# Optimizing Hydraulic Cold Pressing For Enhanced Oil Extraction From Hemp Seeds

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## Abstract

Industrial hempseed and its co-products (cake and oil) are rich sources of protein and essential fatty acids, making them a promising alternative ingredient for aquafeed. Oil extraction method influences both the yield and product quality. Although chemical and screw pressing are commonly used, they are energy-intensive, complex for small-scale use, and ineffective for dehulled hempseed.

This study aims to develop a hydraulic pressing system for separating oil and protein from dehulled hempseed. To this end, a preliminary experiment was conducted using a lab-scale rosin press, focusing on optimizing the pressing chamber where seeds are compressed, in preparation for a 100-ton scale-up. A 2-inch PVC pipe was modified with fifteen 7/64-inch holes to form a custom oil expeller chamber. The rosin press was set to 1000 PSI with a press time of 180 seconds. For each trial, 14 g of hempseed (whole or dehulled) was pressed using the rosin press. Two chamber types (modified and unmodified) were tested in five replicates. Oil extraction rate, total oil yield, and residual oil in the cake were measured. Residual cake samples were oven-dried, and crude lipid content was analyzed following the AOAC methods.

The results of the study showed that drilling holes in the chamber significantly increased the oil yield, improved oil flow, and resulted in a more consistent collection from dehulled seeds, compared to the unmodified chamber. The residual oil in the cake was inversely proportional to the amount of oil collected via pressing, with average values of 38.91% for the unmodified chamber and 34.27% for the modified chamber. Dehulled seeds yielded more oil than whole seeds, possibly due to hull removal. These findings provide insight into scaling up the 100-ton press with perforated chambers to enhance efficiency and oil recovery of hempseed in the larger press.

## Introduction

The SUSHI project (Sustainable Use of Safe Hemp Ingredients) explores the potential of hemp seed as a novel ingredient in fish feed for sustainable aquaculture production. Currently, fish diets rely heavily on protein and oils derived from other fish, but this is not a sustainable system. Hemp seeds may serve to provide sustainable aquaculture feed ingredient due to its richness in beneficial fatty acids and high-quality, digestible protein.

Chemical and screw press methods are the most commonly used commercial oil extraction techniques for plant seeds. Chemical extraction methods are limited by their need for organic solvents and expensive processing infrastructure that is unaffordable to small producers. Screw presses can mechanically extract oil but need a high fiber content to successfully expel the oil. Often fish diets cannot incorporate high levels of fiber.

With these limitations in mind, we wanted to develop a system to separate the protein and oil from dehulled hemp seed (low fiber content). Hydraulic pressing could eliminate the need for solvents, expensive infrastructure, and high fiber content.

To optimize the performance of a 100-ton commercial-scale press, we conducted a series of preliminary experiments using a smaller-scale rosin press. Tests centered on modifications of the pressing chamber which is the area where hemp seeds are compressed.

## Methodology

A rosin press was used as a model system to optimize parameters for a commercial scale oil press (Figure 1). Earlier studies identified a need for holes in the pressing chamber. Preliminary work test drilled 4 holes in sizes of 0, 3/32, 7/64, 1/8, 9/64, 5/32, and 11/64 inch. A 7/64 inch hole size tentatively gave the best oil removal. We modified a 2-inch PVC pipe by drilling fifteen 7/64-inch holes along its surface to create a unique oil expeller chamber. Comparisons were made across dehulled hemp seeds and whole hemp seeds, in order to determine which produced the highest and most consistent oil yields. For each experimental condition (modified vs. unmodified chamber) a rosin press set to 1000 PSI and a press time of 180 seconds. The oil extraction rate, total oil yield, and residual oil retained in the seed cake was measured. For each trial, we prepared a 14 g seed sample for pressing. Once assembled, the container was placed into the press, and pressure was applied manually using the handle, maintaining approximately 1000 PSI throughout the process. Each condition was tested in five replicates to ensure consistency and reliability of the results.

Once the oil was extracted using the rosin press, the pressed cake samples were oven-dried to remove residual moisture. The crude lipid content of the samples were determined following the AOAC soxhlet extraction method.

