

# An automated multi-sensor/multi-parameter sampling system for multi-variant/multi-sample experiment

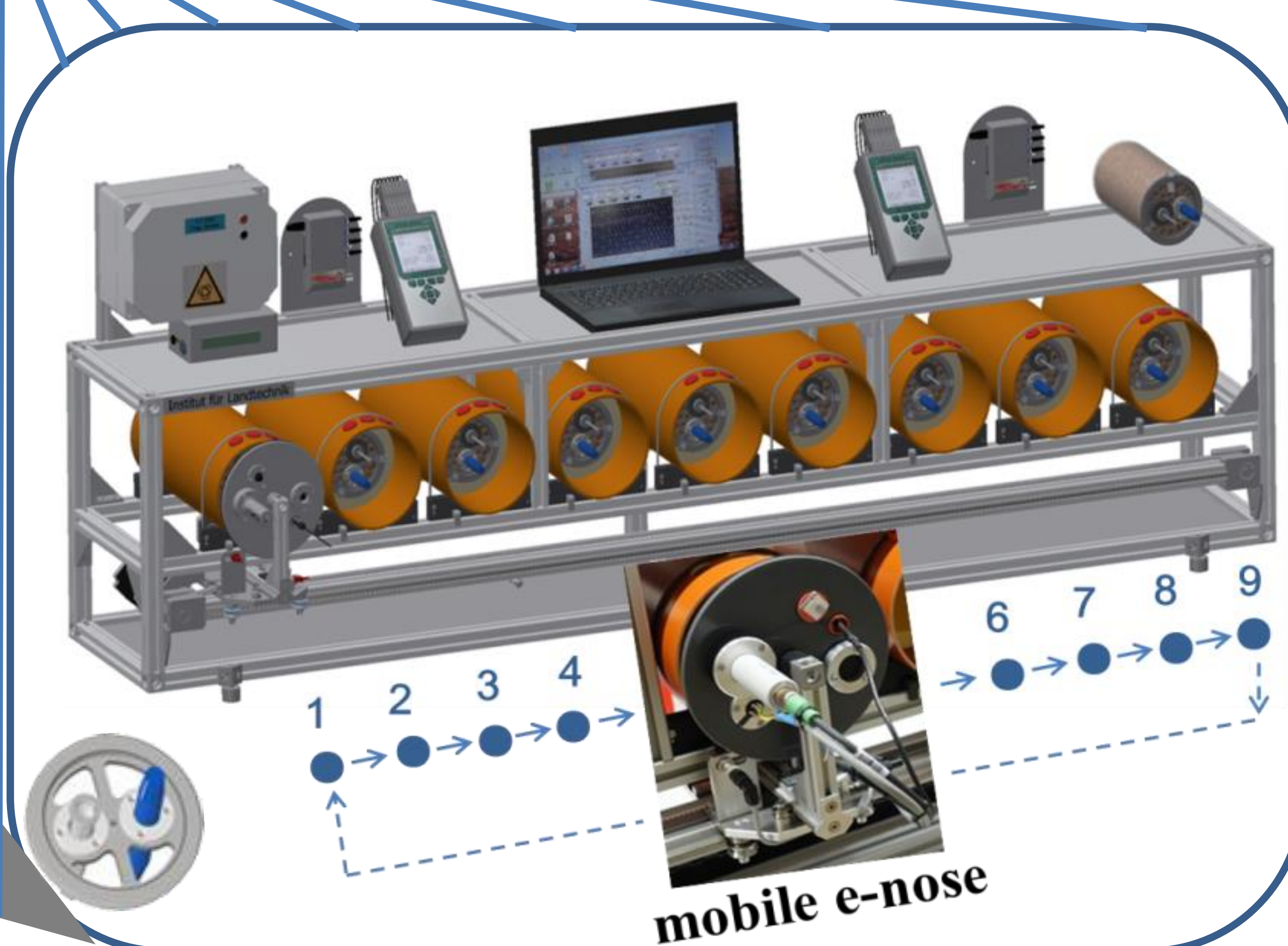
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## Prototype Introduction

