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NUTRIENT CONCENTRATE FERMENTATION BASED SHRIMP WASTE AND EFFECT ON PRODUCTION PERFORMANCE PHASE LAYER NATIVE CHICKEN

Abun[1], Tuti WIDJASTUTI[1], Kiki HAETAMI[2], Denny RUSMANA[1], Jhondri[1]

[1]Faculty of Animal Husbandry, Padjadjaran University, Jalan Raya Bandung-Sumedang KM. 21, 45363, Sumedang-West Java, Indonesia, (phone) +6222 7798241, (fax) +6222 7798212.
[2]Faculty of Fisheries and Marine Science, Padjadjaran University, Jalan Raya Bandung-Sumedang KM. 21, 45363, Sumedang-West Java, Indonesia, (phone) +6222 7798241, (fax) +6222 7798212.

Corresponding author emails: abunhasbunap@gmail.com; abun_hasbuna.fapet @ yahoo.co.id

Abstract

Efforts toward improving the quality of waste containing high chitin through bioprocess shrimp waste utilizing Bacillus licheniformis, Lactobacillus sp. and Saccharomyces cereviseae, in order to obtain the product (Nutrient Concentrate) quality in order to meet the nutritional needs of local poultry (native chicken). Biological test products in the ration to determine its effectiveness towards achieving the optimal performance needs to be done. Native chicken has an important role as a provider of meat and eggs to be relied. The study was conducted using a laboratory experiment using a completely randomized design, consisting of 6 treatments rations and each repeated four times. Ration treatment: R0 = control diet (15% protein and ME 2,750 kcal/kg); R1 = rations containing 5% Nutrient Concentrate (Protein 15% and ME 2,750 kcal/kg); R2 = ration containing 10% Nutrient Concentrate (Protein 15% and ME 2,750 kcal/kg); R3 = rations containing 15% Nutrient Concentrate (Protein 15% and ME 2,750 kcal/kg); R4 = rations containing 20% Nutrient Concentrate (Protein 15% and ME 2,750 kcal/kg); and RS = standard ration (Protein 18% and ME 2,750 kcal/kg). Variables observed that the performance of native chicken layer phase (egg weight, number of eggs, daily egg production and feed efficiency) and hematological values chicken blood (erythrocytes, leukocytes, and blood hematocrit). Data were analyzed by analysis of variance and differences between treatments were tested by Duncan's multiple range test. The results obtained by the performance of native chicken layer phase with the use Nutrient Concentrate at the rate of 20% in the ration equivalent to the standard ration, the weight of the eggs ranged from 40.51 to 43.46 g/grain, the number of eggs from 32.37 to 33.16 grains/2 months, han-day 53.95% - 55.26% and feed efficiency of 54.02% - 58.95%.). Values range chicken blood hematological phase layer in the normal range, the number of erythrocytes ranged from 2.06 to 2.16 $\times 10^6$ /mm^3; leukocytes from 36.42 to 37.27 $\times 10^3$ /mm^3; and hematocrit 33.25% - 34.25%. Nutrient Concentrate can be used as a source of animal protein in the ration formulation native chicken layer phase and use up to the level of 20%.

Key words*: nutrient concentrate, shrimp waste, bioprocess, layer phase, native chicken.*

INTRODUCTION

Industrial waste material processing frozen shrimp is the potential to serve an alternative feed ingredients for poultry. It is based on nutritional content, ie: 43.41% crude protein, 18.25% crude fiber, 7.27% fat, 5.54% calcium, 1.31% phosphorus, 3.11% lysine, 1.26% methionine and 0.51% cystine, and gross energy 3,892 kcal/kg (Abun, 2008). Factors limiting the use of waste materials such as poultry feed is the presence of chitin in the amount of about 15-20%. Chitin bind strongly to protein, fat and mineral covalent bond ß (1-4) so difficult to be digested by the digestive enzymes of poultry (Leeson and Summers, 2001). Poultry do not have enzymes that can break the glycosidic bond β-(1-4), so that before used as feed material, the waste must be processed first. One of the efforts to transform organic material into useful new products and nutritional value better is to exploit microbes through bioprocess.

