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Deep Dive of Vitamin D among Respiratory Diseased and Healthy Calves

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Abstract

The requirement for vitamin D intake of dairy cattle has been better understood within the past few years and is well accepted by dairy producers and veterinary surgeons. In our country, as to the present author knowledge. In our country, as to the present author knowledge whether current recommendations and practices for supplemental vitamin D are meeting the needs of dairy cattle, however, is not well known. Circulatory vitamin D status of calves has been truly denoted via 25-hydroxyvitamin D [25(OH)D] metabolite levels in serum/plasma, with a concentration of 30 ng/mL proposed as a lower threshold for sufficiency. The present author was unaware of finding documented reports regarding vitamin d and its alterations among calves with respiratory distress. In the present study 16 calves (Group 1) were presenting clinical signs of respiratory problems and other 12 (Group 2) were selected as healthy control group. All necessary blood samples were taken were analyzed by Savant Fluorescent Immunoassay Device by use of Savant 25(OH)D test kits. Vitamin D (ng/mL) ($\bar{X} \pm$ SE) among healthy calves and calves with pneumonia were detected as 63.21 ± 5.63 vs. 23.80 ± 2.75 with a statistical significance ($p \leq 0{,}001$). In summary it should not be unwise to draw conclusion that pulmonary defence against respiratory infections should involve Vitamin D supplementation at appropriate dosages among calves.

Keywords: Calves, disease, health, vitamin D.

INTRODUCTION

Vitamin D in feed could originite from plant for fungal sources (vitamin D2--ergocalciferol) or animal-origin (vitamin D3--cholecalciferol) (Ferrari et al., 2017). As a well-known data cows might synthesize self-cholecalciferol via integumentary system [i.e., skin contact of UVB of 7-dehydrocholesterol (Herrmann et al., 2017). Following long term UVB exposure, previtamin D3 is issued to photodegradation for transformation into inactive material. Through gastrointestinal processing involving synthesis within the cutaneous tissue, vitamin D2 and D3 are conveyed to the liver, for hydroxylation initally for forming 25-hydroxy-vitamin D (25-OHD)/calcidiol. Furthermore, second hydroxylation (by 1α-hydroxylase) took place within the proximal tubules of kidneys for transforming into calcitriol/1,25-dihydroxy-vitamin D (1,25-(OH)2D), active form of vitamin D (Herrmann et al., 2017).

Immunological and inflammatory cells might transform 25OHD into calcitriol, with local efficacy (Colotta et al., 2017). It is unclear whether calcitriol could participate a significant role in the activity, mitosis, and divergence of selected immune cells (Nelson et al., 2012). Calcitriol elevates phagocytosis and modulates H_2O_2 secretion, which in turns participated within the microbicidal/ tumoricidal interactions for macrophages (Reinhardt and Hustmyer, 1987). On the other hand, calcitriol diminished the production of type 1 proinflammatory cytokines and elevated the existence of type 2 anti-inflammatory cytokines (Colotta et al., 2017).
In the present study the hypothesis involved that Vitamin D3 levels could present diminished expression to those of calves with respiratory disease, which prompted the present author to perform field investigation. Table 1 showed recommended Vitamin D3 supplementation for field conditions. Through detailed literature search, the present author was unaware of finding documented reports on this subject, aroused her interest to search this relationship, comperatively analyzing.

MATERIALS AND METHODS

Demographic Field Data

This field prospective study was performed at a commercially valued operational cattle unit with 75 calves. Out of those calves 16 (Group 1) were presenting clinical signs of respiratory problems and other 12 (Group 2) were selected as healthy denoting control group. Presenting author of this research is an agriculture engineer and from department of zootechnics, used a noninvasive and thereof practical scoring, namely calf respiratory scoring chart (Poulsen and McGuirk, 2009) were adopted based on interpretation of diseased calves at 4 different categories [nasal discharge, coughing, body temperature and ear/eye assessment]. Scores withdrawn from the latter signs were summed up to predict a total respiratory score. A total respiratory score of >5 denoted that the calf was diseased whereas, score under 5 were detected as healthy calves which were enrolled at control group, similar to a novel study (Alic Ural and Ural, 2023). All necessary blood samples were taken throughout the trial were performed by an experienced veterinary surgeon. All diseased calves with respiratory problems were participated with written owner consent. This field trial was approved by the local ethic committee of Aydin Adnan Menderes University-

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HADYEK report no: 64583101/2021/146 (27.10.2021). Diseased calves were 12 females, 4 male), at the age of 23 to 62 days old.

