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(*Anas Platyrhynchos Domesticus*)

The Effect of Garlic (*Allium sativum*) as Supplementary Feed on Growth Performance of Cherry Valley Ducks (*Anas platyrhynchos domesticus*)

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ABSTRACT

The study was conducted to investigate the effect of garlic (*Allium sativum*) at the concentration of 0 %, 1% and 3% on growth performance of 27 Cherry Valley ducks (*Anas platyrhynchos domesticus*). The ducks were housed in battery cages with 3 ducks per partition of cages with access to water and diets for 2 weeks adjustment period and later, 4 weeks for feeding trial. Proximate analysis like moisture, crude protein, crude lipid, crude fibre, ash and nitrogen free extract were conducted on feed samples prior to feeding experiment while body weight gain, feed conversion ratio, feed intake and mortality rate were parameters used to measure growth performances. Data obtained were analysed by using one way ANOVA of IBM SPSS Statistic version 22. Moisture and crude lipid showed significant difference ($p < 0.05$) among treatments. There were no significant differences of protein, ash, fibre and nitrogen free extract for all treatments. Sampling of growth performance parameters were taken every 7 days for 4 weeks. Body weight gain showed significant difference ($p < 0.05$) among all treatments. There were no significant differences ($p > 0.05$) among all treatments in feed intake, mortality rate and feed conversion ratio. It can be concluded that feed supplemented with 1% garlic is suitable to improve growth performance of Cherry Valley ducks within 4 weeks of the feeding trial.

Keywords: Garlic, *Allium sativum*, Cherry Valley duck, *Anas platyrhynchos domesticus*

ABSTRAK

Satu kajian telah dijalankan untuk mengenalpasti kesan bawang putih pada kepekatan 0%, 1% dan 3% terhadap tumbesaran 27 ekor itik Cherry Valley (*Anas platyrhynchos domesticus*). Itik-itik tersebut ditempatkan di dalam sangkar dengan kapasiti 3 ekor per sangkar serta diberikan air dan rawatan makanan yang mengandungi variasi supplemen bawang putih sebagai regim diet untuk 2 minggu tempoh penyesuaian dan 4 minggu tempoh eksperimen. Analisa proksimat seperti kandungan kelembapan, protin, lemak, fiber, abu dan ekstraks bebas nitrogen dijalankan pada sampel makanan sebelum kajian pemakanan manakala kadar kenaikan berat badan, nisbah penukaran makanan, jumlah makanan yang diambil oleh itik dan kadar kematian merupakan parameter untuk mengukur kadar tumbesaran. Data bagi kenaikan berat badan, nisbah konversi makanan, sisa makanan and kadar kematian diambil dan direkod untuk mengukur tahap tumbesaran itik. IBM SPSS Statistic 22, 1 hala ANOVA digunakan untuk menganalisa data. Komposisi proksimat menunjukkan perbezaan yang nyata ($p < 0.05$) bagi data kandungan kelembapan dan kandungan lemak di antara semua rawatan. Komposisi nutrisi bagi protein, abu, fiber and juga ekstraks bebas nitrogen menunjukkan tiada perbezaan yang nyata ($p > 0.05$) bagi semua rawatan. Kadar tumbesaran itik diukur dengan kadar kenaikan berat badan, jumlah makanan yang diambil oleh itik, kadar kematian dan nisbah penukaran makanan yang diambil dalam tempoh masa setiap 7 hari untuk tempoh 4 minggu eksperimen. Bagi kenaikan berat badan, terdapat perbezaan yang nyata ($p < 0.05$) dalam semua rawatan. Tiada perbezaan yang nyata ($p > 0.05$) bagi data jumlah makanan yang diambil, kadar kematian dan nisbah konversi makanan bagi semua rawatan. Sebagai kesimpulan, pemakanan dengan 1% bawang putih sesuai untuk menaikkan kadar tumbesaran itik Cherry Valley dalam tempoh 4 minggu eksperimen.

Katakunci: Bawang putih, *Allium sativum*, Itik Cherry Valley, *Anas platyrhynchos domesticus*

INTRODUCTION

Feed additives such as antibiotics, enzymes and probiotics are capable to ameliorate the feed intake and growth rate in monogastric animal (Ademola, 2003). Herbs skin garlic (*Allium sativum*) is a species in the onion genus, *Allium* in the family Liliaceae is a potential feed additive which is widely used major in culinary and medicine intention. Parts of their metabolites content can directly be used in treatment and averting of infectious disease and cancer, or indirectly by induced the immune system with its high antioxidant traits and ability to prevent many degenerative diseases (Gomez-Flores *et al.*, 2008; Hakim *et al.*, 2007). Studies show the potentials of garlic as a choice of growth promoter in livestock production were conducted and its salutary effects on growth, digestibility and carcass traits have been reported (Bampidis *et al.*, 2005; Tatara *et al.*, 2008).

