

Physical Quality and pH of Chicory Silase (*Cichorium Intybus L*) and Onggok with the Addition of Tannins as Additives

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ABSTRACT

This study aims to examine the effect of the addition of tannins as additives on the physical quality of chicory mixed silage (*Cichorium intybus L.*) and onggok. The method used was a Complete Random Design (RAL) consisting of 5 treatments and 5 replicates. The treatment used consisted of P0(-) (100% onggory without the addition of tannins), P1(+) (100% onggok + 12 grams of tannins), P2 (chicory 75% + 25% onggok + tannin 12 grams), P3 (chicory 50% + onggok 50% + tannins 12 grams), P4 (chicory 25% + onggok 75% + tannins 12 grams). The data was analyzed by Kruskal Wallis analysis, if there was a real difference, the Dunn test was continued. The results showed that tannins significantly improved the physical quality of silage with parameters in the form of color, aroma, texture, the presence of mold, and pH. Chicory increases the nutrient content, while tannins play the role of special antibacterial and antifungal agents that can make bacteria and fungi brittle. This makes silage have a longer shelf life for the effectiveness of ruminant feed.

Keywords: chicory; clogs; silage; tannins

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INTRODUCTION

Increased ruminant productivity is highly dependent on the availability of quality feed throughout the year (Vienna, 2005). However, the instability of forage production due to seasonal changes is an obstacle in its supply. To overcome these obstacles, one of the efforts that can be made is to maximize feed preservation technology, such as silage. Silage is an effort to preserve fresh forage with a fermentation method that aims to increase the shelf life, especially during the dry season (Wati et al., 2018). Farmers in many countries have used this method for the preservation of forage (Raza et al., 2021). The process of making silage is carried out by lactic acid fermentation process under anaerobic conditions, thereby lowering the pH and preventing the growth of spoilage microorganisms (McDonald et al., 1991). Various additives are used to improve the quality of silage, one of which is tannins which have been proven to have a positive effect in improving the fermentation quality and nutritional value of silage. (Jayanegara et al., 2018).

Onggok is waste that comes from the tapioca industry, which is also used as animal feed because it is easy to get and relatively cheap (Sriroth et al., 2000). Onggok can be a source of energy because it has a high carbohydrate content reaching (72.49-85.99%) (Febrianti et al., 2017). Chicory (*Cichorium intybus L.*) It is a potential feed crop to be used as silage material because it has high productivity. The content of good nutritional value with crude protein reached 23.83%; and 25.83% crude fiber and wide adaptability to various environmental conditions (Li & Kemp, 2005; Jasmine, 2022). The addition of chicory to chicory silage can increase nutrients such as crude protein content, and digestible fiber (Perović et al., 2021). The use of onggok in silage has a complementary effect where onggok rich in carbohydrates can provide a good fermentation substrate, while chicory can contribute additional nutrients and bioactive compounds that are beneficial to livestock health (Marley et al., 2005).

Physical qualities such as color, aroma, texture, and pH are important indicators in determining the success of the fermentation process and the quality of the resulting silage (Liu et al., 2023). One of the efforts that can be made to improve the physical quality of the silage produced is by adding tannins.

Tannins are polyphenol compounds that are widely found in plants, and have been shown to have positive benefits for inhibiting the growth of unwanted microorganisms during the ensilage process (Makkar, 2003). This condition makes pathogenic microbes and fungi unable to develop during the ensilage process so that the physical quality of the silage produced is better. It can also extend the shelf life of silage (Kumar & Singh, 1984). In addition, tannins have the potential to protect feed proteins from excessive rumen degradation, as well as can improve the efficiency of protein utilization by ruminants. (Mueller-Harvey, 2006).

The urgency of this research is very important considering the livestock industry's dependence on the availability of stable quality feed throughout the year. In many areas, especially during the dry season, forage production is limited, which can reduce livestock productivity and cause economic losses for farmers. Therefore, it is important to find a solution that can overcome this problem, such as the use of feed preservation technology with the silage method that can extend the shelf life of forage forage. In this context, research on the use of natural ingredients such as chicory and ongkok in the manufacture of silage is very relevant and urgent to be carried out, as it can help improve the quality of feed while taking advantage of cheap and abundant local resources.

