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# Fluctuations in Immunoglobulin A Level in Colostrum of Dairy Cows: Implication for Daily Postpartum Measurement

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## ABSTRACT

The study aimed to identify the Immunoglobulin A (IgA) level fluctuations in colostrum during different lactation days, with practical implications for daily postpartum measurement. The purposive sampling of 15 lactating dairy cows' colostrum was used in varied lactation periods (lactation 1-7) for 7 days with sampling time at 5 AM and 3 PM Indonesian Time. The IgA levels in colostrum from HF cows were measured using an ELISA kit assay following the standard protocol. The IgA levels in colostrum from cows at various lactation periods were analyzed using One-way ANOVA, followed by Duncan's Multiple Range Test (DMRT). The highest IgA level (32.128±2.475mg/mL) collected at morning milking was in D3 and at afternoon milking was in D2 (32.444±5.098mg/mL). The lowest IgA level both at the morning and afternoon milking was in D1 with 26.583±1.774mg/mL and 27.687±2.10mg/mL, respectively. On average, the highest IgA level was in D3 at 30.958±2.582mg/mL, while the lowest average IgA level was in D1 at 27.135±1.941mg/mL. It was concluded that the mean IgA levels in colostrum increase from the first day (D1) to the second day (D2), then rise further, peaking on the third day (D3), before declining by the fourth day (D4). Subsequently, the mean values tend to stabilize with minor variations from the fifth day (D5) to the seventh day (D7).

**Key words:** IgA; Fluctuation; Colostrum, Cow.

## INTRODUCTION

Colostrum is the first milk that mammals, including cows, produce immediately after giving birth (McGrath et al. 2015). It is rich in essential nutrients, antibodies, growth factors, and other bioactive compounds, making it crucial for the health and development of newborn calves (Vries et al. 2018). Colostrum is highly concentrated and contains higher levels of protein, fats, vitamins, and minerals compared to regular milk. It is particularly rich in immunoglobulins (IgA, IgG, and IgM), which provide passive immunity to the calf (Hasan et al. 2016). The presence of biologically active proteins such as lactoferrin, cytokines, growth factors, and antimicrobial agents can significantly enhance the immune system and protect against infectious diseases (Soloshenko et al. 2020). Farming management can significantly impact colostrum production and its quality (Surjowardojo et al. 2021).

Immunoglobulin A (IgA) is one of the crucial components found in cow's colostrum, playing a pivotal role in providing early protection and supporting the neonatal immune system, including calves (Santos-Argumedo et al. 2021). While IgA is very rich in colostrum compared to milk, it is not specific to colostrum and can also be found in milk throughout lactation (Quesnel and Farmer 2019). Research has demonstrated that IgA acts as the primary defense against pathogens by preventing the colonization of pathogenic bacteria on mucosal surfaces and facilitating the early recognition of pathogens by the calf's immune system without inducing excessive inflammation (Şensoy and Sahinduran 2022). Adequate intake of colostrum within the first 24 hours post-birth is vital for the establishment of passive immunity in calves, directly influencing their morbidity, mortality rates, growth, and long-term health (Godden, 2008). Studies have emphasized the significance of IgA in colostrum for safeguarding calves against gastrointestinal and respiratory

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infections, underscoring the importance of early colostrum consumption in bolstering immune defenses and overall well-being (Stelwagen et al. 2009). Insufficient IgG provision in colostrum can result in the failure of passive immunity transfer in calves, highlighting the critical role of IgA and other immunoglobulins in colostrum for calf health (Drikic et al. 2018).

This research offers valuable insights into how passive immunity develops in the early stages of livestock life. It provides a foundation for the development of farming practices focused on enhancing animal welfare and production efficiency. Thus, this research is relevant not only to the academic community but also to practitioners in the field, enriching knowledge that can be applied to improve livestock production outcomes while ensuring animal welfare.

## MATERIALS AND METHODS

### Research design and sampling

The research was conducted observationally on smallholder dairy farms in East Java Province, Indonesia. The purposive sampling of 15 lactating dairy cows' colostrum was used for 7 days with sampling time at 5 AM and 3 PM West Indonesian Time (UTC+7).

### Analysis of IgA levels in colostrum by ELISA

Colostrum from dairy cows with different lactation periods and lactation days was collected twice daily. The IgA levels in colostrum FH cows were measured using an ELISA kit assay using standard protocol. The 50µL standard was added to the standard well without adding an antibody. The 40µL sample and 10µL anti-IgA antibody were added to the sample wells, and then 50µL streptavidin HRP was added to sample wells and standard wells. The plate was covered with a plastic seal and incubated for 60min at 37°C. The sealer was removed, and 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 10min at 37°C in the dark. Stop solution 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 450nm.

### Data analysis

The IgA levels of colostrum cow in various lactation periods were analyzed by One-way ANOVA followed by DMRT (Duncan Multiple Range Test), integrated in R Program version 4.4.0 with "agicolae" package.