The treatment of garlic as a natural alternative antibiotic had increased the body weight and feed consumption of duck (Mohamed *et al.*, 2000). In addition to that, Adibmoradi *et al.* (2006) noted that garlic supplementation within range of 5–20 g/kg had positively affected histological structure of the small intestine in broiler chicks, which may enhance the nutrient digestion and absorption to increase the growth performance. Garlic has potential property of reducing stress as reported by Tollaba and Hassan (2003) who suggested that garlic supplementation could improve growth performance in broilers under heat stress conditions.

According to Department of Veterinary Services (2008), the feed conversion ratio of Cherry Valley ducks can reach about 2.61 that indicates high requirement of feed for better growth. At present, the per capita consumption of duck meat in Malaysia shows an incremental pattern from 1996 which is 0.88 kg and 1.71 kg in 2004. However, it is still lower compared to chicken meat consumption which is 28.35 kg in 1996 and 35.72 kg in 2004 by Veterinary Service of Malaysia. In addition, perception of high fat level in duck meat could also be a contributing factor to poor duck meat industry. High feed conversion ratio is also another factor that lowers the preference of rearing the ducks. Therefore, it is timely to undertake this research to address these problems. Therefore, lots of strategies need to be undertaken so that duck meat consumption in Malaysia will increase as well as to increase the economy of the duck farmers.

The aim for this experiment is to study the effect of garlic (*Allium sativum*) as supplementary feed on growth performance of Cherry Valley ducks (*Anas platyrhynchos domesticus*) in terms of body weight, feed conversion ratio, feed intake and mortality rate. Also, to determine the best ration of garlic supplement for Cherry Valley ducks.

MATERIALS AND METHODS

Feed preparation

The commercial feeds were bought from a petshop at Jerneh, Terengganu and Bachok, Kelantan with average weight of 50kg per bag. The brand used were broiler chicken starter 201C from Gold Coin for brooding purpose for 2 weeks period and broiler chicken grower 202P from Gold Coin for feed trial. The diets were kept in dry place at room temperature at approximately 27°C prior to experiment. The garlic samples were purchased from the Pasaraya Supermas, Kuala Besut with the estimated quantity about 40 kg throughout the experiment and kept in chiller at 4°C to avoid condensation. Garlic were peeled by using a knife according to Fridman *et al.*, (2014) before dried using the oven at 60°C for 76 hours. The dried garlic were then chopped into crumble form by using the knife and blended together by using a commercial blender. The concentrations of garlic that were supplemented into the commercial diet were 0% (100% commercial diets), 1% of garlic supplemented and 3% garlic supplemented respectively.

Experimental animal management

Twenty-seven tails of 2 days old duckling with approximate weight of 50 g to 60 g were used in this study. The ducklings were purchased from the HP Kampung Chick Trading, at Bachok, Kelantan area. The ducklings were reared in 9 separated cages. 3 ducklings were grouped as 1 group. The battery cages were designed for easy management of feeds and water distribution. The arrangement of battery cages house and ducklings was chosen by random sampling according to Completely Randomized Design method. The ducklings were provided with commercial feed supplemented with specific concentration of garlic as sources of feed and water daily. The feeds were distributed twice per day (0800) hour and (1700) hour and water was given at *ad-libitum*. Ducks were given morning bath daily in 200-300 liter freshwater pools as a management approach to improve their feed intake.

3 treatments in this feeding trial were includes:

* 100% CF = 100% commercial feed diet

G1% = 1% garlic supplemented, 99% commercial feed diet

G3% = 3% garlic supplemented, 97% commercial feed diet

Growth performance parameters

Ducklings were weighted using weight machine in every 7 days of 4 weeks feeding trial after the brooding period while feed intake and mortality rate were also recorded daily. Feed conversion ratio (FCR) and body weight gain were calculated after the brooding period in. Calculation of growth performance parameters were as follows:

BWG, Body Weight Gain (%) = $100 \times (\text{final weight} - \text{initial weight}) / (\text{initial weight})$

FI, Feed Intake = Total feed given – total feed leftover

Mortality rate = Total of the dead ducks

FCR, Feed Conversion Ratio = Feed intake / Body weight gain

Proximate composition analysis

The garlic sample, commercial feed diets sample, G1% feed sample and G3% feed sample were analyzed for their moisture content, crude protein, crude lipid, crude fiber, total ash content and nitrogen free extract according to protocols by AOAC (1990). Moisture content was determined by oven drying at 105°C up to constant weight. Ash content was determined by heating samples in muffle furnace at 550°C up to constant weight. The crude fibre was determined by using Fibretherm® system. The crude protein was determined by Kjeldahl method while lipid content was determined by Soxhlet method. Nitrogen free extract (NFE) was calculated by subtracting the sum of percentages of all the nutrients, which is assume brings the total 100% (AOAC, 1990).

