Utilization of Garlic with and without Addition of Enzymes on Black-capped Lory (*Lorius lory* Linnaeus, 1758) in Captive Breeding (Penggunaan Bawang Putih Dengan dan Tanpa Pemberian Enzim pada Burung Nuri Kepala Hitam (*Lorius lory* Linnaeus, 1758) di Penangkaran)

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ABSTRACT

Phytogenic feed additives are plant-derived product such as herbs, spices, and essential oils used in animal feed to improve their performances and health. Garlic (*Allium sativum*) is well-known as a spice and herbal medicine. Garlic possesses antimicrobial activity and increase nutrient digestibility in animal. The objectives of this study were to compare the effect of supplementing garlic, exogenous enzyme and combination of both on Black-capped Lory (*Lorius lory*) in digestibility and bacterial count on excreta. Five Black-capped Lory were used in the study and fed with control diet (K1), control diet supplemented with garlic powder (K2), control diet supplemented with Allzyme SSF (K3), and control diet supplemented with both garlic powder and Allzyme SSF (K4). Variables observed include feed consumption, Apparent Metabolizable Energy (AME) value and bacterial count in excreta. Adding enzyme to the diet increased AME compared to control. AME value of K1 was 3,579 kcal/kg, meanwhile AME value of diet K3 and K4 were 3,690 kcal/kg and 3,619 kcal/kg respectively. Adding garlic to the diet did not give significant improvement to AME value. The highest inhibition of bacterial population was in K2 mash. Combination of allzyme and garlic addition showed decreased in bacterial number.

Keywords: Allzyme SSF, AME value, bacterial population, black-capped Lory, garlic

ABSTRAK

Pakan aditif fitogenik merupakan produk yang berasal dari tumbuhan seperti herba, rempah-rempah, dan minyak esensial yang digunakan sebagai bahan pakan hewan sehingga dapat meningkatkan performa dan kesehatan hewan. Bawang putih (*Allium sativum*) digunakan secara luas sebagai bumbu dapur dan pengobatan herbal untuk mencegah dan mengobati berbagai penyakit. Bawang putih juga memiliki kemampuan sebagai antibiotik dan dapat meningkatkan kecernaan nutrien pada hewan. Studi ini bertujuan untuk membandingkan efek pemberian bawang putih sebagai *feed additive*, enzim dan kombinasi keduanya terhadap kecernaan nutrien dan jumlah bakteri ekskreta pada burung nuri kepala hitam. Burung nuri kepala hitam sebanyak 5 ekor digunakan selama penelitian. Burung mendapat perlakuan pakan kontrol (K1), pakan kontrol yang diberi bawang putih (K2), pakan kontrol yang diberi Allzyme SSF (K3), pakan kontrol yang diberi bawang putih dan Allzyme SSF (K4). Data yang diamati antara lain adalah nilai konsumsi pakan, nilai energi metabolis semu (AME) dan jumlah bakteri pada ekskreta. Pemberian enzim pada pakan meningkatkan nilai AME dibandingkan kontrol. Nilai AME pada perlakuan K1 yaitu 3.579 kkal/kg, sedangkan pada perlakuan K3 dan K4 masing-masing sebesar 3690 kkal/kg dan 3619 kkal/kg. Pemberian bawang putih pada pakan tidak memberikan peningkatam yang signifikan terhadap nilai AME. Penghambatan jumlah bakteri pada ekskreta terdapat pada burung yang diberi perlakuan K2. Kombinasi bawang putih dan enzim menunjukkan penurunan jumlah bakteri.

Kata Kunci : Allzyme, bawang putih SSF, jumlah bakteri, nilai AME, nuri kepala hitam

INTRODUCTION

Phytogenic feed additives are plant-derived product such as herbs, spices, and essential oils used in animal feed to improve their performances and health (Abbas 2012). Recently, the use of phytogenic feed additive increased due to restrictions of antibiotic feed additive usage by European Union. Garlic (*Allium sativum*) is well -known as a spice and herbal medicine. Garlic possesses antimicrobial activity and causes beneficial effects on cardiovascular and immune system as well (Harris *et al.* 2001). Previous research concluded that garlic extract enhanced nutrient digestibility in broilers (JongKwan *et al.* 2009). Minh *et al.* (2010) also reported that

supplementation of dried garlic to diets led to improved total digestibility tract of broiler chicken.