The novelty of this research lies in the combination of two materials that are relatively rarely used together in the manufacture of silage, namely chicory and ongkok. Although chicory is already known as a feed plant with good nutritional value, its development in making silage with a combination of ongkok as an additional ingredient to improve the quality of fermentation is a new thing. The study also focuses on improving silage quality by using natural additives that are inexpensive and easy to obtain, which can be a sustainable solution for the livestock sector in the face of fluctuations in feed availability.

The benefits of this research are enormous, both for farmers, the animal feed industry, and for the development of science in the field of animal feed technology. This research is expected to provide useful information about more efficient and environmentally friendly feed preservation alternatives. By using chicory and ongkok as ingredients for silage, farmers can obtain high-quality feed that is more affordable, as well as reduce dependence on limited fresh forage feed. In addition, the results of this research can also be a reference for the development of feed technology based on local resources that support the sustainability of livestock in Indonesia.

Research on the physical quality of chicory and ongkok silage with the addition of tannins is still limited. Therefore, this study aims to examine the effect of tannin addition on the physical properties of silage produced from the mixed feed. The results of this study are expected to provide useful information for the development of silage technology which aims to improve the quality of ruminant animal feed.

METHODS

Place and Time of Research

The research was carried out from August to September 2024. Research and testing are carried out at the Laboratory of Ruminant Livestock Nutrition and Animal Feed Chemistry, Faculty of Animal Husbandry, Padjadajaran University.

Material

The material used in this study is chicory (*Cichorium intybus L.*) which comes from the Jogjakarta area, ongkok, and the type of tannin used is Oak Galls.

Research Variables

The variables measured in this study are the physical quality of the chicory ongkok such as (color, aroma, texture, and the presence of mold). This physical quality evaluation was observed by organoleptic tests conducted by 10 panelists.

Table 1. Physical Qualities of Chicory and Onggok Silage

Parameters Quality Physical Silage	Assessment Score			
	4	3	2	1

Color	Yellowish Brown	Light Brown	Dark Brown	Black
Aroma	Smells of acidity	Slightly acidic	Somewhat smelly	Smells bad
Texture	Non-slimy and dense	Solid and slightly slimy	Mushy and slimy	Crushed and a lot of mucus
Mushroom	No mold	There is a slight amount of mold	Lots of mushrooms	There are so many mushrooms

Research Methods

This study used a complete randomized design (RAL) with four treatments and five replicates. The treatments used include:

- P0(-) (500 grams without tannin addition) as negative control
- P1(+) (500 grams + 12 grams tannins) as a positive control
- P2 (chicory 375 grams + 125 grams + tannins 12 grams)
- P3 (chicory 250 grams + 250 grams of tonggok + tannins 12 grams)
- P4 (chicory 125 grams + onggok 375 grams + tannins 12 grams)

Research Procedure

The first step in this study is that chicory is harvested at the age of 6-8 weeks or reaches a height of 30-40 cm. Then the chicory is wilted to reduce the moisture content until the moisture content of the material ranges from 60-70%. Next, the chicory is cut into 2-5 cm pieces to facilitate compacting and fermentation. Then chicory, onggok, and tannin are weighed according to the predetermined ratio. After that, the ingredients are mixed in a container until homogeneous, on the sidelines of the mixing process, 10 mL of aquades is added. The process of making silage uses the method of (Rufino et al., 2022). Then the silage is put into the vacuum plastic and the air is expelled using *vaccum sealer* until anaerobic conditions are created. After that the plastic vacuum in the *Seal* so that anaerobic conditions are maintained. Store in a covered place *Aluminum Foil* and closed at room temperature. Perform a 37-day ensilage process, which enters the maturation and stabilization phase (Burns, 1982). Furthermore, the harvesting process was carried out the next day to measure the pH level and physical quality of the silage produced.

RESULTS AND DISCUSSION

Based on the organoleptic results carried out by the panelists, as well as the results of data processing using *Kruskall-Wallis*, it was found that significant different parameters ($p < 0.05$) were found in all parameters, namely, color, texture, aroma, and the presence of fungi. This is suspected to be due to the influence of the addition of tannins as additives to the silage of chicory onggok. Different treatments on each parameter were further tested using *a dunn test* to determine the difference between treatments. The results of *the Kruskall wallis test and the further test* are presented in Table 2.

