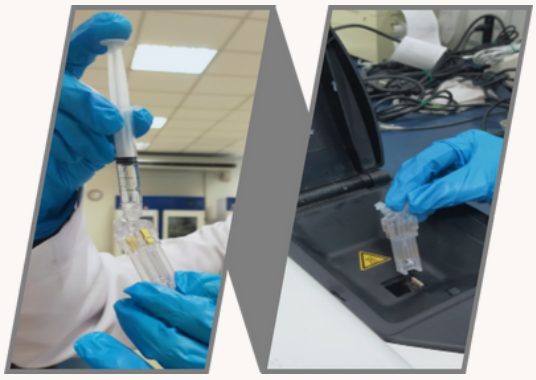
DEPARTMENT OF PHARMACEUTICS: INNOVATING IDEAS INTO INVENTION

Pharmaceutics is a branch of pharmacy that focuses on the formulation, development, and optimization of active pharmaceutical ingredients (API) to ensure their safe effective use by consumers. For instance, while consuming sweet wormwood plants directly to obtain their antimalarial properties may result in an unpleasant experience, opting for artemisinin in pill form is a more feasible and tolerable alternative. Extracting the artemisinin from Artemisia and turning it into edible dosage form is an example of how advancements in pharmaceutics have facilitated improvements in our quality of life. Moreover, this advancement ensured that consumers are required to ingest only a minimal quantity of these pills, thanks to ongoing research in this field. If you have a promising idea for a pharmaceutical product, you will need the proper equipment to develop it. At the Department of Pharmaceutics, we provide the necessary tools and support to help you transform your concept into reality.

ZETASIZER

Zetasizer is a popular laboratory appliance among users. It is used to measure the particle and molecular size of colloidal molecules in a solution. It operates on the principle of dynamic light scattering (DLS) to measure the particles' size. Take two balls as an example, a small ball and a large ball, and use the same force to let them roll in front of a white screen. At the same time, rapidly flash a light beam to both balls for 20 intervals and observe the formation of shadows on the wall. In the end, you will see that larger shadows will have a higher correlation between time intervals, that is the shadow positions are close to each other, in contrast to the shadows of the small ball. Then, these correlation data of fluctuating light are used by Zetasizer to deduce the size of the balls.



Left: A laboratory staff demonstrating accurate way of filling the Zetasizer cuvette with sample. The cuvette can be bought from the laboratory at a reasonable price.
Right: Loading of the cuvette into the Zetasizer. The solution's particle size and zeta potential will be measured on operator's click.

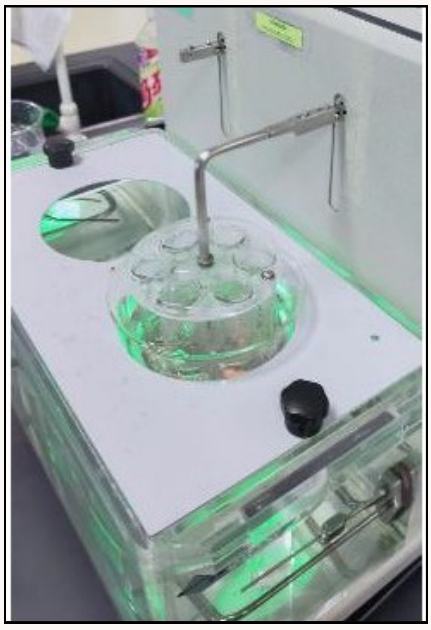
Now, you've understood the "sizer" part but how about the "Zeta" aspect of the equipment? Zeta potential is a measure of the magnitude of electrostatic repulsion between particles, which influences the stability of colloidal dispersions. The quantified inter-particle parameter will give you an idea of whether the particles tend to aggregate or disperse throughout the solution. Using the principle of electrophoretic light scattering (ELS), an electrical field is applied to the sample and Zetasizer will measure the particles' velocity in the same way it detects the balls' movement from our previous example. Colloids with high zeta potential, either positive or negative, are more stable and will maintain their dispersion while colloids with low zeta potential tend to coagulate among themselves. From this important information, you can assess not just the stability of your formulation but how well the active compounds will be absorbed through a permeable layer.

