



Effect of Cinnamon Powder on Protein Balance, and Blood Profile of Etawa Crossbreed Goats

CATUR SUCI PURWATI¹, CHUSNUL HANIM^{2*}, LIES MIRA YUSIATI², BUDI PRASETYO WIDYOBROTO³

¹Graduate School, Faculty of Animal Science, Universitas Gadjah Mada, Jl. Fauna No. 3 Bulaksumur, Yogyakarta 55281, Indonesia; ²Department of Animal Nutrition and Feed Science, Faculty of Animal Science, Universitas Gadjah Mada, Jl. Fauna No. 3 Bulaksumur, Yogyakarta 55281, Indonesia; ³Department of Animal Production, Faculty of Animal Science, Universitas Gadjah Mada, Jl. Fauna No. 3 Bulaksumur, Yogyakarta 55281, Indonesia.

Abstract | The use of formaldehyde in protein protection results in the formation of a strong bond, making it challenging for rumen microbes to break down the protein. An alternative natural material that can be used for protection is the sinamaldehyde compound. This compound is a secondary metabolite derived from cinnamon plants. This research aimed to investigate effect of cinnamon powder on protein balance, and blood profile of etawah crossbreed goats. A total of 15 goats with an average initial body weight of 15 - 23 kg and age 8 - 12 months, were used in the study with completely randomised design (CRD) consisting of three treatments and six replications. The three treatments tested were as follows: A: without adding cinnamon powder (0 g/kg feed DM); treatment B: Concentrate with cinnamon powder addition (30 g/kg feed DM); treatment C: Concentrate with cinnamon powder addition (60 g/kg feed DM). Protein balance and blood metabolic profile measured. The results showed that the goats that were treated B had the highest protein in feces up to 3,37 g/head/day, but it was not significantly different from other treatments. Cinnamon powder added at 30 g/kg feed DM reduced protein in faeces, which protected feed protein and had no negative effects on protein consumption, amount of digestible protein, protein urine, protein retention, BV, NNU, Glucose, total protein, total cholesterol, BUN, and phosphate.

Keywords | Blood profile, Cinnamon powder, Etawa crossbreed goats, Protein protection, Protein balance

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***Correspondence** | Chusnul Hanim, Department of Animal Nutrition and Feed Science, Faculty of Animal Science, Universitas Gadjah Mada, Jl. Fauna No. 3 Bulaksumur, Yogyakarta 55281, Indonesia; **Email:** c.hanim@mail.ugm.ac.id

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INTRODUCTION

Indonesian goat farmers raise various breeds of goats. Each species has special traits that are influenced by their specific geographical origins (Ilham *et al.*, 2023). Indonesia is home to a population of six million goats (Winaya *et al.*, 2017). The Etawa Crossbreed can contribute to achieving the target of self-sufficiency in milk production. Etawa Crossbreed have been selectively bred for a long time. These goats are regarded as superior in quality than other local goats in Indonesia. The Etawa Crossbreed goat

is capable of producing both milk and meat. It has the characteristics of both the Etawa and Kacang goat breeds. One more reason to choose Etawa Crossbreed goats is their rapid growth rate, leading to litter sizes of up to two offspring. Raising a goat is also simple and does not require a large space (Rosartio *et al.*, 2015). The livestock has a remarkable ability to adapt to various types of climates and environments, allowing it to thrive in diverse regions. The utilisation of feed in dairy farming has a significant impact on milk production. Access to sufficient feed is often a challenge for smallholder farmers in developing countries

(Sidawi *et al.*, 2021). The availability of feed sources in the surrounding environment greatly affects the productivity of livestock, as they may not provide sufficient nutrition. The feed sources commonly utilized are often difficult to digest and have a relatively low protein content. Therefore, it is essential to improve feed quality and explore new feed sources.

