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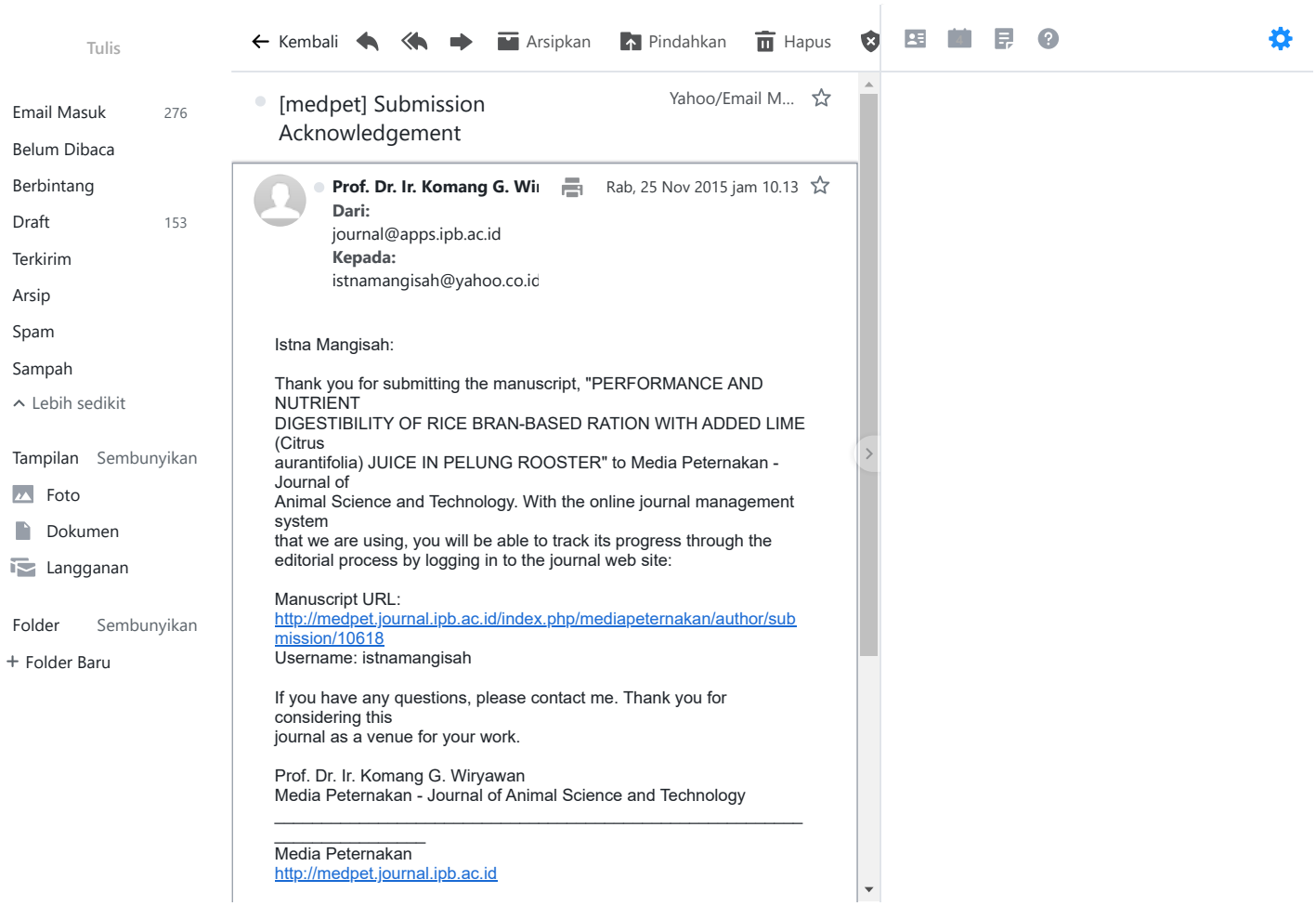

PERFORMANCE AND NUTRIENT DIGESTIBILITY OF RICE BRAN-BASED RATION WITH ADDED LIME (*Citrus aurantifolia)* JUICE IN PELUNG ROOSTER

NUTRIENT DIGESTIBILITY AND PERFORMANCE IN MALE PELUNG CHICKEN FED RICE BRAN-BASED RATION WITH ADDITIONAL LIME (*Citrus aurantifolia)* JUICE

Comment [U1]: The title possibly be better to be changed as indicated by the blue-color sentence

ABSTRACT

The study aimed to ~~determine~~ evaluate the effect of additional lime juice in a rice bran-based ration ~~fed to Pelung roosters~~ on the utilization of nutrients in male Pelung chickens. Sixty four ~~heads~~ birds of 12 weeks old male Pelung chickens, ~~12 weeks old~~ were used in this research and assigned into randomized completely block design. The treatments were dietary addition of lime juice ~~in the ration~~ at the level of 0 (T0), 1(T1), 2 (T2) and 3 ml (T3). Parameters measured were feed consumption, protein, fat and fiber ~~digestibility~~ digestibilties, apperant metabolizable energy (AME), rate of passage, feed conversion ratio (FCR) and daily weight gain. Results showed that addition of lime juice did not affect feed consumption, but significantly ($P<0.05$) increased coefficient ~~digestibility~~ digestibilities of protein, fat and fiber, AME, rate of passage, FCR and daily weight gain of Pelung roosters. Even though ~~adding~~ dietary addition of 2 or 3 ml lime juice ~~in the ration had~~ resulted similar ~~amount~~ values of AME, and digested protein, fat and fiber ~~digested~~, but both levels were ~~shown~~ brought about a better protein, and fat ~~and fiber~~ digestions, and AME ~~and absorption~~ when compared to those ration without or with 1 ml lime juice. The conclusion ~~was~~ is that dietary addition of 3 ml lime juice ~~in the ration~~ increases the digestion processes in the gastrointestinal and increasing daily weight gain of male Pelung chickens.

Comment [U2]: Fiber digestibility of 2 and 3 ml lime juice added diet was similar to that of 1 ml lime juice, even that of 2 ml was the same to that of kontrol diet, only 3 ml lime juice indicated significant compared to control diet. Please check carefully the data of Table 1.

Comment [U3]: No data of absorption was described in the Table of results. Pleaase omit.

Comment [U4]: The sentence (s) of Conclusion should be better in the form of present tens

Keywords: Pelung rooster, lime juice, nutrient digestibility, ~~lime juice, Pelung rooster~~, daily weight gain

ABSTRAK

Penelitian bertujuan untuk mengetahui pengaruh penambahan sari jeruk nipis dalam ransum berbasis dedak padi terhadap kecernaan nutrien pada ayam Pelung jantan. Ayam Pelung jantan umur 12 minggu berjumlah 64 ekor, ~~penelitian dilakukan umur 12 minggu dan menggunakan~~ dialokasikan ke dalam rancangan acak kelompok. Perlakuan yang diberikan adalah jeruk nipis dicampur dalam ransum ~~adalah~~ dengan level 0(T0), 1(T1), 2(T2) and 3 ml(T3). Parameter yang diukur adalah konsumsi ransum, kecernaan protein, lemak, dan serat, energi metabolis semu, laju digesta, konversi ransum dan pertambahan bobot badan harian. Hasil penelitian menunjukkan bahwa penambahan jeruk nipis tidak berpengaruh terhadap konsumsi ransum, tetapi nyata ($P<0,05$) meningkatkan ~~signifikan terhadap~~ kecernaan protein, lemak, dan serat, energi metabolis semu, laju digesta, konversi ransum dan pertambahan bobot badan harian ayam Pelung jantan. Meskipun penambahan 2 atau 3 ml jeruk nipis dalam ransum tidak menunjukkan perbedaan terhadap energi metabolis semu, kecernaan protein, lemak dan serat, tetapi kecernaan protein, dan lemak ~~dan serat~~ lebih baik dibandingkan ransum basal dengan 1 ml jeruk nipis. Simpulan bahwa penambahan 3 ml jeruk nipis meningkatkan proses kecernaan nutrien dalam saluran pencernaan dan meningkatkan pertambahan bobot badan harian pada ayam Pelung jantan.

Kata kunci: ayam pelung jantan, jeruk nipis, kecernaan nutrien, ~~jeruk nipis, ayam pelung jantan~~, pertambahan bobot badan

Comment [U5]: Same as Comment U2

INTRODUCTION

Pelung chicken is a local type chickens originated from Cianjur, West Java, which is included among those of broiler and a fancy chicken that produce a very good sound of crow. The farmer that bred this Pelung chicken usually used fine rice bran in the diet as high as 60% from the total ration. Sutardi (1992) stated that rice bran contain 73.85% neutral detergent fiber (NDF) ~~73.85%~~, 35.04% acid detergent fiber (ADF) ~~35.04%~~ and 3-4% lignin ~~3-4%~~. Therefore, ~~60% rice bran in the~~ diet composed of high rice bran (60%) caused high dietary content of crude fiber ~~content of the ration~~ that would also increase ~~the~~ fiber consumption. High crude fiber content in the diet ~~will~~ affect rate of passage of the digesta, ~~hence affected~~ and further bring about the negative impact on either ~~the~~ nutrient digestibility ~~as well as the~~ or nutrient absorption. The higher passage rates of the digesta, the fewer the nutrients ~~to~~ can be absorbed and utilized by the animal body, and vice versa. To improve nutrient digestibility of the ration that would affect the nutrient utilization for production while at the same time improving the quality of crowed, a research on the different level of lime juice added into rice bran-based ration had been implemented to Pelung roosters.

