

Development of a pH Responsive Ceramic Material

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Food spoilage is a big problem in the food industry which cannot be overcome, but able to be controlled or ways of detection can be developed. In the food industry, identification of food quality minimize health problems and avoid wastage. The objective of this research is to introduce a pH sensitive smart bottle cap. When the pH is going to change the ceramic pallet placed in the cap will change color. When some food item such as milk is being spoiled, there will be lactic acid, which reduce pH, produced. Because of acidic condition pH will be reduced. This pH variation can be identified by pellet. Kaolin is the ceramic material used in this research. Here it is used due to its non-toxicity and chemical inertness. The kaolin based material was prepared in a way it can absorb a dye material to obtain clear view of color change. This research used four types of dye materials. Two of them are anthocyanin containing plant based dyes and other two are commercial dyes. Anthocyanin can undergo molecular rearrangement due to polyphenolic groups and extended conjugation of double bond depending on pH of the medium. Also in methyl orange and methyl red, they show different colors in acidic and basic conditions. Other important thing is those dyes exhibit low toxicity and may not affect to the taste of food item. The air stability of those four dye materials have been checked by the UV visible spectrometer. For the purple cabbage, there were increased of absorbance gained after 72 hours. The pH reduction average is 34.04% after 72 hours. Same as the Hibiscus dye also shown, a increase of absorption and reduction average of pH 25.35% after one day. Same as methyl red dye, it shows 11.7% increase of absorption after one day. Also it shows 20.05% of pH reduction after one day. In methyl orange, it shows 67.67% of absorbance increase and 19.3% of pH reduction. Purple cabbage absorbed pellets show yellow color for the 1.0 M NaOH and pink color for the 1.0 M H₂SO₄. For spoiled milk, blue color pellet turned into the purple. Same results were obtained for the Hibiscus dye. It shows brownish color for the spoiled milk as well. It shows brown color with the spoiled milk. Therefore, it is clear that these ceramic pallets have the potential to be used as smart caps for spoiled food detection.

Keywords: Food soilage, Kaolin caps, Ceramic cap, Commercial dyes, Pit change