Performance and Milk Quality of the Lactating Dairy Cow Consuming *Ganoderma lucidum,* Organic Chromium and CLA as Feed Supplement

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Abstract

The aim of this study was to evaluate the use of feed supplement containing Ganoderma lucidum (GL), orgCr (organic Chromium) and CLA (Conjugated linoleic acid) from roasted soy bean by measurement of performance and milk quality of the lactating dairy cow. Two experiments were carried out in different time based on randomized block design. The first experiment used nine of the lactating dairy cow that consume three rations: R0: control; R1: R0 + GL; R2: R0 + GL + orgCr. The second experiment used twelve of the lactating dairy cow that consume four rations: P0: control; P1: P0 + GL + CLA; P2: P0 + CLA + orgCr; P3: P0 + GL + CLA + orgCr. The parameters for cow performance were consumption, average of daily gain, digestibility and milk production; while milk quality were protein, fat and total solid of milk. The first experiment results were the use of R2 increased as much two times of average of daily gain, 16% of milk production and 22% of milk fat. The second experiment results were P1 significantly increased 13% of the consumption and 18% of digestibility ($P<0.05$). The highest of milk production 4% FCM (9.09 kg/d) was achieved by consume P3 in which milk fat, protein and total solid significantly increased 29%, 21% and 7%, respectively from control ($P<0.05$). As conclusion, the performance and milk quality of the lactating dairy cow could be improved by addition of feed supplement containing Ganoderma lucidum, organic Chromium and roasted soybean as a source of CLA.

Keywords: chromium, CLA, dairy cow, Ganoderma lucidum, milk

Introduction

Good management of rearing the lactating dairy cow is an important step for continuity farm to meet high quality product. The animal in this period should get adequate feed to fulfill the requirement. There are some conditions affect to the quantity and quality of milk production such as low quality and availability of forages, insufficient amount and quality of concentrate, and the climate change. To maintain the stability of its production, there is one alternative way such as feeding management control by giving the feed supplement in certain circumstances like in transition and lactation periods. Feed supplement should be appropriate to its function in animal body. One of feed supplement which popular for human is fruiting body of *Ganoderma lucidum* mushroom. This mushroom having high capability as one of pharmacological substances like immunomodulator due to containing ganoderic acid, triterpenoid, β-D-glucan, etc, that function to improve the immunity system of human (Jin, 2000; Sjabana, 2001).

In our previous research, when sheep consumed 15-30% of *G. lucidum* mycelium for one month, blood lymphocyte increased around 24% compared than control, consumption of dry matter, organic matter and nitrogen retention also increased, but the average of body weight gain decrease by increasing of mycelium in rations (Amirroenas *et al.*, 2002). Based on those results, in this research the use of *G. lucidum* as feed supplement was enriched by addition of organic Chromium. Moreover, source of CLA (*conjugated linoleic acid*) which made from roasted soy bean was added also to the supplement for improving the animal productivity. The aim of these researches were to evaluate the use of feed supplement containing *Ganoderma lucidum* (GL), orgCr (organic Chromium) and/or CLA through measurement of performance and milk quality of the lactating dairy cow.

Materials and Methods

Two experiments were carried out in different time which each of experiment used randomized block design for 8 weeks. Both of experiments used similar type of dairy cow in different number. In the first experiment, nine of the lactating dairy cow with body weight average 392.74 $\pm$ 22.7 kg and 3–9 liter milk production per day were used, and in the second experiment, twelve of the lactating dairy cow with body weight average 380-450 kg and 3–16 kg milk production day were used.

In daily rearing, the cow given the basal ration that suitable to their lactation periods. Both of the experiments used supplement substances such as the fruiting body of *Ganoderma lucidum* and organic Chromium (orgCr), while CLA (*conjugated linoleic acid*) was used in the second experiment only. There were two kinds of substrate that used for producing of organic Chromium (orgCr). To produce orgCr in the first experiment, an-organic Chromium was incorporated into rice straw as a

substrate in fermentation process using *Ganoderma lucidum,* while another orgCr in the second experiment was produced by similar way with soy bean as a substrate in fermentation process using *Rhizopus sp*. For the second experiment, source of CLA was obtained by dry frying the soy bean in 15 minutes. All of supplement substances were added to the lactating dairy cow rations with composition as below, R0= basal ration as a control; R1= R0 + *Ganoderma lucidum* (GL); R2= R0 + GL + orgCr, for the first experiment, and P0= basal ration as a control; P1= P0 + GL + CLA; P2= P0 + CLA + orgCr; P3= P0 + GL + CLA + orgCr, for the second experiment. Doses of supplement substances were GL 100 ppm/day, orgCr 3 ppm/kg DM ration, and CLA 5% of ration total fat. All rations fulfilled the requirement of 14% crude protein and 67% TDN for the lactating dairy cow, where ratio of concentrate and forage was 50:50. For both of experiments, two kinds of parameter were measured such as performance that consisted of dry matter consumption (DMC), average of daily gain (only in the first experiment), dry matter digestibility (DMD) and milk production. The other parameter was milk quality that consisted of protein, fat, total solid and solid non fat. The results data of experiment were analyzed by ANOVA of randomized block design and Duncan's test (Steel and Torrie, 1993).