Bioprocess shrimp waste can be done in two phases, namely deproteination using *Bacillus licheniformis*, and demineralization with *Lactobacillus* sp. and *Saccharomyces cerevisiae. Bacillus licheniformis* is a bacteria that can produce protease and chitinase in relatively large quantities (Williams and Shih, 1989; Rahayu et al., 2004). *Lactobacillus* sp. a microbial decomposers glucose, sucrose,

maltose and lactose into lactic acid, causing mineral deposits (Lee and Tan, 2002). *Saccharomyces cerevisiae* is yeast that can produce the enzymes amylase, lipase, protease and other enzymes that can petrify digestion of nutrients in the digestive organs (Wagstaff, 1989).

The optimal performance of native chicken can only be realized if given rations of quality that meets the requirements in sufficient quantities and balanced. Fulfillment of nutrients in the diet can be done by adding the feed additives. It needs to be considered, as feed additives can improve the quality and value of benefits in native chicken rations. Thus, it is necessary to find alternative feed additives are inexpensive, easy to obtain, the quality is good, as well as non-food. One of them is the use of shrimp waste processed with fermentation technology and hereinafter referred Nutrient Concentrate.

Indonesia is the country's third largest shrimp producer in the world, annually produced about 0.08 million tons from an area of 380,000 hectares of shrimp ponds. Approximately 80-90% of the shrimp is exported in frozen form without heads and skins. Skin, head, and tail shrimp is industrial waste from factories freezing of shrimp, this waste can reach 30 - 40% of the weight of the whole (Krissetiana, 2005). The use of shrimp waste processed product is a source of alternative feed ingredients that can be used in the preparation of chicken rations.

Experts have conducted research to test the product bioprocess. Measurement of metabolizable energy product of fermentation residue oil palm by *Aspergillus niger* in broiler chickens, and the result is an increase in metabolizable energy by 14% from 1,844 kcal/kg to 2,103 kcal/kg (Simanjuntak, 1998). Increasing the value of shrimp waste protein digestibility fermented with *Bacillus licheniformis* and *Aspergillus niger* amounted to 13.27% (from 63.44% to 71.86%) in broiler chickens (Abun, 2008). Improving the quality of nutrition bioprocess resulted in complex molecules or organic compounds such as proteins, carbohydrates and fats into molecules that are simpler and easier to digest (Darana, 1995).

Native chicken has long been known by the people of Indonesia as the local chicken, chicken vegetable, or chicken, in Latin is known *Gallus domesticus*. Range chicken accounts for 20 to 40% of eggs and 25% of meat consumed in the country (Directorate General of Livestock, 2014). Native chicken is more likely to be developed as farm people, given the domestic poultry does not require substantial capital investment, easy maintenance, high adaptability, as well as meat and eggs are more favored by the public.

In general, native chicken reared traditionally-extensive (production is low and the mortality rate is high enough), causing the population to fluctuate from time to time. According to Rasyaf (1990), the potential and prospects of native chicken is very good but to date information and research on the development of native chicken is still small. The low level of productivity of native chicken is influenced by genetic and environmental factors. Genetic factors are poorly coupled with means and feeding the still traditional is the cause of low production of native chicken, both growth and egg production. Egg production reached only 30-60 eggs per year with an average egg weight of 37.5 grams per egg (Kingston, 1982). Rations containing Nutrient Concentrate bioprocess products sought a positive influence on the performance of native chickenlayer phase. It is understood by paying attention to the health of livestock is to know the condition of hematologic. Hematologic circumstances and in accordance with animal health standards causing the transport of oxygen and nutrients into the body to be smooth so the metabolic processes in the body, the better and, in turn, can increase the productivity of native chicken.

MATERIALS AND METHODS

(a) Preparation of "Nutrient Concentrate"

Deproteination. Starter inoculum *B. licheniformis* cultivated in 50 ml broth and incubated for 2 days at a temperature of 50^0C, then inoculated on shrimp waste substrate with a dose of 2% (v/w). Liquid substrate fermentation is done using auto-shakerbath for 2 days at a temperature of 45^0C with a rotation of 120 rpm (Abun et al., 2012).