Research of Khotimah (2002) showed that 100 ~~grams~~ g of lime fruit contains the substances that most relevant to the present study, such as 7% citric acid and 27 mg vitamin C. ~~and 0.04 mg vitamin B1, as high as 86 g of water , 37 calories of energy, 0.80 g protein, 0.1 g fat, 12.30 g carbohydrates, 40 mg calcium, 22 mg phosphorus, and 0.60 mg of iron~~. The citric acid of this lime fruit is a useful of organic acid acidifier which contributes to ~~acidify the digesta of~~ the acidification and lowering pH of the gastrointestinal tract. ~~which affect pH of the stomach,~~ It was also reported that the low pH affect digesta rate of passage because of the decrease ~~of~~ in pathogen bacteria

Comment [U6]: The meaning of this sentence is unclear. Please consider to revice

Comment [U7]: Please add further explanation of why the famer (s) fed the chicken with high rice bran, before stating reference (s).

Comment [U8]: The sentence is difficult to understand and confucing. Please revice

Comment [U9]: It is not necessary to describe all items of nutritional contents, but it will be better to select the most relevant to the problem of the present research. For example, citric acid and vit C, are much more reliable and connect with the following sentence

(Khotimah, 2002). All of these positive effects ~~in~~ on the digestive tract condition would bring about ~~to~~ the increase in ~~of~~ dietary protein ~~digested~~ digestibility and nitrogen retention.

~~The use~~ Dietary inclusion of organic citric acid ~~in the diet~~ would increases the nutrient absorption, ~~especially~~ due to the improved digestion in the small intestine (Rice *et al*., 2002). According to Rafacz *et al*. (2005), addition of citric acid ~~as high as~~ at the level of 2 to 6% in the rations and fed to cross-bred chicken of Colombia hen and Hampshire rooster, increased body weight gain and feed efficiency, ~~while~~ but decreased ~~the~~ feed conversion ratio. Atapattu and Nelligaswatta (2005) stated that 2% of organic citric acid in the ration significantly increased the digestibility of dietary protein and fiber in broiler chickens. Acidifier inclusion in the ration has a positive influence on ~~the~~ growth of the chickens through lowering pH of the digestive tract. A low pH ~~in~~ of the digestive tract reduced pathogenic bacteria since they were not resistant ~~of~~ to low pH atmosphere (Ghazalah *et al*., 2011). Therefore, acidifier agent, would at the same time functions as an antimicrobial. ~~On the other hand~~ Similarly, Ghazalah *et al*. (2011) also stated that the reduction on the buffering capacity in the gastro-intestinal tract has a positive relation to the coefficient digestibility of protein, fat, and fiber, as well as the energy metabolism.

Comment [U10]: Considering the content of this sentence is similar to that of Kothimah (2002) above, so please combine and put/place after Khotimah

~~Optimization~~ Optimalization condition of the digestive tract and the process of digestion ~~and condition of the digestive tract~~ would be an entrance on the nutrient utilization that should be highly accommodated. Ecosystem of poultry digestive tract is a very important aspect on the improvement of the nutrient digestibility, animal health and eventually the bird's performances. The study was conducted in order to ~~know the effect of adding different level~~ evaluate the effect of dietary inclusion of lime juice ~~in~~

~~the ration~~ on protein utilization and performance of 12 weeks old male Pelung ~~rooster~~ chickens.

MATERIALS AND METHODS

The ~~material~~ experimental animal used in this study were 64 birds of 12 weeks old male Pelung ~~roosters~~ chicken, ~~12 weeks old~~ with an average body weight of 1,084.44 ± 210.89 g. ~~and the basal ration~~. ~~Composition of basal ration were 60% rice bran, 35% concentrates of CP 521, 5% mineral mix, and lime juice~~. Diet provided to the chickens which was known as basal ration was composed of 60% rice bran, 35% concentrates of CP 521, and 5% mineral mix. The basal ration contains metabolizable energy (ME) of 2,353.91 kcal/kg and 14.57% protein. The category of treatments were the inclusion level of lime juice into the diet

The research was assigned into randomized completely block design (RCBD) with 4 treatments and 4 groups as replication. Each group consists of 4 birds of male Pelung ~~roosters~~ chicken. The grouping was based on body weight as follows:

G1 = 740-910 g with an average of 835.51 ± 49.48 g

G2 = 910-1,080 g with an average of 985.69 ± 42.04 g

G3 = 1,080 to 1,250 with an average of 1,160.63 ± 55.69 g

G4 = 1,250 to 1m420 with an average of 1,369.06 ± 65.97 g

The dietary treatments were given for 4 weeks ~~which was adding~~ with the different addition level of lime juice ~~to the basal ration,~~ as the following:

T0 = no addition of lime juice

T1 = addition of 1 mL lime juice

T2 = addition of 2 mL lime juice

T3 = addition of 3 mL lime juice.

~~Data gathered~~ Parameters observed were daily feed intake, digestibilities of protein, fat, and fiber, apparent metabolizable energy ~~utilization~~, rate of passage, feed conversion ratio and ~~weekly~~ daily body weight gain. Coefficient of nutrient ~~digestion~~ digestibilty was measured at the end of the experiment using total collection method, and computed according to Sibbald and Wolynetz (1984), as follows:

1. Coefficient digestibility of protein (CDP, %) =

$$\frac{(\text{crude protein consumption} - \text{feces protein})}{\text{crude protein consumption}} \times 100\%$$

2. Protein Digested (g) = Protein Consume x CDP

3. Coefficient digestibility of fiber (%) =

$$\frac{(\text{crude fiber consumption} - \text{feces fiber})}{\text{crude fiber consumption}} \times 100\%$$

4. Coefficient digestibility of fat (%) = $\frac{(\text{crude fat consumption} - \text{feces fat})}{\text{crude fat consumption}} \times 100\%$

5. Apperant Metabolizable Energy (AME, kcal/kg) =

$$\frac{(\text{gross energy consumption} - \text{feces gross energy})}{\text{feed consumption}} \times 1000$$

6. Feed Conversion Ratio = $\frac{\text{feed consumption}}{\text{body weight gain}}$

Rate of passage measurement was recorded based on the total collection method using indicator according to Indreswari *et al.* (2009).

RESULTS AND DISCUSSION

Effect on Nutrient Utilization

The average of coefficient digestibilities of protein, fat, and fiber, and apperant metabolizable energy ~~were~~ are presented in Table 1. ~~Based on the analysis of variance,~~

Comment [U11]: Please change feces into excreta, in poultry feces is mixed with urine called excreta

Comment [U12]: Which one of the technical term is true "Protein digested" or "Protein retained" ?? And also no data of protein digested is described in this manuscript. Please check the data either in Table 1 or Table 2

Comment [U13]: Same as Comment U11

Comment [U14]: Same as Comment U11

Comment [U15]: Same as Comment U11. Is the formula true?? Please check

Dietary addition of lime juice ~~in the diet was~~ significantly affected protein, fat, and fiber digestibilities, and apperant metabolizable energy. ~~Duncan Multiple Range Test shown that the increase of~~ The higher lime juice addition into the rice bran-based ration, ~~significantly increased the utilization of~~ the better dietary protein, fat, fiber, and metabolizable energy utilized by male Pelung ~~roosters after~~ chickens during 4 weeks feeding period.

The similarity of protein consumption was affect of the used of basal ration that had the same protein content of all treatment rations. Besides addition of 1 to 3 ml lime juice to the ration did not affect the metabolizable energy (ME) of the basal diet. Poultry consumption is more influenced by the ME content of the ration. The ME content of the basal diet was 2,353.9 kcal/kg and addition of lime juice would not affect the ME content of the basal ration, since lime juice had no energy value to the roosters. Poultry will consume ration to meet their energy needs. The higher the energy level of the ration the lower the feed consumption, while if the ME content of the ration is low, the feed consumption will increase. Factors affecting feed intake was nutrient content, especially energy and protein level of the ration (Suprijatna *et al*., 2005).

