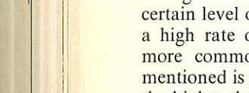
Amino Acids and Protein

SOME OF MY RESEARCH over the past few years has involved determining the amino acid requirements of laying hens. It seems that any studies with protein and amino acid needs are never too far out of fashion. Just wait for the price of soyabean meal to start going up, and protein and amino acid research becomes important. And like the weather, it seems that we do not have to wait very long for the price of soyabean meal to change.

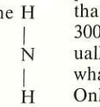
Regardless of the price, a hen needs a certain level of nutrients for her to have a high rate of production. One of the more common nutrient levels that is mentioned is protein content. Generally, the higher the protein content of a feed, the more it costs. From a dollars and cents standpoint, a feed should have enough but not much extra.

Most people talk of a protein requirement for poultry: However, I do not know of any evidence that there is such a thing as a protein requirement for poultry. After such a rash statement, I had better do some fast explaining. In the true sense of the word, a protein is made up of amino acids. Proteins are made of amino acids and they must also have a minimum number of amino acids hooked together before qualifying as a protein. Insulin is one of the smallest proteins and contains about 55 amino acids hooked together.

Before going on to defend my statement about protein requirement, let me talk a little more about amino acids. The general formula for an amino acid is:



The COOH is the acid part, and the



is the amino part.

The thing which makes amino acids different from each other is found in the R group or side chain. There are about 20 different amino acids in the average protein, just as there are 26 letters in our alphabet. Of these 20 amino acids, about 9 of them are essential. Essential means that the chicken cannot make them fast enough to meet its needs for growth or production, so these amino acids must be supplied in adequate amounts in the feed. The chicken can make the nonessential amino acids, so these would not have to be supplied by the feed.

The proteins in poultry feed come mostly from plants and are made up of about 20 different amino acids. An average protein has 300 to 500 amino acids hooked together. If the amino acids remain hooked together, then the protein is useless to the chicken. Before that protein is of any use, each of these 300 to 500 amino acids must be individually separated from each other. This is what occurs in the process of digestion. Only as individual amino acids can they pass from the digestive system to the blood so that the amino acids can be used by the chicken.

That is my explanation for why a

(Continued on page 64)

Aminosäuren und Protein

Zusammenfassung—Ein Teil meiner Forschungsarbeiten der vergangenen Jahre beschäftigte sich mit der Bestimmung des Aminosäurenbedarfs von Legehennen. Um mit hoher Produktionsrate aufwarten zu können, braucht die Henne bestimmte Nährstoffmengen—egal, was die dafür erforderlichen Nährstoffträger im Futter auch immer kosten mögen. Von den Nährstoffgehalten des Futters wird Protein am häufigsten erwähnt.

Die meisten Leute reden vom Proteinbedarf des Geflügels. Mir ist allerdings nicht ein einziger Beweis dafür bekannt, dass es so etwas überhaupt gibt. Um es genauer zu sagen: Protein besteht aus Aminosäuren.

In einem durchschnittlichen Proteinbaustein befinden sich ca. 20 verschiedene Aminosäuren. Von diesen 20 Aminosäuren sind rund 9 sogenannte essentielle Aminosäuren. Unter essentiell ist zu verstehen, dass das Huhn nicht in der Lage ist, diese Aminosäuren zur Stützung des Körperwachstums oder der Produktionsleistung selbst schnell genug zu synthetisieren, so dass besagte (essentielle) Aminosäuren in adäquaten Mengen im Futter vorhanden sein müssen. Ein durchschnittliches Protein besteht aus einer zusammenhängenden Verbindung von 300—500 Aminosäuren.

Ehe Protein überhaupt verwertet werden kann, muss jede dieser 300—500 Aminosäuren einzeln aus dieser Verbindung gelöst werden. Und genau das geschieht beim Verdauungsvorgang. Denn nur einzelne Aminosäuren können aus dem Verdauungssystem in die Blutbahn übergehen, um so vom Huhn verwertet zu werden.

