

DAFTAR PUSTAKA

- Abd Hamid, H., Sileshi Zeyohannes Roziyahira M, S., & Yusoff, M. M. (2016). *Rhodomyrtus tomentosa*: a phytochemical and pharmacological review. *Asian Journal of Pharmaceutical and Clinical Research*, 10(1), 10. <https://doi.org/10.22159/ajpcr.2017.v10i1.12773>
- Abrar, A., Tsukahara, T., Kondo, M., Ban-Tokuda, T., Chao, W., & Matsui, H. (2015). Effect of monensin withdrawal on rumen fermentation, methanogenesis and microbial populations in cattle. *Animal Science Journal*, 86(9), 849–854. <https://doi.org/10.1111/asj.12368>
- Agarwal, S., & Mehrotra, R. (2016). An overview of molecular simulation. *JSM Chemistry*, 4(2), 1024–1028.
- Ahvanooei, M. R. R., Norouzian, M. A., Piray, A. H., Vahmani, P., & Ghaffari, M. H. (2023). Effects of monensin supplementation on rumen fermentation, methane emissions, nitrogen balance, and metabolic responses of dairy cows: a systematic review and dose–response meta-analysis. *Journal of Dairy Science*. 10(10). <https://doi.org/10.3168/jds.2023-23441>
- Antonius, A., Pazla, R., Putri, E. M., Negara, W., Laia, N., Ridla, M., Suharti, S., Jayanegara, A., Asmairicen, S., Marlina, L., & Marta, Y. (2023). Effectiveness of herbal plants on rumen fermentation, methane gas emissions, in vitro nutrient digestibility, and population of protozoa. *Veterinary World*. 1477–1488. <https://doi.org/10.14202/vetworld.2023.1477-1488>
- Baaske, L., Gäbel, G., & Dengler, F. (2020). Ruminant epithelium: a checkpoint for cattle health. *Journal of Dairy Research*. 87(3): 322–329. <https://doi.org/10.1017/S0022029920000369>
- Bach, A., Calsamiglia, S., & Stern, M. D. (2005). Nitrogen metabolism in the rumen. *Journal of Dairy Science*. 88: E9–E21. [https://doi.org/10.3168/jds.S0022-0302\(05\)73133-7](https://doi.org/10.3168/jds.S0022-0302(05)73133-7)
- Bach, Q. N., Hongthong, S., Quach, L. T., Pham, L. V., Pham, T. V., Kuhakarn, C., Reutrakul, V., & Nguyen, P. T. M. (2020a). Antimicrobial activity of rhodomyrtone isolated from *Rhodomyrtus tomentosa* (Aiton) Hassk. *Natural Product Research*. 34(17): 2518–2523. <https://doi.org/10.1080/14786419.2018.1540479>
- Bach, Q. N., Hongthong, S., Quach, L. T., Pham, L. V., Pham, T. V., Kuhakarn, C., Reutrakul, V., & Nguyen, P. T. M. (2020b). Antimicrobial activity of rhodomyrtone isolated from *Rhodomyrtus tomentosa* (Aiton) Hassk. *Natural Product Research*. 34(17): 2518–2523. <https://doi.org/10.1080/14786419.2018.1540479>
- Baihaqi, Z. A., Widiyono, I., Angeles, A. A., Suwignyo, B., & Nurcahyo, W. (2023). Anthelmintic activity of *Carica pubescens* aqueous seed extract and its

effects on rumen fermentation and methane reduction in Indonesian thin-tailed sheep: An in vitro study. *Veterinary World*, 1421–1428. <https://doi.org/10.14202/vetworld.2023.1421-1428>

Bailly, C., & Vergoten, G. (2021). Anticancer properties and mechanism of action of oblongifolin C, guttiferone K and related polyprenylated acylphloroglucinols. *Natural Products and Bioprospecting*, 11(6), 629–641. <https://doi.org/10.1007/s13659-021-00320-1>

Bandarupalli, V. V. K., & St-Pierre, B. (2020). Identification of a candidate starch utilizing strain of *Prevotella albensis* from bovine rumen. *Microorganisms*, 8(12), 2005. <https://doi.org/10.3390/microorganisms8122005>

Barrios Renteria, J. C., Mauricio-Sandoval, E. A., Espinoza, L. A., Cornelio-Santiago, H. P., Moreno-Quispe, L. A., & Vega Portalatino, E. J. (2022). Antimicrobial potential of camu camu (*Myrciaria dubia*) against bacteria, yeasts, and parasitic protozoa: a review. *Revista Facultad Nacional de Agronomía Medellín*, 75(2). <https://doi.org/10.15446/rfnam.v75n2.98010>

