

EFFECT OF 14 AND 28 DAYS β -ALANINE (CARNOSYN™) SUPPLEMENTATION ON ISOMETRIC ENDURANCE OF THE KNEE EXTENSORS.

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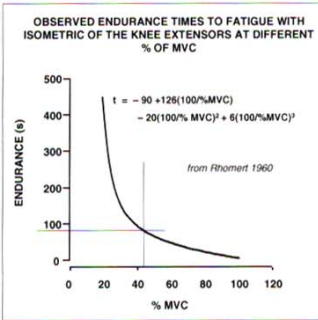
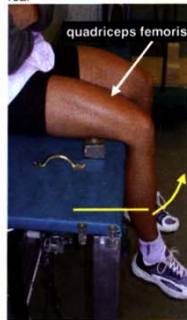
To investigate the effect of: *in Study a) 4 wks supplementation of β -Alanine on isometric endurance time at 45% MVC; in Study b) the effect of 2 wks supplementation with the same total dose of β -Alanine but co-administered in this case with a source of simple sugars to provoke the release of insulin.*

INTRODUCTION

pH decline in muscle from formation and accumulation of -COO^- and H^+ , is seen as a probable cause of fatigue during moderate to intense exercise, although proof of this during whole body exercise in humans is lacking. During isometric exercise of the knee extensors, involving chiefly the *quadriceps femoris*, the circulation is essentially occluded above a contraction force of 40% MVC making this a closed system. H^+ and lactate $^-$ with therefore be retained. Endurance time (ET) is predicted from the curve of Rhomert (1960):

Isometric chair – ankle secured to strain gauge at rear

Rhomert curve – predicts endurance time at different % of Maximal Voluntary Contraction force.



MATERIALS AND METHODS

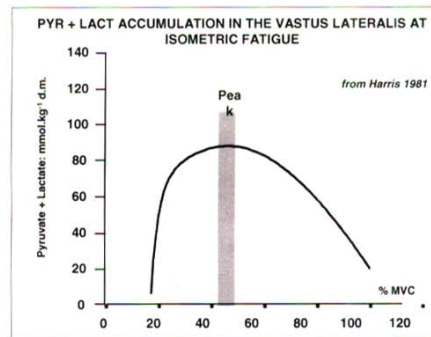
TWO INDEPENDENTLY ORGANISED AND RUN STUDIES

Study a):
14 males 22.9 \pm 5.9 yrs; 80.2 \pm 10.5 kg
TEST (n = 8): 800 mg x 8.d⁻¹ x 28 d of β -Ala (Carnosyn™, NAI San Marcos USA)
CONTROL (n = 6): matching placebo (maltodextrin capsules)

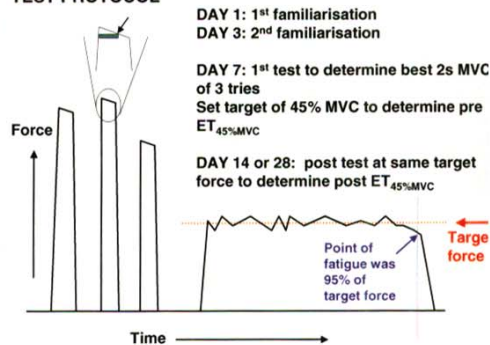
Study b):
20 males 25.3 \pm 7.5 yrs; 78.0 \pm 10.2 kg
TEST (n = 8): 1600 mg x 4.d⁻¹ x 14 d of β -Ala
CONTROL (n = 12): matching placebo (maltodextrin capsules)

Each dose ingested with 45-65g CHO, predominantly glucose

In both studies, subjects performed isometric contractions of the knee extensors (chiefly the quadriceps femoris) at 45% MVC (corresponding to the peak in lactate accumulation in muscle)



TEST PROTOCOL



Carnosine (Carn) is a dipeptide of β -alanine (β -Ala) and histidine with a pKa for the imidazole ring of 6.83 making it a highly effective buffer over the physiological range. Synthesised in muscle, we have recently demonstrated (Harris *et al* Amino Acids 2006; Hill *et al* Amino Acids 2006) ~60 and ~80% increases in M-Carn with 4 and 10 wks β -Ala supplementation, increasing the potential buffering effect by M-Carn to the same extent. Data from our laboratory further suggests that uptake of β -Ala into muscle is enhanced by co-administration with glucose.

