

## THE EFFECT OF ROSELLE EXTRACT AND EGGHELL POWDER CONCENTRATION ON THE CHARACTERISTICS OF CHITOSAN BASED SMART EDIBLE FILM

Russel Jonathan<sup>1</sup>, Erni Setijawaty<sup>1</sup>, Adrianus Rulianto Utomo<sup>1</sup>, Ignasius Radix Ap Jati<sup>1\*</sup>

<sup>1</sup>Department of Food Technology, Universitas Katolik Widya Mandala Surabaya, Surabaya, Indonesia

\*Correspondence: [radix@ukwms.ac.id](mailto:radix@ukwms.ac.id)

### ABSTRACT

Smart edible film packaging is produced from consumable materials and functions as an indicator of food quality. This study aims to evaluate the effects of incorporating roselle flower extract and chicken eggshell powder, as well as their interaction, on the physicochemical properties of chitosan-based smart edible films. A factorial Randomized Block Design (RBD) was applied, with roselle extract concentrations of 0 (control), 1:30 (w/v), and 1:15 (w/v). Eggshell powder was added at concentrations of 0 (control), 0.15% (w/v), and 0.30% (w/v). The evaluated parameters included total phenolic content, total anthocyanins, antioxidant activity, tensile strength, elongation at break, water vapor transmission rate (WVTR), and film color. Additionally, changes in the color, aroma, and pH of chicken meat samples were assessed on storage days 0, 1, 2, and 3. Data were analyzed using ANOVA ( $\alpha = 5\%$ ), followed by Duncan's Multiple Range Test (DMRT) ( $\alpha = 5\%$ ). The resulting smart edible films exhibited total phenolic contents of 87.0711–1007.8933 mg GAE/100 g, total anthocyanins of 0.16–5.75 mg cy-3-glu equivalent/100 g, antioxidant activities of 5.5968–57.2047% RSA, WVTR values of 142.7795–240.9004 g/m<sup>2</sup>/24 h, tensile strengths of 1.511–10.030 N/mm<sup>2</sup>, and elongation percentages of 0.64–21.11%. Significant interactions between treatments were observed for WVTR, tensile strength, and elongation at break. The developed smart edible film effectively functioned as a freshness indicator through detectable color changes during storage and helped reduce the extent of color, aroma, and pH alterations in steamed chicken meat.

**Keywords:** chitosan, eggshell powder, rosella flower extract, smart edible film packaging, sorbitol

### INTRODUCTION

The combination of edible film and smart packaging is known as smart edible packaging. Edible film is a thin sheet resembling plastic composed of polysaccharides, proteins, and lipids (Chhikara & Kumar, 2022). In general, edible film functions as a coating as well as primary packaging that can be consumed with food products. The main advantage of edible film is its edible and biodegradable nature, so it is environmentally friendly and does not produce polluting waste. Various types of hydrocolloids can be used as the base material for edible films, such as sodium alginate, pectin, konjac, chitosan, and carrageenan. Chitosan has the ability to form a film, is hydrophobic, biodegradable, non-toxic, and can improve film transparency (Carnaval et al., 2022). In addition, the use of chitosan can also improve the mechanical properties of the resulting film (Bhatia et al., 2023).

The role of edible film as a packaging can be developed into smart edible packaging through the addition of active components. Rosella flowers (*Hibiscus sabdariffa* Linn.) are one of the potential natural sources of antioxidants (Aydin & Zorlu, 2022). Rosella contains anthocyanins that function as natural antioxidants as well as free radical antibodies. Anthocyanins show red color in acidic conditions and turn blue when the pH increases. The stability of anthocyanins is affected by their pH, light, temperature, and chemical structure (Latiff et al., 2025). The sensitivity of anthocyanins to pH changes allows this compound to be used as a bio-indicator of food spoilage in edible films. In addition, the presence of anthocyanins in the film also provides antioxidant activity that can slow down the decline in product quality and extend its shelf life (Shin et al., 2021).

Other ingredients that can be added to improve the physicochemical properties of smart edible film is chicken egg shell flour. This flour is a source of  $\text{CaCO}_3$  which has good ability to capture  $\text{CO}_2$  (Jati et al., 2025). As a bio filler—fillers derived from natural ingredients—chicken eggshell flour can improve the mechanical strength, sturdiness, and thickness of edible film (Vonnice et al., 2022). An increase in its concentration will result in a thicker film as a higher amount of filler strengthens the matrix and contributes to the mechanical properties of the film (Gregory et al., 2024). Thus, this study was conducted to evaluate the effect of the addition of rosella flower extract, chicken eggshell flour, and the interaction of the two on the physicochemical characteristics of chitosan-based smart edible packaging as food packaging.

