MODEL ESTIMASI SINTESIS PROTEIN MIKROBA BERDASARKAN DERIVAT PURIN URIN KAMBING PERANAKAN ETTAWA DAN SAPERA SERTA APLIKASINYA PADA PROTEKSI PROTEIN PAKAN

INTISARI

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Derivat purin (DP) yang berada di dalam urin merupakan hasil metabolisme basa purin komponen asam nukleat dalam tubuh ternak. Metabolisme adalah proses biokimiawi dibantu oleh enzim. Sintesis enzim dipengaruhi oleh DNA yang kemungkinan berbeda pada setiap bangsa ternak. Tujuan penelitian tahap pertama mendapatkan ekskresi DP endogen kambing PE dan Sapera, tahap kedua kajian metode *spot sampling* dilakukan untuk mendapatkan persamaan korelasi antara kadar DP: kreatinin urin *spot sampling* dengan ekskresi DP total kambing PE dan Sapera, dan tahap ketiga penggunaan tepung kayu manis sebagai agen proteksi protein terhadap kecernaan nutrien dan sintesis protein mikroba serta *balance nitrogen* menggunakan metode *spot sampling* pada kambing PE dan Sapera. Penelitian ini mengunakan dua jenis kambing yaitu kambing PE dan Sapera jantan, umur antara 8-12 bulan. Pakan yang diberikan adalah hijauan rumput pakchong dan *wheat bran pollard*, sedangkan tahap ketiga mengunakan pakan 60% rumput gajah 30%, *wheat bran pollard* 10% bungkil kedelai di proteksi dengan tepung kulit kayu manis dengan level 0, 30, 60 g/kg BK pakan. Penelitian tahap pertama dibagi menjadi dua yaitu periode penentuan ekskresi DP endogen dilakukakan adaptasi 14 hari, kemudian ternak dipuasakan sampai benda keton teramati. Selanjutnya periode saat ternak diberi pakan *ad libitum.* Adaptasi dilakukan selama 14 hari, koleksi selama 7 hari. Tahap kedua koleksi urin *spot sampling* diambil secara periodik dengan interval waktu 3 jam dalam sehari, koleksi urin selama 7 hari. Tahap ketiga perlakuan proteksi protein pakan dengan kulit kayu manis, sebagai aplikasi metode *spot sampling* untuk mengestimasikan jumlah sintesis protein mikroba kambing PE dan Sapera. Sampel pakan, sisa pakan, feses, Untuk menentukan komposisi kimia menentukan kandungan bahan kering (BK), bahan organik (BO), protein kasar (PK), serat kasar (SK) dan lemak kasar (LK) yang dilakukan dengan metode analisis proksimat digunakan untuk menentukan konsumsi dan kecernaan nutrien, sedangkan sampel urin dilakukan analisis kadar derivat purin berupa alantoin, asam urat, xantin dan hipoxantin dan kreatinin pada tahap pertama, kedua dan ketiga, untuk menentukan ekskresi derivat purin. Selanjutnya data ekskresi DP digunakan untuk menentukan estimasi sintesis protein mikroba dan *balance nitrogen*. Data yang sudah diperoleh pada penelitian tahap 1 dan 2 menggunakan rancangan percobaan *Independent Student t-test* untuk membedakan DP bangsa kambing PE dan Sapera, sedangkan penelitian tahap 3 dilakukan uji dengan rancangan acak lengkap (pola faktorial) kemudian untuk mengetahui perbedaan antar nilai rerata dilakukan uji lanjut Duncan atau DMRT (*Duncan's Multiple Range Test*). Hasil penelitian tahap pertama ekskresi DP endogen pada pada kambing PE 0,039 mmol/$W^{0,75}$/hari sehingga didapatkan persamaan Y = 0,84X + (0,039 $W^{0,75}$ $e^{-0,25X}$) sedangkan pada kambing Sapera 0,053 mmol/ $W^{0,75}$/hari sehingga

