International Journal of Veterinary Science and Agriculture Research
Volume 8 Issue 1, January-February 2026
ISSN: 2582-4112, Available at www.ijvsar.com

Effect of nutrition on selected blood parameters in dog

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Abstract: *Adequate mineral nutrition is a key factor in ensuring optimal growth, development, and long-term health in dogs. Calcium (Ca) and phosphorus (P) are among the principal macroelements involved in the formation and remodeling of bone tissue, the regulation of neuromuscular activity, and numerous enzymatic processes. The aim of this study was to evaluate the effect of different feeding regimes on serum Ca and P concentrations in growing dogs. The experiment included twenty healthy dogs aged 4–12 months, divided into two groups: the first group was fed a commercial super-premium, nutritionally balanced diet, while the second group received a homemade diet without nutritional oversight. Blood samples were analyzed using a Fuji Dri-Chem 4000i biochemical analyzer, and the results were statistically evaluated using an unpaired t-test in GraphPad Prism 5. The findings revealed significantly higher serum Ca ($p<0.0001$) and P ($p<0.0001$) concentrations in dogs fed the homemade diet. Such deviations may predispose puppies, whose hormonal regulation of calcium is not yet fully developed, to metabolic and orthopedic disorders. This study underscores the necessity of ensuring an optimal Ca:P content and ratio in canine diets, particularly in young dogs undergoing periods of rapid growth.*

Keywords: *dog, nutrition, calcium, phosphorus, mineral balance, growth, blood parameters*

I. INTRODUCTION

Mineral nutrition, particularly the content and ratio of calcium (Ca) to phosphorus (P) represents a fundamental pillar of proper growth and healthy development in dogs. These two macroelements constitute the primary structural components of bones and teeth, forming the inorganic portion of the bone matrix in the form

of hydroxyapatite. Beyond their structural role, Ca and P are essential for muscle contraction, nerve impulse transmission, blood coagulation, and the regulation of numerous metabolic reactions [1]. In adult dogs, blood Ca concentrations are maintained within a narrow physiological range through tightly coordinated hormonal mechanisms: parathyroid hormone (PTH) promotes Ca mobilization from bone, calcitonin facilitates its deposition, and vitamin D_3 regulates intestinal absorption [2]. Phosphorus, which participates in ATP synthesis and the formation of membrane phospholipids, is equally stringently regulated, and its homeostasis is closely interconnected with Ca metabolism.

The situation differs substantially in growing dogs, particularly those under one year of age, in whom hormonal regulation of Ca is not yet fully mature [3]. Consequently, excessive or insufficient mineral intake is rapidly reflected in serum concentrations and subsequently in the dynamics of bone growth. Calcium excess may, in predisposed breeds especially large and giant breeds induce disturbances in endochondral ossification, slow bone remodeling, and contribute to orthopedic disorders such as osteochondrosis, panosteitis, or limb deformities [4]. Conversely, deficiencies in Ca or P are associated with rickets, impaired growth, and reduced bone strength [5].

For these reasons, maintaining an optimal Ca:P ratio is crucial. According to the recommendations of the NRC [6] and FEDIAF [7], ratio of 1.2–1.4:1 is advised for growing dogs [6-7]. This range supports appropriate bone mineralization while minimizing the risk of metabolic disease. Research indicates that homemade diets lacking nutritional oversight often present an unsuitable Ca:P ratio, particularly when they contain a high proportion of bones or lack appropriate mineral supplementation [8].

In recent years, an increasing number of dog owners have opted for home-prepared diets, frequently without consulting a veterinary professional specializing in canine and feline nutrition. This trend elevates the risk of mineral imbalances especially inappropriate Ca and P proportions which may have long-term adverse health consequences [9].

The aim of the present study was to compare serum Ca and P concentrations in dogs fed a commercial nutritionally balanced diet with those in dogs receiving a homemade diet, and to emphasize the importance of balanced mineral intake in growing dogs.