Feel free to contact our technical staff Ms. Noor Meliza Jamil at 03 – 3258 4682 for consultation on the equipment and sample preparation or visit our Biopharmaceutical and Pharmacokinetics Laboratory.

DISSOLUTION TESTER, DISINTEGRATION TESTER, FRIABILITY TESTER, AND HARDNESS TESTER

The next equipment are Dissolution Tester, Disintegration Tester, Friability Tester, and Hardness Tester. This equipment is indeed crucial in the development and quality control of pharmaceutical products, particularly in assessing the physical properties of a product.

Tablets or capsules are one of the most effective dosage forms to administer an API to a patient. The effectiveness of such a method relies on the drug dissolution while it is in the stomach and its rate of absorption to the bloodstream. The Dissolution Tester evaluates and optimizes the bioavailability of a dosage form. The principle is rather straightforward. You will need to dissolve the tablets or capsules in a solvent (usually a buffered solution like phosphate buffer or even dilute hydrochloric acid to mimic the stomach environment) and sample the solution at determined time intervals. Downstream experiments are then conducted to assess the amount of API that is available in your samples. If your dosage form releases the API too slowly, the treatment will be less effective for the patient. If it releases too much in a short period, patients might risk an overdose which could give adverse effects instead. That's why this parameter needs to be controlled so that the product will give a favourable outcome.

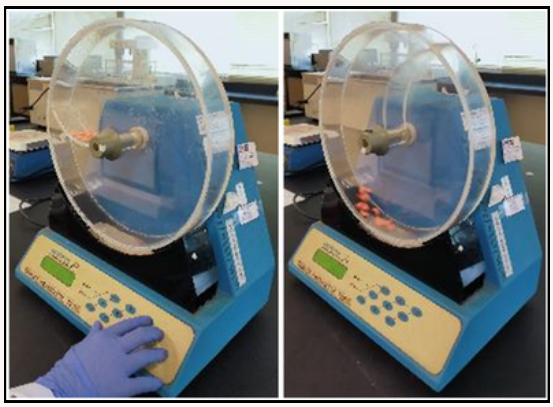


In disintegration test, the basket holds six tablets with each tablet placed in every cells. The basket will be raised and lowered into a beaker with solution. The surrounding water bath ensures the desired temperature of the test solution is maintained throughout the test.

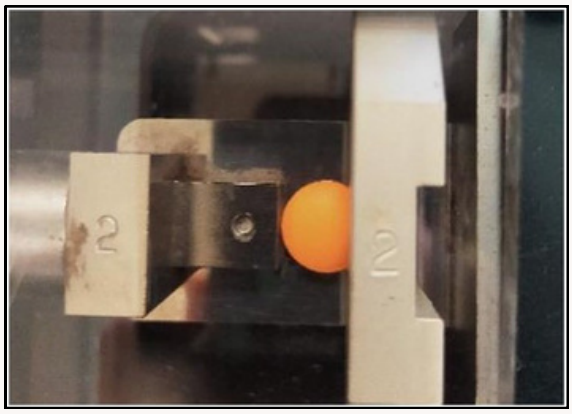
Disintegration Tester measures the time taken for the tablets or capsules to disintegrate. Precisely, it determines the time for a tablet or capsule to break down into smaller particles when placed in a liquid medium at a specific temperature. It goes hand in hand with the Dissolution Test as the ability to break into smaller particles allows for higher surface area contact and as a result, the rate of drug release. If the tablets or capsules are made too hard, you will find that the Dissolution Test for the product yielded a low bioavailability in general and vice versa. The test is done by placing tablets or capsules into the Disintegration Tester and noting the time for them to be completely removed from the basket rack as the dosage form disintegrates into the temperature-controlled solvent. The product should be formulated in such a way that its disintegration time complies with current international standards.

The Friability Tester and Hardness Tester are two pieces of equipment that are designed to test the mechanical strength of tablets, in particular. Ultimately, it ensures that the tablets can maintain their physical integrity and withstand mechanical shocks due to routine handling that comes from manufacturing and logistical processes such as tablet press, packaging, and transportation. To conduct a friability test, tablets of known mass are inserted into a drum which will spin to tumble the sample.

