# Comparative Study Regarding Biological Adaptation in Sports Games

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*Abstract:* There are significant differences between team sports games (handball, football, basketball, volleyball) and individual games (tennis, badminton) regarding motility content, types of effort, the energetic systems and the biological adaptation factors. These differences are determined by game characteristics, by the length of the game, the nature of the effort, the nature and duration of game phases and pauses specific to every type of sports game.
Biological adaptation can be of short or long duration depending on the sports game characteristics, which imply adaptive modifications on all body levels, from cellular to organic and central level, necessary to develop various and complex efforts.
The modifications encountered during the sportive activity, concerning both the internal and the external environment, impose a series of reactions from the human body towards "acquiring" acts, so that the activity is still developed with the maximum efficiency.

*Key Words:* biological adaptation, handball, tennis, energetic system, effort.

## 1. Introduction

A scientific based sport of performance is essentially and major conditioned by the biological adaptation degree of the body to obtain sportive performance. The strategy of sportive training is constantly evolving and the base of this evolution is held by the physiological support. Sportive training is defined as a multilateral, complex, psycho-social, methodical and pedagogical process, which monitors the morphological-functional perfection of the body, with the purpose to increase the sanogenetic standard, the resistance to exogenous and endogenous factors and to improve the psycho-physical effort capacity, all these summed up leading to high sportive performance.

The competition system of sports game is serious and it implies almost daily trainings with volume and intensity increase, for big junior players as well. This involves a compulsory biological preparation and effort recovery, adapted to the requirements imposed by the effort to which the player is subject to during the training period.

The biological preparation for contest and the recovery are two components of sportive training and represent practical ways to optimize it, so that sportive performance can be biologically sustained, and the health state of the sportsman can be protected also. The biological preparation for contest represents the ergothropic phase of sportive training.[2]

The cyclic aspect of the sportive training method is one of the defining and fundamental characteristic of the process, raised at the rank of criterion.

Effort alternation (of high intensity and complex strain of the body) from the actual training in accordance with the repose and post-effort recovery, determines the appearance of a phenomenon of adaptation for the sportsman's body, which the specialists call overcompensation. [6]. It has something specific, not only related to the level of strain but also to each sportsman's body reactivity to the length, type and degree of effort he undertakes. [6]

## 2. Theoretical background

### 2.1 Biological adaptation - conceptual delimitations and profile

Training adaptation regards the set of transformations through which the sportsman's body goes during training with the purpose to develop a superior state of

biological, psychical and motion balance, embodied in easily and efficiently executing a task. [4]

Biological adaptation in sports encompasses "all changes produced in organs and on their functions, by physical and psychical influence of sportive activity, and enclosing both the central nervous system and the neuromuscular system, and adaptable tissues, such as cellular and intercellular elements". [3]

Adaptation can be of high or small degree, depending on the age, preparation level and effort availability of the person subject to instruction.

Adaptation to intense efforts implied by the sportive training of performance is part of an ascendant profile (curve) with tendencies to flattening.

The adaptation profile (the ascendant part) is set by causes that break the sportsman's body homeostasis, as those determined by the volume, intensity and complexity of the effort, after which the transformations are narrower, and if the body's stimulus is not changed, they stabilize.

Practice demonstrated that stimulus change must take place, in general, after 6-8 weeks.

The adjustment of the answer to the stimulus of varied training which takes place through adaptation indicates that the body takes part in the action optimally.

In sports, adaptability is described as trainability (training potential) or as the capacity to rapidly pass from one situation to another, by optimizing behavior and the functionality according to the requirements of the new situation. [4]

## 2.2 Biological adaptation in tennis

Tennis game is based on repetitive motility actions, the periods of maximum intensity of action alternating with short periods of break.

Tennis comprises a complex energetic foundation, based especially on ATP consumption in order to ensure the necessary energetic intake for specific muscular contraction. Energy provision in tennis is obtained through a combination of three energetic systems: anaerobic alactacid, anaerobic lactacid and aerobic. [5]