~~Based on Duncan's multiple range test,~~ Additions of 2 and 3 mL ~~of~~ lime juice into the ration ~~had~~ brought about significantly ($p<0.05$) higher coefficient digestibilities of protein and fat, ~~and fiber~~ and apparent ME as compared to ration either without lime juice ~~addition and ration~~ or with 1 mL added ~~of~~ lime juice (Table 1). ~~but it was not significantly different from ration with 3 mL lime juice.~~ However, only dietary inclusion of lime juice at the level of 3 mL indicated significantly higher fiber digestibility compared to control diet. In general, additional ~~of~~ 3 mL lime juice into the

Comment [U16]: It was actually not protein, fat and fiber UTILIZATIONS but DIGESTIBILITY

Comment [U17]: It is not reliable and less logical when discuss about the effect of lime juice on ME. Also it should be consistence with the purpose of the present study, and the author (s) has/have realized to compose one basal diet with the same protein and ME before experiment. Please consider to omit

Comment [U18]: This paragraph is very common scientific discussion, especially those concerning the relationship between feed consumption and dietary ME content. Please consider to omit

Comment [U19]: Same as Comment U2

rice bran-based ration could improved ~~the~~ protein, fat ~~dan~~ and fiber digestibilities, and apparent ME when fed to the 12 weeks old male Pelung ~~Rooster~~ chickens.

The coefficient digestibility of crude protein was range from 72.79 to 77.43%. ~~This~~ The result of this study was lower than that of the research of Hassan *et al.* (2010), who ~~found out~~ reported that the value of coefficient digestibility of protein ~~added organic acid~~ in broiler chickens added-organic acid was ~~to~~ 89.02%. The diference value of protein digestibility was probably due to the chicken species dependent. However, ~~analysis of variance showed that~~ the present study indicated that lime juice ~~level~~ addition into the rice bran-based ration affected the coefficient digestibility of ~~the~~ protein. As the level of lime juice added into the ration increased, the coefficient digestibility of protein ~~was~~ also increased ~~to~~ by 4-5% higher as compared to the ration without lime juice.

~~Based on Duncan's multiple range test, 3 mL of lime juice in the ration had significantly ($p<0.05$) higher coefficient digestibility of protein, fat and fiber as compared to ration without lime juice addition and ration with 1 mL added of lime juice but it was not significantly different from ration with 3 mL lime juice. Additional of 3 mL lime juice in the rice bran-based ration improve the protein, fat dan fiber digestibility fed to 12 weeks Pelung Rooster.~~

Comment [U20]: This paragraph has been moved to the page 7 above starting on line 162

~~The~~ Citric acid in the lime juice ~~allegedly~~ is believed to be able to ~~make~~ improve atmosphere condition of the digestive tract ~~into acid condition hence~~ by lowering the pH ~~in~~ of the proventriculus and ventriculus, so that the enzymes in these digestive tract actively work to digest ~~the dietary~~ nutrient, especially protein. Beside this function, it was simultaneously able to suppress the growth of harmful bacteria that can ultimately improve health of the digestive tract which in turn would also affect the

nutrient digestibility. ~~Expressed on~~ Gastric acidification gives an impact on both in changing the activation of the enzyme pepsinogen into pepsin and ~~absorb~~ nutrients absorption. that have been flatten by microorganisms (depend on pH range and types of microorganisms). Rice *et al*. (2002), described that the use of organic citric acids in the diet increased nutrients absorption, especially at the small intestine. Ghazalah *et al*. (2011), the addition of acidifier had a positive influence on the growth of chickens including lowering pH of the digestive tract, so that it can reduced pathogenic bacteria that are not resistant to the low pH of the atmosphere, is directly used as an antimicrobial, lowering the counter weight capacity related to the improvements of digestibility values of crude protein, fat, crude fiber and energy metabolism. Atapattu and Nelligaswatta (2005) stated, the effect of organic citric acid at 2 % level significantly (P< 0.05) increased the value of crude protein digestibility and crude fiber. Selle *et al*. (2000) showed that citric acid could degrade phytate, hence increasing the digestibility of crude protein and crude fiber.

Comment [U21]: Is this idiomatic usage correct?? It seems to be very hard to understand

Comment [U22]: Please omite this statement if since the author (s) has/have no data of thef microorganism type. A certain microorganism in relation to the nutrients utilization by the host is indirect activity, but not direct action.

Comment [U23]: Very long sentence , difficult to understand. Please revice ! Considering the similar contents. it will be better to move, insert and be combined with the sentences in page 8, lines 187-192.

Comment [U24]: Is there any relationship of the present study with phytate? If yes, please give additional scientific explanation based on own author (s) argumentation

Effect ~~To~~ on Performance

Performance of pelung chickens observed was feed intake, rate of passage, feed conversion ratio (FCR) and body weight gain ~~that shown at~~ (Table 2). Feed consumption of Pelung cocks aged 12 weeks were T0=98; T1=104.08; T2=99.03 and T3=101.27 g/bird/day, with an overall average of 100.59 g/bird/ day. According to Nataamijaya (2006), the average feed consumption ranged from 90-125 g/bird/day. Feed intake is influenced by several factors like energy and crude fiber in the ration, body weight, temperature and local climate, and ration palatability (Wahju, 1997). However, addition of 1-3 ml lime juice in the ration did not significantly affect feed

Comment [U25]: Please avoid to rewrite the data in the text

consumption of Pelung rooster but significantly affect the protein, fat and fiber digested and body weight gain of chicken.

~~Based on the variance~~ analysis, giving Feeding lime juice significantly slow the rate of passage down. T0 treatment was significantly different from T3. While the amount of rate of passage ~~in among~~ between the treatments of T1 and T2 ~~were~~ was not significantly different. This suggests that the addition of lime juice at the level of 3 ml significantly slow the rate of passage. The higher the lime juice added, the ~~highe~~r faster the rate of passage. This would greatly affected the amount of protein, fat and fiber that can be digested and further absorbed and utilized ~~by the body~~ for gaining body weight.

Body weight gain of Pelung rooster increased significantly as the level of lime juice increases (Table 2). Ration without lime juice had body weight gain of 10.85 g/bird/day which significantly lower as compare to those ration with added lime juice either 1, 2 or 3 mL that had weight gain of 12.95, 12.53 and 14.15 g/bird/day, respectively. This is supported by FCR at 0.3 ml (T3) lower than without lime juice (T0). The experiment Adil *et al*. (2010), diets supplemented with organic acids showed a significant ($P < 0.05$) improvement in the FCR as against the chicks fed the control diet. Nezhad *et al*. (2007), ~~who~~ reported that the addition of citric acid to a broiler diet improved feed efficiency, ~~and the results on~~ as an indication of the beneficial effects of citric acid on feed conversion. Feed conversion ratio can increase with age Pelung rooster. Chicken age 12-16 week have FCR 3.85-4.40 (Iskandar and Susanti, 2007).

The citric acid in lemon juice ~~would~~ decreased the pH ~~and acidity~~ of the gastrointestinal tract, which than affected the populations of pathogenic bacteria. This condition has created a suitable atmosphere inside the GIT that supports the process of digestion and absorption of nutrients. The more nutrients can be absorbed, the more

Comment [U26]: It will be better to express the condition of data first according to statistical analysis, and followed by own argumentations prior to reference (s) cytation.

Comment [U27]: No symbol of treatmnet such as T0, T1, T2 , T3 was found either in the text or Table of data. Please maintain the consistency writing ! It can also be suggested that this statistical results should be better to move and place at the beginning of this paragraph.

Comment [U28]: Same as Comment U25

Comment [U29]: Same as Comment U27

Comment [U30]: The statements are irrerelevant to the treatment and data. The increase in FCR is an unexpected result. Please omite !!

nutrients are possible to be utilized for body tissue. Body weight gain is caused by the increased of nutrient digestibility ~~of the ration~~, that was shown on the increase of protein digested of T2 and T3 ration (addition of 2 ml and 3 ml of lime juice). The increased of protein digested improved the body weight gain. Rafacz *et al.* (2005), stated the addition of citric acid as much as 2-6% in chicken rations increase body weight gain, feed efficiency and feed conversion ratio.

