

**CHROMOPHORES MODIFIED POROUS CLAY HETEROSTRUCTURE  
FOR SMART PACKAGING FILMS**



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## ABSTRACT

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Smart packagings for detecting fish and climacteric fruit freshness were prepared based on polypropylene/chromophores (methyl red) modified functionalized porous clay heterostructure (PCH) nanocomposite films and low density polyethylene/chromophores (bromothymol blue) modified PCH nanocomposite films, respectively. The incorporation of chromophores in porous materials was investigated by N<sub>2</sub> adsorption-desorption, XRD and SEM. The nanocomposite was prepared by twin screw extruder and fabricated into nanocomposite film by compression molding. The color change of PP/APPCH-MR nanocomposite films from red to light orange corresponded to the total volatile basic nitrogen releasing during fish spoilage. The color change of LDPE/PCH-BTB nanocomposite films from green to yellow correlated with standard CO<sub>2</sub> levels, which can be compared to CO<sub>2</sub> levels from respiration during fruit ripening. Porous clay improved the barrier properties of nanocomposite indicated by the reduction of oxygen transmission rate. Thus, PP/APPCH-MR nanocomposite films could be used to determine fish freshness and LDPE/PCH-BTB nanocomposite films can be applied for detecting the quality of climacteric fruit by color change. Moreover, both pH indicators can prolong the shelf-life of product by incorporated porous materials into the films.

## บทคัดย่อ

สุภัจฉรี บุญเรือง : การพัฒนาวัสดุรูพรุนดัดแปรด้วยโครโมฟอร์สำหรับบรรจุภัณฑ์ฉลาด (Chromophores Modified Porous Clay Heterostructure for Smart Packaging Films) อ. ที่ปรึกษา : ผศ.ดร. หทัยกานต์ มนัสปิยะ และ รศ.ดร. รัตนวรรณ มกรพันธุ์ 105 หน้า

บรรจุภัณฑ์ฉลาดสำหรับบ่งบอกความสดของเนื้อปลาสามารถเตรียมได้โดยใช้โพลีพรอพิลีนร่วมกับแร่ดินเหนียวโครงสร้างรูพรุนที่มีหมู่ฟังก์ชันดัดแปรด้วยเมทิลเรดนาโนคอมโพสิต และบรรจุภัณฑ์ฉลาดสำหรับบ่งบอกความสดของผลไม้ชนิด climacteric สามารถเตรียมได้โดยใช้โพลีเอทิลีนความหนาแน่นต่ำร่วมกับแร่ดินเหนียวโครงสร้างรูพรุนที่ดัดแปรด้วยโบรโมโธมอลบลูนาโนคอมโพสิต วัสดุรูพรุนดัดแปรด้วยโครโมฟอร์สามารถตรวจวิเคราะห์ด้วยเทคนิคการดูดซับไนโตรเจน ( $N_2$  adsorption-desorption) เทคนิค XRD และเทคนิค SEM วัสดุนาโนคอมโพสิตที่ไวต่อการเปลี่ยนแปลงความเป็นกรด-เบสสามารถเตรียมได้โดยใช้เครื่องอัดรีดแบบเกลียวคู่ และขึ้นรูปเป็นแผ่นฟิล์มโดยใช้เครื่องขึ้นรูปแบบอัด ฟิล์มโพลีพรอพิลีนเคลย์นาโนคอมโพสิตถูกนำมาใช้ในการบ่งบอกความสดของเนื้อปลาจนกระทั่งเนื้อปลาเกิดความเน่าเสีย เนื่องจากเมื่อเนื้อปลาเกิดการเน่าเสียจะผลิตก๊าซที่ประกอบด้วยสารประกอบไนโตรเจน (TVB-N) ทำให้ค่าความเป็นกรด-เบสเพิ่มขึ้น และสีของเมทิลเรดจะเปลี่ยนจากสีแดงเป็นสีส้ม นอกจากนี้ฟิล์มโพลีเอทิลีนความหนาแน่นต่ำนาโนคอมโพสิตยังถูกนำมาประยุกต์ใช้ในการบ่งบอกความสดของผลไม้ชนิด climacteric เนื่องจากสีของโบรโมโธมอลบลูในนาโนคอมโพสิตฟิล์มจะเปลี่ยนจากสีเขียวเป็นเหลือง เมื่อสัมผัสกับก๊าซคาร์บอนไดออกไซด์และน้ำ ซึ่งสามารถนำไปเปรียบเทียบได้กับการหายใจของผลไม้ชนิด climacteric และมีผลทำให้ค่าความเป็นกรด-เบสลดลง ดังนั้นฟิล์มนาโนคอมโพสิตอินดิเคเตอร์จึงสามารถใช้เป็นวัสดุที่ไวต่อการเปลี่ยนแปลงความเป็นกรด-เบส รวมทั้งสามารถยืดอายุการเก็บรักษาเพื่อใช้ในบรรจุภัณฑ์ได้อย่างมีประสิทธิภาพอีกด้วย

