

Effect of Fermented Concentrate on Growth Performance of Brahman Crossbred Steers: A Preliminary Study

Mohammad Sofi'ul Anam¹, Chusnul Hanim¹, Andriyani Astuti¹ and Ali Agus^{1,*}

¹ Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta

*Corresponding author. Email: aliagus@ugm.ac.id

ABSTRACT

This preliminary study aimed to determine the effect of fermented concentrate on Brahman crossbred steer growth performance. This study used ten Brahman crossbred steers aged 16-20 months weighing an average of 334 kilograms. All animals were randomly divided into two groups: control and treatment ($n = 5/\text{group}$). The control group received freshly harvested king grass combined with commercial concentrate feed ($\pm 3\%$ BW); the treatment group received fresh king grass and fermented commercial concentrate. The fermented concentrate was prepared using inoculum bacteria solutions: freshwater + 5% molasses + 0.5% SBP®. The solutions were added with a concentrate containing 0.5% Agromix Booster® mineral premix. The mixture ($\pm 35\%$ moisture contents) was fermented under anaerobic conditions for at least 6 hours. Each treatment group's animals were fed twice daily and given free access to water. The duration of the fattening period was 145 days, with six times of animals weighting. The results indicated that there were no statistically significant differences between the two groups in terms of final body weight, total live weight increase, average daily gain (ADG), feed intake, feed conversion ratio, and feed cost per gain ($p > 0.05$). However, the value of ADG (0.99 vs 0.71 kg), concentrate intake (8.66 vs 7.59 kg DM) and income over feed cost (2,37 vs 1,83 million IDR/head) in the treatment group was higher ($p > 0.05$) than in the control group. The limited number of replication ($n=5$) might explain the data obtained statistically indifferent between two groups. It would be much of interest to conduct the trial with a greater number of cattle. It might be expected that feeding Brahman crossbred steers with dietary fermented concentrate would significantly have a higher value, including total live weight gain, ADG, feed intake, and income exceeding feed cost in the fattening period.

Keywords: Brahman crossbred steers, fermented concentrate, ADG, feed intake

1. INTRODUCTION

The increasing demand for meat in Indonesia is not equivalent to local meat production, so imported feeder cattle meet the shortage. However, many factors can affect animal production; one of them is nutrients. Nutrients are an essential component in determining the performance of cattle [1]. In livestock enterprises, feed costs can reach up to 70% of the total cost. Animals require high-quality feed to maximize productivity. An effort to raise livestock production by high-quality feed supplementation is assumed to result in a high average daily gain and efficiency [2]. Increased feed efficiency will lead to higher business earnings [3].

One of the feed technology methods that can improve cattle performance is by using fermentation. It is a

process that is essential in the usage of prospective nutrients in maximizing their conservation and minimizing antinutritional compounds in the feed process [4]. The fermentation technique can inhibit microbial pathogens' growth and increase concentrates' nutrient quality [5,6]. Some researchers have observed the benefits of using microbiological inoculants in fermented concentrates, as Kim et al. discovered [7]. They examined fermented feed following the lactic acid bacteria supplementation as microbes source for 21 days of fermentation. They revealed that it might significantly increase feed intake linear with growth efficiency in cattle. Wulandari et al. [8] also reported that using multi-microbial inoculum (SBP®) was a viable fermenter to improve digestibility and reduce cacao pod theobromine. The fermented feed may deliver more dense nutrition, improved palatability, and enhanced digestibility,

thereby meeting cattle protein requirements and enhancing beef cattle performance [9,10].

The use of fermented concentrates in livestock, especially pigs and poultry, has been extensively explored. Nonetheless, research on the use of microbial inoculants to ferment concentrate in ruminants is scarce. However, additional research is necessary to evaluate the effect of fermented concentrate on *in-vivo* studies. The point of the study was to assess the effect of fermented concentrate on Brahman crossbred steer growth performance.

2. MATERIALS AND METHODS

2.1. Fermented Concentrate Preparation

The concentrate was obtained from the commercial product of PT. Widodo Makmur Perkasa, Cianjur. Microbial inoculum of SBP® was produced by CV. Agromix Lestari, Yogyakarta. First, the amount of 20-liter fresh water was added by 5 kg molasses and 500 ml SBP®. The solution was homogenized and left for 2 hours under anaerobic conditions. A total of 100 kg of commercial concentrate, containing 0.5% Agromix Booster® mineral premix, was added to the inoculum bacteria solution earlier. The mixture containing ±35% moisture contents was placed in a mini silo (100 kg) and fermented under anaerobic conditions for at least 6 hours.

