



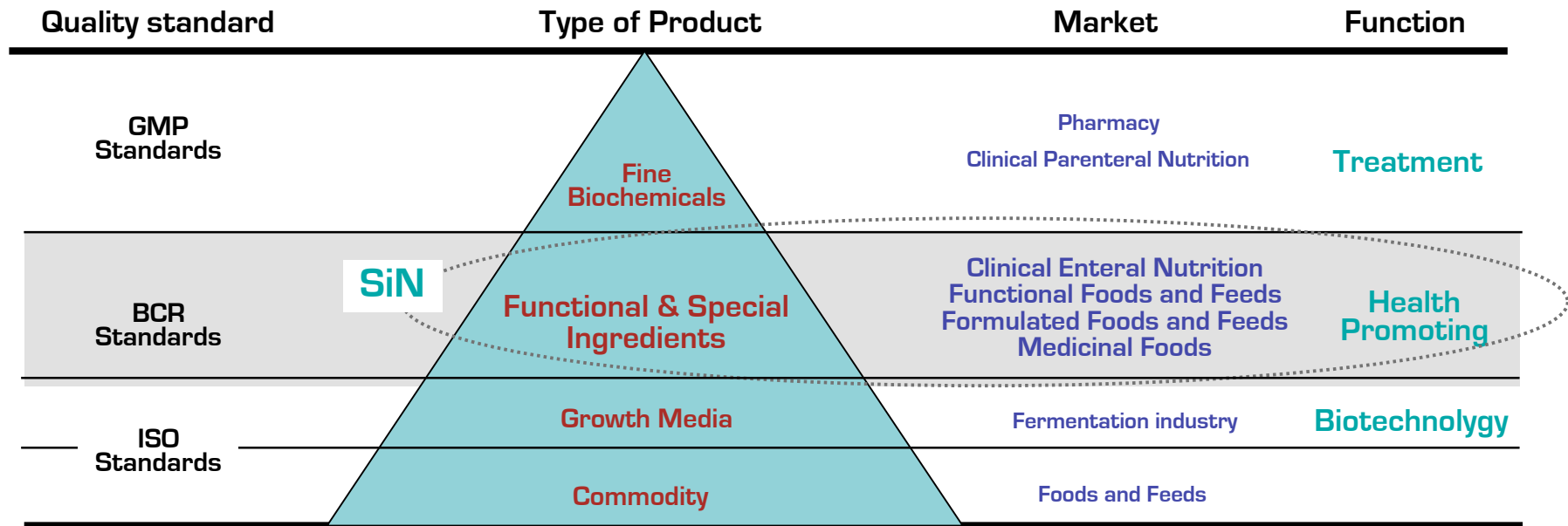
Next Generation Sports Nutrition

*..... can marine peptides be
used as functional ingredients
in sports nutrition?*

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Science in Nutrition - R&D and Innovation Focus

Science in Nutrition develops and documents marine ingredients, and applications based on such ingredients for the human functional food -, formulated food - and sport food market segments as well as for the non-pharmaceutical clinical nutrition market.



Main focus: marine peptides and nucleotides and their applications in formulated foods



Need for Product Development?

Current categories of products in the sports nutrition market:

- *Energy products (basically with maltodextrins as the sole ingredient)*
- *Protein products (basically containing specific single proteins, or combinations of proteins).*
- *Protein supplemented restitution products (usually based on whey protein concentrates and maltodextrins)*
- *Products containing specific single or combinations of ingredients claiming to add performance-enhancing qualities to the products..*

In general: same product - same format - but different labels

In: Report (2006) from: *Scientific Advisory Board on Sports Nutrition and Performance (SAB)* :

"We can now plot a path towards the ultimate sport drink. Following our review, the Scientific Advisory Board recommends that manufacturers focus on the addition of specific ingredients such as high performance peptides (easily digestible protein sources), antioxidants and other nutritional ingredients"