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## TABLE OF CONTENTS

	<b>PAGE</b>
Title Page	i
Abstract (in English)	iii
Abstract (in Thai)	iv
Acknowledgements	v
Table of Contents	vi
List of Tables	ix
List of Figures	xi
<b>CHAPTER</b>	
<b>I INTRODUCTION</b>	<b>1</b>
<b>II LITERATURE REVIEW</b>	<b>3</b>
<b>III EXPERIMENTAL</b>	<b>27</b>
<b>IV SYNTHESIS OF CHROMOPHORES MODIFIED POROUS CLAY HETEROSTRUCTURE</b>	<b>39</b>
4.1 Abstract	39
4.2 Introduction	39
4.3 Experimental	40
4.4 Result and Discussion	43
4.5 Conclusions	55
4.6 Acknowledgements	55
4.7 References	55

<b>CHAPTER</b>		<b>PAGE</b>
<b>V</b>	<b>pH INDICATOR FILM BASED ON PLASTIC/ CHROMOPHORES MODIFIED PCH NANOCOMPOSITE FILMS</b>	<b>57</b>
	5.1 Abstract	57
	5.2 Introduction	57
	5.3 Experimental	59
	5.4 Result and Discussion	63
	5.5 Conclusions	78
	5.6 Acknowledgements	78
	5.7 References	79
<b>VI</b>	<b>PHYSICAL PROPERTIES AND BARRIER PROPERTIES OF pH INDICATOR NANOCOMPOSITE FILMS</b>	<b>80</b>
	6.1 Abstract	80
	6.2 Introduction	80
	6.3 Experimental	81
	6.4 Result and Discussion	83
	6.5 Conclusions	93
	6.6 Acknowledgements	93
	6.7 References	93
<b>VII</b>	<b>CONCLUSIONS AND RECOMMENDATIONS</b>	<b>95</b>
	<b>REFERENCES</b>	<b>97</b>
	<b>APPENDICES</b>	<b>100</b>
	<b>Appendix A</b>	<b>100</b>
	<b>Appendix B</b>	<b>101</b>
	<b>Appendix C</b>	<b>102</b>

<b>CHAPTER</b>	<b>PAGE</b>
<b>Appendix D</b>	103
<b>Appendix E</b>	104
<b>CURRICULUM VITAE</b>	105



## LIST OF TABLES

<b>TABLE</b>		<b>PAGE</b>
<b>CHAPTER II</b>		
2.1	Examples of external and internal indicators and their working principle or reacting compounds to be used in intelligent packaging for quality control of packed food	3
2.2	Rate of respiration of green bananas at different temperatures	12
2.3	The times of respiration rise from pre-ripening phase to peak value at different temperature	13
<b>CHAPTER IV</b>		
4.1	Surface area, pore diameters and pore volume from nitrogen adsorption- desorption	48
4.2	Element analysis result of APPCH	48
4.3	Adsorption of methyl red by APPCH and PCH	49
4.4	Surface area, pore diameters and pore volume from nitrogen adsorption- desorption	50
<b>CHAPTER V</b>		
5.1	Change in hunter color (L, a, b) and total color difference (TCD) values of PP/APPCH-MR (10:1) nanocomposite films after indirect contact with standard ammonia	64
5.2	Change in hunter color (L, a, b) and total color difference (TCD) values of PP/APPCH-MR (20:1) nanocomposite films after indirect contact with standard ammonia	64
5.3	Change in hunter color (L, a, b) and total color difference (TCD) values of PP/APPCH-MR (30:1) nanocomposite films after indirect contact with standard ammonia	65

