



The Effect of the Use of Coconut Husk on Performance, Blood Metabolites, Electrolytes, and Full Blood Counts of Brahman Cross Cattle

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Abstract | The study aimed was to determine the effect of utilization coconut husk on blood metabolites and electrolytes of Brahman cross cattle. Sixteen Brahman cross beef cattle were used in the study. Four treatments, including R0, R1, R3, and R4 was applied in the study, and that every treatment consisted of four replications. The rations were made up of iso-protein and iso-energy, with 11% crude protein and 66% gross digestible nutrients. The treatment used was complete feed R1: fermented coconut husk supplementation of 15%, R2: supplementation of fermented coconut husk of 20%, R3: supplementation of fermented coconut husk of 25%, R4: 30% fermented coconut husk supplementation. This experiment was conducted for 90 days of treatment. The consumption of dry matter, organic matter, crude fiber, and crude protein were observed during the study. The digestibility of dry matter, organic matter, crude fiber, and crude protein were also observed during the experiment. Blood metabolites and electrolytes, and blood counts were all determined. The intake, digestibility, and average daily gain were superior at cattle fed with R2. Blood metabolites, electrolytes, and blood counts were not substantially different ($P > 0.05$) between the treatment groups. Overall, coconut husk may be used to replace rice straw for Brahman cross cattle.

Keywords | Blood counts, Blood metabolites, Cattle, Coconut husk, Electrolytes

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INTRODUCTION

In Indonesia, beef cattle are one of the most popular livestock commodities. The per capita demand for beef cattle has risen in recent years. Beef cattle have long been common livestock in Indonesia. On average, farmers raise two to three heads of beef cattle. The supply of feed, in general, determines the profitability of livestock businesses, including beef cattle (Dolewiku et al., 2016); and the adoption of advanced technology (Mariyono, 2019) in the sector is another factor in improving livestock performance.

Agricultural and plantation waste, industrial waste of agriculture, forage cultivation, and grazing are all potential ruminant feed sources, although the last two sources are often hindered by land-use competition. As a result, it is essential to take advantage of two additional feed sources with consistent supply, high quality, and a reasonable price. Feed costs are the costliest aspect of the beef cattle fattening process, accounting for approximately 70% of overall costs. Seeking alternate feeds that widely available and do not compete with human needs is one way to cut manufacturing costs. The use of local resources such as agricultural waste and plantation waste is needed to reduce feed

costs and reduce environmental pollution (Santoso et al., 2016; Santoso et al., 2017). Until now, coconut husk has not been widely used as animal feed, so coconut husk is only thrown away and even burned, so it exaggerates environmental pollution resulting from agricultural sectors. As studied by Mariyono et al. (2010) and Mariyono (2015), agricultural sectors in Indonesia have started polluting the environment since the Green Revolution Campaign; and the pollution has caused considerable environmentally external costs (Mariyono, 2009; Mariyono et al., 2018). The use of coconut husk as animal feed will be beneficial to reduce pollution and helps save the environment.

Brahman crossbred is a type of cow that is starting to be reared by many farmers in Indonesia. This is because of its good performance and can be maintained in conditions suitable for the climate in Indonesia. Farmers in Boyolali, Klaten, and Sukoharjo started raising this breed of Brahman crossbred (Nuswantara et al., 2020).

Rice straw is an agricultural residue that is widely used for animal feed. Research using rice straw as animal feed has been carried out by several researchers such as Doolatabada et al. (2020), Tayengwa et al. (2020), Nassara et al. (2019), Cherdthong et al. (2021), Thanh (2012), Ware and Zinn (2005), Nuswantara et al. (2020), Nuswantara et al. (2005) and Hoerbe et al. (2020). Rice straw is very potential to be used for livestock production in Indonesia. Rice straw can be used as an animal feed, and up to 20% of the overall feed can have the best ADG (He et al., 2018). However, rice straw is exceedingly scarce during the dry season, a common concern for beef cattle farmers in Indonesia. In this case, alternate feeds that are close to rice straw must be sought.