Sampling and Field Research

In a total of 16 diseased calves participated, 0.7 ml blood was withdrawn through *Vena jugularis* into anticoagulated (Medkimsan green capped lithium heperinized) tubes. Withdrawn blood samples were immediately back brought to Faculty. All samples were analyzed by Savant Fluorescent Immunoassay Device (Beijing Biotechnology Co. Ltd., China) by use of Savant 25(OH)D test kits (Beijing Biotechnology Co. Ltd., China). Each box of commercially available test cartridges involved 50 test kits.

Scoring system for supportive diagnosis of respiratory problems

The present author of this research is occupied as an agriculture engineer origin of academician (senior lecturer) and originated from department of zootechnics, a rapid, practicable (with the easiest methodology) and if possible non-invasive scoring was necessary. Well known calf respiratory scoring patterns were used (Poulsen and McGurik, 2009). Through this non-invasive assessment of diseased calves at four categorizations [i.e., nasal discharge, cough, rectal temperature, and ear/eye], deemed available numerical data are summed up to combine with a total respiratory score. Whether a total respiratory score is >5 (denoting the cutoff point for this research) the calf was detected as diseased simply. Descriptive statistical analytes of obtained data were shown as boxplot and table. Mann-Whitney-U test was deemed available for intragroup comparison. Analysis involved usage of Graphpad Prism (9.2.0, USA) Program, and p values smaller than 0,05 were set as statistically significant.

Table 1. Recommended supplemental and suggested vitamin D3 among calves for quickly achieving sufficiency (Corwin et al., 2016).

Period	Amount
Raising calves on milk	6,000 to 10,000 IU/kg of DM
At birth	50,000 to 100,000 IU bolus

Statistical analyses

Descriptive statistics of the obtained data were performed, and the data were presented in tabular form. Mann-Whitney-U test was used for comparisons between groups. Analyses Using the Graphpad prism (9.2.0, USA) program, cases with a p value less than 0.05 were considered statistically significant.

RESULTS

Commercially available Savant 25(OH)D test kits (Beijing Biotechnology Co. Ltd., China) were purchased (Turkish side distributor RDA Group, Istanbul) were successfully applied to all calves through similar methodology (Alic Ural and Erdogan, 2019) without any error.

Scoring system along with classification attended to the groups

In a total of 2 groups were enrolled; Out of those calves 16 (Group 1) were presenting clinical signs of respiratory problems and other 12 (Group 2) were subjected as <healthy calves. Calves with a score >5 were all denoted as severe pneumonia. Calf respiratory scoring system well differentiated previously (Poulsen and McGuirk, 2009) were adopted herein for interpretation of clinical presentation. Scores were deemed presented from four different category were calculated with a total respiratory score. Total respiratory score is >5 denoted that the calf was diseased. Figure 1 and table 2 showed available statistical interpretation. Regarding circulating Vitamin D3 (ng/mL) values there was significant alterations among diseased calves (p<0,001).

Table 2. Mean ± standard error of circulating Vitamin D_3 levels among healthy and diseased calves enrolled herein at this study.

	Healthy ($\bar{X}$ ± SE)	Calves with pneumonia ($\bar{X}$ ± SE)	P value
Vitamin D (ng/mL)	63.21 ± 5.63	23.80 ± 2.75	0,001

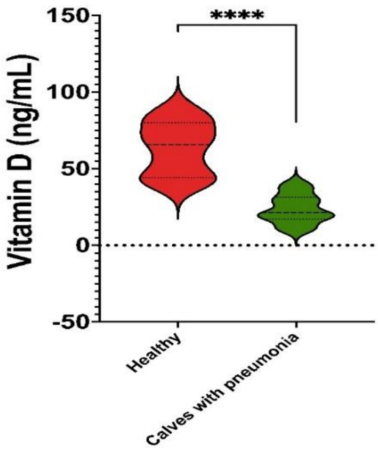

Figure 1. Colored graphic representation of Vitamin D3 levels among healthy and diseased calves enrolled herein at this study.