Key issue in sport - fast and optimal restitution to keep the competitive edge

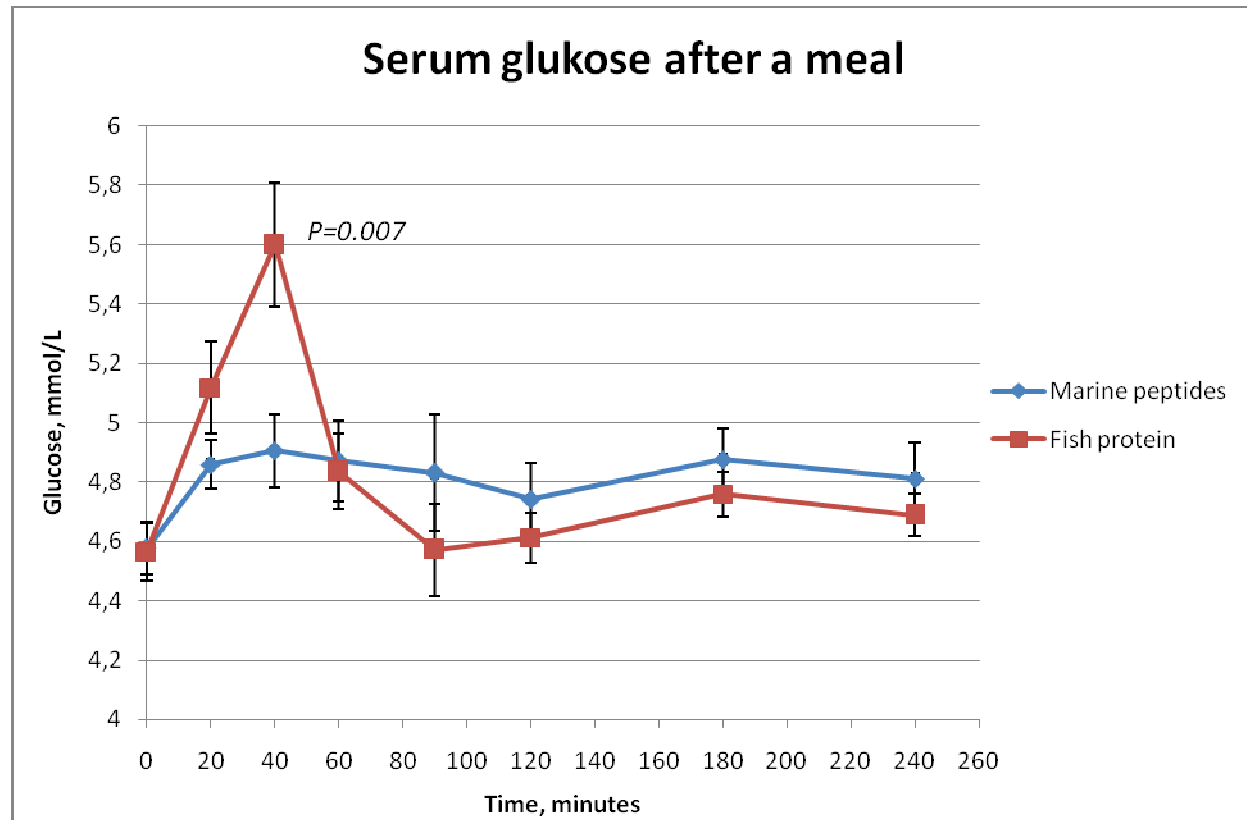
Marine Peptides Lower Postprandial Blood Sugar Response

The study

17 healthy women - 35-55 years old were given two different diets containing either fish protein or fish protein/marine peptides (made from Atlantic cod fillet) at a ratio of 80/20 as the source of protein. The diets were taken within 15 min and the postprandial blood glucose response measured for 240 min (4 hrs) at 20 min intervals in resting test persons.

Result

The postprandial blood sugar response was significantly lower ($P=0,007$) when the test persons were given the diet in which 20 % of the fish protein was replaced by fish peptides.