The soybean meal has a high crude protein content and is rich in amino acids. This requires protein protection to reduce degradability in the rumen and to ensure that soybean meal protein is metabolised optimally in the intestine to maximize livestock productivity. Heating or adding formaldehyde can be used to preserve protein, which can increase the fraction of undegraded protein by 50-80% while maintaining its digestibility in the intestine. The balance of energy and protein is crucial for enhancing the effectiveness of protein. In order to prevent the degradation of the protein in the rumen, it is necessary to provide protection (Widyobroto *et al.*, 2010). Protein protection can be achieved in several methods, including the use of chemicals, heating, tannin-based protection, and formaldehyde-based protection. Formaldehyde treatment is a highly effective method for enhancing the ability of rumen microbes to resist the degradation of proteins. Formaldehyde is an aldehyde-derived organic compound that has the molecular formula HCHO . The use of formaldehyde in protein protection results in the formation of a strong bond, making it challenging for rumen microbes to break down the protein (Risqi *et al.*, 2019). An alternative natural material that can be used for protection is the sinamaldehyde compound. This compound is a secondary metabolite derived from cinnamon plants. Studies on the application of cinnamaldehyde in cinnamon powder as a protein protection agent *in vivo* have not been conducted. Harwanto *et al.* (2014) the use of sinamaldehyde in rumen fluid *in vitro*. Ishlak *et al.* (2015) reported that the addition of sinamaldehyde 400 mg/kg feed DM *in vitro* continuous culture. Hadianito *et al.* (2020) reported that the inclusion of cinnamon, which contains cinnamaldehyde, had no effect on the diversity of rumen bacteria *in vitro*. Additionally, it was found that cinnamon was able to protect proteins from degradation in the rumen, without any negative effects on microbial diversity and the rumen fermentation process. Based on this information, it is important to investigate the impact of adding cinnamon powder to the diet of Etawa Crossbreed goats on their protein levels and overall blood health.

MATERIALS AND METHODS

LOCATION AND LENGTH OF RESEARCH

The research focused on observing living entities for a total of three months. The Etawa Crossbreed goats originated

from the Intra Agri Indonesia Farm, Karangpandan District, Karanganyar Regency, Central Java. The feed consisted of pakchong grass obtained from the Integrated Agricultural Laboratory of Univet Sukoharjo, Central Java, and the Cilacap pollar brand supplied from Ceper District, Klaten Regency. The feed, the amount of protein in waste, and urine were analysed at the Nutritional Biochemistry Laboratory of the Faculty of Animal Science in UGM, Yogyakarta. The analysis of the blood metabolic profile was carried out at the Integrated Research and Testing Laboratory (LPPT), UGM, Yogyakarta.

MAKING CINNAMON POWDER

The process of feed preparation started by producing cinnamon powder from *C. burmannii* species taken from Pendem Village, Kaligesing District, Purworejo, Central Java. The cinnamon bark (Figure 1B) was cleaned, aerated, and then baked at 40°C. The cinnamon bark was ground into a fine powder using a machine. The cinnamon bark powder was analysed at the Laboratory of the Bogor Spices and Medicinal Plants Instrument Standard Testing Center. The results showed a sinamaldehyde concentration of 88.01% and essential oil level of 1.22%. The finished cinnamon bark powder was homogenised with soybean meal, following the specific instructions for each treatment.

MATERIAL

This study employed 15 male Etawa Crossbreed goats (Figure 1A), with body weights of 15-23 kg, aged between 8 and 12 months. The goats were kept in metabolic cages equipped with feed and water containers. The basal ration consisted of forage and concentrate in a ratio of 60:40. The forage used was pakchong grass (*Pennisetum purpureum cv* Thailand), whereas the concentrate consisted of 30% wheat bran pollard and 10% soybean meal and cinnamon powder. The treatments included the addition of cinnamon powder at three different levels: 0 g/kg, 30 g/kg and 60 g/kg dry matter (DM), each with 5 replications.



Figure 1: Etawa crossbreed goats used in the research (A) cinnamon used in the research (B).

Table 1 displays the chemical composition of the feed ingredients that make up the research ration on a dry matter basis.

Table 1: Composition of ingredients and nutrient content of concentrate feed.

Feed ingredients (%)	Treatment ¹⁾		
	A	B	C
Pakchong	60	59.29	58.59
Wheat bran pollard	36	35.57	35.16
Soybean meal	4	3.95	3.91
Cinnamon powder	0	1.19	2.34
Total	100	100	100
Nutrient content (% DM)			
Dry matter	90.30	90.32	90.34
Organic matter	90.34	90.36	90.40
Crude protein	18.74	18.58	18.43
Ether extract	2.60	2.56	2.53
Crude fiber	24.38	24.64	24.88
Nitrogen free extract	35.50	35.56	35.45
Total digestible nutrients	64.22	64.04	63.87

¹⁾A: Concentrate without cinnamon powder addition; B: Concentrate containing cinnamon powder addition (30 g/kg feed DM); C: Concentrate containing cinnamon powder addition (60 g/kg feed DM).

