planned breeding [1].

Feed is the first constraint. On Timor Island the rainy season lasts only about three to four months, and forage quantity and quality fall sharply in the long dry season, when cattle growth often turns negative [2,3]. Native annual grasses such as kume (*Sorghum plumosum* var. *timorense*) are abundant briefly but are highly lignified and poorly digested [4]. Dry-season supplementation studies in West Timor confirm that cow and calf performance respond strongly when nutrient gaps are closed [5].

Reproductive failure is the second constraint, and it is tightly linked to the first. In semi-intensive herds of East Kupang, the pregnancy rate was only 45%, far below the 62.5% national benchmark [1]. Poor nutrition delays uterine involution and the return to oestrus, while postpartum uterine infection, namely metritis and endometritis, directly causes delayed involution, repeat breeding and longer calving intervals [6]. Endometritis is defined as inflammation of the endometrium, and in its clinical form presents as purulent or mucopurulent vaginal discharge 21 days or more after calving [7].

Two practical responses have emerged in the Kupang context. The first is probiotic-based processing: fermenting low-quality forages and crop residues with lactic acid bacteria (LAB), yeasts or commercial microbial products to raise feed value. The second is improved diagnosis and treatment of endometritis, with growing interest in probiotic LAB as an alternative to antibiotics. This review brings both strands together. Its aims are to (1) summarise how probiotic feeds are processed and what they achieve in Bali cattle, (2) summarise the occurrence, diagnosis and treatment of endometritis, and (3) propose an integrated approach suited to smallholders in Kupang.

2 MATERIALS AND METHODS

2.1 Review Design

This study is a narrative literature review. Sources were searched in October 2026 through general web search and scholarly indexes, including Google Scholar-indexed repositories, Garuda (the Indonesian national index), DOAJ, PubMed Central and university repositories (Universitas Nusa Cendana, Universitas Gadjah Mada and IPB University).

2.2 Search Strategy

Search terms combined English and Indonesian keywords: Bali cattle/sapi Bali, probiotic, fermented feed/pakan fermentasi, Kupang, Timor, East Nusa Tenggara/NTT, endometritis, reproductive disorders/gangguan reproduksi, intrauterine, PGF2α, Lugol and lactic acid bacteria.

2.3 Eligibility Criteria

Studies were included if they (1) addressed Bali cattle in NTT or comparable dryland smallholder systems and covered feed processing with probiotics or microbial fermentation; (2) reported reproductive performance or reproductive disorders, including endometritis, in Bali cattle; or (3) were foundational or controlled studies on the definition, diagnosis and treatment of bovine endometritis, including probiotic or LAB-based approaches, even when conducted in dairy cattle. Non-ruminant studies, studies without accessible abstracts or full text, and popular articles without primary data were excluded.

2.4 Data Extraction and Synthesis

For each eligible source, the location, animals, intervention, outcome measures and main findings were extracted. Findings were grouped into two themes, probiotic feed processing and endometritis management, and synthesised qualitatively. Because study designs, units and outcomes differed widely, no meta-analysis was attempted.

3 RESULTS

3.1 Feed Resources and the Dry-Season Gap in Kupang

Smallholder Bali cattle in Kupang graze native pasture and receive cut-and-carry feeds such as *Leucaena leucocephala*, banana stems, field grass, rice straw and maize stover [1]. In West Timor fattening units, leucaena dominated rations in both seasons, but average daily gain and feed conversion were significantly better in the rainy season than in the dry season [3]. Fibrous dry-season residues are therefore the main target for processing.

3.2 Probiotic Feed Processing: Methods and Outcomes

Three processing routes appear in the literature: (1) solid-state fermentation of forage or crop residues with a probiotic inoculum, (2) direct addition of probiotics to the ration or drinking water, and (3) home-made liquid probiotics added to feed or water. Table 1 summarises the studies most relevant to Kupang and NTT.

Table 1: Probiotic and microbial feed-processing studies relevant to Bali cattle in NTT

Study	Location and animals	Feed and processing	Probiotic/inoculum	Main result
Dami Dato et al. [4]	Politani Kupang; 20 young bulls, 3 months	Kume standing hay hydrolysed with rice-hull-ash filtrate, replacing 10-40% king grass	Bioplus + Bioport, 100 g each	Daily gain 0.38 kg (control) vs 0.70 kg at 30% substitution; higher DM, OM and CP intake
Vertygo et al. [8]	Lakanmau, Belu, NTT; 30 farmers	Home-made RABAL liquid probiotic, fermented for 7 days	Tapai yeast (*S. cerevisiae*) + *Lactobacillus casei*, coconut water, molasses	Farmers mastered production; 2 bottle caps per litre of water or per kg feed; about IDR 75,000 per 5 L batch
Sudita et al. [9]	Bali	Rice straw fermented with different probiotics and times	Several commercial probiotics	Probiotic type and fermentation time affected quality; Bio Bali Tani gave the best CP and crude fibre
Muhakka et al. [10]	South Sumatra	Lowland swamp grasses fermented with 0.6% urea for Bali cattle	Probiotic microorganisms at 0.3, 0.5 and 0.7%	Best nutritive value with *Ischaemum rugosum* fermented at 0.7%
Hamerwan [11]	South Sumatra	Swamp grass (*Hymenachne*) + concentrate	Bioplus, 62.5-87.5 g	No significant effect on intake, daily gain or feed efficiency