One of the potentials for alternative feed as a fiber source is coconut husk (the outermost component of a coconut, which is a fibrous layer about 5 cm thick). In 2006, around 1,104,880 tons of coconut husk were estimated to have been produced. This volume can be processed into usable items, so research in that direction is necessary. Coconut husk contains high ingredients of lignin, cellulose, and hemicellulose. Its chemical composition is 42.10% lignin, 32.69% cellulose, and 22.56% hemicellulose (Muensri et al., 2011). Even so, the coconut husk is rich in macronutrients (Neto et al., 2004). Based on the nutritional potential, coconut husk cannot be given to livestock directly. However, because of its high fiber content, it must be reduced by processing feed to increase its nutritional value and digestibility. One of the methods to reduce fiber content and increase the digestibility of the fiber-rich stuff is by fermentation using fiber digesting microbes. In this study, the fiber digesting bacteria were isolated from the buffalo rumen fluid (Wannapat et al., 2009). Cellulolytic bacteria from buffalo rumen are considered feasible because they

have more benefits in terms of degradation value and cellulose digestibility than that from cattle rumen. Buffaloes have a gross cellulolytic bacterium of 3.3×10^9 CFU/ml, which is higher than cows' 2.7×10^8 CFU/ml (Wannapat et al., 2009). Strong xylanase enzymes are believed to be produced by rumen microorganisms (Kulkarni et al., 1999). Therefore, the high content of cellulose and hemicellulose in coconut husk should be degraded by a culture of fiber-digesting bacteria isolated from buffalo rumen fluid used as a starter fermentation process, according to this assumption. Overall, the study aimed to determine the effect of utilization coconut husk on blood metabolites and electrolytes of Brahman cross cattle.

MATERIALS AND METHODS

The animal ethics committee of the Faculty of Animal and Agricultural Sciences, Diponegoro University, approved the experiment (No. 3122/UN.7/III/2020, March 29th, 2020). This study was conducted at the Faculty of Animal and Agricultural Sciences, Diponegoro University Semarang. This study used 16 Brahman cross (male) cattle aged around 8-10 months with a 134-187 kg body weight. The cattle were placed in an individual cage (210 x 120 cm). The study lasted for 14 days for feed adaptation, 90 days for experimental treatment and data collection. Complete feed and drinking water were given *ad libitum* at 7 am, and the remaining feed was weighed at 7 am of the following day. The composition and nutrient content of the complete feed for treatment are presented in Table 2. The content of the complete feed/rations formulation used in this study was in dry form. Fermented coconut husk as a supplement was used in the dry formulation, with crude protein (CP) content of 11% to 12% and TDN 65% to 70%. The research design used was a randomized block design (RBD) with four treatments and four bodyweight groups as replications. The treatment used was complete feed R1: fermented coconut husk supplementation of 15%, R2: supplementation of fermented coconut husk 20%, R3: supplementation of fermented coconut husk 25%, R4: 30% fermented coconut husk supplementation. The proximate analysis of the fermented coconut husk was presented in Table 1.

Table 1: Proximate compositions of fermented coconut husk

Compositions (%)	Coconut husk
Crude protein	7.05
Ether extract	3.61
Crude fiber	22.3
Ash	35.4
Moisture	5.61

Table 2: Treatment and nutrient content of complete feed supplemented with fermented coconut husk

Ingredients	Treatments			
	R1	R2	R3	R4
Composition	----- (%) -----			
Palm Oil	15.00	15.00	14.00	7.00
Corn	20.00	20.00	22.00	25.00
Fermented coconut husk	15.00	20.00	25.00	30.00
Rice Bran	14.00	7.00	5.00	4.00
Kapok seed meal	8.00	8.00	6.00	7.00
Coffee husk	6.00	6.00	3.00	2.00
Coconut oil	1.00	1.00	1.00	1.00
Coconut meal	10.00	12.00	13.00	17.00
CaCO ₃	0.20	0.20	0.10	0.20
Salt	0.20	0.20	0.10	0.10
Molasses	10	10	10	6
Urea	0.6	0.6	0.8	0.7
Nutrient Composition	----- (%) -----			
Dry material (DM)	88.53	88.39	87.15	87.20
Organic material (OM)	91.37	90.85	90.10	92.72
Crude Protein	11.14	11.62	12.29	12.41
Ether extract	4.52	4.00	4.51	5.15
Fiber content	32.53	28.85	31.21	30.41
nitrogen-free extract material	43.19	46.39	42.09	44.75
Total Digestible Nutrient	66,75	69,59	69,20	70,70
Growth energy GE (kal/g)	3633.51	3634.92	3739.36	3683.83