2.2. Animal and Experimental Design

Ten Brahman crossbred steers were obtained between 16 and 20 months and were confined in an individual cage at the Bengkel Kali Jeruk, Sleman, Yogyakarta. These animals were split into two groups, consisting of 5 animals: the control and the treatment group (n=5/group). The control group's initial body weight was 334.60 kg, while the treatment group's initial body weight was 333.40 kg. System of feeding: The control group received fresh king grass (7 kg) with commercial concentrate (9 kg), the treatment group received fresh king grass and fermented concentrate. They were fed experimental feed twice daily at 07.00 and 15.00. Water was provided ad libitum every day. Brahman crossbred steers were kept for 145 days and weighed six times: day-0, day-28, day-68, day-107, day-135, and day-145. The total gain in live weight (TLWG) was calculated as TLWG = final body weight (kg) - initial body weight (kg). The average daily gain (ADG) was determined by dividing the TLWG by the fattening periods. Feed conversion ratio (FCR) was calculated as FCR = feed intake (kg DM)/weight gain (kg). Income over feed cost is an economic evaluation aspect calculated by the difference between feed cost and weight gain in Indonesian rupiah (IDR).

2.3. Nutrient Component of Feed

Random grab samples were crushed through a 1 mm screen to determine the relative concentration of king grass and concentrate. Dry matter content (DM) of king grass was examined after drying in an air-dryer at 55°C for three days using AOAC [11]. Organic matter (OM), crude protein (CP), crude fiber (CF), ether extract (EE) were specified. Total digestible nutrients (TDN) were calculated following Hartadi et al. [12]. The chemical components of King grass and commercial concentrate were shown in Table 1.

Table 1. Nutrient composition of King grass and commercial concentrate

Item (%DM)	King Grass	Concentrate
Dry matter (DM)	20.14	89.87
Organic matter (OM)	84.99	93.78
Crude protein (CP)	8.67	10.62
Crude fiber (CF)	33.00	21.20
Ether extract (EE)	1.30	5.51
Nitrogen free extract (NFE)	42.02	56.45
Total digestible nutrient (TDN)	48.60	48.25

2.4. Statistical analysis

An independent sample T-test of SPSS (version 20) was used to determine significant differences between control and treatment groups. Data were provided as mean ± standard error of the means (SEM). A statistically significant difference was defined as $p < 0.05$.

3. RESULTS AND DISCUSSION

The effect of fermented concentrate on the growth of Brahman Crossbred steers was studied. Animals fed with fermented concentrate showed a higher total feed intake (10.06 kg DM) than the animals fed with non-fermented concentrate (8.99 kg DM) during the fattening period (Table 2). This was due to the concentration difference (8.66 vs 7.59 kg DM), while the forage intake is the same. These findings suggest that the animals preferred to eat fermented feed over control feed. It is likely because of the microbially fermented concentrate. It contains a variety of organic acids that give it a pleasant odor and flavor. A similar study with various silages was conducted in Hanwoo steers; the authors stated that animals fed a mixture of silage and concentrate consumed total feed than animals fed concentrate with rice straw [13]. However, Junior et al. [14] found that animals fed silage consumed less than animals fed a control diet, contradicting our findings.

Table 2. Effect of fermented concentrate on feed intake and growth performance of Brahman crossbred steers during the fattening period.

Items	Sig.	Control ¹ (C)	Treatment ² (T)	SEM ³	Differences (T-C)
IBW, 0-day (kg)	ns	334.60	333.40	9.18	-1.20
28-day (kg)	ns	365.20	369.80	9.29	4.60
68-day (kg)	ns	416.60	418.20	12.75	1.60
107-day (kg)	ns	444.80	461.20	16.09	16.40
135-day (kg)	ns	466.60	486.80	22.47	20.20
FBW, 145-day (kg)	ns	463.20	491.20	19.58	28.00
Feed intake (kg DM)	-	8.99	10.06	-	-
King grass (kg DM)	-	1.41	1.41	-	-
Concentrate (kg DM)	-	7.59	8.66	-	-
TLWG (kg)	ns	128.60	157.80	16.96	29.20
ADG (kg)	ns	0.71	0.99	0.12	0.29
FCR	ns	13.67	9.64	1.82	-4.03
Feed cost of gain	ns	42,273	30,316	8,758	-12,409
Income over feed cost (IDR/head)	ns	1,831,500	2,371,900	2,455,395	540,380

¹ Control group: Brahman crossbred steers fed fresh king grass + commercial concentrate;

² Treatment group: Brahman Crossbred steers fed fresh king grass + fermented commercial concentrate; IBW: Initial body weight; FBW: Final body weight; TLWG: Total live weight gain; ADG: Average daily gain; FCR: Feed conversion ratio;

³ Standard error of the mean (*p*-value).