dihasilkan persamaan Y = 0,84X + (0,053 $W^{0,75}$ $e^{-0,25X}$) dengan Y merupakan ekskresi DP, X adalah DP terabsorbsi, $W^{0,75}$ berat badan metabolik, sedangkan $e^{-0,25X}$ merupakan logaritma alam. Konsumsi dan kecernaan nutrien pada saat ternak diberi pakan *adlibitum* hasilnya tidak berbeda nyata (P>0,05), perbedaan bangsa kambing PE dan Sapera tidak berpengaruh terhadap kadar alantoin, xantin hipoxantin dan DP, serta ekskresi alantoin namun pada kadar asam urat, kambing PE lebih tinggi dari kambing Sapera, sedangkan ekskresi asam urat, xantin – hipoxantin dan DP kambing Sapera lebih tinggi dari PE. Berdasarkan hasil penelitian tahap dua diperoleh korelasi spot sampling terkuat kambing PE pada waktu pengambilan spot sampling terdapat pada rentang waktu 11.00 sampai 14.00 dengan R^2= 0,9735 dengan persamaan regeresi linier Y = 1,0178X + 2,1201. Waktu antara lain 3 sampai 6 jam setelah pemberian makan pagi. Korelasi spot sampling yang paling kuat pada kambing Sapera yaitu rentang waktu pada pukul 02.00 hingga 05.00 waktu tersebut 11 hingga 14 jam setelah pemberian pakan sore dengan R^2= 0,8248, dengan persamaan regresi linier Y = 3,5122X + 1,9378. Hasil penelitian tahap ketiga menunjukkan bahwa perbedaan bangsa kambing PE dan Sapera serta penambahan level kulit kayu manis yang berbeda tidak berpengaruh nyata (P>0,05) terhadap konsumsi dan kecernaan nutrien. Pada kadar alantoin dan DP tidak berpengaruh nyata terhadap bangsa Kambing PE dan Sapera serta pada penambahan level kayu manis sampai 60 g/kg BK pakan. Namun penambahan kayu manis dapat meningkatkan kadar asam urat, dan xantin hipoxantin. Kadar asam urat dan xantin hipoxantin tertinggi pada kambing PE dengan penambahan level kayu manis 30 g/kg BK pakan. Ekskresi DP kambing PE dan Sapera yang diberikan level kayu manis sampai 60 g/kg BK pakan tidak berpengaruh terhadap ekskresi xantin-hipoxantin baik sebelum dan sesudah nyatakan dalam BBM, namun penambahan kayu manis level 30 dan 60 g/kg BK dapat menurunkan ekskresi alantoin, asam urat, dan DP dibandingkan dengan kontrol (0 g/kg BK). Hasil perhitungan antara EMNS, DOMR, BOT, EMNS/DOMR dan *balance nitrogen* pada kambing PE dan Sapera yang diberikan pakan tepung kayu manis menunjukkan perbedaan yang tidak nyata. Berdasarkan hasil penelitian dapat disimpulkan bahwa terdapat perbedaan model estimasi sintesis protein mikroba rumen berdasarkan ekskresi DP pada urin kambing PE dan Sapera, serta penggunaan kayu manis untuk proteksi protein pakan dapat menurunkan ekskresi derivat purin, namun tidak berpengaruh negatif terhadap sintesis protein mikroba rumen kambing PE dan Sapera. Persamaan estimasi sintesis protein mikroba berbeda antar bangsa, terbukti bahwa antara kambing PE dan Sapera didapatkan persamaan estimasi yang berbeda. Persamaan estimasi sintesis protein mikroba berbeda antar bangsa, terbukti bahwa antara kambing PE dan Sapera didapatkan persamaan estimasi yang berbeda. Persamaan tersebut dapat digunakan untuk mengkaji aspek nutrisi secara luas dan mengkaji efisiensi penggunaan pakan serta standar penyusunan ransum pada ternak ruminansia

Kata kunci: Ekskresi derivat purin endogen, Kambing PE, Kambing Sapera, Kayu manis, Metode *spot sampling*, Proteksi protein

ESTIMATION MODEL OF MICROBIAL PROTEIN SYNTHESIS BASED ON PURINE DERIVATIVES IN THE URINE OF ETTAWA AND SAPERA CROSSBRED GOATS AND ITS APPLICATION IN FEED PROTEIN PROTECTION

