An hypothesis on complementary amino acids in nectar

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ABSTRACT: Differences in the amino–acid composition of nectar may promote cross–pollination.

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The presence of amino acids in nectar is well known and perhaps ubiquitous (see Baker & Baker, 1976, 1982, 1983 for examples and thorough reviews). All floral nectars so far tested contain some amino acids in concentrations between 0.19 to 4.63 μmoles/ml; the concentrations seem to reflect the nutritive needs of flower visitors. Nectars of flowers pollinated by settling moths and butterflies are richer in amino acids than are nectars of flowers pollinated by bees and wasps. The former have few sources of amino acids in their diets as adults whereas the latter consume such protein–rich foods as pollen or insect prey. Nectars of flowers pollinated by carrion and dung insects are the richest in amino acids, perhaps reflecting the pollinators' dietary needs. Particularly interesting is the remarkable constancy of the amino–acid complement of nectar from flowers of a given species, in or among populations, and additivity of the complements in species of hybrid origin. This constancy is maintained even where the sexes of the flowers are different (Baker, 1978). Baker (1976) had already noted that "no single nectar contains all the protein–building amino acids ... However, it must be remembered that the great majority of flower visitors in the tropics take nectar from one plant species...."

Ten amino acids are essential in the diet of insects; the others can be synthesized (Chapman, 1983). The ten essential amino acids are: arginine (0.9), isoleucine (0.73), threonine (0.67), valine (0.76), leucine (0.66), phenylalanine (0.55), tryptophane (0.48), lysine (0.40), methionine (0.20) and histidine (0.19) (Chapman (1983: 87); numbers in parentheses indicate the frequency of occurrence of each amino acid in nectar according to Baker and Baker, 1983). It is noteworthy that some of the most frequent amino acids in nectar, alanine (0.96), serine (0.89) and proline (0.87) are not essential.

In diecious plants with nectariferous flowers, especially trees which produce enough nectar for the needs of an individual pollinator, the pollinators are sometimes more or less confined to one plant gender and cross pollination could be restricted because of relatively few intermorph bouts of foraging (Stephenson, 1989). There is then an open question, how can floral rewards "reinforce" movements between the two separated genders, especially in trees? To address this problem we propose the following hypothesis: Diecious species (especially trees) may have nutritionally complementary sets of essential amino acids for their pollinators, especially when the latter feed solely or mainly on nectar. The anthophiles' need for nectar from flowers of both genders could serve as a drive for their making intermorph visits and thus causing cross–pollination.

Evidence in support of this hypothesis is wanting and Baker's (1978) data do not support the idea. However, a more detailed examination of the amino acid complements of floral nectar of diecious trees pollinated by settling moth or butterflies may be rewarding.

A situation analogous to the one we propose occurs in *Freycinetia reineckei.* Cox

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(1984) showed that in this bat–pollinated plant, the flowers do not produce nectar, but the floral bracts are eaten by bats. The male bracts contain 18 amino acids while the females only 10. Four of the amino acids in the females which are absent in the males, are regarded as essential amino acids (arginine, lysine, valine and tryptophan). Although Cox did not postulate nutritional complementarity by the two genders it is logical to assume that the bats (mainly the flying fox *Pteropus samoensis*) benefit more by consuming both sexes of flowers than by restricting their feeding to one. Another related situation is described by Appanah (1982) who found in *Xerospermum intermedium* (a dimorphic species, separate male and hermaphrodite trees) ≈ 49 nmols/ml amino acids in the male flowers and 290 to 585 nmols/ml in the hermaphrodite flowers. The nectar contains 14 amino acids (6 of which are essential), which are qualitatively similar for both sexes. The pollinators are mainly meliponid bees of the genus *Trigona* which visited both sexes of trees similarly. The bees gather mainly nectar and never gather only pollen at the male plant while on the hermaphrodite plant they forage only for nectar. Appanah considers the difference in nectar quantity as a factor that may promote inter–tree movements of pollen vectors between the sexes.

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