Demineralization. Starter inoculum *Lactobacillus* sp. cultivated, mixed standard

solution (0.5% (w/v) yeast extract, 0.5% NH_4NO_3; 0.05% KCl; 0.05% $MgSO_4$; 0.01% $FeSO_4$; and 0.001% $CuSO_4$. inoculum of *Lactobacillus* sp. added to the product deproteination a dose of 2% (v/w) for 2 days at a temperature of 45^0C with a rotation of 120 rpm (Abun et al., 2012).

Fermentation with *Saccharomyces cerevisae*. *Saccharomyces cerevisiae* pure cultures were incubated for 3 days, then made inoculum to prepare a standard solution (NH_4NO_3 0.5%; 0.05% KCl; $MgSO_4.7H_2O$ 0.05%; $FeSO_4.7H_2O$ 0.01%; and $CuSO_4.5H_2O$ 0,001 %) and then fermented in auto-shakerbath. Product demineralization, then added inoculum of *Saccharomyces cerevisiaese* lot of 3% (v/w), then incubated for 2 days at a temperature of 35^0C (Haetami et al., 2010).

(b) Feeding Trial

Research using native chicken (*chicken Sentul*) of the Research Institute of Poultry Jatiwangi, Majalengka-West Java, Indonesia, grower phase. Chickens were randomly divided in 24 units cages, each cage contains one tail and on each cage are numbered. The chicken used in the study has a coefficient of variation of the initial weight of 4.07%.

Cages used in this study is a cage cages are divided into 24 cages with a capacity of 1 fish per cages, one unit cage measuring 50 cm long, 50 cm wide and 80 cm high. The enclosure has insulation made of bamboo, each bulkhead are numbered treatment. Each group comes with a cage where food and drink are made of plastic.

Feed materials making up the ration consists of: yellow corn, fine bran, soybean meal, coconut meal, fish meal, grit (flour shells), $CaCO_3$, coconut oil, and Nutrient Concentrate.

Experiment ration. Control diet (R0) and the standard ration (RS) is based on ISO (1995) and Zainuddin, et al. (2004). The content of protein and energy to the control diet (R0) is 15% and 2,750 kcal / kg, and the standard ration (RS) is 18% and 2,750 kcal/kg.

Ration treatment is as follows:

R0 = control diet (15% protein and ME 2,750 kcal/kg); R1 = rations containing 5% Nutrient Concentrate (Protein 15% and ME2,750 kcal/kg); R2 = ration containing 10% Nutrient Concentrate (Protein 15% and ME 2,750 kcal/kg); R3 = rations containing 15% Nutrient Concentrate (Protein 15% and ME 2,750 kcal/kg); R4 = rations containing 20% Nutrient Concentrate (Protein 15% and ME 2,750 kcal/kg); RS = standard ration (Protein 18% and ME 2,750 kcal/kg).

(c) Experimental Procedure

Include the maintenance of native chicken layer phase for 8 weeks (2 months) began laying hen (hand day 5%). Chickens were placed in cages of 24 units, each enclosure consists of one chicken. The stage of collecting and recording data, starting with chicken weighed to determine the initial weight. Measurement of feed intake and the number of eggs and egg weight do every day.

(d) Variable Observed

Variables measured: (1) egg weight (g/grain); (2) The number of eggs (item); (3) daily egg production (hand-day) (%); (4) Efficiency ration (%); (5) The number of erythrocytes (mm^3) is calculated using Haemocytometer; (6) Number of leukocytes (mm^3) was calculated from the total white blood cells; and (7) The hematocrit value (%) to calculate the volume of cells in the blood.