Table 2 Observation Results of Chicory and Onggok Silage

	Treatment	Median	p-value KW	Dunn Test	p-value Dunn Test
Color	P0	2	<0.01	P0 vs P1	0,00184*
	P1	3		P1 vs P2	0,00010*
	P2	2		P1 vs P3	0,0001**
	P3	2		P3 vs P4	0,00861*
	P4	2,5			
Texture	P0	4	<0.01	P0 vs P2	0,0001**
	P1	4		P0 vs P3	0,0001**

	P2	3		P2 vs P4	0,0783*
	P3	3		P3 vs P4	0,0276*
	P4	4			
Aroma	P0	4	0,01299	P0 vs P1	0,0114*
	P1	3			
	P2	4			
	P3	4			
	P4	4			
Mushroom	P0	4	<0.01	P0 vs P1	0,0001**
	P1	4		P1 vs P2	0,0001**
	P2	4		P1 vs P3	0,00265*
	P3	4		P2 vs P4	0,0341*
	P4	4			
Ph	P0	3,34	0,0001944	P0 vs P3	0,0213*
	P1	3,37		P0 vs P4	0,0004**
	P2	3,68		P1 vs P4	0,0017*
	P3	3,87			
	P4	4,31			

Description: * = Significant difference ($P < 0.05$); ** = Very significant difference ($P < 0.05$); KW = Kruskal Wallis; P0₍₋₎ = 500 grams of onggok without the addition of tannins; P1₍₊₎ = 500 grams of onggok + 12 grams of tannins; P2 = chicory 375 grams + onggok 125 grams + tannins 12 grams; P3 = chicory 250 grams + onggok 250 grams + tannins 12 grams; P4 = chicory 125 grams + 375 grams + tannins 12 grams.

1. Color

Color is one of the indicators in the physical quality inspection of silage according to opinion (Kurniawan D, Erwanto, 2015). Based on the results of the data displayed in (Table 2), it shows that the silage color of chicory onggok at P0, P2, P3 produces a median value of 2 which indicates dark brown. In the data P1 produces a median value of 3 which indicates the color of light brown, and P4 produces a median of 2.5 which indicates the color between dark brown and light brown. The color of chicory silage tends to follow the color of the onggok, which is light brown to dark brown. This is in line with the statement (Abdelhadi et al., 2005) that good fermentation produces a color that is not much different from the raw material. According to (Lamid et al., 2012), that the discoloration in plants that undergo the ensilage process is caused by the aerobic respiration process that lasts as long as the oxygen supply is still available, until the plant's sugar runs out. Statistically, chicory silage with the addition of tannins had a real effect ($P < 0.05$). Further test results *Dunn Test* shows a real difference between P0 and P1, in addition that P1 has a real difference with P2 and P3. The treatment of P3 and P4 also showed a significant difference. This indicates that the addition of tannins to P1 does not accelerate the maillard reaction because the concentration is not too high, this is supported by the results of the P2 and P3 treatments, in which chicory is added in both treatments. As is known, chicory also contains quite high tannins, so this makes the maillard reaction occur faster P2 and P3 treatment. The addition of tannins can also protect proteins from degradation during the ensilage process, resulting in higher protein content and increased Maillard reactions (Li & Kemp, 2005).

2. Texture

Texture is one of the indicators in the physical quality inspection of silage. Based on the results of the data displayed in (Table 2), it shows that the texture of chicory silage in P0, P1, P4 produces a median value of 4 which means that the silage texture is not flowing and dense. Meanwhile, the P2 and P3 treatments produced a median value of 3 which indicates that the resulting silage texture

has a dense texture and is slightly slimy in texture. Overall the silage produced has a good texture. This is in accordance with (Aglazziyah et al., 2020) which states that the denser the texture produced or the texture of silage is still like the basic material indicates good quality silage. Statistically, chicory silage with the addition of tannins had a real effect ($P < 0.05$). Further test results *Dunn Test* showed a real difference in P2 and P3 against P0 treatment, and P4 had a real difference with P2 and P3. This indicates that the high addition of chicory produces a slightly slimy texture, this is also supported by the P0 and P1 treatments which have non-slimy silage results due to the absence of the addition of chicory. In addition, it was also in the P4 treatment where the concentration of small chicory addition did not produce silage with a slimy texture. This happens because chicory contains high inulin around (15-20%), when fermented inulin is hydrolyzed into fructose which produces a slightly slimy texture (Gibson et al., 2010).