Benchaa, C., & Greathead, H. (2011). Essential oils and opportunities to mitigate enteric methane emissions from ruminants. *Animal Feed Science and Technology*, 166–167, 338–355. <https://doi.org/10.1016/j.anifeedsci.2011.04.024>

Braun, U., Krüger, S., & Hässig, M. (2013). Ultrasonographic examination of the reticulum, rumen, omasum and abomasum during the first 100 days of life in calves. *Research in Veterinary Science*, 95(2), 326–333. <https://doi.org/10.1016/j.rvsc.2013.03.019>

Butaye, P., Devriese, L. A., & Haesebrouck, F. (2003). Antimicrobial growth promoters used in animal feed: Effects of less well known antibiotics on gram-positive bacteria. *Clinical Microbiology Reviews*, 16(2), 175–188. <https://doi.org/10.1128/CMR.16.2.175-188.2003>

Chaokaur, A., Nishida, T., Phaowphaisal, I., & Sommart, K. (2015). Effects of feeding level on methane emissions and energy utilization of Brahman cattle in the tropics. *Agriculture, Ecosystems and Environment*, 199, 225–230. <https://doi.org/10.1016/j.agee.2014.09.014>

Chaudhary, K. K., & Mishra, N. (2016). A review on molecular docking: novel tool for drug discovery. *JSM Chemistry*, 4(3), 1029. www.pdb.org.

Chaudhry, A. S., & Khan, M. M. H. (2012). Impacts of different spices on in vitro rumen dry matter disappearance, fermentation and methane of wheat or ryegrass hay based substrates. *Livestock Science*, 146(1), 84–90. <https://doi.org/10.1016/j.livsci.2012.01.007>

Chen, H., Gan, Q., & Fan, C. (2020). Methyl-Coenzyme M Reductase and its post-translational modifications. *Frontiers in Microbiology*, 11(October). <https://doi.org/10.3389/fmicb.2020.578356>

- Cherian, G. (2020). A Guide to the Principles of Animal Nutrition. *Oregon State University*, 163. <https://open.oregonstate.edu/animalnutrition/chapter/chapter-18/>
- Collins, W. J., Webber, C. P., Cox, P. M., Huntingford, C., Lowe, J., Sitch, S., Chadburn, S. E., Comyn-Platt, E., Harper, A. B., Hayman, G., & Powell, T. (2018). Increased importance of methane reduction for a 1.5 degree target. *Environmental Research Letters*, 13(5), 054003. <https://doi.org/10.1088/1748-9326/aab89c>
- CONRAD, R. (2020). Importance of hydrogenotrophic, acetoclastic and methylotrophic methanogenesis for methane production in terrestrial, aquatic and other anoxic environments: A mini review. *Pedosphere*, 30(1), 25–39. [https://doi.org/10.1016/S1002-0160\(18\)60052-9](https://doi.org/10.1016/S1002-0160(18)60052-9)
- Dachriyanus, Salni, Sargent, M. V., Skelton, B. W., Soediro, I., Sutisna, M., White, A. H., & Yulinah, E. (2002). Rhodomyrtone, an antibiotic from *Rhodomyrtus tomentosa*. *Australian Journal of Chemistry*, 55(3), 229–232. <https://doi.org/10.1071/CH01194>
- Das, L. K., Kundu, S. S., Kumar, D., & Datt, C. (2014). Metabolizable protein systems in ruminant nutrition: A review. *Veterinary World*, 7(8), 622–629. <https://doi.org/10.14202/vetworld.2014.622-629>
- Dehority, B.A. 2004. Starch digestion, other less numerous species, and facultative anaerobes in the rumen. Pages 243-264 in *Rumen Microbiology*. Nottingham University Press: Nottingham, UK.
- Dewhurst, R. J., & Newbold, J. R. (2022). Effect of ammonia concentration on rumen microbial protein production in vitro. In *British Journal of Nutrition* (Vol. 127, Issue 6, pp. 847–849). Cambridge University Press. <https://doi.org/10.1017/S000711452100458X>
- Dinakarkumar, Y., Rajabathar, J. R., Arokiyaraj, S., Jeyaraj, I., Anjaneyulu, S. R., Sandeep, S., Karthik, C. S., Appaturi, J. N., & Wilson, L. D. (2021). Anti-methanogenic effect of phytochemicals on Methyl-Coenzyme M Reductase—potential: in silico and molecular docking studies for environmental protection. *Micromachines*, 12(11). <https://doi.org/10.3390/M12111425>
- Dlamini, A. M., & Dube, M. A. (2014). Contribution of animal agriculture to greenhouse gases production in swaziland. *American Journal of Climate Change*, 03(03), 253–260. <https://doi.org/10.4236/ajcc.2014.33024>
- Fan, Q., Wanapat, M., Yan, T., & Hou, F. (2020). Altitude influences microbial diversity and herbage fermentation in the rumen of yaks. *BMC Microbiology*, 20(1), 1–13. <https://doi.org/10.1186/s12866-020-02054-5>
- FAO. (2023). Methane emissions in livestock and rice systems. FAO. <https://doi.org/10.4060/cc7607en>

