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Research Article

Additional Feed of Moringa Oleifera Leaf Flour on the Development of Veterinary Embryos

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ABSTRACT

Background: Moringa leaf flour has a protein content of 26.67% in 100% dry matter so it can be a source of protein feed. The use of carotenoid-rich products such as β-carotene in poultry rations can produce low-cholesterol eggs. **Aims:** The aim of this study was to analyze the impact of additional feed of moringa oleifera leaf flour on the development of veterinary embryos. **Method:** The methodology used involves a literature review or analysis of papers collected from 1950 to 2024 through the Google search engine. Furthermore, sources are collected, identified, and evaluated. This research report uses the phrases supplemental feed for dairy calves made from moringa oleifera leaf meal. The literature collection was carried out in 2025 from February 2025 to April 2025. The articles in this collection were published in English and Indonesian in national and international journals, then analyzed with Vosviewer. **Result:** From the results of the analysis carried out, it was found that Additional feed of moringa oleifera leaf flour on the development of veterinary embryos have associations between moringa oleifera, embryo and other factors, moringa oleifera, embryo and other factors have been studied on the 2019-2024, moringa oleifera and embryo have been widely studied than other factors. **Conclusion:** From the results of the analysis carried out, it was found that Additional feed of moringa oleifera leaf flour on the development of veterinary embryos have associations between moringa oleifera, embryo and other factors, moringa oleifera, embryo and other factors have been studied on the 2019-2024, moringa oleifera and embryo have been widely studied than other factors. Need research other factor to embryo veterinary in Additional feed of moringa oleifera leaf flour.

Keywords: Additional feed, moringa oleifera leaf flour, development of veterinary embryos.

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INTRODUCTION

Indonesian people are currently concerned about the high cholesterol content of eggs, whereas consuming large amounts of cholesterol will only increase low density lipoprotein (LDL) levels if consumed by hyper-responders (1). Another review stated that plasma LDL did not change in hypo-responders by consuming 21 grains per person per week or 3 grains per day (2). Excess cholesterol or LDL in the body will only occur in hyperresponders. Excess cholesterol levels in the body cause various dangerous diseases in the form of atherosclerosis, which is narrowing or hardening of blood vessels (3). Moringa is a plant that is very easy to grow in various regions and can be propagated vegetatively (cuttings) or generatively (seeds). As a legume plant, Moringa can be used as a good source of feed for livestock (4). This is because Moringa leaves have been reported to be a food source rich in β-carotene, protein, vitamin C, calcium, potassium, and a good food source as a natural antioxidant due to the presence of various types of antioxidant compounds such as ascorbic acid, flavonoids, phenolics and carotenoids (5). Moringa leaf flour has a protein content of 26.67% in 100% dry matter so it can be a source of protein feed. The use of carotenoid-rich products such as β-carotene in poultry rations can produce low-cholesterol eggs (6).

Therefore, this study was conducted to specifically investigate the effect of *Moringa oleifera* leaf flour supplementation in poultry feed on embryo development, with a broader objective of exploring its potential as a natural feed additive that may contribute to the production of eggs with improved nutritional quality—particularly lower cholesterol content—while supporting healthy embryonic growth. Given the increasing public concern over dietary cholesterol and the accessibility of moringa as a local, nutrient-rich resource, this research aims to provide scientific insight that can inform sustainable and health-oriented poultry feeding strategies in Indonesia.

MATERIALS AND METHODS

The methodology used involves a literature review or analysis of papers collected from 1950 to 2025 through the Google search engine. Furthermore, sources are collected, identified, and evaluated. This research report uses the phrases Additional feed of moringa oleifera leaf flour on the development of veterinary embryos. The literature collection was carried out in 2025 from February 2025 to April 2025. The articles in this collection were published in English and Indonesian in national and international journals, then analyzed with Vosviewer.

