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In Vitro And In Vivo Evaluation Of L-Lysine Solid Lipid Microcapsules For Swine

C. Bonnici, M.F. Marchesi, R. Majer, G. Gallina, A. Piva, E. Grilli

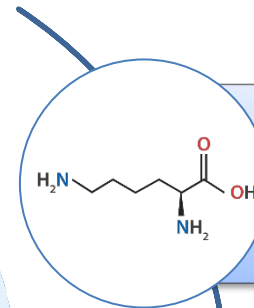
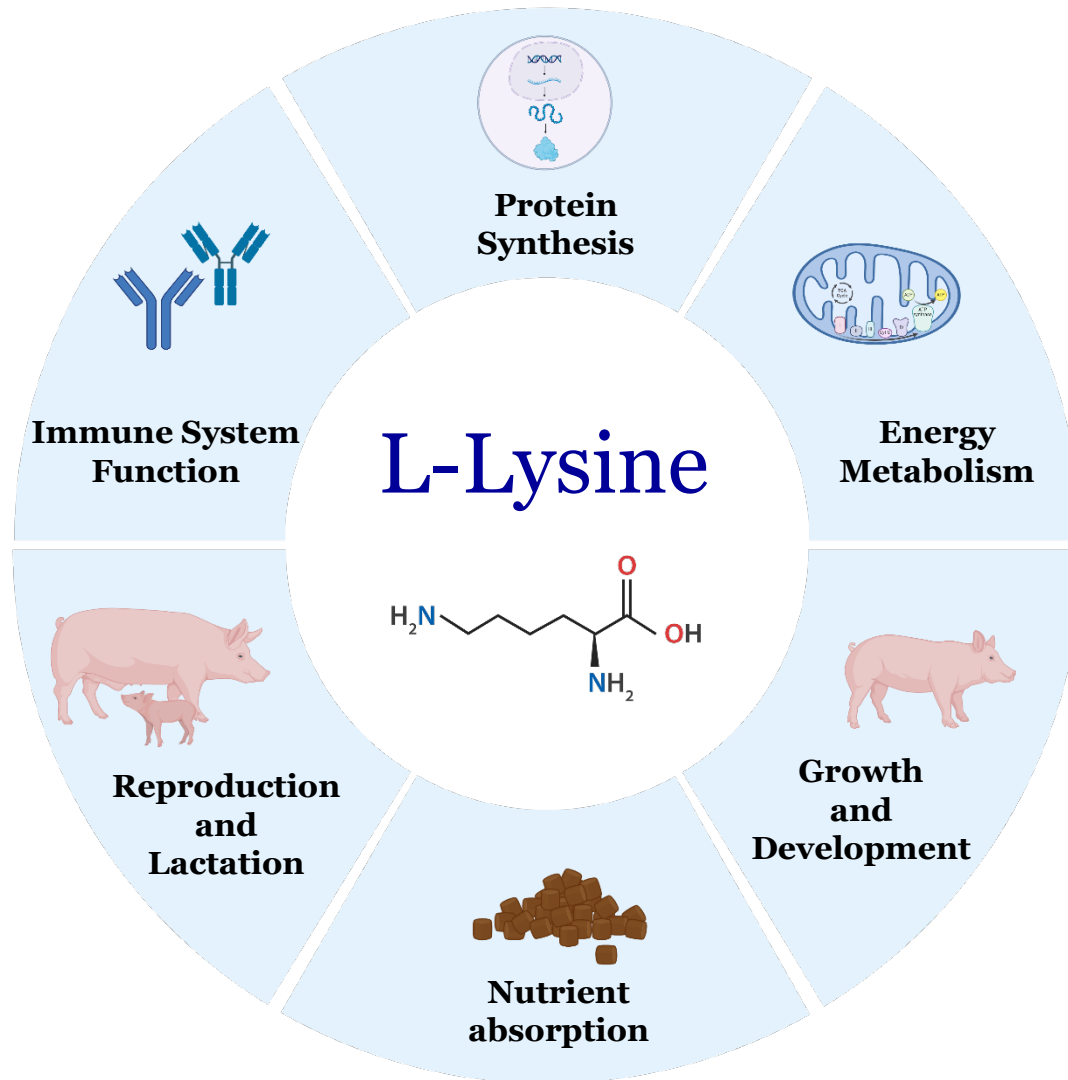
Presented by:

Costanza Bonnici

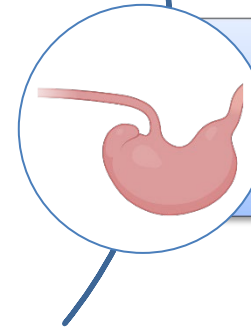
costanza.bonnici2@unibo.it

Department of Veterinary Medical Sciences
University of Bologna

L-Lysine: The Limiting Amino Acid In Swine Nutrition



The *First Limiting Amino Acid*



Free Amino Acid:
Highly Susceptible to Gastric Degradation



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Background Study



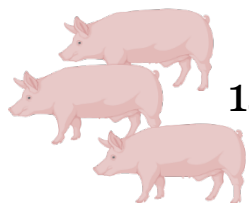
Microencapsulated lysine and low-protein diets: Effects on performance, carcass characteristics and nitrogen excretion in heavy growing–finishing pigs¹

A. Prandini,^{*2} S. Sigolo,^{*} M. Morlacchini,[†] E. Grilli,[‡] and L. Fiorentini^{*}

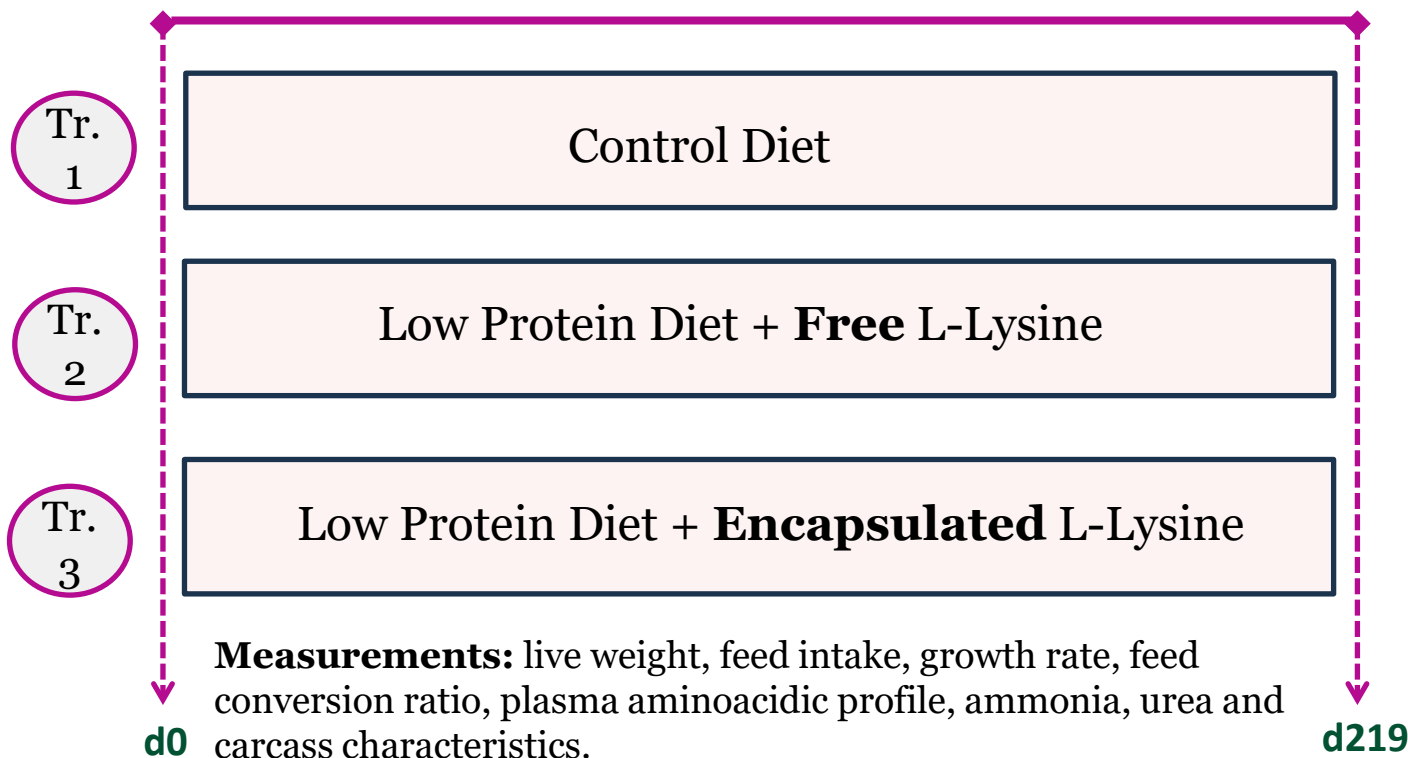
^{*}Feed and Food Science and Nutrition Institute, Agricultural Faculty, Catholic University, 29122 Piacenza, Italy;

[†]CERZOO, Research Center for Zootechny and the Environment, S. Bonico, 29122 Piacenza, Italy; and