- Flythe, M. D., Kagan, I. A., Wang, Y., & Narvaez, N. (2017). Hops (*Humulus lupulus* L.) bitter acids: Modulation of rumen fermentation and potential as an alternative growth promoter. *Frontiers in Veterinary Science*, 4(AUG). <https://doi.org/10.3389/fvets.2017.00131>
- Gilson, M. K., Given, J. A., Bush, B. L., & McCammon, J. A. (1997). The statistical-thermodynamic basis for computation of binding affinities: a critical review. *Biophysical Journal*, 72(3), 1047–1069. [https://doi.org/10.1016/S0006-3495\(97\)78756-3](https://doi.org/10.1016/S0006-3495(97)78756-3)
- Gleason, C. B., Beckett, L. M., & White, R. R. (2022). Rumen fermentation and epithelial gene expression responses to diet ingredients designed to differ in ruminally degradable protein and fiber supplies. *Scientific Reports*, 12(1), 1–11. <https://doi.org/10.1038/s41598-022-06890-5>
- Griffin, S. G., Wyllie, S. G., Markham, J. L., & Leach, D. N. (1999). The role of structure and molecular properties of terpenoids in determining their antimicrobial activity. *Flavour and Fragrance Journal*, 14(5), 322–332. [https://doi.org/10.1002/\(SICI\)1099-1026\(199909/10\)14:5<322::AID-FFJ837>3.0.CO;2-4](https://doi.org/10.1002/(SICI)1099-1026(199909/10)14:5<322::AID-FFJ837>3.0.CO;2-4)
- Guedes, I. A., de Magalhães, C. S., & Dardenne, L. E. (2014). Receptor–ligand molecular docking. *Biophysical Reviews*, 6(1), 75–87. <https://doi.org/10.1007/s12551-013-0130-2>
- Guillaume, S., & Macheboeuf, D. (2022). Association rule mining to shortlist plant phenolic compounds likely to decrease methane emissions by ruminants (pp. 129–158). https://doi.org/10.1007/978-3-030-90287-2_7
- Hackmann, T. J., & Firkins, J. L. (2015). Maximizing efficiency of rumen microbial protein production. *Frontiers in Microbiology*, 6. <https://doi.org/10.3389/fmicb.2015.00465>
- Harirchi, S., Wainaina, S., Sar, T., Nojoumi, S. A., Parchami, M., Parchami, M., Varjani, S., Khanal, S. K., Wong, J., Awasthi, M. K., & Taherzadeh, M. J. (2022). Microbiological insights into anaerobic digestion for biogas, hydrogen or volatile fatty acids (VFAs): a review. *Bioengineered*, 13(3), 6521–6557. <https://doi.org/10.1080/21655979.2022.2035986>
- Hasan, I. R. S. (2019). *Hijauan pakan tropik*. PT Penerbit IPB Press.
- Henrissat, B. A. 1991. Classification of glycosyl hydrolases based on amino acid sequence similarities. *Biochem. J.* 280: 309–316.
- Hiranrat, A., Chitbankluoi, W., Mahabusarakam, W., Limsuwan, S., & Voravuthikunchai, S. P. (2012). A new flavellagic acid derivative and phloroglucinol from *Rhodomyrtus tomentosa*. *Natural Product Research*. 26(20): 1904–1909. <https://doi.org/10.1080/14786419.2011.628666>
- Hiranrat, A., Mahabusarakam, W., Carroll, A. R., Duffy, S., & Avery, V. M. (2012). Tomentosones A and B, hexacyclic phloroglucinol derivatives from the Thai

shrub *Rhodomyrtus tomentosa*. The Journal of Organic Chemistry. 77(1): 680–683. <https://doi.org/10.1021/jo201602y>