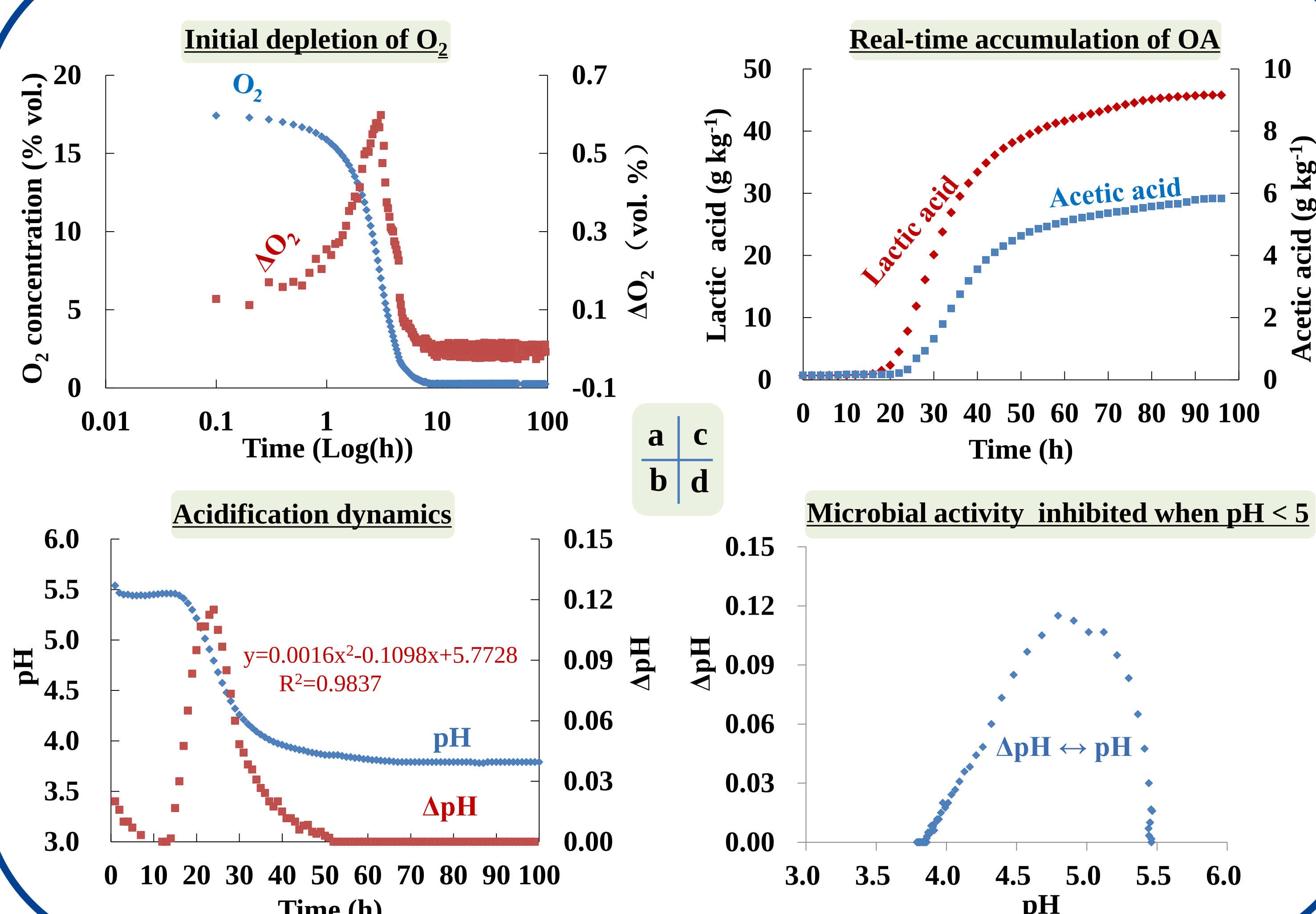
We developed an experimental system (Fig. 1) with 30 sensors for 5 key parameters of silage production and oxidative degradation (O<sub>2</sub>, CO<sub>2</sub>, Ethanol, pH and substrate temperature, T<sub>si</sub>). 9 mini-silos (1.5 L) with real-time data logging and integration are measured in situ. Emission of CO<sub>2</sub> and ethanol during oxidation (analogous to the feed-out phase of production), are measured with a robotic e-Nose that seals and samples each chamber sequentially. Potential applications include (i) comprehensive evaluation of markers and factors influencing the aerobic stability of silage, including the efficacy of additives and inoculants; (ii) investigation of gaseous emissions from silage related to air pollution; and (iii) general microbiological metabolic studies.

