

Total Digestible Nutrient of Diet Containing PUFA- Concentrate Supplemented with Yeast and *Curcuma xanthorrhiza* Roxb for Dairy Goat

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ABSTRACT

This research was designed to evaluate nutrient digestibility, mentioned as Total Digestible Nutrient of diet containing PUFA (polyunsaturated fatty acid) - concentrate supplemented with yeast and *Curcuma xanthorrhiza* Roxb for dairy goat. Twenty Ettawah crossbred goat in late lactation were allocated into 6 treatments in randomized block design. The treatments were PD0: PUFA-diet with no supplement, PDA: with Asifit, PDY: with 0.5% yeast, PDC: with 2% curcuma, and PDM: with 0.5% yeast + 2% curcuma. The PUFA-diet contained of 80% PUFA- concentrate as basic diet and 20% *Pennisetum purpureum*. While the PUFA sources were roasted ground corn and roasted soybean meal, and corn oil. Results showed that intakes of DM, OM, CP, CF, NFE, ADF, and GE were not affected significantly by dietary treatments. However, EE and NDF among treatments were different significantly ($P < 0.05$), whereas Ca and P were different very significantly ($P < 0.01$). High nutrient contents (DM, OM, CP, EE, CF, NDF, and GE) were found in feces of the goat with curcuma diet (PDC), consequently showed the opposite effects by giving the lowest digestibility ($P < 0.05$ or $P < 0.01$) of these nutrients. Total digestible nutrient (TDN) of PDY and PDM were markedly higher (79.89% and 79.37%, respectively) than that in other diets, such as being the lowest was in PDC (69.94%). This suggested that the yeast concentration of 1.8×10^8 cfu/d, given singly or in combination with 2% Curcuma could be considered as the right level for improving nutrient digestibility in the late lactation goat in our study.

Keywords: curcuma, dairy goat, PUFA-diet, TDN, yeast

ABSTRAK

Penelitian ini didisain untuk mengevaluasi pencernaan nutrisi, dinyatakan dalam TDN, dari ransum yang mengandung PUFA konsentrat yang disuplementasi yeast dan *Curcuma xanthorrhiza* Roxb pada kambing perah. Dua puluh ekor kambing Peranakan Ettawah (PE) pada fase laktasi akhir dialokasikan kedalam 6 perlakuan dengan Rancangan Acak Kelompok. Perlakuan tersebut adalah: PD0: PUFA-diet tanpa suplemen, PDA: dengan Asifit, PDY: dengan 0,5% yeast, PDC: dengan 2% curcuma, dan PDM: dengan 0,5% yeast + 2% curcuma. Ransum- PUFA terdiri atas 80% PUFA- konsentrat sebagai ransum dasar dan 20% rumput gajah. Sumber PUFA terdiri atas jagung giling sangrai, tepung kedelai sangrai, dan minyak jagung. Hasil menunjukkan bahwa konsumsi DM, OM, CP, CF, NFE, ADF, dan GE tidak terpengaruh oleh perlakuan. Namun, EE dan NDF antarperlakuan berbeda signifikan ($P < 0.05$), sedang Ca dan P berbeda sangat signifikan ($P < 0.01$). Kandungan nutrisi yang tinggi (DM, OM, CP, EE, CF, NDF, and GE) ditemukan di feces pada kambing dengan perlakuan Curcuma (PDC), konsekuensinya adalah pencernaan nutrisinya secara signifikan ($P < 0.05$) atau sangat signifikan ($P < 0.01$) terendah. Total digestible nutrient (TDN) dari PDY dan PDM secara signifikan tinggi (79,89% dan 79,37%) dibanding ransum lainnya, terendah pada PDC (69,94%). Hal ini menunjukkan bahwa yeast atau ragi dengan konsentrasi $1,8 \times 10^8$ cfu/d baik disuplementasikan tunggal atau dikombinasi dengan 2% Curcuma dapat dikatakan sebagai kandungan yang tepat untuk memperbaiki pencernaan nutrisi pada kambing perah dengan laktasi akhir pada penelitian ini.

