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The Effect of Mangosteen Peel Extract (*Garcia Mangostana* L) and Shelf Life on the Physical Quality of Chicken Eggs

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A B S T R A C T

This study investigates the effect of mangosteen peel extract immersion on the quality of broiler chicken eggs during storage. Mangosteen peel (Garcinia mangostana L) contains bioactive compounds, such as xanthones, with antioxidant properties that can protect cells from oxidative damage, including egg cells. The research employed a completely randomized design with two factors: different concentrations of mangosteen peel extract (0%, 5%, 10%, and 15%) and storage durations (0, 1, 2, 3, and 4 weeks). Data were analyzed using ANOVA, followed by the Duncan test for significant results ($P < 0.05$). The findings revealed a highly significant effect ($P < 0.01$) of mangosteen peel extract on egg quality, measured through pH, egg white index, egg yolk index, and Haugh unit. Notably, eggs soaked in 10% mangosteen peel extract for 24 hours showed the highest Haugh unit value after 4 weeks of storage. The study suggests that tannins in the extract prevent egg white dilution, effectively preserving egg quality during storage.

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INTRODUCTION

The broiler chicken industry plays an important role in meeting the needs of animal protein for the community. The quality of broiler chicken eggs is the main factor that influences the success of production and consumer satisfaction. In addition to genetic factors and feed management, the storage environment also contributes to the physical quality of eggs. One of the environmental factors that can affect egg quality is the level of immersion in mangosteen peel extract (Soewarno, 2013).

Mangosteen peel extract (*Garcia mangostana* L) is known to contain bioactive compounds, such as xanthones, which have antioxidant properties (Pramudita et al., 2014). These antioxidant properties can play a role in protecting cells from oxidative damage, including cells that form chicken eggs (Sakinah et al., 2015). Therefore, research on the effect of mangosteen peel extract immersion level on the physical quality of chicken eggs is important to explore.

In addition to the influence of the level of immersion in mangosteen peel extract, shelf life is also a crucial factor in maintaining egg quality (Pramudita et al., 2014). The right storage process can maintain the nutritional content and physical characteristics of eggs (Samli et al., 2005) (Trihadi and Triawan, 2016). Therefore, it is necessary to conduct research on how shelf life can affect the physical quality of broiler chicken eggs that have been soaked in mangosteen peel extract.

This study aims to utilize mangosteen waste and evaluate the effect of mangosteen peel extract immersion level and storage time to maintain the physical quality of broiler chicken eggs. Thus, the results of this study are expected to provide a deeper understanding of the potential of mangosteen peel extract in maintaining the quality of broiler chicken eggs and other factors that can affect the quality. In addition, the findings of this study can also be the basis for the development of better management practices in the broiler chicken farming industry.

LITERATURE REVIEW

Skin Mangosteen

Mangosteen rind contains many beneficial ingredients, one of which is tannin. The tannin contained in mangosteen rind is between 20.46 to 28.05 mg/100 grams (Suttirak and Manurakchinakorn, 2014). Mangosteen rind contains various substances that are beneficial for health, including antioxidants: Mangosteen rind contains antioxidants, especially xanthones, which have antibacterial, anti-inflammatory, and antifungal effects. Mangosteen rind contains vitamin C which is a natural antioxidant and is important for maintaining body health. Mangosteen rind contains dietary fiber that can help improve bowel function and prevent constipation. Mangosteen rind contains minerals such as copper, which are important for body health. In addition, mangosteen rind contains Xanthones which are a type of unique plant compound known to have strong antioxidant properties and have been shown to have anti-inflammatory, anticancer, anti-aging, and antidiabetic effects (Suttirak and Manurakchinakorn, 2014).

Mangosteen peel extract contains tannin compounds that function to coat the eggshell, inhibit the release of CO2, and inhibit microorganisms that enter through the pores of the eggshell, thus affecting the pH of the egg white and yolk and preventing the mixing process of the egg white with the yolk which causes the color of the egg yolk to fade. In addition, mangosteen peel can also be used as a medium for making salted eggs containing antioxidants (Agustina and Dharmayudha.2015). Preservation of chicken eggs by applying the soxhletation method in the manufacture of mangosteen peel extract solution using alcohol solvents is effective as a preservative at concentration levels of 10%, 15%, and 20% with a shelf life of up to 28 days at room temperature (Trihadi and Triawan,2016).

