
SBPMat
B-MRS
SOCIEDADE BRASILEIRA
DE PESQUISA EM MATERIAIS
SALVADOR
XXIII B-MRS Meeting 2025
September 28th to October 2nd
BRICS
Brasil 2025

# Moisture sensors for food packaging: colorimetric cryogels based on starch and cobalt chloride

Lívia Yumi Nakashima[1], Laís Canniatti Brazaca[2], Bianca Chieregato Maniglia[3]

[1]São Carlos Institute of Chemistry (*Physical Chemistry*) , [2]São Carlos Institute of Chemistry, University of São Paulo, [3]Institute of Chemistry, University of São Paulo (*Físico Química - IQSC*)

*e-mail: livia.yumi@usp.br*

Food packaging with sensing capabilities has emerged as a promising strategy to reduce waste and improve food quality monitoring [1, 2]. This study investigates the potential of starch-based cryogels with cobalt chloride ($CoCl_2$) to act as colorimetric humidity sensors for food packaging. Native potato starch hydrogels were prepared and freeze-dried to form porous cryogels. $CoCl_2$ was incorporated at concentrations of 5, 10, 15, and 20 g/100 g starch (dry basis), and the resulting cryogels were tested under controlled relative humidity (RH) environments (18%, 60%, and 99%) to evaluate their analytical performance. Colorimetric changes were quantified using CIELAB parameters (L*, a*, b*) and ΔE*, with measurements taken via a colorimeter and by image analysis with ImageJ. Among the samples, cryogels with 20% $CoCl_2$ showed the most significant and visually distinct color shifts. The colors changed from blue (18%) to pink (99%) demonstrating high sensitivity and potential for practical application. These sensors also exhibited water absorption proportional to the salt concentration, as well as increased solubility and hydrophilicity, which are desirable traits for environmentally friendly disposal. The results indicate that starch cryogels with $CoCl_2$ can serve as low-cost, biodegradable humidity sensors in food packaging, with excellent potential for consumer-level visual monitoring. Future steps include testing the cryogels under more RH levels, assessing mechanical and chemical properties, and evaluating *in situ* performance in conventional and biodegradable snack packages.

**Acknowledgements**
CNPq PIBIC (127377/2024-7), FAPESP (2020/08727-0 and 2023/10141-2)

**References**
Ravindran, R., Jaiswal, A. K., & Jaiswal, S. Food Packaging and Shelf Life, 30, 100743 (2021)

Shukla, V., Juneja, M., & Soni, R. Food Reviews International, 38(1), 1–22 (2020)