ABSTRACT

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Urinary purine derivatives originate from the metabolism of nucleic acid-derived purine bases in livestock. This biochemical process is enzyme-mediated, with enzyme synthesis influenced by DNA and potentially varying among livestock breeds. The first stage of this study aimed to determine endogenous PD excretion in Ettawa and Saanen crossbred goats. The second stage investigated the spot sampling method to correlate the PD:creatinine ratio in spot urine with total PD excretion in these goats. The third stage examined the use of cinnamon powder as a protein protection agent for nutrient digestibility, microbial protein synthesis, and nitrogen balance using the spot sampling method in Ettawa and Saanen crossbred goats. This study examined two goat breeds: male Ettawa crossbreed and Saanen crossbreed, aged 8 to 12 months. Their diet consisted of pakchong grass and wheat bran powder. In the third phase, the feed composition was 60% elephant grass, 30% wheat bran pollard, and 10% soybean meal, with cinnamon bark powder added at 0, 30, and 60 g/kg feed dry matter. This study was conducted in three stages. The first stage, divided into two parts, determined endogenous PD excretion through a 14-day adaptation period, followed by fasting until ketone bodies appeared. The subjects then received unlimited feed for a 14-day adaptation and 7-day collection period. The second stage involved collecting urine samples every 3 h for 7 days. The third stage applied the spot sampling method to assess microbial protein synthesis in both goat breeds using cinnamon bark for feed protein protection. Feed, residue, and feces were analyzed for chemical composition, including dry matter (DM), organic matter (OM), crude protein (CP), crude fiber (CF), and crude fat (CF) using proximate analysis to evaluate nutrient intake and digestibility. Urine samples from all stages were examined for purine derivatives (allantoin, uric acid, xanthine, hypoxanthine, and creatinine) to determine excretion levels. These data were then used to estimate microbial protein synthesis and nitrogen balance. The data obtained from phases I and II of the study utilized an independent Student's t-test design to differentiate the purine derivatives of the Ettawa crossbreed and Saanen crossbreed goats, whereas phase III of the study employed a completely randomized design (factorial pattern). To determine the differences among the mean values, Duncan's Multiple Range Test (DMRT) was conducted. The results of the first phase of research on the excretion of endogenous PD in crossbred Ettawa goats demonstrated 0.039 mmol/W0,75/day, leading to the equation $Y = 0{,}84X + (0{,}039\ W^{0,75}\ e^{-0,25X})$. Conversely, in crossbred Saanen Ettawa goats, excretion was 0.053 mmol/W0,75/day, resulting in the equation $Y = 0{,}84X + (0{,}053\ W^{0,75}\ e^{-0,25X})$. The consumption and digestion of nutrients when livestock were provided ad libitum

exhibited no significant difference (P > 0.05). The differences between Ettawa and Saanen crossbred goats did not affect the levels of allantoin, xanthine, hypoxanthine, PD, or allantoin excretion. However, Ettawa crossbred goats exhibited higher uric acid levels than Saanen crossbred goats, whereas the excretion of uric acid, xanthine, hypoxanthine, and PD was higher in Saanen crossbred goats than in Ettawa crossbred goats. Based on the results of the second phase of the research, the strongest correlation for spot sampling of Ettawa breed goats occurred during the sampling period from 11:00 AM to 2:00 PM, with R^2 = 0.9735 and the linear regression equation Y = 1.0178X + 2.1201. This time is approximately 3 to 6 h after the morning feeding. In contrast, for Sanen breed goats, the strongest correlation for spot sampling was observed in the time range from 2:00 AM to 5:00 AM, which is 11–14 h after evening feeding, with R^2 = 0.8248 and the linear regression equation Y = 3.5122X + 1.9378. The results of the third phase of the study indicated that the differences between Ettawa crossbreed goats and Sanen Ettawa crossbreed goats, as well as the addition of different levels of cinnamon bark, did not have a significant effect (P>0.05) on nutrient consumption and digestibility. The levels of allantoin and PD did not have a significant effect on Ettawa crossbred goats and Sanen crossbred goats, as well as on the addition of cinnamon up to 60 g/kg of feed dry matter. However, the addition of cinnamon increased the levels of uric acid and hypoxanthine. The highest levels of uric acid and hypoxanthine xanthine were observed in Ettawa crossbred goats fed 30 g/kg cinnamon. The excretion of goat DP PE and Sapera-administered cinnamon levels of up to 60 g/kg of feed dry matter did not affect the excretion of xanthine-hypoxanthine either before or after being stated in dry matter. However, the addition of cinnamon at levels of 30 and 60 g/kg of feed dry matter reduced the excretion of allantoin, uric acid, and DP compared to the control (0 g/kg of feed dry matter). The results of the calculations between EMNS, DOMR, BOT, EMNS/DOMR, and nitrogen balance in Ettawa crossbreed goats and Sanen crossbreed goats fed cinnamon powder showed no significant differences (P > 0.05). Based on these findings, Ettawa crossbreed goats and Sanen crossbreed goats do not differ in microbial synthesis efficiency, because utilization of the same feed results in microbial activity in synthesizing microbial protein with similar capabilities. PD excretion is positively correlated with microbial protein synthesis and enzymes. Enzyme synthesis is influenced by DNA, which may vary among different livestock breeds. The objective of the first stage of the research was to determine the endogenous PD excretion of Ettawa crossbred and Saanen crossbred goats. The second stage involved an investigation of the spot sampling method to establish a correlation between the PD: creatinine ratio in spot urine sampling and the total PD excretion of Ettawa and Saanen crossbreed goats. The third stage focuses on the utilization of cinnamon powder as a protein protection agent for nutrient digestibility and microbial protein synthesis, as well as nitrogen balance, using the spot sampling method on Ettawa and Saanen crossbreed goats. This research involved two types of goats, specifically male Ettawa crossbreed and Saanen crossbreed goats, aged between 8 and 12 months. The feed provided comprised pakchong grass and wheat bran pollard, while the third stage utilized a feed composition of 60% elephant grass, 30% wheat bran pollard, and 10% soybean meal, supplemented with cinnamon bark powder at levels of 0, 30, and 60 g/kg of feed dry matter. The first stage of the research is divided into two parts: the period for determining endogenous PD excretion involves a 14-day adaptation, followed by fasting the livestock until ketone bodies are observed. Subsequently,