Chicken Eggs

Eggs are a cheap and easily available source of animal protein for Indonesian people. Eggs have complete nutritional content ranging from protein, fat, vitamins, and minerals. The complete essential amino acid content makes eggs a benchmark in determining the protein quality of various food ingredients (Indrawan et al., 2012). On the other hand, eggs are easily degraded in quality due to physical damage, as well as evaporation of water, carbon dioxide, ammonia, nitrogen, and hydrogen sulfide from inside the egg (Muchtadi et al, 2012).

Egg quality factors are divided into two, namely exterior quality factors which include color, shape, texture, integrity, cleanliness of the shell. Interior factors include the condition of the egg white, namely its viscosity, the shape of the egg yolk, namely there are no stains on the white or yolk. Storage time also has a very significant effect on egg quality in terms of the Haugh Unit of eggs and the Egg Yolk Index (Haryoto, 2010).

Egg Preservation

Eggs at room temperature can only last up to 10-14 days (Sakinah et al., 2015). One effort to maintain the freshness of eggs is to preserve them. Egg preservation is a technique or action of an effort carried out or used by humans on a material (food or others) in such a way that the material becomes less easily damaged (Haryono, 2000). According to the Regulation of the Minister of Health of the Republic of Indonesia number 722 / MenKes / Per / IX / 1988 which has been amended by the Regulation of the Minister of Health of the Republic of Indonesia number 1168 / MenKes / Per / X / 1999 concerning food additives, preservatives are additional ingredients in food that can prevent or inhibit the fermentation process, packaging or other decomposition of food materials caused by microorganisms. The purpose of food preservation according to (Hudaya and Daradjat. 1980) is: a) Preservation of food during the journey from producer to consumer, by avoiding unwanted changes in terms of integrity (not defective or reduced), nutritional value or organoleptic quality using methods that can control the growth of microorganisms, reduce physical, chemical, physiological and digestive changes. b) Maintaining product quality. c) Avoiding poisoning due to contamination by microorganisms. d) Facilitating handling, storage and transportation, for example by packaging.

There are two ways to preserve eggs, namely a) preservation of whole eggs is done by dry packing, immersion in liquid, closing the egg shell with preservatives (Shell Sealing) and cooling (cold storage). b) preservation of broken eggs is done by freezing eggs (frozen Egg) or processed into egg powder (Dried Egg) (Koppel et al., 2014).

METHODOLOGY

The research was conducted in the Basic Sciences laboratory of the Faculty of Agriculture, Warmadewa University, located in Tanjung Bungkak, Sumerta Village, East Denpasar District, Denpasar City. The research period starts from May - December 2024.

The tools used were sample containers, basins, analytical scales, ovens, porcelain dishes, pH meters, thermometers, petri dishes, measuring cups, beakers, and calipers. The materials used were chicken eggs used in this study that were newly harvested, obtained directly from farmers as many as 120 eggs. Mangosteen peel was obtained directly from farmers from the Tabanan area. Other materials used were distilled water.

This study used a factorial RAL pattern with 3 replications. The first factor was the concentration of mangosteen peel solution, namely 0%, 10%, 20%, and 30%. The second factor was storage time, egg storage was carried out at room temperature and observed in weeks 0, 1, 2, 3, and 4.

The extraction method used in making the extract is the maceration/soaking method. The initial stage is to separate the mangosteen peel from the fruit, then the mangosteen peel is cut into small pieces to make it easier to grind, then dried in an oven at a temperature of 50 ° C, then the mangosteen peel is ground by pounding to produce simplicia. Furthermore, the simplicia is extracted using the maceration/soaking method.