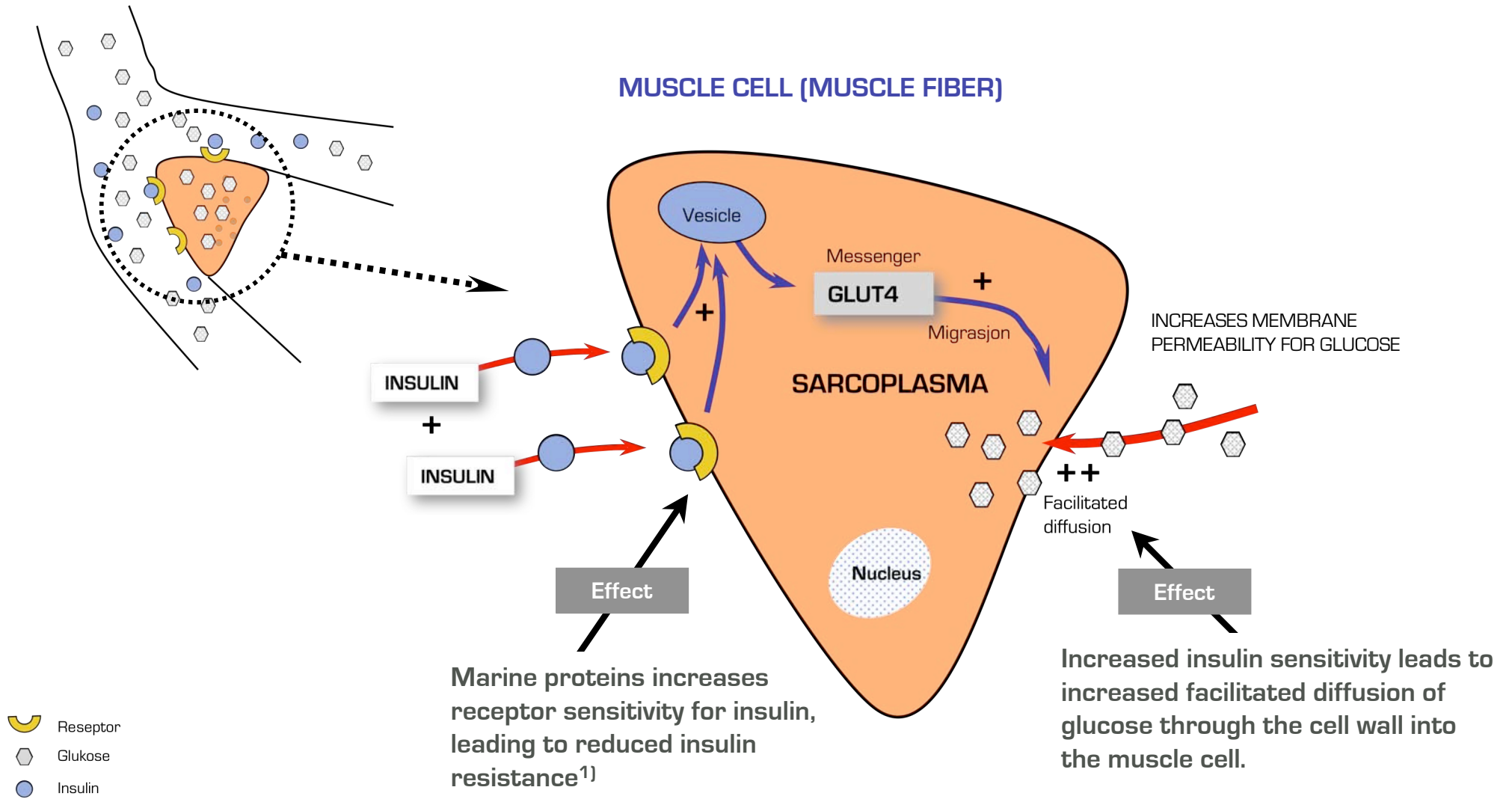


Data collected from the first clinical study carried out at Uppsala University by Maria von Post & Bengt Vessby - 2002-2003.

Registered name: NutriPeptin™; Norwegian Patent filed in 2003



Postulated Mechanism



¹⁾Tremblay F., Lavigne C., Jacques H., Marette A. (2003). *Diabetes* 52, 29-37.

Marine Peptides vs GLP-1

Intake of marine peptides increases the concentration of GLP-1 in blood - most likely by stimulating the intestinal L-cells