(e) The experimental design and statistical analysis

The experiments were performed using the experimental method in the laboratory. The experimental design used was a completely randomized design, consisting of 6 treatments ration (R0 = ration low in protein / 15%; R1 = rations containing 5% Nutrient Concentrate / protein 15%; R2 = rations containing 10% Nutrient Concentrate / protein 15%; R3 = rations containing 15% Nutrient Concentrate / protein 15%; R4 = rations containing 20% Nutrient Concentrate / protein 15%; and RS = high ration protein18%) and each repeated four times. Data were analyzed with Fingerprint Car (Test F) and the differences among the treatments tested using Duncan's Multiple Range Test.

RESULTS AND DISCUSSIONS

The average egg weight, number of eggs, the daily production and feed efficiency of native chicken layer phase for 8 weeks (2 months) experiment is shown in Table 1.

Table 1. Egg weight, number of eggs, eggs daily production and efficiency phase native chicken layer rations for 8 weeks (2 months) trial

Variables	Treatments					
	R0	R1	R2	R3	R4	RS
Egg Weight (g/item)	44.21^{A}	43.46^{A}	43.00^{A}	43.43^{A}	40.51^{A}	44.65^{A}
Number og Eggs (grains)	32.37^{A}	33.16^{A}	33.16^{A}	33.16^{A}	32.37^{A}	33.16^{A}
Eggs Daily Production (%)	53.95^{A}	55.26^{A}	55.26^{A}	55.26^{A}	53.95^{A}	55.26^{A}
Efficiency Ration (%)	59.53^{A}	58.95^{A}	57.33^{A}	57.90^{A}	54.02^{A}	57.95^{A}

The average weight range chicken eggs experimental results ranged from 40.51 to 44.65 grams/grain. The analysis showed that the treatment ration showed no significant differences (P>0.05) to the weight range chicken eggs. Use of Nutrient Concentrate up to the level of 20% in native chicken ration phase layer does not affect the egg weight.

The average number eggs of native chicken layer phase for 8 weeks of the experiment results ranged from 32.37 to 33.16 grains. The analysis showed that the treatment ration showed no significant differences (P>0.05) to the number eggs of native chicken layer phase. Use of Nutrient Concentrate up to the level of 20% in native chicken ration phase layer does not affect the number of eggs.

The mean hand day production range native chicken eggs for 8 weeks of the experiment results ranged from 53.95 to 55.26%. The analysis showed that the treatment ration showed no significant differences (P>0.05) on hand day production range native chicken eggs. Use of Nutrient Concentrate up to the level of 20% in native chicken ration phase layer does not affect the hand day egg production.

The average efficiency feed of native chicken trial results for 8 weeks ranged from 54.02 to 59.53%. The analysis showed that the treatment ration showed no significant differences (P>0.05) on the efficiency of feed utilization of native chicken. Use of Nutrient Concentrate up to the level of 20% in native chicken ration phase layer does not affect the efficiency of feed utilization.

Use of Nutrient Concentrate up to the level of 20% in the diet did not negatively impact performance in native chicken egg production, and the results were equivalent to a standard diet (18% protein ration). Chicken body weight during the study are relatively homogeneous with a coefficient of variation of body weight ranged between 3.80% - 4.07%, with each chicken feed consumption of 75 g/day.

The mean value of erythrocytes, leukocytes, and blood hematocrit range native chicken layer phase containing rations Nutrient Concentrate for two months trial are presented in Table 2.

Table 2. Values of erythrocytes, leukocytes, and blood hematocrit native chicken phase layer rations containing nutrient concentrate for two month trial

Variables	Treatments					
	R0	R1	R2	R3	R4	RS
Erythrocytes($\times 10^6$/mm^3)	2.18^{AB}	2.16^{AB}	2.13^{AB}	2.06^{B}	2.09^{AB}	2.22^{A}
Leukocytes($\times 10^3$/mm^3)	36.07^{AB}	36.42^{AB}	36.65^{AB}	36.79B^{B}	37.27^{AB}	36.53^{A}
Hematocrit (%)	33.00^{B}	33.25^{B}	33.38^{B}	33.63^{AB}	34.25^{A}	33.38^{B}

The average value range chicken blood erythrocyte experiment results for 8 weeks ranged from 2.065 to 2.221$\times 10^6$ /mm^3.

