

DAFTAR PUSTAKA

- Afandi, R., Hartono, B., and Djunaidi, I. 2020. The analysis of production costs of laying hen farms using semi self-mixing and total self-mixing feeds in Blitar Regency, East Java. *Tropical Animal Science Journal*, 43(1), 70.
- Bach, A. C. S. S. M. D., Calsamiglia, S., and Stern, M. D. 2005. Nitrogen metabolism in the rumen. *Journal of dairy science*, 88, E9-E21.
- Beauchemin, K. A., Ungerfeld, E. M., Eckard, R. J., and Wang, M. 2020. Fifty years of research on rumen methanogenesis: Lessons learned and future challenges for mitigation. *Animal*, 14(S1), s2-s16.
- Bhatta, R., Uyeno, Y., Tajima, K., Takenaka, A., Yabumoto, Y., Nonaka, I., ... dan Kurihara, M. (2009). Perbedaan sifat tanin pada produksi metana rumen in vitro dan asam lemak volatil serta pada populasi archaea dan protozoa metanogenik. *Jurnal Ilmu Peternakan Sapi Perah* , 92 (11), 5512-5522.
- Agustin, F., Suryadi, H., and Jamarun, N. 2022. March. The Use of Calcium Hydroxide with Different Soaking Time on Cassava Peel for Reducing HCN, and Its Effect on Rumen Fermentation. In *International Conference on Improving Tropical Animal Production for Food Security (ITAPS 2021)* (pp. 274-281). Atlantis Press.
- CABI. 2014. *Tithonia diversifolia* (Mexican sunflower). *Invasive Species Compendium*. CAB International.
- Chrystal, P. V., Greenhalgh, S., Selle, P. H., and Liu, S. Y. 2020. Facilitating the acceptance of tangibly reduced-crude protein diets for chicken-meat production. *Animal Nutrition*, 6(3), 247-257.
- Conway, E.J. 1950. *Microdiffusion analysis and volumetric error*. Crosby Lockwood and Son, London.
- Direktorat Jenderal Peternakan dan Kesehatan Hewan. 2024. *Buku Statistik Peternakan dan Kesehatan Hewan 2024*. Kementerian Pertanian Republik Indonesia, Jakarta.
- Dhalimi, A. 2006. Permasalahan gambir (*Uncaria gambir* L.) di Sumatera Barat dan alternatif pemecahannya. *Perspektif: Review Penelitian Tanaman Industri*, 5(1), 46-59.
- Elihasridas, E. 2012. Respon suplementasi mineral Zink (Zn) terhadap pencernaan in-vitro ransum tongkol jagung amoniasi. *Jurnal Peternakan UIN Sultan Syarif Kasim* , 9 (1), 126210.

- Faradilla, F., Nuswantara, L. K., Christiyanto, M., and Pangestu, E. 2019. Kecernaan bahan kering, bahan organik, lemak kasar dan total digestible nutrients berbagai hijauan secara in vitro. *Jurnal Litbang Provinsi Jawa Tengah*, 17(2), 185-193.
- Fasuyi, AO, Dairo, FAS, dan Ibitayo, FJ. 2010. Ensilase daun bunga matahari liar (*Tithonia diversifolia*) dengan molase tebu. *Penelitian Peternakan untuk Pembangunan Pedesaan* , 22 (3), 2010.
- FAO (Food and Agriculture Organization). 2015. *The State of the World's Livestock 2015: Livestock in the Balance*. Food and Agriculture Organization of the United Nations, Rome.
- Fievez, V., Babayemi, O. J., & Demeyer, D. 2005. Estimation of direct and indirect gas production in syringes: A tool to estimate short chain fatty acid production that requires minimal laboratory facilities. *Animal Feed Science and Technology*, 123, 197-210.
- France, J., and Dijkstra, J. 2005. Volatile fatty acid production.
- Firkins, J. L., Yu, Z., and Morrison, M. 2007. Ruminant nitrogen metabolism: perspectives for integration of microbiology and nutrition for dairy. *Journal of dairy science*, 90, E1-E16.
- Getachew, G., Makkar, H. P. S., and Becker, K. 2000. Tannins in tropical browses: effects on in vitro microbial fermentation and microbial protein synthesis in media containing different amounts of nitrogen. *Journal of Agricultural and Food Chemistry*, 48(8), 3581-3588.
- Goel, G., Makkar, H. P., and Becker, K. (2008). Effects of *Sesbania sesban* and *Carduus pycnocephalus* leaves and Fenugreek (*Trigonella foenum-graecum* L.) seeds and their extracts on partitioning of nutrients from roughage-and concentrate-based feeds to methane. *Animal Feed Science and Technology*, 147(1-3), 72-89.
- Gopar, R. A., Despal, P. D., Fassah, D. M., and Maulana, S. 2025. Synergistic effects of micromineral mixtures and protected palm fatty acid distillate on in vitro rumen fermentation and digestibility. *Adv. Anim. Vet. Sci*, 13(12), 2716-2727.
- Gore, A. J., and Bhagwat, S. S. 2022. Separation of tocol (tocopherol & tocotrienol) and phytosterols from palm fatty acid distillate by saponification and purification by low temperature solvent crystallization. *Journal of food science and technology*, 59(8), 2962-2971.
- Grobbelaar, T. J. 2026. *Effect of dietary starch and exogenous α -amylase on in vitro gas production kinetics and lactation performance of lactating dairy cows* (Doctoral dissertation, Stellenbosch: Stellenbosch University).