Treatment Stage Eggs were soaked in mangosteen peel extract solution with different concentrations (0%, 5%, 10%, and 15%). P0 0% = without mangosteen peel extract + 1 liter of water, P1 5% = 50 grams of mangosteen peel extract + 1 liter of water, P2 10% = 100 grams of mangosteen peel extract + 1 liter of water, P3 15% = 150 grams of mangosteen peel extract + 1 liter of water. Egg soaking was carried out for 24 hours. Eggs were stored at room temperature for 0, 1, 2, 3 and 4 weeks.

The physical quality parameters observed include: egg yolk index (IKT), egg white index (IPT), egg yolk color, egg pH, and egg water content.

RESEARCH RESULT

Based on the analysis of variance, the level of immersion of mangosteen peel extract (*Garcia Mangostana* L) and storage life had a very significant effect ($P<0.01$) on weight loss, pH, egg yolk index, egg white index and haught unit of broiler chicken eggs. However, the effect was not significant ($P>0.05$) on the color of broiler chicken egg yolk.

Table 1. Weight loss, egg yolk color and pH of chicken eggs due to the treatment of mangosteen peel levels during storage

Treatment	Weight Loss (%)		Egg Yolk Color		pH	
Mangosteen skin level 0% Storage 1 week	2.19	i	7.67	a	7.78	a
Mangosteen skin level 5% Storage 1 week	1.15	fg	8.33	a	7.39	bcdef
Mangosteen skin level 10% Storage 1 week	1.83	c	8.00	a	7.43	a B C
Mangosteen skin level 15% Storage 1 week	1.48	a	7.67	a	7.42	ef
Mangosteen skin level 0% Storage 2 weeks	4.48	j	7.00	a	7.42	bcdef
Mangosteen skin level 5% Storage 2 weeks	3.49	h	8.33	a	7.53	bcde
Mangosteen skin level 10% Storage 2 weeks	4.66	ef	9.00	a	7.27	ab
Mangosteen skin level 15% Storage 2 weeks	3.32	c	8.33	a	7.57	cdef
Mangosteen skin level 0% Storage 3 weeks	6.80	ij	7.33	a	7.61	bcdef
Mangosteen skin level 5% Storage 3 weeks	5.08	fg	7.00	a	7.62	ef
Mangosteen skin level 10% Storage 3 weeks	6.09	d	7.00	a	7.64	ab
Mangosteen skin level 15% Storage 3 weeks	4.26	b	7.00	a	7.21	def
Mangosteen skin level 0% Storage 4 weeks	8.50	ij	7.33	a	7.25	bcdef
Mangosteen skin level 5% Storage 4 weeks	6.78	h	8.00	a	7.33	abcd
Mangosteen skin level 10% Storage 4 weeks	7.84	g	7.67	a	7.32	f
Mangosteen skin level 15% Storage 4 weeks	5.68	with	7.67	a	7.22	f

Description: The average value followed by the same letter in the same column indicates no significant difference in the Duncan test at 5% level.

Table 2. Egg yolk index, egg white index and Haugh unit of broiler chicken eggs due to the treatment of mangosteen peel levels during storage

Treatment	Egg Yolk Index		Egg White Index		Haugh Unit	
Mangosteen skin level 0% Storage 1 week	0.21	b	0.23	CD	42.70	def
Mangosteen skin level 5% Storage 1 week	0.29	CD	0.36	efgh	59.76	fg
Mangosteen skin level 10% Storage 1 week	0.27	def	0.51	fgh	65.45	defg
Mangosteen skin level 15% Storage 1 week	0.21	f	0.30	h	51.84	h
Mangosteen skin level 0% Storage 2 weeks	0.14	a	0.15	b	32.51	ab
Mangosteen skin level 5% Storage 2 weeks	0.13	cd	0.24	CD	44.91	cd
Mangosteen skin level 10% Storage 2 weeks	0.18	ef	0.23	defgh	48.24	fg
Mangosteen skin level 15% Storage 2 weeks	0.13	f	0.23	h	45.86	h
Mangosteen skin level 0% Storage 3 weeks	0.10	a	0.15	a	34.32	a
Mangosteen skin level 5% Storage 3 weeks	0.07	bc	0.16	cd	31.69	c
Mangosteen skin level 10% Storage 3 weeks	0.14	CD	0.13	gh	24.89	gh
Mangosteen skin level 15% Storage 3 weeks	0.16	CD	0.19	gh	35.41	cdef
Mangosteen skin level 0% Storage 4 weeks	0.04	b	0.09	bc	17.46	bc
Mangosteen skin level 5% Storage 4 weeks	0.06	cd	0.09	cdef	18.52	cd
Mangosteen skin level 10% Storage 4 weeks	0.13	bcd	0.14	defg	43.60	defg
Mangosteen skin level 15% Storage 4 weeks	0.18	bc	0.18	defg	32.78	efg

