WHEN THE LIVER FAILS

During the transition period, dairy cows risk of overloading their liver metabolic capacity to cope with the greater energy requirement thus suffering fatty liver, ammonia intoxication and oxidative stress. Dr. Roberto Farina, researcher at Fatro Italy, offers some suggestions for keeping these metabolic disorders under control.

The control of metabolic disorders is of vital importance in modern dairy herds. Intensive rearing and the high susceptibility of high-yield cows causes an increase in the incidence of metabolic diseases.

Metabolism means all the biochemical and physical changes which take place in the organism to ensure its growth and proper functions. The coordination of metabolism requires two types of regulation: homeostasis (resistance to change for the maintenance of physiological equilibrium) and homeorhesis (the coordination of changes to adapt to a new physiological state).

A typical homeoretic adaptation occurs during the transition period in the dairy cow, which covers the three weeks prior to, and the three weeks following calving. During this period, a series of critical changes must take place to permit satisfactory lactation. That is the reason why the majority of metabolic diseases and infections are found during or after this period: ketosis, milk fever, fatty liver, downer cow syndrome, left displacement of the abomasum, mastitis, metritis and reproductive associated problems.

This metabolic imbalance is produced by the Negative Energy Balance which is created in the peripartum, as there is a greater energy requirement and a lower consumption of dry matter owing to a reduction in appetite. The supply of glucose is less than demand by approximately 500 g/day.

THE LIVER AS A CROSSROADS FOR METABOLIC PATHWAYS

At this point, the "centrality of the liver" as the main organ involved in maintenance of equilibrium is clear. The liver is the crossroads for metabolic pathways and its rapid adaptation is crucial for a peripartum period free from problems. Demonstrating this adaptation, a greater flow of hepatic blood, an increase in hepatic consumption of oxygen and an increase in the metabolic activity of the liver are found. The great challenges to the liver in the puerperal period are to satisfy the high energy requirements and contrast the extensive mobilisation of Non-Esterified Fatty Acids (NEFA) originating from body fat, which

must be burned to produce energy as an alternative source in the presence of a glucose deficit. When the metabolic capacity of the liver to perform this function is abused, the following problems are observed: fatty liver, ammonia intoxication and oxidative stress.

Fatty Liver: This is the accumulation of fats, such as triglycerides, in the liver and it is present in more than 50% of high-yield cows. This metabolic disease causes a reduction in consumption and immunity and the formation of ketone bodies. Ketone bodies are substances which the liver produces to "free itself" of the excess of fatty acids (NEFA) and which are the cause of subclinical or clinical ketosis.

A fundamental role in the prevention of fatty liver is performed by Carnitine, an amino acid which performs two important functions: it binds to fatty acids and transports them into the mitochondria of hepatic cells, where they are burned and transformed into energy; it removes acetyl groups, preventing the formation of ketone bodies (figures 1 and 2).

Ammonia intoxication: the amount of ammonia in the blood doubles when the concentration of triglycerides in the liver increases during the peripartum, as hepatic ureogenic capacity (detoxification of ammonia) is reduced by 40%. L-Ornithine, L- Citrulline and L-Arginine are indispensable amino acids for the metabolism and detoxification of ammonia. Ammonia is very toxic

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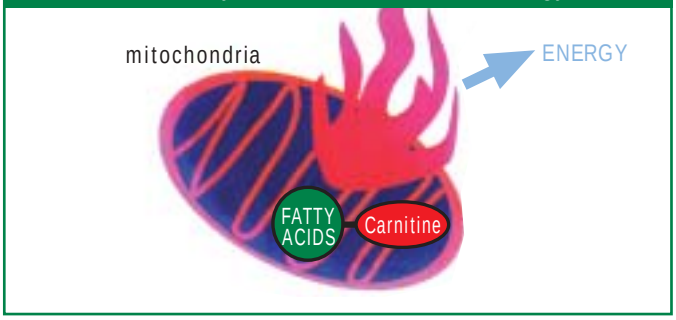
as it impairs intermediate metabolism, reducing the capacity of the liver to synthesise glucose and decreasing milk production; it is toxic for oocytes and embryos, thus reducing reproductive performance.