- Hailemariam, S., Zhao, S., He, Y., and Wang, J. 2021. Urea transport and hydrolysis in the rumen: A review. *Animal nutrition*, 7(4), 989-996.
- Haryanto, B., dan Thalib, A. 2009. Emisi metana dari fermentasi enterik: kontribusinya secara nasional dan faktor-faktor yang mempengaruhinya pada ternak. *Wartazoa*, 19(4), 157-165.
- Henderson, G., Cox, F., Ganesh, S., Jonker, A., Young, W., and Janssen, P. H. 2015. Rumen microbial community composition varies with diet and host, but a core microbiome is found across a wide geographical range. *Scientific reports*, 5(1), 14567.
- Herliatika, A., Widiawati, Y., Jayanegara, A., Harahap, R. P., Kusumaningrum, D. A., Shiddieqy, M. I., ... and Adiati, U. 2024. Meta-analysis of the relationship between dietary starch intake and enteric methane emissions in cattle from in vivo experiments. *Journal of Advanced Veterinary and Animal Research*, 11(1), 212.
- Hristov, A. N., Oh, J., Firkins, J. L., Dijkstra, J., Kebreab, E., Waghorn, G., ... and Tricarico, J. M. 2013. Special topics—Mitigation of methane and nitrous oxide emissions from animal operations: I. A review of enteric methane mitigation options. *Journal of animal science*, 91(11), 5045-5069.
- Huws, S. A., Creevey, C. J., Oyama, L. B., Mizrahi, I., Denman, S. E., Popova, M., ... and Morgavi, D. P. 2018. Addressing global ruminant agricultural challenges through understanding the rumen microbiome: past, present, and future. *Frontiers in microbiology*, 9, 2161.
- Ishaq, S. L., AlZahal, O., Walker, N., and McBride, B. 2017. An investigation into rumen fungal and protozoal diversity in three rumen fractions, during high-fiber or grain-induced sub-acute ruminal acidosis conditions, with or without active dry yeast supplementation. *Frontiers in microbiology*, 8, 1943.
- Jama, B., Palm, C. A., Buresh, R. J., Niang, A. L., Gachengo, C., Nziguheba, G., and Amadalo, B. 2000. *Tithonia diversifolia* as a green manure for soil fertility improvement in western Kenya: A review. *Agroforestry systems*, 49(2), 201-221.
- Janssen, P. H. (2010). Influence of hydrogen on rumen methane formation and fermentation balances through microbial growth kinetics and fermentation thermodynamics. *Animal feed science and technology*, 160(1-2), 1-22.
- Jenkins, T. C., Wallace, R. J., Moate, P. J., and Mosley, E. E. 2008. Board-invited review: Recent advances in biohydrogenation of unsaturated fatty acids within the rumen microbial ecosystem. *Journal of animal science*, 86(2), 397-412.

