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Homogenization of White Rice, Moong Beans and Kidney Beans

APPARATUS: Geno/Grinder®

APPLICATION: Homogenizing White Rice, Moong Beans and Kidney Beans

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Overview

Cereals, rice, and pulses (beans, peas, lentils, chickpeas) are staple foods with diverse applications and nutritional significance. Effective grinding of these materials is essential for subsequent analyses, chemical composition, texture, and sensory evaluations. In addition, studies related to genetic engineering where analytical methods used in sample testing and analysis are crucial for ensuring the successful development, safety, and quality of crops. Protein Analysis, Metabolite Analysis and Nucleic Acid Analysis (DNA and RNA based methods) are fundamental for detecting, identifying, and quantifying genetic modifications.

Traditional grinding methods (mortar and pestle) are not easily reproducible, inconsistent results as well as cross-contamination from inefficient cleaning procedures. The Geno/Grinder® 2010 addresses these challenges by providing a controlled and precise processing environment, ensuring uniform particle size while maintaining the sample integrity.

This application note outlines the practical considerations involved in homogenization of seeds, emphasizing common challenges, homogenizer selection, and process optimization.

Abstract

This application note demonstrates the efficacy of the Geno/Grinder® 2010 to homogenize (or grind) a diverse range of materials, including pulses, rice, and cereals. Engineered to meet day-to-day use in the laboratory, the Geno/Grinder® is an advanced high-throughput homogenizer designed to enhance efficiency and improve consistency of sample preparation.

Equipment and Materials Used

- HG-600 Geno/Grinder® 2010 Homogenizer
- 2253-PC-48 (50 mL) Polycarbonate Vial
- 2156 Grinding Ball, stainless steel, diameter 7/16 in. (11 mm)
- 2196-16-PE Holder for 50 mL Vials
- Balance (accuracy: 0.01 g, capacity: 500 g)

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Process Execution

Grinding (Bead Beating)

- **Sample Preparation**: Test samples of rice, moong beans and kidney beans were selected. Approximately
  5 grams of sample weighed and placed in a 50 mL polycarbonate vial with two 11 mm stainless steel balls with cap firmly applied to secure the contents of the vial. Note: the standard 50 mL vial holder can accommodate 16 vials. For higher throughput, the 2014 Clamp is optional to run 30 vials.
- **Setup**: The HG-600 Geno/Grinder® 2010 was set to the optimal runtime, cycles, rest time, and rate based on the sample hardness to facilitate effective grinding.
- **Run Protocol**: The Geno/Grinder® 2010 was used to grind the samples into a fine homogeneous powder using the parameters listed in the table below.

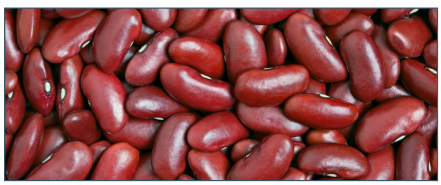
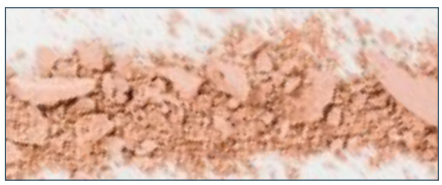
Sample	Quantity	Run Time	Rest Time	Cycles	Rate
White Rice	5 g	5 min.	—	1	1750 rpm
Moong Beans	5 g	5 min.	—	1	1750 rpm
Kidney Beans	5 g	10 min,	30 sec.	2	1750 rpm

The run protocols for each sample type were saved in the Geno/Grinder® for future operations. The homogenized powder was immediately collected and stored in a suitable environment to prevent degradation or contamination.

Before and After - White Rice


Before and After - Moong Beans


Before and After - Kidney Beans

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Results

The Geno/Grinder® efficiently pulverized samples like cereals, rice, and pulses, resulting in consistent particle sizes which improved the overall sample preparation process.

- Cereals were ground into a uniform powder with particle sizes ranging from 100 to 500 microns.
- Rice was processed into a fine powder with a median particle size of 150 microns.
- Pulses were ground into a uniform powder with a median particle size of 200 microns.

The grinding was quick, taking only 2 to 4 minutes depending on the sample. Importantly, the process generated very little heat, which helped to preserve the integrity of the samples.