The selection of literature was conducted systematically by using relevant keywords such as *"Moringa oleifera," "leaf flour," "veterinary embryo development,"* and *"egg quality"* to ensure the relevance and specificity of the sources. Inclusion criteria were applied, focusing on peer-reviewed journal articles, conference proceedings, and scientific reports that specifically addressed the nutritional effects of *Moringa oleifera* in animal feed, particularly in relation to embryo development and

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egg composition. Articles that lacked empirical data or did not focus on poultry or veterinary embryos were excluded from the analysis. The collected data were then processed and mapped using VOSviewer software to visualize the bibliometric patterns, co-occurrence of keywords, and thematic clusters, enabling a clearer understanding of research trends, dominant themes, and knowledge gaps within the studied period. This method allows the research to not only synthesize findings from previous studies but also to identify potential directions for future research based on current academic discourse.

RESULTS

Based on the association analysis conducted using VOSviewer software, it was revealed that the topic *"Additional feed of Moringa oleifera leaf flour on the development of veterinary embryos"* shows strong conceptual linkages among the keywords *Moringa oleifera*, *embryo*, and various related factors. These associations indicate that these terms frequently co-occur in relevant literature, suggesting their central role in the research discourse surrounding animal feed and embryo development (Figure 1).

Furthermore, the overlay visualization analysis shows that the majority of studies exploring the relationship between *Moringa oleifera* supplementation and veterinary embryo development were published between 2019 and 2024. This time frame highlights a growing research interest in the subject in recent years (Figure 2).

In addition, the density visualization demonstrates that the terms *Moringa oleifera* and *embryo* appear with higher frequency and intensity compared to other related terms, indicating that these two concepts have been more extensively studied. This suggests that while research has focused primarily on these two aspects, there remains room for further exploration of additional influencing factors within the same thematic area (Figure 3).

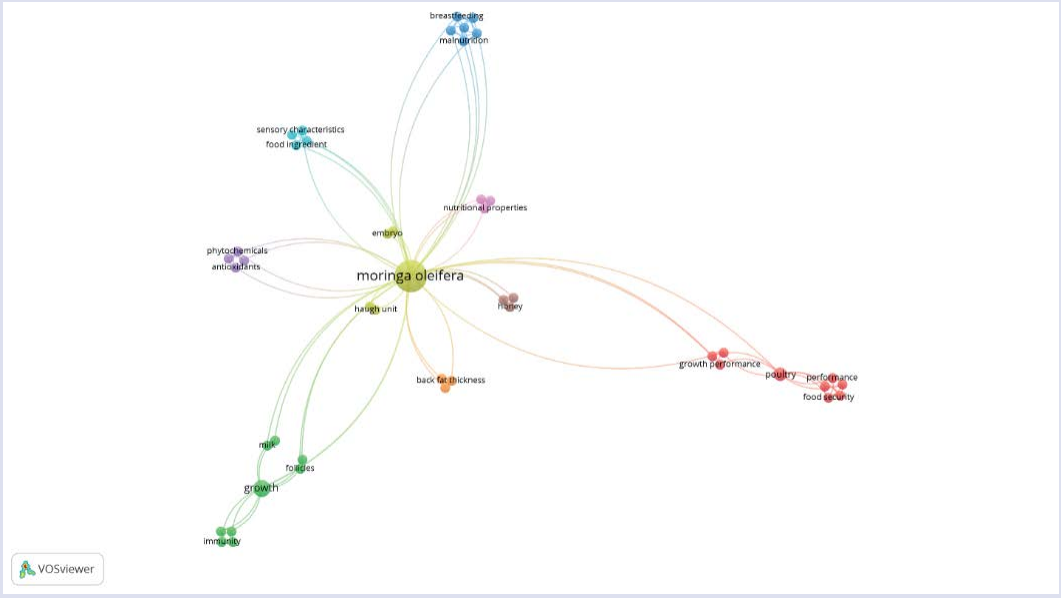

Figure 1. Association results using the words supplemental feed for dairy calves made from moringa oleifera leaf meal using vosviewer.