As a natural antibiotic, garlic is potential as a good inhibitor of *Escherichia coli* and *Salmonella thyphimurium* in vivo (Griggs & Jacob 2005). *Escherichia coli* is common bacteria in intestinal tract, and some of their strain can cause infection on birds. While, *S. thyphimurium* can cause disease called salmonellosis that resulted in death in wild birds (Friend & Franson 1999). Intestinal microflora of birds plays an important role in host nutrition, growth performance and health of the host. The interaction is very complex and depending on the composition and activity of the intestinal microflora, it can have either positive and negative effects on the health and growth of the birds. Positively, the good intestinal microflora can enchance the gut system by interacting with nutrient utilization and the development of gut system of the host (Barrow 1992). On the other hand, several enteric pathogens associated with the intestinal microflora of birds can attach to the mucosa, gut integrity and function are severely affected and immune system threatened (Neish 2002). Some well known intestinal pathogens for birds are *Salmonella* spp., *Clostridium perfringens, Chlamydia psittaci, Campylobacter jejuni, Pseudomonas* sp., pathogenic strain of *Escherichia coli*, and some other enterobacteria. Enterobacteriaceae can function as primary or secondary pathogens. Stress, malnutrition, poor hygieni and concurrent disease often predispose birds to opportunistic bacterial overgrowth (Hoefer 1997).

Black-capped Lory (*Lorius lory*) also known as tricolored parrot is a parrot found in Papua island and New Guinea. It is relatively robust lory. Adult lory have green wings, red heads and body around the wing, a black cap, grey-black cere, yellow underwings, and blue legs and belly. They also have a blue nape and mantle. This species has attractive voice, may be loud at times. Due to liquid diet, this bird is quite messy. In the wild, they eat pollen, nectar, flowers, fruits and insects. The Black-capped lory inhabits the primary forest and forest edges in most lowland, also has been recorded in well grown secondary forest (Forshaw 1989). It is listed on Appendix II of CITES and Least Concern by the IUCN

The objectives of this study were to compare the effect of supplementing garlic, exogenous enzyme and combination of both in Black-capped Lory (*Lorius lory*) on some aspect such as digestibility and bacterial count on excreta.

MATERIALS AND METHODS

This research was conducted in the Bird Captivity, Zoology Division, Research Center for Biology-Indonesian Institute of Sciences, Cibinong. Nutrient feed and excreta analysis were carried out in the Laboratory of Nutrition Testing, Zoology Division, Research Center for Biology-Indonesian Institute of Sciences, Cibinong. The studies consisted of 2 experiments of 7 days of preliminary study and 2 periods of 21 days each of data collection. Five Black-capped Lory were used as replicants. During the study, the birds were placed in metabolic cage with the size of 70 cm x 43 cm x 52 cm.

Feed treatments consisted of control diet (K1), control diet supplemented with garlic powder (K2), control diet supplemented with Allzyme SSF (K3), and control diet supplemented with both garlic powder and Allzyme SSF (K4). The ingredient compositions of experimental diets are shown in Table 1.

The diets were given two times at 08.00 am and 03.00 pm. The amounts of feed consumed and remained were weighed and recorded every day, as well as the amount of excreta produced. Excreta were collected in the sealed plastic bag and stored in the freezer -20^{o} C until further analysis. Variables observed include feed consumption and Apparent Metabolizable Energy value.

Analysis of dry matter, crude protein, and ash of feed and excreta were carried out according to standard procedure of AOAC (1995). Gross Energy of feed and excreta were determined using adiabatic bomb calorimeter (Parr Instrument 1266 Illinois, USA). Apparent Metabolizable Energy was calculated based on Zarei (2006) formulation as well as nutrient digestibility (Sales & Janssens 2006).

Total plate count was performed based on microbial contamination test from Indonesian National Standard (SNI) 01-2897-1992. Serial dilutions were prepared on buffer peptone

Table 1. Ingredient and Compositions of Diet.

