Chapter IV: Nitrogenous diet

In addition to energy, the supply of sufficient quantities of any substance used by the body for its synthesis is necessary to properly feed animals.

a. nitrogen is found mainly in proteins whose structural and functional roles are well known.

b. animal proteins are characterized by a high content of essential amino acids (example: 8 to 10% lysine compared to only 3-4% in vegetable proteins)

1. Importance

Digestive utilization of dietary nitrogen varies among animal species

1.1. Nitrogenous feeding of monogastrics

The monogastric animal can practically not use non-protein nitrogen. Its nitrogen requirement is essentially an amino acid requirement; in this case, only the protein nitrogen intake must be taken into account.

In addition, it is necessary to provide it with a sufficient quantity of each of the essential AAs; if one of these AAs is missing, protein synthesis is stopped at the level of the animal organism.

Ingested dietary proteins must be able to provide a sufficient quantity of amino acids distributed according to a well-defined profile (ideal protein). When there is a deficiency in an amino acid, body protein synthesis is reduced, performance is impaired and carcasses become fatter. It is therefore necessary to formulate diets containing

- sufficient crude protein content (12-25%) of the dry matter ingested depending on the animal species) and the type of production.
- a sufficient content, in this protein, of the main essential amino acids (lysine, methionine,

cystine, threonine, tryptophan). To be even more precise in the intake, diets are currently formulated by considering, on the one hand, the "amino acid energy" balance and, on the other hand, the content of amino acids absorbed in the small intestine (by measuring their digestibility between the ingested and the end of the ileum).

1.2. Nitrogen feeding of ruminants

The rumen is the site of hydrolysis of dietary proteins by microbial enzymes and intense microbial protein synthesis. These proteins, which cover approximately 2/3 of the animal's needs, are particularly rich in essential amino acids. On the other hand, part of the dietary nitrogen degraded into NH3may be lost through urine in excess.

So the proteins digested in the small intestine have a dual origin: dietary and microbial.

Dietary digestible proteins (DDP) correspond to the digestible fraction of dietary proteins reaching the intestine without having been degraded by rumen microbes: these are non-fermentable nitrogenous materials.

Microbially digestible proteins (MDPs) are synthesized in the rumen by bacteria and protozoa in the form of microbial nitrogenous matter (MNM) from fermentable nitrogen: ammonia (NH3) and carbon chains resulting from fermentation of organic matter in the rumen.

2. The PDI system

To take these two phenomena into account, a system of adapted feeding units has been created. These are the PDI (Protéines Digestibles dans l'Intestine). The values of the foods and the nutritional requirements are expressed in g of PDI quantifying the incoming flow of AA at the duodenal level. The calculation of the PDI values of the foods is carried out by the addition of the PDIA which correspond to the protein fraction not degraded in the rumen of dietary origin and the PDIM resulting from microbial protein synthesis which can itself be limited by the nitrogen (PDIMN) or the energy (PDIME) provided by the ration.

3. Effects of nutritional deficiency or excess

A deficiency in protein, or in certain essential amino acids, affects the performance of animals, the quality of their products (e.g., milk protein content) and their health. On the other hand, excess leads to an increase in the flow of urinary nitrogenous waste, which can be polluting if the animal's surface area is too high, leads to additional energy expenditure to eliminate the excess,

as it can cause serious problems: a drop in milk production in cows, digestive problems ,particularly in young animals. Excess can also lead to the appearance of cases of sterility in breeding animals.