Results and Discussion

The results of feed supplement effect of ration containing *G. lucidum* (GL), orgCr and CLA to the performance and milk quality of the lactating dairy cows in difference time of experiment were written in Table 1. In the first experiment, addition of GL and also orgCr (R1 and R2) showed no different effect to dry matter consumption (DMC) and dry matter digestibility (DMD), but significantly increased around 13% of DMC and 18% of DMD when roasted soy bean were added to the supplements (P1 and P2) ($P<0.05$). Linoleic acid from soy bean can be used as a precursor of CLA in the rumen. Or-Rashid *et al*. (2011) reported that the major isomer of CLA synthesized from linoleic acid was 9*c*11*t*-CLA isomer and the second largest was 10*t*12*c* produced predominantly by the bacterial suspension (12 hours of incubation in rumen). Bacteria and protozoa can hydrogenize CLA isomer of stearic acid (18:0) through the reduction of 18:1 isomers. However, lipids including polyunsaturated fatty acids (PUFA) that present in ruminant forage/ration undergo extensive hydrolysis and biohydrogenation in the rumen. Hence, in the presence of PUFA at 50 μg ml^{-1} inhibited grow of cellulolytic bacteria. Toxicity to growth was ranked EPA (eicosapentaenoic acid) > DHA (docosahexaenoic acid) > LNA(alpha linolenic acid) > LA (linoleic acid) (Maia *et al.*, 2007). Increasing of digestibility was corresponding to increasing of the consumption. In addition of CLA together with orgCr and *G. lucidum* in P2 and P3, there were occurred slight decreasing of digestibility also consumption.

In the first experiment, there was two times increasing of the average daily

gain when dairy cows consumed R2. This increasing might affected by addition of chromium (Cr) to the supplement. As a *Glucose tolerance factor* (GTF), Cr will interact to insulin and cell receptor, then induce glucose enter cell, after that change to energy then used for protein synthesis, maintaining cell and growth of tissue in the body (Vincent and Davies, 1997).

There was no different effect of GL addition (R1) in the ration to milk production and milk production in 4% FCM than control, but increasing percentages of those milk parameters were occurred in addition of orgCr in R2 as much 16% and 30%, respectively. These results were more increase in the second experiment by addition of orgCr and CLA in P1 (72% and 80%), P2 (85% and 102%) and P3 (91% and 112%), and also were higher than Adawiah (2006) when used similar amount of roasted soy bean as a source of CLA in the ration, and found increasing of milk production and production of 4% FCM on dairy cow were 14.96% and 17.79%, respectively than control.

In case of milk quality especially in solid non fat for both of experiments, there were no different effect, also in milk protein and total solid (R1 and R2), but increased by addition of orgCr (P2 and P3). Milk protein and solid non fat from the first experiment were suitable to SNI 01-3141-1998 (2.7% and 8.0%), but their percentages were higher in the second experiment. Increasing of milk protein of

Table1. Effect of the feed supplement containing *Ganoderic lucidum*, organic Chromium and CLA to performance and milk quality of the lactating dairy cow

Parameters	The First Experiment			The Second Experiment			
	R0	R1	R2	P0	P1	P2	P3
Performance:							
Consumption (kg/d)	14.60±0.46	14.31±0.60	14.65±0.33	7.44±0.32^{c}	8.45±0.69^{a}	8.35±0.43^{a}	7.87±0.65^{b}
Digestibility (%)	75.10±0.8	78.80±1.0	78.20±0.5	49.40±0.5^{c}	58.20±0.8^{a}	57.80±0.5^{a}	55.20±0.7^{b}
Avg of daily gain (kg/d)	-0.03±0.48	-0.11±0.30	0.03±0.34	-	-	-	-
Milk production (l/d)	5.43±1.93	5.28±3.08	6.30±4.24	3.97±2.12	6.81±4.20	7.34±5.14	7.60±2.38
Milk production 4% FCM (kg/d)	5.20±1.77	5.41±2.41	6.74±4.43	4.28±2.01	7.72±4.81	8.65±6.00	9.09±2.83
Milk Quality:							
Protein (%)	2.90±0.60	2.50±0.30	2.70±0.10	3.40±0.60^{b}	3.80±0.20^{a}	4.00±0.10^{a}	4.10±0.50^{a}
Fat (%)	3.70±0.60	4.50±1.00	4.60±0.20	4.10±0.20^{b}	4.80±0.30^{b}	5.20±0.10^{a}	5.30±0.90^{a}
Total Solid (%)	12.00±0.80	12.30±1.00	12.60±0.20	12.40±0.80^{b}	12.80±0.30^{b}	13.10±0.40^{a}	13.30±0.80^{a}
SNF (%)	8.20±0.30	7.70±0.20	8.00±0.10	8.30±0.90	8.00±0.30	7.90±0.40	8.00±0.60