Amino Acides Et Protéines

Sommaire—Dans une partie de mes recherches de ces dernières années, j'ai essayé de déterminer les besoins en amino acides des pondeuses. Quel qu'en soit le prix, une poule a besoin d'une certaine quantité d'éléments nutritifs pour obtenir un taux élevé de production. Une des concentrations les plus courantes mentionnées en ce qui concerne les éléments nutritifs est la teneur en protéines.

La plupart des gens parlent des besoins en protéines des volailles; mais je n'ai aucune preuve de l'existence d'une telle chose. Selon le véritable sens du mot, une protéine est faite d'amino acides.

Il existe environ 20 amino acides différents dans la protéine moyenne. Sur ces 20 amino acides, environ 9 d'entre eux sont indispensables. Indispensable signifie que les poulets ne peuvent pas les faire assez rapidement pour répondre à leurs besoins de croissance ou de production, aussi faut-il fournir ces amino acides en quantité suffisante dans la nourriture. Dans une protéine moyenne il y a de 300 à 500 amino acides liés entre eux.

Avant qu'une protéine ne soit utile, chacun de ces 300 à 500 amino acides doit être séparé des autres. C'est ce qui se passe dans le processus de digestion. Ce n'est qu'en temps qu'amino acides individuels qu'ils peuvent passer du système digestif au sang où ils peuvent être utilisés par le poulet.

Aminoácidos y Proteína

Resumen—Parte de mis investigaciones de los últimos años han comprendido determinar los requisitos de aminoácidos de gallinas de postura. Sin consideración del precio, la gallina necesita cierto nivel de nutrientes para tener un alto régimen de producción. Uno de los niveles de nutrientes más comunes que se menciona, es el contenido de proteína.

Muchas personas hablan de un requisito de proteína para aves. Sin embargo, no tengo ninguna prueba de que haya tal cosa. En el verdadero sentido de la palabra, la proteína se compone de aminoácidos.

En la proteína de tipo promedio hay unos 20 aminoácidos diferentes. De estos 20 aminoácidos, 9 de ellos podrían ser esenciales. Por "esenciales" se quiere decir que la gallina no puede generarlos con bastante rapidez para satisfacer sus necesidades de desarrollo o producción, de modo que estos aminoácidos deben ser suministrados en cantidades adecuadas en el pienso. La proteína promedio tiene 300 a 500 aminoácidos.

Antes de ser útil la proteína, cada uno de estos 300 a 500 aminoácidos debe ser separado de los restantes. Esto es lo que ocurre en el proceso de la digestión. Solo en carácter de aminoácidos individuales pueden pasar del aparato digestivo a la sangre, para que los aminoácidos puedan ser aprovechados por el ave.

Amino-acidi e proteine

Riassunto—Nelle mie ricerche degli ultimi anni ho cercato di determinare il fabbisogno di amino acidi delle ovaiole. Senza tener conto del costo, le ovaiole hanno bisogno di un certo livello nutritivo per poter raggiungere un alto tasso di produzione. Uno dei livelli nutritivi più menzionati é quello di proteine.

Si parla molto del bisogno di proteine del pollame; non esiste tuttavia una prova evidente che esista una tal cosa. Nel vero senso della parola, una proteina é fatta di amino-acidi.

Vi sono differenti amino-acidi nella proteina media. Di questi 20 amino-acidi, circa 9 sono essenziali. Il che significa che il pulcino non può produrli abbastanza rapidamente per soddisfare il suo bisogno di crescita o di produzione. Quindi questi amino-acidi devono esser aggiunti al mangime in quantità adeguate. In una proteina media si trovano legati l'uno all'altro circa 300-500 amino-acidi. Per poter usar bene la proteina bisgona separare individualmente ciascuno dei 300-500 amino-acidi.

Questo succede durante la digestione. Solo come amino-acidi individuali possono passare dal sistema digestivo al sangue ed esser usati cosi' dai pulcini.