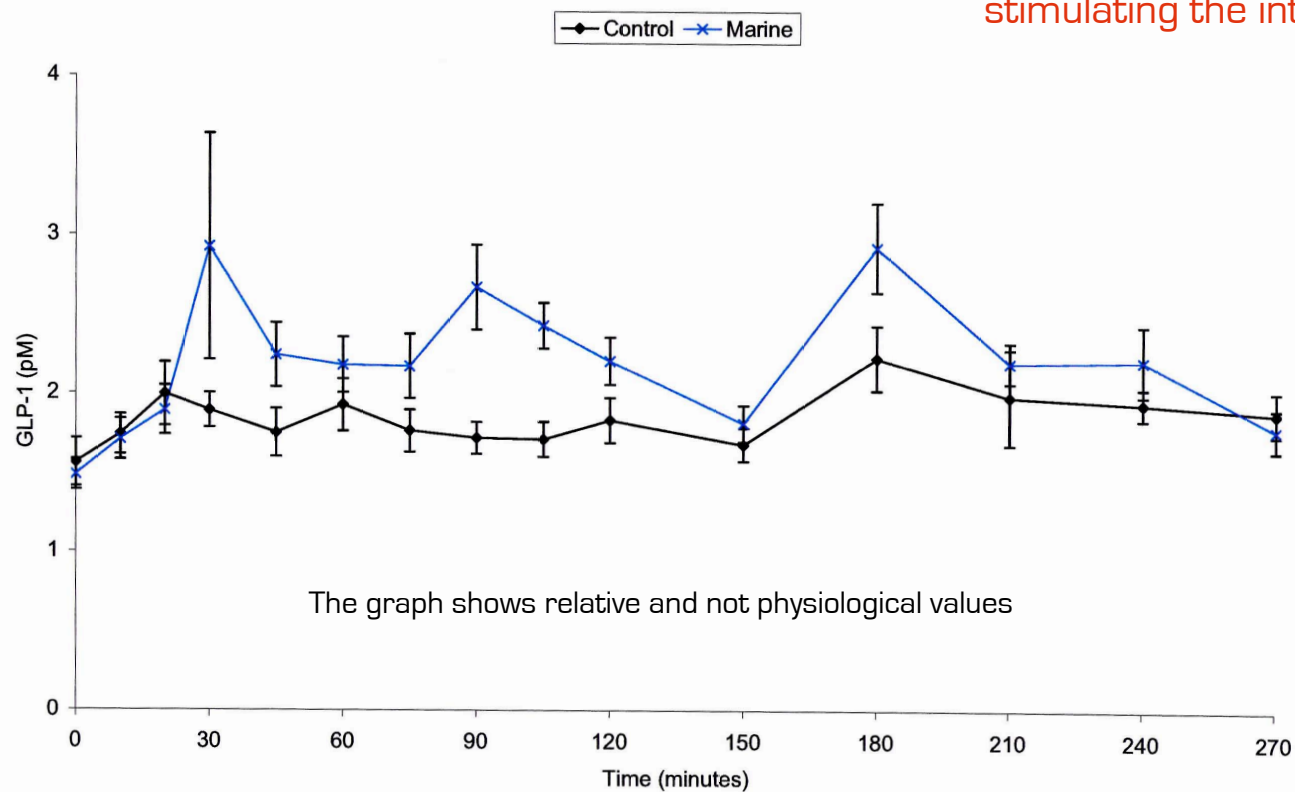


Figure 33: Mean plasma GLP-1 response to the preloads (t=0) and subsequent standardised meal (t=150) for the marine preload (n=9) and the control (n=9). Values are expressed as mean \pm SEM.

Sara Hull & Fiona Angus, "The Perceived and Physiological Effects of Dietary Proteins and Peptides on Satiety. Report - Leatherhead Food International 2008, 93 pp.



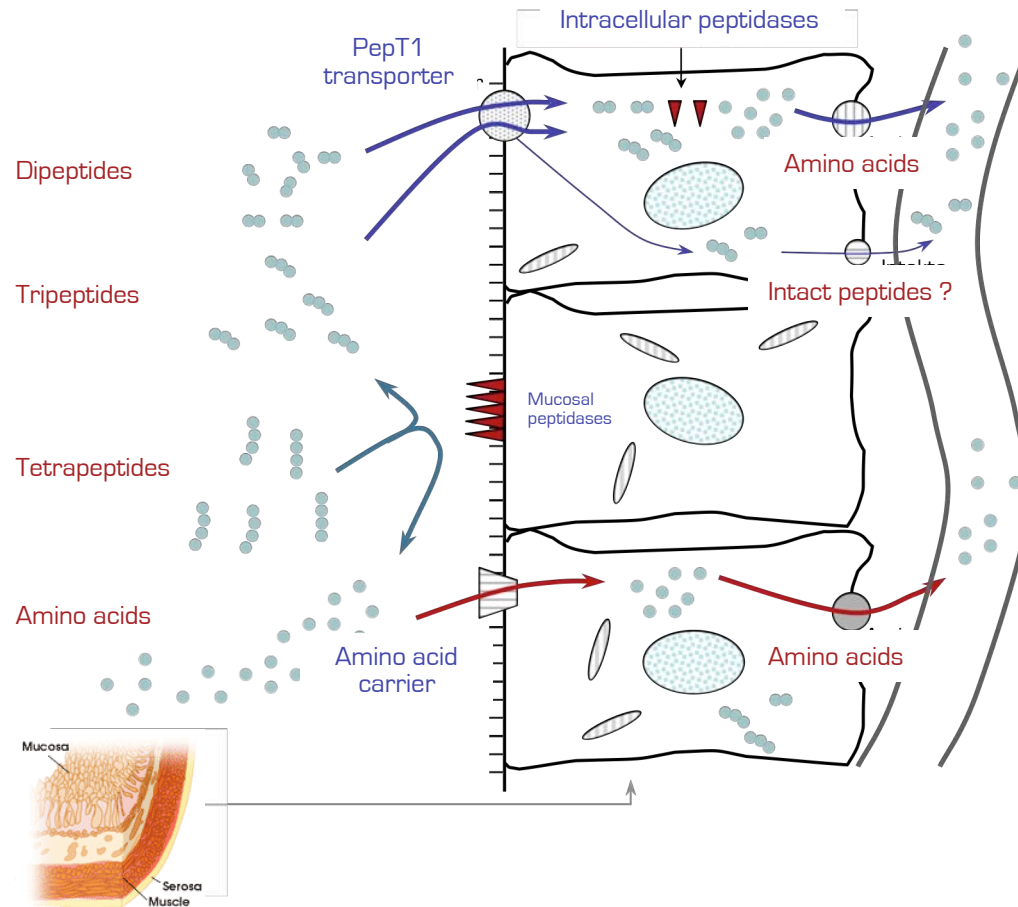
-a marine protein hydrolysate/peptide powder (≥ 88 % crude protein and < 0.1 % fat) manufactured by enzymatic hydrolysis of fish meat protein.
- molecular weight distribution: 85 % less than 5.000 D, 75 % less than 2.500 D and 50 % less than 1.000 D.
- produced from raw materials usually used for foods and foodstuffs, and by using food approved processing technology including food approved enzymes.
- food approved ingredient, and not classified as novel food according to EU regulations.

