

In-vitro digestibility assays for  
ruminants and monogastric  
animals made easier

## Gas Endeavour



# In-vitro digestibility assessment of feeds

For the purpose of feed evaluation, in-vitro digestion and fermentation methods are ethically superior, faster and less expensive than in-vivo techniques. A good example of an in-vitro fermentation method is the in-vitro gas production technique, in which the gas evolved as a result of fermentation is used as the primary measurement. This method relies on the relationship between degradation and gas production to evaluate the nutritional parameters of a feed. Although the gas production technique is well-established in the area of ruminant feed evaluation, data can also be found for nutritive evaluation of feed for monogastric animals and even for humans.

The benefits of in-vitro gas production techniques for digestibility evaluation include the possibility to run large batches simultaneously at a low cost, the ability to measure fermentation kinetics of soluble and insoluble fractions of feed or food, and to easily make relative comparisons among different samples.

The Gas Endeavour® is our premier automatic instrument for continuous monitoring of fermentation gas (i.e., hydrogen, methane, carbon dioxide) released in in-vitro ruminant digestive models and in-vitro monogastric hindgut digestive model for animals and humans. In comparison with the other in-vitro methods measuring the transformation of fermentable substrate, the Gas Endeavour® allows highly accurate analysis of a large number of samples in a short time. In addition, the automated in-vitro protocol based on the Gas Endeavour® significantly reduces the workload compared with manual analyses.

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# 18

test lines

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# 2

measuring  
resolutions

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Incubation unit



Flow meter array and DAQ unit

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Modular design for  
easy replacement  
and maintenance

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Continuous monitoring of  
fermentation gases  
released in in-vitro  
ruminant & monogastric  
hindgut digestive models

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### Highly precise and accurate data

The Gas Endeavour® gives you a better understanding of the digestion kinetics of fermentable substrates. The precision of measurement and data calculations have been validated with the highest quality and standards by scientists in international interlaboratory studies.

### Standardised measurement procedures, data interpretations and reports

Real-time temperature and pressure compensations minimises the impact of possible variation in measurement conditions and standardise data presentation satisfying the highest demands for data accuracy and precision. An non-linear mathematical model is also implemented in the latest released Gas Endeavour® to achieve an outstanding high linearity for in-vitro gas production analysis across measurement ranges.

The instrument provides advantages in the standardisation of measurement procedures, data interpretation and reporting. This allows for data from different laboratories around the world to be easily compared.

### Significantly reduce labour demands

The instrument allows fully automated analytical procedures, extendable testing capacity and full control of experiments with remote access. The Gas Endeavour® reduces the time and labour requirement for in-vitro digestibility analysis and make the test being less skill dependent for precise and accurate data.

### Compact and modular design

The modular approach enables flexible system set-up, easy upgrading options and simple maintenance. The Gas Endeavour® can easily be further expanded by connecting multiple instruments with a network switch.

### User-friendly operations with remote access

The instrument is simple to use and easy to learn. The web-based software application makes setting up and monitoring experiments very easy. The Gas Endeavour® allows easy access from a remote location using any computer, smartphone or tablet.

# Software for Gas Endeavour

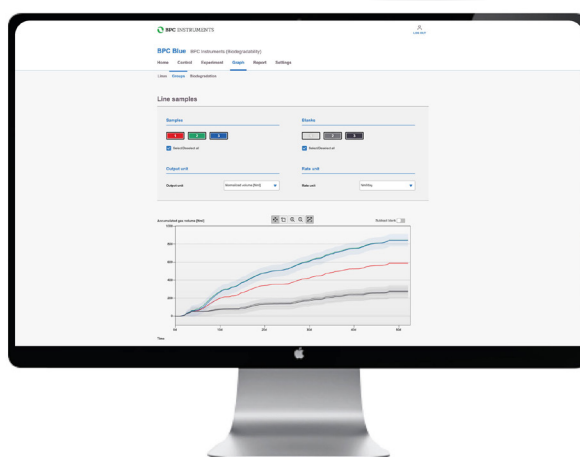
## A simple and intuitive software application

The Gas Endeavour® software application has been specifically designed to be applicable for a wide range of batch tests where gas volume or gas flow needs to be measured with high demand on accuracy and precision. This application, which is easy to understand and navigate, allows users to set up an experiment, monitor its progress, and download results with little effort. Moreover, all data is in a standard format that allows for easy analysis. The software application is simply a natural extension of a universal hardware platform that has been designed for carrying out various batch tests where gas flow, volume, and composition measurements are important.

## Total control throughout an experiment

The control feature of the Gas Endeavour® software application allows users to control the status of each batch test in real-time during an experiment. For the system with our multifunctional agitation system, users can control the interval, speed, rotation directions, and on/off time of the mixing of reactors, to ensure each reactor is operated under optimum mass transfer conditions. Users can also easily start, pause, and stop data acquisition of an ongoing experiment at any time by means of a simple to use control feature, which also indicates the status of each test line at all times.

Overall, this allows users to have optimal control of all test vessels and batch experiments at all times with the simple click of a virtual button from the software user interface.



The graph feature of the Gas Endeavour® software application and embedded web server allows users to see their experiment in real-time and from any location. Users can easily monitor the accumulated gas volume and flow rate of each reactor in real-time by selecting and viewing only the one they wish to see.