## METHODS

### Materials

The materials used to make edible film are sorbitol obtained from PT Sorini Agro Asia Corporindo, Cargill and chitosan obtained commercially from the city of Surabaya, with a moisture content of 8.78%, viscosity of 106.24 mPa.S, and a particle size of 200–300 mesh. The active ingredients used are dried rosella flowers with a moisture content ranging from 10–12% obtained from Mojokerto City, East Java and white eggshell flour, and have a moisture content of 1% obtained from Depok City, West Java which is sold commercially. The materials used for the analysis consisted of aquades, KCl (Supelco), HCl (Honeywell), concentrated HCl (Honeywell), gallic acid (Honeywell), silica gel,  $\text{Na}_2\text{CO}_3$  solution (Merck), Folin-Ciocalteu reagent (Supelco), methanol (Supelco), DPPH solution (Sigma Aldrich), saturated NaCl (Merck), Na-acetate ( $\text{CH}_3\text{COONa}$ ) (Merck), and steamed chicken breast.

### Method

The study was designed with a two-factor Completely Randomized Design (CRD), namely three levels of rosella flower extract concentration and three levels of chicken eggshell flour concentration. The study was done with three repetitions for each treatment, bringing the total number of experimental units to 27 (Table 1). The research formulation is in Table 2.

**Table 1.** Research design

Rosella Flower Extract Concentration	Chicken Egg Shell Flour Concentration % (b/v)		
	C <sub>1</sub> (0/Control)	C <sub>2</sub> (0.15)	C <sub>3</sub> (0.30)
R <sub>1</sub> (0/Control)	(R1C1)1	(R1C2)1	(R1C3)1
	(R1C1)2	(R1C2)2	(R1C3)2
	(R1C1)3	(R1C2)3	(R1C3)3
R <sub>2</sub> (1:30 b/v)	(R2C1)1	(R2C2)1	(R2C3)1
	(R2C1)2	(R2C2)2	(R2C3)2
	(R2C1)3	(R2C2)3	(R2C3)3
R <sub>3</sub> (1:15 b/v)	(R3C1)1	(R3C2)1	(R3C3)1
	(R3C1)2	(R3C2)2	(R3C3)2
	(R3C1)3	(R3C2)3	(R3C3)3

### Preparation of Rosella Flower Extract

The dried rosella flowers that have been sorted are then reduced in size with a chopper (1 minute). After that, it is extracted with water (60°C). The extraction process is carried out using a water bath shaker (30 minutes). Next, filtration is carried out (Whatman No. 42), and the filtrate is used as a material in the process of making smart edible film.

**Table 2.** Smart edible film formulation

Material	Treatments								
	R1C1	R1C2	R1C3	R2C1	R2C2	R2C3	R3C1	R3C2	R3C3
Chitosan 1,5% (b/v) (g)*	12	12	12	12	12	12	12	12	12
Sorbitol 1% (v/v) (mL)*	8	8	8	8	8	8	8	8	8
Water (mL)	800	800	800	-	-	-	-	-	-
Extract Roselle (mL)	-	-	-	800	800	800	800	800	800
Egg-shell powder (g)	-	1.2	2.4	-	1.2	2.4	-	1.2	2.4

\*Note: percentage of konjac and sorbitol flour based on water/rosella flower extract used.

### Preparation of Eggshell Powder

The eggshell flour is crushed again using a chopper for 3 minutes. The mashed eggshells are then sifted. The sieve used is 100 mesh in size. Eggshell flour is stored in an airtight container filled with silica gel until use.

### Production of Edible Film

The manufacture of edible film refers to the method of Ekrami et al. (2022). Rosella flower extract is heated to a temperature of 85°C and 1.5% chitosan, chicken egg shell, and 1% sorbitol are added. Stir in a water bath for 15 minutes. Next, 80 mL of solution with a size of 10 x 15 cm was printed on an aluminum mold. The mold is dried at 21±2°C and RH 44±5% for 72 hours. Once dry, the edible film is removed from the mold and stored in a sealed packaging containing silica gel.

### Sample Extraction

The extraction procedure was carried out with reference to Jati et al. (2024). Smart edible film packaging is cut into small sizes, then as much as 1 g is put into a beaker. After that, 20 mL of aqueducts and 10 mL of methanol are added. The mixture is stirred and extracted in a shaking water bath at 40°C at a speed of 125 rpm for 1 hour. Next, the solution is filtered using Whatman No. 42 filter paper. The obtained filtrate is stored in a dark glass bottle in cold conditions until it is ready for use.

