Understanding Nutrition

AMINO ACIDS — THEIR SOURCE AND UTILIZATION

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In the first article of this series which appeared in the last issue of THE WATCH-BIRD, Leibig's Law of Minimums was discussed. Briefly stated it says that the growth of an organism depends not upon the factors which are abundant, but upon those factors which are in short supply. Throughout this series we shall continually return to this principle. In the material presented below we shall examine the amino acid requirements of animals, especially birds.

The amino acid is an important molecule for several reasons: first and foremost is their incorporation into proteins, and secondly their utilization by the organism as basic building blocks for many other biologically important compounds. This latter concept we shall not consider at present but shall place emphasis on the first. Listed below are the various functions of proteins. Proteins are simply long chains of amino acids joined together. The sequence of amino acids is very precise and an amino acid in good supply will not substitute for an amino acid in short supply. This list should impress the reader of the importance of these basic building blocks — the amino acids.

Functions of proteins:

a. Enzymes — speed up the chemical processes in the cell.
b. Structural proteins — these include parts of cells, bones, feathers and claws.
c. Hormones — regulations of growth and changes that result as an animal becomes an adult. (Not all hormones are proteins it should be noted.)
d. Antibodies — proteins which defend the organism against invasion by harmful foreign organisms like viruses and bacteria.
e. Contractile proteins — these are the muscle proteins that are necessary for flight, movement and other activities.
f. Transport proteins — many important small molecules (i.e. some vitamins) are carried in the blood by these proteins.
g. Storage proteins — these provide a source of amino acids for the next generation. The yolk and white of an egg fall into this category. From the above list it stands to reason that if an amino acid is in short supply, inadequate amounts of any or all of the above proteins could be found in a bird leading to a substandard health profile.

Just what are amino acids and where do they come from? Amino acids are chemical compounds as shown in the generalized structure in Figure 1. The chemical group containing the nitrogen is the amino group. The chemical group COOH has acid properties (vinegar or acetic acid has the chemical formula of CH_3-COOH). Thus the name amino acid. Most of the amino acids readily dissolve in water. There are 20 amino acids found in animal proteins. All have the same basic structure as shown in Figure 1 but vary only in the groups represented by R.

Where do amino acids come from? In the biological world only bacteria and plants can synthesize all the amino acids. Animals can synthesize only certain ones but require all of them. For example, man needs 20 different amino acids in his body to synthesize the necessary proteins. Of these 20, man can make all but 8. These eight amino acids (called essential amino acids) must be obtained from the diet. Every animal known has a quota of essential amino acids. The chicken is perhaps the best known bird for which the essential amino acids are known. These number around twelve. At present the essential amino acids are not known for any exotic bird.

Amino acids are usually not found in large amounts in the free form but in the long protein chains. This fact requires that if an animal such as a bird is to get its amino acid compliment, it must break down these proteins into the individual amino acids and then rebuild them into its own proteins. This is stated here because there is a common misconception that proteins are absorbed by an animal from its diet. At present the best information available shows that this information is not true and that proteins must be broken down before they are absorbed.

While it is probably possible for a carnivore to obtain its required amino acids from a single prey animal, the vegetarian animal, as many seed-eating birds mainly are, is not so lucky. The reason for this is that a single vegetable protein usually does not contain adequate quantities of all the

essential amino acids. Since we know almost nothing of the amino acid requirements of even the commonest cage bird let us look at a human example to demonstrate a point. Corn is a good source of most amino acids but is low in an essential amino acid called lysine. Legumes (beans) are high in lysine but low in another essential amino acid – methionine. If, however, a man eats a combination of these two (corn and beans) he will get all the essential amino acids that he needs.

In the science of aviculture the ideal breeding situation would be to know the precise amounts of amino acids required by each species of bird. Then a proper seed mixture could be developed. This is not at all practical or possible at this time. The chicken is the only fowl that has its nutritional requirements known in any detail and this is because of its commercial significance. Since we do not know what is truly required for finch, psitticine, etc., our efforts must center around insuring an adequate availability in the seed mix and from there hope that the bird will eat correctly.

The practical consideration of this is the following. In order for the bird to obtain adequate amounts of specific amino acids, a **variety** of seeds must be available and these seeds should **compliment** each other with respect to the various amino acids present. Herein lies the importance of teaching your birds to eat a variety of foods. (It is interesting to note several articles that have appeared in THE WATCHBIRD and other bird journals written by successful breeders. If one will read these carefully, one will generally see a very complex feed mixture. Perhaps this is the factor that separates the consistent breeder from the casual one.)

The above explains the rationale by which better seed mixtures are made. The ideal seed mixture will not contain a predominant seed type. Such a mixture would allow the bird to eat exclusively of one type to the exclusion of the others.

It is often assumed that a bird "knows" its nutritional requirements and that it will choose what it needs at a particular time. This is perhaps one of the most dangerous nutritional fallacies. I once heard of a cockatoo which would eat only frozen peas. The reason it survived is that it probably ate enough peas to obtain its amino acid requirements, and the excess amino acids were excreted. It is imperative that the aviculturist never equate survival or even longevity of a bird with good health. The living organism has a remarkable ability to survive at suboptimal conditions.

There are perhaps some readers who might wish to challenge some of the above remarks by stating that they have had success in breeding even while breaking the above rules. Granted, it is difficult to argue with success. However, it would be interesting to compare these breeders' results with the results of those who use a varied diet and measure such factors as clutch size, clutch survival and second generation productivity.

In conclusion, I call upon the Federation to develop a research project that would measure the various amino composition of the seeds commonly used in aviculture and publish these so that the readers can have some security in making seed mixtures. A recent attempt at this was done by Richard Topper of Gilroy, California. He has developed a seed mixture which has balanced amino acid levels. These levels are published on every bag of seed mix. This is a very noteworthy step and one that should be followed by other commercial seed producers.

Figure 1. Generalized structure for an amino acid. The chemical symbols stand for the following: N = nitrogen, H = hydrogen, O = oxygen, C = carbon, R = a chemical convention that describes various chemical groups that attach at this point.