# 5 Amino Acids, Brain Amines and Precursor Loading

Individual amino acids are the very basis of the successful use of the treatment program we have just outlined. It therefore may be helpful to know something of what they are and how they work.

There are twenty-two major identified amino acids that make up body protein. Many other minor amino acids that participate in body functions are less understood and new amino acids are still being discovered. Each one has its unique functions and potentials, yet all are necessary. Many scientists believe amino acids are the most elementary and essential of all food substances, even though all nutrients are interdependent. In fact, without amino acids we would have no structural bodies. While carbohydrates and fats give us energy with which to drive our body machines, twenty of the amino acids are the actual physical body builders that create "us" in the first place. They are imperative to the formation and maintenance of our skin, bones, muscles, blood, organs, hair and nails. They also help form our body's enzymes, hormones, antibodies and brain neurotransmitters.

Since amino acids are the very basis of the suc-

cessful nutritional treatment of depression, and since one of the most important aspects of obtaining a good diet is the balancing of amino acids, we'll take a closer look at the ways these food substances function.

## AMINO ACIDS AND PROTEINS

Each protein food is made up of a unique combination of amino acids, in a specific order. The body's need for protein is really a need for amino acids.

Of the basic twenty-two, there are ten essential and twelve nonessential amino acids. The label "nonessential" does not mean not important. All of the amino acids are vitally necessary and have their various and unique functions in your body. The essential ones can only be obtained from your diet, whereas the nonessential amino acids can also come directly from your diet or be created in your body by conversion from the essential dietary amino acids. In order for this conversion to take place, there has to be an adequate level of an essential amino acid left over after it has performed its primary functions in your body. Even then, the conversion can only take place when other nutrient and enzyme substances are present to facilitate the process.

Nature's irrepressible law of balance is persistently evident in our nutritional needs and is especially highlighted when it comes to amino acids and proteins. The essential amino acids must be consumed in proportions that closely approximate the pattern required by our bodies. The lowest level of an individual amino acid in a meal is called the limiting amount, and the meal is nutritionally useful only to that extent. For example, a lunch containing 100 percent of your body's phenylalanine requirement, but

only 20 percent of your tryptophan requirement, results in only 20 percent of the protein in that meal being used by your body for the vital functions of replenishing and building tissue. The rest of the protein you've eaten can be used only for fuel, thereby creating more of the unwanted waste products of urea and uric acid.

Some foods have the full range of essential amino acids in relatively balanced amounts. These are fish, fowl, red meats, eggs, milk, cheese, sesame seeds and pumpkin seeds. Other foods such as nuts, beans, rice, vegetables and grains have low levels of certain amino acids and adequate levels of others. To be effective in building tissue, the full range of essential amino acids must be eaten at the same time, not part at one time of day and the rest at another time or on another day. Therefore, when some amino acids are low or completely missing in a food, that food must be combined with a complementary protein food which makes up for the deficiency in order to provide amino acid balance. Such combining is well described in the popular book *Diet For a Small Planet,* by Frances Moore Lappé.

The RDA (Recommended Dietary Allowance) for amino acids has little practical value, as Doctors Roger Williams, Jeffrey Bland and others have demonstrated in their research on biochemical individuality. Each person is unique in his needs for all nutrients. These variations can be marked, so there are considerable differences between individuals in their amino acid requirements. You may need four times as many amino acids as your husband, for instance. Perhaps some cases of depression are only secondary to an individual having an unusually high need for certain amino acids. Or stress may create a situation in which nonessential amino acids cannot be adequately produced to meet our brains' needs.

Also, a nonessential nutrient can become essential when our body processes fail to work optimally in their conversion processes.

The basic amino acids are listed below.

Often in my practice I do an analysis of my patients' diets. Among other things, this reveals how many grams of protein they are eating daily and what the amino acid breakdown of the protein is. Even when the total protein intake is in the normal range of 45 to 80 daily depending on size, age, and physical

| ESSENTIAL AMINO ACIDS | SUGGESTED OPTIMUM DAILY INTAKE |
|---|---|
| Phenylalanine | 4100–6600 mg |
| Tryptophan | 1000–2000 mg |
| Arginine* | Not available |
| Histidine* | Not established |
| Leucine | 7300–12,200 mg |
| Isoleucine | 5200–8600 mg |
| Lysine | 7000–12,000 mg |
| Methionine | 2400–3700 mg |
| Threonine | 3600–6100 mg |
| Valine | 5300–9300 mg |

| NONESSENTIAL AMINO ACIDS | |
|---|---|
| Proline | Asparaganine |
| Taurine | Aspartic acid |
| Tyrosine | Ornithine |
| Glutamine | Serine |
| Glutamic acid | Alanine |
| Cysteine | |
| Glycine | |

*These two are essential and important in youth and old age but not during the inbetween ages.

activity, some of the component amino acids are often low because, although they are eating *enough* protein, it is not good quality. Even excessive intake, such as 100 to 150 of protein daily, can still result in amino acid deficiency. This pattern, together with high fat intake, is often found in those who eat large amounts of dairy products.