Materials Suitable for Homogenization

Material Category	Common Examples	Common Applications
Beans	Kidney beans, black beans, navy beans, pinto beans, moong beans	PCR, Protein Analysis, Gel Electrophoresis, Microarrays, DNA/RNA Based Methods
Peas	Green peas, yellow peas, split peas	PCR, Protein Analysis, Gel Electrophoresis, Microarrays, DNA/RNA Based Methods
Lentils	Red lentils, brown lentils, green lentils	PCR, Protein Analysis, Gel Electrophoresis, Microarrays, DNA/RNA Based Methods
Chickpeas	Garbanzo beans, also known as chickpeas	PCR, Protein Analysis, Gel Electrophoresis, Microarrays, DNA/RNA Based Methods
Rice	White rice, brown rice, wild rice	PCR, Protein Analysis, Gel Electrophoresis, Microarrays, DNA/RNA Based Methods

Process Challenges and Optimization

- **Temperature Control**: Optimal runtime prevents excessive heat generation from grinding media, which can lead to DNA shearing or molecular degradation.
- **Agglomeration**: As particles are reduced in size, they tend to clump together because of surface energy. This agglomeration can be minimized by using the right size grinding media for homogenization and by controlling the environment, such as, managing humidity and frictional heat generation from the grinding media.
- **Process Tuning**: Runtime, grinding media, sample amount, and run rate must be adjusted to meet target specifications without compromising sample integrity.

Selecting the Right Homogenizer

Selecting the appropriate homogenizer or bead beater involves a detailed evaluation of the material's characteristics, how efficiently it processes, the available accessories like tubes, vials, and grinding media, potential contamination, and how easy it is to use. Making the right choice is crucial for achieving uniform particle size reduction, maintaining the integrity of the sample, and ensuring the process can be repeated reliably.

Why Choose the Cole-Parmer SamplePrep HG-600 Geno/Grinder® 2010 Homogenizer?

The Cole-Parmer SamplePrep HG-600 Geno/Grinder® 2010 Homogenizer stands out among other homogenizers due to its precision engineering, superior process control, and versatility in handling various materials.

What Sets Us Apart?

The Geno/Grinder® is a device that uses vertical shaking of multiple sample containers (like plates, jars, tubes, or vials) to break down cells. This process mixes the samples with steel balls or beads and a solution that helps to release molecules like DNA, RNA, and proteins, making it useful for preparing samples for further analysis

Note on Performance:

The HG-600 Geno/Grinder® 2010 with its unique shaking motion, using steel balls or beads, provides the optimum force to effectively pulverize and homogenize samples for various extraction methods. To get nucleic acids from samples, you first need to break them down mechanically before extracting and purifying the nucleic acids or constituents. While you can grind the sample by hand using a mortar and pestle, this is too slow for processing many samples at once and can lead to contamination. A better way is to use plates, tubes, or vials with grinding balls or beads to mechanically disrupt the samples. After this, standard methods can be used to get the nucleic acids from the broken-down material.

Contact and Additional Resources

For more details on homogenization solutions, application notes, and product specifications, visit cpsampleprep.com.

For technical support and inquiries, please contact us at +1.732.623.0465 or via email at sampleprep@coleparmer.com.

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Additional Resources

The following research articles are recommended as supplemental references to strengthen the scientific relevance and application breadth of the GenoGrinder 2010 in plant tissue homogenization workflows.

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2. Kim, Sung-Ryul, Ebrahim Abdelbagi Eltayeb, and Hyun-Jin Chung. 2016. "A Simple DNA Preparation Method for High Quality Polymerase Chain Reaction in Rice." Korean Journal of Breeding Science 48 (1): 47–54. https://www.researchgate.net/publication/296621832

3. Iqbal, Muhammad, Muhammad Ashraf, Muhammad Ashfaq, and M. Yasin Ashraf. 2015. "Genotypic Variation in Salt Tolerance of Mungbean (Vigna radiata L.) in Relation to Ion Accumulation, Antioxidant Enzymes and Leaf Gas Exchange." Archives of Biological Sciences 67 (4): 1231–1241. https://doi.org/10.1080/13102818.2015.1088401

4. Iqbal, Muhammad, Irshad Ahmad, Muhammad Kamran, Hafiz M. Atif, Adil Hussain, Muhammad Shahbaz, et al. 2024. "Salt Tolerance in Mungbean Is Associated with Controlling Na and Cl Transport across Roots, Regulating Na and Cl Accumulation in Chloroplasts and Maintaining High K in Root and Leaf Mesophyll Cells." Plant, Cell & Environment 47 (2): 293–310. https://doi.org/10.1111/pce.14943

5. Viteri, David M., Hang Wang, Juan M. Osorno, Phillip E. McClean, and Matthew W. Blair. 2022. "The Phaseolus vulgaris L. Yellow Bean Collection: Genetic Diversity and Characterization for Cooking Time." Genetic Resources and Crop Evolution 69 (2): 757–772. https://doi.org/10.1007/s10722-021-01323-0

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