### Total Phenolic Components

The total analysis of the phenolic component refers to Jati et al. (2022). As much as 1 mL of extract was mixed with 0.5 mL of Folin-Ciocalteu reagent in a test tube which was then sealed using aluminum foil. The mixture is left for 8 minutes before 4.5 mL of Na<sub>2</sub>CO<sub>3</sub> 2% solution is added. After that, the solution is homogenized using a vortex and stored in a dark place for 1 hour. The absorbance of the sample was measured using a spectrophotometer at a wavelength of 765 nm. The absorbance value is plotted on a standard curve, and the total phenolic component (TKF) is expressed as mg of gallic acid equivalent per gram of sample (mg GAE/g smart edible film packaging) according to the following equation:

$$Total\ Phenolic = \frac{Total\ phenol}{1000\ mL} \times \frac{Sample\ (mL)}{Sample\ (g)} \times Dilution\ Factor \quad (1)$$

### Total Anthocyanin

The analysis was carried out based on the method used by Jati et al. (2022). A total of 1 mL of extract was put into two different test tubes (tubes A and B). Into tube A is added 10 mL of pH 1 buffer solution, while B tube is added 10 mL of pH 4.5 buffer solution. The two mixtures were then homogenized using a vortex, and their absorbance was measured at wavelengths of 530 nm and 700 nm. The absorbance value of the sample is calculated using the following equation:

$$A = (A_{530\text{ nm}} - A_{700\text{ nm}})_{\text{pH } 1,0} - (A_{530\text{ nm}} - A_{700\text{ nm}})_{\text{pH } 4,5} \quad (2)$$

Calculation of the total anthocyanins with the following equation:

$$\text{Total Anthocyanin} = \frac{A \times MW \times DF}{\epsilon \times l} \times \frac{\text{Sample (mL)}}{\text{Sample (g)}} \times 100 \text{ g} \quad (3)$$

Where:

A = Sample absorbance; MW = Molecule weigh of cyanidin-3-glucoside (449,2 g /mol); DF = Dilution factor;  $\epsilon$  = Molar absorptivity of cyanidin-3-glucoside (26.900 L/mol. cm); l = Cuvette width (1 cm)

### Antioxidant Activity

A total of 0.25 mL of samples were put into the test tube, then 0.5 mL of 0.1 mM DPPH solution and 4 mL of methanol were added. The mixture is homogenized and left in a dark state for 30 minutes. Furthermore, absorbance (Abs) was measured using a spectrophotometer at a wavelength of 517 nm. Antioxidant activity is expressed as the percentage of radical scavenging activity (RSA) (Muhtadi & Ningrum, 2019) and is calculated using the following equation:

$$\text{Radical Scavenging Activity (\%)} = \frac{\text{Abs DPPH (control)} - \text{Abs Sample}}{\text{Abs DPPH (control)}} \times 100 \quad (4)$$

### Tensile Strength Test

The test is carried out with reference to the ASTM D-882 standard, which is the standard method for determining the tensile properties of plastic materials. The sample used is in the form of an elongated strip with the width and thickness according to standard requirements, has parallel sides, and is stored on the controlled environmental conditions (temperature and humidity) before testing. The sample was cut to a size of 145 × 10 mm. The test is carried out using a tensile testing machine, where smart edible film packaging is clamped at both ends and pulled at a certain speed and clamp distance until the sample is broken. The tensile strength of the film is then expressed as pressure per unit area (N/mm<sup>2</sup>).

### Elongation

The sample is prepared by being measured and cut into 145 × 10 mm sizes. Each sample is then tested using a tensile testing machine, where smart edible film packaging is clamped at both ends and pulled at a certain speed and clamp distance until the film breaks off. The elongation percentage of smart edible film packaging was calculated using an equation from Santoso et al. (2022):

$$\text{Elongation (\%)} = \frac{b - a}{a} \times 100 \quad (5)$$

Where:

a = Initial length of smart edible film packaging; b = Length of smart edible film packaging when teared

### Water Vapor Transmission Rate

The water vapor transmission rate (WVTR) test refers to the method used in the research of Arifin et al. (2023), as much as 10 g of silica gel is put into a shot glass, then the surface of the glass is immediately covered with a sample of smart edible film packaging that has been cut and glued as a cover. The shot glass is then placed in a desiccant containing a saturated NaCl solution 75% at 27 ± 3°C. Silica gel weighing is carried out daily for 5 days. The WVTR value is then calculated using the equation:

$$WVTR = \frac{\text{Slope of silica gel weight increase (g/days)}}{\text{area of shot glass (m}^2\text{)}} \quad (6)$$

### Capability of Smart Packaging in Steamed Chicken Meat Models

The chicken breast is cut into 2×2×2 cm cubes, then steamed for 10 minutes. After the steaming process, the chicken pieces are drained and placed in a plastic container 7.5 cm in diameter by 5 cm in height. The container is then closed using smart edible packaging that is tightly glued. Samples were stored for 72 hours, and color changes in smart edible film packaging were observed using a color reader every 24-hour interval.