Description: BK, dry matter (DM); BO, organic matter (OM); Crude protein (CP); Ether extract (EE); crude fiber (CF); nitrogen-free extract material NFEM; TDN, total digestible nutrients; GE, gross energy. TDN calculation based on Hartadi et al. (1993).

FERMENTATION PROCESS

The buffalo rumen fluid microbial culture with the highest enzyme activity was re-inoculated in a liquid medium for 16 hours before being used as an inoculum in the coconut husk fermentation method. The coconut husk was shaved to a size of 1 to 2 cm. Fermentation was carried out by adding 0.1% urea, 3% molasses, distilled water (calculation of 60% moisture content based on dry coconut husk material), and 5% inoculum. The coconut husk mixed evenly was put in an airtight room and incubated for four weeks. Before being used as a complete feed, the fermented coconut husk was analyzed for its proximate analysis (AOAC, 2005).

This research was conducted for 90 days of treatment. The consumption of dry matter, organic matter, crude fiber, and crude protein were observed during the study. The digestibility of dry matter, organic matter, crude fiber, and crude protein was also determined during the experiment. Blood metabolites, electrolytes, and blood counts were among the parameters measured.

FEED CONSUMPTION

Feed consumption is calculated by weighing the feed before it is given to livestock minus the remaining unconsumed feed in the form of % DM. Consumption of feed nutrients which includes DM, OM, CP and CF (g/kg BW 0.75) The following is the consumption formula (Purbo-wati et al., 2004).

- a. DM consumption (kg/head/day) = feed given (kg) x% DM feed - leftover feed (kg) x % DM leftover feed
- b. OM consumption (kg head/day) = consumption of feed DM (kg) x% OM
- c. CP consumption (kg/head/day) = consumption of DM feed (kg) x% CP
- d. CF consumption (kg/head/day) = consumption of DM feed (kg) x% CF

Digestibility is the percentage of nutrients that are absorbed in the digestive tract which can be determined by looking at the difference between the amount of nutrients eaten and the amount of nutrients released in feces.

Dry Matter Digestibility (DMD). Dry matter digestibility

Table 3: Consumption of beef cattle fed with coconut husk supplementation in the feed

Parameter	Treatments			
	R1	R2	R3	R4
Dry matter consumption	6.47±0.14 ^a	6.31±0.13 ^a	4.32±0.10 ^b	6.25±0.11 ^a
Organic matter consumption	5.80±0.32 ^a	5.69±0.13 ^a	3.82±0.31 ^b	5.64±0.45 ^a
Crude protein consumption	702.51±39.17 ^a	727.96±16.84 ^a	520.98±42.30 ^b	754.59±59.94 ^a
Crude fiber consumption	2.77±0.15	2.75±0.064	2.41±0.083	2.70±0.216

Different superscripts on the same line indicate significant differences (P <0.05)

Table 4: Digestibility of beef cattle fed with coconut husk supplementation in the feed

Parameter	Treatments			
	R1	R2	R3	R4
Dry matter digestibility	67.85±1.75 ^a	67.32±0.74 ^a	51.515±4.07 ^b	66.49±2.51 ^a
Organic matter digestibility	70.13±1.62 ^a	69.42±0.7 ^a	54.32±3.83 ^b	69.32±2.3 ^a
Crude protein digestibility	70.48±3.23 ^{ab}	73.15±1.44 ^{ab}	68.88±4.56 ^b	76.12±3.3 ^a
Crude fiber digestibility	62.94±3.53 ^b	73.82±1.77 ^a	74.95±2.75 ^a	72.81±5.217 ^a

Different superscripts on the same line indicate significant differences (P <0.05)

is measured by calculating according to the formula:

$$DMD = \left(\frac{DM\ consumption - DM\ feces}{DM\ consumption} \right) \times 100\% \quad (1)$$

The consumption and excretion of feces are obtained in the measurement period during the collection period of one week.

