The Effect and the Evaluation of Major Minerals and Vitamins During the Development Period of Juvenile Dogs

Qian Qiao*

Department of Agricultural and Environmental, University of California Davis, 95616, United States

*Corresponding author: qqqqiao@ucdavis.edu

Abstract. As bone development is one of the fundamental health problems in juvenile dogs, feeding supplements help with bone growth and provide steady growth of joints during the young age of dogs. As there are multiple products from pet medicine companies that target the skeletal development of juvenile dogs through different ingredients, it is difficult for customers to tell which product brings more effect. This passage mainly analyzed the influence of five important nutrients, vitamin D, vitamin C, phosphorous, calcium, and magnesium, on the early stage of bone development. Moreover, this article utilized the research of those five fundamental nutrients to determine which product of the bone health supplement among three worldwide well-known companies, Dasiquin, Vetriscience, and Virbac, brings more benefit. After the comparison of the ingredient table of the products, the result remains unclear. All dog owners need to have a clear idea of what is provided to their dogs, especially for health. The research of different products of bone supplements not only saves time for dog owners questioning the product but also acknowledges what nutrients are essential for the health of the dogs. Even though the most effective product remains unclear, deepening the components of the ingredients might be helpful.

Keywords: Skeletal growth, juvenile dogs, phosphorous, bone development.

1. Introduction

As the "pet culture" gradually became viral worldwide, people started to treat pets as family members. More and more pet owners have begun to pay attention to the health issues of pets. Of all the pets, dogs have become one of the most popular mainstream people prefer as they not only bring owners happiness but also health. To maintain a healthy pattern of body development, dog owners need to pay attention to bone development during the early stages of dogs, especially for those owners who choose to raise breeds that experience a higher frequency of suffering from an abnormality of bone development.

Providing supplements at the early developing stage of a dog also helps prevent bone and joint problems later in life. The results from the scientific articles showed that feeding adequate amounts of minerals like calcium, phosphorus, and magnesium in each dog species is vital for early-stage skeletal development. A sufficient amount of calcium, phosphorus, and vitamin D are important in the process of enchondral ossification. Since growth hormone and insulin-like growth factors ensure the efficiency of enchondral ossification, a diet lacking calcium, phosphorus, and vitamin D would decrease insulin-like growth factor I release in the liver, affecting enchondral ossification and overall growth [1]. Another noteworthy thing is the excess of calcium in the diet may have a chance of causing orthopedic disease. Thus, maintaining calcium at a healthy range is an important topic for dog owners, eviting bone diseases in dogs at the early stage of growth [2]. Magnesium also plays an important part in the early stage of growth in dogs. The ones who lack magnesium in the diet in the early stage of growth would have a hard time growing joint cartilage, which leads to limping [3]. Maintaining a normal level of Growth Hormone (GH), which means paying attention to Vitamin D, also affects the growth of bones during the early stage of bone development. [4]

Moreover, abnormal development of the early stage of bone growth in dogs could lead to limping, panosteitis, hypertrophic osteodystrophy, and different types of dysplasia, according to the article "Bone Disease of Growing Dogs." The research nowadays related to joint and bone supplements for dogs demonstrates the effectiveness of providing diet supplements to dogs that would help those who

suffer from Osteoarthritis [5] and osteoporosis [6]. Research articles also highlight the necessity of supplementing with calcium and phosphorous in the diet as they help avoid bone abnormalities during the early stage of growth [7].

The main purpose of this paper is to let dog owners have a better idea of which type of nutrient is more critical and needs to be focused on for the early stage of life of dogs. Evaluating the overall nutrients in the nutrient table of the supplement packets could provide a better view for the dog owners of which product would be most helpful to ensure healthy early-stage skeletal growth of dogs for all small, medium, and giant-sized dogs. This article includes three brands of the most popular bone supplements worldwide, Dasuquin, VetriScience, and Virbac, for evaluation.