Hiranrat, W., Hiranrat, A., & Mahabusarakam, W. (2017). Rhodomyrtosones G and H, minor phloroglucinols from the leaves of *Rhodomyrtus tomentosa*. *Phytochemistry Letters*, 21, 25–28. <https://doi.org/10.1016/j.phytol.2017.05.013>

Hua D, Hendriks WH, Xiong B, Pellikaan WF. 2022. Starch and cellulose degradation in the rumen and applications of metagenomics on ruminal microorganisms. *Animals*. 12(21):3020. <https://doi.org/10.3390/ani12213020>

Huang, R., Romero, P., Belanche, A., Ungerfeld, E. M., Yanez-Ruiz, D., Morgavi, D. P., & Popova, M. (2023). Evaluating the effect of phenolic compounds as hydrogen acceptors when ruminal methanogenesis is inhibited in vitro – Part 1. Dairy cows. *Animal*, 17(5), 100788. <https://doi.org/10.1016/j.animal.2023.100788>

Huang, Y., Marden, J. P., Julien, C., & Bayourthe, C. (2018). Redox potential: An intrinsic parameter of the rumen environment. *Journal of Animal Physiology and Animal Nutrition*, 102(2), 393–402. <https://doi.org/10.1111/jpn.12855>

Hughes, B. P., & Heritage, J. (1998). FAO antibiotic growth-promoters in food animals.

Hui, W. H., Li, M.-M., & Luk, K. (1975). Triterpenoids and steroids from *Rhodomyrtus tomentosa*. *Phytochemistry*, 14, 833–834. <https://api.semanticscholar.org/CorpusID:85404066>

Husson, O. (2013). Redox potential (Eh) and pH as drivers of soil/plant/microorganism systems: a transdisciplinary overview pointing to integrative opportunities for agronomy. *Plant and Soil*, 362(1–2), 389–417. <https://doi.org/10.1007/s11104-012-1429-7>

Huws, S. A., Creevey, C. J., Oyama, L. B., Mizrahi, I., Denman, S. E., Popova, M., Muñoz-Tamayo, R., Forano, E., Waters, S. M., Hess, M., Tapio, I., Smidt, H., Krizsan, S. J., Yáñez-Ruiz, D. R., Belanche, A., Guan, L., Gruninger, R. J., McAllister, T. A., Newbold, C. J., ... Morgavi, D. P. (2018). Addressing global ruminant agricultural challenges through understanding the rumen microbiome: past, present, and future. *Frontiers in Microbiology*, 9. <https://doi.org/10.3389/fmicb.2018.02161>

Inaba, R., Nagoya, M., Kouzuma, A., & Watanabe, K. (2019). Metatranscriptomic evidence for magnetite nanoparticle-simulated acetoclastic methanogenesis under continuous agitation. *Applied and Environmental Microbiology*, 85(23). <https://doi.org/10.1128/AEM.01733-19>

Jackson, R. B., Saunio, M., Bousquet, P., Canadell, J. G., Poulter, B., Stavert, A. R., Bergamaschi, P., Niwa, Y., Segers, A., & Tsuruta, A. (2020). Increasing anthropogenic methane emissions arise equally from agricultural and fossil fuel sources. *Environmental Research Letters*, 15(7), 071002.