[‡]Department of Veterinary Medical Science, University of Bologna, Ozzano Emilia, 40064 Bologna, Italy



144 pigs (barrows and gilts)



Results:

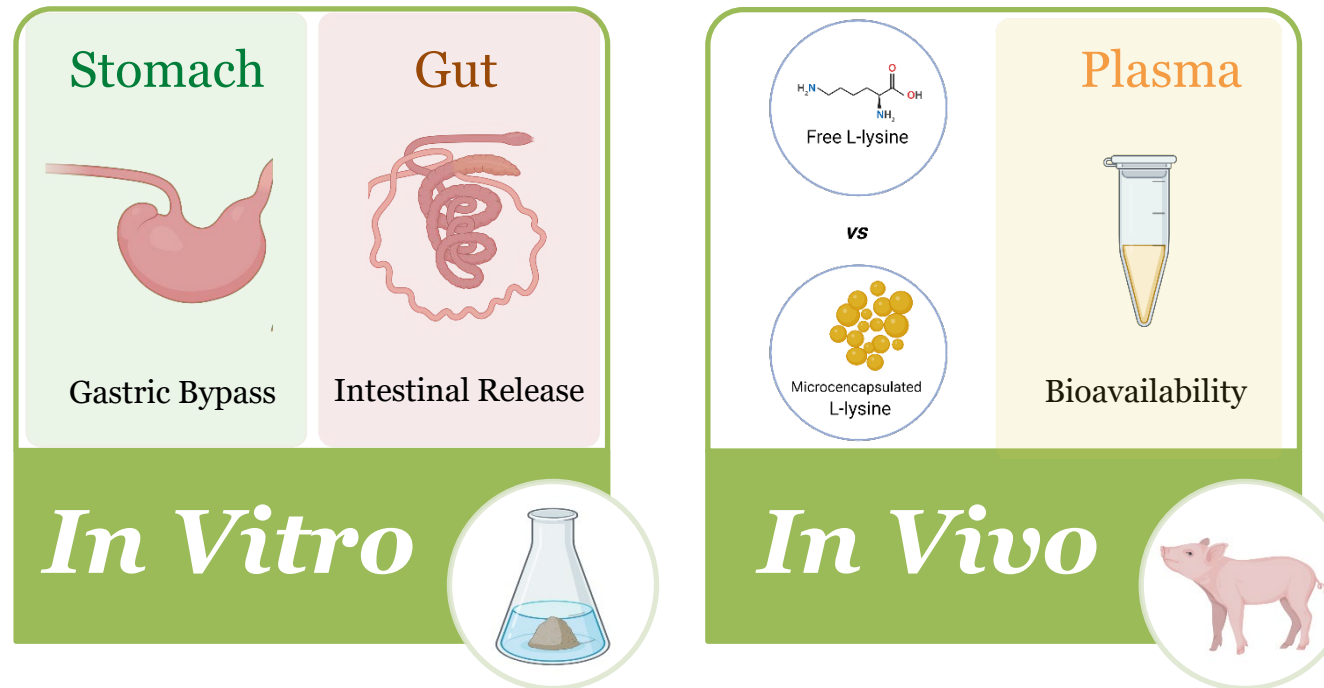
❖ **Similar Growth Performance, BW and Carcass Characteristics**

❖ **Better N₂ Retention**



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Our Study: A Deeper Understanding of Solid Lipid Microcapsules Delivery System



❖ **Gastroprotection**

❖ **Intestinal Release**

❖ **Pharmacokinetic Profile**

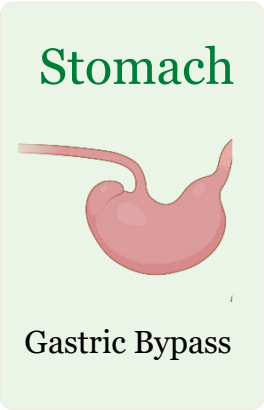
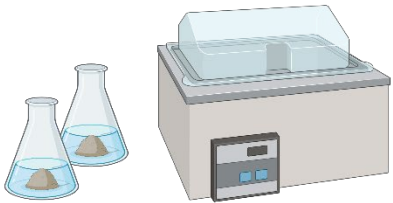
❖ **Bioavailability**



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In Vitro Test: Matrixes

In Vitro



Prototype 1

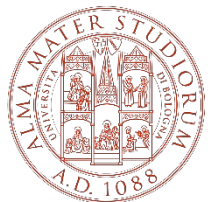
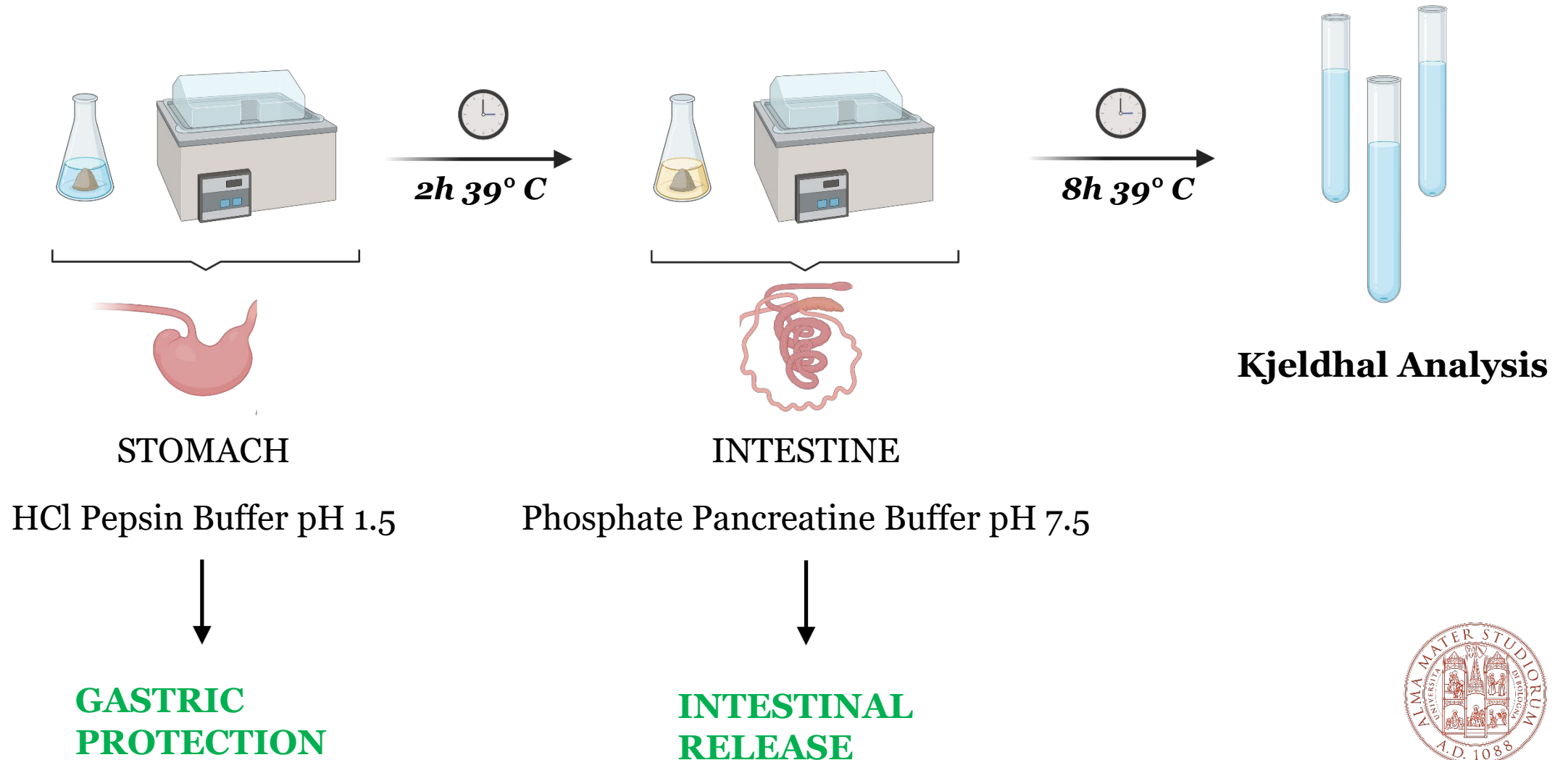
Prototype 2

Prototype 3

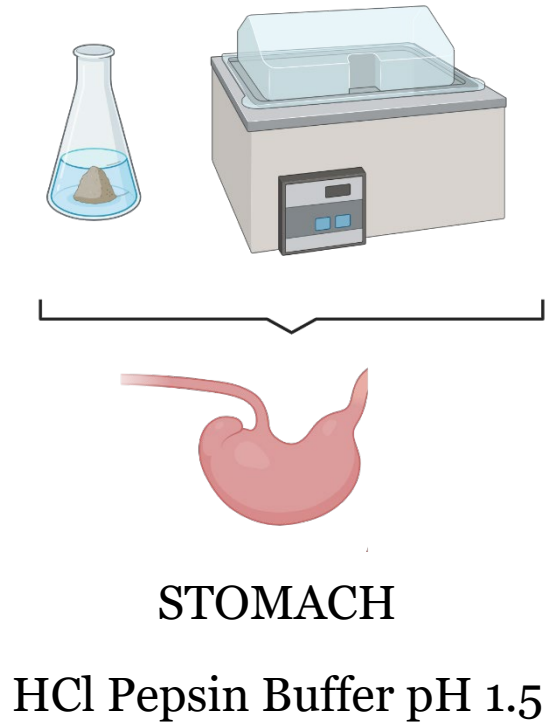
Matrices of Microencapsulated Prototypes