Organic Matter Digestibility (OMD). The digestibility of organic matter can be measured by calculating according to the formula:

$$OMD = \left(\frac{OM\ consumption - OM\ feces}{OM\ consumption} \right) \times 100\% \quad (2)$$

BLOOD SAMPLES

Blood samples were collected at the end of the treatment during maintenance before feeding the cows. Blood samples were collected into heparinized tubes, centrifuges at 1000 x g for 15 min at 4°C, and plasma was immediately frozen (-20°C) until the determination of blood metabolites, electrolytes, and blood counts. A blood sample of 3 ml was taken from each cow through the jugular vein with a syringe (size 10 ml), then the measurement of blood metabolites and electrolytes was carried out by means of a blood sample that had been obtained by centrifuge for 15 minutes at a speed of 3000 rpm to take a plasma. The plasma was analyzed for blood metabolites, electrolytes, and blood counts, and urea nitrogen levels using a device of microlab 300 spectrophotometer.

The data obtained were analyzed based on Analysis of Variance (ANOVA). If there were differences, continue with the Duncan Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

As shown in Table 3, there were significant differences between treatments. Dry matter consumption, organic matter consumption, and crude protein consumption of beef cattle fed R3 was lower (P < 0.05) than R1, R2, and R4. Crude fiber consumption of beef cattle fed R3 was the lowest among other treatments. Table 4 shows that beef cattle fed R1, R2, and R4 had higher digestibility (P < 0.05) than beef cattle fed R3. Beef cattle served 15%, 20%, or 30% of fermented coconut husk in their feed have high digestibility. As shown in Figure 1, there was a significant difference in ADG of beef cattle given with coconut husk in the feed. Beef cattle fed R2 (20%) coconut husk had the best ADG. As shown in Table 5, there was no significant difference between blood metabolites, electrolytes, and blood counts of beef cattle fed coconut husk. This condition shows that feeding coconut fiber in the feed did not have a negative effect. Beef cattle were able to utilize coconut fiber to meet fiber needs. Hence, fermented coconut husk can be used to replace rice straw. To determine the adverse effects of using coconut husk in beef cattle, blood metabolism, electrolytes, and complete blood count analysis were also carried out.

The content of blood metabolites, electrolytes, and total blood counts was not significantly (P > 0.05) different among treatments showing that beef cattle could make good use of fiber sources. In Indonesia, the dry season is often quite long, at which time the availability of rice straw is running low. Coconut husk in Indonesia is only used as

Table 5: Effect of giving TMR groups R1, R2, R3 and R4 on constituent blood metabolites, electrolytes and hematology.

Parameter	Treatments			
	R1	R2	R3	R4
Albumin (g/dL)	3.3	2.9	3.2	3.1
Globulin (g/dL)	3.3	3.2	3.3	3.7
Albumin/globulin	0.9	0.9	0.9	0.8
Alkali phosphatase (IU/L)	319.5	307.9	257.4	240.1
Hematology				
WBC (x10 ³ /μL)	11.7	11.3	10.8	11.2
RBC (x10 ⁶ /μL)	8.6	7.7	8.9	8.5
HGB (g/dL)	11.6	10.6	11.2	9.5
HCT (%)	38.5	33.8	35.8	30.1
MCV (fL)	44.9	43.9	45.9	43.6
MCHC (g/dL)	30.4	31.2	31.5	31.4
Electrolyte				
Ca ⁺ (mg/dL)	10.6	10.6	10.7	9.6
Inorganic P ⁻ (mg/dL)	8.6	9.7	9.1	8.2
K ⁺ (mmol/L)	3.0	3.4	3.6	3.3
Phosphorus (mg/dL)	2.8	3.1	2.9	2.6

Different superscripts on the same line indicate significant differences (P <0.05)

