

Evaluation of UPHO Bead Beater on Plant Tissues: An Efficient and Easy-to-use Disruption Device

The bead beating technology is a mechanical sample disruption method, which originates from the mortar and pestle principle. It involves rapid agitation of samples in vials containing beads with a shaking device, called bead beater. Depending on sample type and bead beater used, a wide range of beads of various size and material (e.g. metal, glass or ceramic) can be used and processing can be performed dry or with buffer at either ambient or cryogenic temperatures.

Initially used to perform lysis of microorganisms, this sample preparation method has since been used for a wide range of applications from tissue disruption to sample homogenization.

This versatility made the use of bead beating very common in biology laboratories, especially when lysis or disruption is performed daily on various sample types (e.g. food industry or biobank). Other advantages of these devices include:

- Processing of multiple samples at once
- Short runtimes
- Efficiency and reproducibility
- Reagent-free procedures and
- Cost effectiveness

The UPHO System

The UPHO system (Figure 1) is a new bead beater from Geneeye which enables:

- Short runtime compared to other systems
- Higher shaking frequency (70 Hz) than most systems on the market
- High flexibility for sample size with interchangeable adaptors
- Low laboratory disturbances with a limited noise emission (<65 dB)
- Processing of up to 64 samples simultaneously



Figure 1: The UPHO bead beater

A product evaluation run was trialed in an academic laboratory to assess performance for plant tissue preparation against their incumbent system from a major bead-beater provider. In this laboratory, the incumbent system was causing tubes to crack during the grinding process. Risk of system contamination due to tube damage was an important concern and this was included in the evaluation.

Reduced Risk of System Contamination

With the incumbent system, large cracks or broken microtubes are typically observed at maximum frequency (25 Hz).

To assess UPHO bead beater on this parameter, 2 mL microtubes were used without samples and containing one 4 mm stainless steel bead. UPHO tubes and tubes typically used in the laboratory were compared for the UPHO system. Tests were performed at 25 Hz shaking frequency.

Results are summarized in Table 1 below.

| Frequency | Run time | Adaptor Pre-treatment | Vessel | Results |
|-----------|----------|-----------------------|--------------------------------|-------------------------------------|
| 25 Hz | 1:30 min | None | UPHO 2 mL microtube | No cracks |
| | | | 2 mL microtube from laboratory | No cracks |
| 25 Hz | 1:30 min | Liquid nitrogen | UPHO 2 mL microtube | No cracks |
| | | | 2 mL microtube from laboratory | Slight cracks in the microtube caps |

Table 1: Assessment of tube damage caused by bead beating.

When the same frequency is applied, no or lower damage are observed compared to incumbent system. In addition, tubes provided with UPHO system are more robust than the microtubes typically used in the laboratory.

Performance

Several protocols were tested to compare the UPHO system with the competitive system for two types of samples (*Arabidopsis* leaves and rosettes). Adaptors and reaction vials were pre-frozen separately in liquid nitrogen.

Two parameters were visually evaluated after processing:

- Aspect of the grinding vessel (20 mL container or 2 mL tubes)
- Powder fineness

Results of the performance study are reported in the Table 2.

| Sample | Run parameters | Vessel size | Beads | Aspect of the grinding vessel after processing | Power fineness after processing (compared to incumbent) |
|--|----------------------------------|-------------|---------------------------|--|---|
| <i>Arabidopsis</i> leaves (50-100 mg) | 1 x 1:30 min at 25 Hz | 2 mL | 1 x 4 mm stainless steel | Intact | Similar |
| <i>Arabidopsis</i> rosettes (<1 g) | 1 x 1:30 min at 25 Hz | 20 mL | 1 x 15 mm stainless steel | Intact | Similar |
| <i>Arabidopsis</i> rosettes (<1 g) | 2 x 1:30 min at 20 Hz | 20 mL | 1 x 15 mm stainless steel | Intact | Similar |
| <i>Arabidopsis</i> rosette (0.8 – 2.5 g) | 2 x 1:30 min at 25 Hz then 35 Hz | 20 mL | 6 x 4 mm stainless steel | Intact | Similar |
| <i>Arabidopsis</i> rosette (0.8 – 2.5 g) | 2 x 1:30 min at 35 Hz | 20 mL | 6 x 4 mm stainless steel | Intact | Finer |
| <i>Arabidopsis</i> rosette (0.8 – 2.5 g) | 1 x 1:30 min at 50 Hz | 20 mL | 6 x 4 mm stainless steel | Intact | Finer |

Table 2: Results after grinding with various protocols on UPHO bead beater.

All samples were pretreated with liquid nitrogen. Comparable results were obtained with *Arabidopsis* root samples.

The powder that was produced with the UPHO device was finely ground (Figure 2) and was of similar quality and even more finely ground than the competitive machine. The samples were still frozen after the removal from the vials.

All protocols applied did not cause any visible damage to the vials. Compared to the incumbent device, higher frequencies could be applied without causing damage to the vials neither.

Different bead beating programs (e.g. 2 cycles of 1:30 min at 35 Hz or 1 cycle of 1:30 min at 50 Hz) can be chosen to produce the same level of power quality. As a result, the protocol can be tailored to the needs of subsequent analysis and time constraint. As an example, the runtime can be divided by 2 when frequency is increased from 35 Hz to 50 Hz.



Arabidopsis sample (before grinding)



Leaves (after grinding)



Roots (after grinding)

Figure 2: Arabidopsis samples before and after treatment with UPHO bead beater

Conclusion

User feedback highlighted ease-of-use and simplified versatility as major benefits of using the UPHO bead beater. In terms of performance, UPHO bead beater provided similar or finer grinding results for their samples compared to the competitive system.

In addition to similar or increased performance, testers experienced:

- Reduced risk of contamination with lower damage to tubes. The frequencies that could be applied without causing damage to the vials were higher than the competitive device.
- Flexibility in terms of protocol design with UPHO higher frequency range. Either runtime can be shortened, or lower shaking frequency can be applied for a smoother processing of sample prior specific subsequent analysis.

The UPHO system was evaluated in other laboratories and has been successfully used to process a wide range of samples including:

- Bacteria and yeast,
- Small animal organs and tissues (e.g. skin, muscle, cartilage, bones),
- Food samples (e.g. tuna, corn, tomato branches, dried olives) and
- Mineral samples (e.g. concrete).

About Geneye

Geneye designs, manufactures, markets and commercialises the highest quality laboratory consumables, reagents and devices for Scientists working in the life sciences.

Geneye was founded in 2016 as a brand of Biowire Limited, a Hong Kong company, and is present in London, Rennes, Shanghai, Beijing and Hong Kong. Geneye works with a network of qualified, national and regional distribution partners to bring affordable solutions to Scientist and Researchers around the globe.



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