- Kelly, W. J., Leahy, S. C., Kamke, J., Soni, P., Koike, S., Mackie, R., ... and Attwood, G. T. 2019. *Occurrence and expression of genes encoding methyl-compound production in rumen bacteria. Animal Microbiome*, 1 (1), 1-15.
- Koenig, K. M., Newbold, C. J., McIntosh, F. M., and Rode, L. M. 2000. Effects of protozoa on bacterial nitrogen recycling in the rumen. *Journal of animal science*, 78(9), 2431-2445.
- Makkar, H.P.S., Tran, G., Heuzé, V., Giger-Reverdin, S., Lessire, M., Lebas, F. and Ankers, P. 2016. Seaweeds for livestock diets: A review. *Animal Feed Science and Technology*. 212:1–17.
- Mardalena, S. 2017. Pengaruh Perlakuan Ransum Berbeda Terhadap Kecernaan Protein Kasar Dan Serat Kasar Pada Kambing Peranakan Etawa (PE) Jantan.
- Masruroh, S., Prayitno, C.H. dan Suwarno. 2013. Populasi protozoa dan produksi total gas dari rumen kambing perah yang pakannya disuplementasi ekstrak herbal secara in vitro. *Jurnal Ilmiah Peternakan*. 1(2):420–429.
- Mauricio, R. M., Calsavara, L. H. F., Ribeiro, R. S., Pereira, L. G. R., De Freitas, D. S., Paciullo, D. S., ... and Murgueitio, E. 2017. Feed ruminants using *Tithonia diversifolia* as forage. *Journal of Dairy, Veterinary and Animal Research*, 5(3), 117-120.
- Mijena, D. 2021. Feeding and Nutritional Strategies to Reduce Methane Emission from Large Ruminants. *Journal of Aquaculture and Livestock Production*.
- Moss, A., Jouany, J. P., and Newbold, J. 2000. Methane production by ruminants: its contribution to global warming. In *Annales de zootechnie* (Vol. 49, No. 3, pp. 231-253).
- Murgueitio, E. 2023. *Tithonia diversifolia*, a different Asteraceae: its function in sustainable systems of cattle production. *Cuban Journal of Agricultural Science*, 57.
- Muslim, G., Sihombing, J. E., Fauziah, S., Abrar, A., & Fariani, A. (2014). Aktivitas proporsi berbagai cairan rumen dalam mengatasi tannin dengan tehnik in vitro. *Jurnal Peternakan Sriwijaya*, 3(1), 25-36..
- Nauman, H. D., Tedeschi, L. O., Zeller, W. E., and Huntley, N. F. 2017. The role of condensed tannins in ruminant animal production: advances, limitations and future directions. *Revista Brasileira de Zootecnia*, 46, 929-949.
- Newbold, C. J., De La Fuente, G., Belanche, A., Ramos-Morales, E., and McEwan, N. R. 2015. The role of ciliate protozoa in the rumen. *Frontiers in microbiology*, 6, 1313.

- Nurjannah, S. 2016. Pengaruh tingkat penambahan complete rumen modifier (CRM) dalam ransum berbasis pucuk tebu (*saccharum officinarum*) terhadap degradasi bahan kering dan produksi gas metan (in vitro). *Students e-Journal*, 5(2).
- Oluwasola, T. A., and Dairo, F. A. S. 2016. Proximate composition, amino acid profile and some anti-nutrients of *Tithonia diversifolia* cut at two different times. *African Journal of Agricultural Research*, 11(38), 3659-3663.
- Osuga, I. M., Abdulrazak, S. A., Muleke, C. I., and Fujihara, T. 2012. Potential nutritive value of various parts of wild sunflower (*Tithonia diversifolia*) as source of feed for ruminants in Kenya. *Journal of Food, Agriculture and Environment*, 10(2), 632-635.
- Panahiha, P., Mirzaei-Alamouti, H., Kazemi-Bonchenari, M., and Aschenbach, J. R. 2022. Growth performance, nutrient digestibility, and ruminal fermentation of dairy calves fed starter diets with alfalfa hay versus corn silage as forage and soybean oil versus palm fatty acids as fat source. *Journal of Dairy Science*, 105(12), 9597-9609.
- Paramita, D. 2025. Pengaruh Penggunaan *Tithonia* (*Tithonia diversifolia*) sebagai Pengganti Konsentrat terhadap Produksi Gas, Biomassa Mikroba dan Total Populasi Protozoa secara In Vitro. Skripsi. Fakultas Peternakan, Universitas Andalas, Padang.
- Patra, A. K. 2016. Recent advances in measurement and dietary mitigation of enteric methane emissions in ruminants. *Frontiers in veterinary science*, 3, 39.
- Patra, A.K. dan Saxena, J. 2011. Exploitation of dietary tannins to improve rumen metabolism and ruminant nutrition. *Journal of the Science of Food and Agriculture*. 91(1):24–37.
- Pazla, R., Natsir, A., Hidayat, R., Ginting, N., Zain, M., Antonius, ... and Sukma Sucitra, L. 2025a. May. Regional Variation in Antinutrient Content of Gambir (*Uncaria gambir*): Implications for Ruminant Feed Efficiency and Methane Reduction. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1497, No. 1, p. 012051). IOP Publishing.
- Pazla, R., Antonius, Jamarun, N., Elihasridas, Arief, Ikhlās, Z., ... and Ardani, L. R. 2025b. Gambir leaf catechins as potential natural feed additives to improve digestibility and mitigate methane emissions in ruminants.
- Pazla, R., Natsir, A., Hidayat, R., Ginting, N., Jamarun, N., Zain, M., ... and Hidayat, M. Z. 2025c. The role of dosage and regional origin of Gambir (*Uncaria gambir*) leaf extract in enhancing rumen fermentation and suppressing methane emissions. *Energy Nexus*, 100564.

