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ANALYZING THE CORRELATION BETWEEN BETA-LACTOGLOBULIN POLYMORPHISM AND THE INCIDENCE OF CLINICAL MASTITIS AND REPRODUCTIVE DISORDERS IN FRIESIAN COWS IN THE PANGALENGAN AREA

Saskia Putri Romina[1], Septiyani[2, a], Nurcholidah Solihati[3]
[1]*Veterinary Medicine Study Program, Faculty of Medicine, Padjadjaran University*
[2]*Department of Biomedical Sciences, Veterinary Medicine Study Program, Faculty of Medicine, Padjadjaran University*
[3]*Department of Animal Production, Faculty of Animal Husbandry, Padjadjaran University*
[a]*email:* drh.septiyani@unpad.ac.id

Abstract
Beta-lactoglobulin genetics, one of the whey proteins in cow's milk, influence improvements in milk composition, production, and component levels. Reproductive disorders and clinical mastitis in livestock are often related to genetic, hormonal, and environmental factors. Research on the correlation between beta-lactoglobulin and cow reproduction is still very limited. This study aims to determine the correlation between beta-lactoglobulin genotype and clinical mastitis as well as reproductive disorders (dystocia, retained placenta, and endometritis). This research utilizes secondary data obtained from the Koperasi Peternakan Bandung Selatan (KPBS) Pangalengan headquarters, consisting of genotype examination results of beta-lactoglobulin and medical records of cows experiencing clinical mastitis and reproductive disorders. A total of 113 samples were collected. The data were analyzed using quantitative methods, followed by Chi-Square tests using Microsoft Excel and SPSS version 25.0 for data analysis. The results showed that the beta-lactoglobulin genotype was not associated with the incidence of clinical mastitis (p=0.509) or reproductive disorders such as dystocia (p=0.789), retained placenta (p=0.193), and endometritis (p=0.685). All test results indicated significance values ≥0.05. This study concludes that polymorphism beta-lactoglobulin does not have a significant correlation with clinical mastitis and reproductive disorders occurring in Friesian Holstein cows at Pangalengan area.
Keywords: beta-lactoglobulin, clinical mastitis, dystocia, endometritis, Friesian Holstein cow, retained placenta.

ANALISIS KORELASI POLIMORFISME BETA-LAKTOGLOBULIN DENGAN KEJADIAN MASTITIS KLINIS DAN GANGGUAN REPRODUKSI PADA SAPI FRIESIAN DI WILAYAH PANGALENGAN

Abstrak
Genetik beta-laktoglobulin merupakan salah satu protein whey dalam susu sapi yang dapat berpengaruh terhadap perbaikan komposisi susu, produksi susu, dan kadar komponen susu. Gangguan reproduksi dan mastitis klinis pada hewan ternak seringkali berkaitan dengan faktor-faktor genetik, hormonal, dan lingkungan. Penelitian mengenai hubungan beta-laktoglobulin dengan reproduksi sapi masih sangat sedikit. Maka dari itu, tujuan penelitian ini yaitu untuk mengetahui hubungan genotipe beta-laktoglobulin dengan mastitis klinis dan gangguan reproduksi (distokia, retensio plasenta, dan endometritis). Penelitian ini menggunakan data sekunder yang didapatkan dari kantor pusat KPBS Pangalengan berupa data hasil pemeriksaan genotipe beta-laktoglobulin dan data rekam medis sapi yang mengalami mastitis klinis dan gangguan reproduksi. Data yang didapatkan sebanyak 113 sampel. Data dianalisis menggunakan metode kuantitatif, kemudian dilakukan uji analisis data menggunakan uji Chi-Square dengan perangkat lunak Microsoft Excel dan SPSS versi 25.0. Hasil penelitian menunjukkan bahwa genotipe beta-laktoglobulin tidak berhubungan dengan kejadian mastitis klinis (p=0,509) dan gangguan reproduksi yaitu distokia (p=0,789) retensio plasenta (p=0,193), dan endometritis (p=0,685). Seluruh hasil uji menunjukkan nilai signifikansi ≥0,05. Kesimpulan dari penelitian ini adalah beta-laktoglobulin tidak terdapat hubungan yang signifikan dengan mastitis klinis dan gangguan reproduksi yang terjadi pada Sapi Friesian Holstein yang berada di wilayah Pangalengan.
Kata kunci: beta-laktoglobulin, distokia, endometritis, mastitis klinis, retensio plasenta, sapi Friesian Holstein