2. Major Nutrients

2.1. Vitamins

Vitamins, one of the most important nutrients for all living creatures, can be an important player in the early stage of growth in bones. Not only in dogs, the growth of bones in humans is also related to vitamins. Among all types of vitamins, Vitamin D and Vitamin C are most mentioned in the early stages of growth.

Vitamin D, an essential nutrient for humans and some animals is a critical regulator of calcium metabolism. Vitamin D influences the growth of bones by maintaining calcium and phosphorous homeostasis [8]. One of the basic uses of Vitamin D is to help regulate calcium and phosphorous in people's bodies. Moreover, Vitamin D is looked at as a supplement for enhancing the maintenance of bone structure. One of the most well-known types of Vitamin D is called Vitamin D2, ergocalciferol, which comes from plants. Vitamin D3 and cholecalciferol, which come from animals. Both vitamin D2 and D3 are water-soluble vitamins that enhance the absorption of calcium and phosphorus to maintain bone strength. During the early stage of skeletal growth in dogs, dogs need a diet that contains Vitamin D as herbivores and other omnivores synthesize enough Vitamin D3 from provitamin D due to exposure to sunlight. Vitamin D in the small intestine bound to plasma globulin and then being sent to liver. After a few terms of hydroxylation, Vitamin D in the body became more biologically active. This new form of vitamin D, working with Calcium and Phosphorus, activates osteoid synthesis during the bone growth period. Interestingly, this active form of Vitamin D also is a permission factor of the action of Parathyroid hormone on osteoblast. By enhancing the intestinal absorption of calcium and Phosphorus, vitamin D made more minerals used in mineralization for cartilage and osteoid that formed, thus enhancing the growth and maintenance of bones [9]. Without the support of extra Vitamin D in the diet, the puppy would have a chance to suffer from rickets and osteomalacia [10]. In conclusion, Vitamin D is essential to add to the diet for recruiting more calcium and phosphorus, stimulating the growth of bones during the early stages of life in dogs.

Vitamin C, on the other hand, is not as necessary as Vitamin D when it comes to skeletal growth in juvenile dogs. Vitamin C is known as one of the critical vitamins for humans. This water-soluble vitamin is an antioxidant and an enzyme cofactor that is the main function of repairing and growth of all parts of body tissues. However, an experiment demonstrated the unnecessity of adding Vitamin C supplements into dogs' diets. The experimenters observed the growth and damage of bones of 147 to 154-day-old canine neonates while feeding them diets that lacked Vitamin C. As a result, a diet lacking Vitamin C does not influence either growth or bone damage [11]. In conclusion, the inclusion of Vitamin C in the supplement is not foundational since no research has proven Vitamin C affects the early stages of growth in the bones of juvenile dogs.

2.2. Minerals

Minerals also play a foundational role in both human and animal diet nutrition. Without essential minerals in the diet, neither humans nor animals could develop muscles and bones without

abnormalities. When it comes to the growth of bones and joints in the early development stage of dogs, calcium, phosphorous, and Magnesium are three of the critical minerals that cannot be ignored.

Calcium, one of the minerals that is most mentioned for the health of skeletal growth, is stored in bones and teeth. Calcium provides a steady structure to the growth of bones. Another significant function of calcium is to move muscles and make sure nerves send signals between brains and parts of bodies [12]. However, excess amounts of calcium added to the diet of canine neonates have a higher chance of diagnosing disease than canine neonates who were fed a low-calcium diet. A scientific article called 'Adaptation to Different Calcium Intakes in Dogs' reveals the fact that "after studies, the groups of juvenile dogs that are fed with low calcium diet retained calcium much more efficiency than those fed higher levels." This article proves the unimportance of adding calcium supplements into juvenile dogs' diets to maintain skeletal development. On the other hand, an excess amount of calcium in the diet during the early stage of growth in the bones of canine neonates may cause problems. Larger breeds of dogs tend to have a higher frequency of developing bone problems during the growing stage, with an excess amount of calcium, the chance of diagnosing skeletal diseases like developmental orthopedic increases [13]. Moreover, research also proved that an excess amount of calcium in the diet would have a higher chance of causing disease in dogs in the growing stage compared to adult dogs when phosphorous is also low in the diet [13]. As a result, calcium might not be the most important player in bone growth supplements, but being aware of the amount of calcium added to the supplement product for the health of juvenile dogs is always nice, especially for dog owners who raise large breeds of dogs.