The Kupang trial by Dami Dato et al. [4] is the most direct evidence. Male Bali cattle with an initial weight of about 137 kg fed hydrolysed kume hay with Bioplus and Bioport gained 0.70 kg/day at 30% substitution, nearly double the control. The authors concluded that kume hay could replace king grass up to 30% and that the probiotic additives raised nutrient intake and growth. Because probiotics and hydrolysis were applied together, their separate effects cannot be isolated.

The RABAL model [8] shows that a low-cost probiotic can be produced in NTT villages from yeast, a commercial *L. casei* drink, coconut water and molasses. Its main barriers were access to ingredients and contamination risk, not technical difficulty. Its effect on Bali cattle growth was not measured.

Mechanistically, probiotics, defined by FAO/WHO as live microorganisms that confer a health benefit when given in adequate amounts, can stabilise rumen fermentation, improve fibre digestion and support gut immunity [12].

Responses are, however, inconsistent across studies, partly because the resident gut microbiota differs between animals and diets [12].

3.3 Reproductive Performance and Endometritis in Bali Cattle

Four semi-intensive herds in Pukdale, East Kupang (40 cows aged 4-7 years), had a pregnancy rate of 45%, days open of 112.5 days and a calving interval of 13.1 months [1]. The authors attributed low pregnancy mainly to a shortage of breeding bulls, with seasonal feed quality and poor oestrus detection as further causes.

Table 2: Reproductive disorders reported in Bali cattle field surveys

Study	Location	Cows examined	Main findings	Endometritis finding
Pian et al. [1]	Kupang Regency, NTT	40	Pregnancy rate 45%, days open 112.5 d, calving interval 13.1 months	Cows with endometritis excluded at sampling
Budiyanto et al. [6]	Bengkulu (semi-intensive)	333	193 cows (57.95%) with disorders; 80 (41.45%) returned to oestrus after treatment	Metritis and endometritis among main diagnoses
Rizal [13]	Kandis, Riau	137 disorder cases	Retained placenta 25.6%, ovarian hypofunction 23.4%, persistent CL 16.1%	Endometritis 8.0%; pyometra 4.4%; metritis 2.9%

No published prevalence figure specific to endometritis in Kupang Bali cattle was found. Budiyanto et al. [6], whose team included the Universitas Nusa Cendana veterinary faculty, linked high uterine infection rates to non-specific bacterial contamination at mating or calving, dystocia, retained placenta and impaired uterine leukocyte function.

3.4 Diagnosis and Treatment of Endometritis

Clinical endometritis is defined as purulent (>50% pus) uterine discharge in the vagina at 21 days or more postpartum, or mucopurulent discharge after 26 days; subclinical endometritis is defined by increased neutrophils on endometrial cytology without discharge [7]. Vaginal examination and rectal palpation are the practical field tools in Kupang [1,6]. Table 3 summarises the main treatment approaches.

Table 3: Treatment approaches for bovine endometritis

Approach	Evidence	Key finding	Field suitability for Kupang
Intrauterine antibiotics + PGF2α	Melia et al. [14]; 6 cows	Gentamicin + flumequine with PGF2α was more effective than antibiotics alone	High; drugs available, but antimicrobial resistance and withdrawal times are concerns
Lugol's iodine 2% + PGF2α	Melia et al. [15]; 6 cows	Not effective in Aceh cows; Lugol caused strong straining that expelled the PGF2α; a 30-min gap between drugs helped one cow	Moderate; cheap, but irritant if over-concentrated
PGF2α, povidone-iodine, GnRH, vitamin ADE	Budiyanto et al. [6]; 193 cases	Case-by-case therapy; 41.45% returned to oestrus	High; already used by field veterinarians
Intrauterine *L. buchneri*	Peter et al. [16]; 116 dairy cows	More first-service pregnancies, shorter days to conception, lower endometrial inflammatory gene expression	Experimental; needs a defined, safe strain
Intravaginal LAB before calving	Genís et al. [17]; 135 dairy cows	Pre-partum vaginal LAB cut metritis from 14/45 to 6/45 cows; intrauterine dose after calving had no effect	Promising for prevention; untested in Bali cows

Antibiotic-based intrauterine therapy remains the field standard, but growing antimicrobial resistance has driven interest in LAB as an alternative [16]. In dairy cows, intrauterine *Lactobacillus buchneri* given on days 24-30 postpartum to cows with subclinical endometritis improved first-service pregnancy and shortened days to conception [16].