Matrix Type	Chemical Structure
Vetegable Oil Triglycerides	$ \begin{array}{c} \text{O} \\ \parallel \\ \text{H}_2\text{C}-\text{O}-\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3 \\ \\ \text{O} \\ \parallel \\ \text{H}_2\text{C}-\text{O}-\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3 \\ \\ \text{O} \\ \parallel \\ \text{H}_2\text{C}-\text{O}-\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3 \end{array} $
Vetegable Oil Triglycerides + Emulsifier	$ \begin{array}{c} \text{O} \\ \parallel \\ \text{H}_2\text{C}-\text{O}-\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3 \\ \\ \text{O} \\ \parallel \\ \text{H}_2\text{C}-\text{O}-\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3 \\ \\ \text{O} \\ \parallel \\ \text{H}_2\text{C}-\text{O}-\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3 \end{array} + \begin{array}{c} \bullet \quad \bullet \\ \quad \\ \text{---} \quad \text{---} \end{array} $
Vetegable Oil Triglycerides + Emulsifier	$ \begin{array}{c} \text{O} \\ \parallel \\ \text{H}_2\text{C}-\text{O}-\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3 \\ \\ \text{O} \\ \parallel \\ \text{H}_2\text{C}-\text{O}-\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3 \\ \\ \text{O} \\ \parallel \\ \text{H}_2\text{C}-\text{O}-\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3 \end{array} + \begin{array}{c} \bullet \quad \bullet \\ \quad \\ \text{---} \quad \text{---} \end{array} $ DIFFERENT PARTICLE SIZE DISTRIBUTION

In Vitro Test: Monogastric Digestion



In Vitro Test: Results

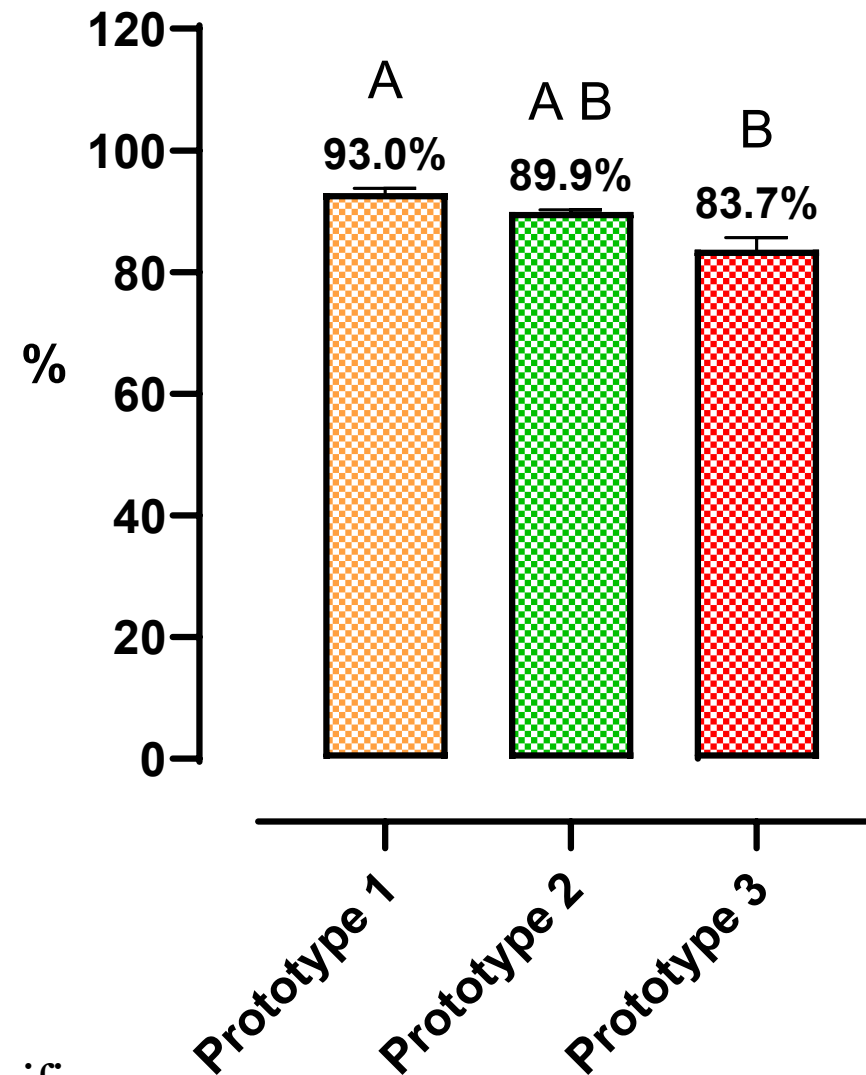


Prototype 1: Vegetable Oil Triglycerides

Prototype 2: Vegetable Oil Triglycerides + Emulsifier

Prototype 3: Vegetable Oil Triglycerides + Emulsifier (Different Particle Distribution)

Gastroprotection

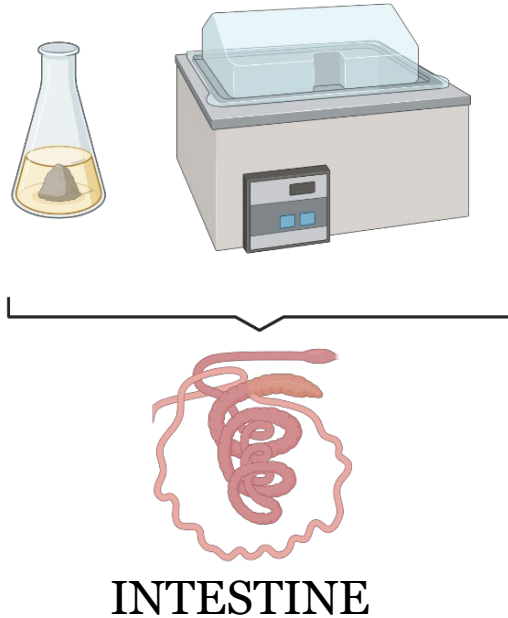


Mean $\pm$ SD
 $p < 0.05$
One-way ANOVA



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In Vitro Test: Results



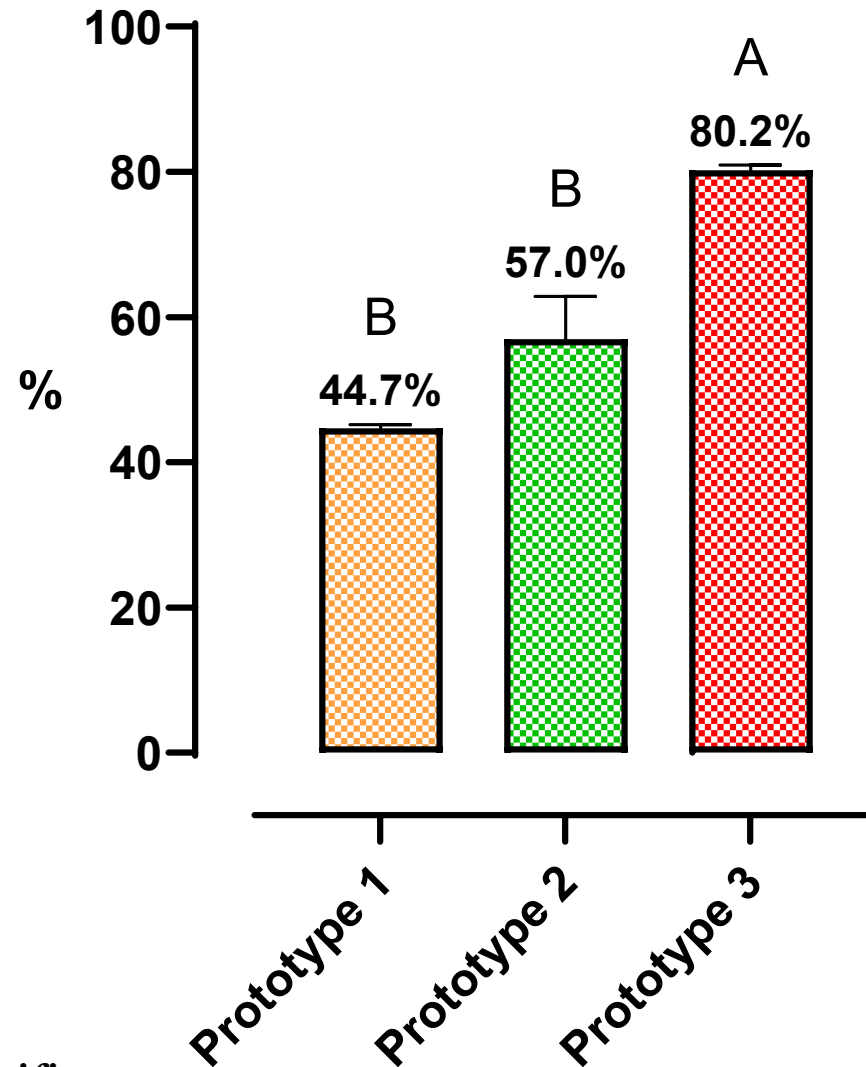
Phosphate Pancreatine Buffer pH 7.5

Prototype 1: Vegetable Oil Triglycerides

Prototype 2: Vegetable Oil Triglycerides + Emulsifier

Prototype 3: Vegetable Oil Triglycerides + Emulsifier (Different Particle Distribution)