However, other researchers have indicated that fermented feed supplemented with ruminants may have an effect on dry matter intake, rumen pH, and total nutrient digestibility. Lin et al. [15] discovered that fermented feedstuffs increased the body weight growth and feed conversion rates of Hanwoo steers after the fattening period. Moreover, Kim et al. [16] also found that fermented feed increased total and daily live weight growth. In the current study, the lack of response to yeast supplementation may be related to a lack of increase in nutritional digestibility. Wulandari et al. [8] stated that fermentation with SBP resulted in the highest dry matter

digestibility percentage. The inoculum of SBP includes of lactic acid bacteria, cellulolytic bacteria, and amylolytic bacteria, which reduce the pH and crude fiber from cellulolytic bacteria. The source of the substrate for the fermentation pattern in this study came from the same concentrate, where the concentrate had a low fiber content and had the same physical form (mash), so the digestibility value of the two ingredients might have also been the same. It caused the performance of cattle to have no significant effect. Doherty and Mayne [17] reported that the fermentation of fiber-based materials would change the chemical composition of nutrients compared

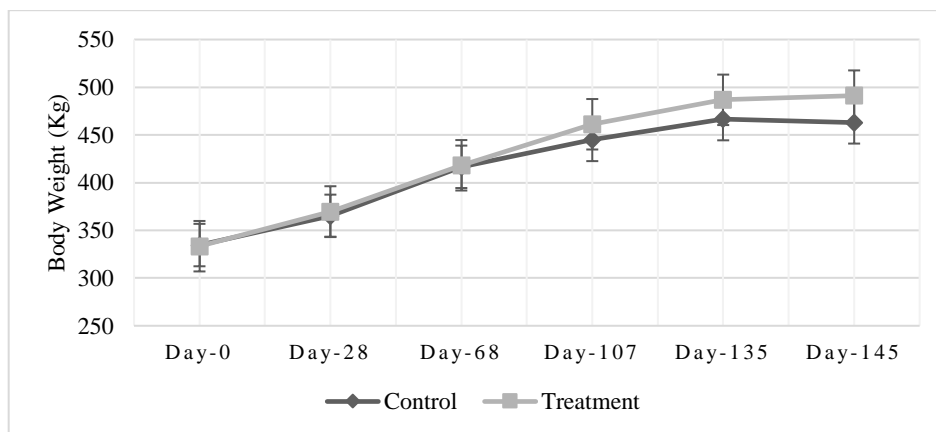


Figure 1 Body weight graphic of Brahman crossbred steers received fermented concentrate during the fattening period (145 days)

to starch-based. In addition, some kinds of literature in the feed fermentation did not use the concentrate only but used the total mix ratio (concentrate and forage). Although *in-vitro* studies, Santoso et al. [18] researched a single concentrate using probiotics. This study's author concentrated on lactic acid bacteria and yeast effectively modified ruminal fermentation patterns by increasing the proportion of propionic acid, total volatile fatty acids concentration, organic matter, and nutrient digestible fiber (NDF) digestibility. In addition to surmising from the component side of the substrate material, we assumed that the low replication in this study tends to affect the statistics. A sufficient number of duplicates was required to acquire a reliable result from an experiment. Since the number of duplicates was correlated to the power of a test, increasing the number of experimental duplicates can give increased statistical power for detecting a desired difference among treatments [19]. The number of duplicates had a practical effect on inference errors in analyzing differences of means or variances [20]. In the Independent sample t-test, the minimum number of replications used was six replications [4, 21]. In contrast, for a large number of replications, Fauzyah et al. [22] and Chang et al. [23] used 18 and 50 replications, respectively.