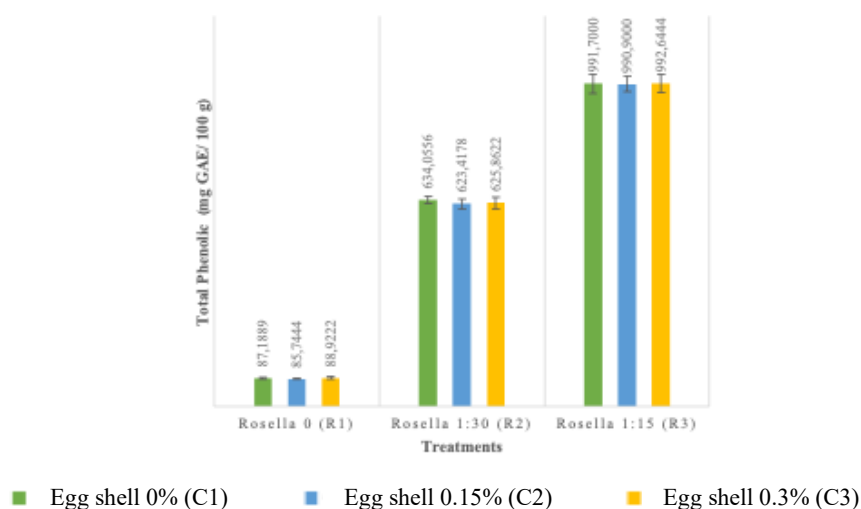
### Data Analysis

The collected data was analyzed using the ANOVA method at a significance level of 5%, then continued with the follow-up test of the Duncan Multiple Range Test (DMRT). The entire statistical analysis process is carried out with the help of SPSS software version 23.

## RESULTS AND DISCUSSION

### Total Phenolic Components

Based on the test results, the total phenol smart edible film packaging ranges from 84.74–992.64 mg GAE/100 g sample. There was an effect of Smart Edible Film adding rosella flower extract with different concentrations to the total phenol of smart edible film packaging and there was no effect of adding chicken egg shell flour with a different concentration to the total phenol of smart edible film packaging. The results of the total phenol smart edible film packaging test are presented in Figure 1.

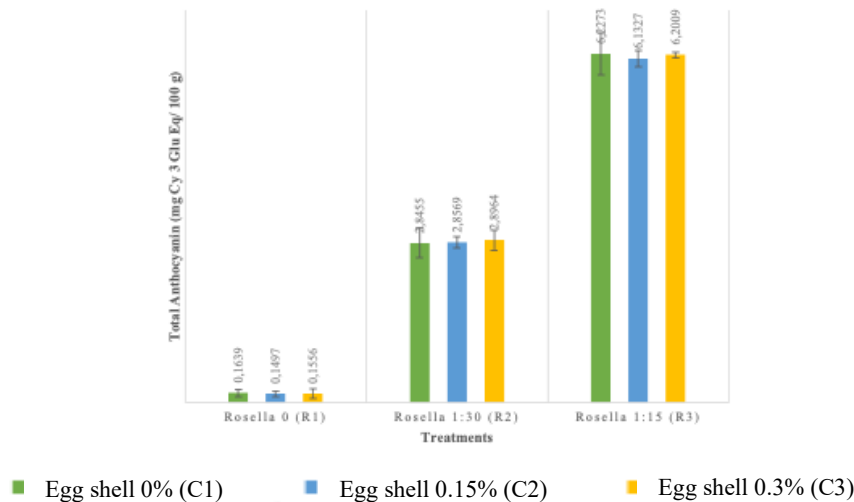


**Figure 1.** Total phenolic

According to Figure 1, the total phenol in the R1 treatment is significantly different from the R2 and R3 treatments. The smaller the ratio of rosella flowers to water, the higher the concentration of rosella flowers added and the more total phenol content contained in the smart edible film packaging. This result is in accordance with the research of Yuliasari et al. (2023), namely an increase in the proportion of telang flower simplicial in solvent (0.5–1.5 g/200 ml) resulting in an increase in the total anthocyanin and total phenolic compounds extracted. Other studies state that the higher the concentration of rosella added, the more the total phenol increases. This result is due to rosella having phenolic compounds (Banwo et al., 2022).

