Dose and form of vitamin D for sows: Impact on bioavailability, performance and bone status markers

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Background

- In swine nutrition, little is known regarding vitamin D in relation to reproduction and health
- Official vitamin D recommendation for sows during gestation and lactation is not based on scientific reports
- Recommendations ranging from 200-1,000 IU vitamin D/kg feed

Purpose of experiment

- To investigate the nutritional benefits of vitamin D for reproducing female pigs with special emphasis on:
- Bioavailability when using two sources of vitamin D
- Performance
- Early reproduction (poster abstract #10627)
- Bone status markers
- Transfer of vitamin D to the progeny

Animals

- Experiment 1: Prepubertal gilts, DL*DY, N=160, mated with mixed sperm.

  Duration: Dietary treatments started from first estrus, mating 21 d thereafter, slaughter on d 28 of gestation

- Experiment 2: Sows parity 2,3,4,or 5, DL*DY, N=160, mated with a Duroc boar (same within each block)

- Duration: Dietary treatments started on the day of artificial insemination and lasted until weaning

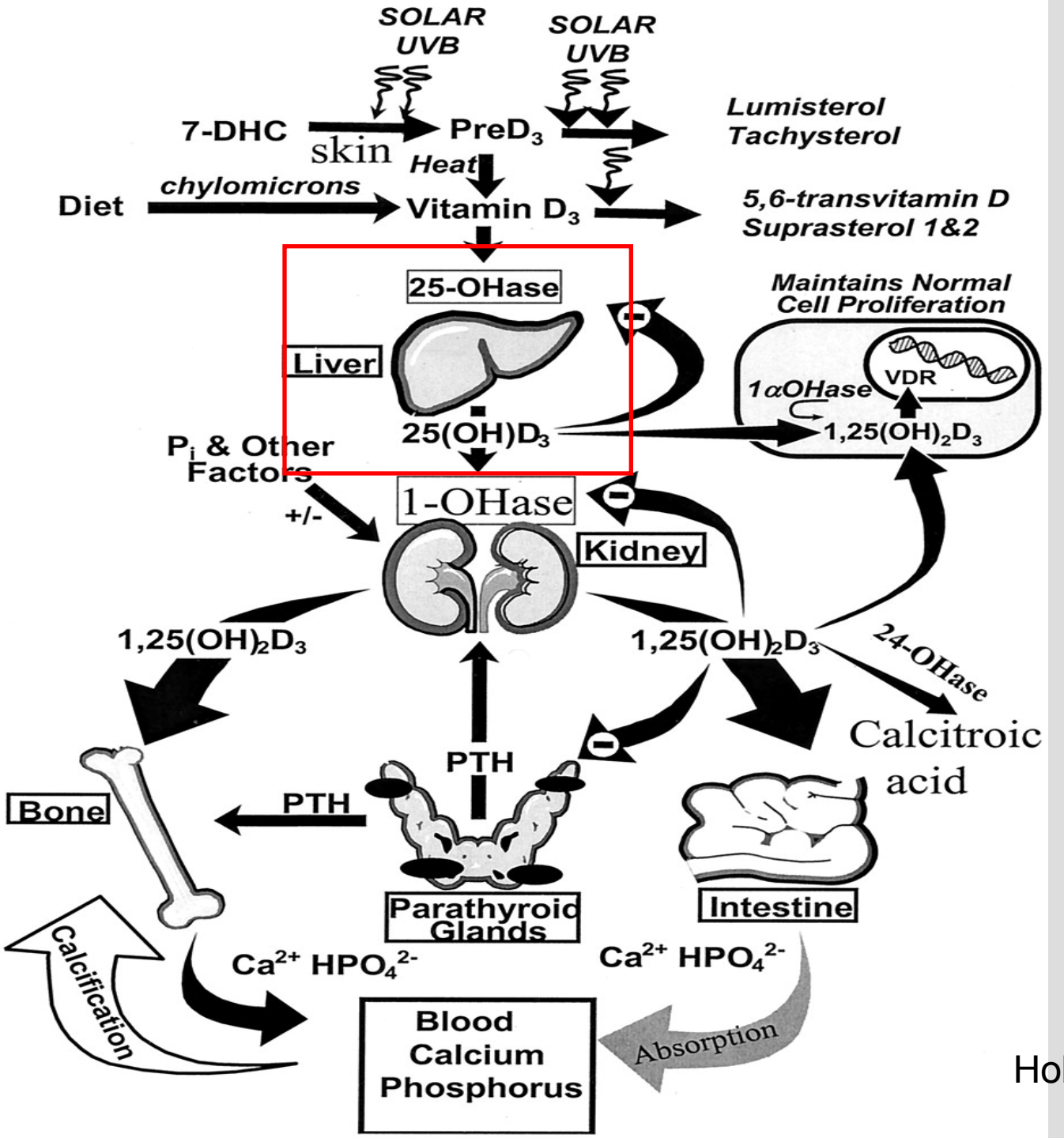