Kata kunci: curcuma, kambing perah, PUFA-diet, TDN, yeast

INTRODUCTION

Yeast supplementation in ruminants has been reported with variable results, depending upon the nature of diets and yeast as well as the lactation stage. Wallace *et al.* (1994) described some increases in microbes

population, fiber digestibility, protein microbes, feed intake, nutrient supply into digestive track, eventually improved production performance. Positive effects of yeast were found on rumen volatile fatty acid, dry matter intake, crude protein, and organic matter digestibility; however the impaired

effect on decreasing lactic acid could be overcome by increasing concentrate in diet (Desnoyers *et al.*, 2009). Improved nutrient digestibility and quantitatively increased fat and energy milk were showed by yeast supplementation (*Saccharomyces cerevisiae* CNCM 1-1077, 1.2×10^{10} cfu/d) in Holstein cows (Bagheri *et al.*, 2009), increased milk yield with 20 g/d in Holstein cows (Sulistiyowati *et al.*, 2010), and improved milk yield and milk fat with 50g RumiSacc in Holstein cows (Yalcin *et al.*, 2011).

Medicinal herbs have been applied to improve health status and production performance as they have galactogogue property and digestive process as reported by Mirzaei and Prasad (2011) that low dose (125mg/kg BW) of polyherbal increased milk yield and kids performance. *Curcuma xanthorrhiza* Roxb powder (15g/kg concentrate) was optimal in improving milk yield and milk composition in Holstein cows (Sulistiyowati *et al.*, 2011); whereas Sinaga *et al.* (2011) reported that curcumin extract (160 ppm) of *C. domestica* improved energy digestibility of ration, decreased rate of passage such that the retention time was longer and increased absorption that finally improved body weight in pig. Curcumin was described to increase bile and lipase that will improve fat digestibility and decrease cholesterol; beside, as anti pathogen microbes, improve nutrient absorption then improve production performance (Bauwman *et al.*, 1983). Therefore, it would be beneficial to apply either yeast or curcuma or in combination in concentrate containing PUFA (polyunsaturated fatty acid) sources to evaluate nutrient digestibility and milk yield in late lactation dairy goat.

MATERIALS AND METHOD

Yeast, Curcuma, PUFA-diet, and Application

Yeast and *Curcuma* powder supplements and PUFA- diets were prepared as reported in Sulistiyowati *et al.* (2013) and Sulistiyowati *et al.* (2014). The diet contained of 18.42% rice brand, 15.79% ground corn (half roasted), 7.89% soybean meal (all roasted), 7.89% cassava meal, 27.49% soybean- byproduct, 2.11% corn oil, 0.53% mineral mix, and 19.88% king grass (*Panicum maximum*).

Treatments were based on the basic diet containing PUFA- concentrate and soybean by- product as PUFA- diet (PD) without supplements designated as (PD0), added with 3 tablets/dairy goat of Asifit (PDA), 0.5% or 5g yeast (PDY), 2% or 20g curcuma powder (PDC), 5g yeast and 20g curcuma powder (PDM). Asifit, a tablet of food supplement for a woman in lactation, contains of 114 mg *Sauropus androgynus*, 20 µg vitamin B12, 15 mg vitamin B6, 2.5 mg vitamin B2, and 10 mg vitamin B1 (produced commercially by Kimia Farma, Indonesia).

The study was conducted according to Complete Block design 5 x 4, with 14 days for adaptation, 21 days for sampling and data recording, and 21 days post treatment was also for data recording. The dairy goats used were PE (Ettawa Crossed), blocked according to their milk production. During the experiment, each of 20 goats was kept individually, provided with feed twice of 0.5kg PUFA- concentrate and 1kg fresh soybean by-product at 07.00 am and 03.00 pm. Forage was given 2kg/goat at afternoon feeding. Orts of concentrate and forage were weighed in the next morning. Milk yield was recorded daily before, during, and after treatment. Sampling of individual milk was collected from two consecutive milkings of the afternoon and the next morning of the last day of collection period. Voluntary feed intake was recorded throughout the experiment, but only the last 7 days were considered for data analysis as they were at the same days for feces collection.

Chemical and Statistical Analysis

The diets (concentrate and forage) and feces were oven dried (60°C for 24 hours), ground finely (1mm sieved size) analyzed for dry matter (DM), organic matter (OM), crude protein (CP) by Kjeldhal method, and ether extract (EE) by Soxhlet method (AOAC 1990). Cell wall contents, neutral detergent fiber (NDF) and acid detergent fiber (ADF) were determined according to Van Soest *et al.* (1991). Calcium (Ca, 422.7 nm) was determined by using Atomic Absorbance AA7000 Shimadzu Co. Serial no A 306647-00345. Phosphor (P, 660 nm) was prepared by wet ashing method and quantified by using Spectrophotometer UV-200 RS UV VIS LW Scientific according to procedure of Dairy Nutrition Laboratory- IPB.

Data were tabulated using Microsoft Office Excel 2003. Analysis of variance with any differences detected by Duncan Multiple Range Test (DMRT) in significances of $P < 0.05$ and $P < 0.01$ according to Lentner and Bishop (1986).