### Total Anthocyanin

The anthocyanin test results showed that the sample had a high anthocyanin content, which was between 0.1497–6.2273 mg cyanidine-3-glucoside/100 g. The concentration of rosella flowers affected the total anthocyanin smart edible film packaging. Whereas the eggshell does not affect the total anthocyanin (Figure 2).



**Figure 2.** Total anthocyanin

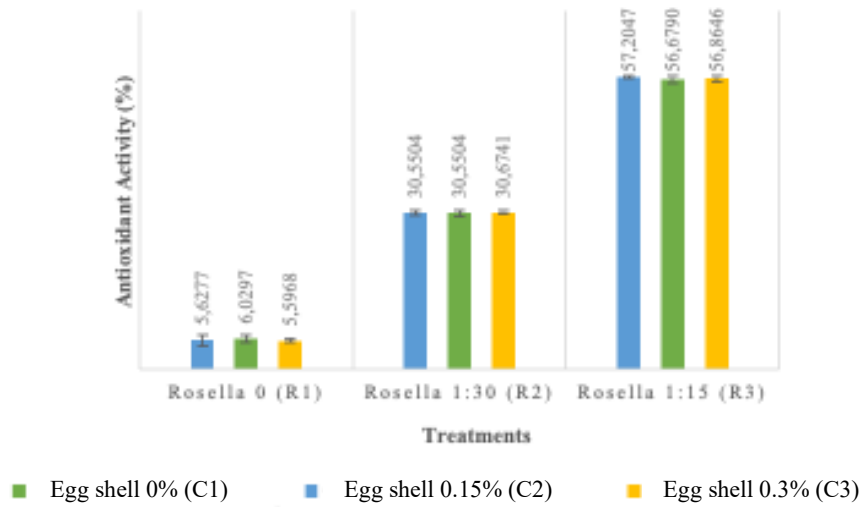
The total value of anthocyanins is directly proportional to the total phenol. The total anthocyanins treated R1 are markedly different from R2 and R3. The test results showed that the smaller the ratio of rosella flowers to water, the greater the total anthocyanin content in the smart edible film packaging. In line with research that has been reported that the smaller the ratio of rosella flower extract to water, the higher the total anthocyanin content (Gregory et al., 2024). Based on the test results, the total value anthocyanins Packaging are directly proportional to total phenols because anthocyanins are included in the polyphenolic group so they can be read in the results of the total phenol test.

### Antioxidant Activity

Antioxidant activity smart edible film packaging ranges from 5.5968–57.2047%. The difference in the concentration of rosella flower extract affects the antioxidant activity of smart edible film packaging. Meanwhile, eggshells do not affect the addition of eggshell flour to its antioxidant activity (Figure 3). The antioxidant activity of smart edible film packaging ranges from 5.5968–57.2047%. There was an effect of adding rosella flower extract with different concentrations on the antioxidant activity of smart edible film packaging and there was no effect of adding eggshell flour on the antioxidant activity of smart edible film packaging. The results of the antioxidant activity test of smart edible film packaging are presented in Figure 3.

Based on the test results, the antioxidant activity value of smart edible film packaging is directly proportional to the total phenol. Figure 3. showed that the antioxidant activity of the R1 treatment was significantly different from the R2 and R3 treatments. Reduced antioxidant activity can be caused by a decrease in the amount of bioactive compound content along with a decrease in the concentration of rosella flower extract used in smart edible film packaging. The increase in total phenol levels is directly proportional to the increase in antioxidant activity due to the ability of phenol compounds as reducing agents because phenolic compounds have hydroxy groups so that they are able to donate their hydrogen and can neutralize the lack of electrons in free radicals (Dadhaneeya et al., 2023). These results are in line with previous