## System Output

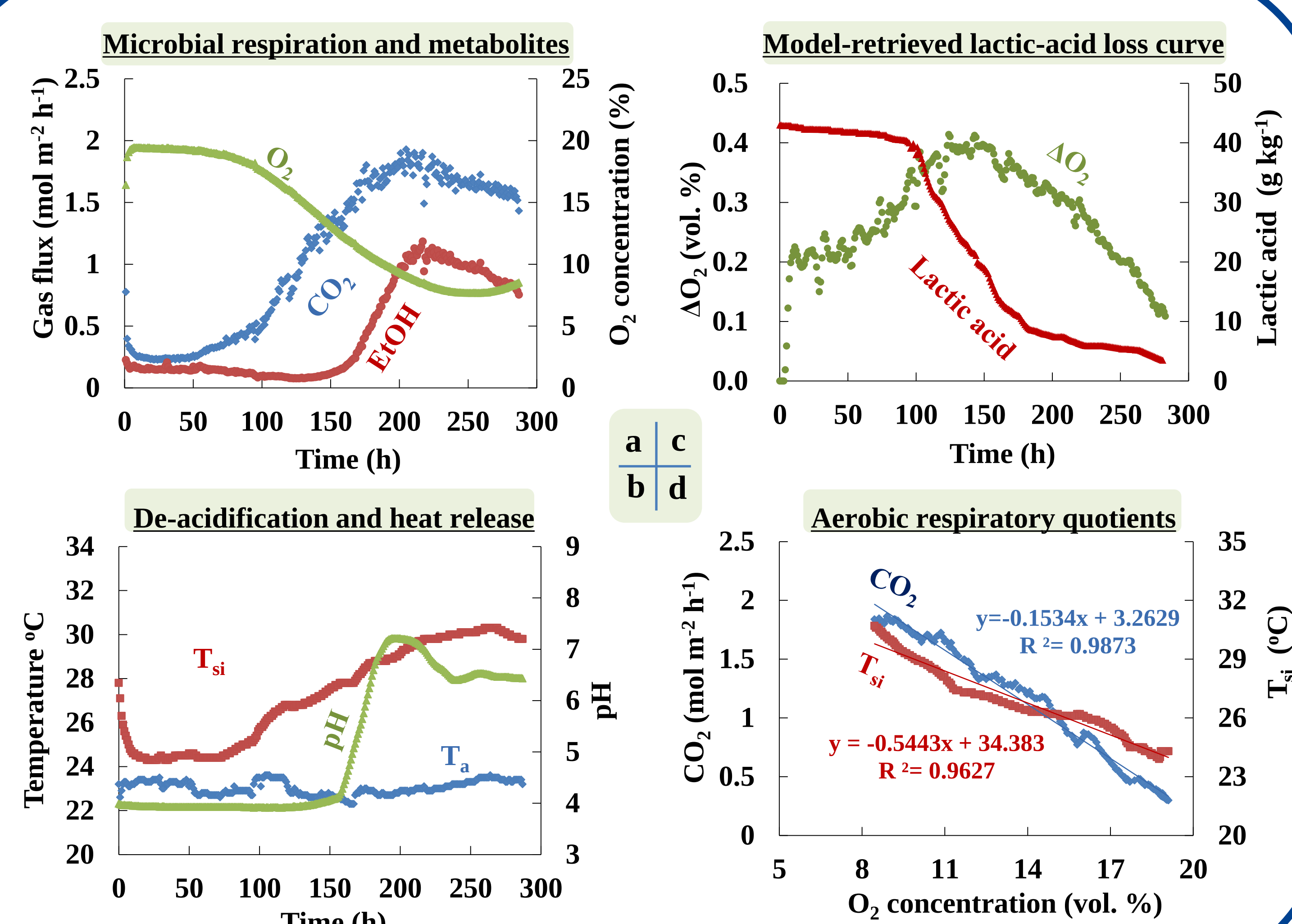
Representative data from anaerobic (Fig. 2) and aerobic (Fig. 3) phases of silage production provide on-line output of time courses of all parameters and real-time calculations of organic acid contents, as well as relationships between these parameters. These novel non-destructive data show that: (i) the fermentation phase was completely anaerobic (Fig. 2a, b); (ii)  $\Delta$ pH is controlled by pH, itself (Fig. 2d); (iii) CO<sub>2</sub> and T<sub>si</sub> increase as O<sub>2</sub> declines during feed-out (Fig. 3a, b); (iv) ethanol emissions begin only after O<sub>2</sub> is depleted (Fig. 3a), and (v) buffering capacity caused the rise in pH to lag other measures of oxidation (Fig 3b). For a test deploying 3-variant  $\times$  3- replicate, sample cross-comparison may provide more interesting data for insight of microbial interaction.



## Anaerobic Fermentation



## Aerobic Stability Test



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