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## BLOOD LACTIC ACID CONCENTRATION CHANGES IN WOMEN HANDBALL PLAYERS DURING A HIGH INTENSITY TRAINING SESSION

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**Keywords:** *handball, blood lactic acid, high performance, specific training.*

### Abstract

The aim of this study was to examine the blood biochemical changes that occur during high intensity handball training in elite handball players' women (age  $22 \pm 2.23$  years). The training protocol was the same for all players. Blood samples were drawn 3-5 minutes before and 2 minutes after finishing the training session in order to determine lactic acid values (LA). After training the studied parameter increased significantly ( $p < 0.001$ ) in all teams. These results demonstrate that handball training is a highly aerobic with a considerable anaerobic component requiring high lactate tolerance. Training sessions should reflect these demands placed on players during competitive match-play.

### 1. Introduction

The physiological demands of team-based field sports have previously described using heart rate (Bangsbo, 1994; D'Ottavio and Castagna 2001) and blood lactate concentration (Bangsbo et al., 1991; Deutsch et al., 1998). Blood lactate concentration has previously been used to estimate the anaerobic glycolytic contribution to metabolism in studies of other field sports, such as soccer (Ekbloom, 1986; Bangsbo et al., 1991) and rugby union (Deutsch et al., 1998).

The aim of the present study was to describe the physiological demands faced by women handball league player in critical moments of a specific high intensity training programme or specific training structures adaptation, according to the permanent player demanding.

### 2. Material and methods

*Subjects.* Fifty handball players from five handball teams acted in the first Romanian league (women) (age,  $22 \pm 2.23$  years) participated in the study. They all received a clear explanation of the study informing them of the risks and benefits associated with participation before providing written informed consent. The

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training protocol and structure was the same for all players and took place in their own sport training hall under strictly coordination.

Blood tested parameters, were determined from 150-200 µl capillarized blood samples taken from hyperaemic fingertips collected into heparinized capillary tubes. Samples were drawn from all players (n=50) within 3-5 minutes before starting the training programme and 2 minutes after the high intensity training programme. All samples were taken while the players were standing and were analyzed by ABL-5-gas analyzer (Radiometer, Copenhagen).

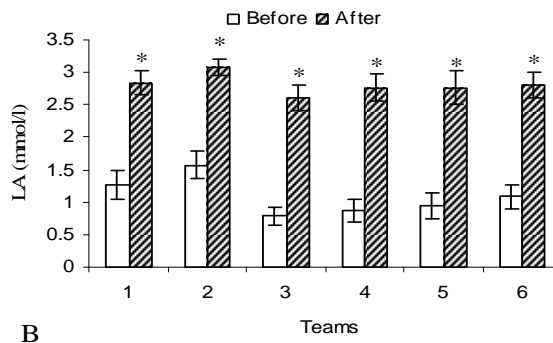
Relating to blood lactate concentration, this gas analyzer has been reported to be accurate up to at least 18.7 mmol.l<sup>-1</sup> and reliable at both high (14.4 mmol. l<sup>-1</sup>) and low (1.7 mmol.l<sup>-1</sup>) concentration.

The significance of acid-base parameters analyzed by us, are the following: Lactic acid (LA) blood concentration was calculated using the following formula:  $LA = [(0.5 - ABE) \times 7.2] : 9.1 \text{ mmol.l}^{-1}$

The results are expressed as means ± S.E.M. The results were analyzed using Student's t-test. Values of P<0.05 were regarded as significant.

### 3. Results and Discussions

Before training the mean blood lactate concentration was 1.085±0.188. After training the mean blood lactate concentration increased significantly by 259% meaning 2,811± 0.197. (Fig.1).



**Figure 1.** The effect of high intensity training session on blood lactic acid concentration (LA) in women handball players

Our results showed that, significant increase in blood lactic acid (LA) concentration. In the women teams, the sense of registered changes in tested parameters was the same as in men (Acsinte A., et al. 2011), but with smaller amplitude.