the livestock was provided with ad libitum feed, with adaptation conducted over 14 days and collection over 7 days. The second stage involves spot sampling urine collected periodically at 3-hour intervals throughout the day, with urine collection lasting 7 days. The third stage involves the treatment of feed protein protection with cinnamon bark as an application of the spot sampling method to estimate the quantity of microbial protein synthesis in Ettawa and Saanen crossbred goats. Feed samples, feed residues, and feces were utilized to determine the chemical composition, including the content of dry matter (DM), organic matter (OM), crude protein (CP), crude fiber (CF), and crude fat (CF), which were analyzed using proximate analysis methods to assess nutrient consumption and digestibility. Concurrently, urine samples undergo analysis for purine derivatives, such as allantoin, uric acid, xanthine, hypoxanthine, and creatinine, in the first, second, and third stages to determine the excretion of purine derivatives. Furthermore, the excretion data of purine derivatives were utilized to estimate microbial protein synthesis and nitrogen balance. The data obtained from phases I and II of the research employed an independent Student's t-test design to differentiate the purine derivatives of the Ettawa crossbreed and Saanen crossbreed goats, whereas phase III of the research utilized a completely randomized design (factorial pattern). To determine the differences among the mean values, Duncan's Multiple Range Test (DMRT) was conducted. The results of the initial phase of research on the excretion of endogenous PD in crossbred Ettawa goats demonstrated 0.039 mmol/$W^{0,75}$/day, yielding the equation $Y = 0,84X + (0,039\ W^{0,75}\ e^{-0,25X})$. In contrast, crossbred Saanen Ettawa goats exhibited excretion of 0.053 mmol/W0,75/day, resulting in the equation $Y = 0,84X + (0,053\ W^{0,75}\ e^{-0,25X})$. The consumption and digestion of nutrients when livestock were provided ad libitum showed no statistically significant difference ($P > 0.05$). Variations between ETTAWA crossbred and Saanen crossbred goats did not significantly influence the levels of allantoin, xanthine, hypoxanthine, PD, or allantoin excretion. However, regarding uric acid levels, Ettawa crossbred goats exhibited higher concentrations than Saanen crossbreed goats, while the excretion of uric acid, xanthine, hypoxanthine, and PD was greater in Saanen crossbreed goats than in Ettawa crossbreed goats. The second phase of the study revealed that the strongest correlation for spot sampling of Ettawa breed goats occurred during the sampling period from 11:00 AM to 2:00 PM, with $R^2 = 0.9735$ and the linear regression equation $Y = 1.0178X + 2.1201$. This time frame is approximately 3 to 6 h post-morning feeding. For Sanen breed goats, the strongest correlation for spot sampling was observed in the time range from 2:00 AM to 5:00 AM, which is 11 to 14 h after the evening feeding, with $R^2 = 0.8248$ and the linear regression equation $Y = 3.5122X + 1.9378$. The findings of the third phase of the study indicated that the differences between Ettawa crossbreed goats and Sanen Ettawa crossbreed goats, as well as the supplementation of varying levels of cinnamon bark, did not exert a statistically significant effect ($P>0.05$) on nutrient consumption and digestibility. The levels of allantoin and PD did not exhibit a significant effect on Ettawa crossbred goats and Sanen crossbred goats, nor did the addition of cinnamon up to 60 g/kg of feed dry matter. However, the addition of cinnamon increased the levels of uric acid and hypoxanthine. The highest levels of uric acid and hypoxanthine xanthine were observed in Ettawa crossbreed goats with the addition of 30 g/kg cinnamon in the feed. The excretion of DP in Ettawa crossbreed and Sanen crossbreed goats administered cinnamon levels of up to 60 g/kg of feed dry matter did not affect the excretion of xanthine-hypoxanthine, both before and

after being stated in dry matter. However, the addition of cinnamon at levels of 30 and 60 g/kg of feed dry matter reduced the excretion of allantoin, uric acid, and DP compared to the control (0 g/kg of feed dry matter). Based on the research results, it can be concluded that there are differences in the estimation models of rumen microbial protein synthesis based on the excretion of DP in the urine of PE and Sapera goats, and the use of cinnamon for feed protein protection can reduce the excretion of purine derivatives, but does not negatively affect the synthesis of rumen microbial protein in PE and Sapera goats..

Keywords: Excretion of endogenous purine derivatives, PE Goat, Sapera Goat, cinnamon flour, Spot sampling method, Protein protection