Marine protein hydrolysates.....:

- ***Increase the uptake of glucose from blood to muscle.***
- ***Increase the secretion of insulin and glucagon-like peptide (GLP-1).***
- ***Increase the catabolism of fat***
- ***Increase protein anabolism***

Marine protein hydrolysates should therefore therefore be well suited as functional ingredients in sports nutrition preparations to optimise performance and restitution.

Transport of Peptides and Amino Acid in the Enterocytes



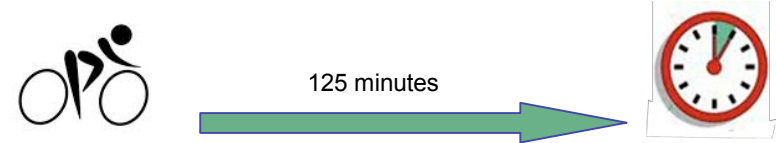
The absorption of peptides via the Pep1 carrier is driven by a proton gradient made by the exchange of Na⁺/H⁺ over the apical membrane of the enterocyte. The Na⁺-gradient is maintained by Na⁺/K⁺ATPase in the basolateral membrane.

The transport of amino acids are, like glucose, mostly linked to the transport of Na⁺: the driving mechanism is the Na⁺-gradient maintained by the Na⁺/K⁺ATPase located in the basolateral membrane.

Peptide absorption results in a faster absorption of amino acids than if the amino acids are absorbed individually.

In general, peptides accounts for about 60 % of the intestinal absorption of protein.