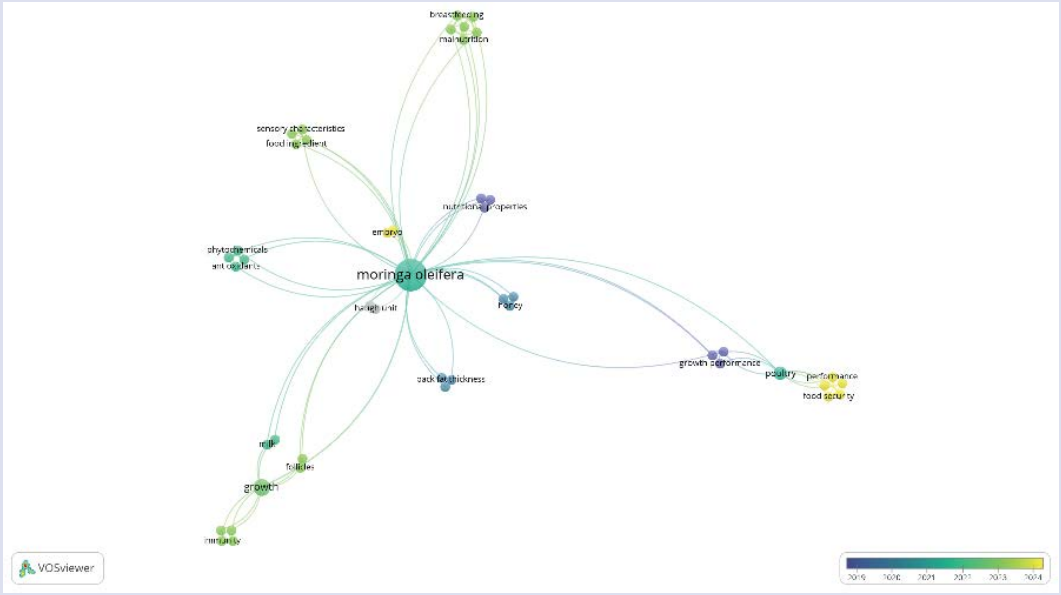

Figure 2. Overlay results using the words supplemental feed for dairy calves made from moringa oleifera leaf meal using vosviewer.