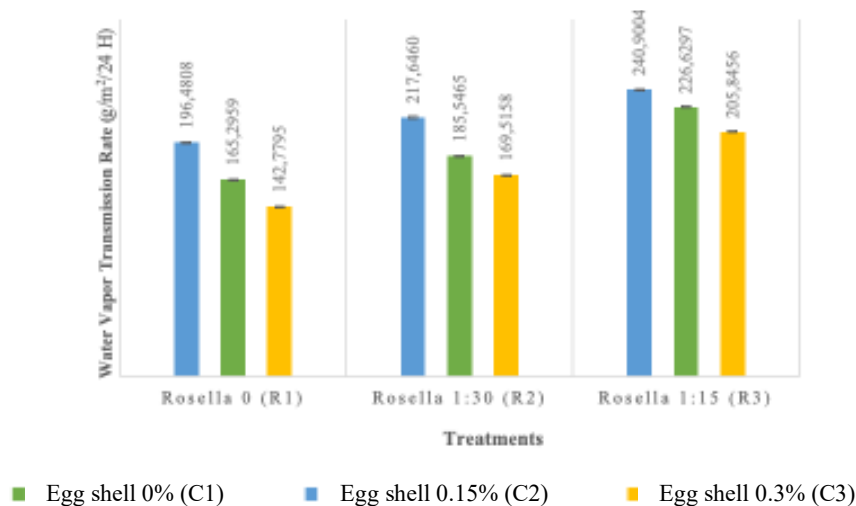
research, which states that the higher the concentration of rosella flower extract, the higher its antioxidant activity (Wu et al., 2018).



**Figure 3.** Antioxidant activity

### Water Vapor Transmission Rate

The WVTR in smart edible film packaging ranges from 142.7795–240.9004 g/m<sup>2</sup>/24 hours (Figure 4). Based on Figure 4, the highest WVTR value of smart edible film packaging was found in the water-compared rosella treatment (1:15) with an eggshell concentration of 0% (R3C1), while the highest WVTR smart edible film packaging value was found in the treatment without the addition of rosella with an eggshell concentration of 0.3% (R1C3). The test results showed that the smaller the ratio of rosella flowers to water, the higher the total phenol as well as the WVTR. Rosella flower extract contains phenols that are hydrophilic. This makes edible film easily penetrated by water vapor (Santoso et al., 2022).



**Figure 4.** Water vapor transmission rate

The addition of chicken eggshell flour affects the moisture permeability of the smart edible film packaging produced. These results are in line with previous research Jati et al. (2024), which stated that the addition of eggshell flour increases the hydrogen bonds formed and strengthens the structure of the edible

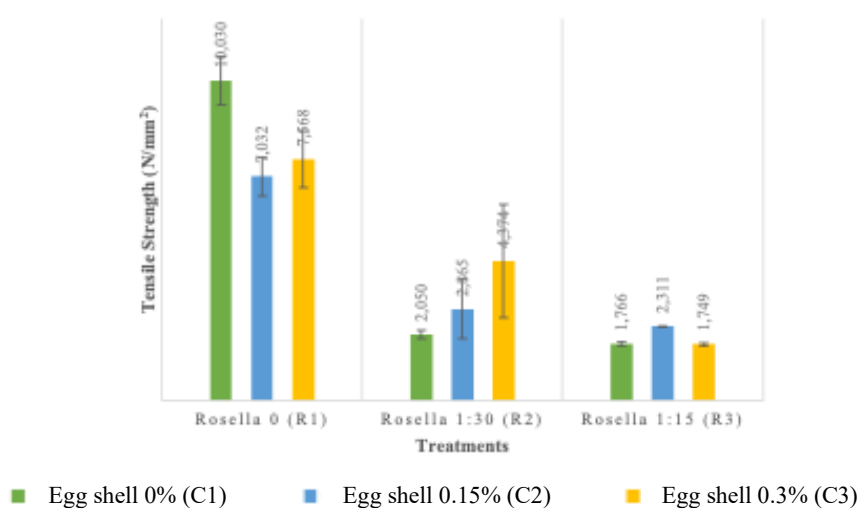
film causing differences in the value of the water vapor transmission rate. The higher the concentration of chicken egg shell flour will lower the value of WVTR smart edible film packaging.

The difference in WVTR value decrease was due to the phenolic component in rosella flower extract and  $\text{Ca}^{2+}$  ions in chicken eggshell flour which had an inversely proportional effect on the smart edible film packaging matrix. The higher the concentration of rosella flower extract and the lower the concentration of chicken egg shell flour added, the higher the value of WVTR smart edible film packaging.

### Tensile Strength

The resulting tensile strength value ranges from 1,511–10,030 N/mm<sup>2</sup> (Figure 5). The highest tensile strength values were obtained by the R1C1 treatment, while the lowest tensile strength values were R2C1, R2C2, R3C1, R3C2, and R3C3. The decrease in the tensile strength value of smart edible film packaging was influenced by hydrophilic components such as sorbitol and rosella flower extract, while the increase in the tensile strength value of smart edible film packaging was influenced by hydrophobic or non-polar components such as chicken eggshell flour (Vonnice et al., 2022). Hydrogen bonds between phenolic compounds in rosella flower extract can interfere with polymer interactions on the film matrix thereby weakening the film tissue. However, based on the test results, the presence of the shell lowers the tensile strength value. In line with previous research Nata et al. (2020), which explained that the addition of chicken eggshell flour increases tensile strength, but the addition of chicken eggshell flour with a certain concentration can reduce tensile strength.

