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Effect of Milling on Food and Pharmaceutical Powders

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Milling is a widely used unit operation in the food and pharmaceutical industries. Raw materials for food products are manufactured into baked goods, beverages, snacks, and meal components. The insoluble fiber fractions with particle sizes greater than 50 µm negatively impact: (a) the ability to manufacture, (b) the stability of the finished product, and (c) the mouth-feel. There is a need for more fundamental insights into how different materials break apart; our approach is to carry out a thorough characterization and to create a model that would eliminate the wasteful and time-consuming effort of trial and error that is currently used. This work displays the characterization of acetaminophen, aspirin, cornstarch, three different versions of lactose, salbutamol sulphate, and sucrose. We determined the stiffness, particle size distribution, surface properties, and the physical appearance through a microscope before and after 5, 15, and 30 minutes of milling. We found significant correlations among the changes in the stiffness. With increased milling time, the stiffness falls into a smaller, more predictable range of values. We also found that milling has a vastly different effect on particle size and the crystalline structure, depending on the material. Furthermore, there is a significant correlation between the powder's contact angle and the particle size. Additionally, we have shown how humidity leads to increased crystallization. With further characterization, correlations can continue to be developed that will be helpful in creating a model for the milling process in the future, one which will increase the possibilities for efficient manufacturing.

Research advisors Teresa Carvajal and Rodolfo Pinal, post-doctoral research associate Andrew Otte, and graduate advisor Yan Zhang write, "Scott conducted research in the laboratories of Drs. Pinal and Carvajal probing mechanical and surface properties of cryo-milled materials used in food and pharmaceutical products. He demonstrated and impressed us with his involvement, commitment, and dedication to his career and the project we assigned."

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