The quality of broiler feed is given citric acid with different storage period

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Abstract. Problems that often arise in the feed are feed damage and low shelf life. The quality of feed raw materials and mixing of feed, as well as the composition of less precise feed ingredients, can increase the problem. Citric acid is one of the ingredients that can be added to preserve feed, the use of citric acid for preservation has been widely carried out on food ingredients for humans. The function of citric acid is not only as a natural preservative but also can improve feed quality. Citric acid has indeed been able to increase productivity, but its influence is expected to be even better. Feeds that can be stored for a long time without changing the quality of the feed are highly expected by farmers so that they can mix the feed when the available feed is sufficient. Mixing large amounts of feed can save energy and production costs and be able to anticipate the availability of highly fluctuating feed ingredients on the market. Citric acid is one of the organic acids which if added to broiler feed can be acidifier which is believed to increase livestock productivity. The research aims to improve shelf life and maintain the quality of broiler feed by adding citric acid at various levels. The research design used was a completely randomized design with 5 x 4 factorial patterns with two replications. The addition of citric acid and storage time significantly (p<0.005) on peroxidation numbers, but there was no interaction between the two. Physical tests show the addition of citric acid can reduce rancidity, mould growth and insect attack. It can be concluded that the addition of citric acid can maintain the quality of feed with low peroxidation numbers and can increase feed quality.

1. Introduction

Food is a requirement that is very essential for humans, as well as the position of feed for livestock. The feed is the main factor that is greatly needed in the livestock industry because most of the production costs are to meet feed needs. At present, the highly developed livestock industry is a poultry industry, the industry is very dependent on availability. So far, our feed is very dependent on imported feed ingredients, but along with the development of farmers' knowledge, we have encountered many small feed industries that use self-mixing. This step is done to reduce the cost of feed. Problems that often arise in the feed are feed damage and low shelf life. The quality of feed raw materials and mixing of feed and the improper composition of feed ingredients can add to the problem. Allama et al. [1] state that the balance of protein and energy is very influential on the amount of feed consumption because the energy in feed is one of the limiting factors for consumption.

Citric acid is one of the ingredients that can be added to preserve feed, the use of citric acid for preservation has been widely used in food for humans. The function of citric acid is not only a natural preservative but also able to improve the quality of feed. Citric acid is one of the organic acids which if
added to broiler feed can be acidifier which is believed to increase livestock productivity. Although organic acid has been widely used as an acidifier, however, the use of citric acid has a better effect. According to [2] that the use of single citric acid was able to increase the body weight of broilers, while the use of lactic acid partially showed lower body weight. Feed conversion (FCR) shows that citric acid is the same as control while lactic acid produces a higher FCR. Research on the use of citric acid reported by [3] that citric acid can increase body weight along with increasing levels, but it also significantly improves feed conversion. Tolba [4] states that the addition of citric acid can reduce pathogenic bacteria. The decrease in pathogenic bacteria causes increased intestinal immunity, which has to do with increasing nutrient availability. Natsir [5] added that encapsulated citric acid was able to increase protein digestibility and metabolic energy. Citric acid has indeed been able to increase productivity, but with influence, it is expected to be even better. Feeds that can be stored for a long time without changing the quality of feed are highly expected by farmers so that they can mix feed when the available feed is sufficient. Mixing large quantities of feed can save energy and production costs and be able to anticipate the availability of highly volatile feed ingredients in the market. The study aimed to improve the storage and quality of broiler feed by adding citric acid at various levels.

2. Materials and methods
The study was divided into two stages, namely the manufacture and storage of rations and the second stage, namely the analysis of the peroxidation test and Physical Test. Feed Making and Physical Tests were conducted at the Non-Ruminant Nutrition Laboratory Faculty of Animal Science Universitas Hasanuddin. The peroxidation test was carried out at the Animal Feed Chemistry Laboratory, Faculty of Animal Science Universitas Hasanuddin. Citric acid is mixed according to the composition of each treatment. The amount of ration made is 40 kg and then divided into 40 packs with one package 1 kg, using plastic. The ration is then stored following the conditions of feed storage in general. The composition of the ration shown in table 1.