The addition of rosella flower extract exerts an inverse effect to the addition of chicken egg shell flour on the tensile strength parameters. This result is due to the presence of phenolic components in rosella flower extract and  $\text{Ca}^{2+}$  ions in chicken egg shell flour which have a direct effect on the tensile strength value of smart edible film packaging. The addition of rosella flower extract will weaken the film tissue, while the addition of chicken eggshell flour will increase the intermolecular bonding of the film (Gregory et al., 2024). The higher the concentration of rosella flower extract and chicken egg shell flour added, the lower the tensile strength value of smart edible film packaging.

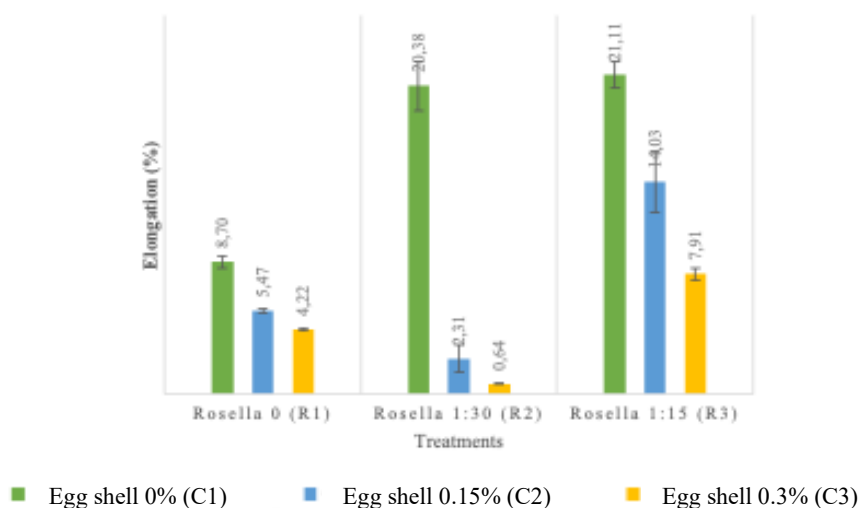


**Figure 5.** Tensile strength

### Elongation

The percentage elongation of the smart edible film ranged from 0.64% to 21.11% (Figure 6). The highest values were observed in treatments R2C1 and R3C1, while the lowest was recorded in the R2C3 treatment (1:30 rosella-to-water ratio with 0.3% eggshell concentration). The increase in elongation with higher rosella

extract concentrations is likely due to its hydrophilic nature, which promotes molecular mobility and hydrogen bonding, effectively plasticizing the matrix (Gregory et al., 2024). Conversely, the addition of eggshell flour reduced elasticity. This is attributed to the  $\text{Ca}^{2+}$  ions in the  $\text{CaCO}_3$  filler, which create a denser network of intermolecular bonds within the polymer matrix, increasing film stiffness and reducing flexibility (Santoso et al., 2022). Chicken egg shells act as fillers that can increase the bond of the smart edible film packaging matrix. The  $\text{Ca}^{2+}$  ions in  $\text{CaCO}_3$  in chicken eggshell flour can form intermolecular bonds in the smart edible film packaging matrix so that the film is stiffer and reduces the elasticity of the film.



**Figure 6.** Elongation

### Smart Edible Film Discoloration

The color change of smart edible film packaging during three days of storage can be seen in Table 3. The results of observations in Table 3. show that the color of smart edible film packaging on day 0 varies according to the concentration of rosella flower extract used. The smaller the ratio of rosella flowers to water, the color of the smart edible film packaging produced will be older or thicker. In addition, the addition of chicken egg shell flour in smart edible film packaging will affect the color of the smart edible film packaging. Based on the test results, chicken egg shell flour has a pH of 8.65 so it will affect the color of the smart edible film packaging. Decrease in color intensity in smart edible film packaging due to changes in anthocyanin structure caused by changes in the pH of packaged food products. The color of the anthocyanins will decrease in intensity as the pH increases. When at pH 1–4, the color of smart edible film packaging is red, at pH 5-6 it is bright red, at pH 7–8 it is magenta, at pH 9 it is maroon, at pH 10 it is gray, at pH 11 it is brown, and at pH 12 it is yellow (Boonsiriwit et al., 2021).