Organic acids are among the alternative growth promoters that are being used to stimulate growth performance in poultry (Hassan *et al*., 2010; Mohamed *et al*., 2014). Many studies demonstrated that supplementation of organic acids to broiler diets increased growth performance (Gunal *et al*., 2006; Abd El-Hakim *et al*., 2009; and Abdel-Fattah *et al*., 2008), improved gut morphology, reduced diseases, and overcame some management problems (Gunal *et al*., 2006), and reduced FCR (Abd El-Hakim *et al*., 2009) compared to those of unsupplemented diet. ~~Abd El-Hakim *et al*. (2009) found that addition of organic acids of broiler diets improved FCR and growth performance. Abdel-Fattah *et al*. (2008) found that broiler chicks fed dietary organic acids had superior improvement in live body weight, body weight gain, and FCR compared to those of unsupplemented diet.~~

On the other hand, the negative effects of phytate in rice bran could be eliminated by addition of lime juice which shown on the increased of protein digestibility. The increase of digested protein would then increased the protein absorbed, which in turn increases the weight gain. According to Selle *et al*. (2000) citric acid could hydrolyze phytate resulting on the increased the digestibility of protein and fiber of the ration that contain phytate. Hanafi (2001) also stated that generally 20% fine rice bran or more in the ration inhibit the growth due to the presence of phytic acid,

Comment [U31]: No data about protein digested or protein retained. Table 1 indicated only protein digestibility

Comment [U32]: Is it true that lime juice can be able to eliminate or have a degradable effect on phyttate?? It seems to be imposible, please consider to make correct !! Also please indicate the amount of pytate in the diet

Comment [U33]: The reviewer has read the content of this reference (Selle *et al*,. 2000), but no any description has been found regarding citric acid can eleminate phytate. Please make a honnest scientific description

which formed complexes with proteins, pectin, and starch or fiber polysaccharides of the ration. This would become an obstacle on protein and phosphorus digestion hence affecting nutrient utilization for weight gain. Phytate affects the digestibility of protein and amino acids in the ration (Kurniawati dan Yuanita, 2014). According Sukria and Liebert (2004) that citric acid (30 g/kg) in a corn soybean-based chicken diet with low native phytase activity and supplementation of microbial phytase increased growth performance, protein, and phosphorus deposition.

CONCLUSION

Based on the results of the research can be concluded that the best utilization of nutrient ~~ration~~ is ~~the ration~~ T3 ~~namely~~ rice bran-based diet with the addition of lime juice ~~as much as~~ at the level of 3 ml. The inclusion of lime juice in the ration of male Pelung ~~rooster~~ chicken ~~could~~ can enhance the nutrient ~~digestion~~ digestibility so that increases ~~the~~ nutrient ~~digested~~ utilization, and ~~feed conversion ratio resulting on the increase of~~ finally improves body weight gain and feed conversion ratio.

Comment [U34]: Same as Comment U27

REFERENCES

Abd El-Hakim, A. S., G. Cherian, and M. N. Ali. 2009. Use of organic acid, herbs and their combination to improve the utilization of commercial low protein broiler diets. Int. J. Poult. Sci. 8: 14-20.

Abdel-Fattah, S. A., M. H. El-Sanhoury, N. M. El-Mednay, and F. Abdel-Azeem. 2008. Thyroid activity, some blood constituents, organs morphology and performance of broiler chicks fed supplemental organic acids. Int. J. Poult. Sci. 7: 215-222.

289 Adil, S., T. Banday, G. A. Bhat, M. S. Mir, and M. Rehman. Effect of dietary
290 supplementation of organic acids on performance, intestinal histomorphology,
291 and serum biochemistry of broiler chicken. Vet. Med. Int. 10(4): 479-485.
292 Atapattu, N. S. B. M. and C. J. Nelligaswatta. 2005. Effects of citric acid on the
293 performance and the utilization of phosphorous and crude protein in broiler
294 chickens fed on rice by-products based diets. Int. J. Poult. Sci. 4(12): 990-993.
295 Ghazalah, A. A., A. M. Atta, K. Elkloub, M. E. L. Moustafa, Riry, and F. H. Shata.
296 2011. Effect of dietary supplementation of organic acids on performance,
297 nutrients digestibility and health of broiler chicks. Int. J. Poult. Sci. 10(3): 176-
298 184.
299 Gunal, M., G. Yayli, O. Kaya, N. Karahan, and O. Sulak. 2006. The effects of antibiotic
300 growth promoter, probiotic or organic acid supplementation on performance,
301 intestinal microflora and tissue of broiler. Int. J. Poult. Sci. 5: 149-155.
302 Hanafi, N. D. 2001. Enzyme as a new alternative in the Quality Improvement Feed for
303 Livestock. Graduate Program, IPB, Bogor.
304 Hassan, H. M. A., M. A. Mohamed, A. W. Youssef, and E. R. Hassan, 2010. Effect of
305 using organic acids to substitute antibiotic growth promoters on performance
306 and intestinal microflora of broilers. Asian-Aust. J. Anim. Sci. 23: 1348-1353.
307 Hassan, H. M. A., A. W. Youssef, H. M Ali, and M. A. Mohamed. 2015. Adding
308 phytogenic material and/or organic acids to broiler diets: effect on performance,
309 nutrient digestibility and net profit. Asian J. Poult. Sci. 9(2): 97-105.
310 Indreswari, R., H. I. Wahyuni, N. Suthama, dan P. W. Ristiana. 2009. Calcium
311 utilization for egg shell formation in laying hens due to the different feeding
312 regimes of morning and afternoon portion. JITAA 34(2):134-138.

Comment [U35]: Add the year of publish

313 Iskandar, S. and T. Susanti. 2007. The characteristic and the use of pelung chicken in
314 indonesia. Indon. Bull. Anim. ~~and~~ Vet. Sci. 17(3): 128-136.
315 Khotimah, K. 2002. Effects of extracts of lime (*Citrus aurantifolia*) and processing
316 methods on the quality of broiler meat. (http://digilib.gunadarma.ac.id/
317 go.php?id=jiptumm-gdl-res-2002-ir-5311orange). Accessed on August 29, 2010.
318 Kurniawati, Y. R. dan L. Yuanita. 2014. Pengaruh asam sitrat dan fitase *Bacillus*
319 *subtilis* HG pada jagung (*Zea mays L.*) terhadap biovailabilitas mineral Ca (*in-*
320 *vitro*). J. Chem. 3(1): 96-102.
321 Mohamed, M. A., E.F. El-Daly, N. A. A. El-Azeem, A. W. Youssef, and H. M. A.
322 Hassan. 2014. Growth performance and histological changes in ileum and
323 immune related organs of broilers fed organic acids or antibiotic growth
324 promoter. Int. J. Poult. Sci. 13: 602-610.
325 Nataamijaya, A. G. 2005. Characteristic appearance of coat color patterns, skin, scales
326 leg, and half chicken and chicken arrowroot Pelung and Sentul in
327 Ciamis.(Http://indoplasma.or.id/publikasi/buletin_pn/pdf/buletin_pn_11_1_2005
328 _1-5_achmad.pdf). Accessed on August 29, 2010.
329 Nezhad, Y. E., M. Shivazad, M. Nazeeradl, and M. M. S. Babak. 2007. Influence of
330 citric acid and microbial phytase on performance and phytate utilization in
331 broiler chicks fed a corn-soybean meal diet. J. Fac. Vet. Med. 61:407–413.
332 Rafacz-Livingston, K. A., C. M. Parsons, and R. A. Jungk. 2005. The effects of various
333 organic acids on phytate phosphorus utilization in chicks. Poult. Sci. 84: 1353.
334 Rice, J. P., R. S. Pleasant, and J. S. Radcliffe. 2002. The effect of citric acid, phytase,
335 and their interaction on gastric pH, and Ca, P, and dry matter digestibilities. Int. J.
336 Poult. Sci. : 36-42.

Selle, P. H., V. Ravindran, R. A. Caldwell, and W. L.Bryden. 2000. Phytates and phytase: Consequences for protein utilitation. Nutr. Res.Rev., 13: 255-278.

Sibbald, I. R. and M. S. Wolynetz, 1984. Estimates or retained nitrogen used to correct estimates of bioavalaible energy. Poult. Sci. 64 : 1506-1513.

Sukria, H. A. and F. Liebert. 2004. Citric acid and microbial phytase inclusion in the diet to improve utilization phytate phosporus and growth of broiler. Med. Pet. 27(1): 21-24.

Suprijatna, E., U. Atmomarsono and R. Kartasudjana. 2005. Livestock Poultry Science Association. Penebar Swadaya, Jakarta.

Sutardi, T. 1992. Basis of Nutrition. Volume I. Department of Food Science Faculty of Animal Husbandry IPB, Bogor.