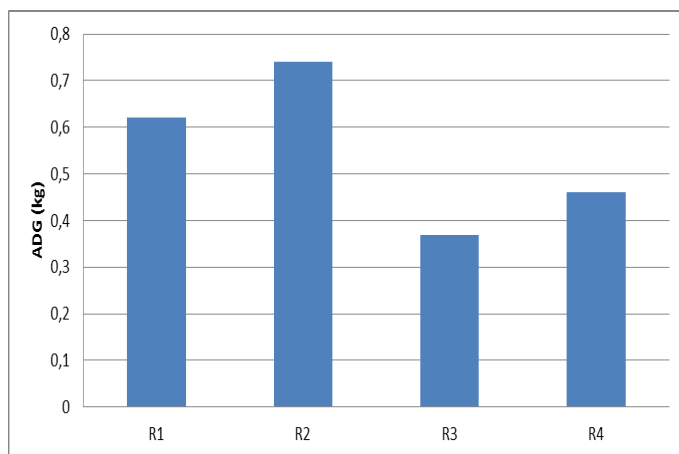


Figure 1: Average Daily Gain (ADG) of beef cattle fed coconut husk in the ration

waste; it has not been used as animal feed, although the crude protein content is quite high. The use of coconut husk as animal feed will reduce feed costs. The use of coconut husk up to 20% in beef cattle feed can produce the best ADG, and this is because, at this 20% level, beef cattle can consume and digest the feed properly without any deleterious effects on the beef cattle. Blood metabolites, electrolytes, and hematology were not significantly different, and their values were in the normal range of healthy cows. Blood metabolism, electrolytes, and hematology reflect the health of cattle. High levels of consumption of the rations R1, R2, and R4 and supported by high nutrient digestibility will cause the nutrients used by the body to increase. The high consumption and digestibility in R2 are supported by the high digestibility level of crude fiber,

which results in higher ADG than R1, R4, and R3. According to Hoerbe et al. (2020), beef cattle can consume high-fiber feed.

According to the present findings, beef cattle were able to make effective use of the fiber sources in a coconut husk and turn it into weight gain. The fermented coconut husk was used up to 20% on beef cattle, which provided good performance in intake and digestibility. In this regard, the fermented coconut husk has many potentials for use in beef cattle, particularly during the dry season when the rice straw is scarce. The results of this study are in line with Hoerbe et al. (2020), which state that beef cattle have an optimum amount of fiber content that can be utilized properly to become ADG. The results of the study are also in line with the research of Tanh et al. (2012), which states that giving rice straw in the feed will provide ADG 0.6 to 0.7. Blood metabolites, electrolytes, and total blood count were not statistically different (P > 0.05). This indicates that beef cattle can also make good use of coconut husk such as rice straw. This is supported by data on blood metabolites such as albumin, globulin, albumin, globulin ratio, and the same alkaline phosphatase, indicating that cattle are in normal condition and are not stressed dehydrated position due to feeding with different coconut husk levels. This can be seen from the results of the study from the average albumin value of 2.96 to 3.3 g/dL. This value, when referenced from the normal standard according to Schalm (1975) and Anderson et al. (1977), is still in the normal range from 2.1 to 3.6 g/dL. At the globulin value with an average value of 3.2 to 3.7 g/dL and if it is

referred to from the normal standard value according to Schalm (1975) and Anderson et al. (1977) is still in the normal range from 2.9 to 4.9 g/dL. Likewise, the value of the albumin: globulin (A/G) balance obtained an average yield ranging from 0.8 to 0.9 g/dL, and when compared with normal standard values according to Schalm (1975) and Anderson et al. (1977), the A/G balance value was below the normal range from 1.1 to 1.5 g/dL. Provision of coconut husk 20% in feed gives the highest ADG without disturbing the cattle's health. This means that the use of coconut husk 20% did not interfere with the metabolic processes in the body of cattle. This indicates that coconut husk is safe to use as animal feed.

CONCLUSION

The results show that beef cattle fed with feeding material containing 20% coconut husk gave the best consumption, digestibility, and ADG results. There is no difference in blood metabolites, electrolytes, and total blood counts. This condition shows that beef cattle were able to well utilize the coconut husk as alternative source of feeding materials. To sum up, so the abundantly availability of coconut husk has a potential to replace rice straw. This study suggests that socialization of this findings to livestock farmers needs to be conducted in order to reduce dependency on other feeding materials.