| Feed ingredients | P0 | P1 | P2 | P3 | P4 |
|------------------|----|----|----|----|----|
| Corn             | 50.0| 50.0| 50.0| 50.0| 50.0|
| Rice brand       | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 |
| Vegetable oil    | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Fish meal        | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Soy bean meal    | 25.0| 25.0| 25.0| 25.0| 25.0|
| Coconut cake     | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 |
| Caco3            | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Methionine       | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Total            | 100.0| 100.0| 100.0| 100.0| 100.0|

| Nutrition content | P0  | P1  | P2  | P3  | P4  |
|-------------------|-----|-----|-----|-----|-----|
| Citric acid       | 0   | 0.4 | 0.6 | 0.8 | 1.0 |
| Energy (kkal/kg)* | 2988.20| 2988.20| 2988.20| 2988.20| 2988.20|
| Metabolizable     | 21.18| 21.18| 21.18| 21.18| 21.18|
| Crude protein**   | 4.48 | 4.48 | 4.48 | 4.48 | 4.48|
| Crude fiber**     | 7.64 | 7.64 | 7.64 | 7.64 | 7.64|
| Crude fat**       | 1.35 | 1.35 | 1.35 | 1.35 | 1.35|
| Lysine**          | 0.70 | 0.70 | 0.70 | 0.70 | 0.70|
| Methionine**      | 0.77 | 0.77 | 0.77 | 0.77 | 0.77|
| Ca*               | 0.39 | 0.39 | 0.39 | 0.39 | 0.39|
| P*                |     |     |     |     |     |

* Results of calculation of nutrient content based on [6]
** Results of analysis of feed chemistry laboratory at Universitas Hasanuddin, 2017
The parameters observed in the study were 1. the number of peroxidation numbers based on [7] method, and 2. physical test of feed. Physical tests carried out in the form of odour tests, fungi and insect attacks carried out every sampling. Physical tests were carried out by giving a score. Smell: peculiar smell of feed (-); rancid (+); very rancid smell (++); fungi : none (-); little (+) and lots (++).

Insect attacks are calculated by sieving feed with sieves until the remaining insects in the sieve are then counted and scored based on the criteria of [8]:
C/A (0): Safe, is not visible and no insects are found from the sample.
C/R (1): Mild, that is, there is no visible insect accumulated or lacking before sample examination, maximum 1-2 heads/kg.
C/M (2): Medium, that is, insects appear to be stacked, around 3-5 heads/kg
C/B (3): Weight, which is a lot of stacked insects, 6-10 heads/kg
C/SB (4): Very heavy which is more than 10 heads/kg.

The data obtained were processed by analysis of variance to determine the effect of treatment on the measured variables. If it is significant, it will be continued with Duncan's Test [9].

3. Results and discussion
Physical tests conducted on broiler feed given citric acid with different storage times are shown in table 2.

| Table 2. Physical test (odor, fungi, insect) citric acid feed with different storage lengths. |
|---------------------------------------------------------------|
| Duration of storage | Treatment | P0 | P1 | P2 | P3 | P4 |
|---------------------|------------|----|----|----|----|----|
| Smell               |            |    |    |    |    |    |
| Without storage     | -          | -  | -  | -  | -  | -  |
| 2 week              | -          | -  | -  | -  | -  | -  |
| 4 week              | -          | -  | -  | -  | -  | -  |
| 6 week              | +          | +  | -  | -  | -  | -  |
| Fungi               |            |    |    |    |    |    |
| Without storage     | -          | -  | -  | -  | -  | -  |
| 2 week              | -          | -  | -  | -  | -  | -  |
| 4 week              | -          | -  | -  | -  | -  | -  |
| 6 week              | +          | +  | -  | -  | -  | -  |
| Insect              |            |    |    |    |    |    |
| Without storage     | 0          | 0  | 0  | 0  | 0  | 0  |
| 2 week              | 0          | 0  | 0  | 0  | 0  | 0  |
| 4 week              | 1          | 1  | 1  | 0  | 0  | 0  |
| 6 week              | 2          | 2  | 1  | 0  | 0  | 0  |

