

Abstract

A Curcuminoid is a bioactive compound which contains 77% of Curcumin, 18% of demethoxycurcumin, and 5% of bisdemethoxycurcumin which contain phenols as functional groups. Many people consume curcumin through curry which is a very well-known Indian food, but once stained in a plate or bowl, curcumin is very hard to remove. This experiment uses sodium hydroxide solution to give an alternative method to remove curcumin effectively. Since curcumin contains phenol which contains hydroxyl group, sodium hydroxide will convert phenol group into phenolate which becomes an ionic group. Therefore, curcumin becomes very easy to dissolve in water, thus easy to remove curcumin stains. The results show that rinsing the curcumin stained tile with pH 14 solution removed the curcumin effectively. This was confirmed through the colorimeter CIELAB yielding 90.96,1.87, 6.70, which closely matched with our reference. Our results showed that removing curcumin stains by converting phenol to phenolate using a basic solution worked well and can be used to clean the stain easily and effectively.

Removal of Curcumin Stains Using Base Chemicals

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Introduction

Turmeric is an ingredient in curry and various popular dishes, but when it leaves a spill on ceramic plates or tiles, it can become difficult to remove. While numerous popular cleaning methods exist, they are often time consuming and inefficient. Fundamentally, turmeric contains phenolic groups that can be converted to phenolate by adjusting pH. Therefore, we hypothesized basic solution will convert phenol to phenolate, thus making curcumionid easily dissolved in water due to having ionic charge (negative).

Methods

The experiment was conducted with three sequential phases to determine the most effective pH, temperature, and stain exposure time for removing turmeric stains from ceramic tiles. First, solutions ranging from pH 7 to pH 14 were prepared by adding calculated amounts of sodium hydroxide to 1L of water and verified using pH indicator paper. A 3% turmeric solution was prepared by mixing approximately 7-8 g of turmeric with 240 mL of water and applied to ceramic tiles. Cotton swabs soaked in each pH solution were used to remove the stains. Each condition was tested in three trials, and the pH condition that produced the best result was used for the next phase. In the second phase, the effect of solution temperature on stain removal was investigated while maintaining the selected pH condition from the first phase. Water was heated to temperatures ranging from 25°C to 75°C in 10°C intervals, and a temperature gun was used to measure and verify the temperature of the water before sodium hydroxide was added to produce a pH 14 solution. Paper towels soaked in the heated pH solution were used to remove the stains. The temperature condition that produced the best result was used for the final phase. In the final phase, stain exposure time was investigated while maintaining the selected pH and temperature conditions from the previous phases. The turmeric solution was allowed to remain on the ceramic tile for times ranging from 10 to 60 seconds in 10 second increments before the application of the selected pH solution. The same stain removal procedure was performed for each exposure time.

Results & Disssussion

For the process of finding the best ph for the sodium hydroxide, out of the 8 ph that were tested, ph 14 seems to show the best result. When tested with a colorimeter, the CIELAB was 90.96, 1.87, 6.70 which is close to the reference, 90.88, 1.79, 6.27, which is a blank white tile. In the second phase, the best time of the sodium hydroxide mixture applied to the tile was tested using ph 14, the standard was 10ml, given that there wouldn’t be a big difference. The time that the tile was soaked in sodium hydroxide was tested in 6 different times, 10, 20, 30, 40, 50, 60. 60 seconds had a CIELAB of 85.71, 3.16, 7.90 which was the closest to the reference 90.88, 1.79, 6.27 out of all the 6 times. In the third phase, the best temperature that erases the stain was tested using the previous results; ph 14 and 60 seconds. The temperatures tested were 25, 35, 45, 55, 65, and 75. 75 seems to have the best outcome according to the colorimeter results. Overall, the best result was a pH of 14, 10mL of solution, at a temperature of 75 degrees C, and a time of 60 seconds had the best results for removing curcumin from the tile. pH of 14 had the best results because curcumin has phenolic -OH groups. In a strongly basic solution like NaOH at a pH of 14, the -OH groups can lose their hydrogen ions (H⁺), forming phenolate ions, thus making the curcumin molecules more negatively charged. We experimented with pH 7-14 because 7 is neutral and 8-14 is base, anything before 7 is an acid. This charged form is more soluble in water, making it easier to remove. Changing the amount of solution did not produce a large difference, so we concluded on 10 mL. The time that the tile was soaked in sodium hydroxide was 60 seconds. It worked the best because the longer the mixture sat, the more time the sodium hydroxide had to interact with the curcumin. A time past 60 seconds did not produce much difference, which is why we decided on 60 seconds. A temperature past 75 degrees C, was too dangerous to experiment with, thus we tested until 75 degrees C. The higher temperature increases molecular movement and mass transfer, allowing the sodium hydroxide to interact with the curcumin better.

