P-ISSN: 2304-3075; E-ISSN: 2305-4360
International Journal of Veterinary Science
www.ijvets.com; editor@ijvets.com
Short Communication https://doi.org/10.47278/journal.ijvs/2022.158

The Performance of IgM Colostrum of Friesian Holstein Dairy Cows at Different Lactation Periods

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Article History: 22-586 Received: 16-Apr-22 Revised: 09-May-22 Accepted: 09-May-22

ABSTRACT

This research identified the performance of colostrum of Friesian Holstein (FH) dairy cows Immunoglobulin M (IgM) in different lactation periods. This research was conducted with observational and laboratory analysis of Dairy Farmers Cooperative (KPSP) Setia Kawan Nongkojajar, Pasuruan, East Java. The purposive sampling of 15 lactating dairy cows's colostrum was used in varied lactation periods (lactation 1-5) for 5 days with sampling time at 5 AM and 3 PM Indonesian Time. ELISA analyzed the IgM from the colostrum sample. The IgM levels were statistically analyzed using one-way ANOVA test at a 95% confidence interval followed by Tukey's HSD test. This study suggested that IgM levels in the colostrum affected by lactation periods and milking days. Research results show that the lactation period of Friesian Holstein dairy cows did not significantly increase the colostrum's IgM level. However, based on the day of milking, the second day of milking had the best performance and signification for colostrum IgM levels with an average IgM value of 2.359±0.688mg/mL.

Key words: IgM, Colostrum, Dairy cows, *Friesian Holstein*

INTRODUCTION

Colostrum is a product of glandular mammae's first secretion produced after parturition. Colostrum contains high nutrition, protein, immunoglobulin, vitamin, mineral, and bactericide (lactoferrin, lysozyme, and lactoperoxidase) (Silva et al. 2019). The vitamin and minerals in colostrum are potentially a laxative agent and contain necessary antibodies for the calf (Godhia and Patel 2013). Colostrum also supplies nutrients that are important for the calf's growth, development, and immunity (Fahey et al. 2020). Macro environment (temperature and humidity) affect the production performance of FH dairy cows (Bouk et al. 2022). A passive immune system of the calf was obtained from the cow through colostrum administration. Furthermore, the immunoglobulin was reported to perform high colostrum concentrations and directly act as an antigen defender (Weaver et al. 2000; Playford and Weiser 2021).

Immunoglobulin-M (IgM) is one of the immunoglobulin classes produced as the body's first response against antigens. The function of IgM is facilitating phagocytosis, agglutination, and performing as a cell B receptor for antigen attachment. Therefore, IgM is more effective for agglutination and cytolytic reaction (Ježek et al. 2012; Telupere 2014; Laksmi et al. 2019; Lin et al. 2022). Daily intake of colostrum revealed a proper immune system. Transfering colostrum from cow to the calf indicated calf protection from pathogens and infectious diseases. Approximately 90% of the disease penetrated the gastrointestinal, while immunoglobulin protected the body from the antigen. Belli (2009) suggested that 6hours after parturition is the optimum time to intake colostrum when the IgM, lysozyme, and growth factor are high. The IgM absorption in small intestinal mucosal occurs for 8-12hours, while intestinal permeability decreases remarkably and stops after 48hours after parturition.

Immunity is essential in protecting the body from infections, such as diarrhea. Diarrhea is a common disease in livestock, especially in calves and it is possible to cause death. Therefore, some strategies are needed to prevent the calves from diarrhea. The administration of colostrum, high in immune and growth factors, might improve the livestock's health (Thapa 2005). Aside from BCS, colostrum production is also affected by the lactation period (Antartika et al. 2014).

Cite This Article as: Susilorini TE, Surjowardojo P, Sikone HY, Wardhana AC and Rifa'i, 2023. The performance of IgM colostrum of Friesian Holstein dairy cows at different lactation periods. International Journal of Veterinary Science 12(1): 136-138. https://doi.org/10.47278/journal.ijvs/2022.158

However, the reports of lactation periods and colostrum levels are limited information. Maintenance management such as steaming up also has a role in colostrum production, this is important for maintain the performance of dairy cow production (Surjowardojo et al. 2021). Therefore, in this study, we performed the impact of lactation periods on FH dairy cows' immunoglobulin levels.

MATERIALS AND METHODS

Research Design and Sampling Techniques

This research was conducted with observational and laboratory analysis of KPSP Setia Kawan Nongkojajar, Pasuruan, East Java. The purposive sampling of 15 lactating dairy cows's colostrum was used in varied lactation periods (lactation 1-5) for 5 days with sampling time at 5 AM and 3 PM Indonesian Time.

Analysis of IgM Level in Colostrum by ELISA

Colostrum from dairy cows with different lactation periods and lactation days was collected twice daily. The IgM levels in colostrum FH cows were measured using an ELISA kit Assay with standard protocol. The 50µL standard was added to the standard well without adding an antibody. The 40µL sample and 10µL anti-IgM antibody was added to the sample wells, then 50µL streptavidin-HRP were added to sample wells and standard wells. The plate was covered with a plastic sealed and incubated for 60 minutes at 37°C. The sealer was removed then the plate was washed 5 times with a wash buffer. The 50µL substrate solution A was added to each well, followed by 50µL substrate solution B. The plate was incubated and covered with a new sealer for 10 minutes at 37°C in the dark. Stop solution, approximately 50µL was added to each well until the color changed (from blue to yellow). The optical density was identified using an ELISA reader at the wavelength 450 nm (Bioassay Technology Laboratory 2018).