ADAPTATION PERIOD

Livestock were weighed to determine the initial body weight and metabolic body weight, then calculated the need for animal feed according to body weight. The first feeding consisted of 3% of the body weight. Subsequently, the amount of feed consumed was observed and additional feed was provided until the residual feed accounted for around 10% of the total provision over a period of 14 days. The process of adaptation and treatment took place within metabolic cages. During this time, the daily consumption of each animal was recorded, enabling us to accurately determine their consumption during feeding. Drinking water was given ad libitum. Feed was divided into 2 parts, which were given twice a day, in the morning at 08.00 and in the afternoon at 16.00. After adaptation, the livestock were moved to metabolic cages equipped with urine and faeces collection devices.

COLLECTION PERIOD

The collection period lasted seven days, and the animals were fed and given water according to each treatment. Feed, feed residue, faeces, and urine were all collected as samples. During the collecting period, 500 g of pakchong grass and 100 g of concentrate were sampled for analysis. The residual feed and faeces from each animal were collected and taken before the animals were fed in the morning. The remaining feed and faeces were weighed, and a 10% composite sample was prepared for analysis. Feed samples and residues were sun-dried for 2-3 days and then dried in an oven at 55°C, and the collected faeces were stored in a

chiller. Samples of feed, feed residue, and faeces collected from each livestock were composited into sub-samples and analysed for proximate nutrient composition. The amount of nutrient consumption, nutrient excretion, and nutrient digestibility were calculated using data from the amount of feed given, the remaining feed, the amount of faeces, and the composition of each nutrient.

The period of urine collection was adjusted based on the findings of previous studies, which revealed that spot sampling periods had the strongest correlation with those found in total collection urine. Urine was collected in a plastic bucket containing 10ml of 10% H₂SO₄. Urine with a pH less than 3 was added to H₂SO₄, and the concentration of H₂SO₄ was measured and recorded.

Feed, feed residue, faeces samples were chemically analysed to determine the content of dry matter (DM), organic matter (OM), crude protein (CP), crude fibre (CF) and ether extract (EE) using the method (AOAC, 2005) to calculate consumption and nutrient digestibility, while urine samples were analysed for nitrogen content.

RESEARCH PARAMETERS

The research parameters observed were (1) Protein consumption = dry matter consumption x ration N content. (2) Protein in faeces was calculated by the formula = faecal excretion x faecal N content. (3) The amount of digestible protein = feed N consumption - faecal N excretion (4) Protein urine = urinary excretion x urine N content. (5) Protein retention was determined by the formula = absorbed N - urinary N excretion. (6) Biological Value (BV) was determined by the formula = N balance / N absorbed x 100%. (7) Net Nitrogen Utilisation (NNU) was determined by the formula N balance/ N consumption x 100%. (8). Glucose method: Glucose levels were measured using the GOD-PAP (Dias, 1999) method in our experiment. (9) Total protein was determined by the biuret method (Weichselbaum, 1946). (10) Total cholesterol Method: GOD PAP, Enzymatic Photometric. (11) Blood Urea Nitrogen (BUN) Level Measurement (KPI/7.2/KD-17) Methods: GLDH urease; Enzymatic UV test.

The method run as follows: (1) Fill bottle 1 with NaOH 0.1 N; KNa-tartrate 16 mmol/l; KI 15 mmol/l; and Cu-sulfate 6 mmol/l and dilute with 40ml distilled water, stability at 15 - 23°C; (2) Fill bottle 2 with NaOH; K-Natartrate16 mmol/l and dilute with 400 ml of distilled water, stability at 15 - 23°C; (3) Fill bottle 3 with 6 g/100 ml protein without dilution, stability at 15 - 23°C; and (4) Pipette and put 0.1 ml of blood sample and 5 ml of bottle 1 solution into the test tube. Next, mix and incubate for 20 minutes at a temperature of 20 - 23°C; Results and samples were measured against bottle solutions 2 and 3; and blood protein levels were calculated by the formula:

C = 19 x E sample (g/100 ml); (c = protein content); E sample = reagent blank. (12). Phosphate methods used were Photometric, Enzymatic.