<b>TABLE</b>	<b>PAGE</b>
5.4 Change in hunter color (L, a, b) and total color difference (TCD) values of PP/APPCH-MR (10:1) nanocomposite films after in direct contact with fresh fish tissue	69
5.5 Change in hunter color (L, a, b) and total color difference (TCD) values of PP/APPCH-MR (20:1) nanocomposite films after in direct contact with fresh fish tissue	70
5.6 Change in hunter color (L, a, b) and total color difference (TCD) values of PP/APPCH-MR (30:1) nanocomposite films after in direct contact with fresh fish tissue	70
5.7 Change in hunter color (L, a, b) and total color difference (TCD) values of LDPE/PCH-BTB (10:1) nanocomposite films after indirect contact with standard carbon dioxide and excess water	72
5.8 Change in hunter color (L, a, b) and total color difference (TCD) values of LDPE/PCH-BTB (20:1) nanocomposite films after indirect contact with standard carbon dioxide and excess water	73
5.9 Change in hunter color (L, a, b) and total color difference (TCD) values of LDPE/PCH-BTB (20:1) nanocomposite films after indirect contact with standard carbon dioxide and excess water	73
 <b>CHAPTER VI</b> 	
6.1 Melting and Crystallization behavior	84
6.2 Thermal behavior	85
6.3 Oxygen gas transmission rate of PP and PP/APPCH-MR nanocomposites	92
6.4 Oxygen gas transmission rate of LDPE and LDPE/PCH-BTB nanocomposites	93

## LIST OF FIGURES

FIGURE	PAGE
<b>CHAPTER II</b>	
2.1	Change in CO <sub>2</sub> level in golden drop at 25°C with indicator level which showed color change with time
	6
2.2	Correlation of sensor response (spin-coated at 1000 rpm) and changes in bacterial population of fresh cod kept at 20°C over time
	8
2.3	Typical BCG sensor responses to a spoiling whiting sample
	9
2.4	Rate of production of carbon dioxide by bananas (initially unripe) at different temperatures
	13
2.5	Heats of respiration of bananas which stored at 13, 17, 20 and 30 °C in ambient air and CAs containing 4% O <sub>2</sub> - 5% CO <sub>2</sub> and 4% O <sub>2</sub> - 10% CO <sub>2</sub>
	15
2.6	O <sub>2</sub> consumption rate of bananas which stored at 13, 17, 20 and 30 °C in ambient air and CAs containing 4% O <sub>2</sub> - 5% CO <sub>2</sub> and 4% O <sub>2</sub> - 10% CO <sub>2</sub>
	15
2.7	CO <sub>2</sub> evolution rate of bananas which stored at 13, 17, 20 and 30 °C in ambient air and CAs containing 4% O <sub>2</sub> - 5% CO <sub>2</sub> and 4% O <sub>2</sub> - 10% CO <sub>2</sub>
	16
2.8	Respiration rate of unheated mango, heat treatment at 42 and 46°C for 85 and 75 min, respectively stored at 13°C
	17
2.9	Mechanism of methyl red indicator in yellow color (left) and red color (right)
	18
2.10	Mechanism of bromoyhymol blue indicator in yellow color (left), intermediate between yellow and blue (middle) and blue color (right)
	18
2.11	Structure of 2:1 layer silicate
	20
2.12	Schematic diagrams for the adsorption of BBF by the acidified APTES particles
	22

