

The distribution of Vanadium in Salpa maxima  
from the Western Aegean Sea

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**Abstract.** The distribution of vanadium in two main parts of the body of the pelagic Tunicate, Salpa maxima, from the Aegean Sea, has been studied by neutron activation and a fast radiochemical separation method. The concentration of vanadium in nucleus and stolon (range 30-7.1 µg/g of dry weight), found to be two orders of magnitude higher than in the rest of the body (range 0.80-0.10 µg/g of dry weight), of the examined species. The vanadium content in the body fluid has been also determined.

**Resumé:** La distribution de vanadium dans les deux parties principales du corps de Tunicier, Salpa maxima de la mer Egée, a été étudiée par radioactivation neutronique combinée avec une méthode radiochimique d'analyse rapide. La concentration de vanadium dans la partie nucleus and stolon (valeurs comprises entre 30 et 6.0 µg/g en poids sec) a été trouvée en deux ordres de grandeur plus élevée que dans le reste du corps (valeurs comprises entre 0.80 et 0.10 µg/g en poids sec) des organismes qui ont été examinés. La concentration de vanadium dans le liquide du corps a été aussi déterminée.

The occurrence of vanadium in Ascidians has been reported long ago by Henze<sup>1</sup>. Thereafter several studies on the distribution of vanadium among Tunicate species, mostly belonging to Ascidiidae, Cionidae and Pyuridae families, have been presented.<sup>2</sup>

The work done in recent years showed that there is a differentiation in the distribution of vanadium among Tunicate families and especially among the primitive ones.<sup>3,4,5</sup>

However, experimental data for the Salpidae family are very limited<sup>3</sup>. This family consists one of the three suborders of Thaliace. The holoplanktonic organisms belonging to this order are distinguished from the other Tunicates not only for their way of pelagic life but also for their morphological differences.

In order to enlarge our knowledge of the trace element distribution in pelagic Tunicates, vanadium has been determined in Salpa maxima (Forksål) a pelagic species belonging to Salpidae family.

Within the framework of IAEA/UNEP Med Pol VIII project 1998/EP, oozoid specimens of Salpa maxima, have been collected from the Aegean Sea, South of Evia Island on August 1979.

Each individual has been dissected in two parts: one containing the nucleus and stolon and the other the rest of the body.

The body fluid of Salpa maxima collected from the "rest of the body", part has also been analysed for vanadium, as a separate sample.

Neutron activation combined with a fast radiochemical separation, by solvent extraction<sup>6</sup> (modified by us, as has been reported in a previous paper)<sup>5</sup>, has been applied for determining vanadium in the wet ashed samples.

All irradiations have been performed in the reactor of the N.R.C. "Demokritos" using the pneumatic tube transfer system at a neutron flux of  $7.5 \times 10^{11} \text{ n}\cdot\text{cm}^{-2}\cdot\text{sec}^{-1}$ .

The 1434 keV  $\gamma$ -energy of  $^{52}\text{V}$ ,  $T_{1/2} = 3.8 \text{ m.}$ , has been measured on a Ge(Li) detector in conjunction with  $\frac{1}{2}$  a multichannel analyzer.

The results obtained from this study are listed in Table I, where the distribution of vanadium in the two main parts of the body of Salpa maxima is presented. The mean value and the standard deviation for twenty samples of "nucleus and stolon" as well as for twenty samples of "the rest of body" are also given.

The difference in the vanadium content between the two groups has been found highly significant by applying a t-test.

Bibliographic data on the values of vanadium distribution in the body of Salpa maxima are rather lacking.

In Vinogradov's<sup>2</sup> review on the elementary composition of marine organisms, has been reported that vanadium is absent in Salpae. However Nicols et al.<sup>7</sup> found a 7 ppm value for vanadium in the ash of Salpa fusiformis.

In this work, the vanadium concentration found to be two orders of magnitude higher in "nucleus and stolon" than in the "rest of the body", which contains the muscular and nervous systems, and the pharynx with the endostyle. Moreover, the vanadium content in the fluid (0.10  $\mu\text{g/g d.w.}$ ), collected from the rest of the body, was found of the same order of magnitude with the vanadium content in the corresponding sample (0.50  $\mu\text{g/g d.w.}$ ).

Thus the presence of vanadium in this species of Salpidae family is not only pointed out but also a selective accumulation of vanadium by certain parts of the body has been found. This accumulation of vanadium in a pelagic species, is similar with the vanadium localization found by Golberg et al.<sup>8</sup> in the gut and ovaries of a non pelagic species belonging to Cionidae family, Ciona intestinalis, although these organisms differ in the way of living.

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TABLE I. Vanadium\* distribution in two main parts of Salpa maxima\*\*

No.	Nucleus and stolon	Rest of the body	No.	Nucleus and stolon	Rest of the body
1	27	0.60	11	23	0.64
2	7.1	0.56	12	30	0.74
3	11	0.10	13	10	0.20
4	16	0.58	14	9.5	0.41
5	17	0.44	15	12	0.61
6	13	0.64	16	17	0.35
7	12	0.53	17	6.0	0.13
8	8.0	0.32	18	18	0.59
9	14	0.71	19	25	0.50
10	19	0.80	20	20	0.43
Nucleus and stolon: Mean value			16±6.7		
Rest of the body: " "			0.50±0.20		

\*Overall st. error <10%.

\*\*Vanadium values in µg/g D.W.

#### References

1. M. Henze, Untersuchungen über das Blut der Ascidien. I. Die Vanadiumbildung der Blut Koperchem. Hoppe-Seyle. Z., 72, 1911, pp.494-501.
2. A.P. Vinogradov, The elementary chemical composition of marine organisms. Sears Foundation for Marine Research, Yale Univ., New Haven, 1953, p. 650.
3. D.A. Webb. The blood of tunicates and the biochemistry of vanadium. Publ. Staz. Zool., Napoli, 1956, 28, pp. 273-288.
4. C.P. Papadopoulou, C.T. Cazianis and A.P. Grimanis. Neutron activation analysis of vanadium, copper, zinc, bromine and iodine in Pyura microcosmus. Proc. Symp. IAEA, "Nuclear activation techniques in the life sciences", Vienna 1967, pp. 365-377.
5. C.P. Papadopoulou, I. Hadzistelios and A.P. Grimanis, Trace elements uptake by Cynthia claudicans (Savigny). Greek Limnol. Oceanogr. 1972, XI, pp. 651-653.

6. R. Fukai, W.W. Meinke, Activation analysis of vanadium, arsenic, molybdenum, tungsten, rhenium and gold in marine organisms. *Limnol. Oceanogr.* 1962, 7, pp. 186-200.
7. G.D. Nicolls, H. Curl and V.T. Bowen, Spectrographic analyses of marine plankton. *Limnol. Oceanogr.*, 1959, 4, pp. 472-478.
8. E.D. Golberg, E.D. McBlair and K.M. Taylor, The uptake of vanadium by tunicates. *Biol. Bull.*, 1951, 101, pp. 84-94.

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"The distribution of vanadium in Salpa maxima from the Western Aegen Sea"

Paper presented by C. Papadopoulou (Greece)

#### Discussion

H.W. Nürnberg: What was the vanadium level in seawater?

C. Papadopoulou: Vanadium content in seawater was 0.00040  $\mu\text{g/ml}$ .