# ALGINATE BEAD BIOSENSORS FOR THE DETERMINATION OF LACTATE LEVELS USING IMAGE ANALYSIS


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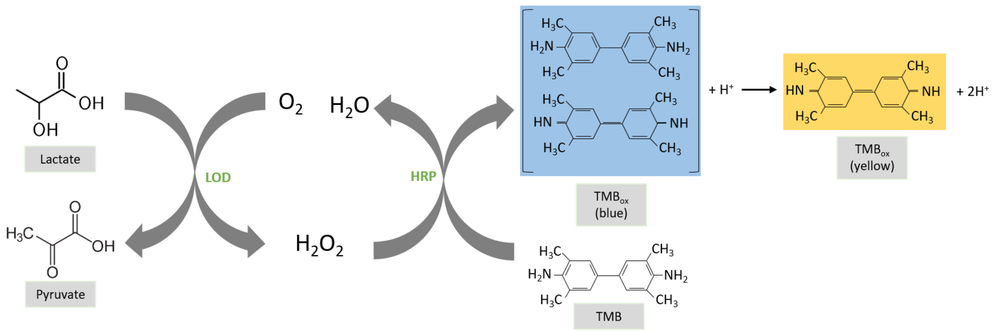
## INTRODUCTION

Sweat is an aqueous solution that provides a high amount of physiological information [1], which together with its accessibility in a non-invasive way, highlights its potential as an emerging alternative to standard blood analysis. In particular, lactate, which is a product of the anaerobic metabolism that takes place during intense exercise, can be used as a biomarker to keep track of the performance of athletes. This states the importance of finding new methods for the determination of lactate levels in sweat, such as alginate, which is a natural and biocompatible anionic polymer that can be crosslinked creating a 3D network. In this work, we present the fabrication and characterization of alginate beads and the integration of the enzymatic assay for the determination of lactate levels in artificial sweat.

## THEORY




*Enzymatic cascade for lactate detection.*

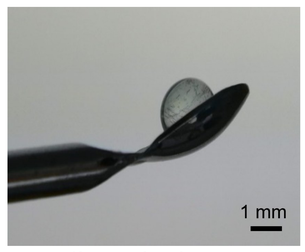
## FABRICATION OF THE ALGINATE BEAD

Reaction mix:

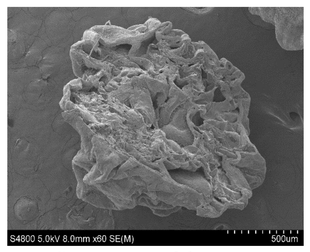
- ✓ 10 µL of LOD 0.40 mg $mL^{-1}$
- ✓ 10 µL HRP 0.05 mg $mL^{-1}$
- ✓ 5 µL of TMB:DMSO
- ✓ 30 µL alginate 1.5 %

Bead volume: **25 µL**

Tested solutions → Lactate **10 – 100 mM** [2] in 60 mM artificial sweat (NaCl and urea).



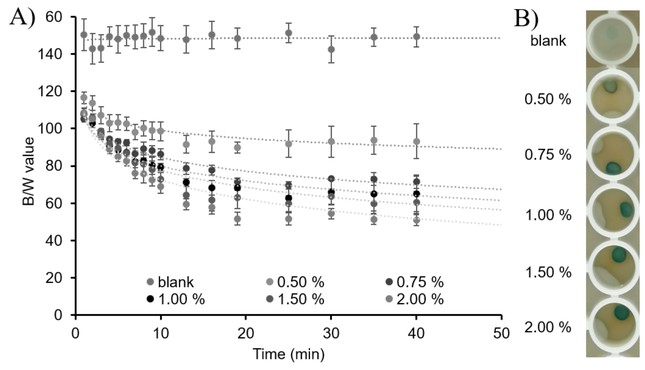

*Alginate bead sensor.*



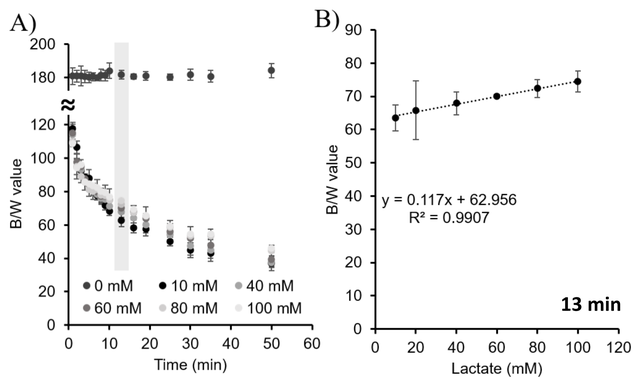

*SEM image of the sensor.*

## LACTATE SENSING IN ARTIFICIAL SWEAT

Images of the beads were taken during 1 h and analyzed using the image color analysis software ImageJ. The black and white value (B/W value) of each bead was measured, where 0 = black and 255 = white values.




*Optimization of the alginate concentration.*




*Calibration of lactate in alginate beads.*

- ✓ A **limit of detection of 6.4 mM** and a **limit of quantification of 21.2 mM** were obtained.
- ✓ The alginate sensor was verified with two solutions of **lactate 20 mM and 45 mM** in artificial sweat, obtaining values of **18 ± 2 mM and 50 ± 7 mM**, respectively.

## CONCLUSIONS

In this work we have demonstrated a new alginate bead sensor approach for **lactate sensing in artificial sweat**. With lactate being a biomarker of the anaerobic metabolism, the research developed here opens a door to a new way of lactate determination using alginate with **applications in sports science and medicine**, as well as new avenues in sensor devices.


## ACKNOWLEDGEMENTS

Gobierno de España, Ministerio de Economía y Competitividad (BIO2016-80417-P), Basque Government (Grant IT1271-19), EU DNASURF (H2020-MSCA-RISE-778001) and EU Horizon 2020 research and innovation program (No. 766007).


## REFERENCES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