4. CONCLUSION

This study concludes that feeding Brahman crossbred steers with fermented concentrate has a potentially higher difference value in total live weight gain, ADG, and income over feed cost in the fattening period. Further study on fermented concentrate with the more significant number of cattle and more detailed parameters such as ruminal parameters, digestibility, carcass, and meat qualities is recommended to be carried out.

AUTHORS' CONTRIBUTIONS

Mohammad Sofi'ul Anam and Ali Agus contributed to the designing, conducting the experiment and preparing the first draft. Chusnul Hanim and Andriyani Astuti conducted the laboratory analysis and interpreted the obtained data.

ACKNOWLEDGMENTS

We would like to thank CV. Agromix Lestari and Bengkel Sapi Kali Jeruk, Yogyakarta for providing all facilities in this study.

REFERENCES

[1] B.W. Hess, S.L. Lake, E.J. Scholljegerdes, T.R. Weston, V. Nayigihugu, J.D.C. Molle and G.E. Moss, Nutritional controls of beef cow reproduction, *Journal of Animal Science*, vol. 83,

pp. E90-E106, 2005. DOI: https://doi.org/10.2527/2005.8313_supplE90x

[2] J. Nkruman, E. Okine, G. Mathison, K. Schmid, C. Li, J. Basarab, M. Price, Z. Wang and S. Moor, Relationships of feedlot feed efficiency, performance and feeding behavior with metabolic rate, methane production and energy partitioning in beef cattle, *Journal of Animal Science*, vol. 84, pp. 145-53, 2006. DOI: <https://doi.org/10.2527/2006.841145x>.

[3] I.G.S. Budisatria, A. Ibrahim, E. Baliarti, T.S.M. Widi, Vierman, H. Koesmara and B.A. Atmoko, Performance of Aceh cattle fed by concentrate with different levels, *IOP Conferences Series: Earth and Environmental Science*, vol. 387, pp. 012040, 2019. DOI: 10.1088/1755-1315/387/1/012040

[4] D. Kim, J.S. Jung and K.C. Choi, A preliminary study on effects of fermented feed supplementation on growth performance, carcass characteristics, and meat quality of Hanwoo steers during the early and late fattening period, *Applied Sciences*, vol. 11, pp. 1-13, 2021. DOI: <https://doi.org/10.3390/app11115202>

[5] Y.L. Lee, J.H. Yang and J.L. Mau, Antioxidant properties of water extracts from *Monascus* fermented soybeans, *Food Chemistry*, vol. 106, pp. 1128-1137, 2008. DOI: <https://doi.org/10.1016/j.foodchem.2007.07.047>.

[6] F.L. Cao, X.H. Zhang, W.W. Yu, L.G. Zhao and T. Wang, Effect of feeding fermented Ginkgo biloba leaves on growth performance, meat quality, and lipid metabolism in broilers, *Poultry Science*, vol. 91, pp. 1210-1221, 2012. DOI: <https://doi.org/10.3382/ps.2011-01886>.

[7] T.I. Kim, V. Mayakrishnan, D.H. Lim, J.H. Yeon and K.S. Baek, Effect of fermented total mixed rations on the growth performance, carcass and meat quality characteristics of Hanwoo steers, *Journal of Animal Science*, vol. 89, pp. 606-615, 2018. DOI: <https://doi.org/10.1111/asj.12958>.

[8] S. Wulandari, A. Agus, M. Soejono and M.N. Cahyanto, Digestibility and biodegradation of cacao pod theobomin with fermentation using multi microbe inoculum, *Agritech*, vol. 34, pp. 160-169, 2014. DOI: <https://doi.org/10.22146/agritech.9506>.

[9] A.T. Niba, J.D. Beal, A.C. Kudi and P.H. Brooks, Potential of bacterial fermentation as a biosafe method of improving feeds for pigs and poultry, *African Journal of Biotechnology*, vol. 8, pp. 1758-176, 2009. <http://www.academicjournals.org/AJB>.

