Vitamin D3 in Pigs: Distribution, Storage and Turnover under Various Input Conditions

Vitamin D3 is important for the mineralization of the skeleton to prevent the deficiency diseases rickets and osteoporosis, and to maintain a healthy skeleton throughout life.

Vitamin D3 is synthesized in the skin after exposure to the sun. Due to the low angle of the sun during wintertime at high latitudes, no or only a negligible amount of vitamin D3 is synthesized and the body needs to rely on its storages of vitamin D3, or dietary vitamin D3 in the form of vitamin D3 and 25-hydroxyvitamin D3. The information of the size of the storages of vitamin D3 in humans is sparse, but very low levels of vitamin D3 is found in tissues from animals fed physiologically relevant doses of vitamin D3. The natural synthesis of vitamin D3 might, however, influence on the storages of vitamin D3. The different inherent properties of the two forms of vitamin D3 might also affect the tissue distribution of vitamin D3 and 25-hydroxyvitamin D3 and how the distribution associates with serum 25-hydroxyvitamin D3.

To study the association between vitamin D3 and 25-hydroxyvitamin D3 in serum and tissue, two analytical methods were developed and validated.

The difference in tissue distribution of vitamin D3 and 25-hydroxyvitamin D3 after supplementation of vitamin D3 and 25-hydroxyvitamin D3 was investigated in slaughter pigs. Tissue 25-hydroxyvitamin D3 was significantly higher in pigs fed 25-hydroxyvitamin D3 compared to vitamin D3, but vitamin D3 in tissue was higher in the pigs fed vitamin D3. The content of 25-hydroxyvitamin D3 in the different tissues correlated with the serum 25-hydroxyvitamin D3 level, but the correlation between the tissue content of vitamin D3 and the serum 25-hydroxyvitamin D3 concentration was dependent on the form of the ingested vitamin D3.

Göttingen minipigs were used to investigate the endogenous storages of vitamin D3 after UV-exposure to stimulate synthesis of vitamin D3 and after oral supplementation of vitamin D3. Furthermore, the minipigs were used to study the turnover of synthesized vitamin D3 in skin and adipose tissue during vitamin D3 shortages.

Daily UV-exposure of minipigs stimulated the cutaneous synthesis of vitamin D3. The results showed an increase in serum vitamin D3 and 25-hydroxyvitamin D3, but also tissues and organs contained vitamin D3 and 25-hydroxyvitamin D3. The vitamin D3 content in adipose tissue from the UV-exposed minipigs was 150-260 ng/g while the content was 90-150 ng/g in the orally supplemented minipigs. Vitamin D3 and 25-hydroxyvitamin D3 declined from the skin and the adipose tissue after the UV-exposure had ceased.

A comprehensive pharmacokinetic-model was established to describe the relation between vitamin D3 in tissue and vitamin D3 and 25-hydroxyvitamin D3 in serum by taking both synthesized and orally supplemented vitamin D3 into account.

General information
State: Published
Organisations: National Food Institute, Division of Food Chemistry, Division of Toxicology and Risk Assessment
Contributors: Burild, A., Jakobsen, J., Frandsen, H. L., Poulsen, M.
Number of pages: 149
Publication date: 2014

Publication information
Place of publication: Kgs. Lyngby
Publisher: Technical University of Denmark (DTU)
ISBN (Print): 978-87-93109-24-7
Original language: English
Research output: Research › Ph.D. thesis – Annual report year: 2015