

Abstract

There is a growing demand for research regarding solutions to skeletal problems in horses. In human medical science, various studies on the effect of vitamin K on human bones showed positive effects of vitamin K supplementation on bone health. In horses, very little information about the role of vitamin K exists. Also, since horses are fed nowadays with a huge proportion of concentrate, it is important to figure out whether this also contributes to the high prevalence of bone problems. Therefore, research on vitamin K manipulation needs to be conducted.

Introduction

- ✓ Horse bone problems can lead not only to potential economic loss but also to negative impacts on horse welfare.
- ✓ Growing research on vitamin K for human bones is an inspiration to conduct similar studies on horses.
- ✓ Horses nowadays are usually fed with concentrate (**rather** than forage) to meet energy demand.

Aims

To elaborate opportunities for future research on the roles of vitamin K in horse bones.

Horse skeletal problems

Horse bone problems vary from developmental orthopedic diseases, musculoskeletal injuries, bone diseases, joint diseases, and bone fractures. Scientists have not uncovered practical solutions both to avoid and to cure these problems.

Research on the use of vitamin K in human

- ✓ There was a higher risk of vertebral fracture in male patients treated with warfarin (Gage et al. 2006)
- ✓ Natto (high level of vitamin K) consumers in Japan were found to have noticeably higher bone mineral density (Fujita et al. 2012)
- ✓ Low bone mineral density was found women having diets with low vitamin K level (Bulló et al. 2011)
- ✓ Vitamin K supplementation reduced incidence of bone fracture in postmenopausal women (Iwamoto et al. 2009).
- ✓ Studies are still required to determine which form of vitamin K and **how** administration will **result in** positive impacts on bone health

What is vitamin K?

- ✓ Fat-soluble vitamin
- ✓ Functions in blood coagulation
- ✓ Divided into phyloquinone, menaquinone, menadione
- ✓ Absorption in small amount
- ✓ The majority of K1 is stored in the liver
- ✓ The rest joins K2 to other tissues with low density lipoproteins
- ✓ Sources
 - ✓ Phyloquinone : green plants
 - ✓ Menaquinone : animal products
 - ✓ Menadione : synthetic form

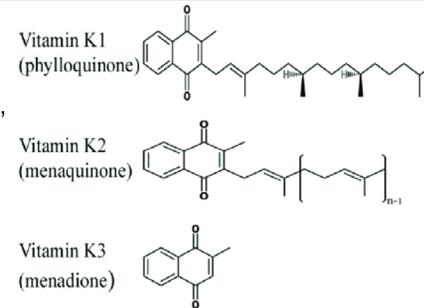


Figure 1. "Three types of vitamin K," The type of vitamin K depends on the number of double bonds. Created by Asmar et al. (2014)

Roles of vitamin K

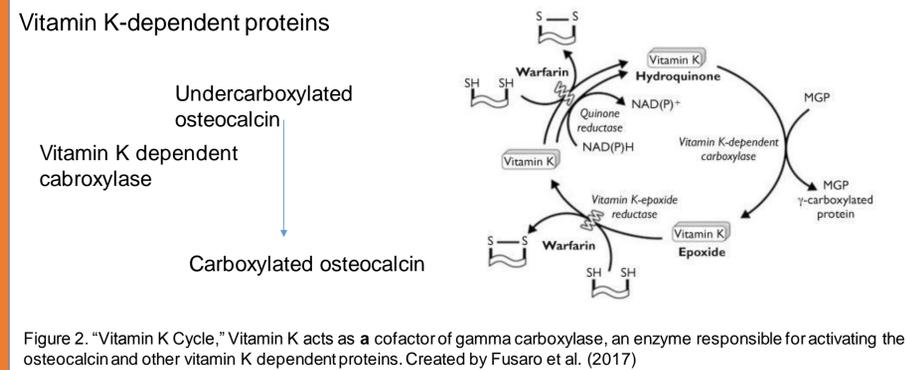


Figure 2. "Vitamin K Cycle," Vitamin K acts as a cofactor of gamma carboxylase, an enzyme responsible for activating the osteocalcin and other vitamin K dependent proteins. Created by Fusaro et al. (2017)

Calcium, vitamin D, and vitamin K

While calcium is an essential component in bone, vitamin D is responsible for its absorption in the intestine to the blood (Christakos et al. 2011). However, in the blood, calcium relies on vitamin K dependent proteins for its metabolism (Fusaro et al. 2017)

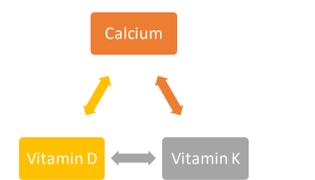


Figure 3. "Relation between Calcium, vitamin D, and vitamin K," Calcium, vitamin D, and vitamin K complement each other

Application in horses

- ✓ Siciliano et al. (2000) showed increasing levels of hydroxyapatite-osteocalcin binding capacity (HOBC) during the first 140 days of age in foals, indicating an increasing requirement for vitamin K.
- ✓ Supplementation of vitamin K (K1, K2, K3) resulted in increases in vitamin K1 in blood but not vitamin K2, suggesting that vitamin K1 is the main form of vitamin K in horse body. (Skinner 2015)
- ✓ There are no publications on the effect of vitamin K on the horse bone or its level of carboxylated osteocalcin

Applications of vitamin K in the horse

- ✓ Vitamin K, in the form of K1, K2, K3, or combination of these can be administered to horses of certain stages (foals, weaners, maiden mares, pregnant mares, post-foaling), or prior to or during training.
- ✓ Vitamin K can also be administered as paste (oral), injection, or by other means

Further research

- ✓ Vitamin K status in lame horses or horses with severe or less severe skeletal problems
- ✓ Proportion of grass and vitamin K level or carboxylated osteocalcin
- ✓ Levels of vitamin K intake and the growth pattern
- ✓ Levels of vitamin K and lameness incidence
- ✓ Vitamin K in fresh vs dry grass

Conclusion

- ✓ There is a demand for bone health solutions for horses.
- ✓ There is very little information about the roles of vitamin K in horses.
- ✓ Vitamin K is a promising solution for horse bone health, hence further research should be conducted.

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