Marine Peptides and Performance 1



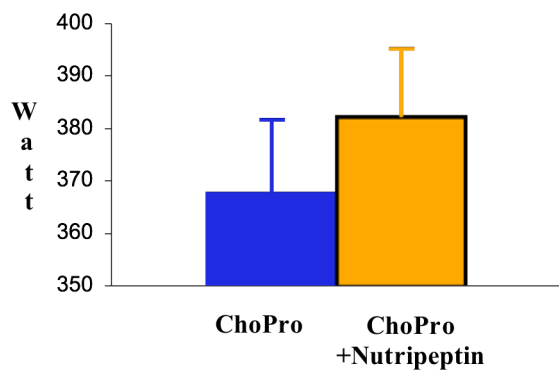
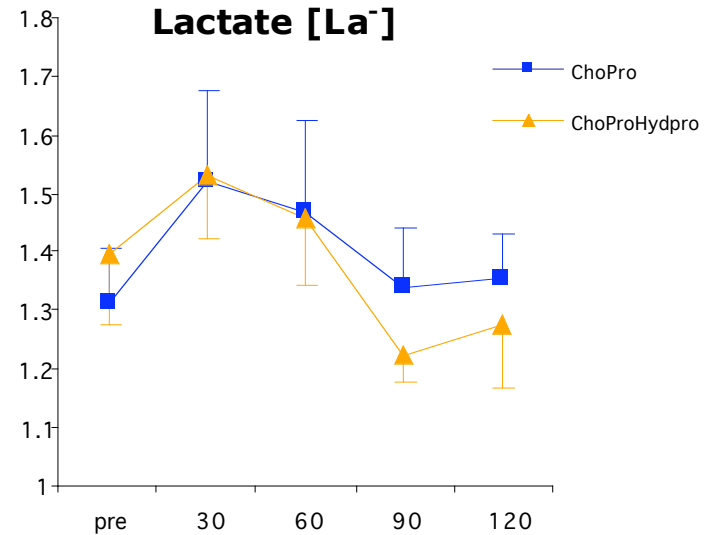
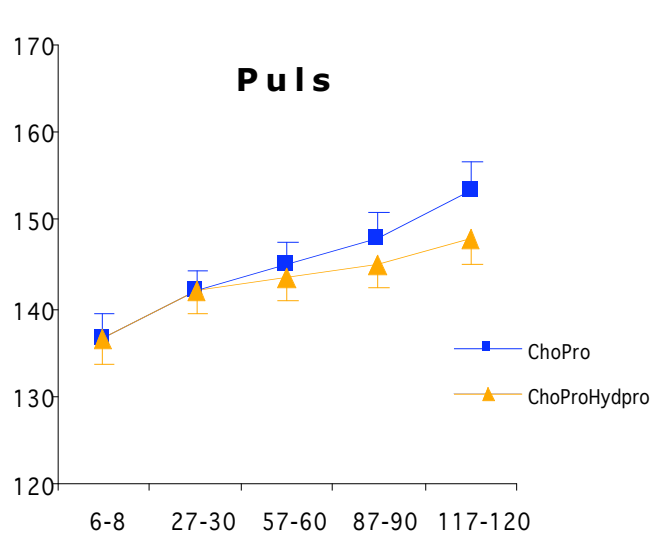
Clinical study with healthy individuals ^{1,2}:



- **Objective:** To examine the effects of supplementing hydrolysed protein to a beverage containing unprocessed protein and carbohydrate on a 5-min all-out performance test following 125 minutes cycling at 50 % of maximal aerobic power (W_{max}).
- **Test individuals:** Sixteen trained men ($VO_2 \text{ max} = 63 \pm 1.52 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$), all using cycling as part of their weekly training, participated in a randomized double-blinded cross-over design.
- **Implementation:** During the standardized 125 minutes of steady-state cycling, 1.8 dl beverage was ingested every 15 minutes. For one beverage this led to ingestion of $58 \text{ g}\cdot\text{h}^{-1}$ carbohydrate and $9.1 \text{ g}\cdot\text{h}^{-1}$ unprocessed protein [ChoPro], and for the other beverage it led to consumption of $58 \text{ g}\cdot\text{h}^{-1}$ carbohydrate, $7.5 \text{ g}\cdot\text{h}^{-1}$ unprocessed protein and $1.6 \text{ g}\cdot\text{h}^{-1}$ hydrolysed protein [ChoProHydro].
- **Analysis:** Blood samples were analysed for whole blood glucose and lactate.

Vegge G, Rønnestad B R, Ellefsen S, (2012). *Improved cycling performance with ingestion of hydrolyzed marine protein depends on performance level.* Journal of the International Society of Sports Nutrition, **9**, 14; <http://www.jissn.com/content/9/1/14>.