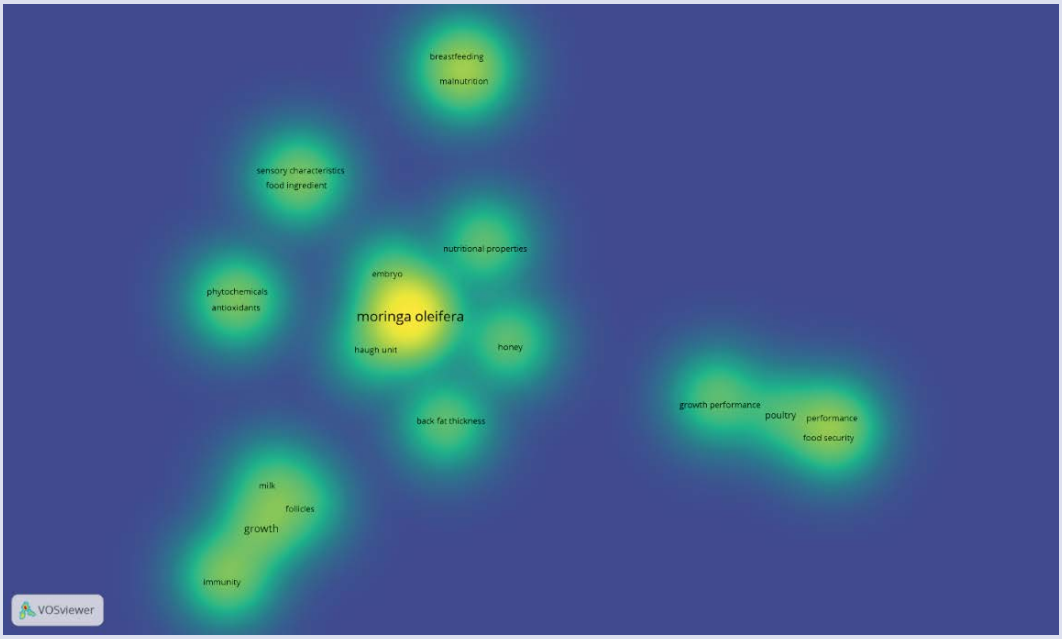

Figure 3. Density results using the words supplemental feed for dairy calves made from moringa oleifera leaf meal using vosviewer.

DISCUSSION

In this study, a study was conducted using bibliometrics, namely using voswiewer. From the results of the analysis carried out, it was found that Additional feed of moringa oleifera leaf flour on the development of veterinary embryos have associations between moringa oleifera, embryo and other factors, moringa oleifera, embryo and other factors have been studied on the 2019-2024, moringa oleifera and embryo have been widely studied than other factors. is an antinutritional compound that can form a complex with protein while in the small intestine, as a result the protein cannot be degraded into derivative products such as amino acids and peptides and is not absorbed by the cells of the small intestine, especially in poultry which are classified as monogastric animals. This is in line with the opinion who stated that the content of tannin compounds in feed can inhibit several digestive enzymes, including trypsin, amylase, and lipase enzymes, which causes a decrease in the availability of protein used to support the egg formation process (7). Furthermore, another research reported that saponins, in addition to being enzyme inhibitors, also have the potential to bind to receptors connected by transporter proteins on the membranes of small intestine cells (8). As a result of this bond, there is disruption of protein transport or absorption of amino acids from digestion.

In other hand, moringa contains 4208 µg of beta carotene in 100 grams of dry leaves and 4 times more than carrots, while yellow corn contains carotenoids ranging from 6.4-11.3 µg/g so that the carotene content in moringa is 4-6 times higher than the carotene content of corn (5). Another source said the use of 5% moringa leaf flour in the ration can provide an egg yolk color of 10.04 on the Roche scale. In addition to the effect of moringa leaf content on feed treatment, other feed ingredients that affect the egg yolk color score are corn and soybeans found in commercial feed (9). Then, the use of 51% corn as a source of xanthophyll in rations is generally not enough to meet the needs of xanthophylls to achieve good egg yolk color quality, therefore it is necessary to add moringa leaf flour to the ration (10). The results of another study stated that obtained a cholesterol content of duck eggs of 12.82-15.35 mg g-1 egg yolk (11). Moringa leaves contain a lot of natural antioxidants such as ascorbic acid, flavonoids, phenolics and carotenoids (12). Antioxidants are compounds that can donate electrons (donate hydrogen atoms) to free radicals, thereby stopping chain reactions and changing free radicals into stable forms. Antioxidants are very easily oxidized so that free radicals will oxidize antioxidants and protect other molecules in cells from damage due to oxidation by free radicals (13).

In another side, the basic chemical structure of cholesterol is steroid. It is found in plasma tissues and lipoproteins in the form of free cholesterol or a combination of long-chain fatty acids as cholesterol esters (14,15). This is what causes the cholesterol content of duck eggs to increase. Cholesterol is a natural substance found in the body that is needed for important processes in the body, both for humans and livestock. Cholesterol is also needed for the development of poultry embryos so that cholesterol must be stored in the egg. The cholesterol content of eggs is 0.548 mg 100 g-1 and in egg yolks is 1.602 mg 100 g-1. Egg yolks contain high cholesterol while egg whites do not contain cholesterol (16). Cholesterol biosynthesis in laying ducks occurs in the liver. Cholesterol biosynthesis takes place in three phases. The first phase, acetyl CoA units condense to form mevalonate. The second phase, mevalonate is converted into 5-carbon isoprene units that undergo phosphorylation and condense to bring a 30-carbon compound, namely squalene, which undergoes cyclization to form lanosterol which has steroid core rings.