Compositions	K1	K2	K3	K4
	----------gram----------			
Rice bran	18	18	18	18
Fish Meal, 40% CP	34	34	34	34
Papaya (*Carica papaya*)	145	145	145	145
Bean sprout (*Phaseolus aureus*)	38	38	38	38
Lampung banana (*Musa paradisiaca*)	115	115	115	115
Honey (tbsp)	1	1	1	1
Water (ml)	100	100	100	100
Garlic (*Allium sativum*)	-	3.5	-	3.5
Allzyme SSF	-	-	1.0	1.0

excreta in 0.1% and 10^{-1} dilution was prepared by mixing 9 ml buffer peptone water and 1 ml excreta sample. Further dilutions (10^{-2}, 10^{-3}, 10^{-4}, etc.), were prepared by mixing 1 ml of previous dilution and 9 ml of 0.1% buffered peptone. Agars media and 'pour plate' method was used for enumeration of 'total plate count (TPC)'. TPC Total Plate Count agar was used. A 12 to 15 ml of sterilized (121^{o}C for 15 min.) rehydrated TPC-agar was mixed with 1 ml of appropriate excreta dilution, in petriplates, which were incubated at 37^{o}C for 48 hours. Numbers of colonies were then counted and microorganisms were recorded as colony forming units per mL (cfu ml^{-1}). Number of microorganisms = ml of dilution used x number of colonies x dilution factor.

RESULTS

Nutrient analysis used in this research is shown in Table 2, while feed intake, excreta production, and apparent metabolizable energy value are shown in Table 3.

From Table 2, diet K4 had the highest nutrient content. Since this diet consisted of garlic and the enzymes, it was resulted the highest portion of some nutrients. The enzyme itself contained *Aspergillus niger* fermentation product that made the energy content increased.

The AME value was increased by the addition of enzyme, but not with the addition of garlic (Table 3). The inclusion of both garlic and Allzyme tend to improve the AME value when compared to control (K1), but tend to

Table 2. Nutrient analysis of the diets (on DM basis)

Diet	DM	Ash	Protein	EE	GE
	----------%				kcal/kg
K1	85.08	16.98	13.72	2.31	3789
K2	86.53	17.03	14.29	2.67	3791
K3	87.20	22.32	16.21	2.75	3815
K4	89.10	22.31	18.62	2.84	3834

Notes: DM = Dry Matter, EE = Ether Extract, GE = Gross Energy

Table 3. Feed intake, excreta production, and AME value of black-capped lory

Parameter	K1	K2	K3	K4
Feed intake (g)	165.62± 24.36	169.93± 27.44	170.26± 24.82	148.96± 27.40
Excreta production (g)	11.13± 3.72	11.41 ± 3.84	6.93 ± 3.38	10.11±3.72
AME (kcal/kg)	3,579	3,549	3,690	3,619

Remarks: Each value represents mean of the birds

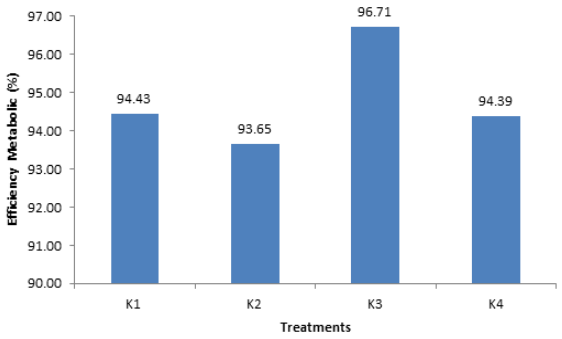

Figure 1. Efficiency metabolic of Black-capped Lory

decrease the value compared to K3 (Allzyme only).

Figure 1 shown that the efficiency metabolic of Black-capped Lory fed with K3 mash was higher compared to the others. As compared to control mash, bird with K4 mash did not give significant improvement.

The effect of adding garlic to K2 mash is inhibiting the bacterial population in excreta (Table 4). The highest bacteria population was in K3 mash.