| Name | Characteristics | Length |
|---|---|---|
| Creatine phosphate (CP) | - Does not require oxygen in order to function;<br>- Offers an immediate form of energy for a short period of time (eg. The sprint in a short hit, a jump in a game);<br>- High release speed, but a small quantity of energy created;<br>- 50-70% is recovered after 30 seconds, and 100% after 3 minutes;<br>- Vital for the explosive ability of the sportsman. | - up to approximately 15 seconds |
| Anaerobic glycolysis | - Does not require oxygen in order to function;<br>- Provides energy for activities lasting more than 15 seconds (eg. Long ball changes, from the glycogen stored in active muscles);<br>- Medium release speed and medium quantity of energy;<br>- Produces lactic acid which goes in the blood leading to fatigue and rigidity;<br>- Large quantities of lactic acid can take more than an hour to be dispersed. | -between 15 seconds and 1 minute |
| Aerobic | - This energetic system requires oxygen in order to function;<br>- Energy provision from oxygen for a long period of activity (eg. the entire length of a game)<br>- Reduced release speed, but large quantity of energy;<br>- Used for the recovery of anaerobic systems. If it is well trained, it can slow down the usage of the anaerobic glycolysis system, delaying the fatigue assault. | -for longer periods |

Table 1.

The characteristics of game actions specific to tennis determine the energetic needs as follows:

-short term actions of 5-15 seconds (short ball exchanges) do not imply significant forms of fatigue, and the recovery of the creatine phosphate system takes place in the first 20 seconds between points and up to 90 seconds, if field parts change.

-long term actions of up to 1-2 minutes determine the manifestation of various fatigue signs, with the appearance of lactic acid, the energetic adaptation being based on anaerobic glycolysis.

-game progress (from a few minutes up to 2-3 hours) implies the usage of anaerobic energetic resources by

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using oxygen which has an important input in the recovery process.

### 2.3 Biological adaptation in handball

Adaptation is also determined by the practicing stage of the sportive discipline; therefore the work volume of a sportsman with a seniority of 2-3 years will be 3-5 times higher than of one with an 8-10 year-stage.

Long term adaptation specific to sports games is characterized not only through a high degree of organs and systems functionality, but also through economy of activity, maximum efficiency with minimum efforts from the body. [1]

Long term adaptation can be maintained only by developing continuous efforts (eg. strength accumulation acquired in two months of training is diminished by approximately 60% after 1-2 weeks of break, and after 2-3 months of break it goes back to the initial level). [1]

Long term adaptation can be realized in a shorter period, but it takes great and maximum efforts and has the disadvantage of being instable.

The combination of oxygen intake estimation with the changes appeared both in sanguine and muscular metabolites offers a clearer image and it can be very clearly observed the increase of anaerobic contribution to sustain effort in a handball game.

According to the handball game features and depending on the energetic level, effort has a variable anaerobic – aerobic lactacid nature. During moments of maximum effort, the main energy provider is the adenosine triphosphoric acid (ATP), mainly produced from the energy provided by the creatine phosphate discomposure but also through anaerobic glycolysis.

During moments of medium and small intensity effort and even in those of game interruption, the phosphagen resynthesis is carried out with ATP energy coming from oxygen consumption during the alactacid phase of oxygen usage. Part of the ATP from the resynthesis goes directly into the muscles, while another quantity is used for the CP re synthesis, which also goes from the deposit directly into the muscles. The anaerobic glycolysis can provide a certain quantity of energy for the CP resynthesis as well.

The higher the phosphagen consumption, that is the higher the effort intensity, the higher the oxygen consumption in order to produce energy necessary to phosphagen resynthesis.

These bio-chemical processes allow the continuity of high intensity efforts after the relaxation moment. It is known the fact that after an effort of maximum intensity, 70% of the consumed ATP is recovered in the first 30 seconds. In order to establish a proper adaptation to these types of efforts, sets of maximal effort will be carried out during training classes. Such efforts stimulate the alactacid resynthesis of the ATP, especially based on CP disaggregation. In order to stimulate the anaerobic glycolysis such efforts will be carried out at a maximum tempo, in sets of 30-50 seconds.

## 3. Problem solution

### 3.1 The purpose and hypothesis of the research

The purpose of the study is to identify the percentage differences between the main energetic systems needed for the biological adaptation of sportsmen practicing handball and tennis.

Hypothesis: the study in matter starts from the premise that biological adaptation is carried out in a different manner during team sports games as compared to the individual ones; the varied influences of main energetic sources participations, specific to every type of effort, are defining.

### 3.2. Means and tools of research

The research is based on a comparative study regarding energetic systems and biological adaptation level in handball- as a team sports game, and tennis – as an individual game.