II. Material and Methods

Sample collection and preparation

The experimental study included 20 clinically healthy dogs of various breeds, aged 4 to 12 months, selected randomly from the available population. The dogs were divided into two groups of 10 individuals each:

Group 1 (Commercial diet):

This group received a super-premium extruded diet with a declared nutrient composition compliant with the current recommendations of the National Research Council (NRC, 2006) and the European Pet Food Industry Federation (FEDIAF, 2016). The diet was balanced with respect to both macro- and micronutrients, with particular emphasis on an optimized calcium-to-phosphorus ratio.

Group 2 (Homemade diet):

Dogs in this group were fed meals prepared in household conditions without prior nutritional analysis and without ensuring an appropriate Ca:P ratio. This group served as a model of common feeding practices associated with nutritionally unbalanced home-prepared diets frequently used by pet owners.

The feeding period lasted 8 weeks, during which the health status and development of all dogs were monitored. After an 8-hour fast, blood samples were collected from the vena cephalica for biochemical analysis. Serum samples were analyzed using a Fuji Dri-Chem 4000i automated biochemical analyzer, and Ca and P concentrations were quantified according to standardized diagnostic protocols using commercially available reagent kits.

Data analysis

Statistical analysis was performed using GraphPad Prism 5. Comparisons of mean values between groups were conducted using an unpaired t-test, with the level of statistical significance set at $p < 0.05$.

III. Results and Discussion

Table 1 presents the mean serum calcium and phosphorus concentrations in both groups of dogs after the 8-week feeding period.

Table 1. Serum Calcium and Phosphorus Concentrations

Parameter	Commercial diet ($\bar{x} \pm SD$)	Homemade diet ($\bar{x} \pm SD$)	p-value
Ca (mmol/l)	2.565 ± 0.216	3.075 ± 0.157	<0.0001
P (mmol/l)	1.202 ± 0.262	1.803 ± 0.184	<0.0001

Serum Ca and P levels were significantly higher in dogs fed the homemade diet compared with those receiving the commercial diet. This finding is consistent with previous studies [5, 8], which highlight the increased risk of mineral imbalances associated with uncontrolled home feeding practices, particularly during periods of rapid growth. Elevated Ca and P concentrations may be linked to excessive inclusion of bones or the use of nutritional supplements without professional oversight, which can adversely influence mineral metabolism and bone mineralization [1].

In growing puppies especially large and giant breeds adherence to an optimal Ca:P ratio between 1.2–1.4:1 is critical [3, 9], as deviations may precipitate osteochondrosis, improper mineralization of the epiphyseal plates, and other orthopedic abnormalities [2]. In the case of homemade diets, it is likely that recommended mineral levels are exceeded, which can lead to pathological conditions characterized by impaired bone mineralization and excessive soft tissue calcification.

In contrast, commercial diets owing to precise formulation and rigorous nutritional control—provide stable and safe mineral concentrations, thereby supporting normal skeletal growth and development [9]. The results of this study underscore the necessity of educating dog owners about the risks associated with nutritionally unregulated homemade feeding and the importance of maintaining balanced mineral ratios, particularly during critical growth stages. Regular monitoring of mineral parameters in dogs fed home-prepared diets is also recommended to prevent long-term complications.

IV. Conclusion

This study clearly demonstrated that feeding growing dogs a commercially balanced diet formulated in accordance with NRC and FEDIAF guidelines results in optimal serum Ca and P concentrations. In contrast, homemade diets lacking appropriate nutritional oversight lead to significant elevations in these minerals, thereby increasing the risk of metabolic and orthopedic disorders during skeletal development. It is therefore essential to ensure adequate nutritional management and regular monitoring of skeletal metabolic parameters in young dogs to prevent health complications associated with improper mineral balance.

V. Acknowledgements

This research was funded by grant KEGA No. 011UVLF-4/2024: *Improving the quality of practical teaching with the support of animal breeding and higher education for students from the subject of animal husbandry and project VEGA 1-0162-23.*

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