



## Micromeritic Analysis of Pharmaceutical Powders: Particle Size Distribution of Paracetamol, Omeprazole, and Talc

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### ABSTRACT

Micromeritics studies the particle size and distribution that affect the properties and quality of pharmaceutical preparations. This study aims to determine the particle size distribution of paracetamol, omeprazole, and talc using a sieving method. The study was conducted using a sieving method using 26, 40, and 60 mesh sieves for 5 minutes, then the percentage of retained particles and the average particle diameter ( $D_{av}$ ) were calculated. The results showed that paracetamol was dominated by fine particles (96.86%). Omeprazole had a larger particle size with many retained on 40 and 60 mesh. Talc showed a wider particle distribution. The  $D_{av}$  values were 0.0221; 0.03135; and 0.03091, respectively. Thus, it can be concluded that the sieving method is effective in determining particle size distribution. Differences in particle size can affect the dissolution rate, flow properties, compressibility, and performance of drug formulations.

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**Keywords:** micromeritics; particle size distribution; sieve analysis; paracetamol; omeprazole; talc powder

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### ABSTRACT

Mikromeritik mempelajari ukuran dan distribusi partikel yang memengaruhi sifat serta kualitas sediaan farmasi. Penelitian ini bertujuan menentukan distribusi ukuran partikel parasetamol, omeprazol, dan talk menggunakan metode pengayakan. Penelitian dilakukan dengan metode pengayakan menggunakan ayakan mesh 26, 40, dan 60 selama 5 menit, kemudian dihitung persentase tertahan dan diameter rata-rata partikel ( $D_{av}$ ). Mendapatkan hasil bahwa parasetamol didominasi partikel halus (96,86%). Omeprazol memiliki ukuran partikel lebih besar dengan banyak tertahan pada mesh 40 dan 60. Talk menunjukkan distribusi partikel yang lebih luas. Nilai  $D_{av}$  berturut-turut adalah 0,0221; 0,03135; dan 0,03091. Dengan demikian dapat disimpulkan metode pengayakan efektif untuk menentukan distribusi ukuran partikel. Perbedaan ukuran partikel dapat memengaruhi laju disolusi, sifat alir, kompresibilitas, dan kinerja formulasi obat.

*Kata kunci : mikromeritik; distribusi ukuran partikel; analisis ayakan; parasetamol; omeprazol; serbuk talk*

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## **1. Introduction**

Micromeritics is the study of particle and powder characteristics, including particle size, size distribution, surface area, porosity, density, and flow properties. These parameters are very important in pharmaceutical formulations because they affect material mixing, granulation, tablet pressing, capsule filling, dissolution rate, and drug bioavailability [1]. Smaller particle sizes tend to have larger surface areas, thus increasing the dissolution rate, while larger particles generally provide better flow properties [2]. Therefore, evaluation of particle size distribution is necessary to ensure the quality of pharmaceutical products. This study aims to evaluate the particle size distribution of paracetamol, omeprazole, and talc using the sieve analysis method [3].

In the pharmaceutical field, micromeritic analysis is widely used in the formulation of tablets, capsules, granules, suspensions, and various other drug delivery systems [4]. Particle size distribution information is needed to ensure product uniformity and optimize production processes [5]. One of the most frequently used methods to determine particle size distribution is the sieve analysis method. This method is relatively simple, fast, economical, and suitable for the analysis of coarse to medium-sized particles [6].

Based on the importance of particle size in determining the quality of pharmaceutical preparations, an in vitro study was conducted using a sieving method to evaluate the particle size distribution of paracetamol, omeprazole, and talc. These three materials were chosen because they have different physical characteristics, thus providing an overview of the influence of material properties on the resulting particle size distribution [7].

## **2. Metode**

The practicum was conducted at the Pharmaceutical Technology Laboratory, Department of Pharmacy, Faculty of Sports and Health, Gorontalo State University on May 24, 2026. The tools used in this study were porcelain cups, OPN sieves, fine cloths, coarse cloths, spatulas, analytical scales. The materials used were 70% alcohol, talc powder, omeprazole, and paracetamol. The method was carried out by preparing all the tools and materials used, then grinding the paracetamol using a mortar and pestle until smooth. After that, each initial sample was weighed, namely paracetamol, omeprazole, and talc powder. The next step was to arrange several sieves with certain numbers sequentially from top to bottom on the sieving machine, then insert the paracetamol, omeprazole, and talc powder samples into the sieve arrangement. The sample powder was then sieved for 5 minutes, and after the sieving process was complete, the powder remaining on each sieve number was reweighed to determine its weight. As a final step, the weighing data was recorded and used to create a particle size percentage distribution curve for the three samples.