<https://doi.org/10.1088/1748-9326/ab9ed2>

- Jafari, S., Goh, Y. M., Rajion, M. A., Faseleh Jahromi, M., & Ebrahimi, M. (2016). Ruminal methanogenesis and biohydrogenation reduction potential of papaya (*Carica papaya*) leaf: an in vitro study. *Italian Journal of Animal Science*, 15(1), 157–165. <https://doi.org/10.1080/1828051X.2016.1141031>
- Jayanegara, A. (2009). Ruminal methane production on simple phenolic acids addition in in vitro gas production method institute for animal production in the tropics. *Journal of Dairy Science*, 32(1), 53–62.
- Junior, F. P., Cassiano, E. C. O., Martins, M. F., Romero, L. A., Zapata, D. C. V., Pinedo, L. A., Marino, C. T., & Rodrigues, P. H. M. (2017). Effect of tannins-rich extract from *Acacia mearnsii* or monensin as feed additives on ruminal fermentation efficiency in cattle. *Livestock Science*, 203, 21–29. <https://doi.org/10.1016/j.livsci.2017.06.009>
- Kaneshima, T., Myoda, T., Nakata, M., Fujimori, T., Toeda, K., & Nishizawa, M. (2015). Rhodomyrtone, an antimicrobial acylphloroglucinol, in the peel of *Myrciaria dubia* (Camu-camu). *Food Preserv Sci*, 41(2), 71–76.
- Kaur, H., Kaur, G., Gupta, T., Mittal, D., & Ali, S. A. (2023). Integrating omics technologies for a comprehensive understanding of the microbiome and its impact on cattle production. *Biology*, 12(9), 1200. <https://doi.org/10.3390/biology12091200>
- Kim, M., Felix, T. L., Loerch, S. C., & Yu, Z. (2014). Effect of haylage and monensin supplementation on ruminal bacterial communities of feedlot cattle. *Current Microbiology*, 69(2), 169–175. <https://doi.org/10.1007/s00284-014-0564-1>
- Klevenhusen, F., & Zebeli, Q. (2021). A review on the potentials of using feeds rich in water-soluble carbohydrates to enhance rumen health and sustainability of dairy cattle production. *Journal of the Science of Food and Agriculture*, 101(14), 5737–5746. <https://doi.org/10.1002/jsfa.11358>
- KLHK. (2020). Laporan inventarisasi GRK 2020 dan monitoring, pelaporan, verifikasi (MPV). Kementerian Lingkungan Hidup Dan Kehutanan, 1–143.
- Krause, D.O.; Denman, S.E.; Mackie, R.I.; Morrison, M.; Rae, A.L.; Attwood, G.T.; McSweeney, C.S. 2003. Opportunities to improve fiber degradation in the rumen: microbiology, ecology, and genomics. *FEMS Microbiol. Rev.* 27: 663–693.
- Kristensen, N. B., Danfær, A., & Agergaard, N. (1998). Absorption and metabolism of short-chain fatty acids in ruminants. *Archiv Für Tierernaehrung*, 51(2–3), 165–175. <https://doi.org/10.1080/17450399809381916>
- Ku-Vera, J. C., Jiménez-Ocampo, R., Valencia-Salazar, S. S., Montoya-Flores, M. D., Molina-Botero, I. C., Arango, J., Gómez-Bravo, C. A., Aguilar-Pérez,

- C. F., & Solorio-Sánchez, F. J. (2020). Role of secondary plant metabolites on enteric methane mitigation in ruminants. *Frontiers in Veterinary Science*, 7. <https://doi.org/10.3389/fvets.2020.00584>
- Kumar, R., Ali, S. A., Singh, S. K., Bhushan, V., Mathur, M., Jamwal, S., Mohanty, A. K., Kaushik, J. K., & Kumar, S. (2020). Antimicrobial peptides in farm animals: An updated review on its diversity, function, modes of action and therapeutic prospects. *Veterinary Sciences*, 7(4), 206. <https://doi.org/10.3390/vetsci7040206>
- Kurniawati, A., & Muhsin Al Anas, M. (2021). The effect of a candidate feed additive derived from the essential oils of *Pinus merkusii* (jungh. & de vries) and *Melaleuca leucadendra* (L.) on the kinetics of gas production and methane emitted during in-vitro ruminal fermentation. *BIO Web of Conferences*, 33, 04009. <https://doi.org/10.1051/bioconf/20213304009>
- Kurth, J. M., Op den Camp, H. J. M., & Welte, C. U. (2020). Several ways one goal—methanogenesis from unconventional substrates. *Applied Microbiology and Biotechnology*, 104(16), 6839–6854. <https://doi.org/10.1007/s00253-020-10724-7>
- Lai, T. N. H., André, C., Rogez, H., Mignolet, E., Nguyen, T. B. T., & Larondelle, Y. (2015). Nutritional composition and antioxidant properties of the sim fruit (*Rhodomyrtus tomentosa*). *Food Chemistry*, 168, 410–416. <https://doi.org/10.1016/j.foodchem.2014.07.081>
- Leejae, S., Taylor, P. W., & Voravuthikunchai, S. P. (2013). Antibacterial mechanisms of rhodomyrtone against important hospital-acquired antibiotic-resistant pathogenic bacteria. *Journal of Medical Microbiology*, 62(PART1), 78–85. <https://doi.org/10.1099/jmm.0.049205-0>
- Limsuwan, S., Hesseling-Meinders, A., Voravuthikunchai, S. P., van Dijk, J. M., & Kayser, O. (2011). Potential antibiotic and anti-infective effects of rhodomyrtone from *Rhodomyrtus tomentosa* (Aiton) Hassk. on *Streptococcus pyogenes* as revealed by proteomics. *Phytomedicine*, 18(11), 934–940. <https://doi.org/10.1016/j.phymed.2011.02.007>
- Liu, C., Wu, H., Liu, S., Chai, S., Meng, Q., & Zhou, Z. (2019). Dynamic alterations in yak rumen bacteria community and metabolome characteristics in response to feed type. *Frontiers in Microbiology*, 10. <https://doi.org/10.3389/fmicb.2019.01116>
- Liu, H.-X., Tan, H.-B., & Qiu, S.-X. (2016). Antimicrobial acylphloroglucinols from the leaves of *Rhodomyrtus tomentosa*. *Journal of Asian Natural Products Research*, 18(6), 535–541. <https://doi.org/10.1080/10286020.2015.1121997>
- Loor, J. J., Elolimy, A. A., & McCann, J. C. (2016). Dietary impacts on rumen microbiota in beef and dairy production. *Animal Frontiers*, 6(3), 22–29. <https://doi.org/10.2527/af.2016-0030>
- Lopes, J. C., de Matos, L. F., Harper, M. T., Giallongo, F., Oh, J., Gruen, D., Ono,