Dietary treaments

8 dietary treatments arranged in a complete block design with 20 blocks:

- Two sources of vitamin D: vitamin D_3 (" D_3") and 25-hydroxy vitamin D_3 ("HY·D", provided as Hy•D® by DSM Nutritional products)
- Four doses:

  D_3: 200, 800, 1400 and 2000 IU/kg feed

  HY·D: 5, 20, 35, and 50 µg/kg feed


SOLAR UVB
SOLAR UVB
7-DHC
skin
PreD3
Lumisterol
Tachysterol
Heat
Diet
chylomicrons
Vitamin D3
5,6-transvitamin D
Suprasterol 1&2
25-OHase
Maintains Normal Cell Proliferation
Liver
VDR
1αOHase
25(OH)D3
1,25(OH)2D3
Pi & Other Factors
+/-
1-OHase
Kidney
1,25(OH)2D3
1,25(OH)2D3
24-OHase
Calcitroic acid
PTH
PTH
Bone
Parathyroid Glands
Intestine
Calcification
Ca2+ HPO4 2-
Ca2+ HPO4 2-
Blood
Calcium
Phosphorus
Absorption

Holick (1994)

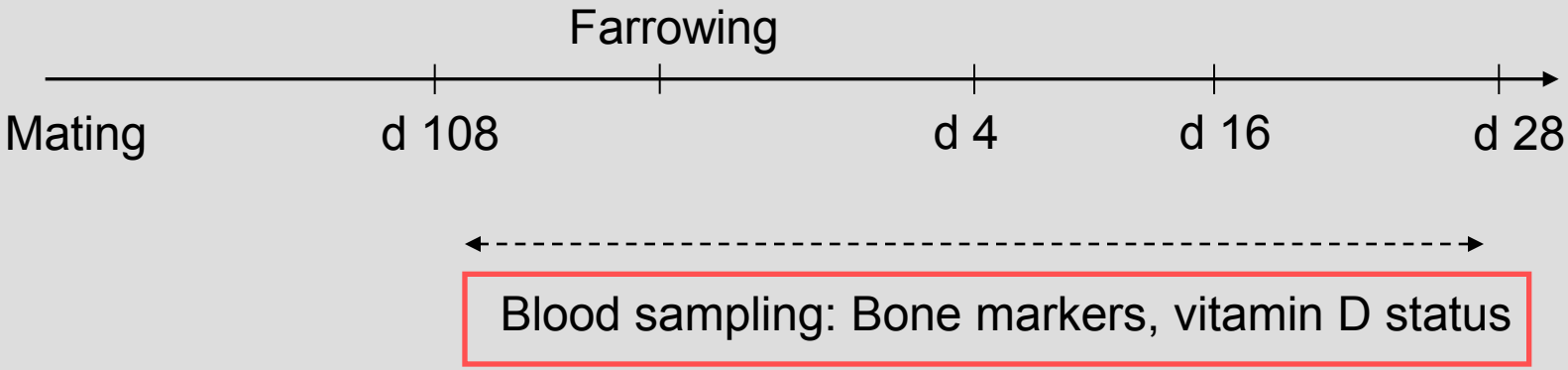
Vitamin D concentration in feed

Dietary treatment	N samples	Analyzed vitamin D_3	Analyzed 25(OH)D_3
		Mean (SD), IU•kg^{-1}	Mean (SD), IU kg^{-1}
200 Vitamin D_3	4	197 (56)	< 200
800 Vitamin D_3	4	712 (31)	
1400 Vitamin D_3	3	1267 (115)	
2000 Vitamin D_3	3	1897 (95)	
200 25(OH)D_3	4	0	200 (40)
800 25(OH)D_3	4		920 (40)
1400 25(OH)D_3	4		1360 (120)
2000 25(OH)D_3	4		2120 (640)