Comment [U36]: This reference is irrelevant and there is no description regarding the relationship of citric acid and elimination of phytate

Table 1. Average of Coefficient Digestibility of Protein, Fat, Fiber and Apperant Metabolizable Energy of Rice Bran-Based Ration With Added Lime Juice Fed To 12 Weeks Old Pelung Rooster For 4 Weeks

Parameter	Level of Lime Juice (mL)			
	0	1	2	3
Coefficient Digestibility of Protein (%)	72.79[b]	73.65[b]	76.90[a]	77.43[a]
Coefficient Digestibility of Fat (%)	71.85[b]	74.40[b]	83.87[a]	82.06[a]
Coefficient Digestibility of Fiber (%)	19.18[b]	22.59[ab]	23.16[ab]	25.18[a]
Apperant Metabolizable Energy (kcal/kg)	2401.99[b]	2420.90[b]	2532.67[a]	2553.60[a]

Different superscript of ~~average~~ mean value for each parameter showed significantly difference ($P \leq 0.05$)

Table 2. Average of Feed Consumption, Rate of Passage and Daily Weight Gain of 12 Weeks Old Pelung Rooster Rice Fed Bran-Based Ration With Added Lime Juice Fed For 4 Weeks

Parameter	Level of Lime Juice (ml)			
	0	1	2	3
Feed Consumption (g/bird/day)	98.00	104.08	99.03	101.27
Rate of Passage (min)	183.60[b]	205.58[ab]	203.28[ab]	221.23[a]
Feed Conversion Ratio	5.08[a]	4.08[ab]	3.94[ab]	3.35[b]
Body Weight Gain (g/bird/day)	10.85[b]	12.95[ab]	12.53[ab]	14.15[a]

Different superscript of ~~average~~ mean value for each parameter showed significantly difference ($P \leq 0.05$)

NUTRIENT DIGESTIBILITY AND PERFORMANCE IN MALE PELUNG CHICKEN FED RICE BRAN-BASED RATION WITH ADDITIONAL LIME (*Citrus aurantifolia)* JUICE

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ABSTRACT

Rearing Pelung chicken in Indonesia in general using ration with high proportion of rice bran, even up to 60%. Considering the high contents of fiber, lignin, and phytic acid, thus feeding high portion of rice bran bring about low nutrient digestibility. The study was aimed to evaluate the effect of additional lime juice in a rice bran-based ration on the utilization of nutrients in male Pelung chicken. Sixty four birds of 12 weeks old male Pelung chicken were used in the present research, and assigned into randomized completely block design. The treatments were dietary addition of lime juice at the level of 0, 1, 2 and 3 mL/100 g. Parameters measured were feed and nutrients consumption, protein, fat and fiber digestibilities, apparent metabolizable energy (AME), rate of passage, feed conversion ratio (FCR) and daily body weight gain. Results showed that addition of lime juice did not affect feed and nutrient consumption, but significantly ($p<0.05$) increased coefficient digestibilities of protein, fat and fiber, AME, rate of passage, FCR and daily body weight gain. However, dietary addition of 2 or 3 mL lime juice resulted similar values of AME, and protein, fat and fiber digestibilities, and both levels brought about better protein and fat digestibilities, and AME when compared to other treatments. The conclusion is that dietary inclusion of 3 ml lime juice increases the digestive processes in the gastrointestinal and increasing daily weight gain of male Pelung chicken.

Keywords: male Pelung chicken, lime juice, nutrient digestibility, daily body weight gain

ABSTRAK

Pemeliharaan ayam Pelung di Indonesia pada umumnya menggunakan ransum dengan proporsi dedak padi tinggi. Porsi dedak padi mencapai 60%, namun, berhubung dedak padi mengandung serat kasar, lignin dan asam fitat tinggi menyebabkan kecernaan nutrien rendah. Penelitian bertujuan untuk mengetahui pengaruh penambahan sari jeruk nipis dalam ransum berbasis dedak padi terhadap kecernaan nutrien pada ayam Pelung jantan. Ayam Pelung jantan umur 12 minggu berjumlah 64 ekor, dialokasikan ke dalam rancangan acak kelompok. Perlakuan yang diberikan adalah jeruk nipis yang dicampur dalam ransum dengan level 0, 1, 2 and 3 ml/100 g. Parameter yang diukur adalah konsumsi ransum dan nutrien, kecernaan protein, lemak, serat, energi metabolis semu, laju digesta, konversi ransum dan pertambahan bobot badan

harian. Hasil penelitian menunjukkan bahwa penambahan jeruk nipis tidak berpengaruh nyata terhadap konsumsi ransum dan nutrien, tetapi nyata ($p<0,05$) meningkatkan kecernaan protein, lemak, dan serat, energi metabolis semu, laju digesta, konversi ransum dan pertambahan bobot badan harian Penambahan 2 atau 3 ml jeruk nipis dalam ransum tidak menyebabkan adanya perbedaan energi metabolis semu, kecernaan protein, lemak dan serat, tetapi kecernaan protein dan lemak lebih baik dibandingkan perlakuan lainnya. Simpulan bahwa penambahan 3 ml jeruk nipis memperbaiki proses pencernaan nutrien dan meningkatkan pertambahan bobot badan harian pada ayam Pelung jantan.

Kata kunci: ayam pelung jantan, jeruk nipis, kecernaan nutrien, pertambahan bobot badan harian

INTRODUCTION

Pelung chicken is an indigenous chickens originated from Cianjur, West Java Indonesia, which is usually reared as a fancy chicken with a very good sound of crow. Although Pelung chickens at first were kept and bred for fancy due to their sound of crow, by looking at their exteriour performance it is considered that those chickens are very potential to be developed becoming more economically valuable. However, problems of feed supply continuation either quality or quantity as well as feed cost are often to be an obstacle for small holder of Pelung chicken farming. Farmers are mostly fed the chickens by mixing commercial concentrate with rice bran in order to achieve low feed cost. Portion of rice bran used in the ration is sometime extremely high, up to 60%. There are numerous weaknesses of feeding high portion of rice bran to the poultry, including Pelung chicken. It is well known that rice bran contains high crude fiber, lignin and phytic acid which can detrimental on the productive performance via its negative effects on nutrients digestibilty. (Ridwan, R., S. Ratnakomala, n.d.) stated that rice bran contain 73.85% neutral detergent fiber (NDF) and 35.04% acid detergent fiber (ADF). High level of dietary crude fiber affected rate of passage of the digesta, hence providing impact on either nutrients digestibility or absorption. The faster rate of

passage of the digesta the fewer nutrients to be absorbed and utilized by the body, and vice versa. There are several factors have been known to overcome the problems of low digestibility, acidifier such as citric acid, is one substance that possible to be implemented to improve nutrients digestibility.

Citric acid is able to provide beneficial effects, such as lowering the digestive tract pH value of poultry. Low intestinal pH is greatly possible to suppress the growth of pathogenic microorganisms, stimulates digestive enzymes, and improve health condition of the digestive tract. This phenomenone lead to the increase in nutrient utilization and ultimately improves productive performance. Previous study indicated that feeding 3% dietary citric acid would increased nutrient digestibility and apparent metabolizable energy (Martinez-Ameaqua, Parsons, & Baker., 2006). According to (Rafacz-Livingston, Parsons, & Jungk., 2005), dietary addition of citric acid at a range of 2 to 6% and fed to cross-bred chicken of Colombia hen and Hampshire rooster, increased body weight gain and feed efficiency, but decreased feed conversion ratio. (Van Antwerpen et al., 2007) reported that additional 2% organic citric acid in the ration significantly increased protein and fiber digestibilities in broiler chickens. It is clear that dietary inclusion of acidifier has a positive influence on growth of the chickens through lowering pH of the digestive tract. Acidic condition of the digestive tract reduced pathogenic bacteria since they were not succeptible to low pH atmosphere (Ghazalah et al., 2011). Therefore, acidifier at the same time would function as an antimicrobial agent. On the other hand, (Ghazalah et al., 2011) also stated that the reduction of buffering capacity has a positive relation to the coefficient digestibility of protein, fat, and fiber, as well as the energy metabolism.

The natural material containing high citric acid is lime fruit. (Maghfiroh, Mangisah, & Ismadi., n.d.) showed that 100 g of lime fruit contains 7% citric acid, 27 mg vitamin C and 0.04 mg vitamin B1. Citric acid content of lime fruit is an useful organic acid acidifier which contributes to the acidifying the digesta in the gastrointestinal tract and affect intestinal pH, and rate of passage because of the decrease in pathogenic bacterial population. All of these positive phenomenones occured in the digestive tract would bring about the increase in dietary protein digestibilty and nitrogen retention.

Optimization condition of the digestive tract and process of digestion would be an entrance of the nutrient utilization that should be highly accommodated. Ecosystem of poultry digestive tract is a very important determinat for the improvement of the nutrient digestibility, animal health and eventually the bird's performances. The study was conducted in order to evaluate the effect of dietary addition of lime juice on protein utilization and performance of 12 weeks old of male Pelung chicken.

MATERIALS AND METHOD

The experimental animals used in the present study were 64 birds of 12 week-old male Pelung chicken, with an average body weight of 1,084.44 ± 210.89 g. The basal ration was composed with 14.57% protein and 2,353.91 kcal/kg metabolizable energy (Table 1).