Statistical analysis

Data on growth performance and composition of proximate analysis were analyzed with one way ANOVA using IBM SPSS Statistic version 22. Significant means were compared at 5% probability level using Duncan and Turkey as provided in SPSS system.

RESULTS AND DISCUSSION

Proximate composition of feed

The proximate analysis composition of sample (garlic), 100%CF, G1%, and G3% was shown in Table 1. Garlic showed the highest moisture (69.97%) among all treatments. The result also showed that garlic is significantly higher ($p < 0.05$) in terms of moisture as compared to 100% CF, G1%, and G3%. For the commercial feed, G1% and G3% treatment, the moisture levels were about 10.87%, 11.15% and 11.07% respectively.

Table 1 Proximate composition for the treatments of the diets

Parameters (%)	Proximate analysis			
	Garlic	100% CF	G1%	G3%
Moisture	69.97 ± 0.09 ^b	10.87 ± 0.13 ^a	11.15 ± 0.04 ^a	11.07 ± 0.02 ^a
CP ¹	19.65 ± 0.23	22.78 ± 0.10	24.3 ± 3.00	23.12 ± 0.14
CLipid ²	1.63 ± 0.15 ^a	5.29 ± 0.14 ^b	5.47 ± 0.14 ^b	6.11 ± 0.12 ^c
Cfibre ³	16.32 ± 0.13	14.67 ± 0.05	14.51 ± 0.05	20.01 ± 4.05
Ash	6.76 ± 0.65	5.81 ± 0.08	5.68 ± 0.09	5.90 ± 0.06
NFE ⁴	55.64 ± 0.56	51.44 ± 0.21	50.04 ± 3.00	44.85 ± 3.95

*Different alphabet a,b,c means there was significant difference between each of the data

¹CP = Crude protein

²CLipid = Crude lipid

³CFiber = Crude fibre

⁴NFE = Nitrogen Free Extract (% of NFE = 100 - CP - CF - EE – Ash)

The results differed from other treatments as dried garlic was used as supplementary feed in commercial feed at G1%, and G3% treatments respectively. Quality of dried garlic is improved as drying improves stability, reduces

water and microbiological activities including chemical changes during its storage (Ahmed *et al.*, 2001; Abano *et al.*, 2012; Arikan *et al.*, 2012). Based on the moisture content as in Table 1, it is not possible to store fresh garlic for a long time. Osmotic dehydration (OD) and pretreatment before drying was found advantageous for enhancing the product quality and for decreasing energy consumption by reducing drying time and cost (Mandala *et al.*, 2005; Garcia *et al.*, 2010). According to Fridman *et al.* (2014), the sources of garlic need to be peeled off. They were then dried using the oven at 60°C for 76 hours continuously. This method was chosen to prolong the shelf life of the garlic.

Results on protein showed no significant different ($p > 0.05$) among garlic, commercial feed, G1% and G3% which was within the range of 19% to 24%. The last two treatments (G1% and G3%) showed slightly higher in protein content. The results showed that the garlic itself has high content of protein similar to commercial feed and the other treatments. The mixture of commercial feed and garlic had also increased the protein content in the diet. G1% monopolized the highest protein content with 24.3%. This results is quite parallel to result of 22.66 % in a study as reported by Choi *et al.* (2010). Dietary garlic powder and alpha-tocopherol supplementation resulted in significantly higher crude protein and lower crude lipid contents. Protein is secondary major source of energy that plays important roles in body performances. In terms of growth performance of animals, the Protein Efficiency Ratio (PER) is one of the famous parameters scale. According to the Jay & Michael, (2004), protein efficiency ratio (PER) discovered the effectiveness of a protein via measurement of animal growth. Therefore, this study suggests that inclusion of dried garlic into diets can provide higher level of protein source for animals.