- Pazla, R., Jamarun, N., Ikhlas, Z., Fitri, Y., Rohaeni, E. S., Rostiana, O., ... and Marlina, L. 2025. Encapsulated Gambir catechin-palm fatty acid distillate as an antibacterial and antioxidant feed additive and its effects on rumen fermentation products. *Results in Engineering*, 27, 105914.
- Pazla, R., Natsir, A., Hidayat, R., Ginting, N., Zain, M., Mohd-Aris, A., ... and Hidayat, M. Z. 2024. Optimization of fiber digestibility and Methane Reduction with Gambier Leaf Extract from Pangkalan for Sustainable Ruminant Farming. *Andalasian Livestock*, 1(2), 114-120.
- Pazla, R., and Pt, S. *Potensi Tithonia diversifolia Fermentasi Sebagai Pakan Ternak ruminansia*. Penerbit Adab.
- Pazla, R., Jamarun, N., Zain, M., Arief, Yanti, G., Putri, E. M., and Candra, R. H. 2022. Impact of *Tithonia diversifolia* and *Pennisetum purpureum*-based ration on nutrient intake, nutrient digestibility and milk yield of Etawa crossbreed dairy goat.
- Pitta, D., Indugu, N., Narayan, K. dan Hennessy, M. 2022. Symposium review: Understanding the role of the rumen microbiome in enteric methane mitigation and productivity in dairy cows. *Journal of Dairy Science*. 105(10):8569–8585.
- Purnama, K.O., Setyaningsih, D., Hambali, E. dan Taniwiryono, D. 2021. Peluang palm fatty acid distillate dari industri minyak sawit dalam pembuatan mono-digliserida (The opportunities of palm fatty acid distillate from palm oil industry in production of mono-diglyceride). *Perspektif: Review Penelitian Tanaman Industri*. 20(1):11–25.
- Putri, A.D. 2018. Karakteristik Fermentabilitas Pakan Komplit yang Mengandung Jerami Padi, Daun Paitan (*Tithonia diversifolia*), dan Daun Kirinyuh (*Chromolaena odorata*) secara In Vitro. Skripsi. Fakultas Peternakan, Universitas Andalas, Padang.
- Qi, W., Xue, M. Y., Jia, M. H., Zhang, S., Yan, Q., and Sun, H. Z. 2023. Understanding the functionality of the rumen microbiota: searching for better opportunities for rumen microbial manipulation. *Animal Bioscience*, 37(2), 370.
- Qin, Y. S., Bai, J. H., Zhang, S. L., Dai, J. G., Xu, X. L., Feng, T., ... and Liu, Y. 2022. Effects of kisspeptin-10 on the reproductive performance of sows in a fixed-time artificial insemination programme. *animal*, 16(5), 100509.
- Rabee, A. E., Mohamed M. Ghandour, M., Sallam, A., Elwakeel, E. A., Mohammed, R. S., Sabra, E. A., ... and Hafez, O. R. 2024. Rumen fermentation and microbiota in Shami goats fed on condensed tannins or herbal mixture. *BMC veterinary research*, 20(1), 35.