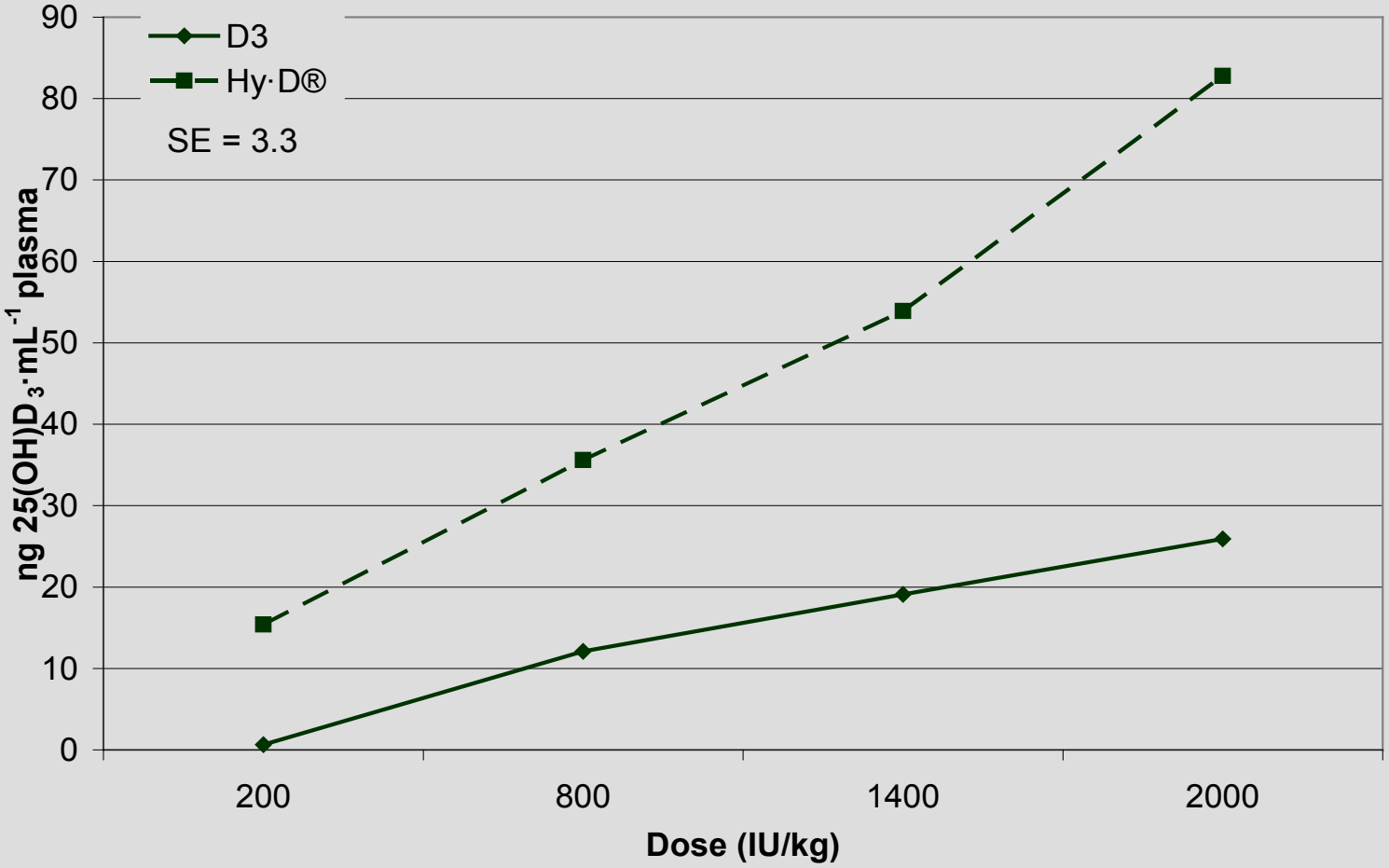
Materials and methods

Experiment 1: gilts