RESULTS AND DISCUSSION

Nutrient intakes

Intakes of dry matter (DM), organic matter (OM), crude protein (CP), crude fiber (CF), nitrogen free extract (NFE), acid detergent fiber (ADF), and gross energy (GE) were not affected significantly by dietary treatments (Table 1). However, ether extract (EE) and neutral detergent fiber (NDF) among treatments were different significantly ($P < 0.05$), whereas Ca and P were different very significantly ($P < 0.01$). The DMI which were around 2.5% (PDA) to 2.8% (PDY) considered lower compared to the dry matter requirement for lactating dairy goat 3.2% to 4.5% (NRC, 1981). This fact may lead to the low milk production of all treatments, besides, the goats were in late lactation phase (Table 2). However, these two treatments (Asifit and yeast) showed quantitatively higher milk

production, describing that *S. androgynus* plus B Vitamin did stimulate lactation hormone, while, *S. cerevisiae* improved rumen metabolism in such a way that nutrient intakes would be utilized efficiently to increase milk production.

Response on intakes of yeast supplementation have been summarized as variable (Desnoyers *et al.*, 2009). There was no effects of dietary live yeast alone (1.2×10^{10} cfu/d) or in combination with mannan-oligosaccharide (32 g/d) on dry matter intake and milk yield of lactating Holstein (Bagheri *et al.*, 2009). In contrast, the result of yeast diet (PDY) intakes in this present study tended to be the highest in dry matter and organic matters, crude fiber, NFE, and NDF. This has been supported by its high milk yield, 4% FCM, and protein content (Sulistiyowati *et al.*, 2014). The supplementation of yeast, rich in *Saccharomyces cerevisiae*, B vitamins, and amino acids, has been reported to stabilize ruminal fermentation, increased rumen pH, and altered VFA levels (William *et al.*, 1991) that eventually improve milk production and milk component.

Table 1. Effects of feeding PUFA-diets supplemented with asifit, yeast and *C. xanthorrhiza* Roxb on nutrient intakes of dairy goats

Intakes (g/d)	PD0	PDA	PDY	PDC	PDM	SEM	P
Dry matter	1228.95	1128.92	1273.07	1153.94	1239.94	60.88	NS
Organic matter	1114.60	1023.76	1159.02	1054.85	1127.59	55.29	NS
Crude protein	181.74	166.89	177.25	172.49	181.52	6.33	NS
Ether extract	79.94 ^{ab}	73.28 ^a	86.67 ^{bc}	80.90 ^{abc}	91.06 ^c	6.79	*
Crude fiber	221.08	203.72	243.23	244.02	231.51	16.85	NS
NDF	914.70 ^{ab}	840.78 ^a	1109.74 ^c	978.10 ^{bc}	992.59 ^{bc}	99.77	*
ADF	516.91	476.58	546.55	442.55	516.27	40.51	NS
Ca	7.78 ^a	7.15 ^a	13.55 ^c	11.03 ^b	9.99 ^b	2.58	**
P	6.32b ^c	5.81 ^b	7.13 ^c	6.74 ^{bc}	4.67 ^a	0.95	**

PUFA- concentrate and soybean by-product without supplements designated as (PD0), added with 3 tablets/dairy goat of ASIFIT (PDA), 0.5% or 5g yeast (PDY), 2% or 20g curcuma powder (PDC), mix of 5g yeast and 20g curcuma powder (PDM). * ($P < 0.05$); ** ($P < 0.01$); NS: not significant.

Nutrient digestibility and Total Digestible Nutrient

Nutrients digestibility of dry matter, organic matter, crude protein, ether extract, crude fiber, NFE, NDF, ADF, gross energy, and TDN were showed statistically the highest ($P < 0.05$) in yeast diet (PDY) and in the mix diet (PDM); as well as for Ca and P were detected the highest in this diet (Table 2). Our

data showed that improved nutrient digestibility as a result of increased nutrient intake that followed by increased milk yield as an average of pre, treatment, and post treatment in PDM (392.00 ml/d) that was with good persistency after the treatment.

Dietary yeast supplement will stimulate rumen microbes growth, increased the use of N- ammonia for protein rumen

microbes, and increased digestibility of fiber, increased feed intakes and nutrient supply to the gut and improved blood metabolites, eventually increased production (Wallace *et al.*, 1994). Supplementation of yeast only or in combination in this treatment did affect the goats reflecting the nature of diets, phase of lactation, feeding regime, yeast type and level, forage type and level, and environment as stated by Yalçın *et al.* (2011).