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CONFLICT OF INTEREST

The authors state there is no conflict of interest.

AUTHOR'S CONTRIBUTION

All authors contribute to the conduct of research, the writing process, and data analysis.

REFERENCES

- Anderson PH, B Sylvia., JB Pamela, HC Nancy, JW Parfitt, DSP Patterson (1977). Biochemical indicators of liver injury in calves with experimental fascioliasis. *Vet. Rec.* 100.:43-45 <https://doi.org/10.1136/vr.100.3.43>
- AOAC (2005). Official Methods of Analysis. Association of Official Chemist. Inc. Virginia.
- Cherdthong A, C Suntara, W Khota, M Wanapat (2021). Feed utilization and rumen fermentation characteristics of Thai-indigenous beef cattle fed ensiled rice straw with *Lactobacillus casei* TH14, molasses, and cellulase enzymes. *Livest. Sci.* 245:104405. <https://doi.org/10.1016/j.livsci.2021.104405>
- Doolatabada SS, M Saria, GR Ghorbani (2020). Effect of partial replacement of dietary starch with fiber and fat on performance, feeding behavior, ruminal fermentation and some blood metabolites of Holstein calves. *Anim. Feed Sci. Technol.* 270:114691. <https://doi.org/10.1016/j.anifeedsci.2020.114691>
- Dolewikou RL, W Sumekar, A Setiadi (2016). The profitability analysis of dairy cattle business on the group of dairy farmers in West Ungaran District, Semarang Regency. *J. Indonesian Trop. Anim. Agric.* 41(4): 216-223. <https://doi.org/10.14710/jitaa.41.4.216-223>
- Hartadi H, S Reksodhadiprodo, AD Tillman. (1993). Tabel Komposisi Pakan untuk Indonesia. Gadjah Mada University Press, Yogyakarta. <https://doi.org/10.1016/j.jclepro.2018.09.156>
- He Y, H. Wang, Z Yu., W Niu., Q Qiu., H Su, B Cao (2018). Effects of the gender differences in cattle rumen fermentation on aerobic fermentation of wheat straw. *Journal of Cleaner Prod.* 205: 845-853. <https://doi.org/10.1016/j.jclepro.2018.09.156>
- Hoerbe JB, AG Sessim., GR Pereira., DD Brutti, TE Oliveira, JOJ Barcellos (2020). Cow-calf intensification through the feeding of rice straw. *Livest. Sci.* 242:104296. <https://doi.org/10.1016/j.livsci.2020.104296>
- Kulkarni NA, SM Rao (1999). Molecular and biotechnological aspects of xylanase. *FEMS Microbiol. Rev.* 23:411-456. <https://doi.org/10.1111/j.1574-6976.1999.tb00407.x>
- Muensri P, T Kunanopparat, P Menut, S Siriwattanayotin (2011). Effect of lignin removal on the properties of coconut coir fiber/wheat gluten biocomposite. *J. Composites: Part A.* 42 (2): 173-179. <https://doi.org/10.1016/j.compositesa.2010.11.002>
- Mariyono J (2009). Socially inefficient use of pesticides due to negative externalities: a case of Indonesian rice agriculture. *Int. J. Ecol. Develop.* 13 (S09): 93-107.
- Mariyono J (2015). Green revolution- and wetland-linked technological change of rice agriculture in Indonesia. *Management of Environmental Quality: An Int. J.* 26 (5) :683-700. <https://doi.org/10.1108/MEQ-07-2014-0104>
- Mariyono J (2019). Micro-credit as catalyst for improving rural livelihoods through agribusiness sector in Indonesia. *J. Entrepreneur. Emerg. Econ.* 11(1) :98-121. <https://doi.org/10.1108/JEEE-06-2017-0046>
- Mariyono J, T Kompas, RQ Grafton (2010). Shifting from the Green Revolution to environmentally sound policies: Technological change in Indonesian rice agriculture. *J. Asia Pacific Econ.* 15(2):128-147.
- Mariyono J, A Kuntariningsih, T Kompas (2018). "Quantity and monetary value of agrochemical pollution from intensive farming in Indonesia", *Manag. Environ. Qualit.* 29(4): 759-779. <https://doi.org/10.1080/13547861003700109>
- Mor P, B Bals, AK Tyagi, F Teymouri, N Tyagi, S Kumar, V Bringi, M VandeHaar (2018). Effect of ammonia fiber expansion on the available energy content of wheat straw fed to lactating cattle and buffalo in India. *J. Dairy Sci.* 101:7990-8003. <https://doi.org/10.3168/jds.2018-14584>
- Nassara MK, S Lyua., J Zentekc, GA Brockmann. (2019). Dietary fiber content affects growth, body composition, and feed intake and their associations with a major growth locus in growing male chickens of an advanced inter