DISCUSSION

Since diet K4 consists of garlic and some media for the enzyme, it resulted in high nutrient content. Based on website of USDA *national nutrient database*, garlic had 1,490 kcal/kg, crude protein 6.36%, ether extract 6.36%, and crude fiber 2.1%. Feed intake of diet K4 was lower than others. Feeding with high energy diet tended to reduce feed consumption. Suprijatna (2005) stated to meet their energy balance, birds need more feed. Feed intake was also influenced by dietary fat. Low dietary fat resulted in high feed intake. Adding enzyme to the diet increased AME compared to control. AME value of control groups (K1) were 3,579 kcal/kg, meanwhile adding Allzyme to the diet K3 (Allzyme only) and K4 (both Allzyme and garlic) were 3,690 kcal/kg and 3,619 kcal/kg respectively. It was reasonable that AME value had positive correlation with dietary gross energy and fat (Olukosi & Adeola 2009).

Besides that, supplementation with enzyme removed the effects of non-starch polysaccharide, which known as anti-nutritive, so the AME value increased. Sari (2015), also reported that Allzyme supplementation improved AME and nutrient digestibility in Blue-crowned hanging parrot. Meanwhile, adding garlic to the diet did not give significant improvement to AME value. Efficiency metabolic of black capped lory shown in Figure 1. Since the efficiency metabolic of K3 mash (allzyme only) was higher, so it can be concluded that bird fed with K3 mash using energy more efficiently to maintain its life.

Milpacher (2010) reported that garlic was best to avoid giving to bird. Garlic may cause haemolytic anemia in pet bird. Others feed to withhold from pet bird include alcohol, aloe vera, avocado, chocolate, coffee bean, oils, oxalic acid-contained food, red bean, herbs and spices. But some experiment stated that garlic may be given to bird in limited dose.

Fecal bacterial count was performed on excreta. The result of bacterial count are shown in Table 4. There appeared to be slightly difference of the number of the bacteria in the excreta among treatments. Treatment K2 (with garlic only) showed the higgest bacterial number while treatment K3 (with allzyme only) showed the lowest bacterial number. Treatment K4 (with allzyme and garlic) reduced bacterial number but not as high as treatment K2. Treatment K3 which had the highest bacterial number, shows little difference with treatment K1 (control group).

Adding garlic to feed tend to decrease bacterial population in excreta bird. The highest inhibition of bacterial population was in K2 mash. Allzyme addition tend to increase bacterial population, while combination of allzyme and garlic addition showed decreased bacterial number but not as high as garlic addition alone. Further study will be needed to clarify the decreased bacterial species with this treatment.

Table 4. Number of Excreta Bacteria in Black-capped Lory

Treatments	Number of Bacteria (CFU/gram)
K1 mash	2.22×10^{8}
K2 mash	$2.28 \times 10^{6*}$
K3 mash	$2.80 \times 10^{8**}$
K4 mash	1.29×10^{7}

Result in present study concur with the result of Jamroz & Kamel (2002) showed that using herbal in broiler feed such as garlic may reduce *E. coli* bacteria compared to control. Tucker (2002) also reported that herbs supplementation containing garlic, anise, and cinnamon significantly inhibited number of *E. coli* in digestive tract. The use of garlic powder as dietary suplementation showed a dose-dependent reduction in log colony forming unit of bacterial count as increasing dose applied on chicken (Olobatoke & Mulugeta. 2011). Peinado *et al* (2012), also observed that using garlic derivate propyl propane thiosulfonate as feed suplementary tend to signficantly decrease the population of intestinal *Salmonela* spp., *Campylobacter jejuni,* enterobacteria and *Eschericia coli* measured with qPCR technique. But the derivate had no effect on *Clostridium perfringens* population.

From the research, it can be concluded that using garlic in black-capped lorry feed has some advantages to increase metabolic efficiency and tend to reduce fecal bacteria population in excreta as well. Even in contrary, this usage is not recommended as feed in pet bird.

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REFERENCES

Abbas, TE. 2012. Phytogenic Feed Additives as a Cocciodistat in Poultry. *Bulletin Environment, Pharmacology and Life Science* 1(7): 22-24.

AOAC. 1995. Official methods of analysis of AOAC international, 16th ed. Association of Official Analytical Chemists, Arlington, VA.