The research was assigned in a randomized completely block design (RCBD) with 4 treatments and 4 groups as replication. Each group consisted of 4 birds of male Pelung chicken. The grouping was based on body weight as follows:

G1 = 740-910 g with an average of 835.51 ± 49.48 g

G2 = 910-1,080 g with an average of 985.69 ± 42.04 g

G3 = 1,080 to 1,250 with an average of 1,160.63 ± 55.69 g

G4 = 1,250 to 1m420 with an average of 1,369.06 ± 65.97 g

The treatments based on the level of lime juice addition to the basal diet were given for 4 weeks as follows:

T0 = no addition of lime juice

T1 = addition of 1 mL lime juice/100 g ration

T2 = addition of 2 mL lime juice/100 g ration

T3 = addition of 3 mL lime juice/100 g ration

Parameters observed were daily feed intake, protein, fat, fiber consumptions, and metabolizable energy, rate of passage, feed conversion ratio and body weight gain. Coefficient of nutrient digestibility was measured at the end of the experiment using total collection method, and computed according to Sibbald and Wolynetz (1984), as follows:

1. Coefficient digestibility of protein (CDP, %) =

$$\frac{(\text{crude protein consumption - excreta protein})}{\text{crude protein consumption}} \text{ x } 100\%$$

2. Coefficient digestibility of fiber (%) =

$$\frac{(\text{crude fiber consumption - excreta fiber})}{\text{crude fiber consumption}} \text{ x } 100\%$$

3. Coefficient digestibility of fat (%) = $\frac{(\text{crude fat consumption - excreta fat})}{\text{crude fat consumption}}$ x100%

4. Apparent Metabolizable Energy (AME, kkal/kg) =

$$\frac{(\text{gross energy consumption - excreta gross energy})}{\text{feed consumption}} \text{ x } 1000$$

5. Feed Conversion Ratio = $\frac{\text{feed consumption}}{\text{body weight gain}}$

Rate of passage measurement was recorded based on the total collection method combined with indicator according to (Indreswari, Wahyuni, Suthama, & Ristiana., 2009).

RESULTS

Effect on Nutrient Utilization

Protein, fat and crude fiber consumptions were not affected by whatever levels of dietary inclusion of lime juice (Table 2) since feed consumption indicated the same value among treatments (Table 3). However, feeding lime juice significantly ($p<0.05$) increased digestibility of nutrient (crude protein, crude fat and crude fiber). When the inclusion level of lime juice into the rice bran-based ration increased by 2 mL (T2) and 3 mL (T3) the coefficient digestibilities of protein and fat, and apparent metabolizable energy was significantly higher than control (T0). Coefficient digestibility of protein improved to be higher by 4 to 5% when the additional level of lime juice into the ration increased (T2 and T3) as compared to control, the ration without lime juice (T0). The significantly ($p<0.05$) slower rate of passage and the significant increase in coefficient digestibility of fiber were only found in the treatment of highest level of lime juice inclusion (T3). However, both parameters (rate of passage and fiber digestibility) among other three treatments (T0, T1 and T2) were not significantly different.

Effect on Growth Performance

Feed consumption did not affected by the dietary inclusion of lime juice, but other parameter such as final body weight, body weight gain either cummulative or daily measurement, and feed conversion ratio were significantly ($p<0.05$) affected by the treatment (Table 3). Final body weight and cummulative body weight gain were significantly ($p<0.05$) improved by the lime juice inclusion of whatever levels with the highest value when 3 mL lime juice (T3) was given. The different phenomenone was found for daily body weight gain dan feed conversion ratio that body weight gain indicated significanly ($p<0.05$) higher value but feed conversion ratio was lower with feeding 3 mL lime juice (T3) only as compared to that of none lime juice addition (T0).

DISCUSSION

Effect on Nutrient Utilization

Feeding lime juice did not interfere with feed consumption since this parameter indicated the same value among treatments (Table 3). However, the effect of dietary lime juice inclusion was more profound on nutrien digestibilities. Digestibilities of nutrient due to the feeding effect of lime juice at 2 mL/100 g ration (T2) and at 3 mL/100 g ration (T3) were significantly higher as compared to that of feeding lime juice at 1 mL/100 g ration (T1). It is known that feeding lime juice can be able to lowering the digestive track pH, especially proventriculus and uper intestine, thus stimulating the digestive enzyme activity. The increase of the determined-metabolizable energy in T2 and T3 was atributable to the the improved digestive process due to the effect of additional lime juice.

Feeding lime juice was also reported to improve the balance of bacterial population in the digestive tract. The balance improvement is suggested to be correlated with the change in potential hydrogen since the decrease in digestive tract pH bring about the beneficial bacteria developed more than pathogenic bacteria. This condition can ensure the better digestive tract health and thus provided a positive impact on the utilization of substrate (especially protein) by animal body. The higher protein availability was closely indicated by the increased protein digestibility and supported by the improved fiber digestibility and also the slower rate of passage (Table 2).

The citric acid content in the lime juice is able to make atmosphere of digestive tract into acidic condition, hence lowering the pH in the proventriculus, ventriculus and uper intestine, so that the enzymes in these digestive tract actively work to digest the dietary protein. As it has been briefly discussed in the previous paragraph that the acidic condition was also simultaneously suppress the growth of harmful bacteria that can ultimately improve digestive tract health which in turn would also affect nutrient digestibility. addition of 3% citric increased nutrient digestibility and apparent metabolizble energy.(Ghazalah et al., 2011) reported that the addition of acidifier has a positive influence on the growth of chickens due to the lowering pH of the digestive tract so that pathogenic bacteria that are not resistant to the low pH can be reduced. This suggested that acidifier could function as an antimicrobial, lowering the population count related to the improvement of digestibility values of crude protein, fat and crude fiber, and metabolizable energy as found in the present study. Gastrointestinal acidification bring about the impact on both changing the activation of the enzyme pepsinogen into pepsin and absorb nutrients that have been flatten by microorganisms (depend on pH range and types of microorganisms). (Martinez-Ameaqua et al., 2006),

described that dietary addition of 3% citric acids increased nutrient digestibility and apparent metabolizble energy. (Van Antwerpen et al., 2007) stated that the feeding effect of organic citric acid at the level of 2 % significantly increased protein and crude fiber digestibilities.

Effect on Growth Performance

Dietary inclusion of lime juice can increase the efficiency of nutrients utilization with the consideration that since nutrients consumption was the same but resulted the increase in nutrients digestibility (Table 2). The beneficial effect of lime juice as a acidifier was further supported by the data of increased body weight gain with lower feed conversion ratio (Table 3). Feed conversion ratio in T2 and T3 treatments were higher when compared to those in T0 and T1. This suggests that the beneficial effect of lime juice as an acidifier was correlated with the improved nutrients utilization efficiency. It was consistence with the finding of (Deepa, Jeyanthi, & Chandrasekaran., 2011) that feeding citric acid could improved body weight gain and feed convertion ratio.

Lowering pH of the digestive tract, due to additional lime juice, increased digestibility of crude protein because lower digestive tract pH is a favourable condition to support the activity of digestive enzyme. Digestive enzyme, especially pepsin has an important role on protein digestion. The increasing protein digestibility (Table 2) is a substrate contributing higher protein availability for body tissue synthesis. The higher body tissue synthesis provided an impact on the increase in body weight gain and improved performance in general. The higher nutrient digestibility, the more can be absorbed and be utilized for growth of body tissue. Body weight gain is closely related

232 to the increased nutrient digestibility, and the case in the present study was indicated by
233 the increase of protein digestibility of T2 and T3 ration (addition of 2 mL and 3 mL of
234 lime juice, respectively). The increase of protein digestibility improved body weight
235 gain. The present result was consistence with the report of (Rafacz-Livingston et al.,
236 2005) that the addition of citric acid by 2 to 6% in chicken rations increased body
237 weight gain, feed efficiency and feed conversion ratio.

238 Other possibility of the improvement performance of male Pelung chicken fed
239 additional lime juice was possibility due to the presence of flavonoid in lime juice. Lime
240 juice contain flavonoid which has a positive effect on growth (A, OC, Okeke, & O.,
241 2004). Chemical property of flavonoid could inhibit growth of virus, bacteria and fungi.
242 The more specific that active compound of flavonoid has the direct role as an
243 antibacterial to reduce bacteria activity. Therefore, feeding lime juice contains flavonoid
244 increasing animal health and finally brought about the higher body weight gain
245 compared to control. (Barrett, Grandison, & Lewis, 1999) supported the present result
246 that feeding citric acid increased lymphoid organs weight persentage (bursa fabricius
247 and thymus) as an indicator body health. Feeding citric acid in broiler chicken even with
248 low dietary protein level (19%) could increased body health indicated by anti-body titer
249 (Malkoski et al., 2001).

250 Organic acids were among alternative growth promoters that were being used to
251 stimulate growth performance in poultry (Biswas, Balac, Narlakanti, Haque, & Hassan,
252 2013) (Mohamed, Clementine, Didier, Gérard, & Marie Noëlle, 2013). Previous study
253 demonstrated that supplementation of organic acids to broiler diets increase growth
254 performance, improve gut morphology, reduce diseases and overcome some
255 management problems (Gunal, Yayli, Kaya, Karahan, & O. Sulak., 2006) . (Abd El-

Hakim, Cherian, & Ali., 2009) found that addition of organic acids to broiler diets improved FCR and growth performance. (Abdel-Fattah, El-Sanhoury, El-Mednay, & Abdel-Azeem., 2008) found that broiler chicks fed dietary organic acids had superior improvement in live body weight, body weight gain and FCR compared to those of unsupplemented diet. Feed conversion ratio of birds fed lime juice at the level of 0.3 mL (T3) was lower than that given without lime juice (T0). The present result can be compromized with the study of (Iqbal, Kazi, Bhanger, Akhtar, & Sarfraz, 2008) who reported that the birds given diet supplemented with organic acids showed a significant improvement in FCR as compared to the chicks fed the control diet. (Nezhad, Shivazad, Nazeeradl, & Babak., 2007) indicated that the addition of citric acid to a broiler diet improved feed efficiency, and the results implied that the beneficial effects of citric acid was on feed conversion.

