



Effects of a Polyherbal Iron-mineral Feed Supplement on Hematological Indices, Milk Performance and Physiological Well Being in Lactating Dairy Cows

D. Nagarjuna¹, V.G. Bhagwat², K. Varun Kumar²

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ABSTRACT

Background: Nutritional management supports productive performance and physiological resilience in dairy cows. This field study evaluated a polyherbal iron-mineral feed supplement (PIMFS) for its influence on field indicators associated with hematological status, milk yield and composition and general well being.

Methods: Sixteen multiparous lactating cows received PIMFS orally (100 mL/animal/day) for 14 consecutive days. Ocular conjunctival coloration was monitored using the FAMACHA scoring system (20); milk yield and milk quality parameters (CLR, fat, SNF) were recorded before, during and after supplementation and general well being indicators (rumen motility, feed intake, activity) were scored using predefined criteria.

Result: Progressive improvement in FAMACHA scores was observed over the supplementation period ($p < 0.05$). Mean daily milk yield increased significantly during and after supplementation compared with baseline ($p < 0.001$), accompanied by improvements in CLR, fat and SNF ($p < 0.001$). Scores related to rumen motility, feed intake and activity improved significantly during supplementation ($p < 0.001$). These findings suggest that dietary supplementation with the evaluated polyherbal iron-mineral formulation supported physiological functions associated with hematological balance, productive performance and general well being in lactating dairy cows under field conditions.

Key words: Dairy cows, Milk quantity and quality, Minerals, Polyherbal, Wellbeing.

INTRODUCTION

Dairy farming contributes substantially to rural livelihoods, food security and nutrition (Radhakrishnan *et al.*, 2018; Martens, 2023). Sustaining milk productivity in smallholders and organized systems requires nutritional strategies that support metabolic efficiency, rumen function and physiological stability. Vector borne hemoprotozoan challenges and suboptimal mineral status are frequently associated with reduced productive performance in tropical dairy systems (Salih *et al.*, 2015; Tewari *et al.*, 2014; Singh *et al.*, 2007; Singh *et al.*, 2009; Juyal *et al.*, 2005; Guan *et al.*, 2010; Narladkar, 2018; Rashid, 2018). Plant derived bioactives integrated into dietary supplements are increasingly explored for their capacity to support digestive function, modulate rumen fermentation and enhance overall performance (Alves *et al.*, 2016; Lopreiato *et al.*, 2020; Hashemzadeh-Cigari *et al.*, 2014; Benchaar *et al.*, 2008; Palmonari *et al.*, 2021; Benchaar *et al.*, 2007). Polyherbal formulations fortified with essential trace minerals may contribute to nutritional adequacy and functional support under field conditions. Hence, it was hypothesized that supplementation with a polyherbal iron-mineral feed supplement PIMFS would improve hematological parameters, milk yield, milk composition and general health status in lactating dairy cows under field conditions. Therefore, the present study aimed to evaluate the efficacy of PIMFS in lactating cows.

¹Veterinary Dispensary, Bannikuppe, Hunsure, Mysore-571 105, Karnataka, India.

²Himalaya Wellness Company, Makali, Bengaluru-562 162, Karnataka, India.

Corresponding Author: V.G. Bhagwat, Himalaya Wellness Company, Makali, Bengaluru-562 162, Karnataka, India.

Email: dr.bhagwat@himalayawellness.com

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MATERIALS AND METHODS

Polyherbal iron-mineral feed supplement. Haemotec™ (PIMFS) is a proprietary liquid formulation containing extracts of *Azadirachta indica* and *Andrographis paniculata*, *Cichorium intybus* and *Zingiber officinale*, fortified with iron and cobalt, intended for dietary supplementation in livestock (Iyare *et al.*, 2014; Kashif and Ullah 2013; Ansari *et al.*, 2004; Peña-Espinoza *et al.*, 2018; Yadav *et al.*, 2016; Mohammadi Gheisar *et al.*, 2018; Vyas *et al.*, 2018; Hapsari *et al.*, 2018; Mardalena, 2015).

Ethical considerations

The study was conducted under Institutional Animal Ethics Committee oversight at Himalaya Wellness Company, Bengaluru.

Animals and management

Sixteen client owned multiparous lactating crossbred cows (Holstein Friesian cross and Jersey cross; 3-5 years of age) maintained under standard farm conditions in Mysuru district, Karnataka, were enrolled. Animals received routine diets (concentrate and roughage) with ad libitum access to water.