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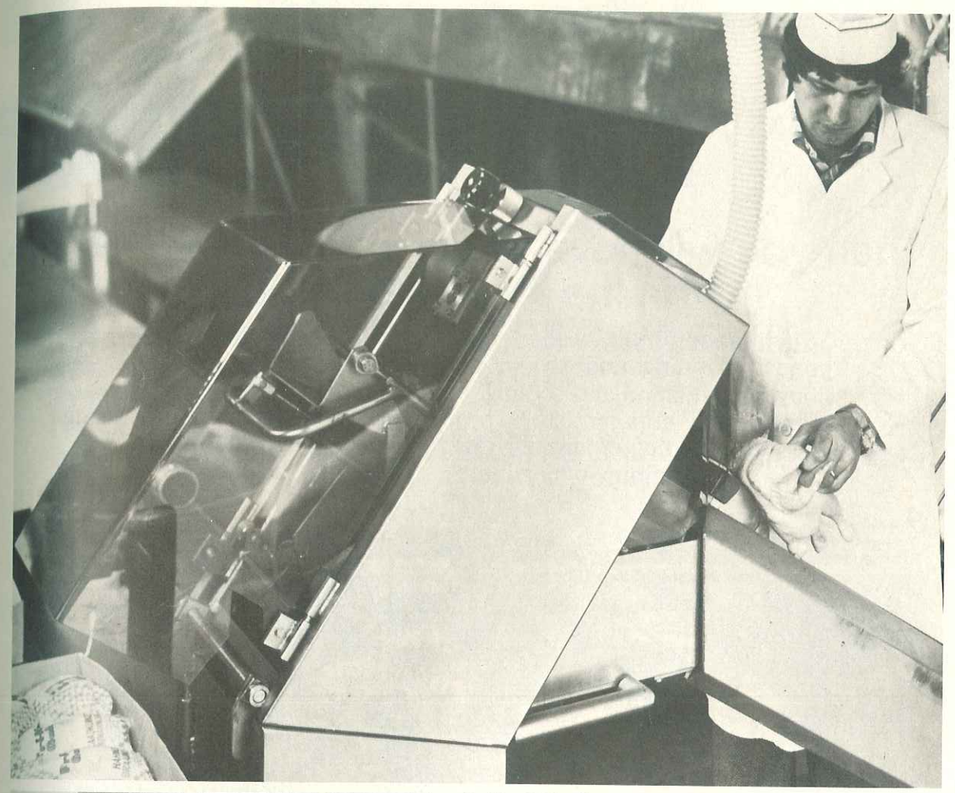

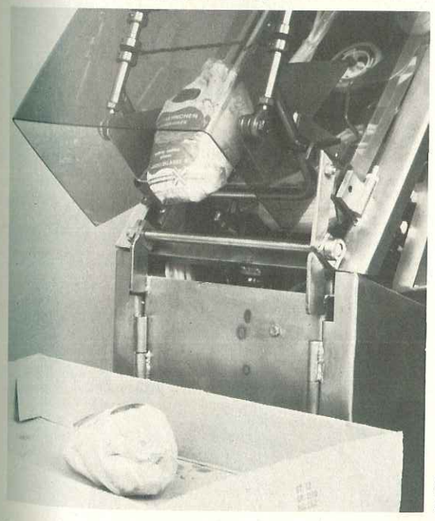

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Amino Acids and Protein

Continued from page 60

chicken does not have a protein requirement. I think it is much better to talk about an amino acid requirement. If a chicken actually had a protein requirement, then we could not feed it chemically pure amino acids out of a bottle and have it grow and produce eggs. However, we can feed a diet with no protein, as I defined it, but adequate in amino acids and have the chickens do well. The other side of the story is that a nutritionist can formulate a diet which meets recommended protein levels but is inadequate in amino acids, and chickens will perform poorly if fed this diet. Under practical poultry conditions it is too expensive to get our amino acids out of a bottle. So we feed protein and make the chicken digest it in order to get the amino acids it needs.