- Ramaiyulis, S. 2018. Pengaruh populasi protozoa rumen terhadap pencernaan pakan dan produksi gas metan pada ternak ruminansia. *Jurnal Ilmu Ternak dan Veteriner*. 23(3):150–160.
- Reis, M. M., Santos, L. D. T., Pegoraro, R. F., Colen, F., Rocha, L. M., and de Paiva Ferreira, G. A. 2016. Nutrition of *Tithonia diversifolia* and attributes of the soil fertilized with biofertilizer in irrigated system.
- Ribeiro, R. S., Terry, S. A., Sacramento, J. P., Silveira, S. R. E., Bento, C. B. P., da Silva, E. F., ... and Chaves, A. V. 2016. *Tithonia diversifolia* as a supplementary feed for dairy cows. *PloS one*, 11(12), e0165751.
- Riestanti, L. U., Retnani, Y., and Andarwulan, N. 2025. Modifikasi Proses Produksi Susu Sapi Kaya Conjugated Linoleic Acid (CLA) Dengan Suplementasi Lemak Terproteksi.
- Rivera, J. E., Villegas, G., Chará, J., Durango, S. G., Romero, M. A., and Verchot, L. 2022. Effect of *Tithonia diversifolia* (Hemsl.) A. Gray intake on in vivo methane (CH₄) emission and milk production in dual-purpose cows in the Colombian Amazonian piedmont. *Translational animal science*, 6(4), txac139.
- Sirait, J. dan Simanihuruk, K. 2021. Pemanfaatan *Tithonia diversifolia* sebagai pakan ruminansia. *Wartazoa*. 31(3):137–146.
- Sugito, K. 2017. Kemampuan Daya Hambat Sediaan Gambir (*Uncaria gambir* Roxb.) Terpurifikasai dengan Kandungan Katekin > 90% terhadap *Candida albicans*. Skripsi. Universitas Hasanuddin.
- Sun, X., Wang, Q., Yang, Z., Xie, T., Wang, Z., Li, S., and Wang, W. 2022. Altering methane emission, fatty acid composition, and microbial profile during in vitro ruminant fermentation by manipulating dietary fatty acid ratios. *Fermentation*, 8(7), 310.
- Sutardi, T. 2017. Landasan Ilmu Nutrisi Ternak. IPB Press, Bogor.
- Tedeschi, L. O., Muir, J. P., Naumann, H. D., Norris, A. B., Ramírez-Restrepo, C. A., and Mertens-Talcott, S. U. 2021. Nutritional aspects of ecologically relevant phytochemicals in ruminant production. *Frontiers in Veterinary Science*, 8, 628445.
- Terry, S.A., Ribeiro, R.S., Freitas, D.S., Delarota, G.D., Pereira, L.G.R., Tomich, T.R., Maurício, R.M. dan Chaves, A.V. 2016. Effects of *Tithonia diversifolia* on in vitro methane production and ruminal fermentation characteristics. *Animal Production Science*. 56(11):1984–1990.
- Thaariq, S. H. 2018. Pengaruh pakan hijauan dan konsentrat terhadap daya cerna pada sapi aceh jantan. *Genta Mulia: Jurnal Ilmiah Pendidikan*, 8(2).

Tilley, J. M. A., and Terry, D. R. 1963. A two-stage technique for the in vitro digestion of forage crops. *Grass and forage science*, 18(2), 104-111.

Trisna, A., Purba, M. A., and Yusni, E. 2023. Waste Animals Treatment Technology with All out System as an Effort to Improve Environmental Biosecurity, Livestock Health and Farmers Income in Activist Farm. *ABDIMAS TALENTA: Jurnal Pengabdian Kepada Masyarakat*, 8(1), 510-517.

Ungerfeld, E. M., Cancino-Padilla, N., & Vera-Aguilera, N. 2023. Fermentation in the rumen. *Microbial fermentations in nature and as designed processes*, 133-165. russel

Wahyuni, I. M. D., Muktiani, A., and Christianto, M. 2014. Penentuan dosis tanin dan saponin untuk defaunasi dan peningkatan fermentabilitas pakan. *Jitp*, 3(3), 133-140.

Widyaningrum. 2020. Karakteristik habitat dan kondisi lingkungan tumbuh *Tithonia diversifolia* di daerah tropis. *Jurnal Agroekoteknologi*. 12(1):55–62.

Yang, Z., Zheng, Y., Liu, S. dan Wang, W. 2024. Rumen metagenome reveals the mechanism of mitigation methane emissions by unsaturated fatty acid while maintaining the performance of dairy cows. *Animal Nutrition*. 18:296–308.

Yanti, G. 2026. International Journal of Veterinary Science. *Int J Vet Sci*, 15(3), 932-941.

Yu, Z., Yan, M. dan Somasundaram, S. 2024. Rumen protozoa and viruses: The predators within and their functions: A mini-review. *JDS Communications*. 5(3):236–240.

