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NUTRITIONAL UTILIZATION OF AMINO ACID AMIDES AND ACID SALTS THEREOF

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The present invention relates to the use of amides of nutritional amino acids and the acid salts thereof as nutrients. More particularly the present invention relates to food compositions containing the amides of the nutritional amino acids or the acid salts thereof, and the method of obtaining proper nutrition through their use.

It has long been known in the art that in order to obtain proper nutrition, the diet of animals must contain certain amounts of nutritional amino acids.

Presently included within the category of nutritional amino acids are glycine, alanine, valine, leucine, isoleucine, phenylalanine, tyrosine, proline, hydroxyproline, serine, threonine, cysteine, cystine, methionine, tryptophan, aspartic acid, glutamic acid, arginine, lysine and histidine, although others can be expected to find future importance in this category. The nutritional amino acids have been divided into two categories: dispensable amino acids and indispensable amino acids. Dispensable amino acids are those amino acids which are necessary for proper growth metabolism and nutrition but which the animal can synthesize itself when presented with proper raw materials. The indispensable amino acids are those amino acids which are necessary for proper growth, metabolism, and nutrition but which cannot be synthesized by the animal system; these amino acids or their close derivatives *must* be present in its diet.

If an indispensable amino acid is not present in the diet in a sufficient amount, the growth of the animal is retarded and one or several deficiency diseases can result. If an indispensable amino acid is totally lacking from the diet for a prolonged period of time, death to the animal will result.

Classification of an amino acid as an indispensable or dispensable amino acid can only be determined for a given animal system. The number and types of amino acids indispensable to an animal system vary from species to species. For example, the rat requires an intake of ten amino acids as indispensable; man requires only eight.

In nature, animals generally fulfill their amino acid requirements through the intake of protein which is hydrolyzed in the digestive tract to form its constituent amino acids. Due to the relatively high cost, frequent lack of availability, weight and inefficient utilization of protein-containing foods, it is not always feasible or possible to provide animals with a diet which will meet all the amino acid requirements and thus insure optimum growth and good health of the animal. This is especially true of domestic animals and poultry where cost is a major factor. It is also true for man under certain conditions. Livestock and poultry feeds are generally manufactured from grain or vegetable materials which are available on the market at low cost. These feeds generally contain sufficient amounts of protein to provide sustaining amounts of all the amino acids but not always in sufficient amounts to maximize the growth of the animal, which is of extreme importance.

Deficiencies of animal feeds can generally be overcome by providing supplements to the feeds, and to the extent feasible this is done. However, due to the high cost and limited availability of amino acids, it is generally only feasible to use amino acid supplementation where the value of the animal justifies the increased cost. The cost of amino acid supplemented feed in the quantity necessary to feed general livestock, for instance, would not only be prohibitive but the expenditure might not be recovered in the growth increase obtained.

For man, the desirability of proper amino acid content and balance in the diet is of even greater importance. In countries of large population and low protein availability, the diet of the majority of the population may not meet the minimum amino acid requirements with the result that the growth and health of the population suffers. In every country the poorer element of society suffers from marginal amino acid diet due to the high cost of proper protein foods. Amino acid supplementation has now been shown to be of greatest potential importance in overcoming the protein malnutrition now being felt by a majority of the world's population, but again expense and lack of availability are prime deterrents.

In specialized areas where weight and bulk become prime factors, as in manned rocket flights, nutrition through use of pure amino acids becomes very important; protein foods are too heavy and bulky for the nutrition which they provide. When used for such purposes, cost and availability perhaps are less important, but toxicity levels become very important. Amino acids can be quite toxic in overdose or imbalance and measurement becomes critical.

Another important use of amino acids lies in nutrition of mutant strains of microorganisms which are of increasing practical value in carrying out synthesis of vitamins, biologicals, and even "heavy chemicals" by fermentation processes. A major U.S. industry is based on the growth and chemical activities of these bacteria, molds, and yeasts. Vast quantities of nutrients are being required to maintain special fermentation processes.

While, as has been stated, many of these problems might be overcome through the use of amino acids supplementation, the cost, unavailability, and toxicity of these compounds make their general use technically and economically unacceptable.

In accordance with the present invention, it has been found that the amides of the nutritional amino acids and the acid salts thereof can be effectively utilized to replace the corresponding amino acids for the nutrition of animals and microorganisms or can be used with standard dietary formulations as supplements to insure the adequate intake of amino acids. The amides of the nutritional amino acids and the acid salts of the amides of the nutritional amino acids can be produced economically and in large quantity at low cost—a fraction of that of the amino acids—which insures a ready availability. The amides of the nutritional amino acids and the acid salts thereof can be utilized as feed supplements and as ingredients in the preparation of culture media with greater facility than can the corresponding amino acids, as they are generally much less toxic, more soluble, and frequently more effective biologically.

The acid salts of the nutritional amino acid amides are more easily administered than are the corresponding nutritional amino acid amides due to their high solubility. The toxicity, however, of the acid salts is dependent upon the acid used and the animal system to which it is applied. For example, a hydrogen cyanide salt of methioninamide would be totally unacceptable for use with mammals as this acid would hydrolyze off from the amino group and would adversely affect the mammal, but certain bacteria might thrive on the hydrogen cyanide salt of methioninamide. The toxicity of the known acids in various animal systems is well known in the art. It is of course necessary that an acid salt be selected whose toxicity levels are such that no toxic effects shall be produced when a nutritional amount of the acid salt of the nutritional amino acid amide is introduced into a given animal system. The amides of the nutritional amino acids