The usability of protein from various foods is as follows in decreasing order of availability:

1. Fish
2. Poultry
3. Red meats
4. Cottage cheese
5. Sesame seeds
6. Pumpkin seeds
7. Peanuts
8. Brazil nuts
9. Almonds
10. Cashews
11. Lentils
12. Soybeans
13. Garbanzo beans
14. Lima beans
15. Brown rice
16. Eggs
17. Milk
18. Cheese

*Information abstracted from *Nutrition Almanac*, Nutrition Search, Inc., John Kirschman, Director. New York: McGraw-Hill, 1973.

## METABOLIZING AMINO ACIDS

Interestingly, some studies show only 60 percent of apparently healthy people have normal levels of *all* the amino acids in their blood.

As you have seen, one reason for such deficiencies is that we eat protein in forms that don't include a full range of the amino acids. Additionally, food protein contains amino acids in what is called a "bound" form, where chains of several amino acids are linked together. When you eat protein your digestion, assimilation and metabolic processes must operate to release or separate the amino acids from the chain or bound form into what is called the "free form" state. If this separation process does not take place, the protein is useless to you.

Here are the basic requirements for the healthy metabolism of amino acids:

1. You regularly eat enough, but not too much, amino acid balanced protein or properly combine those proteins which are not complete to achieve an overall balance.
2. You have no problems digesting this protein and breaking the chains down into their component amino acids.
3. All the other necessary ingredients and nutrients which interact with each amino acid are also available in your body:
   a) A large number of digestive enzymes, many of which are formed by amino acids. Poor usage of amino acids creates digestive enzyme deficiencies, which in turn lead to even less efficient digestion of protein.
   b) Vitamins and minerals. Amino acid deficiencies are prominent in persons with vitamin deficiencies because certain vitamins and minerals, especially $B_6$, $B_3$ and $B_{12}$, are necessary for the metabolism of protein.
4. There are no genetically determined variations in your usage, metabolism or need for amino acids.
5. All the other body functions that involve amino acids are operating normally.
6. You do not have severe stress interfering with these basic metabolic processes.

## PRECURSORS AND PRECURSOR LOADING

Certain neurotransmitters are among the most critical chemicals formed by amino acids. Since a deficiency of certain neurotransmitters can cause depression, how can we increase their quantities in our brains?

Key neurotransmitters like norepinephrine, serotonin, dopamine, acetylcholine and histamine are known to be precursor dependent. Because of this

they can be increased by the process called "precursor loading"—increase the amounts of the precursors in your diet to increase the amount of the end products in your brain. Each meal you eat alters and modifies the amount and nature of these particular neurotransmitters in your brain. "Precursor loading" means eating more of the nutrients that the body converts into the neurotransmitter.

As we've seen, simply eating more food protein does not guarantee such a process. Further, the different amino acids actually compete with each other for absorption, so that even when they are all present together in the digestive system some are more readily absorbed than others.

For precursor loading to be effective the amino acids must be taken separately in the form of singular free form amino acids—and taken in large enough quantities to ensure that enough of the final products do reach the brain to form the neurotransmitters.

In a person experiencing a normal mood, we can assume that dietary protein, as well as certain vitamins and minerals, are present in sufficient quantity, that the metabolism is normal, and the brain is functioning properly in regard to mood regulation. This person does not need singular free form amino acid precursor loading to feel well. But when a person has low moods, he probably has nutritional deficiencies or poor metabolism, or both. Such an individual needs precursor loading to achieve normal neurotransmitter levels.

Since the neurotransmitters serotonin and norepinephrine are the brain amines most important to the cause and relief of depression, increasing their precursors in your diet is the direct route to increasing the levels of these essential chemicals in your brain. This, in turn, will improve the biochemical function-

ing of your brain to specifically counteract any tendency toward depression that you may have.