## Results

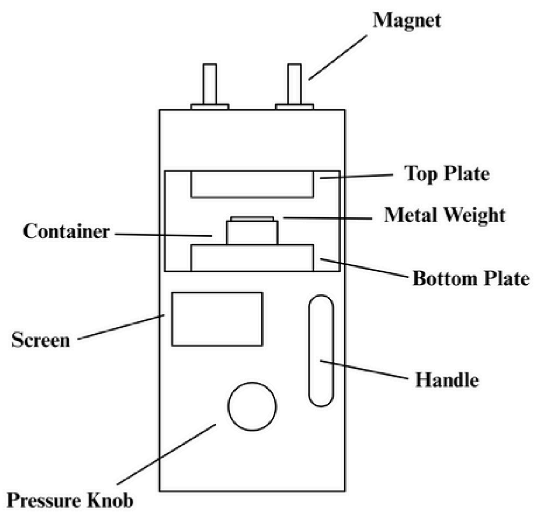


**Figure 1:** Rosin Press Drawing

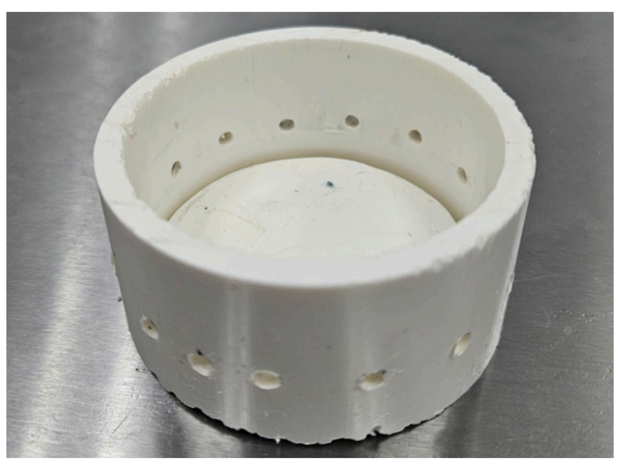

**Figure 2:** Example of 2 inch PVC pipe with 15 holes 7/64th inch in diameter.

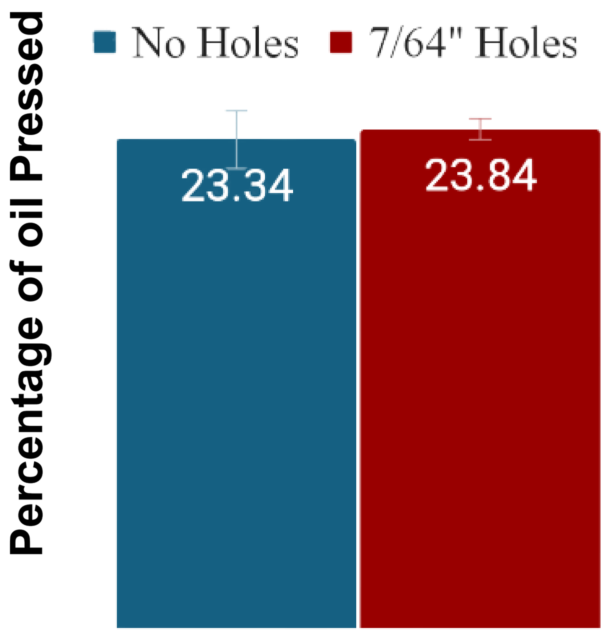


**Figure 3:** Total Oil Pressed from Dehulled Hemp Seeds using a Container with Holes vs. No Holes

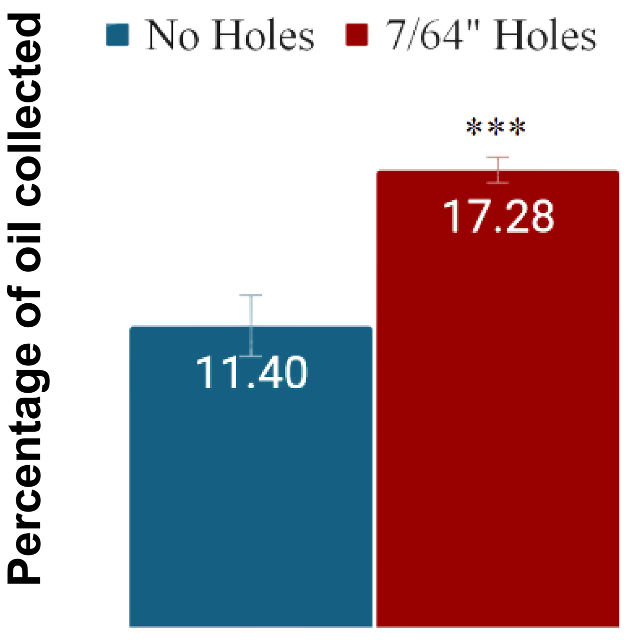


**Figure 4:** Total Oil Collected from Dehulled Hemp Seeds using a Container with Holes vs. No Holes

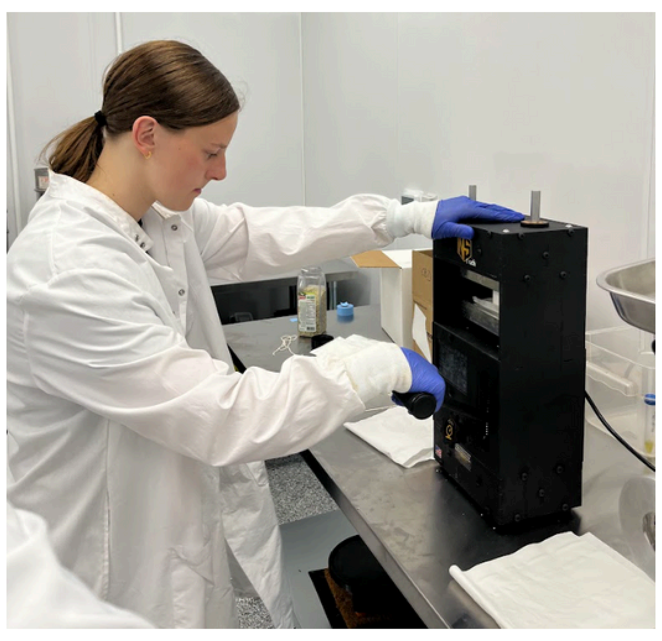

**Figure 5:** Rosin Press Experiment

**Figure 6:** Hannah and Magali with the 100-Ton Press

## Discussion

We observed that the container with no holes and the container with 7/64" holes produce the same amount of oil when used in a rosin press. However, the holes affect how much oil we were able to collect. We were able to collect a significantly higher percentage of oil when using the container with 7/64" holes. These findings suggest that while total yield may remain stable, yield reliability benefits from chamber modification.

## Conclusion

Overall, we observed that dehulled hemp seeds with holes in the chamber facilitated more efficient oil extraction compared to no holes. Not only was the total amount of oil extracted from dehulled hemp seeds using the modified chamber show a significant increase, the consistency of the oil yields was notably improved. Additionally, we noticed that dehulled hemp seeds have a significantly higher oil extraction rate than whole hemp seeds. Moving forward, we will use these insights to scale up the process with the 100-ton press, incorporating drilled holes in the chamber to maintain efficient oil flow. Additionally, we will finalize the design of an auxiliary lifting system to elevate the pressing chamber, allowing for easier removal of both oil and seed cake.

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