- S., Kindermann, M., Duval, S., & Hristov, A. N. (2016). Effect of 3-nitrooxypropanol on methane and hydrogen emissions, methane isotopic signature, and ruminal fermentation in dairy cows. *Journal of Dairy Science*, 99(7), 5335–5344. <https://doi.org/10.3168/jds.2015-10832>
- López-Camacho, E., García-Godoy, M. J., García-Nieto, J., Nebro, A. J., & Aldana-Montes, J. F. (2016). A new multi-objective approach for molecular docking based on RMSD and binding energy (pp. 65–77). https://doi.org/10.1007/978-3-319-38827-4_6
- López-García, A., Saborío-Montero, A., Gutiérrez-Rivas, M., Atxaerandio, R., Goiri, I., García-Rodríguez, A., Jiménez-Montero, J. A., González, C., Tamames, J., Puente-Sánchez, F., Serrano, M., Carrasco, R., Óvilo, C., & González-Recio, O. (2022). Fungal and ciliate protozoa are the main rumen microbes associated with methane emissions in dairy cattle. *GigaScience*, 11. <https://doi.org/10.1093/gigascience/giab088>
- Lopez-Romero, J. C., González-Ríos, H., Borges, A., & Simões, M. (2015). Antibacterial effects and mode of action of selected essential oils components against *Escherichia coli* and *Staphylococcus aureus*. *Evidence-Based Complementary and Alternative Medicine*, 2015, 1–9. <https://doi.org/10.1155/2015/795435>
- Lyu, Z., Shao, N., Akinyemi, T., & Whitman, W. B. (2018). Methanogenesis. *Current Biology*, 28(13), R727–R732. <https://doi.org/10.1016/j.cub.2018.05.021>
- Mar, K. A., Unger, C., Walderdorff, L., & Butler, T. (2022). Beyond CO2 equivalence: The impacts of methane on climate, ecosystems, and health. *Environmental Science and Policy*, 134(March), 127–136. <https://doi.org/10.1016/j.envsci.2022.03.027>
- Marques, R. da S., & Cooke, R. F. (2021). Effects of ionophores on ruminal function of beef cattle. *Animals*, 11(10), 1–11. <https://doi.org/10.3390/ani11102871>
- McDonald, P., Edwards, R. A., Greenhalgh, J. F. D., Morgan, C. A., Sinclair, L. A., & Wilkinson, R. G. (2017). Animal Nutrition *Animal Nutrition*. https://mafiadoc.com/animal-nutrition-animal-nutrition_59d9d9ea1723dd4042af7356.html
- Menke, K. H., Raab, L., Salewski, A., Steingass, H., Fritz, D., & Schneider, W. (1979). The estimation of the digestibility and metabolizable energy content of ruminant feedingstuffs from the gas production when they are incubated with rumen liquor in vitro. *Journal of Agricultural Science*, 93(1), 217–222. <https://doi.org/10.1017/s0021859600086305>
- Mir, W. R., Bhat, B. A., Rather, M. A., Muzamil, S., Almilaibary, A., Alkhanani, M., & Mir, M. A. (2022). Molecular docking analysis and evaluation of the antimicrobial properties of the constituents of *Geranium wallichianum* D. Don ex Sweet from Kashmir Himalaya. *Scientific Reports*, 12(1), 12547.