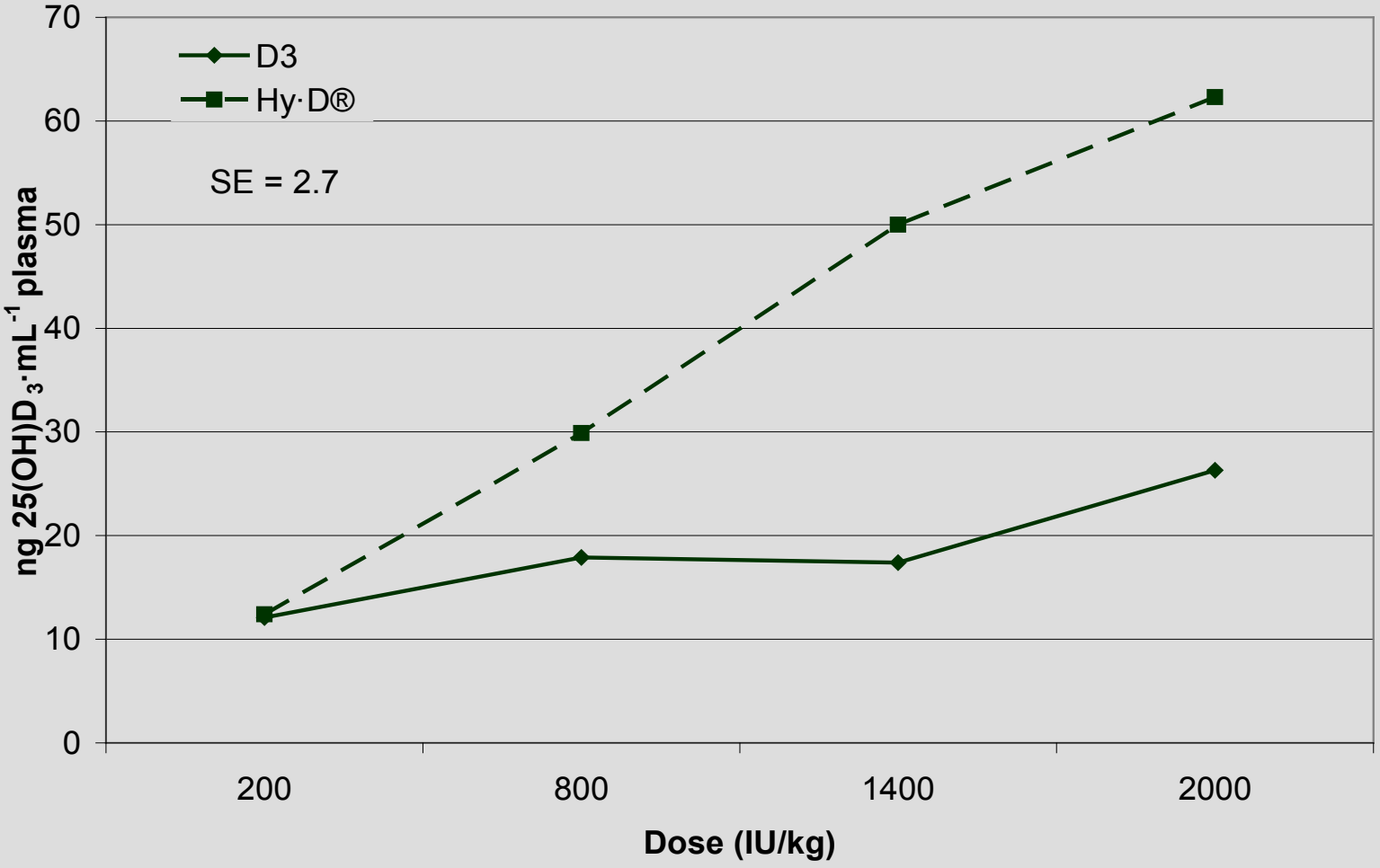
Experiment 2: sows and piglets