The results of this physical test in terms of odour show that the rancid odour appears on the 6th day, the longer the storage, the rancid odour will arise. This rancid odour is caused by oxidized fat. The fish meal used in this study was obtained from people's farms where the storage was uncontrolled, therefore the 6th week of feed began to smell rancid. Feeds that begin to smell rancid can be curated the food has been damaged, damaged food will show characteristic features, namely rancid smell, growing fungi, and insects. The feed given citric acid shows that there is no rancid odour because citric acid can synergize with antioxidants according to [10]. Acid is synergistic against anti-oxidants in preventing rancidity and browning in foods containing carbohydrates, oil/fat proteins. Citric acid can reduce pH, further according to [11]. The lower pH means more H⁺ is free, H⁺ can regenerate antioxidant compounds by binding to phenoxy radicals to form antioxidant compounds again.
The growing fungus is seen by the formation of colonies which are usually black which are often attached to feed on grain. This fungus is usually in the form of *Aspergillus flavus*, which usually contaminates feed ingredients when harvesting or while in a warehouse. The existence of this fungus is very dangerous if consumed by livestock because it can infect the digestive tract and disrupt the productivity of livestock. In this study, the fungus was seen growing at week 6, but the fungus was very small, and in the treatment of citric acid, it was seen that the feed was not contaminated with fungi. This is caused by the content of citric acid which can suppress fungal growth.

Insect attack on feed treatment occurs at the 6th minute, this insect is in the form of fleas that can eat carbohydrates or starch from the feed. Viewed from the shape of insects found are insects of the type *Sitophilus oryzae* L. or commonly called rice lice, these types of insects mostly contaminate rice including follow-up waste, namely bran, although insects of this type also contaminate other grains such as corn, wheat, and beans. Research [12] found that the *Sitophilus oryzae* L. insects were not able to breed in peanuts, soybeans and green beans, but could reduce the weight of feed ingredients in the form of rice, corn, and wheat. Added according to [13] that *Sitophilus oryzae* L. insects prefer feed ingredients that are high in carbohydrates such as rice and corn fragments, while in copra, peanuts and soybeans there is no contamination of these insects.

Insect attack does not occur in the addition of citric acid at the levels of 0.8% and 1%, because citric acid can reduce pH which causes pH conditions do not correspond to the development of insect larvae that may be carried on feed ingredients. This insect attack occurred in the sixth week, naturally, it happened because according to [14] the development of *Sitophilus oryzae* L. insects from eggs to imago was around 31 days.

### Peroxidation number

Laboratory analysis conducted on broiler feed given citric acid and stored with different storage times peroxide was obtained as shown in table 3.

| Duration of storage | Treatment | Average |
|---------------------|-----------|---------|
|                     | P0        | P1      | P2     | P3     | P4     |
| Without storage     | 1.98      | 1.97    | 2.00   | 1.99   | 1.94   | 1.97<sup>d</sup> |
| 2 week              | 4.98      | 3.50    | 2.95   | 3.41   | 2.91   | 3.55<sup>c</sup> |
| 4 week              | 5.97      | 4.97    | 5.00   | 4.68   | 4.49   | 5.02<sup>b</sup> |
| 6 week              | 7.40      | 5.89    | 5.89   | 5.33   | 4.95   | 5.89<sup>a</sup> |
| Average             | 5.08<sup>a</sup> | 4.08<sup>b</sup> | 3.96<sup>bc</sup> | 3.86<sup>bc</sup> | 3.57<sup>c</sup> |

<sup>a,b,c,d</sup> Superscript shows significant differences (p<0.05)

Table 3 shows that storage time has a significant effect (p<0.05) on peroxide numbers, the longer the storage time peroxidation increases, the peroxidation number is a parameter of fat damage, meaning the longer the feed is stored, the higher the risk of fat damage. The same thing happened in [15], pellet feed for ducks also experienced an increase in peroxidation in the sixth week. The level of use of citric acid shows that the higher the level of use of citric acid the lower the value of peroxide. This is caused by the nature of citric acid which functions as an antioxidant so that it can prevent the occurrence of fat damage which is also supported by physical test conditions that do not occur rancidity. This is supported by the opinion of [16] who examined the use of citric acid in rice bran with different storage times, the result of which is the use of citric acid to 4% can reduce the value of peroxidation compared to bran without the use of citric acid. Citric acid is better able to reduce the value of peroxidation compared to the use of BHT (*Butylated Hydroxytoluene*). Citric acid can prevent oxidative damage caused by storage. In this study, there was no interaction between citric acid level and storage time.
4. Conclusion
The addition of citric acid was able to maintain the quality of feed with a low value of peroxidation and was able to increase the quality of feed.

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