In terms of tannin (0.49%) and curcumin (0.12%) contents in the rations as reported separately (Sulistyowati *et al.*, 2013), yeast only (PDY), curcuma only (PDC), or in combination with curcuma (PDM) seemed to

affect intakes and digestibility of ether extract and NDF higher ($P < 0.05$) than that in basal diet or Asifit diet. These supported the result of tannin and saponin sources from *Yucca schidigera* that increased digestibility of NDF, besides increased digestibility of DM, GE, CP, and ADF (Holtshausen *et al.*, 2009).

Total digestible nutrient (TDN) of PDY and PDM were markedly higher (79.89% and 79.37%), respectively than that in other diets, such as being the lowest was in PDC (69.94%). Meaning that, yeast only or in combination with curcuma is more efficient in digesting nutrient than that with curcuma only.

Table 2. Effects of feding PUFA-diets supplemented with asifit, yeast and *C. xanthorrhiza* Roxb on nutrient digestibility of dairy goats

Digestibility (%)	PD0	PDA	PDY	PDC	PDM	SEM	P
Dry matter	77.09 ^{ab}	78.66 ^{abc}	84.82 ^c	73.77 ^a	83.49 ^{bc}	4.57	*
Organic matter	76.89 ^{ab}	78.46 ^{abc}	84.53 ^c	73.31 ^a	83.26 ^{bc}	4.62	*
Crude protein	79.46 ^b	81.00 ^b	85.76 ^b	73.80 ^{ab}	84.96 ^{ab}	4.81	**
Ether extract	83.30 ^a	89.40 ^b	92.13 ^b	81.81 ^a	92.05 ^b	4.88	**
Crude fiber	62.04 ^a	64.31 ^a	76.64 ^b	63.06 ^a	72.25 ^{ab}	6.43	*
NFE	82.82 ^{ab}	83.07 ^{ab}	87.64 ^b	78.24 ^a	87.00 ^b	3.79	**
NDF	71.41 ^a	73.63 ^a	85.99 ^b	74.83 ^a	83.48 ^b	6.45	**
ADF	56.53 ^a	60.60 ^{ab}	75.25 ^c	56.31 ^a	72.98 ^{bc}	9.13	*
Ca	50.45 ^a	70.04 ^b	85.37 ^c	74.50 ^b	87.83 ^c	14.92	**
P	68.76 ^a	82.42 ^b	83.79 ^b	80.52 ^b	86.03 ^b	6.76	**
TDN	72.42 ^a	74.07 ^{ab}	79.89 ^b	69.94 ^a	79.37 ^b	4.36	**
Milk yield (ml/d)	336.33	538.67	522.33	322.33	392.00	102.29	

PUFA- concentrate and soybean by- product without supplements designated as (PD0), added with 3 tablets/dairy goat of ASIFIT (PDA), 0.5% or 5g yeast (PDY), 2% or 20g curcuma powder (PDC), mix of 5g yeast and 20g curcuma powder (PDM). Effects significantly different ($P < 0.05$) or very significantly different ($P < 0.01$); NS: not significant.

To correlate with, the high nutrient contents (DM, OM, CP, EE, CF, NDF, and GE) were found in feces of the goat with curcuma diet (PDC), consequently showed the opposite effects by giving the lowest digestibility ($P < 0.05$ or $P < 0.01$) of these nutrients. This might be as the result of the nature of curcuma powder given on top of the concentrate that would taste bitter and smell strong that the goat avoided or by- passing it in such a way that the nutrient content in the diet would be decreasingly digested. In contrast, the most nutrient digested both in yeast diet (PDY) and mix diet (PDM) were significantly higher ($P < 0.01$), suggesting that yeast

fermented better either singly or in combination with curcuma. Moreover, both treatments produced some good amounts of milk, 522.33 g/d and 392.00 g/d, respectively. These diets were showing higher digestibilities in dry matter, crude fiber, and NDF compared to that of 1.2×10^{10} cfu/d yeast diet in Holstein dairy cows as reported by Bagheri *et al.* (2009). This suggested that the yeast concentration of 1.8×10^8 cfu/d could be considered as the right level for improving nutrient digestibility in the late lactation goat in our study.

CONCLUSION

Diets that contained PUFA- concentrate supplemented with 0.5% yeast singly or in combination with 2% *Curcuma xanthorrhiza* Roxb showed the highest Total Digestible Nutrient (79.89% and 79.37%, respectively) with good amounts of milk in late lactation dairy goat.

