The Cestode Echinococcus multilocularis in Foxes in North Dakota

Abstract. *Red foxes* (Vulpes fulva) *from Ward County, North Dakota, were found to be infected with the cestode* Echinococcus multilocularis, *a parasite which has not hitherto been reported in the United States.*

Echinococcus multilocularis was reported first from North America by Rausch (*1*) who found adult cestodes in red foxes (*Vulpes fulva*) from Point Barrow and in Arctic foxes (*Alopex lagopus*) at Icy Cape and Wainwright on the Arctic Coast and inland near the northern edge of the Brooks Range, all in Alaska. With the exception of the last locality, the brown lemming was the common microtine intermediate host present in the area where the foxes lived. Because of the wide distribution of *Echinococcus multilocularis* in Alaska, Rausch (*1*) believed that it would be introduced into holarctic hiboreal regions of southern Canada and the United States, if, indeed, it was not already there. An abundance of microtine rodents and foxes in these regions provides hosts for the parasite. Six years later Choquette, McPherson, and Cousineau (*2*) discovered *E. multilocularis* in Arctic foxes at Eskimo Point on the western coast of Hudson Bay in Northwest Territories, the first reported occurrence on the Canadian mainland.

One of us (P.D.L.) found six of nine red foxes in Ward County, North Dakota, infected with adult cestodes that appeared to correspond with the descriptions of *E. multilocularis* given by Rausch (*1*), Vogel (*3*), and Yamashita *et al.* (*4*). Examination of 19 stained preparations of these cestodes by us and ten by personnel of the Communicable Disease Center of the U.S. Public Health Service (*5*) definitely identified them as *E. multilocularis*.

This first record of isolation of *E. multilocularis* from the United States amply confirms Rausch's postulation of its widespread distribution. This isolation also emphasizes that *E. multilocularis* is far more common than has been heretofore recognized in North America.

While Rausch (*1*) emphasized that this parasite goes through a sylvatic cycle (fox to microtine rodent to fox), others have pointed out that various species of domestic animals can serve as hosts. For example, Vogel (*6*) suggested that in urban areas there could be a domestic cat, house mouse, cat cycle. Thus this cestode would appear to have a greater role in zoonotic public health. Vibe (*7*) reported having infected dogs with *E. multilocularis* from livers of sheep containing the hydatids. Petrov and Lukoshenko (*8*) infected five of eight cats with adult parasites by feeding them livers of white mice and cotton rats containing alveolar hydatids. The viability of the eggs of the parasites was demonstrated by successful infection of white mice.

With a better understanding of the morphological differences between adults of *E. granulosus* and *E. multilocularis*, as pointed out so clearly by Rausch (*1*), a reexamination of specimens already in collections and critical evaluation of those collected in the future should clarify the distribution of these two species of cestodes in North America.

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References and Notes

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Preservation of Chlorophyll in Leaf Sections by Substances Obtained from Root Exudate

Abstract. *Root exudate of sunflower plants was purified by means of paper chromatography. Two zones of the chromatogram were active in retarding senescence of barley leaf sections.*

The protein content of excised leaves decreases rapidly. A visible sign of this decrease is yellowing of the blade due to chlorophyll degradation. The breakdown of protein and chlorophyll can be retarded when the cut leaves are supplied with kinetin (6-furfurylaminopurine). This observation was first made in detached primary leaves of *Xanthium pennsylvanicum* by Richmond and Lang (*1*). Mothes and co-workers showed that a kinetin-treated spot of an isolated tobacco leaf remained green and attracted metabolites from the yellowing parts of the blade (*2*). Kinetin sustains RNA synthesis in cut leaves and thus affects protein metabolism (*3*). Although kinetin is active in a wide variety of plants (*4*), it has no effect on cut autumn leaves of cherry where, however, certain auxins retard senescence (*5*).

Aging of excised leaves is prevented or even reversed by the formation of new roots on the petiole. This fact led to the hypothesis that certain factors supplied by the root are responsible for regulating protein metabolism in the leaves (*6*). Recently Kulaeva tested root exudate for its capacity to retard chlorophyll breakdown by applying it directly to detached tobacco leaves (*4*). The response obtained was comparable to that induced by a low kinetin concentration, and it disappeared within a relatively short time.

This report describes evidence for the presence of two factors in root exudate which are active in delaying chlorophyll degradation in leaf sections. Sunflower plants (*Helianthus annuus*) were grown in natural greenhouse conditions for 8 weeks to a height of 50 to 60 cm. They were topped just below the cotyledonary node, and exudate was collected from the stump three to four times daily for three consecutive days.

The sap was frozen immediately after collection and dried in a lyophilization apparatus. The residue was chromatographed in an ascending system on Whatman No. 3 paper with a mixture of *n*-butanol, acetic acid, and water (4:1:1 by volume) as solvent. After the solvent front had moved 20 cm the paper was dried and cut into 2-cm strips; the fractions were eluted with 80 percent ethanol and tested for their capacity to retard chlorophyll degradation on sections of barley leaves. The barley was grown at 20°C under continuous illumination for 13 days. At this time the first leaf was fully expanded and the second had just begun to appear.

Plants were selected for uniformity, and a piece of each leaf was cut