EXPERIMENTAL DESIGN

This study applied an in vivo approach with a Completely Randomised Design (CRD), with three treatments and five replications for each. The researchers conducted tests on three different factors. First, goats were fed with concentrate but without adding cinnamon powder (0 g/kg feed DM); treatment B: Concentrate with cinnamon powder addition (30 g/kg feed DM); treatment C: Concentrate with cinnamon powder addition (60 g/kg feed DM).

STATISTICAL ANALYSIS

The data was analysed using the Analysis of variance (ANOVA), and the Duncan's multiple distance test was employed to assess the difference in treatment mean at a confidence range of 5% and 1%. The P-value (< 0.05) was used to establish statistical significance (IBM SPSS Statistics, version 26).

ETHICAL APPROVAL

The Ethics Committee of the Faculty of Veterinary Medicine Universitas Gadjah Mada has approved the research plan. The certificate number is No. 007/EC-FKH/Eks/2023.

RESULTS AND DISCUSSION

CHEMICAL COMPOSITION OF PAKCONG GRASS LEAVES AND POLLAR BRAN

The average proximate content of pakcong grass leaves and pollar bran is presented in (Table 1). The variables observed were dry matter (DM), organic matter (OM), ether extract (EE), crude protein (CP), carbohydrates, NFE (extract without nitrogen), and total digestible nutrients (TDN). These components in the form of carbohydrates, fat, and protein, provide energy for livestock to perform their tasks. As a result, pakcong grass leaves contained 90.32% DM, 88.58% OM, 16.98% CP, 1.94% EE, 34.17% CF, 35.50% NFE, and 58.55% TDN. While the chemical composition of the polar bran was 90.14% DM, 95.20% OM, 19.22% CP, 3.93% EE, 10.47% CF, 58.30% NFE, and 80.20% TDN.

PROTEIN BALANCE OF ETAWA CROSSBREED GOAT FED CINNAMON POWDER A PROTEIN PROTECTION AGENT

The addition of cinnamon powder as a source of cinnamaldehyde is unlikely to interfere with nutrient consumption in Etawa Crossbreed goats. The physical condition and health of livestock, livestock breed, production phase, feed quality, and environmental

conditions all have an impact on nutrient consumption. Adding more chemicals to a food product does not alter the body's ability to break down the protein in it. The body's protein balance remains unaffected (Abarghuei *et al.*, 2013). This study indicated that for all the treatments, goats maintained almost the same quantity of protein in their bodies (Table 2). In this study, feed quality was improved by protective feeding with cinnamon up to a level of 0 to 60 g/kg DM. Cinnamon contains various active compounds that provide flavor and aroma. Though the taste and smell of sinamaldehyde compounds in cinnamon powder is believed not to affect palatability, the results of this study indicated that it did not have a major impact on the digestive process of goats. Palatability is the main factor affecting differences in consumption of dry matter, organic matter and crude protein (CP). In addition, the non-different nutrient consumption suggests that the digestive tract of the goat may effectively use nutrients in the feed that are not degraded by the addition of cinnamon powder.

Table 2: Protein balance of f Etawa crossbreed goat given cinnamon powder as a protein protection agent.

Variable (g/head/d)	Treatment ¹⁾		
	A	B	C
Protein consumption	4.96±4.49	19.27±6.44	16.11±4.09
Protein in feces	2.92 ^a ±0.37	3.37 ^{ab} ±0.66	2.39 ^b ±0.67
Amount of digestible protein	12.04±4.37	15.90±6.99	13.72±3.59
Protein urine	1.25±0.68	1.71±0.86	1.96±0.85
Protein retention	10.79±3.82	14.19±7.45	11.76±3.63
Biological Value (%)	89.83±3.38	87.42±7.58	85.13±6.50
Net Nitrogen utilization (NNU) (%)	71.13±5.32	70.80±11.36	72.51±7.65

¹⁾A: Concentrate without Cinnamon powder addition; B: Concentrate containing Cinnamon powder addition (30 g/kg feed DM); C: Concentrate containing Cinnamon powder addition (60 g/kg feed DM). ^{ab} Different superscripts in the same row are significantly different (P < 0.05)