## RESULTS AND DISCUSSION

The graph below illustrates the results of an analysis of variance (ANOVA) conducted on the mean colostrum IgA levels (IgA average) in dairy cows over seven days (D1 to D7). Fig. 1 The statistical analysis results demonstrate the distribution of IgA levels with the median (bold line within the box), the first and third quartiles (lower and upper limits of the box), and outliner values (individual points distant from the box). Meanwhile, the blue line with red dots on the graph connects the daily mean IgA levels, indicating the trend of the IgA level changes daily.

The results indicate variations in the average IgA levels from the first day of colostrum to subsequent days. Specific days, such as D2 and D3, exhibit higher averages and wider distributions, reflecting greater variability on those days. Conversely, days like D1 and D5 show narrower distributions, indicating higher consistency in values.

The timing of colostrum collection affects the IgA levels in dairy cow colostrum in the morning and afternoon (Table 1). Lactation day significantly influences IgA levels during morning milking (Fig. 2). In contrast, it does not significantly impact afternoon milking (Fig. 3) or the daily average milking (Fig. 1). The trend shows an increase from D1 to D3, followed by a decline starting after D3. However, the increase from D1 to D3 and the subsequent decrease from D3 to D7 are not statistically significant. Changes in IgA levels can form the basis for further analysis regarding factors affecting IgA levels and the necessary actions to maintain consistency and improve average IgA levels. Previous studies by (Gomes et al. 2011) detected that immunoglobulin concentration in Holstein cow colostrum is influenced by the number of milkings post-calving and the number of lactations.