Intestinal Release



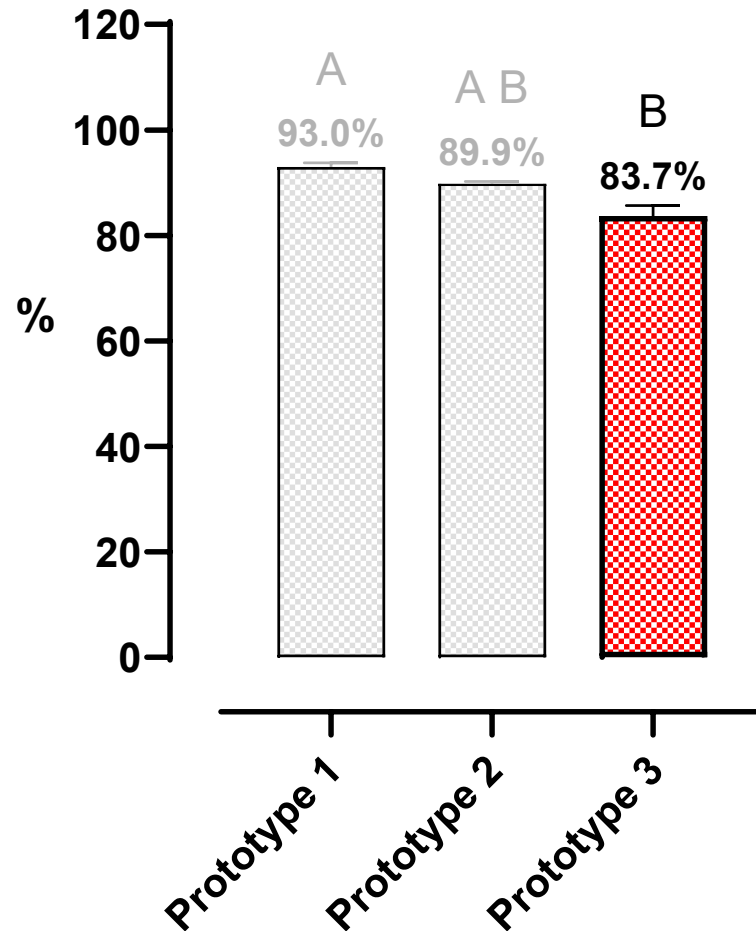
Mean $\pm$ SD
 $p < 0.05$
One-way ANOVA



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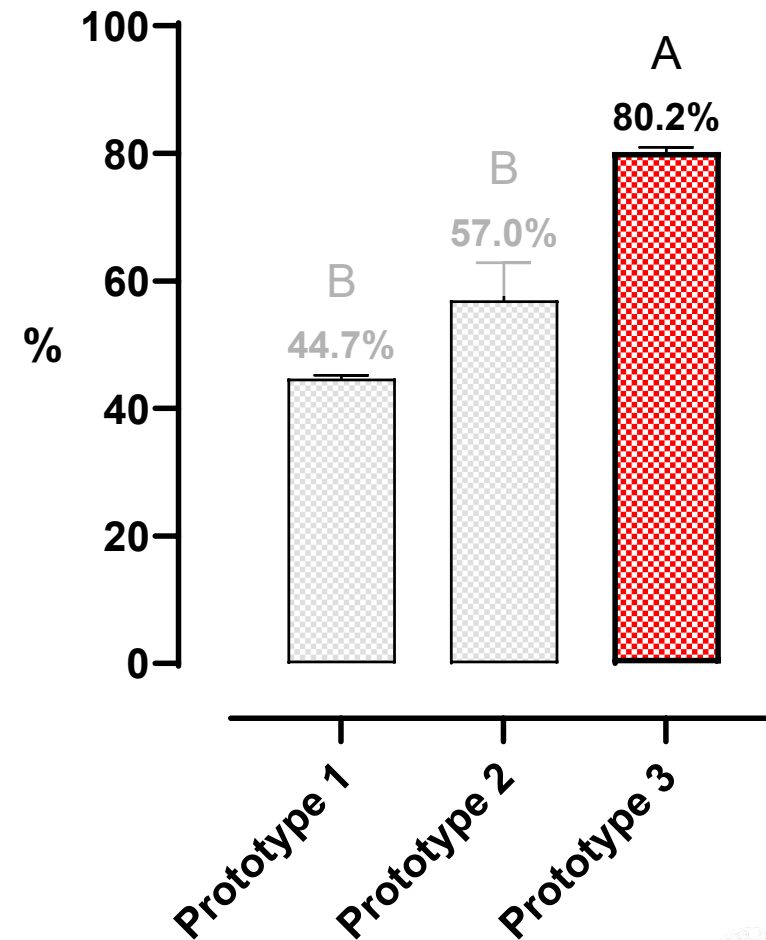
In Vitro Test: Results

