P-ISSN:1979519X
International Conference LabMa Scientific Fair 2021, Yogyakarta E-ISSN: 27458733

Active and Intelligent Packaging Based on Chitosan and Anthocyaninfrom the Extract of Rosella Flower (Hibiscus sabdariffa) with the Addition of Citronella Essential Oil (Cymbopogon citrratus)

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ABSTRACT

Background: The development in various industrial sectors in Indonesia is not far from the development of advanced materials in food packaging applications. In terms of material, 44% of the circulating packaging is in flexible form, 14% is rigid plastic packaging, and 28% is paperboard packaging. The food in packaging has expired or has decayed before expiration date due to contact with other compounds. Currently, a system has been developed forthe development of materials for food packaging so as to increase the safetyand shelf life of food ingredients which is commonly referred to as intelligentand active packaging.
Method: This active and intelligent packaging system will utilize biopolymer compounds combined withdyes in pH-sensitive edible film preparations so they are be able to show color changes when there is a change in pH. The author uses the method of studying literature in national and international journals whose validity is verified to examine the use of chitosan biopolymer from shrimp shells with the addition of anthocyanin compounds from Rosella flowers as colorindicators and lemongrass as an antioxidant that will extend the shelf life of food.
Result: Based on the results the authors can conclude that this active and intelligent packaging innovation has goodpotential as an indicator to determine freshness and prolong shelf life of fresh food products. The incorporation of Rosella flower extract in the film can increase the value of light transmission, opacity, water content, and
sensitivity to pH. Meanwhile, the incorporation of essential oils significantlyincreases the elongation and opacity values and produces a smoother film surface. The hydrophobic nature of essential oils can reduce value of water content in the film. **Conclusion:** Authors hope that the Intelligent Packaging based on chitosan and anthocyanin from Rosella flower extract with the addition of essential oils can be applied further.
Keyword: anthocyanin, chitosan, essential oil, intelligent packaging, rosella

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Table1. Lemongrass Essential Oil
Active

Packaging Clear Zone Diameter (mm)

	Pseudomonas fluorescens	*Aspergillus niger*
Control	6,009[a] ± 0,199	12,212[a] ± 0,274
Essential Oil 2%	6,931[b] ± 0,071	14,425[a] ± 2,652
Essential Oil 4%	6,941[b] ± 0,393	15,431[a] ± 1,043
Essential Oil 6%	7,094[b] ± 0,079	12,925[a] ± 2,157

Table 2. Lemongrass Essential Oil Bacterial Control Clear Zone Diameter (mm)

Active Paper	After saving (20 days)	Before saving (20 days)	
Before saving		After saving	
		Pseudomonas fluorescens	*Aspergillus niger*
Control	6,010[A a] ±0,20	5,837[A a] ± 0,04	12,212[A a]±0,27	10,086[A a] ± 1,14
Concentration 2%	6,930[A a] ±0,10	6,418[A a] ± 0,10	14,425[A a]±2,65	12,243[A a] ± 2,32

Table 3. Rosella Flower Characteristics Data

Parameter Analysis Result
Total Anthocyanins(%) 23,67
pH 3,65
Residual Solvent (%) 5,43
Brightness (L*) 16,54
Redness (a*) 40,31
Yellowish (b*) 4,68

Table 4. Rosella Flower Antioxidant Effectiveness Test Rsult Comparison

Condition	**Score**	**Description**	
Antiocidant activity (DPPH test)	Beginning end (cold storage)	38,22% 33,93%	There was a decrease of 11.25% t test result : significantly different (t count = 4.21)
Total content of monomeric anthocyanins	Beginning end (cold storage)	3,45 mg/L 2,17 mg/L	There was a decrease of

39.12% t test result : significantly different (t count = 6.77)

Table 5. Tensile Strength and Thickness Test Result

Films Thickness	SPVA 88.06 ±	Water content (%)	Elongation atbreak (%)	Tensile Strength (Mpa)
		49.12 ± 2.09c	88.25 ±	
		2.57b	22.04 ± 1.33[b]	45.17 ± 1.78[b]
SPVA/RACNs 30		60.24 ± 3.18b	93.89 ±	
SPVA/RACNs 60		3.13b	18.50 ± 0.98[c]	41.85 ± 2.03[c]
SPVA/RACNs 120				
3.10b	25.50 ± 0.98[a]	48.97 ± 2.36[a]	88.28 ± 3.51a	
44.15 ± 2.42d	88.40 ±			
3.21b	25.21 ± 1.47[a]	48.21 ± 2.60[a]		

Table 6. Chitosan Characteristics

Film	Thickness (μm)	Water solubility (%S)	WVP (g $m^{-1}s^{-1}$ Pa^{-1})	Tensile strength (MPa)	Elongation at break (%)
Starch	97.21 ± 8.04[e]	21.40 ± 3.43[d]	32.38 ± 4.00 × 10^{-11} f	5.31 ± 0.26[e]	121.95 ± 10.20[g]
Chitosan	31.21 ± 3.77[a]	75.93 ± 4.59[f]	7.02 ± 0.74 × 10^{-11} d	38.10 ± 3.53[c]	29.65 ± 5.67[a]
F127 0%	44.68 ± 2.84[b]	42.58 ± 1.37[e]	21.33 ± 2.22 × 10^{-11} e	4.24 ± 0.61[a]	149.05 ± 11.68[f]
F127 1%	51.01 ± 4.40[c]	7.81 ± 1.40[bc]	6.66 ± 0.07 × 10^{-14} bc	6.49 ± 0.55[ab]	53.30 ± 5.51[b]
F127 3%	77.55 ± 6.54[d]	4.02 ± 1.27[ab]	3.47 ± 0.13 × 10^{-14} ab	4.96 ± 0.67[a]	95.20 ± 7.70[c]
F127 5%	71.30 ± 6.64[d]	3.34 ± 0.70[a]	2.76 ± 0.06 × 10^{-14} a	3.68 ± 0.25[a]	84.96 ± 5.43[c]

Table 7. Mechanical Properties

Bioplastic		Tensile Strength (MPa)	Elongation (%)
DPMA +	Glycerol	1,15	38,62
	Glycerol	2,65	46,60
	Sorbitol	49,60	40,23
	Sorbitol + CMC	51,80	40,93
DMKA +	Glycerol	1,90	70,28
	Glycerol	2,25	45,60
	Sorbitol	75,25	29,70
	Sorbitol + CMC	27,10	35,73

P-ISSN:1979519X
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Image 1. Color Changes To Ph

SMART

PACKAGING INDICATOR

VERY GOOD

GOOD

Image 2. Ph Indicator On The Product

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