- [10] E. Humer, W. Wetscherek, C. Schwarz and K. Schedle, Effect of maize conservation technique and phytase supplementation on total tract apparent digestibility of phosphorus, calcium, ash, dry matter, organic matter and crude protein in growing pigs, *Animal Feed Science and Technology*, vol. 185, pp. 70-77, 2013. DOI: <https://doi.org/10.1016/j.anifeedsci.2013.07.001>.
- [11] AOAC, Official Methods of Analysis, 11th ed., Washington: Association of Official Analytical Chemists, Washington DC, 2005.
- [12] H. Hartadi, S. Reksahadiprodo, S. Lebdosukojo, A.D. Tillman, L.C. Kearl and L.E. Harris, Tables of Feed Composition for Indonesia, The International Feedstuffs Institute, Utah Agricultural Experiment Station, Utah State University. Logan Utah, 1980.
- [13] S.M. Lee, Y.I. Kim and W.S. Kwak, Effect of by-product mixing silage feeding on the eating and ruminating behavior of hanwoo steer, *Journal of The Korean Society of Grassland and Forage Science*, vol. 30, pp. 159-168, 2010. DOI: <https://doi.org/10.5333/KGFS.2010.30.2.159>.
- [14] D.T. Junior, R.L. Missio, M.P.R. Sforcini, M.D.S. de Oliveira, V.B. Ferrari and R.F. Santos, Productive performance of dairy cows fed with hydrolyzed sugarcane, *Ciencia Rural*, vol. 45, pp. 1848-1853, 2015. DOI: <https://doi.org/10.1590/0103-8478cr20131605>.
- [15] G.Z. Lin, B.W. Kim, H.S. Kim, K.I. Sung, S.J. Ohh, B.J. Hong and J.S. Shin, Changes in serum metabolites and growth characteristics of Korean native steers fed alcohol-fermented feeds, *Asian-Australasian Journal of Animal Sciences*, vol. 17, pp. 648-654, 2004. DOI: <https://doi.org/10.5713/ajas.2004.648>.
- [16] S.H. Kim, M.J. Alam, M.J. Gu, K.W. Park, C.O. Jeon, J.K. Ha, K.K. Cho and S.S. Lee, Effect of total mixed ration with fermented feed on ruminal in vitro fermentation, growth performance and blood characteristics of Hanwoo Steers. *Asian-Australasian Journal of Animal Sciences*, vol. 25, pp. 213-223, 2012. DOI: <https://doi.org/10.5713/ajas.2011.11186>.
- [17] J.G. Doherty and C.S. Mayne, The effect of concentrate type and supplementary lactic acid or soya oil on milk production characteristics in dairy cows offered grass silages of contrasting fermentation type. *Animal Sciences*, vol. 62, pp. 187, 1996. DOI: <https://doi.org/10.1017/S135772980001448X>
- [18] B. Santoso, B.Tj. Hariadi and H. Abubakar, The effect of concentrate containing probiotics on fermentation characteristics, methanogenesis and in vitro nutrient digestibility, *Journal of The Indonesian Tropical Animal Agriculture*, vol. 39, pp. 210-216, 2016. DOI: <https://doi.org/10.14710/jitaa.39.4.210-216>.
- [19] S. Seo, S. Jeon and J.K. Ha, Guidelines for experimental design and statistical analyses in animal studies submitted for publication in the Asian-Australasian Journal of Animal Sciences, *Asian-Australasian Journal of Animal Sciences*, vol. 31, pp. 1381-1386, 2018. DOI: <https://doi.org/10.5713/ajas.18.0468>.
- [20] P. Blainey, M. Krzywinski and N. Altman, Replication, *Nature Methods*, vol. 11, pp. 879-880, 2014. <https://www.nature.com/articles/nmeth.3091>
- [21] J.Y. Kim, B.H. Lee, B. Chemere, D.H. Min, B.W. Kim, K.I. Sung, *In vivo* nutritive value of rice feed for sheep and its application for cattle feed, *Journal of Animal Science and Technology*, vol. 61, pp. 254-259, 2019. DOI: <https://doi.org/10.5187/jast.2019.61.5.254>
- [22] A. Fauzyah, Panjono, A. Agus, I.G.S. Budisatria and B.P. Widyobroto, The effect of rumen undegradable protein level of concentrate with rice straw as basal diet on growth performance of Sumba Ongole beef cattle, *Bulletin of Animal Science*, vol. 41, pp. 142-149, 2017. DOI: <https://doi.org/10.21059/buletinpeternak.v41i2.11990>.
- [23] Z. Chang, S. Shi, B. Yunlong, W. Dong, X. Cheng and X. Chuang, Plasma protein comparison between dairy cows with inactive ovaries and estrus, *Nature Reserach*, vol. 9, pp. 13709, 2019. DOI: <https://doi.org/10.1038/s41598-019-49785-8>.