The crude lipid content, garlic showed the least fat content compare to others with significant different of ($p < 0.05$), whereas G3% also showed significant different ($p < 0.05$) as the highest fat content amount in the diet. Crude lipid for garlic, 100% CF, G1% and G3% are 1.63%, 5.29%, 5.47% and 6.11% respectively. The trend shows that crude lipid gradually increased with higher inclusion of garlic. The result conforms to a study by Nwinuka *et al.* (2005) that crude lipid content of garlic is approximately 0.68 ± 0.01 . Crude lipid in garlic indicates that there is an amount of lipid content in the feed when garlic is consumed. The increment in crude lipid in both G1% and G3% also suggests that the nutritional content may be altered when garlic is mixed with the commercial feed. However, further analysis was not done to confirm this observation. In addition to that, crude lipid provides high energy nutrient and does not add to the bulk of the diet (Atasie *et al.*, 2009). The active component of garlic has also some beneficial effects for livestock, and having hypocholesterolemic effects and growth promoting (Lewis *et al.*, 2003).

The crude fibre content that ranged from 14% to 20% showed no significant differences ($p > 0.05$) among treatments. The garlic itself has higher fibre content as compared to the commercial feed which are 16.32% and 14.67% respectively. As a herbacious plant, garlic has higher fibre content as compared to commercial feed. According to Turner & Lupton, (2011), dietary fiber are plant cell wall materials that cannot be digested by endogenous enzymes. Fibers are commonly used to improve the digestion in animals. It is interesting to note that fiber in chicken diets was also reported to influence the behavior of birds by decreasing cannibalism cases as birds spend more time eating than pecking each other (Hughes & Duncan, 1972; Hartini *et al.*, 2002).

Crude ash proximate compositions did not show any significant differences ($p > 0.05$) among treatments. The ash contents were 6.76%, 5.81%, 5.68% and 5.90% for garlic, 100%CF, G1% and G3%, respectively. The ash content in garlic was quite high which 6.76%. Ash is an indicator that shows the total of mineral varieties and vitamins content in diet. According to an article by Garlic Nutrition Facts, 100 grams of garlic contain various vitamin and minerals such as 95% of vitamin B-6 (pyridoxine), 52% of vitamin C, 33% of copper, 21% of iron, 18% of calcium, 26% selenium, and 73% of manganese. Both vitamins and minerals are important to support some of the nutritional requirements of ducks as well as to give energy booster that contributed to growth performance of ducks.

The Nitrogen Free Extract obtained from the value of crude protein, crude lipid, crude fiber and ash subtracted by 100% also did not significantly prove the differences ($p > 0.05$) between garlic and other treatments. The content of NFE are those that are not contained in crude protein, crude lipid, crude fiber and ash, and the major ingredients are soluble carbohydrates such as starch and sugars, as well as organic acids and lignin. NFE is one of the crucial nutrients as well as an energy source for animals.

Growth performance of the ducks

The growth performance parameters data is tabulated in Table 2. Results show that there is significant differences with ($p < 0.05$) for all treatments in body weight gain (BWG). However, feed intake, mortality rate and feed conversion ratio showed no significant differences ($p > 0.05$) among treatments.

Table 2 Growth performance for the each treatment

Growth Performance Parameters				
Parameters	BWG ¹ (%)	FI ² (g)	Mortality ³	FCR ³
⁵ 100%CF	58.98 ± 1.01 ^a	185.63 ± 7.63	0.00 ± 0.00	3.05 ± 0.01
⁶ G1%	63.21 ± 0.90 ^b	179.58 ± 3.61	0.33 ± 0.33	2.92 ± 0.07
⁷ G3%	61.81 ± 0.35 ^{ab}	184.17 ± 2.34	0.00 ± 0.00	2.98 ± 0.05

*Different alphabet a,b,c means there was significant difference between each of the data

¹BWG, Body Weight Gain (%) = $100 \times (\text{final weight} - \text{initial weight}) / (\text{initial weight})$

²FI, Feed Intake = Total feed given – total feed leftover

³Mortality, Mortality rate = Total of the dead ducks

⁴FCR, Feed Conversion Ratio = Feed intake / Body weight gain

⁵100%CF, 100% commercial feed given

⁶G1%, 1% garlic supplemented, 99% commercial feed

⁷G3%, 3% garlic supplemented, 97% commercial feed

Growth performance parameters like body weight gain, feed intake, fat content, carcass weight and feed conversion ratio are the key indexes or indicators to measure the growth of ducks. In this research, the growth performance parameters used were body weight gain (BWG), feed intake (FI), feed conversion ratio (FCR) and mortality rate.