While talking about protein and amino acids, it might be good to mention how each is determined. Determination of both protein and amino acids is done by chemical procedures in a laboratory. For finding the protein content, we make use of the fact that each amino acid has at least one nitrogen (N) molecule in it. By using severe acid and heat conditions, amino acids can be torn apart so that the nitrogen in the amino group can be turned into ammonia.

The ammonia can then be trapped and measured and the amount of nitrogen calculated. It has been found that the average nitrogen in a protein is 16% of the protein weight. Therefore, to convert the amount of nitrogen to the amount of protein, we divide by 0.16 or multiply by 6.25 × (100/16). This procedure, called the Kjeldahl procedure, provides a good estimate of the protein content of feed ingredients.

The one serious drawback of this procedure is that it can convert any kind of nitrogen to ammonia, not only that in amino acids. For instance, if someone spiked poultry feed with urea or a high nitrogen fertiliser, the Kjeldahl procedure would show a high protein content. However, the performance of the chicken would soon tell you that it cannot use nitrogen which is not in an amino acid.

To determine the amounts of amino acids in a feed, the conditions must be less severe than those used in the Kjeldahl procedure. The amino acids in the protein must be unhooked from each other, but the individual amino acids should not be destroyed. This is done with the proper acid and heat conditions.

The amino acids can then be separated from each other by ion exchange. Ion exchange is the same principle which is used in home water softeners. The salt you put in your softener has an ion, sodium, which can be exchanged and which does not make the water hard. Sodium from the salt is exchanged for iron and calcium, ions in well water which make the water hard. The same principle of ion exchange is used to separate amino acids. Once the amino acids have been separated from each other, it is fairly easy to find how much of each one was in the original feed sample.

When you look at the composition of feed on a feed tag, you will find the protein content as determined by the Kjeldahl procedure. Rarely will you find the amino acid analysis. Compared to amino acid analysis, protein determination is a quick and dirty procedure. It is relatively easy and cheap and is all that is required for quality control.

—Professor J. David Latshaw

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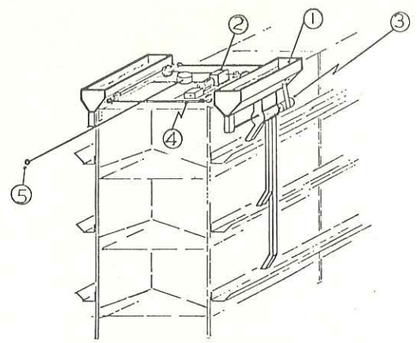

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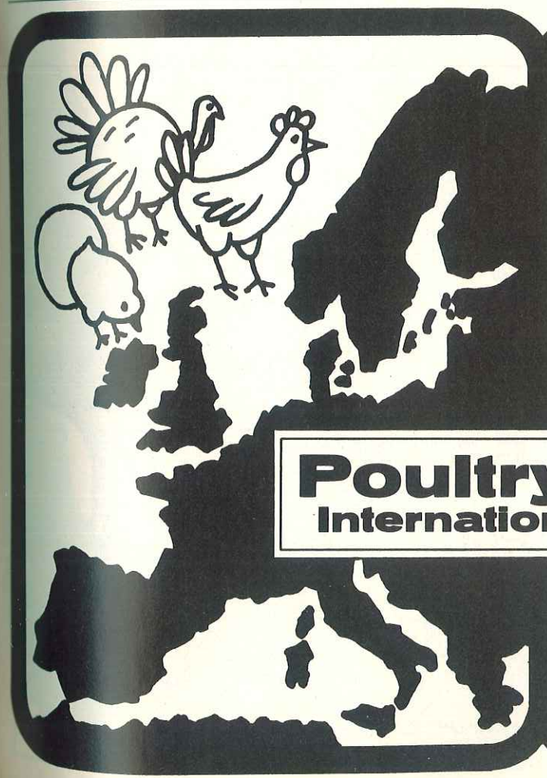

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