Through ureogenesis in the liver (Urea Cycle), ammonia is transformed into less toxic compounds (urea) which are eliminated via the urine. On the other hand, there is an extrahepatic detoxification of ammonia, for which a further two amino acids are necessary: glutamic acid and aspartic acid (figure 3).

Oxidative Stress: It occurs when free radicals and their products exceed the antioxidant defence system in the organism. Free radicals, which are natural by-products of oxidative metabolism, continually produced by cells and neutralised by antioxidant mechanisms, cause notable damage to cells and tissues. Mitochondrial function, the immune response, enzymatic activity and DNA are compromised.

FIG. 1

CARNITINE I
It transports fatty acids into the mitochondria, where they are burned to release energy



Oxidative stress appears when antioxidant mechanisms are overused and this is what also occurs with high-yield cows during the transition period. There is also a close relationship between oxidative stress and successful treatment of metabolic diseases.

FIG. 2

CARNITINE II
It removes acetyl groups, which are formed starting from lipid and amino acid metabolism, from the mitochondria

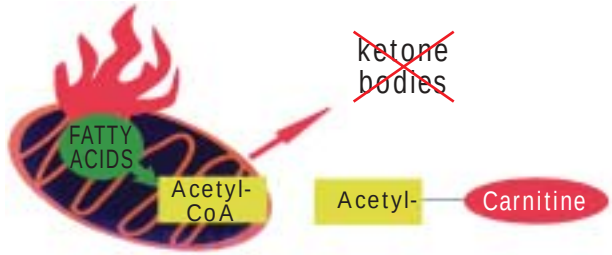
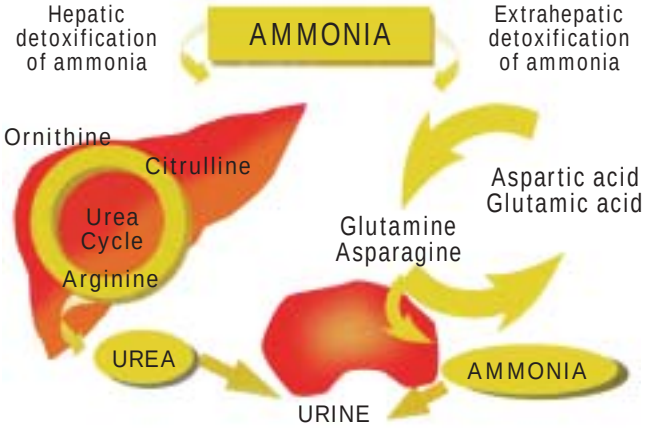


FIG. 3

AMMONIA DETOXIFICATION
High ammonia blood levels are very toxic and cause, in addition to other damage, a reduction in reproductive efficiency and milk production



THE IDEAL ANTIOXIDANT

A substance which can contrast oxidative stress is Thioctic acid (a.k.a. Lipoic Acid), considered the "ideal antioxidant". This acid acts by neutralising free radicals and intervenes in detoxification processes and in numerous biochemical reactions in sugar, fat and protein metabolism.

All the important substances we have examined (Carnitine, Ornithine, Citrulline, Arginine, Glutamic, Aspartic and Thioctic acids) are contained as active substances in the product Metabolase, which also supplies other important elements which contribute to the prevention and treatment of metabolic diseases: sugars such as fructose and sorbitol, and vitamins B6 and B12.

Fructose: this is a form of sugar found in fruit and honey. It is a substance with the same empirical formula as glucose but with a different structure. It is a rapid-release source of energy.

Sorbitol: this is a slow-release source of energy. It has a diuretic function which favours renal activity, compromised in cases of toxicosis and stimulates hepatic function, particularly increasing bile production.

Vitamin B6: This is important for protein metabolism. It is also an vital regulator of hepatic functions and the metabolism of the nervous system, skin and red blood cells.

Vitamin B12: It intervenes in synthesis of nucleic acids, proteins and VLDL (Very Low Density Lipoproteins), preventing Fatty Liver. It also intervenes in production of glucose and red blood cells and is an indispensable element for milk and meat production.

It is for all these reasons that Metabolase is both a fundamental tool in the prevention and treatment of metabolic diseases of dairy cows during the peripartum period, and a hepatic tonic for many disorders (infectious, parasitic, nutritional or toxic).

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