Feeding high level of rice bran (60%) contributed to the content of phytate in feed by 4.14%, because rice bran containing 6.9% phytat. Phytate have affinity as chelating agent on divalent ions of some minerals (Ca, Fe, Cu, Mn, dan Zn) and also on protein, thus such nutrients availability for poultry growth is low. This condition can interfere with the body metabolism and resulted low body weight gain. Phytate affected the digestibility of dietary protein and amino acids in poultry (Kurniawati & Yuanita., 2014). The negative effects of phytate in rice bran could be eliminated by addition of lime juice, and the evidence of the process can be proved by the increased protein digestibility (Table 2). The increase in digested protein would then correlates with the increase in absorbed protein, which in turn increased body weight gain. Generally, ration composed of 20% rice bran or more could inhibit growth due to the presence of phytic acid, which formed complexes with protein, pectin, and starch or fiber

polysaccharides. This would become an obstacle on protein and phosphorus digestion hence affecting nutrient utilization for growth. Inclusion of citric acid (30 g/kg) in corn-soybean based diet for chicken with low native phytase activity and supplementation of microbial phytase increased protein and phosphorus depositions, and growth performance (Sukria & Liebert., 2004).

CONCLUSION

Based on the results of the research can be concluded that the best nutrient utilization is achieved by T3 treatment, namely rice bran-based diet added with 3 mL lime juice. Dietary inclusion of higher level of lime juice in male Pelung chicken can enhance the nutrient digestibility and finally resulting the increase in body weight gain and improvement of feed conversion ratio.

REFERENCES

Abd El-Hakim, A. S., G. Cherian, and M. N. Ali. 2009. Use of organic acid, herbs and their combination to improve the utilization of commercial low protein broiler diets. Int. J. Poult. Sci. 8: 14-20.

Abdel-Fattah, S. A., M. H. El-Sanhoury, N. M. El-Mednay, and F. Abdel-Azeem. 2008. Thyroid activity, some blood constituents, organs morphology and performance of broiler chicks fed supplemental organic acids. Int. J. Poult. Sci. 7: 215-222.

Adil, S., T. Banday, G. A. Bhat, M. S. Mir, and M. Rehman. 2010. Effect of dietary supplementation of organic acids on performance, intestinal histomorphology, and serum biochemistry of broiler chicken. Vet. Med. Int. 10(4): 479-485.

Atapattu, N. S. B. M. and C. J. Nelligaswatta. 2005. Effects of citric acid on the performance and the utilization of phosphorous and crude protein in broiler chickens fed on rice by-products based diets. Int. J. Poult. Sci. 4(12): 990-993.

Das S. K, Islam K. M. S., Islam M. A. 2011. Efficacy of citric acid in diet contains low levels of protein and energy on the performance and immunity of broiler. 7th International Poultry Show and Seminar - 2011 World's Poultry Science Association - Bangladesh Branch, 25-27 March 2011, Dhaka, Bangladesh. p. 318-324.

Deepa, C., G. P. Jeyanthi, and D. Chandrasekaran. 2011. Effect of phytase and citric acid supplementation on the growth performance, phosphorus, calcium and nitrogen retention on broiler chicks fed with low level of available phosphorus. Asian J. Poult. Sci. 5:28-34

Ghazalah, A. A., A. M. Atta, K. Elkloub, M. E. L. Moustafa, Riry, and F. H. Shata. 2011. Effect of dietary supplementation of organic acids on performance, nutrients digestibility and health of broiler chicks. Int. J. Poult. Sci. 10(3): 176-184.

Gunal, M., G. Yayli, O. Kaya, N. Karahan, and O. Sulak. 2006. The effects of antibiotic growth promoter, probiotic or organic acid supplementation on performance, intestinal microflora and tissue of broiler. Int. J. Poult. Sci. 5: 149-155.

Hassan, H. M. A., M. A. Mohamed, A. W. Youssef, and E. R. Hassan, 2010. Effect of using organic acids to substitute antibiotic growth promoters on performance and intestinal microflora of broilers. Asian-Aust. J. Anim. Sci. 23: 1348-1353.

Indreswari, R., H. I. Wahyuni, N. Suthama, dan P. W. Ristiana. 2009. Calcium utilization for egg shell formation in laying hens due to the different feeding regimes of morning and afternoon portion. JITAA 34(2):134-138.

Kurniawati, Y. R. dan L. Yuanita. 2014. Pengaruh asam sitrat dan fitase *Bacillus subtilis* HG pada jagung (*Zea mays L.*) terhadap biovailabilitas mineral Ca (*in-vitro*). J. Chemistry 3(1): 96-102.

Maghfiroh, K., I. Mangisah dan V. D. Y. B. Ismadi. Pengaruh penambahan sari jeruk nipis (*Citrus aurantifolia*) dalam ransum terhadap kecernaan protein kasar dan retensi nitrogen pada itik magelang jantan. Anim. Agric. J. 1(1): 669-683.

Martinez-Ameaqua, C., C. M. Parsons and D. H. Baker. 2006. Effect of microbial phytase and citric acid on phosporus bioavability, apparent metabolizable enegy and amino acid digestibility in distiller dried grains with solubles in chicks. Poult. Sci. 85(3): 470-475.

Mohamed, M. A., E. F. El-Daly, N. A. A. El-Azeem, A. W. Youssef, and H. M. A. Hassan. 2014. Growth performance and histological changes in ileum and immune related organs of broilers fed organic acids or antibiotic growth promoter. Int. J. Poult. Sci. 13: 602-610.

Nezhad, Y. E., M. Shivazad, M. Nazeeradl, and M. M. S. Babak. 2007. Influence of citric acid and microbial phytase on performance and phytate utilization in broiler chicks fed a corn-soybean meal diet. J. Fac. Vet. Med. 61:407–413.

Nourmohammadi, R., S. M. Hosseini, H. Saraee, A. Arab, H. Arefinia. 2011. Plasma thyroid hormone concentration and pH value of some GI-tract segments of broiler feed on different dietary citric acid and microbial phytase level. J. Anim. Vet. Adv. 10:1450-1454.

Onyeagba R. A, Ugbogu OC, Okeke, Iroakasi O. 2004. Studies on the antimicrobial effects of garlic (Allium sativum linn). Ginger (Zingiber officinale roscoe) and lime (Citrus aurantifolia linn). Afr. J. Biotechnol. 3:552-554.

Rafacz-Livingston, K. A., C. M. Parsons, and R. A. Jungk. 2005. The effects of various organic acids on phytate phosphorus utilization in chicks. Poult. Sci. 84: 1353.

Ridwan, R., S. Ratnakomala, G. Kartina dan Y. Widyastuti. Pengaruh penambahan dedak padi dan *Lactobacillus plantarum* 1BL-2 dalam pembuatan silase rumput gajah (*Pennisetum purpureum*). Med. Pet. 28(3): 117-123.

Sibbald, I. R. and M. S. Wolynetz, 1984. Estimates or retained nitrogen used to correct estimates of bioavalaible energy. Poult. Sci. 64 : 1506-1513.

Sukria, H. A. and F. Liebert. 2004. Citric acid and microbial phytase inclusion in the diet to improve utilization phytate phosporus and growth of broiler. Med. Pet. 27(1): 21-24.