Gastroprotection



Mean ± SD
 $p < 0.05$
One-way ANOVA

Intestinal Release

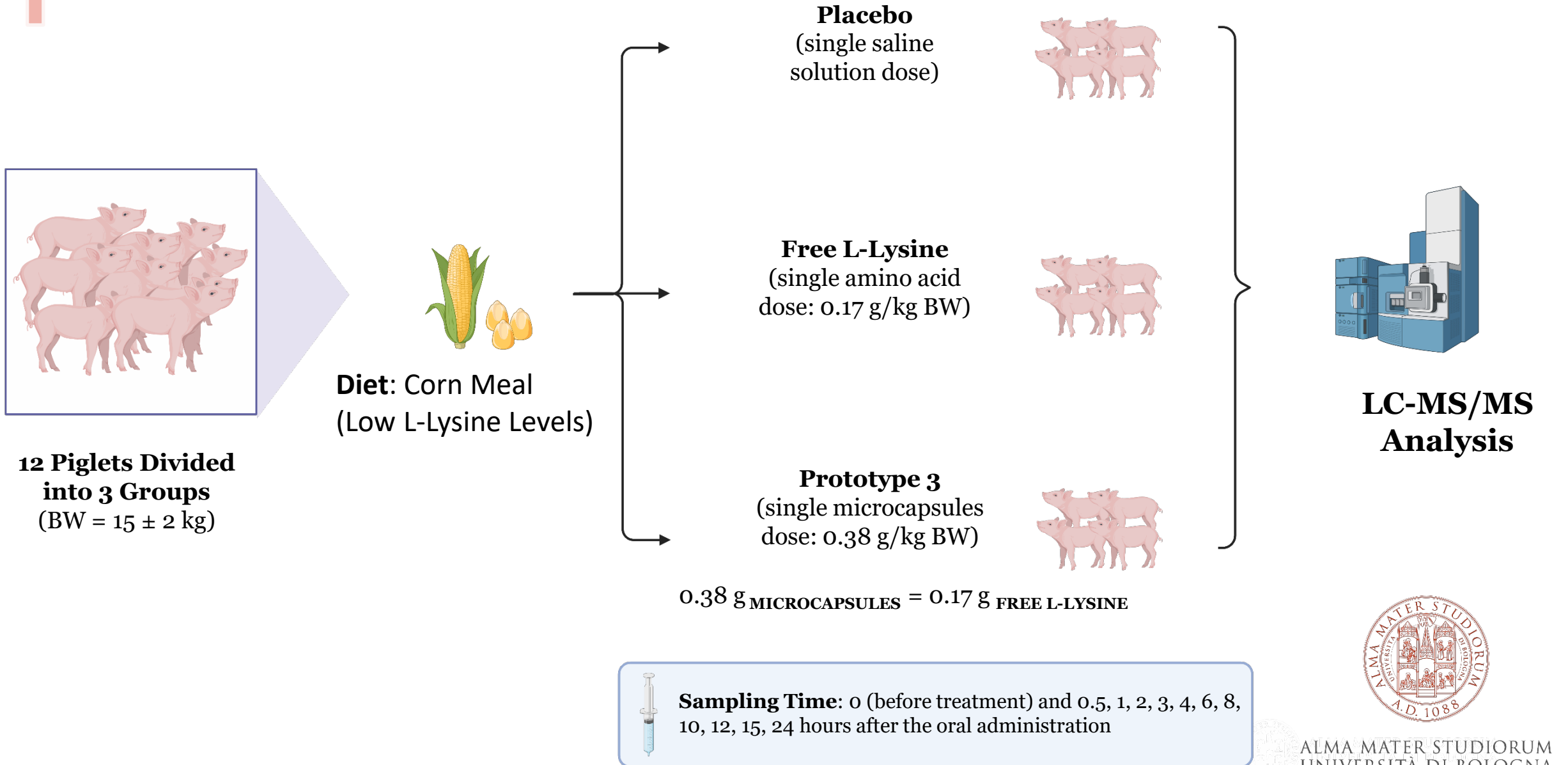


Mean ± SD
 $p < 0.05$
One-way ANOVA

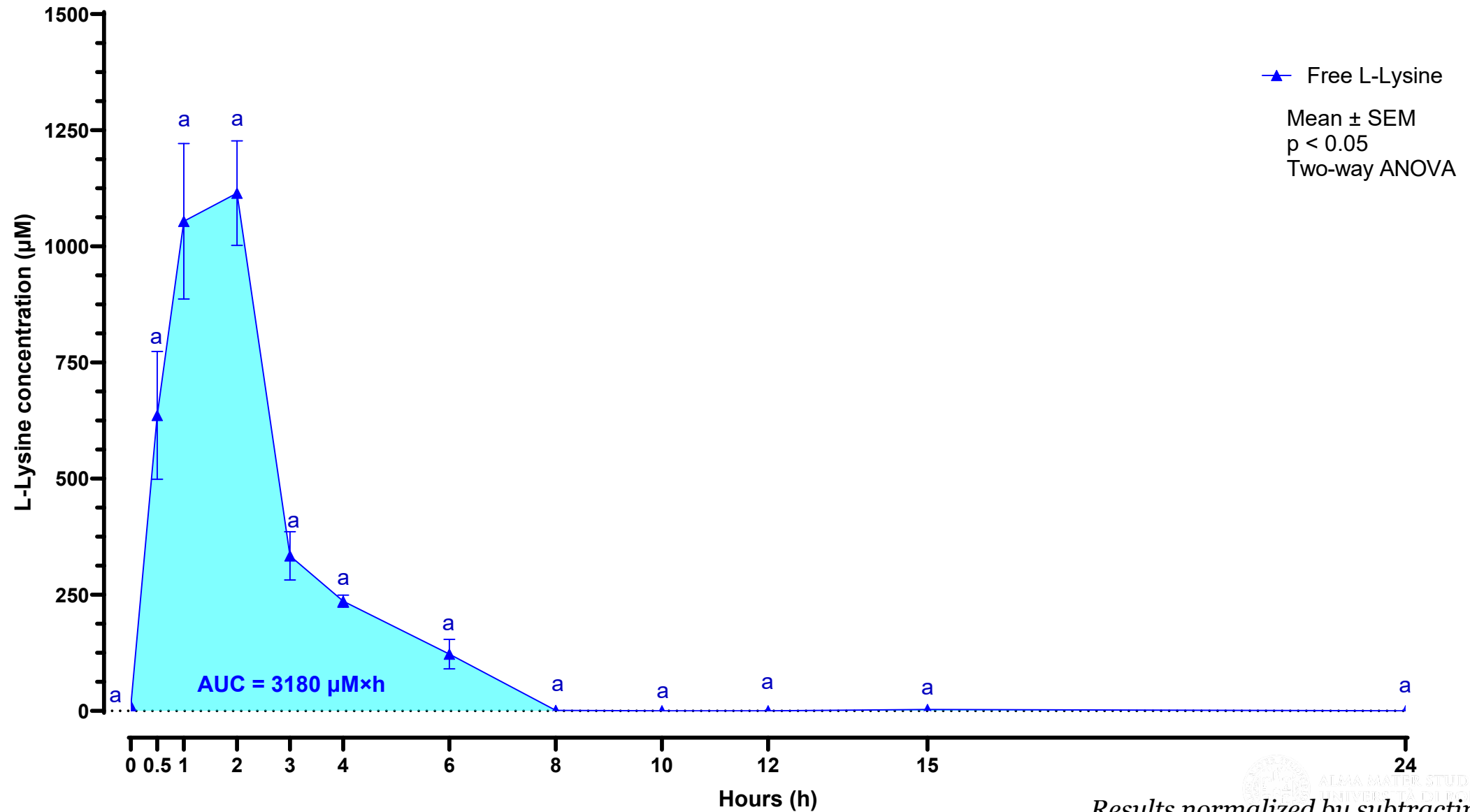


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In Vivo Test: Oral Administration