The precursor to serotonin is the amino acid L-tryptophan. The precursors to norepinephrine are the amino acids L-tyrosine and L-phenylalanine. If the precursors are chronically deficient, the neurotransmitters they form will also be low.

A current study by Aatron Medical Laboratories indicates *none of the depressed persons examined have had completely normal blood amino acid levels.* So far, the five hundred patients analyzed show a pattern of low tyrosine, phenylalanine and tryptophan. Fifty percent of them have low glutamine, which is another important brain fuel and stimulant.

## L-TRYPTOPHAN AND SEROTONIN

As we have seen, L-tryptophan is one of the essential amino acids and the required intake for optimum health in the "normal" person is 1000 to 2000 mg daily. The person with depression may be getting less than this amount, or may actually need more because of various metabolic problems. Paradoxically, merely eating extra protein to try to get more tryptophan will actually give you less, because of the competition from other amino acids. (On the other hand, a high carbohydrate and low protein meal will stimulate insulin production, which helps drive more tryptophan into your brain.)

Tryptophan is carried into your brain, where it is converted to serotonin and then released to carry messages as a neurotransmitter. These messages influence your mood, sleep, appetite, sex drive and pain perception, and the secretion of certain hormones. They also aid in the inhibitory control of a variety of complex behaviors. Increasing brain serotonin levels

decreases the perception of pain and stimulates the sex centers in the male and female brain. Evidence now supports the role of a serotonin deficiency in depression, alcoholism, eating disorders, chronic pain, short attention span in childhood, seizure disorders, violent behavior and Alzheimer's disease.

Serotonin's role in normal sleep has been getting a lot of attention recently. When a normal body biorhythm is operating, serotonin naturally increases at night to promote the onset of sleep. Low serotonin levels are therefore related to certain cases of insomnia.

Extensive research has shown that there are reduced levels of serotonin in the brains of some depressed people. There is also a link between low serotonin levels and suicidal or aggressive impulses. Autopsies on many suicides reveal a low brain serotonin content. A recent study also found a 44 percent increase in the number of serotonin receptors in a part of the brain of suicide victims. It is speculated that there is a need for more sensitive and a greater number of receptors when serotonin availability declines. It's as if the brain is hungry for this particular brain food and develops many extra receptors to try to gobble it up.

The chemical reaction and necessary ingredients for the formation of serotonin from tryptophan are listed in the appendix.

## L-PHENYLALANINE, L-TYROSINE AND NOREPINEPHRINE

L-phenylalanine is another essential amino acid that the body cannot manufacture from the other amino acids. L-tyrosine is nonessential and can be obtained from the conversion of L-phenylalanine.

The optimum dietary intake of phenylalanine is

4100 to 6600 mg daily for the person with normal metabolism and conversion processes. Your body will derive part of the tyrosine it needs from this phenylalanine and part directly from your diet. Eating more protein helps increase the levels of these amino acids in your brain. The best food sources are meats, eggs and dairy products. However, food sources alone will not provide the pure forms and quantities necessary for correcting low moods and depression.

Two neurotransmitters, norepinephrine and dopamine, can be derived from tyrosine and phenylalanine. (Low dopamine is also implicated in some depressions, but the focus of this book remains with serotonin and norepinephrine.)

Norepinephrine is involved in mood and appetite regulation, and influences those centers of the brain having to do with reward and punishment behavior, specifically helping one to feel purpose, pleasure and gratification with a consequent elevated, positive mood. Norepinephrine is also important in promoting drive, ambition, alert mental functioning and memory.

The synthesis pathway of norepinephrine from precursors is detailed in the appendix.

## ENZYMES AND COENZYMES

Enzymes and coenzymes are substances whose presence makes chemical reactions possible. Vitamins $B_6$, C, biotin and folic acid, as well as the minerals magnesium, zinc, copper, iron and manganese, are coenzymes necessary for creating the chemical changes we are discussing. They are essential to the success of the process. Pancreatic enzymes are also necessary.

A deficiency in any of these can indirectly lead to lowered mood because any chain of metabolic events in the body is only as good as its weakest link. A reaction depending upon seven nutrients cannot occur properly if only six are there in sufficient amount. This again underlines the importance of nutritional balance. *No single vitamin, mineral or amino acid functions entirely on its own.*

## CONCLUSION

Tryptophan, L-tyrosine and L-phenylalanine are amino acids that act as precursors to brain amines. If for any reason the body does not have sufficient quantities of these substances, low moods and depression are the likely result. And, of course, the prevention and treatment of these conditions is dependent on these "big three" of the amino acids.