The addition of different levels of cinnamon powder had no significant effect (P>0.05) on protein consumption in Etawa Crossbreed goats. The average protein consumption was 14.96–19.27 g/head/day with the addition of cinnamon powder at a level of 0–60 g/kg DM. The protein consumption results at the level of cinnamon provision are almost same since the nutrient content of the feed is nearly identical. The protein consumption in this study was about 3.67% of body weight. High levels of consumption affect livestock production performance (Pazla *et al.*, 2021). Harwanto *et al.* (2014) identified that using a sinamaldehyde level of 600 mg/kg DM feed or equivalent with adding cinnamon powder as much as 45.0 g/kg DM feed, decreased protein digestibility *in vitro*. Ishlak *et al.*

(2015) reported that the addition of sinamaldehyde 400 mg/kg DM feed decreased protein digestibility by 37.5% compared to the control ration without the addition of sinamaldehyde.

Physiologically high protein consumption indicates that livestock are attempting to meet their protein requirements, particularly in the form of N and/or amino acids. These needs can be functional, such as rumen microbial development and the activity of digestive enzymes and hormones, or structural needs, such as improving livestock growth rate. According to Putra (2012), goats treated with 68% natural pasture and 31.94% concentrate supplemented with 0.064% PIGNOX consumed the most protein, which was 10.8 g/head/day. In comparison to this study, protein consumption was between 14.96-19.27 g/head/day, indicating higher results.

The protein in feces (Table 2) treatment B was higher than treatments A and C. Consumption of protein in very high amounts can lead to excess protein that is not digested and excreted through the feces, in this study the highest protein consumption was seen in treatment B (Table 2). It occurred due to the increased use of cinnamon powder, which resulted in a higher concentration of cinnamaldehyde in the feed. More protein will be retained in the body if it can be prevented from being broken down in the cattle stomach. The amount of protein that goats consume is influenced by various factors, such as the breed, age, body weight, type of feed, and the purpose of raising the animal. The presence of nitrogen in animal feed is typically associated with the protein content of the feed. The protein percentage of the feed supplied to each treatment in this investigation was consistent, ranging from 18.43 to 18.74% (Table 1). In the A treatment, the maximum protein content in faeces was discovered when 30 g/kg (Table 2) of cinnamon powder was added, whereas in treatment C it can be interpreted that cinnamaldehyde protection can successfully increase the efficiency of protein use in goats, as well as increase the availability of protein for absorption in the small intestine and reduce protein degradation in the rumen. As a result, less protein is wasted and excreted in the feces, reducing the protein content in the feces. Nutritional efficiency in feed can also be seen from fecal protein excretion, which has the smallest value in treatment C. The amount of protein in faeces is greatly influenced by both the intake of protein and the extent to which the protein in the diet is digested. The study revealed that treatment B had the highest protein consumption (Table 2), with an average of 19.27 g/head/day. Consequently, this treatment also resulted in the highest faecal nitrogen excretion.

The excretion of protein in faeces primarily takes place in the form of urea, ammonia, or other nitrogenous compounds. Nitrogen excretion is not the only form of

nitrogen removal from the bodies of livestock. Other physiological processes, such as urinary excretion and respiration, also contribute to the elimination of excess nitrogen from the body. Putra (2012) conducted a study which demonstrated that the protein in the faeces of goats given 68% natural grassland, 31.8% concentrate feed, and 0.2% minerals was higher than the protein in the faeces of goats in this study. The quantity of protein in faeces is significantly influenced by the digestibility of the ration and the level of protein consumption. The protein content of faeces was 3.37% lower than that of this study.

Dinata and Sentana (2014) conducted research on Etawa Crossbreed goats that were given different levels of concentrate and forage. The results of their study indicated that the absorbed nitrogen ranged from 14.87 to 21.49 g/head/d, while the absorbed nitrogen in this study was between 12.04 and 15.90 g/head/d (Table 2). The presence of positive N balance indicates that the feed given is of high quality, with a sufficient protein content and efficiency. The nitrogen absorption was not influenced by the administration of cinnamon at a rate of up to 60 g/kg dry matter (DM).

The protein urine in this study was higher than that of study conducted by Dinata and Sentana (2014), which was ranging from 6.99-7.73 g/head/day. As protein intake increases, the amount of protein excreted through urine also increases. The crude protein content of urine can originate from the body's protein catabolism, resulting in the production of blood urea or purine derivatives. These derivatives can be produced from microorganisms that are absorbed in the digestive tract and metabolised in the body's cells (McDonald *et al.*, 1988). If urea ($\text{CO}(\text{NH})_2$) is not recycled, urine protein levels will rise.