- cross population. *Livest. Sci.* 227: 135–142. <https://doi.org/10.1016/j.livsci.2019.07.015>
- Neto CPCT, FFH Ferreira, FC Bezerra, RF Sousa, MLF Cavalcanti (2004). Efeito de diferentes substratos na aclimatizaco “ex-vitro” de mudas de *Violeta Africana* (*Saintpaulia ionantha* Wendl.). *Revista de Biologia e Ciencias da Terra.* 4(2): 2-6.
 - Nuswantara LK, Sunarso, M Arifin, A Setiadi (2020). Komponen serat sabut kelapa yang difermentasi menggunakan mikroba pencerna serat dari rumen kerbau. *Jurnal Agripet.* 20(1):1-8 <https://doi.org/10.17969/agripet.v20i1.15545>.
 - Nuswantara LK, M Soejono, R Utomo, BP Widyobroto (2005). Kecernaan nutrient ransum prekursor nitrogen dan energi tinggi pada sapi perah yang diberikan pakan basal jerami padi. *J. Indonesian Trop. Anim. Agric.* 30(3): 172–178.
 - Purbowati EE, Baliarti, SPS Budhi (2004). Tampilan Glukosa, NH₃ dan urea darah domba yang digemukan secara feedlot dengan pakan dasar dan level kosentrat yang berbeda. *J. Pengembangan Peternakan Trop.* 1: 81-85.
 - Santoso SI, S Susanti, A Setiadi (2017), Economic analysis of male broiler chickens fed diets supplemented with *Salvinia molesta*. *Int. J. Poult. Sci.* 16 (6): 233–237. <https://doi.org/10.3923/ijps.2017.233.237>
 - Santoso SI, E Suprijatna, A Setiadi, S Susanti (2016). Effect of duck diet supplemented with fermented seaweed wastes on carcass characteristics and production efficiency of indigenous Indonesian ducks, *Indian J. Anim. Res.* 50(5): 699–704. <https://doi.org/10.18805/ijar.11160>
 - Schalm ON (1975). *Veterinary Hematology.* 3rd Ed. Department of Clinical Pathology of Veterinary Medicine. University of California. Lea and Febiger. Philadelphia.
 - Tayengwaa T, OC Chikwanhaa, MER Dugan, T Mutsvangwac, C Mapiyea (2020). Influence of feeding fruit by-products as alternative dietary fibre sources to wheat bran on beef production and quality of Angus steers. *Meat Sci.* 161:107969. <https://doi.org/10.1016/j.meatsci.2019.107969>
 - Thanh VTK (2012). The effect on introduction of adding urea to rice straw for cattle and buffalo calves. *Livest. Sci.* 150:111-113. <https://doi.org/10.1016/j.livsci.2012.08.007>
 - Wannapat M, R Pilajun, P Kongmun (2009). Ruminant ecology of swamp buffalo as influenced by dietary sources. *Animal Feed Sci. Technol.* 151: 205–214. <https://doi.org/10.1016/j.anifeedsci.2009.01.017>
 - Ware RA, RA Zinn (2005). Effect of pelletizing on the feeding value of rice straw in steam-flaked corn growing-finishing diets for feedlot cattle. *Anim. Feed Sci. Technol.* 123–124:631–642. <https://doi.org/10.1016/j.anifeedsci.2005.04.051>