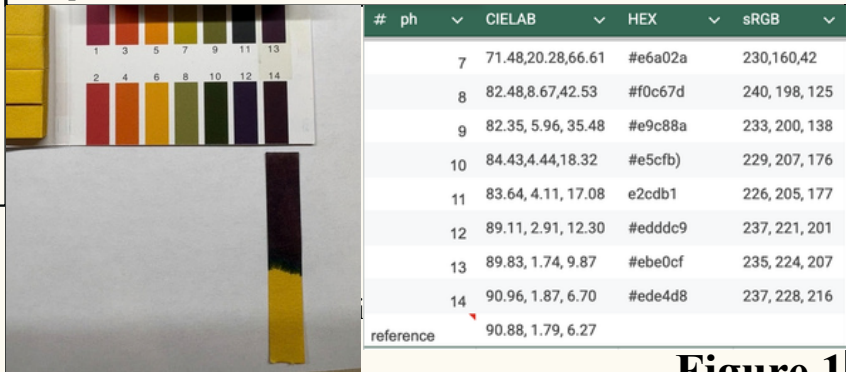
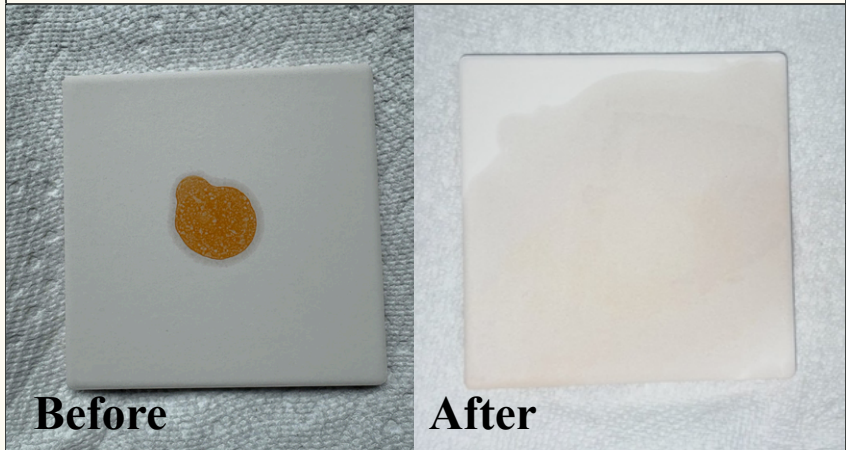


Figure 1



Before

After

Conclusion

This study investigated the one of methods for removing turmeric stains from ceramic tiles by evaluating varying pH levels, solution temperatures, and exposure times across three experiments. Through methodical testing, we determined that a pH 14 sodium hydroxide solution had the best stain removal. Building upon this baseline, methodical experimental phases identified 75C as the ideal solution temperature and 60 seconds as the most effective exposure time for removing the stains.

References

Numberreferenceencesquentiallybyorder of appearance, not alphabetically. Refer to the reference number, as [3]
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