Different superscript in the same line means significantly different ($P<0.05$).
R0= basal ration as control; R1= R0 + Ganoderma lucidum (GL); R2= R0 + GL + orgCr;
P0= control; P1= P0 + GL + CLA; P2= P0 + CLA + orgCr; P3= P0 + GL + CLA + orgCr

P1, P2 and P3 were 11.8, 17.6 and 20.6%, respectively. Those results in this experiment were higher than 11.44% when used the similar amount of roasted soy bean (Adawiah, 2006).

In both of experiments, milk fat showed higher than SNI (3.0%). The addition of GL and orgCr increased the milk fat in R1 (21%) and R2 (22%) than control (R0), and were higher when added by orgCr and CLA in P1 (17%), P2 (27%) and P3 (29%) than control (P0). In this case, those results also were higher than 18.54% that found by Adawiah (2006). There are two substances affect to the quality of milk i.e. orgCr and source of CLA. Cr caused increasing of nutrient flow rate from the blood to the cell, availability of substrate for milk production also increase by addition of orgCr and then facilitate the insulin to activate some enzyme for synthesize of milk component (Pechova and Pavlata, 2007; Mertz, 1977). Addition of roasted soy bean as CLA source in the ration, support increasing of protein and energy sources. By roasted process might protect the soy bean from degradation by rumen microbes then absorbed in the digestive tract post rumen and transfer the nutrients for milk synthesize (Adawiah, 2006). From those phenomenon's suggesting the use *G. lucidum* as a supplement should be added by orgCr and/or CLA to increase the milk production.

Conclusions

The conclusion of two experiments were the feed supplement containing *Ganoderma lucidum* should added by the organic Chromium-Tempeh and roasted soy bean as source of CLA (*conjugated linoleic acid*) to achieve the highest of performance and milk quality on the lactating dairy cow.

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References

Adawiah. 2006. Responses of Roasted Soy bean, Calcium Soap and Organic Mineral in Diets on Dairy Cattle Intake and Milk Production. Buletin Penelitian, Juni 2006, Vol.9 (1), hal.70-79.

Amirroenas, D. E., T. T. Irawadi, D. Taniwiryono, Lubnah, A. Kurniastuti, I. F. Purwaningrum, E. Priono dan Asriningrum. 2002. Peningkatan Nutrisi Limbah Serat Kelapa Sawit untuk Pakan Hijauan Alternatif melalui Pengolahan dengan

Kapang Isolat dan *Ganoderma lucidum*. Laporan Akhir Hibah Penelitian Projek DUE-*like* IPB tahun Anggaran 2002.

Jin, L. S. 2000. Ganotheraphy. SIP. Jakarta.

Maia, M. R. G., L. C. Chaudhary, L. Figueres and R. J. Wallace. 2007. Metabolism of polyunsaturated fatty acids and their toxicity to the microflora of the rumen.

Antonie van Leeuwenhoek, Volume 91, Number 4: 303 - 314. http://www.springer-link.com/content/kr6752466658hw38/ tanggal 26 Mei 2012.

Mertz W. 1993. Chromium in human nutrition. *J. Nutr* 123:626-633.

Or-Rashid, M. M., O. AlZahal and B. W. McBride. 2011. Comparative studies on the metabolism of linoleic acid by rumen bacteria, protozoa, and their mixture in vitro. Applied Microbiology and Biotechnology, Volume 89, Number 2, 387-395.

Pechova, A and I. Pavlata. 2007. Chromium as an essential nutrient: a review. Vet Med 57:1-18.

Sjabana, D. 2001. Manfaat *Ganoderma lucidum*. Yayasan DHS. Jakarta.

Steel, R. G. D. and J. H. Torrie. 1993. Prinsip dan Prosedur Statistika. Suatu Pendekatan Biometrik. Gramedia. Jakarta.

Vincent J. B. and C. M. Davis. 1997. Chromium in carbohydrate and lipid metabolism. Minireview. *JBIC* 2:675-679.