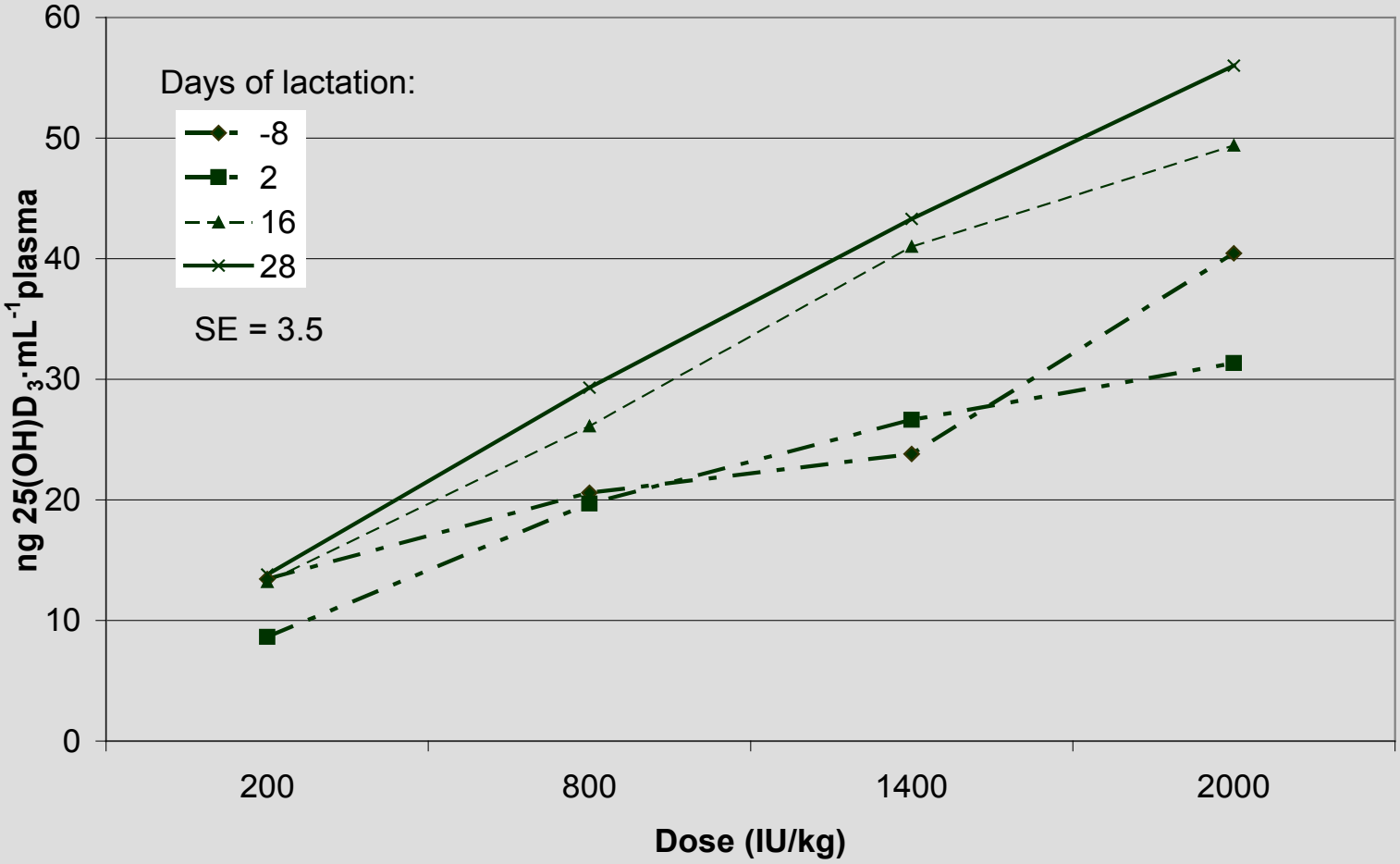
Bioavailability of vitamin D (exp. 1, gilts on d 28 of gestation)