Marine Peptides and Performance ... 2

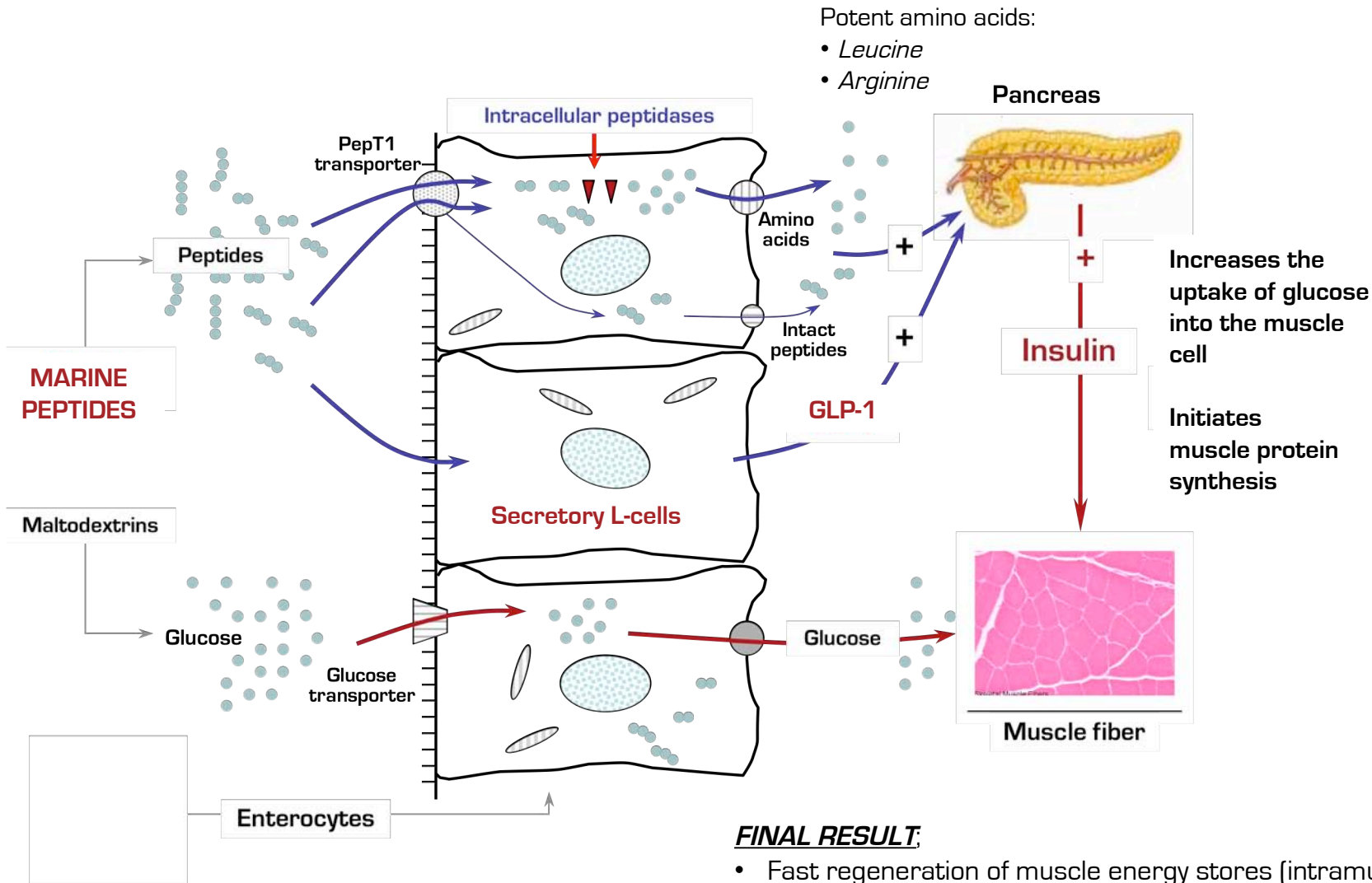


Conclusion

Supplementation of a protein/carbohydrate [20 % PE/TE] sports drink by 4 % of marine peptides resulted in a **4 %** increase ($p=0.04$) in performance (ie working capacity).

Vegge G, Rønnestad B R, Ellefsen S, (2012). *Improved cycling performance with ingestion of hydrolyzed marine protein depends on performance level.* Journal of the International Society of Sports Nutrition, **9**, 14; <http://www.jissn.com/content/9/1/14>

Proposed mode of action:



1. Fast absorption of peptides into the enterocyte
2. Peptides are hydrolysed by intracellular peptidases
3. Peptides stimulates secretion of GLP-1
4. Specific amino acids stimulate the secretion of insulin
5. Insulin stimulates the uptake of glucose and initiates protein synthesis in muscle tissue
6. 75 % of the blood glucose is absorbed by the muscle tissue

FINAL RESULT:

- Fast regeneration of muscle energy stores (intramuscular glycogen and fat).
- Fast restitution of muscle tissue in the form of muscle fiber repair and compensatory muscle fiber growth.

“Marine Peptides Inside”

SPORTS NUTRITION

Marine peptides is used as a functional ingredient in the sports nutrition products:

Restitution Sport Nutrition Booster - On the Road

Designed to satisfy the specific nutrition demands during and after work-outs and competitions.



Restitution Sport in Tour de France, Giro d'Italia and Vuelta a Espana



Restitution - Sport was tested and used by TEAM CSC, both in Tour de France, Giro d'Italia, and Vuelata a Espana i 2005, 2006 and 2007.



Restitution™ Sport and Booster - On the Road was tested by the Norwegian team participating in 1001 Miglia Italia 2012 comprising 1.650 km and 21.000 height meters in 5 days.