Study design and supplementation

Each cow received PIMFS at 100 mL orally once daily for 14 consecutive days, mixed thoroughly with concentrate feed and water immediately prior to feeding. No concurrent iron containing supplements were allowed during the trial period.

Outcome assessments

Field indicators associated with hematological status were assessed using the FAMACHA® scoring system based on ocular conjunctival coloration (20), a widely used field-based indicator for identifying animals at risk of anemia under practical farm conditions. Due to field constraints and the non-invasive nature of the study, laboratory hematological parameters such as hemoglobin (Hb), packed cell volume (PCV) and total erythrocyte count (TEC) were not evaluated. Therefore, animals included in the study were categorized as having “anemia-associated clinical signs” based on FAMACHA scoring and general clinical examination rather than laboratory-confirmed anemia.

A total of 16 lactating animals showing moderate to severe FAMACHA scores were enrolled based on availability and farmer consent under field conditions. The study was conducted as a single-group field supplementation trial; therefore, no untreated control group was included. The objective was to evaluate changes in production and general well-being indicators before, during and after supplementation under practical management conditions.

Milk yield (L/day) was recorded daily throughout the experimental period. Milk quality parameters, including Corrected Lactometer Reading (CLR), milk fat (%) and Solids-Not-Fat (SNF, %), were assessed at predefined intervals before supplementation, during supplementation and during the post-supplementation observation period of 14 days. Milk composition analysis was performed using standard dairy field-testing procedures and calibrated lactometer-based measurements routinely employed in dairy practice.

General well-being indicators, including rumen motility, feed intake and activity level, were evaluated using a

predefined clinical grading rubric (see rubric). Animals were monitored regularly throughout the supplementation and post-supplementation periods to document observable changes in health and production performance under field conditions.

General health parameter grading system (scoring rubric)

Rumen motility: 3 = normal (2-5 contractions/2 min), 2 = hypermotility (>5/2 min) or hypomotility (<2/2 min), 1 = stasis (no motility). Feed intake: 4 = full feed, 3 = ~50% feed, 2 = ~25% feed, 1 = no feed. Activity level: 3 = active/alert, 2 = dull/depressed, 1 = sluggish/lethargic.

Statistical analysis

Data were expressed as Mean $\pm$ SD. Repeated measures one way ANOVA followed by Dunnett's multiple comparison test compared baseline with during and post supplementation phases; significance was set at $p < 0.05$.

RESULTS AND DISCUSSION

Effect on ocular mucosal coloration (FAMACHA score). A progressive and statistically significant improvement in ocular mucosal coloration was observed following supplementation with the polyherbal iron–mineral feed supplement. The mean FAMACHA score decreased from a baseline value of 3.44 ± 0.70 on Day 1 to 1.38 ± 0.48 by Day 14 ($p < 0.05$), indicating a shift from mild anemia-associated coloration toward a non anemic ocular conjunctival appearance (Table 1). The FAMACHA system used is a field validated tool for ocular mucosal coloration (Van Wyk *et al.*, 2002; Sunder *et al.*, 2025).

Effect on milk yield

Mean daily milk yield increased significantly during and after the supplementation period compared to baseline values. Prior to supplementation, the cows produced an average of 5.69 ± 1.03 L/day. This increased to 7.49 ± 0.82 L/day during the supplementation phase and further increased to 9.63 ± 1.81 L/day during the post supplementation period ($p < 0.001$) (Table 2). The observed increase corresponded to an improvement of 1.80 L/day during supplementation and 3.94 L/day after supplementation.

Effect on milk quality parameters

Milk quality parameters demonstrated significant improvements following supplementation. Corrected Lactometer Reading (CLR) increased from a baseline value of 23.97 ± 1.05 to 24.71 ± 0.77 during supplementation and

Table 1: Effect of PIMFS on anemic conditions in dairy cows.

Parameters	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 10	Day 12	Day 14
Anemic condition (FAMACHA Score)	3.44 ± 0.70	3.44 ± 0.70	3.19 ± 0.81	2.94 ± 0.66	2.94 ± 0.24	2.81 ± 0.39	2.56 ± 0.50	2.31 ± 0.46	1.88 ± 0.48	1.38 ± 0.48

Values are expressed as Mean $\pm$ SD; n=16.