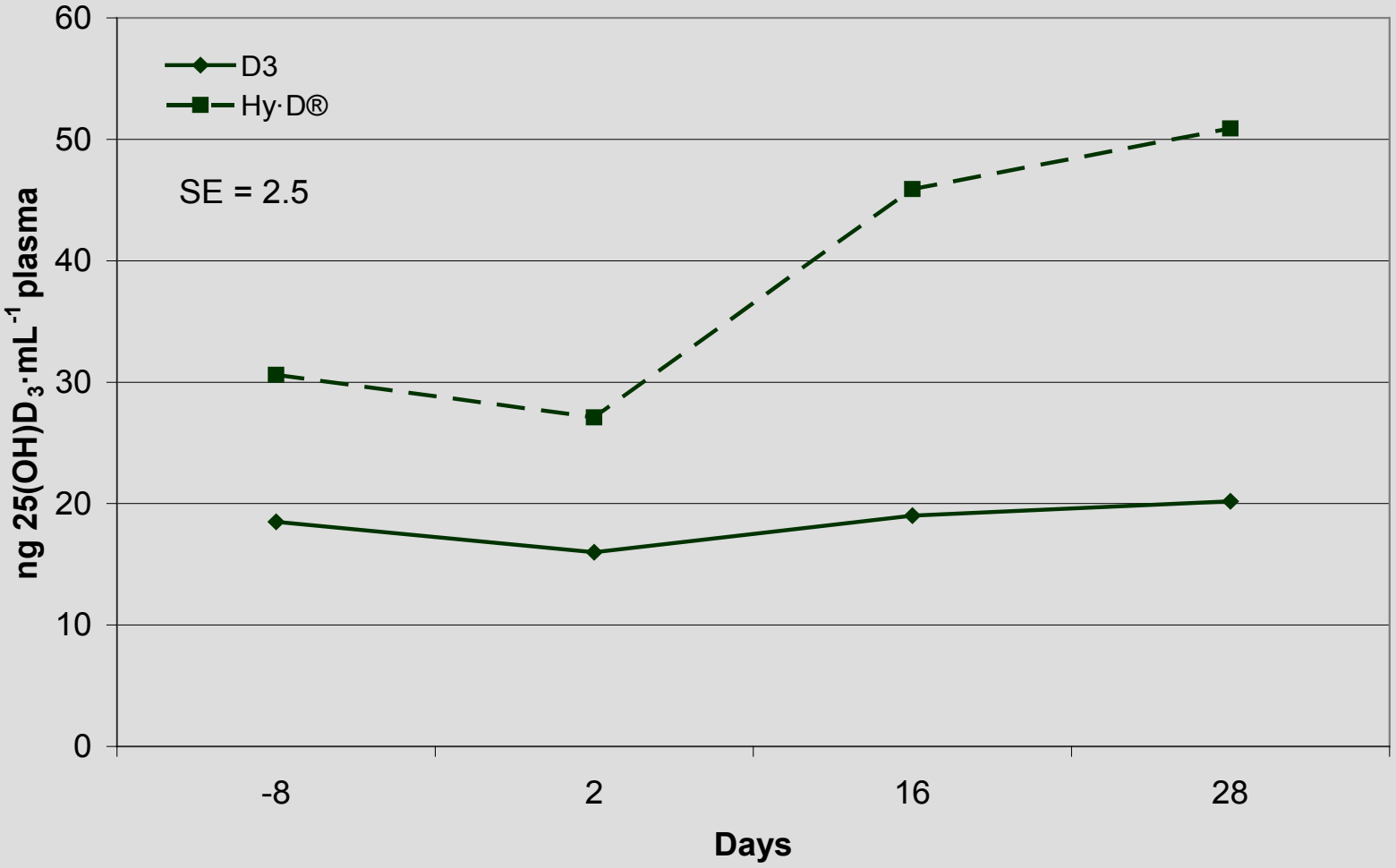
Bioavailability of vitamin D
Exp. 2: Sows (Dose*form)



Bioavailability of vitamin D
Exp. 2: Sows during lactation (day*dose)



Bioavailability of vitamin D
Exp. 2: Sows (Day * form)



