ERGOGENIC AGENTS IN BASKETBALL: BUFFERING FOR HIGH INTENSITY PERFORMANCE
NEW PERSPECTIVES

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Ergogenic aids are substances, devices, or practices that enhance performance through individual's energy use, production, or recovery.

Some surveys have indicated that approximately 50% of the general population, 76% of college athletes, and 100% of top level athletes take supplements.

New products appear on the market every week, but among different ergogenic supplements for team sports, rare products have clear scientific support.

Most popular nutritional and physiological ergogenic supplements in basketball

- CAFFEINE
- CREATINE
- β-ALANINE
- COLOSTERUM
- BICARBONATES
- BCAA
- GLUTAMINE
- RIBOSE
- PROBIOTICS
- MANY MORE...

Is the effective buffering agent what we strive most in top-level basketball nutrition?

Exercise-induced acidosis is a common metabolic disturbance among basketball players.

- It occurs during vigorous exercise when muscle cells are forced to rely on non-mitochondrial ATP turnover which leads to proton release and is characterized by build-up of lactate and low muscle and/or serum pH which could negatively affect exercise performance.
- Buildup of hydrogen ions can inhibit glycolysis by inhibiting the activities of phosphofructokinase and phosphorylase, inhibit calcium binding to troponin C and its release from the sarcoplasmic reticulum, and decrease muscle contractile force all of which can result in increased fatigue and reduced performance.
- Intense basketball exercise can cause significant decreases in muscle pH (resting values of >7.0 to <6.5 post-exhaustion) and serum pH (resting values of >7.4 to <7.3 post-exhaustion).
- Higher buffering capacity in humans has been directly associated with improved performance, from long distance to high-intensity exercises, with the initial goal for basketballers with acidemia is to raise the systemic pH with an alkalizing agent.
During high-intensity exercise, with increased H+ production (which causes a decrease in pH), many different innate metabolic processes and physio-chemical properties contribute to total buffering capacity in attempts to maintain intramuscular pH. Figure 1. Muscle histidine (essential amino acid) and the breakdown of PCr provide nearly ~60% of the total natural buffering capacity of the muscle, while bicarbonate and other processes provide the remaining ~40%. 

**Alkalinizing agents in basketball**

- Nutritional supplements not on WADA list
- Rise the systemic pH after exercise-induced acidosis
- Low-to-moderate incidence of adverse effects
- Applicability of formulation to basketball

- SODIUM BICARBONATE / CITRATE
- β -ALANINE
- CREATINE
- ALKALINE (HYDROGEN-RICH) WATER

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**Sodium bicarbonate**

- Extracellular buffering system
- Turned-on when intracellular buffering can become overwhelmed and insufficient

\[ \text{NaHCO}_3 + \text{H}^+ \rightarrow \text{NaH}_2\text{CO}_3 \text{ (carbonic acid)} \]

- Design and administration protocol
  - Acute supplementation: 150 mg/kg per 1 L of water 1-3 hours before anaerobic exercise
  - Chronic supplementation: 500 mg/kg per day prior to exercise (split up into 4 daily doses)

- Ergogenic potential
  - Improvement in exercise lasting 1 to 5 min or repeated sprints
  - Less pronounced effects in single sprints (< 60 sec) or prolonged exercise (> 10 minutes)

- Side-effects includes stomach upset, diarrhoea, edema, cardiovascular overload etc.

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**Creatine**

- Well known as high-energy phosphate donor for ATP regeneration during exercise
- Also acts as intracellular buffer with ~ 30% of total muscle buffering capacity

- Dosage and administration protocol
  - With loading phase: 20 g/day for 1 week and 5 g/days for the next 3 weeks
  - Chronic supplementation: 3-5 g/day

- Ergogenic potential
  - It is hard to isolate energy boosting vs. buffering effects of creatine
  - 10-20% increase in muscle Cr could increase muscle buffering capacity by ~3%

- Side-effects includes weight gain, muscle cramping, etc.

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**β alanine**

- Carnosine ([β-alanyl-L-histidine]) has been described as a potent intracellular buffer
- In nitrogen containing side iridodial ring can directly accept and buffer H+ ions
- Carnosine contributes to total intracellular buffering capacity up to ~15%

- Prolonged β-alanine supplementation increases muscle carnosine

- Design and administration protocol
  - Supplementation: 3 g/day for 4 weeks and 1.5 g/day thereafter
  - Withdrawal phase: 14 to 15 weeks after a 50% increase in muscle carnosine

- Ergogenic potential
  - Improvement in intense exercise lasting 1 to 6 min or repeated sprints
  - Reduced creatine loss in long-term exercise
  - Side-effects includes mild paresthesia, skin vasodilation, flushing.

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**Alkaline (hydrogen-rich) water**

- Alkaline water (also known as hydrogen-rich water - HRW) is produced during electrolysis
- HRW has a high pH (pH 8) with low dissolved oxygen and negative redox potential values
- HRW increases fasting arterial blood pH and post-exercise pH in men

- Design and administration protocol
  - Acute protocol: 2 L per day for 2 weeks
  - Prolonged administration: 1.5 L per day for 6 months

- Ergogenic potential
  - Improvement in time to exhaustion during incremental test
  - Reduced rates of perceived exhaustion during exercise
  - Side-effects includes mild diarrhoea.
Alkaline (hydrogen-rich) water

Figure 1. Effect of hydrogen-rich water (2 L daily) on fasting and post-exercise blood pH (mean ± SD) in healthy volunteers (n = 19). P values are for comparisons with 0 week (paired t test).

Alkiling agents: summary
- Low-to-medium effectiveness
- Limited design, differing and pharmacokinetics data
- Low-to-medium safety
- No unique protocol for basketball
- Further investigation needed
- Acute vs. chronic administration
- Intracellular and extracellular buffers co-administration
- Level of competition, age and gender administration protocol differences

Use for supplements: cost vs. benefits

It is very important to think through the process of supplements use by a thorough cost-benefits analysis

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<tr>
<th>COST</th>
<th>BENEFITS</th>
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<td>PERFORMANCE</td>
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The sensible athletes will want to use positive reasons to use supplements.

CONCLUSION

Buffering supplements can't replace training or nutrition
Most supplements lack strong scientific evidence
Non-critical use of supplements is strongly discouraged

cost vs. benefit

Gracias por su atención