* $p < 0.05$ and *** $p < 0.001$ as compared to day 1 based on Repeated Measures One-way ANOVA followed by Dunnett's multiple comparison *post-hoc* test.

Table 2: Effect of PIMFS on milk yield, CLR, milk fat (%) and solids not fat (SNF) in dairy cows.

Parameter	Before supplementation	During supplementation	After supplementation
Milk yield (L/day)	5.69±1.03	7.49±0.82***	9.63±1.81***
Improvement in milk yield (L/day)	-	1.80	3.94
CLR	23.97±1.05	24.71±0.77	25.37±1.05***
Improvement in CLR	-	0.74	1.40
Milk fat (%)	2.97±0.14	3.26±0.13***	3.44±0.14***
Improvement in fat (%)	-	0.29	0.47
SNF (%)	7.71±0.21	8.09±0.21***	8.44±0.19***
Improvement in SNF (%)	-	0.38	0.73

Values are expressed as Mean ± SD; n=16.

***p<0.001 as compared to baseline based on Repeated Measures One-way ANOVA followed by Dunnett's multiple comparison *post-hoc* test.

reached 25.37±1.05 in the post supplementation phase (p<0.001) (Table 2). Milk fat percentage increased significantly from 2.97±0.14 at baseline to 3.26±0.13 during supplementation and further to 3.44±0.14 after supplementation (p<0.001) (Table 2). Similarly, solids not fat (SNF) content increased from 7.71±0.21 at baseline to 8.09±0.21 during supplementation and 8.44±0.19 after supplementation (p<0.001) (Table 2). Improved milk quality parameters were recorded following supplementation (Table 2).

Effect on general well being indicators

Scores related to general well being parameters, including rumen motility, feed intake and activity level, showed consistent and statistically significant improvements during the supplementation period (p<0.001) (Table 3). Rumen motility improved from reduced or irregular contractions at baseline to near normal physiological patterns by Day 10. Feed intake scores progressed from reduced intake at baseline to near complete feed consumption by Day 10. Activity levels similarly transitioned from lethargic or dull behavior to alert and active behavior.

Hemoprotozoan challenges are a significant constraint to dairy productivity in tropical production systems and are frequently associated with reduced feed intake, impaired nutrient utilization and alterations in physiological status that collectively limit productive performance (Salih *et al.*, 2015; Tewari *et al.*, 2014; Singh *et al.*, 2007; Singh *et al.*, 2009; Juyal *et al.*, 2005; Guan *et al.*, 2010; Narladkar, 2018; Rashid, 2018; Sathishkumar *et al.*, 2025). Although therapeutic interventions remain the primary approach for managing clinical disease, nutritional supplementation may play a supportive role in maintaining animal performance and aiding physiological recovery during and following disease challenges (Alves *et al.*, 2016; Lopreiato *et al.*, 2020; Hashemzadeh-Cigari *et al.*, 2014; Benchaar *et al.*, 2007; Benchaar *et al.*, 2008; Palmonari *et al.*, 2021; Maurya *et al.*, 2016).

In the present field study, supplementation with the polyherbal iron-mineral feed supplement was associated with an improvement in FAMACHA scores, a practical field-

based indicator of ocular mucosal coloration (Van Wyk *et al.*, 2002; Sunder *et al.*, 2025). While improved mucosal color may be suggestive of a better physiological status, the absence of laboratory hematological measurements precludes direct conclusions regarding haemoglobin concentration, erythrocyte status, or anemia correction. Therefore, the observed FAMACHA response should be interpreted as an improvement in a field indicator associated with animal condition rather than definitive evidence of enhanced hematological parameters. Potential contributors to this response include the trace mineral content of the supplement and the presence of bioactive phytochemicals. *Azadirachta indica* leaves contain iron and other micronutrients that have been associated with support of normal hematological profiles in livestock and experimental models (Iyare and Obaji, 2014; Kashif and Ullah, 2013; Ansari *et al.*, 2004). Likewise, *Cichorium intybus* has demonstrated antiparasitic and gastrointestinal modulatory properties that may contribute indirectly to nutrient availability and overall physiological resilience (Peña-Espinoza *et al.*, 2018).

