CHAPTER 01 : The Biological Basis of Sports Training.

PART I: THE BIOLOGICAL BASES OF SPORTS TRAINING:

Generalities and definitions:

"Sports biology and its direct extension, biological preparation, do not constitute a panacea either. It does not replace training, but on the contrary optimizes it to the extent that it contributes to making it profitable in terms of performance, by removing the empiricism of stadiums" (GARNIER AND ROUILLON, 1991).

This definition leads us to describe and explain certain concepts:

I.1. Cellular Metabolism

During intensive work, which requires a large amount of energy per unit of time, the muscle cell uses the anaerobic pathway. Creatine phosphate stores are quickly depleted, and the accumulation of lactate resulting from anaerobic glycolysis blocks intracellular metabolism. The muscle cell tries to use the aerobic pathway (oxidative phosphorylation) as much as possible, provided that the muscle fibers are sufficiently supplied with oxygen. When transitioning from rest to exercise, the supply of oxygen to the muscles is insufficient because, at rest, nearly 90% of the capillaries are closed; blood circulates mainly to other organs (HEGNER, 1990).

Physical exertion leads, among other things, to an activation of the cardiopulmonary system, an increase in oxygen transport and an opening (vasodilation) of the capillaries of the working muscles. If the intensity of the exertion is greater and despite maximum blood flow, the oxygen supply is not sufficient to cover the needs, the muscle cells are then forced to use the aerobic pathway and, thus, to degrade glucose first into pyruvate and then into lactate. These two substances have a toxic effect on muscle fibers, even in small concentrations.

Lactate, however, has the advantage of being able to leave the cell. It can be transported by the blood and used as an energy source by the heart muscle. The bloodstream also transports some of it to the liver, which converts it back into glucose. Thus, lactate can be eliminated and disappears from the body. "The more an athlete trains, the faster they can eliminate lactate and thus delay the moment when its concentration increases in the blood." (HEGNER, 1990).

I.1-1 Aerobic Power:

It is a measure of the performance a person can produce using only the aerobic pathway. It is expressed in Joules/Second = WATT, and determines how fast we can run without acidifying the blood by increasing lactate.

I.1-2 Aerobic Capacity

Depends on the quantity (volume) of cellular energy reserves and allows the athlete to withstand long-term effort. It is expressed in joules and is improved by very long-term efforts, which lead to depletion of cellular energy reserves.

I.1-3 Aerobic Threshold

It constitutes the intensity limit up to which the metabolism remains purely aerobic, the lactate values at the aerobic threshold are around 2 mmol.l-1. If the intensity of the effort is further increased, the necessary energy must be partially provided by anaerobic glycolysis.

I.1-4 Anaerobic Threshold

The anaerobic threshold is the intensity level where the amount of lactate released from the cell and its elimination rate are still just in balance (HOLLMANN/HETINGER, 1976). The lactate level at an anaerobic threshold is 4 mmol.l-1. In practice, for training and for research in sports biology, this strict definition of the anaerobic threshold is not sufficient; it must be determined individually, either:

- By measuring blood lactate levels (invasive test) during an exercise of increasing intensity, in stages;

- Or by recording heart rate during the same type of exercise, in shorter and more frequent stages (CONCONI test (1982), interval test, or on a cycloergometer).

I.1-5 Anaerobic Power

It measures the intensity of the effort that an athlete can produce using the anaerobic metabolic pathway. It is expressed in joules/second = WATT.

I.1-6 Anaerobic Capacity

This is the measure of the volume of work that can be provided by the anaerobic metabolic pathway. It depends on the amount of glycogen stores and is limited by the athlete's tolerance to lactate. Depending on the training status, lactate values of more than 20 mmol.l-1 can be achieved and tolerated. However, at 6 to 8 mmol.l-1, coordination qualities, as well as technical and tactical abilities, begin to be disrupted (LIESEN, 1986). Training that includes efforts leading to lactate levels of more than 10 to 14 mmol.l-1 negatively influences aerobic performance. After "speed endurance" training, which can lead to lactate concentrations of more than 15 mmol.l-1 (up to 24l), the ability to learn complex movements can be impaired for 48 hours (LIESEN, 1986, cited by HEGNER, 1990). In view of these negative concomitant phenomena caused by high lactate concentrations, anaerobic capacity training must be planned very carefully.