### CONCLUSION

The incorporation of rosella flower extract in smart edible film packaging formulations has been proven to increase the total content of phenols, anthocyanins, and antioxidant activity. In contrast, the variation in the concentration of chicken eggshell flour used did not show a significant influence on the three parameters. The elongation percentage of the film increases as the concentration of rosella extract increases, while the value of water vapor transmission rate (WVTR) tends to improve the barrier properties with the higher use of eggshell flour. In addition, there is an increase in color intensity in the film when applied to the storage of steamed chicken meat. Thus, the addition of rosella extract and chicken egg shell flour has great potential in improving the functional properties and quality of chitosan-based smart edible film packaging.

**Table 3.** Color change of smart edible film packaging for three days of storage

Treatments	Days	Color Attribute				
		L	a*	b*	C*	°Hue
R1C1	0	88,1±0,6	-0,6±0,1	-0,5±0,1	0,8±0,2	38,0±1,9
	1	86,7±0,8	-0,2±0,1	-0,3±0,0	0,4±0,1	51,9±10,5
	2	85,6±0,7	-0,3±0,0	-0,4±0,1	0,5±0,1	46,5±10,5
	3	85,1±1,0	-0,2±0,1	-0,2±0,1	0,3±0,1	46,6±11,5
R1C2	0	81,5±0,6	0,3±0,1	0,3±0,1	0,5±0,1	41,5±13,0
	1	80,6±0,3	0,3±0,1	0,8±0,1	0,8±0,1	71,4±5,5
	2	80,2±0,2	0,4±0,2	1,0±0,2	1,1±0,1	68,7±9,5
	3	80,1±0,6	0,5±0,2	1,6±0,2	1,7±0,2	74,4±3,2
R1C3	0	76,8±0,6	0,3±0,2	0,8±0,2	0,8±0,1	60,8±9,6
	1	75,8±0,3	0,4±0,1	1,3±0,2	1,4±0,2	71,1±7,6
	2	75,8±0,6	0,6±0,1	2,3±0,1	2,3±0,1	75,8±3,2
	3	76,1±0,4	0,4±0,2	2,6±0,0	2,6±0,1	81,4±5,1
R2C1	0	44,9±0,5	51,7±0,7	7,8±0,3	52,3±0,7	8,6±0,4
	1	43,0±0,8	47,7±0,3	4,6±0,2	62,7±0,2	40,5±0,3
	2	42,5±0,4	45,5±0,2	1,5±0,5	45,5±0,2	1,9±0,6
	3	42,1±0,7	39,1±1,0	0,5±0,1	39,1±1,0	0,7±0,2
R2C2	0	42,2±0,6	45,1±1,0	5,1±0,3	45,4±1,0	6,5±0,4
	1	40,0±1,5	41,3±0,5	2,9±0,3	41,4±0,5	4,0±0,4
	2	38,5±0,5	36,4±0,6	1,9±0,5	36,4±0,7	2,9±0,8
	3	38,2±0,3	31,7±0,5	1,0±0,2	31,7±0,5	1,9±0,3
R2C3	0	37,2±0,7	36,1±0,8	3,4±0,4	36,3±0,8	5,3±0,6
	1	36,1±0,8	30,2±0,7	2,1±0,8	30,2±0,6	4,0±1,6
	2	34,7±0,6	23,2±0,4	1,4±0,2	23,2±0,4	3,4±0,4
	3	34,5±0,7	21,6±0,4	0,5±0,3	21,6±0,4	1,2±0,8
R3C1	0	41,6±0,2	50,7±0,9	12,0±0,7	52,1±1,0	13,3±0,6
	1	41,0±0,3	49,4±0,7	8,0±0,8	50,0±0,8	9,2±0,8
	2	40,2±0,5	41,9±0,5	6,0±0,6	42,3±0,6	8,2±0,7
	3	40,3±0,3	35,8±0,4	3,4±0,4	36,0±0,4	5,5±0,6
R3C2	0	37,2±0,4	41,9±0,4	10,3±0,4	43,1±0,5	13,8±0,4
	1	35,9±0,7	40,7±0,8	7,2±0,4	41,4±0,8	10,1±0,8
	2	35,9±0,7	35,3±0,6	4,7±0,2	35,6±0,6	7,5±0,4
	3	36,0±0,4	23,8±1,6	2,5±0,2	24,0±1,6	6,1±1,0
R3C3	0	35,7±0,9	37,8±0,9	9,6±0,5	38,9±1,0	14,2±0,4
	1	34,7±0,3	32,0±0,7	6,6±0,4	32,7±0,6	11,7±0,9
	2	32,5±0,6	27,1±0,4	3,4±0,2	27,4±0,4	7,2±0,5
	3	33,6±0,9	21,6±0,5	1,7±0,4	21,7±0,5	4,5±0,9

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