The sustained increase in milk yield observed during and after supplementation is consistent with previous reports indicating that phytogenic feed additives can enhance feed acceptability, rumen microbial activity, digestive efficiency and nutrient utilization, ultimately supporting lactational performance (Bhatt *et al.*, 2009; Canada *et al.*, 2018; Mendoza, 2020). Phytobiotics derived from *Zingiber officinale* have been reported to stimulate appetite, improve palatability and favorably influence rumen fermentation characteristics (Yadav *et al.*, 2016; Mohammadi Gheisar *et al.*, 2018; Vyas *et al.*, 2018). These reported effects are consistent with the improvements in rumen motility and feed-intake scores observed in the present study and may partly explain the associated increase in milk production.

The observed improvements in milk fat and solids-not-fat (SNF) percentages are also compatible with enhanced rumen fermentation and volatile fatty acid production. Increased acetate availability is closely linked to milk fat synthesis, whereas propionate contributes to

Table 3: Effect of PIMFS on health parameters in dairy cows.

Parameters	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Rumen motility score	1.44±0.50	2.00±0.00***	2.19±0.39***	2.19±0.39***	2.56±0.50***	2.63±0.48***	2.56±0.50***	2.63±0.48***	2.63±0.48***	2.69±0.46***
Feed intake score	1.69±0.46	2.00±0.00	2.25±0.56*	2.44±0.61***	2.88±0.70***	3.06±0.43***	3.13±0.60***	3.38±0.60***	3.50±0.61***	3.56±0.61***
Activity level score	1.31±0.46	1.63±0.48	2.19±0.63***	2.31±0.58***	2.50±0.50***	2.63±0.48***	2.63±0.48***	2.81±0.39***	2.81±0.39***	3.00±0.00***

Values are expressed as Mean±SD; n=16.

*p<0.05 and ***p<0.001 as compared to day 1 based on repeated measures One-way ANOVA followed by Dunnett's multiple comparison post-hoc test.

gluconeogenesis and energy supply for lactose production and milk secretion (Pinotti *et al.*, 2003; Goselink *et al.*, 2013; Grummer, 2012; Hapsari *et al.*, 2018). Although the present formulation does not provide choline, studies evaluating targeted nutritional interventions that support metabolic efficiency and liver function have similarly reported positive effects on milk production and composition (Pinotti *et al.*, 2010; Shahsavari *et al.*, 2016). These findings collectively support the concept that nutritional supplementation can contribute to improved productive performance when physiological demands are elevated.

Importantly, the evaluated formulation was fed exclusively as a feed supplement mixed with daily feed or drinking water and was not intended or evaluated as a therapeutic agent. Accordingly, the outcomes are interpreted as improvements in production-related and physiological indicators associated with nutritional support, digestive function and metabolic efficiency rather than treatment of disease.

The present investigation was conducted under field conditions with a relatively small number of animals and without a concurrent untreated control group. Consequently, the observed improvements cannot be attributed exclusively to supplementation, as natural recovery, management practices and environmental factors may also have influenced the outcomes. In addition, laboratory hematological measurements were not performed; therefore, changes in FAMACHA scores should be interpreted only as improvements in a field-based indicator of ocular mucosal coloration rather than direct evidence of enhanced haemoglobin status. Future controlled studies involving larger animal populations and comprehensive hematological assessments are warranted to further substantiate these findings.

CONCLUSION

Based on FAMACHA scoring, supplementation of PIMFS at 100 mL per animal once daily for 14 consecutive days supported improvement in haemoglobin status of dairy cows affected by haemoprotozoal stress. PIMFS supplementation was also associated with enhanced milk production and better overall performance. Additionally, PIMFS contributed to improved general health by positively influencing feed intake and rumen motility, indicating its role as a nutritional support for maintaining metabolic and productive efficiency in dairy cows.

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Ethical approval

CCSEA approved protocol No- AHP/LA/14/23.

Disclaimers

The views and conclusions expressed in this article are solely those of the authors and do not necessarily represent the views of their affiliated institutions. The authors are responsible for the accuracy and completeness of the information provided, but do not accept any liability for any direct or indirect losses resulting from the use of this content.

Informed consent

The study was conducted under Institutional Animal Ethics Committee oversight at Himalaya Wellness Company, Bengaluru.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article. No funding or sponsorship influenced the design of the study, data collection, analysis, decision to publish, or preparation of the manuscript.

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