BWG gained during the 28 days of the feeding trial shows that G1% is significant highest $63.21 \pm 0.90\%$ among all treatments. The highest body weight gain is maybe due to the highest protein content, 24.3 ± 3.00 , in the diet. Studies on garlic as preference of growth promoter in livestock production were conducted and its has salutary effects on growth, digestibility and carcass traits leading to increased body weight gain, feed efficiency, protein efficiency ratio (PER) and specific growth rate (Bampidis, *et al.*, 2005). The garlic (*Allium sativum*) has been further investigated and is well documented as antibacterial lead to improve performance and development of the gastrointestinal tract (Sivam, 2001). However, a studied reported by the Chowdury *et al.* (2002) stated that sun – dried garlic powder and garlic oil did not affect the growth performance of the chicken. The experiment conducted by Choi *et al.* (2010), showed that there were no significant differences between control, 1% supplemented and 3% supplemented of the garlic towards growth performance of the chicken. This observation differs from results obtained from this trial as garlic did affect the growth performance in ducks.

There was no significant differences ($p > 0.05$) among all treatments in feed intake. However, the mean value of G1% shows the lowest feed intake value at 179.58 ± 3.61 while control gave the highest feed intake with mean value of 185.63 ± 7.63 . This is probably due to mixture of garlic and commercial feed that produced different taste in feeds, thus causing unfamiliar feed taste to ducks. As a feed additive, garlic expressed its properties as to enhance the feed intake similar to control. Feed additives are commonly used to improve feed intake and to increase growth rate in broilers (Abouelfetouh *et al.*, 2012). Similar observation was also reported by Yalçin *et al.* (2007) that body weight, feed consumption, and feed efficiency were unaffected by the dietary garlic powder. The reason may be due to an odor precursor in garlic that is readily converted to an odorous

component such as allicin or diallyldisulfide which could contribute to an unpleasant taste (Langendijk *et al.*, 2007). Elagib *et al.* (2013) reported that the best performance was attained by the group of birds fed on diet containing 3 percent garlic powder and they reached the highest feed consumption. The lowest performance was obtained by the birds fed on the diet containing 5 percent dietary garlic powder.

The mortality rate is an important indicator to show the effect of garlic on ducks' survival. As concern of using garlic as health elements increased, the mortality rates of the ducks need to be understood more. In this trial, there were no significant differences ($p > 0.05$) of mortality rate among treatments. Besides that, the mortality rates were very low at less than 0.33%. There was only one duck that died throughout the 28 days of feeding trial from G1% treatment. This may be caused by extreme stress condition of the environment. In addition to that, the mortality may also be caused by changes of blood condition due to garlic intake as Iranloye (2002) reported increases in total white blood cell count, neutrophils, lymphocytes and monocytes following 30-day of feeding garlic, illustrating the anti-infection properties of garlic. A similar finding reported by Sahu *et al.* (2007) that serum bactericidal activity was improved in groups treated with garlic. However, these findings could not be proven as no further analysis on blood was conducted in the research.

Feed conversion ratio (FCR) for control and other 2 treatments demonstrated no significant differences ($p > 0.05$) among all treatments. FCR indicates the ratio of amount of feed given to the body weight gain achieved by the animals. The lowest value of feed conversion ratio means that feed given at low concentration but produced good growth rate. The lowest FCR for this recent experiment is 2.92 ± 0.07 which was from G1% treatment. The result conforms to data reported by the Department of Veterinary Services, Malaysia in 2008, which the FCR of ducks was around 2.61. The highest FCR was recorded from the control group which was 3.05 ± 0.01 . Onu (2010), showed that ginger and garlic supplementation at 0.25 percent level in broiler finisher diets amended the feed conversion ratio of the birds. Elagib *et al.* (2013), also reported that the best ratio was attained by the group of birds fed on diet containing 3 percent garlic powder had best feed conversion efficiency. However, Aporn & Adcharatt (2008) observed no significant differences among dietary treatments in feed intake, BWG and FCR in a study with broilers fed garlic powder (7–13 g/kg basal diet) supplemented diets.

CONCLUSION

As a conclusion, the growth performance parameters of the ducks can be enhanced by an introduction of 1 % garlic supplemented in the diet of ducks. The proximate analysis shows that there is a significant different in fat content with 3% garlic supplemented in ducks diets. In growth performance of ducks, G1% proved to improve the body weight gain of ducks. There were no significantly differences ($p > 0.05$), of feed intake and feed conversion ratio of ducks in all treatments. G1% also showed the lowest feed intake consumed and demonstrated better feed conversion ratio among other treatments.

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