The analysis showed that the treatment ration significant effect (P<0,05) to native chicken blood erythrocytes.

Use of Nutrient Concentrate in the ration at the rate of 20% (R4 /15% protein) did not show

significant differences (P>0.05) with standard ration (RS / 18% protein) against the value of the phase range chicken blood erythrocyte layer. Normal red cell count in chickens according to Smith (1987) ranged from 2.0 to 3.2 × 10^6 grains/mm^3, mean blood erythrocyte value of native chicken are still in the normal range. The number of erythrocytes per mm^3 of blood varies according to species and also between individuals within a species. According to Swenson (1977), the number of erythrocytes is influenced by several factors, including age, sex, diet quality, disease and environmental temperature.

The mean value of native chicken blood leukocyte 8-week experiment results ranged from 36.07 to 37.27 ×10^3 / mm^3. The analysis showed that the treatment ration significant effect (P <0.05) on blood leukocytes range chicken. Use of Nutrient Concentrate in the ration at the rate of 20% (R4 / 15% protein) did not show significant differences (P>0.05) with standard ration (RS / 18% protein) against the value of the phase range chicken blood erythrocyte layer. The content of leukocytes from the research results within the normal range according to Smith (1987) that is between 16-40 ×10^3 grains/mm^3. Chicken means not impaired in their blood because of physiological systems across flats are within the normal range. According to Brown, et al (1989), the number of erythrocytes and leukocytes far below varies depending on the type of animal. Fluctuations in the number of leukocytes in each individual is quite large on certain conditions such as: stress, physiological activity, nutrition, age, and others. Frandson (1993), stated that increasing the number of leukocytes is generally a sign of infection or injury.

The mean blood hematocrit values range chicken for 8-week results of the experiment ranged from 33.00 to 34.25%. The analysis showed that the treatment ration significant effect (P <0.05) on blood hematocrit values range chicken. Use of Nutrient Concentrate in the ration at the rate of 20% (R4 / 15% protein) significantly (P <0.05) higher than the standard ration (RS / 18% protein) against native chicken blood hematocrit valuesphase layer. Normal hematocrit values in chickens according Sturkie (1986) ranged from 29-40%, meaning chicken not impaired in their blood because of physiological systems across flats are within the normal range. The high hematocrit value caused by the tendency of the red cell count is high. According to Swenson (1977), hematocrit value has a positive relationship with the number of erythrocytes. Frandson (1993), adding that the hematocrit value is the percentage of blood that consists of red blood cells (erythrocytes). Hematocrit value of all treatments on the results of this study are in the normal range.

Native chickenby layer phase containing rations Nutrient Concentrate 20% during the study had hematologic value good (healthy) and decent as test animals. The fact that the value of the erythrocytes obtained ranged from 2.06 to 2.2 ×10^6 grains/mm^3 in the normal range (poultry ranged between 2.0 to 3.2 ×10^6 grains/mm^3). Leukocyte values ranged from 36.07 to 37.27 ×10^3 grains/mm^3 in the normal range (poultry ranged between 16-40 ×10^3 grains/mm^3). Hematocrit values ranged from 33.00 to 34.25% in the normal range (poultry ranges between 29-40%).

CONCLUSIONS

Production of the optimal range native chicken eggs for 60 days of maintenance is the treatment of rations containing 20% Nutrient Concentrate with the average egg weight 40.51 g/grain; the number of eggs 32.37 grains; and the production of hand-day 53, 95%; the feed efficiency of 54.02%.

Nutrient Concentrates can be used up to a level of 20% in native chicken ration phase layer without affecting the health of chickens (erythrocytes = 2.06 to 2.22 × 10^6/mm^3; leukocytes = 36.07 to 37.27 × 10^3/mm^3; and hematocrit = 33.00 to 34.25%).

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REFERENCES

Abun, R.L. Balia, S. Darana, 2012. Bioproses Limbah Udang Windu (*Penaeus monodon*) melalui Tahapan Deproteinasi dan Mineralisasi untuk Meningkatkan Kandunan Gizi Pakan. Jurnal Ilmu-Ilmu Hayati dan Fisik Bionatura. Vol.14, No.1. Sumedang.