INTRODUCTION

Dairy cattle are ruminants reared specifically for their milk production. The demand for domestic fresh milk in Indonesia is increasing over time, resulting in the need for increased population and milk production to meet those needs. Reproductive disorders, which result in low fertility rates and poor reproductive efficiency, directly impact milk production and the number of calves born per

year (Rahayu, 2021). Several examples of reproductive disorders that most commonly affect Friesian Holstein cows in West Java, most notably Pangalengan area, are retained placental, dystocia, and endometritis. Another disease that indirectly has a significant impact on the reproductive health of cows is mastitis.

Milk production can be increased by providing better feed, health, environment, and genetics. Cows with good genetics usually have higher milk production capacity. The genetic beta-lactoglobulin gene can be used in selecting cattle to improve milk composition, milk production, and milk component levels (Nury & Anggraeni, 2014). Beta-lactoglobulin is a protein contained in milk. Beta-lactoglobulin (β-LG) is included in the group of lipocalin proteins that are dominant in ruminant milk such as cows, goats, and sheep (Broersen, 2020). Beta-lactoglobulin is a polymorphic protein and the most commonly identified alleles are A and B and produce three genotypes namely A/A, B/B, and A/B (Nury, 2010).

The beta-lactoglobulin gene indirectly affects reproductive efficiency in cows through its influence on milk quality and production (Nury, 2010). Cows with the B/B genotype have longer calving intervals (Felenczak et al., 2008).

Research investigating the influence of genetic polymorphisms in milk proteins on milk production traits is abundant, but few studies have explored their correlation with cattle reproduction. Therefore, this study was conducted to add references and examine how the beta-lactoglobulin gene relates to Friesian Holstein (FH) cows experiencing clinical mastitis and reproductive disorders, particularly those with retained placenta, dystocia, and endometritis.

This study aimed to investigate the hypotheses related to the connection between beta-lactoglobulin and clinical mastitis and reproductive disorders in Friesian Holstein cattle in the Pangalengan area.

MATERIALS AND METHODS

Data collection was conducted from July to September 2024 at the KPBS (Koperasi Peternakan Bandung Selatan) Pangalengan Headquarters, located at Jalan Raya Pangalengan No. 340, Pangalengan District, Bandung Regency. The research method used was descriptive quantitative with a cross-sectional approach.

The data required for this study consisted of secondary data, which was obtained from a recording system regarding cattle that experienced reproductive disorders and beta-lactoglobulin genotype data. The samples for this study were not selected randomly (purposive sampling). The research criteria included pregnant heifer Friesian Holsteins that have calved and were experiencing clinical mastitis and reproductive disorders between January to June 2024. A total of 113 samples that met these criteria were obtained.

The data resulting from the research were recorded and tabulated using Microsoft Excel, followed by analysis utilizing the Pearson Chi-Square test assisted by SPSS version 25.0. Before conducting the hypothesis testing, the researcher calculated mean, minimum value, maximum value, standard deviation, and also performed prerequisite analysis checks. The analysis test used in this study was the Pearson Chi Square test as a nonparametric test with a nominal data scale.

The research was conducted at a cooperative in Pangalengan, a milk-producing region of West Java. This cooperative primarily focuses on dairy cattle farming, milk processing, and marketing dairy products. Pangalengan had approximately 2,600 farmer members and a total population of 13,107 dairy cows recorded as of July 2024. The number of female cattle was 10,386, while the number of males was 2,721 (KPBS Pangalengan, 2024).

