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# SHORT REPORTS

# POLYAMINES IN TURIONS AND YOUNG PLANTS OF *HYDROCHARIS MORSUS-RANAE* AND *UTRICULARIA INTERMEDIA*

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**Key Word Index**—*Hydrocharis morsus-ranae*; Hydrocharitaceae; *Utricularia intermedia*; Lentibulariaceae; turion; dormancy; cadaverine; homospermidine; norspermidine; putrescine; spermidine; spermine.

**Abstract**—Spermidine is the most abundant polyamine in dormant turions of *Hydrocharis morsus-ranae* and *Utricularia intermedia*, and it is also the dominant polyamine in sprouts of *U. intermedia*. The putrescine level is high in young leaves of *H. morsus-ranae*. Cadaverine and homospermidine occur respectively in vernalized turions of *H. morsus-ranae* and of *U. intermedia*.

## INTRODUCTION

Polyamines are ubiquitous in prokaryotes and eukaryotes [1–3]. Putrescine, spermidine and spermine have received much attention, and evidence has been obtained for their involvement in the control of nucleic acid metabolism and protein synthesis [4–6] and in stimulation of the division of plant cells and stabilization of protoplasts [6, 7]. The possible role of polyamines in dormancy regulation in turions of *Hydrocharis morsus-ranae* and *Utricularia intermedia* is reported in this paper. These are rather uncommon aquatic vascular plants of Northern Europe and they propagate vegetatively by forming turions which remain in a wet condition throughout the winter (*H. morsus-ranae* on the bed of eutrophic lakes and ponds). *U. intermedia* is an amphibic plant which especially grows in fens.

## RESULTS AND DISCUSSION

High performance chromatographic polyamine analysis [8] showed that dormant turions of *H. morsus-ranae* and *U. intermedia* contain a relatively high level of spermidine (Tables 1 and 2). In both species the putrescine content of actively growing plants is greater than that in turions. Homospermidine and spermine are also present in dormant turions of *H. morsus-cranae* (Table 2). The experimental conditions were not quite identical for the species studied, but the development stages are comparable. The amount of spermine is much lower in turions of *U. intermedia* than in those of *H. morsus-ranae*; in the former the homospermidine content of the turions increases after the break of dormancy (Table 2). In *H. morsus-ranae* the turions contain much more arginine than do the young leaves, but the latter have higher levels of putrescine and ornithine than do the organs, which remain alive throughout the winter.

The occurrence of cadaverine is characteristic of vernalized turions of *H. morsus-ranae*. They also contain nearly three times more lysine, the cadaverine precursor, than do the dormant turions. Putrescine, spermidine and spermine are known to break the dormancy of tubers of *Helianthus tuberosus* [4]. The appearance of cadaverine in cells during the transition from an inactive to an active physiological stage has been observed in germinating

Table 1. Polyamines in turions and sprouts of *Utricularia intermedia* (mean of four treatments)

| Compound | Dormant turions (μmol/g dry wt) | Turions after break of dormancy (μmol/g dry wt) | Sprouts (2 cm) (μmol/g dry wt) |
|---|---|---|---|
| Cadaverine | 0.01 | — | — |
| Putrescine | 0.1 | 0.05 | 0.18 |
| Spermidine | 1 0 | 1.3 | 1.8 |
| Homospermidine | — | 0.07 | 0.17 |
| Norspermidine | — | — | 0.02 |
| Spermine | 0.07 | 0 03 | 0.01 |

Table 2. Polyamines and their precursors in turions and leaves of *Hydrocharis morsus-ranae*

| Compound | Dormant turions (μmol/g dry wt) | Turions after break of dormancy (μmol/g dry wt) | Leaves (μmol/g dry wt) |
|---|---|---|---|
| Cadaverine | — | 0.2 | — |
| Putrescine | 0.5 | 0.9 | 3.6 |
| Spermidine | 1.9 | 2.4 | 0 4 |
| Homospermidine | 0.5 | 0.9 | 0 5 |
| Spermine | 0.2 | 0.3 | — |
| Ornithine | 1.8 | 2.7 | 5.6 |
| Lysine | 2.4 | 6.6 | 12.3 |
| Arginine | 325 | 518 | 113 |

seeds [9]. This polyamine may also play some role in activating metabolic processes in turions of *H. morsus-ranae*; homospermidine could play the same role in the case of *U. intermedia*.

Particularly spectacular is the high arginine content of *H. morsus-ranae* (Table 2).

## EXPERIMENTAL

*Plant material.* Turions of *Utricularia intermedia* Hayne were collected from a ditch during the middle of September 1983 in Southern Finland (Hattula). One part was lyophilized and the other part was stored in $H_2O$ at 4° in darkness for 9.5 weeks. The turions were germinated in a dilute (1:100) mineral nutrient medium [10] (changed once) for 2 weeks with alternating light and temp. (18 hr day, 20°, Airam 40 W, 35 E/m$^2$ per sec; dark, 15°, 6 hr). During this time the turions sprouted and plants (2 cm in length) were lyophilized and stored in a desiccator (4°) until analysed.

Turions of *Hydrocharis morsus-ranae* L. were collected from a small pond (Hattula) at the end of September 1981. They were separated into two groups, one of which was lyophilized and the other stored in $H_2O$ at 4° in darkness. The leaves which developed from turions germinated at 25° in daylight for 15 days (20 April–5 May 1981) were stored for analysis as described above.

*Extraction of amines.* Turions and leaves or sprouts were extracted twice with 5 vols. 5% TCA in 0.05 M HCl in a mortar with a pestle [11]. After centrifugation, the supernatants were pooled and aliquots were employed directly for amine analyses.

*Amine analyses.* The automatic ion exchange chromatographic method described earlier [9] was used. An ICAP-10 integrator was coupled to a fluorometer for quantification of amines, using 1,7-diaminoheptane as internal standard. Due to the high level of mucilaginous material in *U. intermedia*, the amino acid composition could not be analysed in this plant.

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