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REFERENCES

- Bagheri, M., G.R. Ghorbani, H.R. Rahmani, M. Khorvash, N. Nili, and K.H. Südekum. 2009. Effect of live yeast and mannan-oligosaccharides on performance of early-lactation holstein dairy cows. *Asian-Aust J Anim Sci.* Vol. 22, No. 6 : 812 – 818.
- Bawman, J.C. 1983. Concerning the effect of chelidonium, curcuma, absinth, and milkhistle on biliary and pancreatic secretion in hepatothopathy. *Med Monalsschrift* 29: 173- 180.
- Desnoyers, M., S. Giger-Reverdin, G. Bertin, C. Duvaux-Ponter, and D. Sauvart. 2009. Meta-analysis of the influence of *Saccharomyces cerevisiae* supplementation on ruminal parameters and milk production of ruminants. *J Dairy Sci.* 92 :1620–1632.
- Holtshausen, L., A. V. Chaves, K. A. Beauchemin, S. M. McGinn, T. A. McAllister, N. E. Odongo, P. R. Cheeke, and C. Benchaar. 2009. Feeding saponin- containing *Yucca schidigera* and *Quillaja saponaria* to decrease enteric methane production in dairy cows. *J. Dairy Sci.* 92: 2809-2821.
- Lentner M, Bishop T. 1986. *Experimental Design and Analysis.* Valley Book Co. VA.
- Mirzaei, F. and S. Prasad. 2011. Influence of dietary phytoadditive as polyherbal combination on performance of does and respective litters in cross bred dairy goats. *Asian- Aust J Anim Sci.* 24 (10): 1386-1392.
- [NRC]. National Research Council. 1981. National Research Council. Nutrient Requirements of Goats: Angora, Dairy, and Meat Goats in Temperate and Tropical Countries. National Academy Press. Washington, DC (US).
- Sinaga, S, D.T.H. Sihombing, M. Bintang, and Kartiarso. 2011. The effect of ration containing curcumin (extract turmeric/*Curcuma domestica*) in pigs rations to replace antibiotic synthetic as growth promoter). *Forum Pascasarjana* Vol. 33 No. 2: 123-131.
- Sulistiyowati, E., I. Badarina, and E. Soetrisno. 2010. Supplementation of Starbio probiotic and yeast on milk production and nutrient digestibility of lactating Holstein cows fed a ration containing cassava meal. *J Dairy Sci.* 93. E- Suppl. 1: 860.
- Sulistiyowati, E., U. Santoso, and I. Badarina. 2011. Supplementation of concentrate with different levels of temulawak (*Curcuma xanthorrhiza* Roxb) on milk production of lactating Frisien Holland cows. *Proceedings: The 2nd International Symposium on Temulawak- the 40th Meeting on National Working Group on Indonesian Medicinal Plant.* ISBN: 978-979-25-1209-0. Pp: 116- 120.
- Sulistiyowati, E., A. Sudarman , K.G. Wiryawan, and T. Toharmat. 2013. Quality of milk fatty acid during late lactation in dairy goat fed on PUFA-diet supplemented with yeast and *Curcuma xanthorrhiza* Roxb. *J.Indonesian Trop Anim Agric.* 38(4): 247- 256.
- Sulistiyowati, E., A. Sudarman, K.G. Wiryawan, and T. Toharmat. 2014. Milk production of late lactation dairy goat fed PUFA-diet supplemented with yeast and *C. xanthorrhiza* Roxb. *Proceeding the 2nd Asian- Australasian Dairy Goat Conference.* April 25- 27- 2014. Bogor. Indonesia. Pp: 223-226.
- Van Soest PJ, Robertson JB, and Lewis BA. 1991. Methods for dietary fiber, neutral detergent fiber and non starch polysaccharides in relation to animal nutrition. *J Dairy Sci.* 74:3583- 3592.

- Wallace, R.J. 1994. Ruminant microbiology, biotechnology, and ruminant nutrition: progress and problems. *J Anim Sci.* 72:2992-3003.
- William, P.E.V., C.A.G. Tait, G.M. Innes, and C.J. Newbold. 1991. Effects of the inclusion of yeast culture (*Saccharomyces cerevisiae* plus growth medium) in the diet of dairy cows on milk yield and forage degradation and fermentation patterns in the rumen of steers. *J Anim Sci.* 69:3016- 3026.
- Yalçın S, C. Pınar, O. Arif, Gürdal, C. Bağcı, and O. Eltan. 2011. The nutritive value of live yeast culture (*Saccharomyces cerevisiae*) and its effect on milk yield, milk composition and some blood parameters of dairy cows. *Asian- Aust J Anim Sci* 24 (10): 1377-1385.