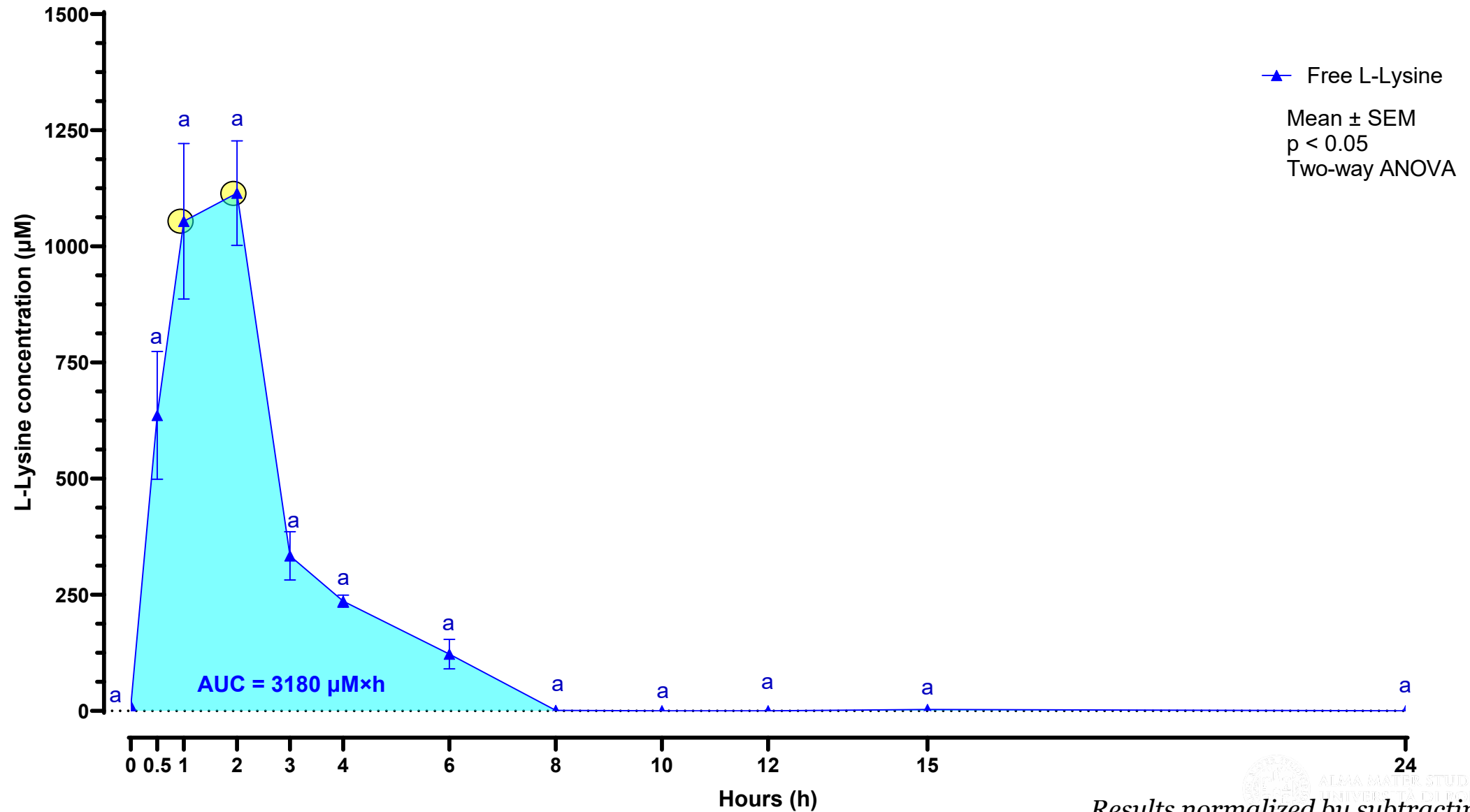


In Vivo Test: Pharmacokinetic L-Lysine Profile



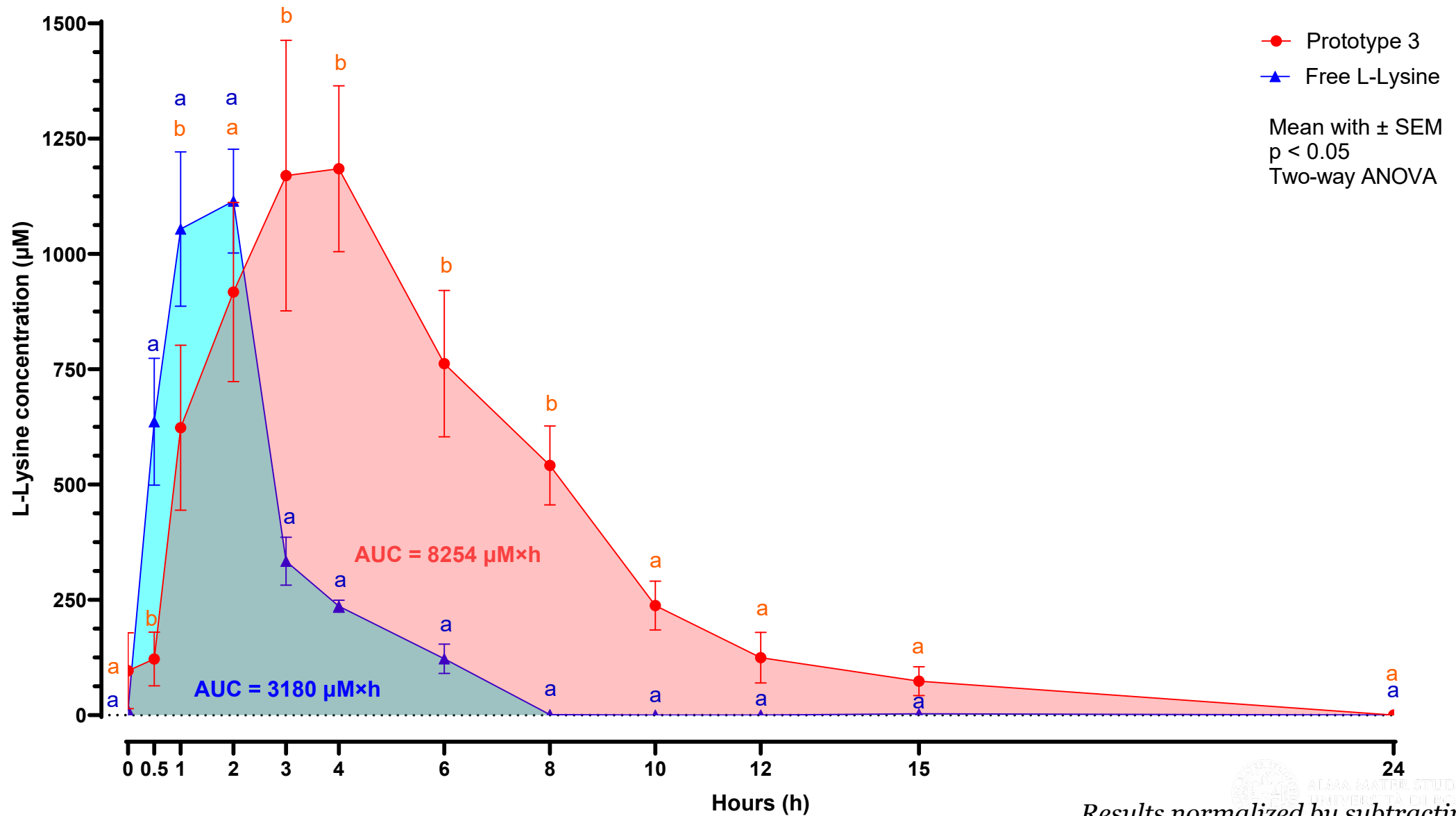
Results normalized by subtracting placebo

In Vivo Test: Pharmacokinetic L-Lysine Profile



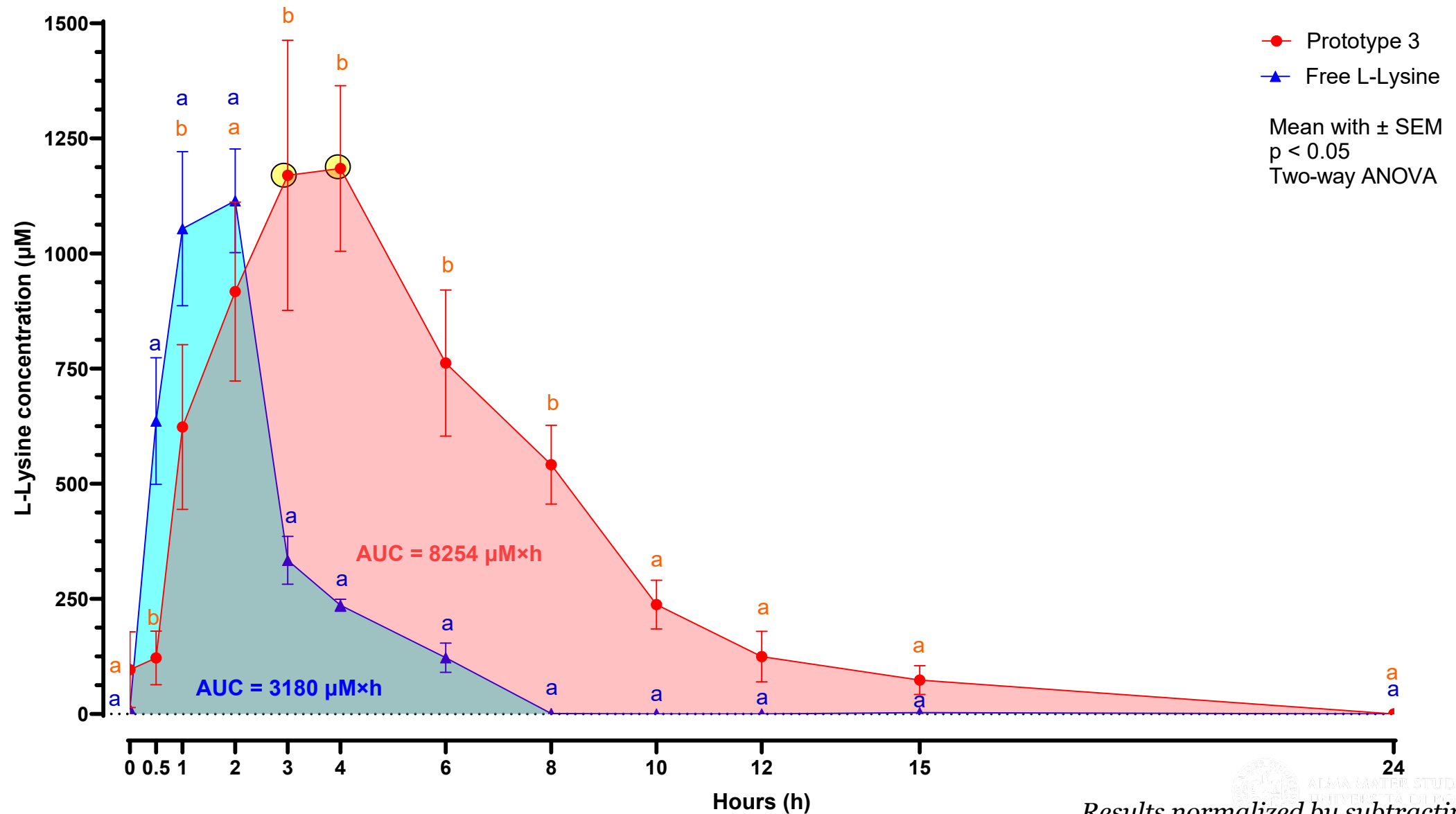
Results normalized by subtracting placebo