Performance

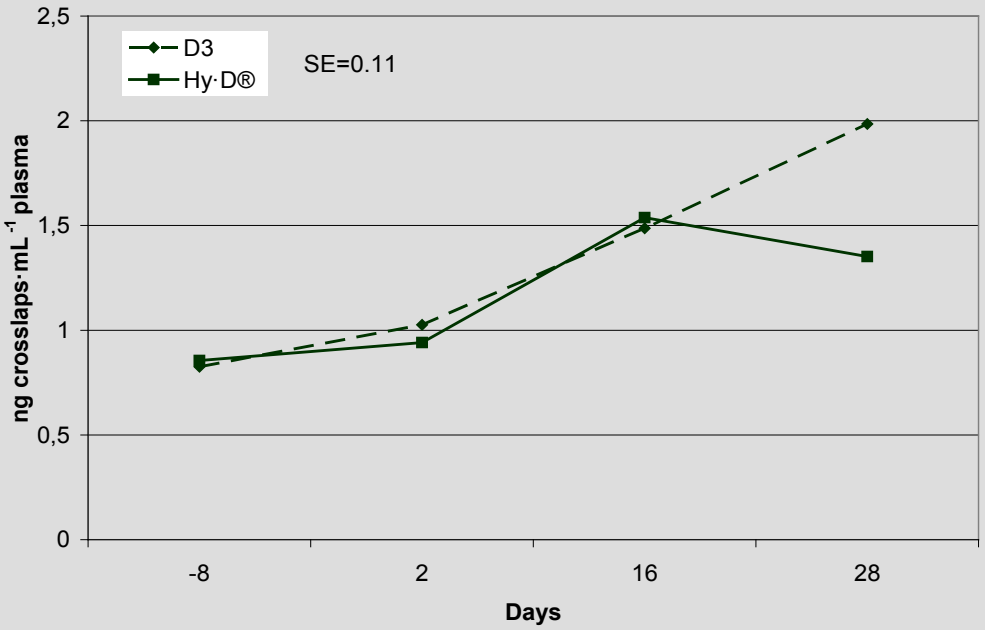
- Reproductive performance not affected
- Feed intake of sows: Interaction between parity*form*dose (0.009)
- Body weight changes not affected
- Number of live born piglets, and litter performance until weaning not affected
- # still born piglets less (P=0.03) with larger doses of vitamin D!

Bone status markers
Exp. 1: gilts

- Ultimate strength of bones and content of ash higher with D_3 than with HY·D
- No influence on plasma bone status markers (alkaline phosphatase, Ca, P)

Bone status markers
Exp. 2: sows and piglets

- Lactation day rather than dietary vitamin D influenced concentration of osteocalcin, Ca, P, and inorganic P, bone related enzymes
- However, forms influenced cross laps



Transfer of vitamin D to the progeny (Exp. 2: Piglets)

- 25(OH)D_3 only detectable in 154 out of 576 samples (obtained at day 4, 16 and 28 of age)
- Low concentration: 4.3 (2.8) ng/mL plasma
- Lowest concentration in piglets suckling sows fed 200 IU D3, and highest in piglets suckling sows fed 50 µg HY·D
- 3.34 (2.11), 4.16 (2.79) and 4.84 (3.05) ng 25(OH)D3/mL plasma for piglets aged 4, 16 and 28 days

Conclusion (dose)

- Although results of the present study did not show any major differences between dietary treatments in terms of performance, reproduction and bone status markers of gilts and sows,
- the lower number of still born piglets and the higher vitamin D status may indicate a dietary level around 1,400 IU vitamin D to be recommendable for reproducing swine.

Conclusion (form)

- The potency of the dietary Hy•D® in relation to vitamin D_3 depended on the level tested but above 200 IU, Hy•D® was more bioavailable than the vitamin D3, and could as such been considered as an equivalent or even more advantageous source of vitamin D.

Conclusion (bioavailability)

- Irrespective dietary dose and form of vitamin D for the sows, very little vitamin D was transferred to the progeny
- Suckling piglets without exposure to sunlight may need a vitamin D supplement (?)

Conclusion (bone status markers)

- Difference in absolute numbers (where effect of dietary vitamin D was found) probably not physiologically relevant
- Lactation stage of sows and age of the suckling piglets influenced the measured bone status markers.

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Reproductive performance and bone status markers of gilts and lactating sows supplemented with two different forms of vitamin D

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