

Vitamin A Repletion in Rats with Concurrent Vitamin A and Iodine Deficiency Affects Pituitary TSH β Gene Expression and Reduces Thyroid Hyperstimulation and Thyroid Size

R. Biebinger¹, M. Arnold², W. Langhans², R.F. Hurrell¹, M.B. Zimmermann¹

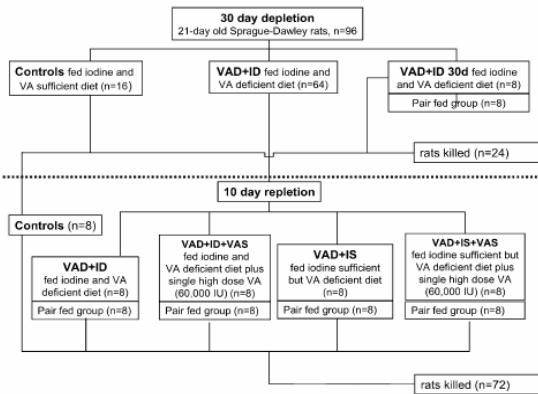
¹Human Nutrition Laboratory, Institute of Food Science and Nutrition, ETH Zurich, Switzerland ²Physiology and Behaviour Group, Institute of Animal Sciences, ETH Zurich, Switzerland

Objective

Concurrent vitamin A (VA) deficiency (VAD) and iodine deficiency (ID) are common in developing countries. VAD has effects on thyroid metabolism that may be dependent on iodine status.

Aim of this study was to investigate the effect of VA supplementation (VAS) and/or dietary iodine repletion, alone and in combination, on the thyroid-pituitary axis in rats with concurrent VAD and ID.

Study Design



Results

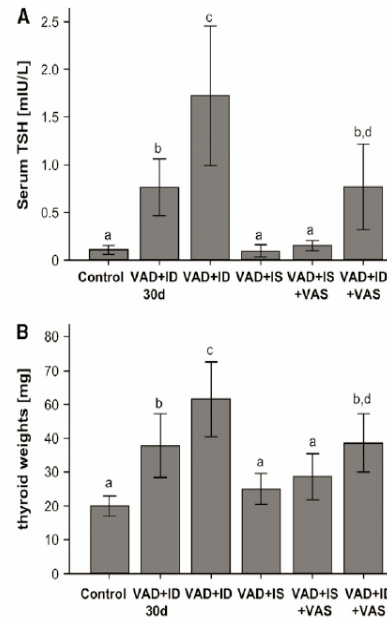


Figure: Serum TSH concentrations and thyroid weights. Means with a common letter differ, P < 0.05

30-d depletion period:

- Moderate vitamin A deficiency, with SR concentrations reduced by $\approx 35\%$;
- Primary hypothyroidism, with increases in serum TSH, pituitary TSH β mRNA expression and thyroid size, and a decrease in thyroid hormone concentrations.

10-d repletion period:

- Single high dose of VA was sufficient to return SR concentrations to normal, in both iodine deficient and iodine sufficient rats
- Despite continuing VA deficiency, provision of a iodine sufficient diet entirely reversed the abnormalities of the pituitary-thyroid axis produced by VA and iodine depletion
- High dose of VA in iodine sufficient rats had no discernible effects on the pituitary-thyroid axis
- High dose of VA in iodine deficient rats slightly reduced pituitary production of TSH and reduced stimulation of the thyroid, but had no effect on thyroid hormone concentrations.

Table: SR and thyroid hormone concentrations and TSH β mRNA expression. Means with a common letter differ, P < 0.05

parameter	control	VAD+ID 30d	VAD+ID	VAD+IS	VAD+IS+VAS	VAD+ID+VAS
SR [umol/L]	1.94 \pm 0.34 ^a	1.11 \pm 0.08 ^b	1.03 \pm 0.20 ^b	0.89 \pm 0.26 ^b	1.94 \pm 0.31 ^a	1.67 \pm 0.16 ^a
TT4 [ug/L]	0.67 \pm 0.06 ^a	0.12 \pm 0.03 ^b	0.13 \pm 0.08 ^b	0.85 \pm 0.13 ^a	0.70 \pm 0.09 ^a	0.17 \pm 0.18 ^b
FT4 [ng/L]	0.36 \pm 0.07 ^a	0.21 \pm 0.06 ^b	0.10 \pm 0.02 ^b	0.41 \pm 0.12 ^a	0.31 \pm 0.03 ^a	0.12 \pm 0.07 ^b
TT3 [ng/L]	12.31 \pm 1.59 ^{a,b}	12.44 \pm 2.24 ^{a,b}	9.97 \pm 2.29 ^b	13.50 \pm 1.21 ^{a,b}	12.65 \pm 2.33 ^{a,b}	10.08 \pm 1.91 ^b
FT3 [ng/L]	6.08 \pm 1.54 ^a	4.60 \pm 1.12 ^{a,b}	4.10 \pm 1.13 ^b	5.89 \pm 0.93 ^{a,b}	6.05 \pm 0.83 ^{a,b}	4.64 \pm 1.50 ^{a,b}
TSH β mRNA	1 ^b	6.54 \pm 2.66 ^a	7.19 \pm 1.43 ^a	1.02 \pm 0.2 ^b	1.28 \pm 0.25 ^b	6.30 \pm 1.26 ^a

Measurements

Blood sample was taken, rats were sacrificed and the thyroid and pituitary were dissected. Serum retinol (SR), thyroid hormones, serum TSH, pituitary TSH β mRNA and thyroid weights were determined.

Conclusion

In summary, in rats with concurrent moderate VAD and ID, primary hypothyroidism due to ID does not reduce the efficacy of high doses of oral VA to increase SR, nor does VAD reduce the efficacy of dietary iodine to correct pituitary-thyroid axis dysfunction due to ID. However, VAS has effects on the pituitary thyroid axis that are dependent on the iodine status of the rats. Given alone, high-dose VAS in combined VAD and ID reduces thyroid stimulation by TSH and reduces risk for goiter.