The addition of cinnamon powder did not affect the overall levels of protein retention. This is because an increase in protein retention is an indicator of an improvement in the CP balance of livestock. Therefore, there will be an increase in the formation of meat vein weave. If the animals are supplied with an adequate amount of nitrogen, they will gain weight and grow. The nitrogen balance can be employed to determine the quantity of protein required for growth. The protein requirement of the animal in question is determined by the minimum protein dose that ensures optimal growth retention in this nitrogen balance.

Biological Value (BV) is a metric used to assess the utilization of protein from a feed by livestock. This parameter quantifies the degree to which the protein in the feed can be efficiently absorbed and utilized by the body. The BV of B is generally the lowest, with a value of 85.13%, while the BV of treatment A (Table 2) is the highest, with a value of 89.83%. However, statistically, there

is no significant difference between the two. BV refers to the efficiency with which protein rations can be retained in relation to the amount of protein that can be digested or nitrogen that can be absorbed. Protein measurement, as defined by Kishan and Singh (1988), is commonly used to assess the nutritional status of livestock. According to Ranjhan (1977), it is not sufficient to use digestible crude protein as a basis for assessing the nutritional status of livestock, especially ruminants. The primary concern in this circumstance is to prioritise the optimal level of protein absorption and utilization in animals.

Net Nitrogen Utilisation (NNU) refers to the extent to which the protein consumed by goats can be utilised (retained) in their bodies. In a study conducted by Dinata and Sentana (2014), Etawa Crossbreed goats were given different levels of concentrate and forage, which resulted in a lower NNU value compared to this study 70.80 – 72.51%, (Table 2), with values was between 35.11 and 45.95%. According to (Dinata and Sentana, 2014) the increasing BV and NNU provides an illustration that quantitatively feed together can increase BV ration protein. This shows that the process of digestion and metabolism of proteins, especially microbial proteins and acids more aminos are absorbed in the small intestine efficient.

BLOOD METABOLIC PROFILE

Feeding high levels of protected protein has several significant effects on blood metabolism. These effects are mainly related to increased protein and nitrogen metabolism in the body. Protein is broken down into amino acids in the body. When these amino acids are used for energy or the synthesis of other compounds, the amine group is released and converted to urea in the liver. This urea is then excreted through urine. Therefore, high protein consumption can increase metabolic profile (blood urea nitrogen, BUN). The process in which animals metabolise feed serves as an indicator of the feed's nutritional value. In this research, the feed provided to the animals was nearly the same. This condition changes how nutrients are supplied to the body, but it does not significantly impact the levels of chemicals in the blood (Table 3).

The level of sugar in the blood is indicative of the animal's energy levels. The sugar in the blood plays a crucial role in continuously nourishing the body tissues (Wahyuni *et al.*, 2011). The blood glucose levels observed in this study were found to be lower than the average blood glucose level of Etawa crossbreed goats reported by Cakra *et al.* (2022), which was 47.12 mg/dl levels. The blood sugar levels did not show any significant different depending on the animals' feed consumption. It because the body absorbs all the components of the food and converts them into glucose. When carbohydrates are broken down in ruminant

animals, they produce glucose, acetic acids, propionate, butyrate, CO₂, and methane gas. When animals consume food, their stomach undergo a process of breaking down the food into acids. These acids are transported through their bloodstream and to the liver, where they are turned into energy, fat, and sugar. VFA is the biggest energy source for animals that chew their cud (McDonald *et al.*, 2010).

Table 3: Metabolic profile of Etawa crossbreed goat blood fed cinnamon powder as a protein protection agent.

Variable (mg/dl)	Treatment ¹⁾		
	A	B	C
Glucose	18.44±5.40	28.52±9.70	24.18±13.37
Total protein (g/dl)	2.79±0.20	3.06±0.15	2.81±0.47
Total cholesterol	36.54±16.74	41.94±18.46	36.78±19.29
Blood Urea Nitrogen (BUN)	42.76±7.14	49.32±11.01	51.70±6.85
Alkaline Phosphate	6.70±1.15	7.84±1.82	5.36±1.82

¹⁾A: Concentrate without Cinnamon powder addition; B: Concentrate containing Cinnamon powder addition (30 g/kg feed DM); C: Concentrate containing Cinnamon powder addition (60 g/kg feed DM).