Blood lactate concentration is often used as an indicator of energy production from anaerobic glycolytic processes (Bangsbo, 1997). Blood lactate concentration

in field sports that require prolonged, high-intensity, intermittent activity, such as soccer (Ekbloom, 1986; Bangsbo, 1994) and rugby (Deutsch et al. 1998) has been reported to be between 1.9 and 14.3 mmol.l<sup>-1</sup>, with a large variability between players and standards of competition. The present results show that mean blood lactate concentration in men handball players (6.009±0.407mmol.l<sup>-1</sup>) during high intensity training programme is slightly below that reported for Swedish first division professional soccer players (9.5 mmol.l<sup>-1</sup>), but higher than that reported for elite rugby union players (4.0mmol.l<sup>-1</sup>) (Coutts et al., 2003). The higher blood lactate concentrations in the present study may reflect the higher intensity and impacts involved in competitive handball league in comparison with most other team's sports (Bangsbo, 1997; Deutsch et al., 1998). However, caution must be taken during competitive matches, as many factors, including individual fitness, emotional stress, time of measurement and environmental conditions may affect the results. Catecholamine could be a cause of the increased LA blood concentration (Christensen and Galbo, 1983; Mazzeo, 1991; Podolin, 1991; Sargent et al., 2002). For example, Bangsbo et al. (1991) reported a relationship between lactate concentration and intensity of activity in the minutes before blood sampling of elite soccer players during match-play. In the present study, the blood samples were taken 2 minutes after training programme while the players were standing.

Blood LA concentration has a different significance when it is accompanied by two different P<sub>CO2</sub> values (Yoshida, 1990). 6.009mmol.l<sup>-1</sup> compared with P<sub>CO2</sub> of 31.6mmHg.

#### 4. Conclusions

The present results show that our first league handball players is played at a high intensity with considerable contributions from both the aerobic and anaerobic energy systems, requiring high lactate tolerance, related to energy production. However, accurate conclusion cannot be made about the contribution of anaerobic glycolysis to handball league performance.

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## MODIFICĂRILE CONCENTRAȚIEI ACIDULUI LACTIC SANGVIN LA HANDBALISTE ÎN TIMPUL ANTRENAMENTELOR CU INTENSITATE CRESCUTĂ

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**Cuvinte cheie:** *handbal, acid lactic sanguin, înaltă performanță, antrenament specific.*

### Rezumat

Scopul acestui studiu a fost acela de a determina modificările concentrației acidului lactic la nivelul handbalistelor de primă ligă, pe parcursul antrenamentelor cu intensitate crescută (vârsta 22±2.23 ani). Protocolul a fost același pentru toți subiecții. Eșantioanele sanguine au fost prelevate cu 3-5 minute înainte de antrenament și cu 2 minute înainte de finalizarea antrenamentelor, în vederea determinării concentrației acidului lactic sanguin (AL). După antrenamente, concentrația acidului lactic sanguin a crescut semnificativ ( $p < 0.001$ ) la toate

jucătoarele testate. Rezultatele au demonstrat că jocul de handbal este un sport ce solicită intens resursele aerobe, cu perioade anaerobe notabile ce determină toleranțe la lactat dintre cele mai înalte.

## 1. Introducere

La nivelul sporturilor de echipă, evaluările solicitărilor de ordin fiziologic se efectuau utilizând frecvența cardiacă precum și concentrația acidului lactic sangvin. De asemenea, concentrația acidului lactic sangvin se folosea pentru aprecierea contribuției glicolizei anaerobe metabolice la nivelul altor sporturi cum ar fi fotbalul și rugby-ul.

Scopul studiului de față a fost acela de a determina anvergura solicitărilor de ordin fiziologic la nivelul handbalistelor de înaltă performanță pe parcursul antrenamentelor cu intensitate crescută.

## 2. Material și metode

*Subiecți:* Subiecții studiului nostru au fost cincizeci de handbaliste din Liga națională a României, (vârsta,  $22 \pm 2.23$  ani). Subiecții au fost instruiți cu privire la protocolul de lucru, după care s-a semnat un acord de colaborare. Testările s-au efectuat în sălile de antrenament ale fiecărei echipe testate. Fiecare echipă a respectat același protocol de testare.