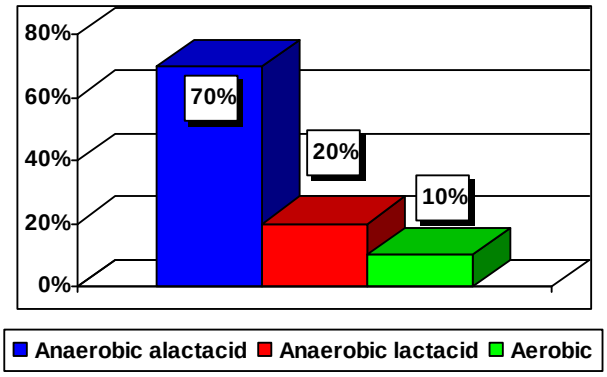
For this study, we chose as unit of comparison indicators of energetic systems specific to biological adaptation of handball and tennis players. We selected the two games because handball is a very complex team game and requires a continuous dynamic regarding the scientific training conduction, whereas tennis is an individual or pair game, subject to continuous perfection, each parameter or training factor being decisive for the optimization of performance.

The study starts with the assertion that biological adaptation is carried out in a different manner during team sports games as compared to the individual ones; the varied influences of main energetic sources participations, specific to every type of effort, are defining.

During this research we compared the energetic systems and the level of biological adaptation in sports, between handball as a team game and tennis, as an individual game.

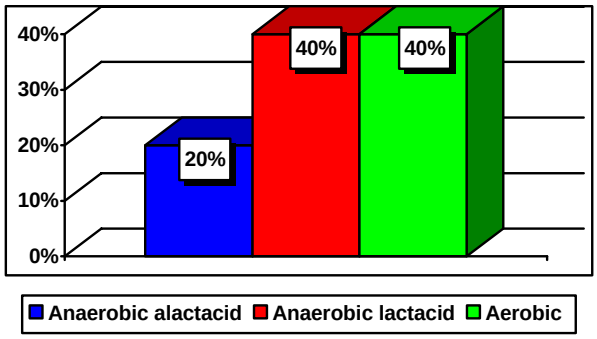
### 3.3 Comparative results

All research reveals the fact that the energetic system specific to tennis is 70% anaerobic alactacid, 20% anaerobic lactacid, and the resources of the aerobic energetic system are of 10%.




*Graphic 1 Energetic system in tennis [5]*

From the energetic perspective, physical effort during handball game has a mixed nature, the anaerobic rate being of 60% during the effective game, and the aerobic rate of 40% of the time, which implies a very good anaerobic capacity, doubled by the aerobic capacity, also a very good one.




*Graphic.2 Energetic system in handball*

### 3.4 Result interpretation

By analyzing the results shown in the graphics, it can be observed that while the effort during the tennis game is predominantly anaerobic alactacid, during the handball game the effort is equally anaerobic alactacid and aerobic.

## 4. Conclusion

The differences between the selected sports games, namely the handball game as a team game and the tennis game as an individual game, reveal the fact that they equally require an optimal biological adaptation, always following an ascendant dynamic, due to the increase of the sportsmen' techniques, the strain factor specific to competitions, the effort dynamic, the modification of criteria for biological, motility and functional selection of sportsmen, for the echelons of high performance, of regulation requirements, etc.

The complexity of the used means of actions, in which the intensity and volume vary judiciously, has to ensure a preparation more appropriate for effort load during trainings. The rapport between the volume, intensity, density, length and complexity of means varies according to particularities, preparation phases and according to the team or sportsman's possibilities, but the effort characteristics specific to sports game have to be taken into account.

Biological adaptation in sports games, as a result of a scientific training, seeks to improve the degree of biological adaptation of the sportsman, by setting up some energetic resources, especially in the pre-competition phase; in the competition phase it aims to reach new limits concerning the energetic system indispensable to the actual sportive performance.

Techniques and tactics learning is made mostly based on work volume increase and the body's adaptation to effort is carried out based on intensity.

The increase of effort complexity leads therefore to intensity increase, this being carried out by the augmentation of the difficulty degree of means of actions and by technical-tactical combinations which are learned also through creating more difficult and varied situations, which have to be resolved by sportsmen during trainings.

It become important for future to develop a informatics model for analyse the energetic system in different sports, like a tools for couch activities.

Optimizing the performance in sports is conditioned by the results obtain by multidisciplinary bioinformatics analyses.

Training based by scientific models is possible only using the particular answer of each sportsman to the efforts in different task of training and competitive and processing and analyzing these results compared to other relevant parameters. For this purpose the computer application could be essential.

Great performance today is conditioned by this report of biometrics in order to optimize the preparation and competition

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