Phosphorus is a main player in maintaining bone health in both humans and animals. Phosphorous also affects the growth of bones through collaboration with calcium, vitamin D, and parathyroid hormone. The major function of phosphorus is to form the bones and teeth of the organism. In the early stages of growth in canine neonates, a sufficient amount of phosphorous in the diet would help with the growth of bones. The importance of phosphorous was proved by a scientific article written by B. Kiefer-Hecker, which experimented on 12-week-old juvenile dogs with a low phosphorous diet versus a nutrient-balanced diet group. The outcome indicates the group with phosphorous deficiency tends to have multiple symptoms like slow growth and low quality of fur and skin. Most importantly, disturbed musculoskeletal system and limb axis with hyperflexion of the joint also appeared after a low phosphorous diet [14]. One noteworthy point is the ratio of phosphorous and calcium in the diet. Excess amounts of calcium may lead to P deficiency and developing bone diseases like hypophosphatemia. On the other hand, an excess amount of phosphorous in the diet was tested not as toxic as an excess amount of calcium in the diet. Thus, dog owners need to balance the ratio of phosphorous and calcium to avoid abnormalities in the development of bones. In conclusion, phosphorous is a fundamental source of nutrients in the diet. A sufficient amount of phosphorous in the diet would help juvenile dogs avoid problems in skeletal development.

Magnesium, one of the foundational minerals in animals and humans, is also a major mineral that maintains a normal stage of growth of bones in dogs through its function of stabilizing the bones and helping mineralization. Also, magnesium helps to regulate calcium for a better use of calcium in the body [15]. During the early phase of developing bones and joints, magnesium can induce the growth of bones and mineralization by activating phosphatase [16]. Without the support of magnesium, an article indicates the outcome of canine neonates from the growing phase would suffer from limping. Several of the experiment dogs have abnormal front legs [17]. The article further proves the importance of having sufficient magnesium in the diet for the joint development of the canine neonates. As a result, having a healthy amount of magnesium in the diet of a puppy is necessary for maintaining a healthy structure and normal growth of bones.

3. Three Brands to Evaluate

Three brands that will be used to evaluate are Dasuquin, VetriScience, and Virbac. Each of them is a well-known bone supplement brand for dogs worldwide. Dasuquin is a brand that only produces

joint supplements for pets and is supported by Nutramax Laboratories Veterinary Sciences. This brand also markets itself as the number-one veterinarian-recommended supplement company. The product varies based on the ingredients and the age of the pets.

VetriScience is a brand from the United States and is known for its products of more than ten types of supplements for dogs and cats. The company has been open for more than forty years. This brand mainly markets the longevity of the brand, FDA-registered ingredients, and veterinarian recommendations. The product for joints varies due to the size of the dog and the ingredients.

Virbac, a company that was founded by a French veterinarian, mainly targets health care and health products for animals, including pets. The brand is well-known for its worldwide labs and businesses. Additionally, this company also offers services like diagnosing, preventing, and even treating the pathology of most species of animals. The company targets more than 100 countries, producing medicine for animals suffering from different types of diseases. Bone and joint disease is one of their targets. The product varies by the size of the dogs.