3. Aroma

The smell of silage is one of the indicators of the quality of the silage produced. Based on the results of the data displayed in (Table 2), it shows that the aroma of chicory silage onggok at P0, P2, P3, and P4 produces a median value of 4 which indicates a pleasant aroma of acidity. In the P1 data, a median value of 3 is produced which indicates a slightly sour aroma. Statistically, chicory silage with the addition of tannins had a real effect ($P < 0.05$). Further test results *Dunn Test* showed a noticeable difference in P0 and P1. This indicates that the addition of tannins can add a distinctive aroma. Tannins can help create favorable conditions for lactic acid bacteria, and the distinctive aroma is a hallmark of well-developed lactic acid bacteria (Jayanegara et al., 2018). This shows that the addition of tannins physically makes the physical quality of silage good.

4. Presence of Fungi

The presence of mold is one of the indicators in the physical quality inspection of silage. Based on the results of the data displayed in (Table 2), it shows that the presence of fungi in the chicory silage P0, P1, P2, P3, and P4 produces a median value of 4 which indicates the absence of fungi. Statistically, chicory silage with the addition of tannins had a real effect ($P < 0.05$). Further test results *Dunn Test* shows a real difference between P0 and P1, in addition that P1 has a real difference with P2 and P3, as well as P2 and P4. This indicates that the addition of tannins to P1 has an effect on the presence of fungi in the silage produced. The influence of pH also plays a role in the presence of fungi in silage yields, where the average pH of silage treatment is less than 6, this shows that fungi cannot grow at low pH and the possibility of good silage processing. Tannins also have antifungal activity which can inhibit fungal growth and damage fungal cell walls through the binding of membrane proteins (Scalbert, 1991).

5. Ph

According to Utomo (2013), pH can be used as a determinant of silage quality in lieu of lactic acid variables in silage. Based on the results of the data displayed in (Table 2), it shows that the pH P0, P1, P2, P3, and P4 have a median ranging from (3.34 – 4,31). Statistically, chicory silage with the addition of tannins had a real effect ($P < 0.05$). Further test results *Dunn Test* shows a noticeable difference in P1 and P4 in addition, P0 has a significant difference with P3 and P4. The results indicate that the addition of tannins and chicory to P3 and P4 has an effect on the pH value of silage produced because chicory has a carbohydrate composition to support lactic acid fermentation and accelerate the decrease in pH (Logtenberg et al., 2020). The average value of pH P0 without the addition of tannins is 3.34, while Average pH value P1 with the addition of tannins is 3.37. Lactic acid bacteria can grow and survive in acidic atmospheres, which is 4.0 – 4.68 (Aglazziyah et al., 2020). Tannins help lower The pH of silage rapidly, as well as a low pH ranging (3-4) is the optimal pH for lactic acid fermentation, creating a distinctive acidic but not pungent aroma (Burns, 1982).

CONCLUSION

Based on the results and discussion of the study, it can be concluded that overall, the addition of tannins to *Chicory* and onggok silage significantly improves the physical quality parameters of the silage, such as color, texture, aroma, and pH, and reduces the presence of mold compared to negative control (P0). Positive control (P1) with tannins also resulted in better silage quality compared to P0, but the addition of *Chicory* in P2, P3, and P4 resulted in even better quality because *Chicory* added nutrients and bioactive compounds that are important for fermentation. Tannins have been shown to maintain

silage quality by inhibiting the growth of disease and fungal microorganisms during fermentation, which contributes to decreasing nutrient degradation and extending shelf life. Silage with added tannins also exhibits a lower pH, denser texture, and a distinctive acidic aroma, indicating that fermentation is running optimally. Tannins function as antibacterial and antifungal agents, improve fermentation environmental conditions, and maintain better aroma and color.

Overall, the addition of tannins in *Chicory* silage and onggok can improve the quality and stability of silage, so this method is recommended to improve the effectiveness of ruminant feed throughout the year, especially in seasons with limited availability of forage feed.

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