365

366 Table 1. Basal Rations and Nutrient Content (As Fed Weight Basis)

Feedstuff	Composition
	----------%----------
Rice Bran	60
Concentrate CP 521 Merck	35
Mineral Mix	5
Total	100
Nutritional Content (%) :	
Metabolic Energy (kcal/kg)	2,353.91
Crude Protein (%)	14.57
Crude Fat (%)	6.57
Crude Fiber (%)	21.37
Calsium (%)	0.45
Posphor (%)	0.34

367

368 Table 2. Average of Nutrient Consumption, Coefficient Digestibility of Protein,
369 Fat, Fiber and Apparent Metabolizable Energy of Rice Bran-Based
370 Ration with Added Lime Juice Fed to 12 Weeks Old Male Pelung
371 Chicken
372

Parameter	Treatments			
	T0 (0 mL)	T1 (1 mL)	T2 (2 mL)	T3 (3 mL)
Protein consumption (g)	14.28±1.08	15.16±2.15	14.42±3.28	14.76±3.34
Fat consumption (g)	6.44±1.56	6.84±1.72	6.51±1.58	6.65±1.14
Fiber consumption (g)	20.94±1.26	22.24±1.37	21.16±0.98	21.64±1.15
Rate of passage (min)	183.60±5.74^{b}	205.58±10.04^{ab}	203.28±5.75^{ab}	221.23±10.36^{a}
Coefficient digestibility of protein (%)	72.79±1.18^{b}	73.65±1.24^{b}	76.90±1.05^{a}	77.43±1.74^{a}
Coefficient digestibility of fat (%)	71.85±2.66^{b}	74.40±2.00^{b}	83.87±2.66^{a}	82.06±2.70^{a}
Coefficient digestibility of fiber (%)	19.18±2.35^{b}	22.59±2.14^{ab}	23.16±2.37^{ab}	25.18±2.15^{a}
Apparent Metabolizable Energy (kcal/kg)	2401.99±5.30^{b}	2420.90±4.56^{b}	2532.67±5.08^{a}	2553.60±5.86^{a}

[a-b]Mean value of each parameter followed by different superscript showed significantly difference ($P \leq 0.05$)

Table 3. Average of Feed Consumption, Daily Weight Gain and Feed Conversion Ratio of 12 Weeks Old male Pelung Chicken Rice Fed Bran-Based Ration with Added Lime Juice Fed

Parameter	Treatments			
	T0 (0 mL)	T1 (1 mL)	T2 (2 mL)	T3 (3 mL)
Feed consumption (g/bird/day)	98.00±5.90	104.08±6.41	99.03±4.59	101.27±5.39
Initial body weight (g/bird)	998.50±12.44	1058.66±13.09	1095.54±13.52	1085.45±11.64
Final body weight (g/bird)	1331.10±10.05[c]	1400.46±12.44[b]	1446.38±11.88[ab]	1481.65±9.05[a]
Cummulative body weight gain (g/bird)	332.60±7.12[c]	341.80±8.80[b]	350.84±9.10[ab]	396.2±7.27 [a]
Daily body weight gain (g/bird/day)	10.85±0.71[b]	12.95±1.16[ab]	12.53±0.89[ab]	14.15±1.69[a]
Feed conversion ratio	9.02±4.08[b]	8.04±4.70[ab]	7.90±5.04[ab]	7.16±4.82[a]

[a-c]Mean value of each parameter followed by different superscript showed significantly difference ($P \leq 0.05$)

A, O. R., OC, U., Okeke, & O., I. (2004). Studies on the antimicrobial effects of garlic (Allium sativum linn). Ginger (Zingiber officinale roscoe) and lime (Citrus aurantifolia linn). *Afr. J. Biotechnol*, *3*, 552–554.

Abd El-Hakim, A. S., Cherian, G., & Ali., M. N. (2009). Use of organic acid, herbs and their combination to improve the utilization of commercial low protein broiler diets. *Int. J. Poult. Sci.*, *8*, 14 –20.

Abdel-Fattah, S. A., El-Sanhoury, M. H., El-Mednay, N. M., & Abdel-Azeem., F.

(2008). Thyroid activity, some blood constituents, organs morphology and performance of broiler chicks fed supplemental organic acids. *Int. J. Poult. Sci.*, *7*, 215–222.

Barrett, N. E., Grandison, A. S., & Lewis, M. J. (1999). Contribution of the lactoperoxidase system to keeping quality of pasteurized milk. *Journal of Dairy Research*, *66*, 73–80.

Biswas, N., Balac, P., Narlakanti, S. K., Haque, M. D. E., & Hassan, M. D. M. (2013). Identification of Phenolic Compounds in Processed Cranberries by HPLC Method. *Journal Nutrition Food Sciences*, *3*(181), 1–5.

Deepa, C., Jeyanthi, G. P., & Chandrasekaran., D. (2011). Effect of phytase and citric acid supplementation on the growth performance, phosphorus, calcium and nitrogen retention on broiler chicks fed with low level of available phosphorus. *Asian J. Poult. Sci.*, *5*, 28–34.

Ghazalah, A. A., Atta, A. M., Elkloub, K., Moustafa, M. E. L., Riry, & Shata, F. H. (2011). Effect of dietary supplementation of organic acids on performance, nutrients digestibility and health of broiler chicks. *Int. J. Poult. Sci.*, *10*(3), 176–184.

Gunal, M., Yayli, G., Kaya, O., Karahan, N., & O. Sulak. (2006). The effects of antibiotic growth promoter, probiotic or organic acid supplementation on performance, intestinal microflora and tissue of broiler. *Int. J. Poult. Sci.*, *5*, 149–155.

Indreswari, R., Wahyuni, H. I., Suthama, N., & Ristiana., P. W. (2009). Calcium

413 utilization for egg shell formation in laying hens due to the different feeding
414 regimes of morning and afternoon portion. *JITAA*, *34*(2), 134–138.

415 Iqbal, S., Kazi, T. G., Bhanger, M. I., Akhtar, M., & Sarfraz, R. A. (2008).
416 Determination of selenium content in selected Pakistani foods. *International*
417 *Journal of Food Science & Technology*, *43*(2), 339–345. doi:10.1111/j.1365-
418 2621.2006.01447.x

419 Kurniawati, Y. R., & Yuanita., L. (2014). Pengaruh asam sitrat dan fitase Bacillus
420 subtilis HG pada jagung (Zea mays L.) terhadap biovailabilitas mineral Ca (in-
421 vitro). *J. Chemistry*, *3*(1), 96–102.

422 Maghfiroh, K., Mangisah, I., & Ismadi., V. D. Y. B. (n.d.). Pengaruh penambahan sari
423 jeruk nipis (Citrus aurantifolia) dalam ransum terhadap kecernaan protein kasar
424 dan retensi nitrogen pada itik magelang jantan. *Anim. Agric. J.*, *1*(1), 669–683.

425 Malkoski, M., Dashper, S. G., Simpson, N. M. O. B., Talbo, G. H., Macris, M., Cross,
426 K. J., & Reynolds, E. C. (2001). Kappacin , a Novel Antibacterial Peptide from
427 Bovine Milk, *45*(8), 2309–2315. doi:10.1128/AAC.45.8.2309

428 Martinez-Ameaqua, C., Parsons, C. M., & Baker., D. H. (2006). Martinez-Ameaqua, C.,
429 C. M. Effect of microbial phytase and citric acid on phosporus bioavability,
430 apparent metabolizable enegy and amino acid digestibility in distiller dried grains
431 with solubles in chicks. *Poult. Sci.*, *85*(3), 470–475.

432 Mohamed, C., Clementine, K. A., Didier, M., Gérard, L., & Marie Noëlle, D.-C. (2013).
433 Antimicrobial and physical properties of edible chitosan films enhanced by
434 lactoperoxidase system. *Food Hydrocolloids*, *30*(2), 576–580.

435 doi:10.1016/j.foodhyd.2012.07.018

436 Nezhad, Y. E., Shivazad, M., Nazeeradl, M., & Babak., M. M. S. (2007). Influence of
437 citric acid and microbial phytase on performance and phytate utilization in broiler
438 chicks fed a corn-soybean meal diet. *J. Fac. Vet. Med., 61*, 407–413.

439 Rafacz-Livingston, K. A., Parsons, C. M., & Jungk., R. A. (2005). The effects of
440 various organic acids on phytate phosphorus utilization in chicks. *Poult. Sci*, *84*,
441 1353.

442 Ridwan, R., S. Ratnakomala, G. K. dan Y. W. (n.d.). Pengaruh penambahan dedak padi
443 dan Lactobacillus plantarum 1BL-2 dalam pembuatan silase rumput gajah
444 (Pennisetum purpureum). *Med. Pet.*, *28*(3), 117–123.

445 Sukria, H. A., & Liebert., F. (2004). Citric acid and microbial phytase inclusion in the
446 diet to improve utilization phytate phosporus and growth of broiler. *Med. Pet*,
447 *27*(1), 21–24.

448 Van Antwerpen, P., Dufrasne, F., Lequeux, M., Boudjeltia, K. Z., Lessgyer, I., Babar,
449 S., … Nève, J. (2007). Inhibition of the myeloperoxidase chlorinating activity by
450 non-steroidal anti-inflammatory drugs: flufenamic acid and its 5-chloro-derivative
451 directly interact with a recombinant human myeloperoxidase to inhibit the
452 synthesis of hypochlorous acid. *European Journal of Pharmacology*, *570*(1-3),
453 235–43. doi:10.1016/j.ejphar.2007.05.057

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I am pleased to inform you that your article submitted to Media Peternakan, entitled: "Nutrient Digestibility and Performance of Male Pelung Chicken Fed Rice Bran-Based Ration Suplemented with Lime (*Citrus aurantifolia*) Juice" has been approved to be published in Media Peternakan Vol. 39 No. 2 Year 2016 (August Edition). Please find the PROOF of your manuscript in the attached file. If there are still any corrections in the manuscript, please give us the revised article before August 25, 2016.

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