<https://doi.org/10.1038/s41598-022-16102-9>

- Mitsumori, M., Enishi, O., Shinkai, T., Higuchi, K., Kobayashi, Y., Takenaka, A., Nagashima, K., Mochizuki, M., & Kobayashi, Y. (2014). Effect of cashew nut shell liquid on metabolic hydrogen flow on bovine rumen fermentation. *Animal Science Journal*, 85(3), 227–232. <https://doi.org/10.1111/asj.12133>
- Mitsuwan, W., Olaya-Abril, A., Calderón-Santiago, M., Jiménez-Munguía, I., González-Reyes, J. A., Priego-Capote, F., Voravuthikunchai, S. P., & Rodríguez-Ortega, M. J. (2017). Integrated proteomic and metabolomic analysis reveals that rhodomyrtone reduces the capsule in *Streptococcus pneumoniae*. *Scientific Reports*, 7(1), 2715. <https://doi.org/10.1038/s41598-017-02996-3>
- Mitsuwan, W., Wintachai, P., & Voravuthikunchai, S. P. (2020). Rhodomyrtus tomentosa leaf extract and rhodomyrtone combat *Streptococcus pneumoniae* biofilm and inhibit invasiveness to human lung epithelial and enhance pneumococcal phagocytosis by macrophage. *Current Microbiology*, 77(11), 3546–3554. <https://doi.org/10.1007/s00284-020-02164-3>
- Mordmuang, A., Brouillette, E., Voravuthikunchai, S. P., & Malouin, F. (2019). Evaluation of a *Rhodomyrtus tomentosa* ethanolic extract for its therapeutic potential on *Staphylococcus aureus* infections using in vitro and in vivo models of mastitis. *Veterinary Research*, 50(1). <https://doi.org/10.1186/s13567-019-0664-9>
- Morkunas, M., Dube, L., Götz, F., & Maier, M. E. (2013). Synthesis of the acylphloroglucinols rhodomyrtone and rhodomyrtosone B. *Tetrahedron*, 69(40), 8559–8563. <https://doi.org/10.1016/j.tet.2013.07.091>
- Nabil, M., Alam, R., Rahman, Q. A., Ul Islam, M. M., & Noor, M. A. A. (2020). In silico molecular docking study of some already approved antiviral drugs, vitamins and phytochemical components against Rna dependent Rna polymerase of Sars-Cov-2 virus. *Journal of Applied Bioinformatics & Computational Biology*, 9(5). [https://doi.org/10.37532/jabcb.2020.9\(5\).182](https://doi.org/10.37532/jabcb.2020.9(5).182)
- Narabe, C., Kamiyama, S., Saito, M., Boonsaen, P., Khongpradit, A., Sawanon, S., Suzuki, Y., Koike, S., & Kobayashi, Y. (2021). Cashew nut shell liquid potentially mitigates methane emission from the feces of Thai native ruminant livestock by modifying fecal microbiota. *Animal Science Journal*, 92(1). <https://doi.org/10.1111/asj.13614>
- Navarro Marcos, C., de Evan Rozada, T., Carro Travieso, M. D., Novoa-Garrido, M., Yen, Y., Fernández-Yepes, J. E., & Molina-Alcaide, E. (2023). Evaluation of different ensiling methods for *Saccharina latissima* preservation: influence on chemical composition and in vitro ruminal fermentation. *Archives of Animal Nutrition*, 77(4), 308–322. <https://doi.org/10.1080/1745039X.2023.2241339>
- Nazzaro, F., Fratianni, F., De Martino, L., Coppola, R., & De Feo, V. (2013).

Effect of essential oils on pathogenic bacteria. *Pharmaceuticals*, 6(12), 1451–1474. <https://doi.org/10.3390/ph6121451>

Newbold, C. J., De la Fuente, G., Belanche, A., Ramos-Morales, E., & McEwan, N. R. (2015). The role of ciliate protozoa in the rumen. *Frontiers in Microbiology*, 6(NOV), 1–14. <https://doi.org/10.3389/fmicb.2015.01313>

Nourbakhsh, F., Lotfalizadeh, M., Badpeyma, M., Shakeri, A., & Soheili, V. (2022). From plants to antimicrobials: Natural products against bacterial membranes. *Phytotherapy Research*, 36(1), 33–52. <https://doi.org/10.1002/ptr.7275>