“Marine Peptides Inside” further development:

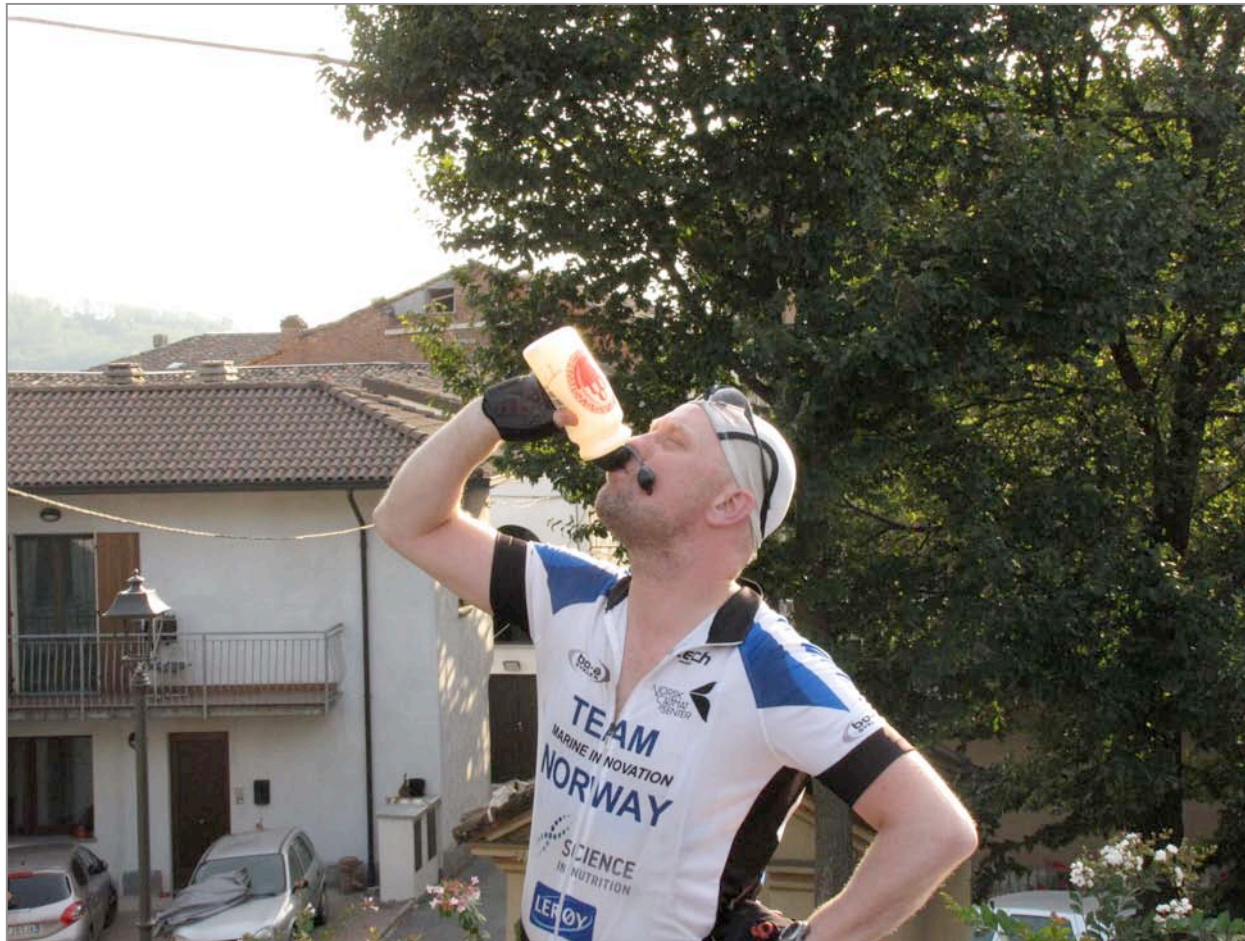
Recover Sports Nutrition has later been refined into a clinical nutrition product - RECOVER Nutrition - addressing pre- and post bariatric (overweight) surgery, indigestion and functional gastrointestinal disorders

- *Recover Nutrition was recently evaluated by the Norwegian Scientific Committee for Food Safety and the Norwegian Food Safety Authority for medical use.*
- *Recover Nutrition was approved for use as medical food for nutrition treatment based on the indications given above.*
- *Final step: application to Norwegian Health Authority (HELLFO) for approval as prescribed medical food for nutrition treatment.*

First product ever (to our knowledge) containing functional marine peptides and nucleotides approved for use in clinical nutrition



*“Marine Peptides Inside”.....
Optimal Nutrition for Maximal Performance*



THANK YOU FOR YOUR ATTENTION