In Vivo Test: Pharmacokinetic L-Lysine Profile



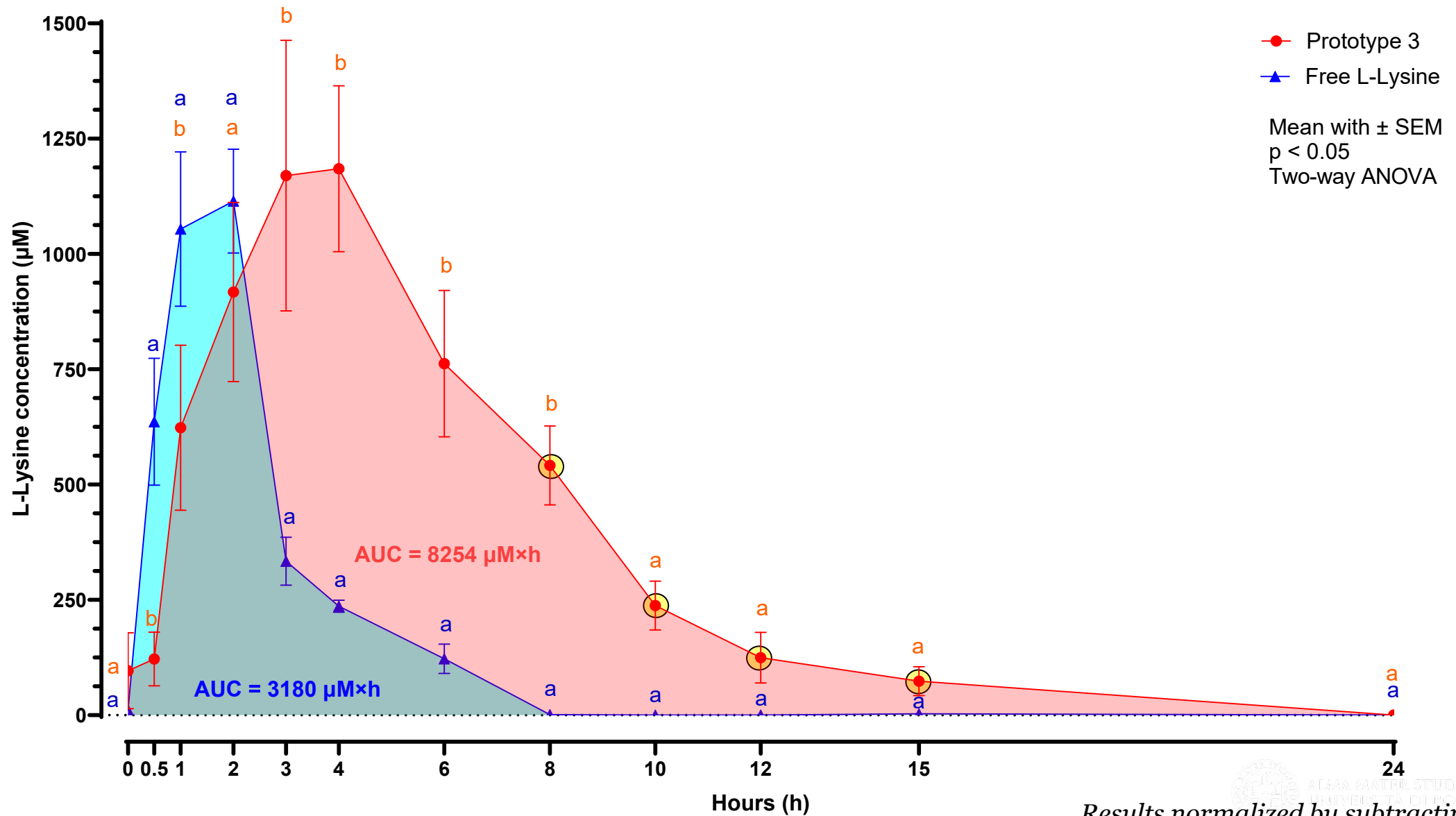
Results normalized by subtracting placebo

In Vivo Test: Pharmacokinetic L-Lysine Profile



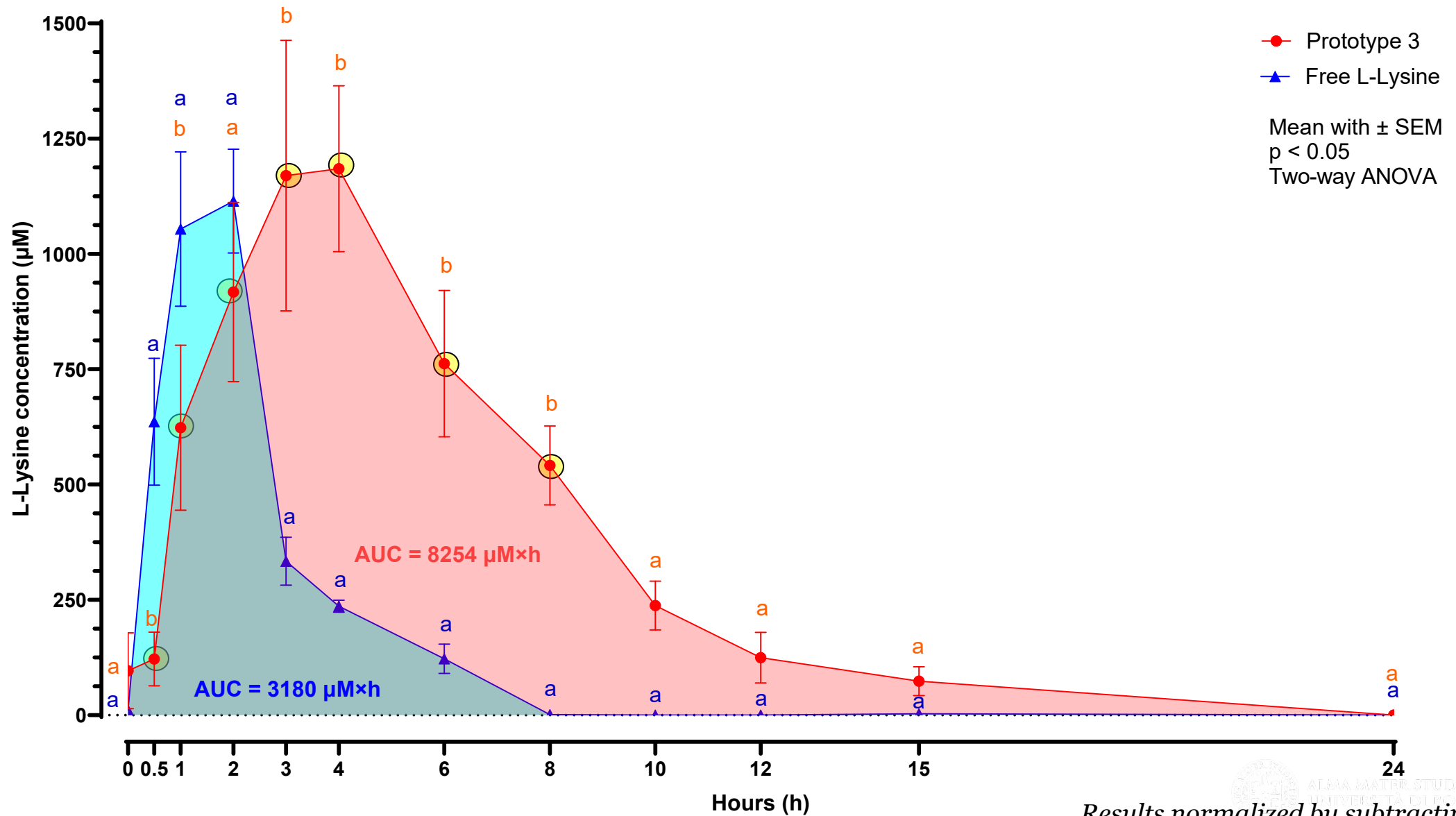
Results normalized by subtracting placebo

In Vivo Test: Pharmacokinetic L-Lysine Profile



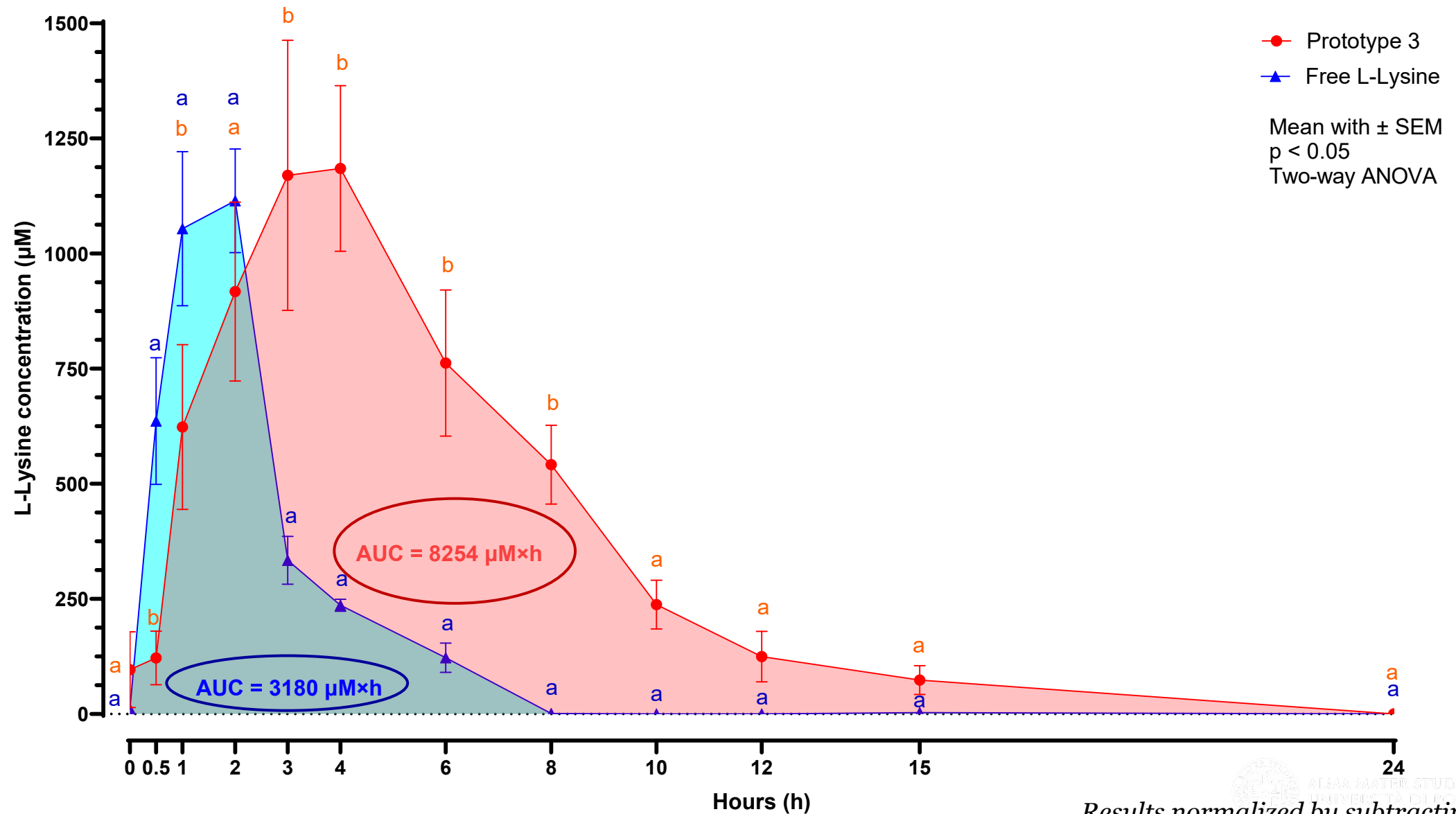
Results normalized by subtracting placebo