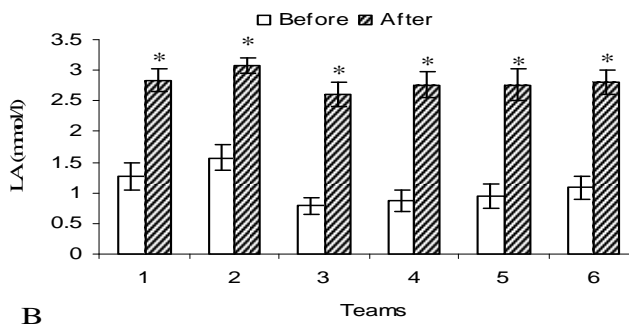
Probele sangvine s-au prelevat cu 3-5 minute înainte de începerea antrenamentului și cu 2 minute după terminarea acestuia, fiind colectate în vase de sticlă heparinizate de 150-200  $\mu$ l. Probele sangvine au fost evaluate folosind dispozitivul ABL 5 Radiometer Copenhagen (Analizorul de gaze din sânge.) Semnificația parametrilor acido-bazici testați, (concentrația acidului lactic sangvin, în cazul nostru), respectă formula de mai jos:

$$LA = [(0.5 - ABE) \times 7.2] : 9.1 \text{ mmol.l}^{-1}$$

Rezultatele obținute au reprezentat valorile medii  $\pm$  S.E.M. S-a folosit Testul student ( $P < 0.05$ ) pentru evaluarea pragului de semnificație al datelor obținute.

## 3. Rezultate și discuții

Înainte de antrenament, valorile medii obținute au fost  $1.085 \pm 0.188$ , iar după antrenament  $2.811 \pm 0.197$ ., ceea ce reprezintă o creștere de 259% (Fig.1).



**Figura 1.** Efectul antrenamentului de intensitate crescută asupra concentrației acidului lactic sangvin la handbalistele de performanță.

Rezultatele noastre arată o creștere semnificativă a concentrației acidului lactic sangvin la subiecții testați. La nivelul handbalistelor s-au înregistrat modificări comparative cu cele înregistrate la nivelul handbaliștilor de înaltă performanță (Acsinte A., și colab. 2011.) dar cu o amplitudine mai mică. Concentrația acidului lactic sangvin este des utilizată ca indicator al proceselor glicolitice anaerobe (Bangsbo, 1997). La nivelul fotbaliștilor (Ekbloom, 1986; Bangsbo, 1994) și rugbiștilor (Deutsch et al. 1998) s-u înregistrat valori între 1.9 and 14.3 mmol.l<sup>-1</sup>, cu o mare variabilitate raportate la diferitele circumstanțe de antrenament și competiție. Cea mai mare concentrație de acid lactic înregistrată în studiul nostru reflectă impactul deosebit pe care l-au avut structurile de antrenament asupra fondului fiziologic al handbalistelor în comparație cu alte discipline sportive (Bangsbo, 1997; Deutsch et al., 1998)

Totuși, în cazul nostru trebuie să ținem cont și de influența pe care o pot avea și alți factori adiționali asupra dinamicii unor indici fiziologici, cum ar fi, condiția fizică individuală, stress-ul, momentul efectuării testelor, condițiile ambientale etc. Secreția de catecolamine poate, de asemenea, influența concentrația acidului lactic sangvin, (Christensen and Galbo, 1983; Mazzeo, 1991; Podolin, 1991; Sargent et al., 2002). De exemplu Bangsbo și colab. (1991) au raportat o relație directă între concentrația lactatului și intensitatea activității înainte cu câteva minute de momentul efectuării unor teste la nivelul fotbaliștilor.

Trebuie subliniat, de asemenea, că interpretarea valorilor concentrației acidului lactic sangvin poate lua o turnură interesantă dacă se face asociat cu valorile P<sub>CO2</sub> (Yoshida, 1990).

#### 4. Concluzii

Studiul nostru arată că handbalistele la nivel de înaltă performanță, desfășoară o activitate cu intensitate maximală pe parcursul antrenamentelor, efortul fiind caracterizat ca mixt, solicitând surse energetice atât cu caracter aerob, cât și anerob, reclamând o toleranță crescută la lactat din partea organismului, în strictă corelație cu producerea de energie specifică. De asemenea, nu putem aprecia

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influența glicolizei anaerobe asupra performanțelor sportivelor testate, datorită anvergurei reduse a parametrilor testați.

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