Description: The average value followed by the same letter in the same column indicates no significant difference in the Duncan test at 5% level.

DISCUSSION

The highest weight loss was obtained at the level of 0% mangosteen peel for 4 weeks of storage, which was 8.50%. The results showed that the higher the level of mangosteen peel, the lower the weight loss of broiler chicken eggs during storage. This is because the tannin content in the mangosteen peel is lacking. So that the tannin in the mangosteen peel cannot function optimally in

coating and covering the pores of the shell which causes the tannin to not react with the protein contained in the egg shell, therefore the weight loss in the treatment with the addition of mangosteen peel solution decreased, while the weight loss without the addition of mangosteen peel solution (P0) was relatively stable because there were no tannin components coming out and entering. As well as the evaporation of water and the release of CO2 gas from the contents of the egg continue to occur continuously. The length of storage at room temperature is also one of the factors that causes shrinkage. This opinion is supported by Buckle et al, (2007), that eggs will shrink due to the evaporation of water during storage and a small amount of evaporation of CO2, NH3, N2 and H2S gases due to the degradation of organic components.

The provision of mangosteen peel levels during storage does not affect the color of chicken egg yolks. Egg yolk color is greatly influenced by the levels of carotenoids, especially xanthophylls, in the feed given to chickens. The higher the levels of carotenoid pigments in the ration, the more concentrated the color of the egg yolk. These pigments accumulate in the egg yolk and provide a brighter and more concentrated yellow color. Storage temperature plays an important role in maintaining the quality of egg yolks (Darmawan et al., 2016). Storage at low temperatures can slow down the decline in quality, including the color of the egg yolk. Conversely, high temperatures can accelerate the loss of pigmentation and cause the color of the egg yolk to fade (Suradi, 2006).

The pH value of broiler chicken eggs decreased during storage. Treatment of 5% mangosteen peel level during 4 weeks of storage gave a pH value of 7.33 which was not significantly different from 1 week of storage. This shows that giving 5% mangosteen peel level can maintain the pH of broiler chicken eggs. One of the main causes of the decrease in pH is the evaporation of CO2 from inside the egg. CO2 dissolved in egg white functions to keep the pH stable. When eggs are stored, CO2 evaporates through the pores of the eggshell, which causes a decrease in the concentration of CO2 in the solution and, as a result, a decrease in pH. This process occurs faster at higher storage temperatures, where CO2 evaporation increases. Microbial contamination can also contribute to changes in pH (Djaelani, 2015). Microbes that enter through the pores of the eggshell can break down components in the egg, producing acids that lower the pH. This process often occurs when the protective layer (cuticle) on the eggshell is lost due to washing or damage, making it easier for microbes to enter (Dayurani et al., 2019).