RESULTS (Mean \pm SE) ET (s) and impulse (kN.s⁻¹)

Pre supplementation MVC, ET and impulse in studies a) and b)

			Study a)		Study b)	
			Control	Test	Control	Test
MVC (N)	Pre	Mean	720	754	653	685
		SE	91	54	51	38
ET (s)	Pre	Mean	74.6	75.5	74.5	70.0
		SE	6.5	6.8	4.1	5.3
Impulse (kN.s)	Pre	Mean	23.3	25.5	23.4	21.8
		SE	2.3	2.7	2.1	1.7

Fig 1: Study a) ET increased by 9s (11.1%)

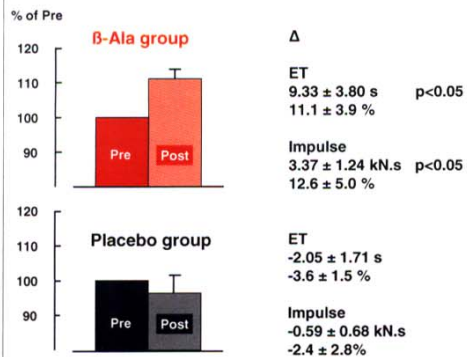
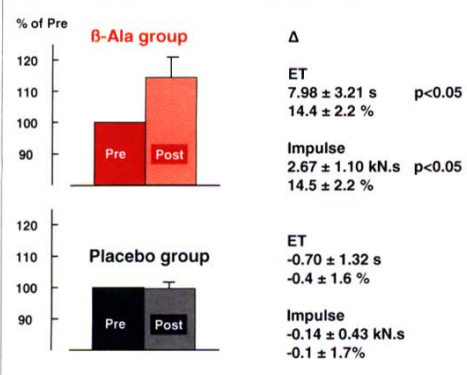


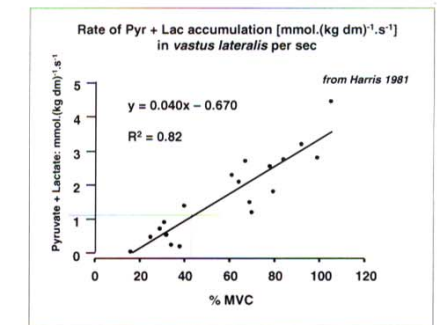
Fig 2: Study b) ET increased by 8s (14.4%)



CONCLUSIONS:

The endurance time of isometric contraction of the knee extensors at ~45% MVC is significantly increased by 8-9s with β -Ala supplementation, most probably as a result of the increase in muscle buffering capacity as M-Carn is increased.

From Harris 1981 an extra 8.5s contraction @ 45% MVC would result in the additional accumulation of [Pyr + Lac] of ~9 mmol.kg⁻¹ dm. At 45%MVC the VL behaves as a closed system. The result would be an additional accumulation ALSO of 7-9 mmol H⁺ kg⁻¹ dm.



From Harris *et al* 2006 and Hill *et al* 2006 we should expect an increase in M-Carn of ~15 mmol.kg⁻¹ dm, which from pH = pKa + log([Carn]/[CarnH]) would have a buffering capacity between pH 7.1 (rest) and 6.3 (fatigue) of ~7mmol H⁺ kg⁻¹ dm, matching the increase in [H⁺].

TAKE HOME MESSAGE

THE INCREASE IN ENDURANCE TIME CAN BE EXPLAINED BY AN INCREASE IN MUSCLE BUFFERING, RESULTING FROM THE INCREASE IN CARNOSINE, WHICH STOICHIOMETRICALLY MATCHES THE INCREASE IN CARBOXYL GROUP (MOSTLY LACTATE) ACCUMULATION.

Harris RC (1981) Muscle energy metabolism in man in response to isometric contraction. A biopsy study. MSc Thesis, University of Wales, pp180.

Harris RC, Tallon MJ, Dunnett M, Boobis L, Coakley J, Kim HJ, Fallowfield JL, Hill CA, Sale C, Wise JA (2006) The absorption of orally supplied β -alanine and its effect on muscle carnosine synthesis in human vastus lateralis. *Amino Acids* X: xx-xx.

Hill CA, Harris RC, Kim HJ, Harris BD, Sale C, Boobis LH, Kim CK, Wise JA (2006) Influence of β -alanine supplementation on skeletal muscle carnosine concentrations and high intensity cycling capacity. *Amino Acids* (accepted).

Rhomert W (1960) *Intern Z Agnew Physiol* 18: 123