Abun, 2008. Biokonversi Limbah Udang Windu (*Penaeus monodon*) oleh *Bacillus licheniformis* dan *Aspergillus niger* serta Implementasinya terhadap Performan Broiler. Disertasi, Pascasarjana Universitas Padjadjaran, Bandung.

Brown D., Dellman P., 1989. Histologi Veteriner 1. Edisi ke 3. UI Press, Jakarta.

Bell D., W.D.Weaver, 2002. Commercial Chicken Production Meat and EggProduction. 5thEdition. Springer Science and Business Media Inc., United Stated.

Darana S., 1995. Penggunaan Sorghum bicolour L. Moench yang Difermentasi dengan Kapang Rhizopus oligosphorus dalam Ransum Ayam Broiler. Disertasi. Program Pascasarjana, IPB, Bogor.

Direktorat Jenderal Peternakan, 2014. Produksi Daging (ton), 2000 – 2014. Jakatra.

FrandsonR.D., 1993. Anatomi dan Fisiologi Ternak. Ed.Ke-4.GadjahMadaUniversity Press, Yogyakarta.

Haetami K., Junianto, Abun, 2010. Kajian Pemanfaatan Limbah Inti Sawit dalam Produksi Bio-Mos (Mannan Oligosakarida) sebagai Sumber Energi pada Pakan Nila. Laporan Penelitian, LPPM Unpad, Sumedang.

Krissetiana H., 2005. Kitin dan Kitosan dari Limbah Udang. H.U. Suara Merdeka, 31- Mei. Jakarta.

Lee V., E. Tan, 2002. Enzymatic Hydrolysis of Prawn Shell Waste for The Purification of Chitin. Departement of Chemical Engineering, Loughborough University.

Leeson S., J.D. Summers, 2001. Commercial Poultry Nutrition. University Books Guelph, p. 70.

National Research Council, 1994. Nutrient Requirement of Poultry. 9th ed. National Academy Press, Washington DC. 12:21-22.

Rahayu S., F. Tanuwidjaya, T. Rukayadi, A. Suwarto, M.T. Suhartono, J.K. Hwang, Y.R. Pyun, 2004. Study of Thermostable Chitinase Enzymes from Indonesian Bacillus K29-14. J. Microbiology. Biotechnology. 14(4) : 647-652.

Rasyaf M., 1990.BeternakAyam Pedaging. Penebar Swadaya. Jakarta.

Scott M.L., M.C. Nesheim, R.J. Young, 1982. Nutrition of the Chicken. M.L. Scott and Associate, New York.

Simanjuntak S.D.D., 1998. Penggunaan Aspergillus niger untuk Meningkatkan Nilai Gizi Bungkil Inti Sawit dalam Ransum Broiler. Tesis. Institut Pertanian Bogor, Bogor.

Smith J.B, 1987. Pemeliharaan, Pembiakan dan Penggunaan Hewan Percobaan di Daerah Tropis. UI Press, Jakarta.

Sturkie, 1986. Body Fluids, dalam avian physiology. Springer Verlag. New York, Berlin, Tokyo : 108 – 117.

Swenson M.J., 1977. Blood Circulation and Cardiovascular System, dalam Dukes Physiology of domestic animals. Ad.Cornell. Univ.Press Ithaca. London, 574-587.

Wagstaff R.K., 1989. Improved Digestibility of Feeds by Enzyme Addition. Kemin Industries, Inc. Des Moines. Iowa USA.

Williams C.M., J.C.H. Shih, 1989. Enumeration of Some Microbial Groups In Thermophilic Poultry Waste Disasters and Enrichment of a Feather- Degrading Culture. J. Appl. Bacteriol 67 : 25 – 35.

Zainuddin D., 2004. Strategi Pemanfaatan Pakan Sumberdaya Lokal dan Perbaikan Manajemen untuk Ayam Lokal. Balai Penelitian Ternak Ciawi, Bogor.