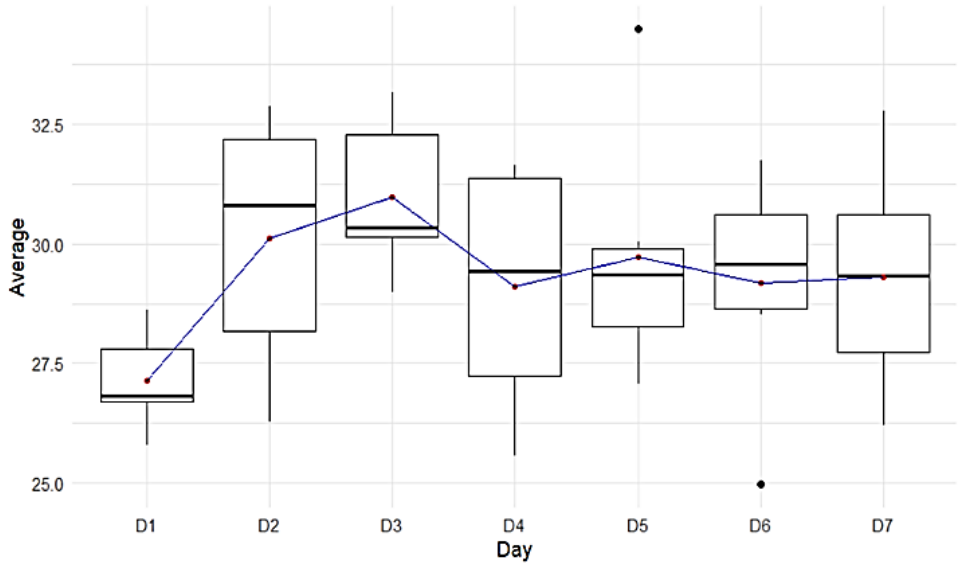


**Fig. 1:** ANOVA plot of mean IgA levels in colostrum over seven days of lactation (D1 to D7).

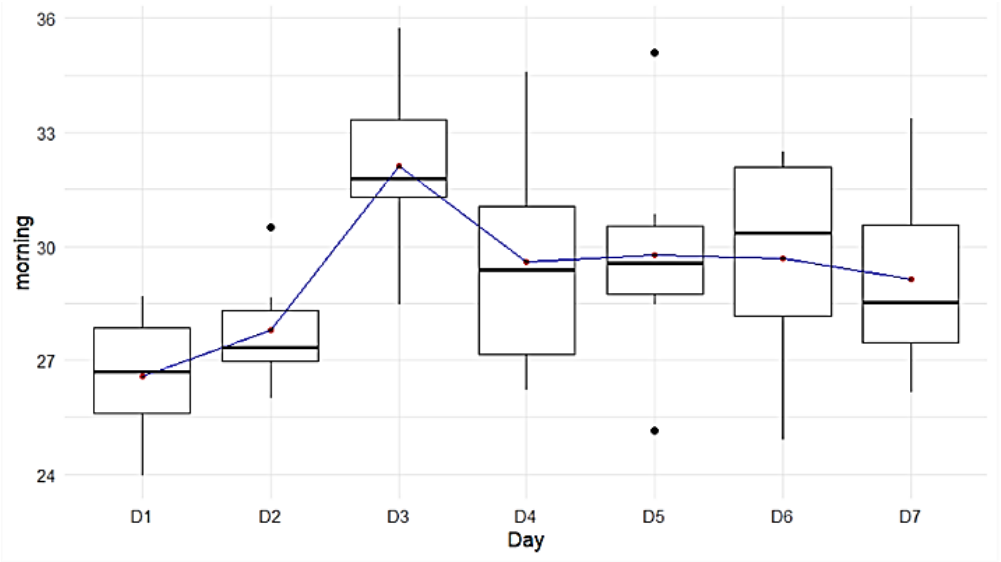


**Fig. 2:** ANOVA plot of mean IgA levels in colostrum during morning milking over seven days (D1 to D7).

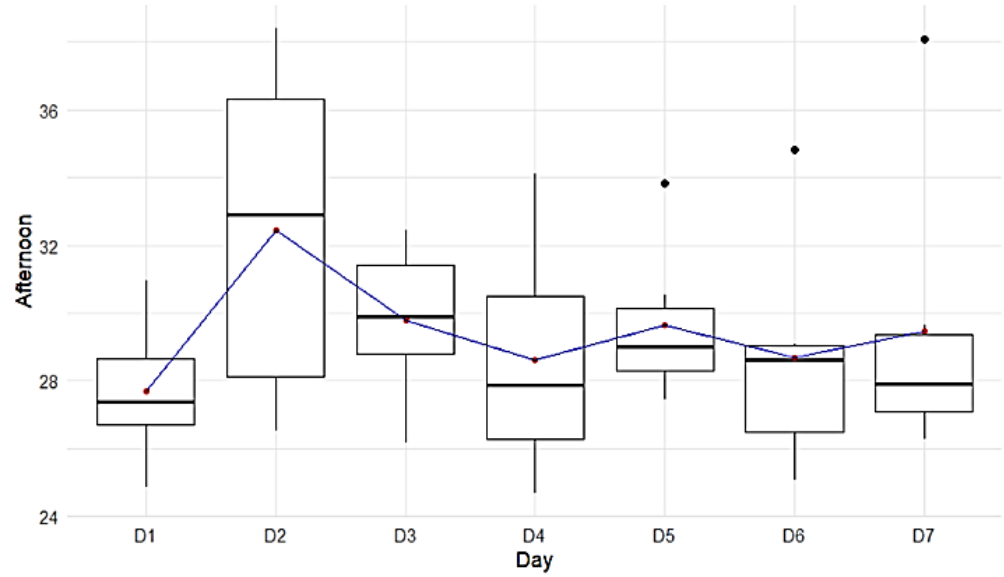


**Fig. 3:** ANOVA plot of mean IgA levels in colostrum during afternoon milking over seven days (D1 to D7).

**Table 1:** The IgA profiles of colostrum of Friesian Holstein dairy cows based on lactation day

| Lactation Day | Colostrum IgA Levels (mg/mL) | | |
|---|---|---|---|
| | Morning Sample | Afternoon Sample | Average |
| D1 | 26.583±1.774b | 27.687±2.10 | 27.135±1.941 |
| D2 | 27.778±1.595b | 32.444±5.098 | 30.111±4.348 |
| D3 | 32.128±2.475a | 29.789±2.294 | 30.958±2.582 |
| D4 | 29.592±3.159ab | 28.612±3.532 | 29.102±3.235 |
| D5 | 29.775±3.254ab | 29.642±2.305 | 29.708±2.689 |
| D6 | 29.692±3.027ab | 28.676±3.441 | 29.184±3.135 |
| D7 | 29.147±2.669ab | 29.473±4.392 | 29.310±3.469 |

Values (Mean±SD) bearing different alphabets in a column differ significantly (P<0.05).

Eihvalde et al. (2012) reported that colostrum with high immunoglobulin concentration provides passive immunity to newborn calves. Susilorini et al. (2023) stated that immunity is crucial in protecting calves from infections, such as diarrhea. Diarrhea is a common disease in livestock, especially in calves, and it can potentially lead to death. Gulliksen et al. (2008) emphasized the need for improved colostrum quality control and adjustments in colostrum feeding practices to ensure a protective immunological status in newborn calves.

## Conclusion

In essence, the mean IgA levels in colostrum increase from the first day (D1) to the second day (D2). It rose further, peaking on the third day (D3), before declining by the fourth day (D4). Subsequently, the mean values tend to stabilize with minor variations from the fifth day (D5) to the seventh day (D7).

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## Author's Contribution

All authors designed the study; Puguh Surjowardojo, Rifa'i, and Aditya Cahya Wardhana performed the practical procedures, analyzed, and interpreted the data. Primasatya Nugraha wrote the manuscript. This manuscript content was authored, reviewed, and approved by Hanum Muarifah and Zia Ul Rahman Fithron for publication.

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