SOME METABOLIC ADAPTATIONS OF INSECTS THAT FEED ON XYLEM FLUID

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Xylem fluid is the most dilute and has the lowest chemical diversity of any plant tissue. The osmolality of xylem is typically 10 to 20 mM, and mainly consists of monomeric organic compounds (19 amino acids, 7 organic acids and 3 or 4 sugars), proteins (peroxidases, etc.) and inorganic ions. For Citrus and Vitis, the contribution of free amino acids in protein form is far less than free amino acids. The amino acid profile of xylem fluid is highly unbalanced. The amides, glutamine and asparagine, are the most abundant nitrogen form of transport in xylem fluid in most woody plants that we have investigated, and may account for over 75% or more of total free amino acids. Citrus xylem fluid is an exception where proline is a predominant amino acid. The chemistry of xylem fluid is highly variable within a plant species and is dependent on time of day, season of the year, soil fertility, and light levels. Xylem fluid is also under considerable tension, and ostensibly the extraction of fluid requires a considerable expenditure of energy. Thus, the chemical and physical properties of xylem fluid are in constant flux. Most of our leafhopper database is in reference to *Homalodisca vitripennis* Germar (formerly *Homalodisca coagulata* Say), but we have also examined *Homalodisca insolita* (Wlk) and *Cuerna costalis* F. Xylopagous leafhoppers are economically important since they transmit the bacterium, *Xylella fastidiosa*, which incites Pierce's disease, citrus variegated chlorosis and numerous scorch diseases in the Americas. The dilute nature of xylem fluid has led to several adaptations by xylophagous leafhoppers. They may feed at rates exceeding 100 times their dry body weight per day. *H. vitripennis* is highly polyphagous and may feed on hundreds of different plant species. Both the food source (xylem fluid) and insect excreta have been extensively analyzed. Host plant acceptance is based on gustatory sampling and is a function of the nutritional compliment of xylem fluid. Leafhopper abundance (host selection) is linked to the chemistry of xylem fluid. Our database indicates that glutamine is a phagostimulant for adult *H. vitripennis*. The N:C ratio of xylem fluid is higher than that any plant tissue and higher than that of pure protein. Leafhoppers ability to subsist on such dilute carbon diets is a result of assimilated efficiencies exceeding 99 % for organic compounds including amino acids, organic acids and sugars. The excretion of ammonia as a primary waste product confers maximum carbon assimilation efficiencies (95 to 99 %) and maximum caloric gain. By contrast, nitrogen retention is generally less than 60 % of that ingested. This pattern is opposite of that observed for aphids and other phloem feeders where 2 to 20 % dietary nitrogen and 70 % carbon is excreted. Feeding rates and the nutritional content of xylem fluid are generally highest during midday, whilst xylem tension is also at a maximum. The only experiment involving a water stress level that precluded feeding was when plants approached a condition of permanent wilt. The elucidation of chemical and physical plant properties in determining leafhopper behavior and performance may have great utility in controlling *X. fastidiosa*-mediated diseases.