RESULTS AND DISCUSSION

This study focuses on heifers that are pregnant until they give birth, as well as those experiencing clinical mastitis and reproductive disorders. A total of 200 pregnant heifers distributed across various Pangalengan areas had been successfully identified for their beta-lactoglobulin genotype, resulting in the genotypes of A/A, B/B, and A/B. Among the 200 pregnant heifers with known beta-lactoglobulin genotypes, 113 experienced clinical mastitis, dystocia, retained placenta, and endometritis from January to July after giving birth. Out of the 113 individuals, 23 had the A/A genotype, 38 had the B/B genotype, and 52 have the A/B genotype.

All the sample data obtained was then tabulated using Microsoft Excel software. Based on the results of this tabulation, cows with certain genotypes can experience different disease occurrences and may even suffer from more than one disease.

This study was conducted to examine whether the beta-lactoglobulin polymorphism is related to clinical mastitis and reproductive disorders. The results of this study indicated no significant correlation between the beta-lactoglobulin polymorphism and clinical mastitis or reproductive disorders, and there were only a few similar studies conducted. This research differs from previous studies because the variables investigated earlier included reproductive performance (calving interval, age at first calving, and insemination index).

Research by Ambarwati et al. (2019) indicates that variations in the beta-lactoglobulin gene can serve as molecular markers to enhance milk production and composition, while studies discussing the impact of beta-lactoglobulin on livestock reproduction are still very limited.

Research conducted by Tsiaras et al. (2005) revealed that beta-lactoglobulin has a significant effect on gestation length, with a p-value of less than 0.05. Cows with the A/B and B/B genotypes had a gestation period that was two days longer compared to cows with the A/A genotype. The calving interval and age at first calving in this study did not show a significant effect.

Correlation between beta-lactoglobulin and clinical mastitis

Table 1 present the results of the chi-square hypothesis test analysis. A p-value > 0.05, means no significant relationship between the variables. Therefore, since the result yielded a p-value of 0,509 (p-value > 0.05), it can be concluded that the beta-lactoglobulin genotype is not related to the occurrence of clinical mastitis.

Mastitis in dairy cows has been linked to genetic factors in several studies, such as Beishova et al. (2024) who investigated the relationship between polymorphism variants of the PRL gene and Beta-lactoglobulin with resistance and susceptibility to mastitis in Friesian Holstein cows.

The results indicated a potential relationship between genetic variants of the beta-lactoglobulin gene and the risk of mastitis in cows, particularly in the Friesian Holstein breed. This study showed that cows with the A/B genotype are significantly associated with mastitis resistance.

Singh et al. (2015), observed that somatic cell count (SCC) in cows with the A/A genotype was significantly ($p < 0.05$) lower than that in cows with A/B and B/B genotypes, suggesting that cows with the A/A genotype are better candidates for selection as mastitis-tolerant animals.

Correlation between beta-lactoglobulin and retained placenta

Table 2 shows that the results of the chi-square hypothesis test have a p-value=0.789 (p-value > 0.05), which means there is no correlation between the beta-lactoglobulin genotype and retained placenta.

Retained placenta in cows is not directly related to the beta-lactoglobulin gene. Retained placenta in cows is usually influenced by several factors such as the physical condition and health of the cow, as well as individual variations. Retained placenta is most commonly associated with dystocia, milk fever (a metabolic disease), and twin births. Dystocia, or difficulty during parturition, such as that involving a large calf or abnormal presentation, can lead to retained placenta due to prolonged uterine contractions that weaken the muscles (Tucho et al., 2017). Retained placenta in milk fever or hypocalcemia occurs due to metabolic stress. Low calcium levels inhibit uterine contractions, while increased cortisol and adrenaline further stimulate fetal expulsion during the birthing process (Mordak et al., 2017).

Correlation between beta-lactoglobulin and dystocia

The chi-square hypothesis test yielded a result of 0.193 (Table 3). Similar to the previous variable, the p-value > 0.05 leads to the acceptance of the null hypothesis (H0), meaning that the beta-lactoglobulin genotype is not related to dystocia.

Dystocia is a condition that affects cows and buffalo more frequently compared to other domestic animals (Purohit et al., 2011). The occurrence of dystocia in dairy cows is more prevalent than in beef cattle. The incidence of dystocia in heifers is higher at 30%, while in multiparous cows, it is around 10% (Tenhagen et al., 2007).