Then, the tablets will be collected and re-weighted to calculate the percentage of weight loss due to the process, reflecting on how friable the tablets are. Hardness testing (or more accurately breaking force testing as preferred by US Pharmacopoeia) is done by placing a tablet between anvils, of which one is fixed to a load cell while the other one is attached to a motor. The motorized jaw will slowly and steadily apply an increasing force as it pushes the tablet to the fixed jaw until it breaks, giving a tablet hardness reading as the maximum force applied immediately before the tablet breaks.



All these tests are requirements as stipulated by many pharmacopeial standards and each parameter has its acceptance criterion to comply with. More than just for cosmetic finishing purposes, a chipped or malformed tablet will contain less dosage of the intended API thus, will not provide an optimal therapeutic effect.



Left: The motorized anvil will push the tablet through a tunnel (to ensure acceptable tablet thickness) until the sample reaches the fixed wall. Later, gradual force is exerted to break the tablets. Right: The anvil will return to its position once a breakage or crack is detected.

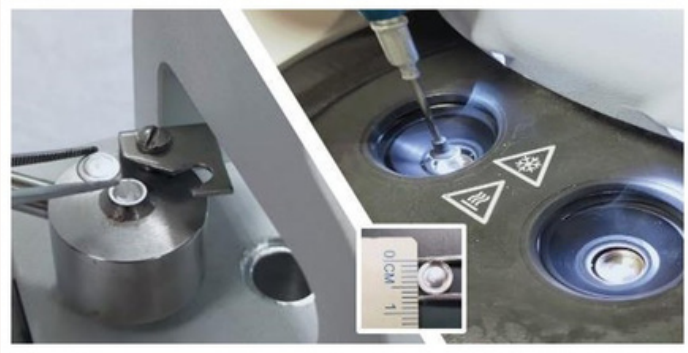
Feel free to contact our staff
Ms. Nor Hidayah Mohamed Mobin at 03 – 3258 4800 or
Ms. Nor Zaleha Ishak at 03 – 3258 4810 for consultation.

Differential Scanning Calorimetry

The next equipment, Differential Scanning Calorimetry (DSC) is also popular among the users, and it operates on the principle of heat. Pharmaceutical products do not necessarily exist or derive chemically, and some products are biological in nature. Proteins, DNA- or RNA-based therapeutics, or even lipid carriers are examples of biological pharmaceutical products, which make them more sensitive to temperature. By using DSC, researchers can study the biomolecule sample's denaturation and thermal stability. Take a protein formulation as an example. A sample consisting of protein-buffer solution will be heated up in a pan together with a reference of buffer-only solution in a separate pan. As both samples are heated, the protein-buffer mix will require more temperature to reach a volatile phase as proteins themselves will absorb more heat to denature due to the existence of intramolecular bonds. The difference between the two temperatures from the two pans is used to determine the thermal transition temperature (TM) of the proteins in the buffer solution. This allows researchers to screen for more stable, high TM biological molecules to be used in their pharmaceutical product development.

While the example given revolves around biologics, the DSC is applicable to vast research methodologies involving thermal analysis. The sample could be polymers, metals, or liquids. **Kindly contact Ms. Siti Hanim Mohd Noor at 03 – 3258 4795** for booking and technical advice.

Our laboratory equipment is not limited to this equipment. Those listed are among the most popular among users due to affordable and competitive prices.



Left: Sample is placed inside the pan and covered with a lid before it is sealed through mechanical clamping. Middle box: A sealed DSC pan. The single use pan and lid can be bought from the laboratory at a very reasonable price.
Right: Sealed pan with sample to be tested is placed on its dock and a reference blank is placed on another dock. Both pans are heated under same parameters simultaneously to generate sample's heat profile.

If you are seeking different equipment, all you need to do is simply scan the attached QR code for an exhaustive list of laboratories and services available at the Faculty of Pharmacy or go to the website for further information. We also invite requests for technical consultations from our experts, as well as opportunities for research collaborations.

SERVICES & RATES

Mr. Ahmad Assakir Ahmad Shukri
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