DISCUSSION AND CONCLUSION

Vitamin D levels has been the subject of some selected national studies (Çamkerten et al., 2019, Erdogan et al., 2020). The present author of this manuscript stated that following completion of study, the hypothesis was proved, in which calves with pneumonia presented deep dive of Vitamin D3 in comparison to healthy ones. This findig would be briefly discussed at bottom lines. As a preliminary finding, veterinary surgeons should be aware of Vitamin D supplements, if necessary, on field conditions, following vitamin D3 analysis.

In a prior research forty-eight Holstein–Friesian calves were classified in 4 groups in an attempt to investigate contrasting vitamin D levels for a 7-month period. In that study circulating 25-hydroxyvitamin D (25OHD) levels were analysed by bovine ELISA test kits ranged at birth as 7.64 ± 3.21 ng/ml presenting vitamin D deficiency. Interestingly none intervention [Vit D3 injection at birth vs. milk replacer] presented alterations among pre-weaning circulating concentration of 25OHD. Furthermore, none of the calves exhibited suggested concentration of vitamin D immune sufficiency [30 ng/ml of 25OHD] until 90 days with maximal levels of 60.86 ± 7.32 ng/ml at 5 months of age (Flores-Villalva et al., 2021). In a prior research article on human being the probable efficacy of vitamin D on the disease state of pulmonary infection were investigated. Hypothesis included the influence of vitamin D on cellular/humoral immunity, whether if diminishing the inflammatory process. In a total of 89 patients with moderate (n=50) to severe (n=39) pneumonia; severe infectious diseases caused vitamin D deficiency occurring in 88% of cases (p=0.001). On the other hand, mean 25- (OH) D level in patients with lung infection was 18.63 ± 5.73, in contrast to 27.47 ± 3.65ng / ml levels detected in humans without bronchopulmonary pathology) (p<0.001). In that study a relationship was detected within the concentrations of vitamin D and the etiology of the disease (r=-0.54, p=0.0002). Hence bacterial lung infection presented elevated vitamin D deficiency, in contrast to pneumonia of viral etiology (Luchnikova and Prikhodko, 2020). In the present study in comparison to above mentioned studies; as this was not the purpose, etiological investigation was not performed which allowed the present author to conclude respiratory problems were in bacterial or viral origin. However, without etiological approach, calves with pneumonia exhibited significantly diminished Vitamin D3 (ng/mL) levels ($\bar{X} \pm SE$) in contrast to healthy ones enrolled (23.80 ± 2.75 vs. 63.21 ± 5.63, respectively, (p<0,00).

1n a well-designed review vitamin D has been given with its physiological value out of bone health and well-known calcium homeostasis. Based on its proof of evidence through beneficiary role among prevention and/or therapeutical role for several diseases, relationship among vitamin D and immune function were denoted in association with respiratory health (Hughes and Norton, 2009). It has been reported that a probability existed that excessive vitamin D consumption could trigger Th2 responses in adult asthmatic patients (Hughes and Norton, 2009) whereas vitamin D has the potential to a) elevate pulmonary defence against respiratory infections and b) diminish triggered asthma exacerbations (Nicholson et al., 1993).

Vitamin D probably, exhibit suppressive efficiency for pulmonary inflammation and there of modulatory defensive mechanisms for battling respiratory pathological agents at the present study. This relatively interesting data regarding vitamin D status of calves showed that calves with respiratory disease might exhibit diminished levels, therefore increase disease susceptibility.

Conflict of Interest

The authors declared that there is no conflict of interest.

Authorship contributions

Concept: D.A.U., Design: D.A.U., Control/Supervision: D.A.U., Data Collection and / or Processing: D.A.U., Analysis and / or Interpretation: D.A.U.

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Ethical Approval

This field trial was approved by the local ethic committee of Aydin Adnan Menderes University-HADYEK report no: 64583101/2021/146 (27.10.2021).

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