Total protein and protein fractions (albumin and blood globulin) is expected can give an idea about various proteins obtained from the results body secretions especially physiological conditions body related biochemical determinations and basic livestock maintenance (Tothova *et al.*, 2016). Blood protein levels associated with protein consumption were not significantly different (Table 3). This is in line with the research of Cakra *et al.* (2022) who found that there was no effect of giving Hibiscus leaf on total blood protein. The study found that the total protein in goat blood collected was lower than the results of the previous study. Rostini and Zakir (2017) discovered that the average protein level in the blood of Etawa goats is 7.47 mg/dl. The blood plasma protein levels found were between 5.97 and 7.60 mg/dl. Total protein normal goats range between 6.0 - 7.9 g/dl (Hanggara, 2017), 7.2 - 8.0 g/dl (Kaslow, 2010), in Etawa crossbreed goats 5.5 - 8.10 g/dl (Baratawidjaja, 2006). In this study the total blood protein interval was 2.79 - 3.06 g/dl, when compared with several studies, the total protein in this study was lower.

The addition of cinnamon powder containing cinnamaldehyde did not affect the overall levels of cholesterol with average 36.54–41.94 mg/dl (Table 3). The cholesterol levels were not different as the animals consumed almost the same amount of organic matter and digested it almost the same way. It is because all the parts of the food consumed by animals, like carbs and protein, are absorbed by the body and converted into fat. Subsequently, this fat serves as energy source for the animals to maintain their health, reproduce, and produce things like milk.

NOVELTY STATEMENT

Protein protection using cinnamon as a source of cinnamaldehyde has no negative effect on protein balance and blood metabolic profile of Etawah crossbreed goats

AUTHOR'S CONTRIBUTION

Catur Suci Purwati: Carried out the experiment, carried out the laboratory analysis, analysed the data and drafted the manuscript. Chusnul Hanim: Supervised the experiment and revised the manuscript. Lies Mira Yusiati: Supervised the experiment. Budi Prasetyo Widyobroto: Designed and supervised the experiment. All authors were responsible for reading and approving the final manuscript.

CONFLICT OF INTEREST

The authors have declared no conflict of interest.

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After the breakdown of protein, blood urea nitrogen (BUN) remains in the body. The BUN levels observed in this study ranged from 42.76 to 51.70 mg/dl. Kramer (2000) explains that the normal BUN level is between 10 and 26 mg/dl. It is possible that the decrease in the BUN is a result of reduced protein breakdown in the cow's stomach, leading to a decrease in the production of ammonia. Lower ammonia levels in the stomach mean more protein is being digested and used, which decreases the amount of harmful ammonia in the blood. As a result, the liver produces fewer harmful waste products, leading to a reduction in BUN levels. Khattab *et al.* (2013) found a connection between BUN levels and ammonia nitrogen levels in the rumen. They assert that cow's stomach converts protein into ammonia, which is then utilized by bacteria to synthesize more protein. If an excessive amount of ammonia is produced, it may be absorbed by the stomach, circulate in the bloodstream, and ultimately reach the liver. The liver transforms into urea with the help of an enzyme known as the urea cycle (Peter *et al.*, 2010). Urea is discharged into the blood and can be assessed using a BUN test.

Normal alkaline phosphate levels in the blood are between 4.20 and 7.75 mg/dl. Elevated levels of creatinine may suggest muscle breakdown. The alkaline phosphate level in this study ranged from 5.36 to 7.84 mg/dl. The goats' unusually high alkaline phosphate levels indicate they are not suffering from bone disease, liver disease, or bile obstruction. There can be differences in the collection and handling of feed and blood samples, genetics, environment, and the age and sex of animals. The regular levels of urea suggest the body effectively utilised protein and consumed high-quality protein. According to Ocheja *et al.* (2021), they found that the levels of alkaline phosphate were between 57.55 and 58.10 m/l.

CONCLUSION

Cinnamon powder added at 30 g/kg feed DM reduced protein in faeces, which protected feed protein and had no negative effects on protein consumption, amount of digestible protein, protein urine, protein retention, BV, NNU, Glucose, total protein, total cholesterol, BUN, and phosphate.

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