Data Analysis

The IgM levels of colostrum cow in various lactation periods were analyzed by One-way ANOVA followed by Tukey's HSD (Honestly Significant Difference) test, integrated in SPSS software version 19. The P value of ($P<0.05$) was used as significant test.

RESULTS AND DISCUSSION

Collection time of colostrum affected the IgM levels of cow's colostrum, in the afternoon showed higher IgM levels than morning collection time (Table 1). Lactation 2 (L2) presented the highest IgM levels, while the lowest IgM levels was performed in L5. However, statistical analysis revealed that the IgM levels of five lactations were not significant ($P>0.05$). Table 2 depicted the IgM level in colostrum based on milking days. The highest IgM level in the colostrum of dairy cows was shown on the first day of lactation and decreased gradually until the fifth day significantly ($P<0.05$).

Various levels of IgM in cows might be depending on the environmental factor and cow's management. Moreover, cow's diseases also contributed to the IgM synthesis immune system stimulated (Mazzullo et al. 2014; Abdelatif and Alameen 2012).

Table 1: IgM profiles of colostrum of Friesian Holstein dairy cows based on lactation

Lactation Period	Colostrum IgM Levels		
	Morning Sample	Afternoon Sample	Average
L1	1.056	1.741	1.399±0.484^{ns}
L2	1.711	2.534	2.122±0.582^{ns}
L3	1.693	1.949	1.821±0.181^{ns}
L4	1474	1.536	1.505±0.043^{ns}
L5	0.957	1.210	1.083±0179^{ns}

ns indicates a non-significant difference ($P>0.05$).

Table 2: The IgM profiles of colostrum of Friesian Holstein dairy cows based on lactation day

Lactation Day	Colostrum IgM Levels		
	Morning Sample	Afternoon Sample	Average
H1	1.761	2.146	1.954±0.273^{a}
H2	1.872	2.846	2.359±0.688^{a}
H3	0.999	1.700	1.349±0.496^{ab}
H4	1.721	1.470	1.595±0.177^{ab}
H5	0.539	0.806	0.673±0.189^{b}

^{a} indicates a significant difference ($P<0.05$).

Ježek et al. (2012) reported that IgM of adult cows showed higher level than calves. The passive transfer of colostrum in the early age of cows, then, the auto synthesis of immunoglobulin occurred when the cows were getting older. Previous studies by Bayram et al. (2016) detected IgM levels in Holstein Friesian cattle also had low levels and varied because they were influenced by environmental conditions and maintenance.

The IgM level on the first day ranged from 1.761-2.146mg/mL, on the second day were 1.872-2.846mg/mL, on the third day were 0.999-1.700mg/mL, on the third-day fourth day, were 1.721-1.470mg/mL. Then, the IgM level significantly decreased to 0.530-0.806mg/mL on the fifth day. Tukey's HSD test result showed that the IgM in colostrum for the first day of milking and the second day of milking were not significantly different, while lactation in days 3, 4 and 5 reduced IgM levels significantly.

As shown in the data, the IgM level keeps decreasing gradually depending on livestock's hormonal activity and physiological condition. Parity had no significant effects on IgG and IgM concentrations, but colostrum quality may be affected by calving season (Zarei et al. 2017; Hughes et al. 2022). Immunoglobulin level in colostrum is immensely reduced after parturition (Kuralkar and Kuralkar 2010). Thus, colostrum is best consumed as soon as it is produced. Six hours after parturition is the optimum time for the baby to consume colostrum. It has high titers of lysozyme and growth factor (Belli 2009). The immunoglobulin from colostrum also will be absorbed rapidly in the intestine for approximately 8-12hours. It is therefore suggested that total LgM is a better biomarker of innate immunocompetence in dairy cows in the early postpartum period (Silva et al. 2020).

The study also found the relationship between milking time with the IgM level. Previous findings mentioned that milking time in the morning will increase 0.16-0.17% of IgM in the colostrum compared to the milking time in the evening (Asmayadi et al. 2016; Costa et al. 2021). The IgM level in the colostrum of morning milking time is 1.378±0.758mg/mL. While the milking time in the evening only exhibited 1.794±1.006mg/mL of IgM in colostrum.

Conclusion

The lactation period of Friesian Holstein dairy cows did not significantly increase the colostrum's IgM level.

However, based on the day of milking, the second day of milking had the best performance and signification for colostrum IgM levels with an average IgM value of 2.359±0.688mg/mL.

Acknowledgment

The authors thank to the supports from Institute of Research and Community Services Brawijaya University (LPMM).

Author's Contribution

TES and PS designed the study, and manuscript writing, ACW and R collected in samples and collection data, HYS data analysis and manuscript writing. All authors drafted and revised the manuscript as read and approved the final manuscript.

Conflict of Interest

The authors declare that they have no conflict of interests.

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