Research conducted by Czerniawska-Piątkowska et al. (2023) shows that more than 45% of cows with the A/B genotype experience an easy parturition process. This finding contradicts the current study, as cows with the beta-lactoglobulin A/A genotype experience less dystocia compared to those with the B/B and A/B genotypes.

Many factors can influence the occurrence of dystocia, including the weight and sex of the calf, the body size and pelvic diameter of the dam, metabolic disorders such as hypocalcemia, and environmental stress during or before parturition. Dystocia can also be caused by genetic factors. Cows that undergo crossbreeding are susceptible to dystocia due to mismatches in size, shape, and weight between the fetus and the dam (Mekonnen & Moges, 2016).

Correlation between beta-lactoglobulin and endometritis

The chi-square test results from the data comparing beta-lactoglobulin with the incidence of endometritis in Pangalengan area were 0.685 (Table 4).

Since this result exceeds the significance threshold of p-value > 0.05, it can be concluded that there is no correlation between the beta-lactoglobulin genotype and endometritis occurrences. Several causes of endometritis include bacterial infections, retained placenta, abnormal births such as abortion, dystocia, and prematurity, as well as poor hygiene management. Retained placenta that is left untreated can lead to secondary infections, one of which is endometritis. Approximately 58.7% of cows that experience retained placenta will subsequently develop endometritis or metritis. Research directly linking genetics to the occurrence of endometritis is still very limited. Therefore, the occurrence of endometritis in cows is not related to the beta-lactoglobulin genetics.

Table 1. Correlation between Polymorphism Beta-Lactoglobulin and Clinical Mastitis

Gene B-LG	Clinical Mastitis Cases				P-value
	No Clinical Mastitis		Clinical Mastitis		
	N	%	N	%	
A/A	23	20,3	-	0%	0,509
B/B	36	31,9	2	1,8	
A/B	49	43,4	3	2,6	

Table 2. Correlation between Polymorphism Beta-Lactoglobulin and Retained Placenta

Gene B-LG	Retained Placenta Cases				P-value
	No Retained Placenta		Retained Placenta		
	N	%	N	%	
A/A	19	16,9	4	3,5	0,789
B/B	33	29,2	5	4,4	
A/B	46	40,7	6	5,3	

Table 3. Correlation between Polymorphism Beta-Lactoglobulin and Dystocia

Gene B-LG	Dystocia Cases				P-value
	No Dystocia		Dystocia		
	N	%	N	%	
A/A	3	2,6	20	17,7	
B/B	1	0,9	37	32,7	0,193
A/B	7	6,2	45	39,9	

Table 4. Correlation between Polymorphism Beta-Lactoglobulin and Endometritis

Gene B-LG	Endometritis Cases				P-value
	No Endometritis		Endometritis		
	N	%	N	%	
A/A	22	19,5	1	0,9	
B/B	34	30,1	4	3,5	0,685
A/B	48	42,5	4	3,5	

CONCLUSIONS

This study concludes that there was no significant correlation between the beta-lactoglobulin polymorphism and clinical mastitis, reproductive disorders (placental retention, dystocia, and endometritis) in Friesian Holstein cattle located at Pangalengan area.

The analysis of beta-lactoglobulin (BLG) gene polymorphism in relation to health and reproductive traits in Friesian Holstein cattle in the Pangalengan region revealed no significant correlation with the incidence of clinical mastitis or reproductive complications such as retained placenta, dystocia, and endometritis. This absence of association suggests that the BLG gene, although functionally relevant in milk protein synthesis, may not play a direct role in immunological or reproductive pathways that underlie these health issues.

These findings underscore the complexity of genetic influences on bovine health and reproduction, highlighting the need to explore other genetic markers or environmental factors that might more directly influence susceptibility to mastitis and reproductive disorders. It is also possible that polygenic effects or gene-environment interactions obscure any minor contribution of the BLG gene. Therefore, focusing on genes involved in immune response regulation or uterine health may provide more insight into the genetic basis of these conditions in dairy cattle.

SUGGESTION

Based on the conclusions of the research above further research is needed to validate these findings across different environmental settings.

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