Barrow, PA. 1992. Probiotics for chickens, in: Fuller, R (Ed.) *Probiotics: The scientific basis*. London: Chapman and Hall.

Friend, M. & JC. Franson. 1999. Field Manual of Wildlife Diseases. U. S. Department of the Interior, Washington, D. C., USA.

Forshaw, JM. 1989. *Parrots of The World. 3rd (revised) edition.* Melbourne: Lans Downe Edition: Melbourne. 78-81.

Griggs, JP. & JP. Jacob. 2005. Alternatives to Antibiotics for Organic Poultry Production. *Journal of Applied Poultry Research* 14: 750-756.

Harris, LC., SL. Cottrell, S. Plummer & D. Lloyd. 2001. Antimicrobial properties of Allium sativum (garlic). *Applied Microbiology and Biotechnology* 57: 282-286.

Hoefer, HL. 1997. Disease of The Gastrointestinal Tract. in: Altman, R.B., Clubb, S.L., Dorrestein, G.M. & Quesenberry, K. *Avian Medicine and Surgery*. Philadelphia: W.B. Saunders Co.

Jamroz, D. & C. Kamel. 2002. Plant extracts enhance broiler performance. Poult. Sci. Assoc. 91st Ann. Meeting, 11-14 Aug. 2002, Newark, Delaware. *Poultry Science* 80 Suppl: 41.

Jong Kwan, J., Y. SeYoung, K. JinSu, K. Young Woo, Y. Ku, K. IlKyung & C. ByungJo. 2009. Effect of Garlic Extract Supplementation on Growth Performance, Nutrient Digestibility, Carcass Characteristics, and Meat Composition in Broilers. *Korean Journal of Poultry Science* 36(4):287-292.

Milpacher, D. 2010. Human Foods: Are Some Dangerous for Parrots? http://www.parrots.org/pdfs/all_about_parrots/reference_library/health_and_nutrition/dangerous_foods_for_parrots.pdf.

Minh, DV., LV. Huyen, PC. Thieu, TQ. Tuan, NT. Nga & NQ. Khiem. 2010. Effects of Supplementation of Ginger (*Zigiberofficinale*) and Garlic (*Allium sativum* L) Extracts (Phyto-antibiotics) on Digestibility and Performance of Broiler Chicken. MEKARN Conference. Livestock Production, Climate Change and Resource Depletion. http://www.mekarn.org/workshops/pakse/abstracts/minh_nias.htm.

Neish, AS. 2002. The gut microflora and intestinal epithelial cells: A continuing dialogue. *Microbes and Infection* 4: 309-317.

Olobatoke, RY & SD Muluget. 2011. Effect of

dietary garlic powder on layer performance, fecal bacterial load and egg quality. *Poultry Science* 90: 665-670.

Olukosi, OA. & O. Adeola. 2009. Estimation of Metabolizable Energy Content of Meat and Bone Meal for Swine. *Journal of Animal Science* 87:2590-2599.

Peinado, MJ., R. Ruiz, A. Echavarri, & LA. Rubio. 2012. Garlic derivate propyl propane thiosulfonate is effective againts broiler enteropathogens in vivo. *Poultry Science.* 91: 2148-2157.

Sales, J. & GPJ. Janssens. 2006. A Note on Ash as Indigestible Dietary Marker to Determine Digestibility of Seeds in Adult Granivorous Birds. *Journal of Animal Feed Science* 15: 97-102.

Sari, AP. & R. Rachmatika. 2015. Effectiveness of Exogenous Enzymes on Apparent Metabolizable Energy and Nutrient Digestibility of Blue-crowned Hanging Parrot (*Loriculus galgulus*). *International Journal of Academic Research* 7(1):64-68.

Suprijatna, E., U. Atmomarsono & R. Kartasudjana. 2005. *Ilmu Dasar Ternak Unggas*. Jakarta: Penebar Swadaya.

Tucker, LA. 2002. Plant extracts to maintain poultry performance. *Feed International* 23 (9): 26-29.

Zarei, A. 2006. Apparent and True Metabolizable Energy in Artemia Meal. *International Journal of Poultry Science* 5 (7): 627-628.