Lanosterol is modified through a series of reactions to form cholesterol (17). In addition to antioxidant factors, the crude fiber content in moringa leaf flour can also reduce the cholesterol content in duck eggs. This is based on the results of research which stated that lower cholesterol levels were caused by high crude fiber levels in rations by 14% (18). Based on anothers research its stated, that the use of ratios with 3-4% crude fiber did not significantly affect blood cholesterol levels (19). And the results of this study are also supported by the another statement which stated that there was no real effect of giving 5-10% moringa leaves on cholesterol levels in eggs (20). The research report of Mulo (21) stated that moringa leaves have a high protein content of 28.44%. The high protein content in moringa leaves has an impact on increasing the protein levels of duck eggs in normal digestive and metabolic conditions. Moringa leaves (Moringa oleifera) are very rich in nutrients, one of which is protein (22). According to another

research, stated that moringa leaves have a protein content that can reach 43% (23).

Rosida (24) found that the protein content in pengging duck eggs did not differ significantly between the control group and those given *Moringa oleifera* leaf flour at various concentrations (2.5%, 5%, 7.5%, and 10%). This indicates that, under the conditions of the study, the addition of moringa leaf flour had a limited impact on enhancing the overall protein levels in the eggs. One plausible explanation for this is that the bioactive compounds present in moringa leaf flour, even at concentrations up to 10%, may not have been sufficient to trigger notable changes in protein metabolism or assimilation in the ducks.

Despite the lack of statistical significance, the protein content in eggs treated with moringa leaf flour showed a numerical range of 10.74–10.90%, reporting a broader protein content range between 9.24–15.88% (24). Supporting this, another research reported a protein content range of 9.30–11.80% with moringa leaf supplementation (25). A closer look at the data suggests a trend where increased levels of moringa leaf flour are associated with slightly higher protein content, hinting at a dose-dependent effect, albeit one that may require further optimization or longer-term treatment to manifest significantly.

From a broader perspective, the addition of moringa leaf flour to duck feed shows potential in improving the nutritional profile of eggs, particularly in terms of protein content. However, these changes might not reach statistical significance due to variability in experimental conditions, physiological responses of the ducks, or the bioavailability of active compounds in the moringa leaves. Consequently, future studies are needed to explore different dosages, durations of feeding, and possibly synergistic effects with other feed ingredients to maximize the benefits of moringa supplementation in poultry nutrition.

CONCLUSIONS

Based on bibliometric analysis using VOSviewer and a review of relevant literature, it can be concluded that *Moringa oleifera* leaf flour holds considerable potential as a feed additive to improve the quality of poultry eggs, particularly in terms of yolk color, cholesterol levels, and protein content. *Moringa oleifera* is rich in beta-carotene, antioxidants, and protein, which theoretically support egg formation and embryonic development. However, the presence of antinutritional compounds such as tannins and saponins can inhibit protein absorption and digestive enzymes, especially in monogastric animals like poultry. While some studies show improvements in egg quality, including increased protein levels and reduced cholesterol, these findings are often not statistically significant. Therefore, further research is needed to optimize the dosage and formulation of *Moringa oleifera* leaf flour in poultry feed to fully harness its nutritional benefits while minimizing the negative impact of antinutritional factors.

AUTHOR CONTRIBUTIONS

Conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, writing—original draft preparation, writing—review and editing, visualization, supervision, and funding acquisition: M.M. The author has read and agreed to the published version of the manuscript.

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INSTITUTIONAL REVIEW BOARD STATEMENT

Protocols for the animal study were approved by the Ethical Review Committee of Universitas Airlangga.

INFORMED CONSENT STATEMENT

Not applicable.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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