In Vivo Test: Pharmacokinetic L-Lysine Profile



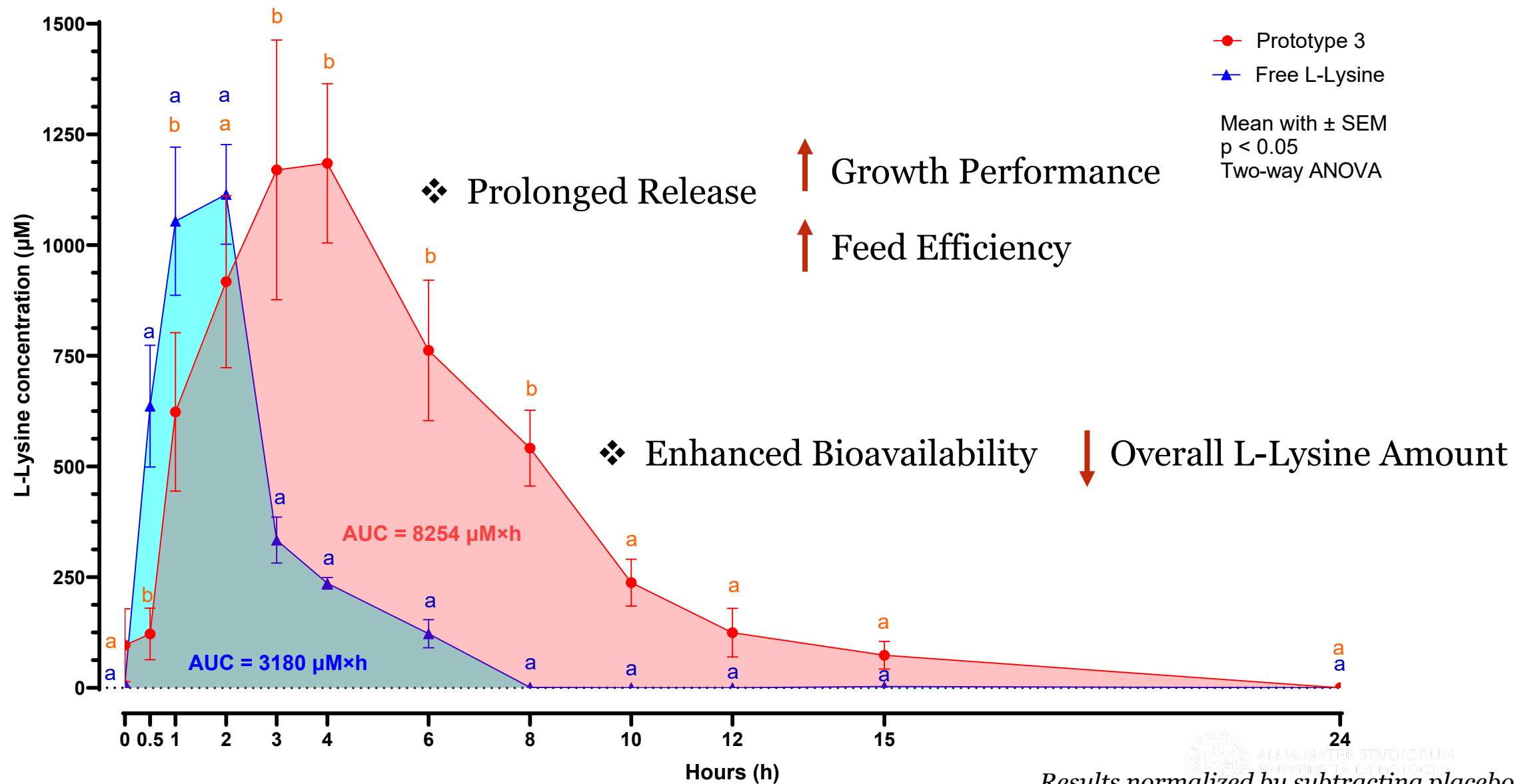
Results normalized by subtracting placebo

In Vivo Test: Pharmacokinetic L-Lysine Profile



Results normalized by subtracting placebo

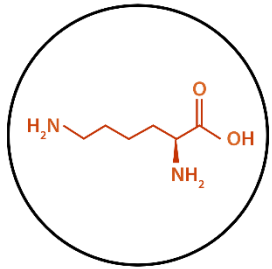
In Vivo Test: Pharmacokinetic L-Lysine Profile



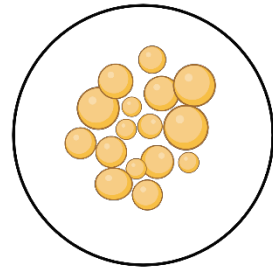
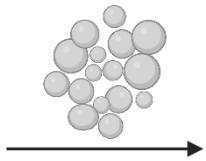
Results normalized by subtracting placebo

Final Conclusion:

L-Lysine Solid Lipid Microcapsules Are An Effective Delivery System in Swine Nutrition



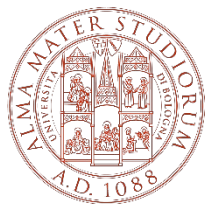
Free L-Lysine



Encapsulated L-Lysine



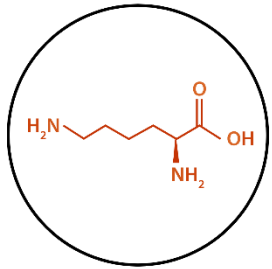
In Vitro:
Substantial Gastroprotection
Improved Intestinal Release



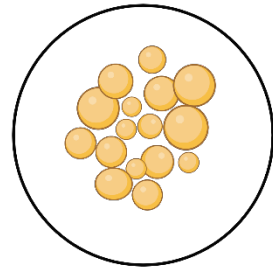
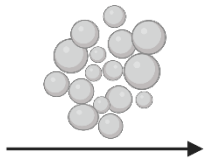
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Final Conclusion:

Solid Lipid Microcapsules an Effective L-Lysine Delivery System in Swine Nutrition



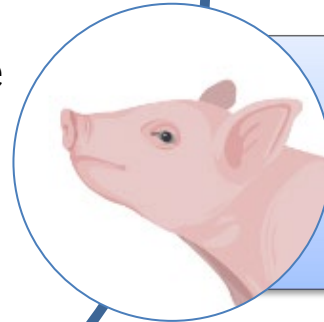
Free L-Lysine



Encapsulated L-Lysine



In Vitro:
Substantial Gastroprotection
Improved Intestinal Release

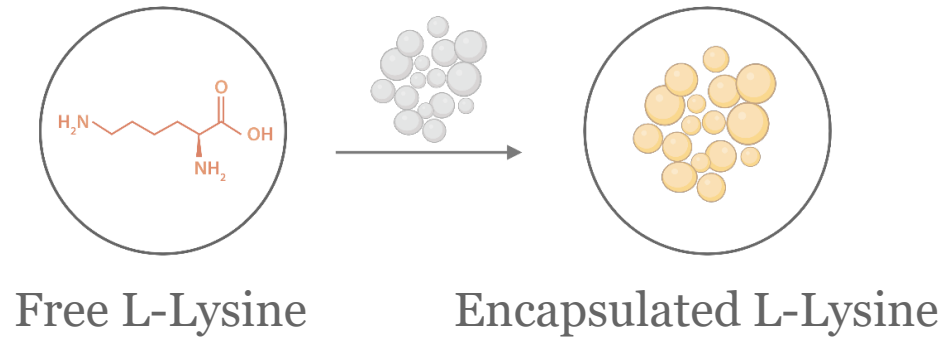


In Vivo:
Prolonged Release
Enhanced Bioavailability

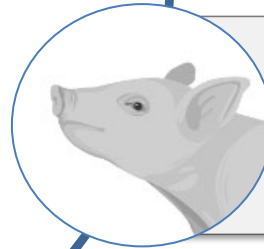


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Final Conclusion:



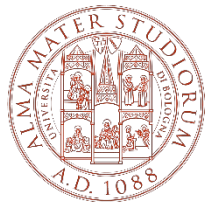
In Vitro:
Substantial Gastroprotection
Improved Intestinal Release



In Vivo:
Enhanced Bioavailability

Future Direction

To Evaluate *In Vivo* Performance Levels and
Environmental Impact of Solid Lipid Microcapsules



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Acknowledgements



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VETSPIN





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