Moreover, all values displayed are already adjusted for gas volumes normalised to 1 atmospheric pressure, 0 °C, and zero moisture content.

If a flush gas with a different gas composition from the produced gas is used to establish initial headspace gas conditions, the impact of the flush gas is also taken care of by the Gas Endeavour® software application.

This flexibility and precision allows Gas Endeavour® users to always know the status of an experiment, as well as keep an eye on the data being produced.

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Always have total control over your experiment at any time and any place

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An evolution tool for in-vitro digestibility analysis

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# Application areas

## **In-vitro digestibility assay for ruminants**

Gas Endeavour® is a powerful analytical tool to predict the rumen feed degradation potential through provision of kinetic information. Examples of application include estimating the energy content of feedstuffs for diet formulation, optimising efficiency of feed utilization, ruminant output, assessing bioactive components with antimethanogenic properties as well as antinutritive factors.

## **In-vitro hindgut digestion/fermentation for monogastric animals**

Like the rumen, the large intestine of simple-stomached animals is essentially a fermentation chamber where material is degraded by gut bacteria. The cumulative gas production technique can also be applied here and Gas Endeavour® can be an ideal batch test platform of in-vitro hindgut digestion to investigate differences among feedstuffs, unweaned and adult animals and also the effect of enzymatic pre-treatment on fermentation kinetics.

## **In-vitro hindgut digestion/fermentation for humans**

The fermentation of dietary fibers by gut microbiota results in the generation of gas and production of short-chain fatty acids (SCFA), and can also provide selective substrates for growth of specific groups of bacteria that may enhance the intestinal health of the host. Gas Endeavour® is an automated batch test platform of in-vitro gastrointestinal digestion and human fecal fermentation for studying microbiota population in lower gastrointestinal tract and fermentation properties of various dietary fibers.



# Technical Specifications

Sample incubation unit with shaking

Maximum number of reactors per system: 18

Reactor material: glass

Standard reactor volume: 250 ml

Dimension: 53 x 33 x 28 cm

Temperature control: up to 95 °C (203 °F) (precision of 0.2 °C)



Ex-situ gas absorption unit

Gas trap bottles: 18

Bottle material: glass

Bottle volume: 250 ml

Dimension of unit: 55 x 28 x 17 cm

Absorption liquid: depending on gas to be removed.

For CO<sub>2</sub> removal: 3 M NaOH with pH indicator, 200 ml per bottle (not included)



## Flow meter array and DAQ unit

Working principle: Liquid displacement and buoyancy. Up to 18 independent gas flow measurement units and built-in sensors for real-time temperature and pressure compensation.

Single gas measurement for 18 test vessels in parallel

Measuring resolution: 2 or 9 ml

Detection capacity: up to 1600 l cumulative gas for each batch test for 2 ml flow cell and up to 7200 l cumulative gas for each batch test for 9 ml flow cell

Measuring range: 0.2 to 1500 ml/h\* for 2 ml flow cell and 1 to 6000 ml/h\* for 9 ml flow cell

Dimension of unit: 51 x 26 x 17 cm

Housing: aluminium and plastic

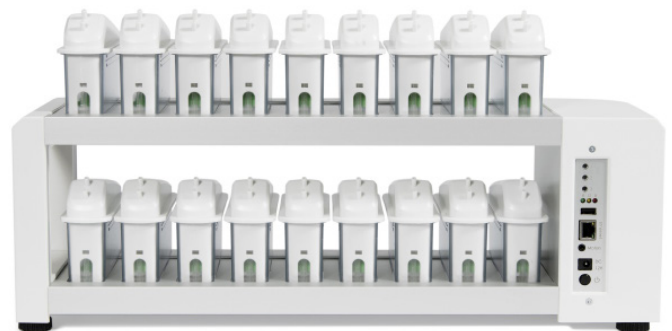
Measuring precision:  $CV \leq 1\%$

\* Lower range limit refers to measurement of gases with low solubility in water (e.g.  $N_2$ ,  $CH_4$ ,  $O_2$ ,  $CH_4$ ,  $H_2$ )



## Software and System

- User friendly web-based software running on an embedded server, with no need of pre-installation on pc, tablet, or smartphone
- Online real-time gas flow and volume display
- Automatic real-time pressure and temperature compensation
- Extended measurement linearity for high gas flow analysis
- Real-time gas flow and volume normalisation
- Algorithm to avoid over- or underestimation of gas flow and volume that may be introduced by flush gas during experiment setup
- Possibility of multiplexing, allowing for simultaneous batch analysis at different start-up times
- Online system logger for operational diagnosis
- Power supply: 12 V DC /1 A (flow cell array and DAQ unit),
- Usage: indoor



# BPC Instruments – Excellence is built on precision and accuracy

BPC Instruments is a global Sweden-based technology company developing and selling automated, analytical instruments enabling more efficient, reliable, and higher quality research and analysis in the clean-tech and health industries. The result is not only significant reduction in time consumption and labour requirement for performing analysis, but also higher accuracy and precision. The BPC Instruments innovative products offer high quality hardware and software based on deep knowledge and experience of target applications. The solutions are the first of their kind, making the company a pioneer in its field. Today, BPC Instruments exports to 70+ countries around the world.

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