### 3. Results and discussion

**Table 1.** Paracetamol as much as 17.188 grams

No sieve	Pore size	Weight left behind	% Left behind	%left behind × average pore size
60/72	231 μm	0.06825	0.0082	1.8942
40/60	373.5 μm	0.15835	0.01916	6.4665
26/40	567.5 μm	0.2926	0.0353	20,0214
Fines	-	16.01	0.9686	-
	Σ: 1.136	Σ: 16,529	Σ: 1.08146	Σ: 28.3934

Based on table 1 for 17.188 grams of paracetamol, it was found that by using the sieving method on a sample of 17.188 grams of paracetamol, it was found that most of the powder was in the fines fraction weighing 16.01 grams or 96.86% of the total sample, while the fractions retained on the 60/72 mesh (231 μm), 40/60 mesh (373.5 μm), and 26/40 mesh (567.5 μm) sieves were only 0.06825 grams (0.82%), 0.15835 grams (1.916%), and 0.2926 grams (3.53%), respectively. These results indicate that the particle size distribution of paracetamol is dominated by fine particles so that they have a large surface area which can increase the dissolution rate of the drug [8]. The percentage of retained powder increased on coarser sieves, indicating that there were still a small number of larger particles or agglomerates that had not been completely broken down during the refining process [9]. Overall, the particle size distribution obtained showed that the sample had the characteristics of a fine powder with fairly good size homogeneity. These results are in line with previous studies which reported that finer paracetamol particle sizes provide a larger surface area and influence the physical properties of the powder, especially in the compression and dissolution processes of pharmaceutical preparations [10]

**Table 2.** Omeprazole 9,99 grams

No sieve	Pore size	The weight left behind	%Left behind	%Left × average pore size
60/72	231 μm	4,778	0.983	227.07
40/60	373.5 μm	4,782	0.984	332.1
26/40	567.5 μm	0.158	0.032	18.16
Fines	-	-	-	-
	Σ: 1.136	Σ: 9,718	Σ: 1,999	Σ: 577.33

Based on table 2 for omeprazole as much as 9.99 grams, it was found that by using the sieving method on the omeprazole sample as much as 9.99 grams, it was found that most of the particles were retained on the 40/60 mesh and 60/72 mesh sieves with a weight of 4.782 grams (98.4%) and 4.778 grams (98.3%), respectively, while on the 26/40 OPN sieve only 0.158 grams (3.2%) were retained. These results indicate that the particle size distribution of omeprazole is dominated by medium-sized particles with a size range of around 231–373.5  $\mu\text{m}$ , so that the particle size tends to be more uniform and does not contain many coarse particles [11]. The dominance of particles on the 40/60 OPN sieve indicates that the refining process produces a relatively homogeneous size distribution, which can support the uniformity of mixing and the manufacturing process of pharmaceutical preparations. Uniform particle size also affects the dissolution rate, stability, and bioavailability of the drug [12]. These results are in line with research stating that the particle size characteristics of omeprazole have an important role in determining the flow properties, compression process, and drug release from pharmaceutical preparations [13].

**Table 3.** 50 grams of talc

No sieve	Pore size	The weight left behind	%Left behind	%Left $\times$ average pore size
60/72	231 $\mu\text{m}$	2,146	1,5099	348.7
40/60	373.5 $\mu\text{m}$	0.264	0.2054	69.32
26/40	567.5 $\mu\text{m}$	0.2495	0.1755	99.59
Fines	-	0.183	0.0643	-
	$\Sigma$ : 1.136	$\Sigma$ : 2.8425	$\Sigma$ : 1.9551	$\Sigma$ : 517.61

Based on table 3, the results for 50 grams of talc were obtained that using the sieving method on a 50 gram talc sample, it was found that the most particles were retained on the 60/72 mesh sieve with a weight of 2.146 grams (150.99%), followed by the 40/60 mesh sieve at 0.264 grams (20.54%), the 26/40 OPN sieve at 0.2495 grams (17.55%), and the fines fraction at 0.183 grams (6.43%). These results indicate that most of the talc particles have a relatively fine size with a dominance in the size range of around 231  $\mu\text{m}$ . This characteristic is in accordance with the natural properties of talc as a very fine powder and has a large surface area [14]. The fine particle size provides good capabilities as a glidant and antiadherent in pharmaceutical formulations because it can improve the flow properties of the powder mixture and reduce adhesion to equipment during the production process [15]. The relatively even particle size distribution across the various sieve fractions also indicates that the sample has fairly good homogeneity. These results are consistent with research reporting that pharmaceutical talc generally has a fine particle size that plays an important role in improving the flow properties and stability of powder mixtures in the tablet and capsule manufacturing process [16].

#### **4. Conclusion**

The sieving method was successfully used to determine the particle size distribution of paracetamol, omeprazole, and talc. Paracetamol showed a predominance of fine particles, while omeprazole and talc had a larger particle distribution. These differences in characteristics can affect the dissolution rate, flow properties, compressibility, and performance of formulations. Therefore, micromeritic testing is a crucial step in the development and quality control of pharmaceutical preparations.

#### **Confession**

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