Intravaginal LAB given before calving reduced metritis, while the same mixture given into the uterus after calving did not [17]. In vitro, a LAB combination limited *Escherichia coli* infection and inflammation of bovine endometrium [18].

4 DISCUSSION

4.1 Probiotic Feed Processing: Promise and Limits

The evidence supports probiotic fermentation as a way to make Kupang's abundant but poor dry-season fibre usable. The strongest local result, 0.70 versus 0.38 kg/day in Bali bulls fed hydrolysed kume hay with probiotics [4], came from a combined treatment, so the probiotic contribution alone is unknown. Results elsewhere are mixed: fermentation reliably improves crude protein and fibre fractions [9,10], but direct Bioplus supplementation did not change gain in Bali cattle fed swamp grass [11]. This matches the broader finding that probiotic responses in ruminants are inconsistent and depend on diet and the resident microbiota [12].

The practical lesson is that probiotics work best as part of processing that also addresses the feed's main limitation, whether lignin, low nitrogen or low energy. Combining fermentation with alkali treatment, urea or a legume such as leucaena is more likely to pay off than adding a probiotic to unchanged hay. Low-cost village probiotics such as RABAL [8] lower the cost barrier, but they need quality control, and their effect on cattle performance has not yet been measured.

4.2 Why Feed Matters for Endometritis

Nutrition and uterine health are linked. Energy and protein deficits suppress GnRH and LH pulsatility, delay ovarian activity and prolong postpartum anoestrus; in parallel, poor body condition weakens uterine leukocyte function and slows involution, letting bacterial contamination persist as endometritis [6]. Budiyanto et al. [6] recommended correcting nutrition in cows with a body condition score below 2 before hormonal therapy. Improved dry-season feeding is therefore not only a growth measure but also part of endometritis prevention. In West Timor, strategic dry-season supplementation already improves calf survival and growth [5].

4.3 Endometritis Management in Kupang

The absence of endometritis-specific prevalence data for Kupang is a key gap: Pian et al. [1] excluded affected cows, and the larger disorder surveys come from Bengkulu and Riau [6,13]. Standardised postpartum checks using the definitions of Sheldon et al. [7] would allow comparable local data.

For treatment, PGF2α remains central because it lyses the corpus luteum, lowers progesterone and promotes uterine contraction and clearance. Adding it to intrauterine antibiotics improved outcomes over antibiotics alone [14]. Lugol's iodine is cheap but can provoke straining and drug loss, so timing matters [15]. Antibiotic use should be restrained and guided by veterinarians, given resistance concerns.

Probiotic LAB offer a bridge between the two themes of this review. Intrauterine *L. buchneri* improved fertility in dairy cows with subclinical endometritis [16], and pre-calving intravaginal LAB cut metritis by up to 58% [17]. These results come from high-yielding dairy herds. Bali cows differ in physiology and calve mostly on pasture, so strains, doses and delivery routes must be tested before field use. Uterine LAB products also require pharmaceutical-grade preparation; village feed probiotics such as RABAL must never be used intrauterine.

4.4 A Practical Integrated Approach for Kupang Smallholders

Based on the evidence reviewed, the following sequence is proposed: (1) in late gestation and the dry season, feed probiotic-fermented local fibre (kume hay, rice straw, maize stover) with leucaena or concentrate, targeting a body condition score of at least 2 at calving; (2) at calving, keep calving areas clean, assist dystocia hygienically and record retained placenta, a known risk factor for uterine infection; (3) on days 21-35 postpartum, have a field veterinarian check vaginal discharge and palpate the uterus, classifying cases with standard definitions; (4) treat confirmed endometritis with PGF2α where a corpus luteum is present, plus intrauterine antiseptic or antibiotic as prescribed by the veterinarian; (5) mate or inseminate from about 60-90 days postpartum once oestrus resumes, aiming for a 12-month calving interval; and (6) run controlled trials of village probiotics on Bali cow body condition and fertility, and of LAB for endometritis prevention.

5 CONCLUSION

Probiotic processing of local fibrous feeds is a feasible, low-cost way to narrow Kupang's dry-season nutrient gap, with one local trial showing daily gain rising from 0.38 to 0.70 kg when probiotics were combined with alkali-treated kume hay. Its benefits are most reliable when fermentation is paired with treatments that address lignin and nitrogen limits.

Endometritis is a recurring cause of reproductive inefficiency in Bali cattle, and its control depends on adequate nutrition, hygienic calving, early postpartum examination and PGF2α-based therapy under veterinary supervision. Lactic acid bacteria show promise as an antibiotic-sparing tool for preventing and treating uterine infection, but evidence is limited to dairy cattle.

Priority research for Kupang includes (1) endometritis prevalence surveys using standard definitions, (2) controlled trials of village probiotics on Bali cow body condition and fertility, and (3) safety and efficacy trials of LAB for endometritis in Bali cows.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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Disclosure of conflict of interest

The authors declare no financial or non-financial conflicts of interest related to this review.

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