Novel Biosensor for Measuring Lactate from Sweat

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Technology

Prof. Alfonta and her team created a highly sensitive, physiological range diagnostic tool for Lactate. By covalently attaching additional cytochrome to the cytochrome domain of *S. cerevisiae* lactate dehydrogenase (LDH), they improved the efficiency of the catalytic activity of the enzyme and the electron transfer (ET) to the electrode. Four different constructs of LDH were engineered: (1) native LDH lacking its CytB (termed LDH); (2) native LDH with its CytB (termed LDH-CytB); (3) LDH with minimal cytochrome c (MCD) fused to the CytB N-terminus (termed LDH-CytB-CytC) and (4) LDH containing MCD only (termed LDH-CytC). The fastest ET was observed for the variant containing two cytochromes, i.e., **LDH-CytB-CytC**. Assessing *in vitro* biocatalytic performance as reflected by lactate oxidation revealed the di-cytochrome fusion enzyme to have 12-fold higher activity than the native enzyme. This was especially true at the higher lactate concentrations considered, thus rendering di-cytochrome fusion enzyme a suitable candidate for monitoring high levels of physiological lactate concentrations in **sweat**. In addition, they found that the new fusion enzyme is highly efficient in the lactate dependent reduction of oxygen in low overpotentials and could probably be extended to the reduction of other molecules and metal ions in a similar way. Lactate dehydrogenase (LDH) is an enzyme all organisms use as part of their primary metabolic enzyme pool that reversibly oxidizes lactate to pyruvate in a two-electron redox process. Lactate levels in the different body fluids and tissue cultures indicate multiple conditions, such as oxidative stress, cancers, and lactic acidosis, a symptom of various other conditions, such as muscular stress and fatigue, important parameters to monitor the performance of athletes. Lactate monitoring is also critical in food safety and for assessing the quality of fermented food and products containing lactate, as well as for detecting pathogenic bacteria in foods that secrete lactate.

Application

Lactate measurement can be used for several purposes, including:

- Diagnosing medical conditions: High levels of lactate in the blood can indicate the presence of medical conditions such as sepsis, oxidative stress, cancers, lactic acidosis, shock, or respiratory failure.
- Assessing athletic performance: Lactate levels can be used to determine an athlete's anaerobic, to measure training process and to build training program.
- Food safety: detecting pathogenic bacteria.

Advantages

- Various of applications
- Can be used also for non-invasive measurements
- Highly sensitive
- Not sensitive to oxygen

Patent

A patent covering the invention was filed by BGN technology.