Comparing three brands with one of each product, Dasiquin with MSM Chewable tablets with the price of 44.99 dollars contain six major ingredients. Glucosamine Hydrochloride is 99% the greatest part of the ingredient, which helps delay the breakdown of cartilage [18]. There is no vitamin D, vitamin C, calcium, phosphorous, or magnesium specifically mentioned in the ingredient table.

The product from VetriScience that will be used in the passage is the product called 'GlycoFlex Everday.' There are three main ingredients listed in the ingredient table. Perna canaliculus weighs 600 mg and takes the greatest portion of the ingredient. Perna canaliculus, according to an article published in PubMed, is an ingredient for both humans and animals in supplements and medicine targeted for anti-inflammatory [19]. Among all the ingredients, only calcium is mentioned in the ingredient table.

MOVOFLEX Advanced from Virbac sold for 64.69 dollars per 60 chews. There are five major ingredients with the weight listed. BIOVAFLEX eggshell membrane took the greatest part of all the ingredients and weighed 132 mg per box. The ingredients of the BIOVAFLEX eggshell, according to the BIOVA official website, are collagen, elastin, and glycosaminoglycans, which have the overall purpose of protecting joints [20]. Among all the ingredients, vitamin D3 was mentioned with a weight of 100 IU per box. Among the ingredients of MOVOFLEX, the flaxseed meal is a good source of magnesium [21].

Comparing the three products of these brands, there are rarely overlapping ingredients among the three products. Each of the brands has its very own ingredients. The purpose of comparing those three products is to observe which product is more effective for juvenile dogs that are in the growing stage, with dramatically different ingredients for each product. It is difficult to tell which product would perform better during the skeletal growth of juvenile dogs.

4. Problem-Related to Supplement Product

Among all the products, the minerals and vitamins listed in the passage are rarely directly mentioned in the ingredient tables. Based on the conclusions and research above, calcium and vitamin C do not have to be in the supplement as the absence of calcium and Vitamin C would not develop potential bone disease. One problem related to these supplement products might be the ingredients listed on the product. The complicated chemistry and the professional feeding ingredients listed on the product might bring confusion to the customers. Customers have to search the components of the ingredients to find out what is fed to their pets. For example, flaxseed in the MOVOFLEX is a great source of magnesium. However, without researching the components of flaxseed, customers would not acknowledge what is included in the flaxseed. Ingredients like lecithin also bring confusion to customers as it is a great source of choline. However, the major use of choline is for the health of the brain and nervous system for memory and mood, which is unrelated to the purpose of improving skeletal health during the juvenile stage of the dog [22]. Without the acknowledgment of a professional veterinarian or animal nutritionist, it is difficult for normal customers to compare which

product might be more effective. As a result, pet owners might infer the product that costs more might be the most effective for their dogs. This might not always be true, as less expensive products might also be as effective as expensive products. One way to solve the confusion is to list the detailed ingredients next to the complicated components of the product so that pet owners have a clear idea of what they're paying for.

5. Conclusion

In conclusion, a healthy amount of vitamin D, phosphorous, and magnesium in the feed of juvenile dogs is fundamental for the growth of bones. Also, pay attention to the calcium provided to the juvenile dogs, as excess amounts might bring negative effects. Vitamin C does not have any effect on the health of bone in juvenile dogs. Comparing three of the supplements for the bone health of juvenile dogs, Dasiquin with MSM Chewable tablets does not mention any of the nutrients talked about in this passage in the ingredients; GlycoFlex Everyday from Vetriscience mentioned calcium in the ingredients of the supplement, and MOVOFLEX Advanced from Virbac included Vitamin D3 and magnesium in the ingredient. With all the analysis and research, GkycoFlex every day might be the product that includes the essential nutrients the most. However, the components of the rest of the ingredients did not include the nutrients mentioned in the article, which made the overall effect of the product unclear. Deepening the research of the components of the ingredients of the product might provide a better idea of which product might be more effective. With more detailed research on each ingredient of the skeletal health products, dog owners would spend less time comparing products and less worried about whether the product is helpful.

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