<b>FIGURE</b>	<b>PAGE</b>
2.13 Structure of surlyn <sup>®</sup>	24
<b>CHAPTER III</b>	
3.1 The color of boric solution changed from pink to green	35
3.2 The color changed back to pink after titrated with 0.01 N HCl	35
<b>CHAPTER IV</b>	
4.1 (a) Na-BTN, (b) OBTN, (c) PCH and (d) APPCH	43
4.2 The XRD patterns of (a) Na-BTN, (b) OBTN (CTAB) and (c) OBTN (CTAC)	44
4.3 Fourier transform infrared spectroscopy spectra of (a) Na-BTN, (b) OBTN, (c) PCH and (d) APPCH	45
4.4 Scanning Electron Microscope images of (a) Na-BTN, (b) PCH and (c) APPCH	47
4.5 Adsorption of methyl red by (a) APPCH and (b) PCH	49
4.6 (a) methyl red modified APPCH and (b) bromothymol blue modified PCH at various weight ratio of clay and pH dye; 10:1, 20:1 and 30:1	51
4.7 The XRD patterns of (a) APPCH, (b) APPCH-MR 10:1, (c) APPCH-MR 20:1 and (d) APPCH-MR 30:1	51
4.8 The XRD patterns of (a) PCH, (b) PCH-BTB 10:1, (c) PCH-BTB 20:1 and (d) PCH-BTB 30:1	52
4.9 SEM images of (a) APPCH-MR 10:1, (b) APPCH-MR 20:1 and (c) APPCH-MR 30:1	53
4.10 SEM images of (a) PCH-BTB 10:1, (b) PCH-BTB 20:1 and (c) PCH-BTB 30:1	54
<b>CHAPTER V</b>	
5.1 Changes in TCD values of the pH indicator films after indirect contact with standard ammonia during storage at room temperature	65

<b>FIGURE</b>	<b>PAGE</b>
5.2 Changes in pH of standard ammonia	66
5.3 Color changes of the pH indicator films (a) before and (b) after indirect contact with 25 ppm standard ammonia during storage at room temperature	66
5.4 Changes in total volatile basic nitrogen (TVB-N) of fresh fish during storage at room temperature	67
5.5 Color changes of PP/APPCH-MR (30:1) nanocomposite films during fish storage at room temperature	68
5.6 Changes in pH of total volatile basic nitrogen (TVB-N) of fresh fish during storage at room temperature	69
5.7 Changes in total color difference values ( $\Delta E$ ) of pH indicator film at various weight ratio of APPCH: MR (a) 10:1 (b) 20:1 and (c) 30:1 during fish storage at room temperature	71
5.8 Changes in total color difference values ( $\Delta E$ ) of pH indicator film at various weight ratio of PCH: BTB (a) 10:1 (b) 20:1 and (c) 30:1	74
5.9 Color changes of LDPE/PCH-BTB (10:1) nanocomposite films after test with standard carbon dioxide at various concentrations (a) 0 ppm (b) 30 ppm (c) 60 ppm (d) 90 ppm (e) 120 ppm and (f) 150 ppm	74
5.10 Changes in pH of fresh banana during storage at room temperature	75
5.11 Reference bananas ripening at room temperature	75
5.12 Color change of LDPE/PCH-BTB (10:1) nanocomposite film during banana ripening	76
5.13 The leakage of methyl red from the PP/APPCH-MR nanocomposite films	77
5.14 The leakage of bromothymol blue from LDPE/PCH-BTB nanocomposite films	78

<b>FIGURE</b>		<b>PAGE</b>
<b>CHAPTER VI</b>		
6.1	DSC thermograms of PP/APPCH-MR nanocomposites (a) crystallization temperature and (b) melting temperature	86
6.2	DSC thermograms of LDPE/PCH-BTB nanocomposites (a) crystallization temperature and (b) melting temperature	87
6.3	TG curves of PP/APPCH-MR nanocomposites	88
6.4	TG curves of LDPE/PCH-BTB nanocomposites	88
6.5	Young's Modulus of PP and PP/APPCH-MR nanocomposite films	89
6.6	Tensile Strength of PP and PP/APPCH-MR nanocomposite films	90
6.7	% Elongation at yield of PP and PP/APPCH-MR nanocomposite films	90
6.8	Young's Modulus of LDPE and LDPE/PCH-BTB nanocomposite films	91
6.9	Tensile strength of LDPE and LDPE/PCH-BTB nanocomposite films	91
6.10	%Elongation at yield of LDPE and LDPE/PCH-BTB nanocomposite films	92