Treatment of 15% mangosteen peel level during 4 weeks of storage produced the highest egg yolk index of 0.18 compared to the treatment of soaking with mangosteen peel in the same week of observation. This shows that soaking with mangosteen peel can maintain the egg yolk index during storage. The treatment of soaking eggs with mangosteen peel powder containing tannin is thought to inhibit the process of water transfer into the egg yolk, so that the elasticity of the vitelline membrane is still good and the egg yolk index value is high. The tannin content is thought to prevent the evaporation of water and CO2, NH3, N2, and H2S gases, so that water migration from the egg white to

the egg yolk can be prevented. This causes the volume of the egg yolk to increase and reduces the permeability of the vitelline. This is in accordance with research (Hajrawati, 2012) stating that the level of tannin as a tanning agent is good enough to close the pores of the egg shell so that the surface where the air moves can be inhibited and can maintain the quality of the egg yolk. The results showed that the egg yolk index decreased during storage. This is possible because the size of the egg yolk diameter increases or widens because the water contained in the albumen is absorbed by the egg yolk. Cornelia et al. (2014), stated that with increasing egg age, the egg yolk index (IKT) decreases due to the increase in the size of the egg yolk diameter as a result of water displacement. Tarigan and Agustina (2016), stated that the age of the egg affects the strength and elasticity of the vitelline membrane which causes the egg yolk to weaken. In addition, the strength and elasticity of the vitelline membrane are influenced by factors such as egg size, storage temperature, egg white pH and egg white viscosity. The weakening of the vitelline membrane is observed by measuring the egg yolk index.

The results showed that the egg white index decreased during storage. The treatment of 15% mangosteen peel level during 4 weeks of storage produced the highest egg white index of 0.18 compared to the treatment of soaking with mangosteen peel in the same week of observation. This shows that soaking with mangosteen peel can maintain the egg white index during storage. Eggs without soaking with mangosteen peel powder have the lowest egg white index, allegedly because there is a change in the gel structure due to physicochemical damage to the ovomucin fibers which causes water to come out of the nets that have been formed, so that the condition of the egg white does not meet quality standards (SNI, 2008). This is in accordance with research (Koswara, 2009), the egg white index will decrease due to the breakdown of ovomucin which is accelerated by increasing pH, while the tannin coating on the egg can protect the egg from gel damage.

Haugh Unit (HU) is a unit used to measure the freshness of eggs, especially the egg white (albumen). The Haugh Unit value is calculated based on the height of the egg white and the weight of the egg. The higher the Haugh Unit value, the better the quality of the egg. Koswara (2009) stated that a HU value > 70 is included in the classification of good quality eggs. Based on the results of the study, the haugh unit value of eggs is categorized as poor quality because the HU value <70. The longer the eggs are stored, the lower the HU value because there are changes in the structure and composition of the egg white. In 4 weeks of storage, the treatment of giving a 10% mangosteen peel level produced the highest HU value. This is because soaking eggs for 24 hours with a mangosteen peel solution containing tannin can prevent egg white dilution so that it can maintain the haugh unit. This is supported by research by Rahmawati (2014) who stated that the haugh unit value is determined based on the correlation between the height of the egg white and the weight of the egg. Egg white that contains less ovomucin will melt faster. The higher the egg white, the greater the haugh unit value obtained.

CONCLUSIONS AND RECOMMENDATIONS

The results showed that the level of immersion in mangosteen peel extract had a very significant effect ($P<0.01$) on the quality of chicken eggs. Soaking in mangosteen peel extract can maintain the quality of chicken eggs seen from the parameters of pH, egg white index, egg yolk index and haught unit. In 4 weeks of storage, the treatment of giving 10% mangosteen peel level produced the highest HU value. This is because soaking eggs for 24 hours with mangosteen peel solution containing tannin can prevent egg white dilution so that it can maintain haugh unit.

ADVANCED RESEARCH

For future research on the effects of mangosteen peel extract (*Garcinia mangostana* L.) and shelf life on the physical quality of chicken eggs, exploring the mechanism behind the antioxidant and antimicrobial properties of mangosteen peel extract in more depth would be beneficial. Specifically, studies could focus on isolating the bioactive compounds, such as xanthones and tannins, to better understand how these components preserve egg quality over time. Furthermore, investigating different extraction methods and optimizing concentration levels beyond 10% could provide insights into more effective treatments. Expanding the study to include sensory evaluations and consumer acceptability would also add practical value. Finally, the environmental and economic impact of using mangosteen peel extract on a commercial scale should be assessed to determine its feasibility as a natural preservative in the poultry industry.

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