Nwabor, O. F., Leejae, S., & Voravuthikunchai, S. P. (2021a). Rhodomyrtone accumulates in bacterial cell wall and cell membrane and inhibits the synthesis of multiple cellular macromolecules in epidemic methicillin-resistant staphylococcus aureus. *Antibiotics*, 10(5). <https://doi.org/10.3390/antibiotics10050543>

Nwabor, O. F., Leejae, S., & Voravuthikunchai, S. P. (2021b). Rhodomyrtone accumulates in bacterial cell wall and cell membrane and inhibits the synthesis of multiple cellular macromolecules in epidemic methicillin-resistant staphylococcus aureus. *Antibiotics*, 10(5). <https://doi.org/10.3390/antibiotics10050543>

Odongo, N. E., Bagg, R., Vessie, G., Dick, P., Or-Rashid, M. M., Hook, S. E., Gray, J. T., Kebreab, E., France, J., & McBride, B. W. (2007). Long-Term effects of feeding monensin on methane production in lactating dairy cows. *Journal of Dairy Science*, 90(4), 1781–1788. <https://doi.org/10.3168/jds.2006-708>

Owoloye, A. J., Ligali, F. C., Enejoh, O. A., Musa, A. Z., Aina, O., Idowu, E. T., & Oyebola, K. M. (2022). Molecular docking, simulation and binding free energy analysis of small molecules as PfHT1 inhibitors. *PLOS ONE*, 17(8), e0268269. <https://doi.org/10.1371/journal.pone.0268269>

Palangi, V., & Lackner, M. (2022). Management of enteric methane emissions in ruminants using feed additives: A review. *Animals*, 12(24), 1–15. <https://doi.org/10.3390/ani12243452>

Palangi, V., Macit, M., Nadaroglu, H., & Taghizadeh, A. (2022). Effects of green-synthesized CuO and ZnO nanoparticles on ruminal mitigation of methane emission to the enhancement of the cleaner environment. *Biomass Conversion and Biorefinery*. <https://doi.org/10.1007/s13399-022-02775-9>

Patra, A. K., & Puchala, R. (2023). Methane mitigation in ruminants with structural analogues and other chemical compounds targeting archaeal methanogenesis pathways. *Biotechnology Advances*, 69(September), 108268. <https://doi.org/10.1016/j.biotechadv.2023.108268>

Patra, A., Park, T., Kim, M., & Yu, Z. (2017a). Rumen methanogens and mitigation of methane emission by anti-methanogenic compounds and

substances. *Journal of Animal Science and Biotechnology*, 8(1), 13. <https://doi.org/10.1186/s40104-017-0145-9>

Patra, A., Park, T., Kim, M., & Yu, Z. (2017b). Rumen methanogens and mitigation of methane emission by anti-methanogenic compounds and substances. In *Journal of Animal Science and Biotechnology* (Vol. 8, Issue 1). BioMed Central Ltd. <https://doi.org/10.1186/s40104-017-0145-9>

Principle, A., & Apparatus, B. (2005). Official methods of analysis of AOAC international 18th Edition 2005. 4–5. https://www.academia.edu/43245633/Of_fi_cial_Methods_of_Anal_y_sis_of_AOAC_IN_TER_NA_TIONAL_18th_Edi_tion_2005

Puniya, A. K., Singh, R., & Kamra, D. N. (Eds.). (2015). *Rumen microbiology: from evolution to revolution*. Springer India. <https://doi.org/10.1007/978-81-322-2401-3>

Ramos, S. C., Jeong, C. D., Mamuad, L. L., Kim, S. H., Kang, S. H., Kim, E. T., Cho, Y. Il, Lee, S. S., & Lee, S. S. (2021). Diet transition from high-forage to high-concentrate alters rumen bacterial community composition, epithelial transcriptomes and ruminal fermentation parameters in dairy cows. *Animals*, 11(3), 1–23. <https://doi.org/10.3390/ani11030838>

Ranga Niroshan Appuhamy, J. A. D., Strathe, A. B., Jayasundara, S., Wagner-Riddle, C., Dijkstra, J., France, J., & Kebreab, E. (2013). Anti-methanogenic effects of monensin in dairy and beef cattle: A meta-analysis. *Journal of Dairy Science*, 96(8), 5161–5173. <https://doi.org/10.3168/jds.2012-5923>

Rietmann, S. J., Gäbel, G., & Dengler, F. (2023). The intraruminal redox potential is stabilised by opposing influences during fermentation. *Journal of Animal Physiology and Animal Nutrition*, 107(1), 53–61. <https://doi.org/10.1111/jpn.13697>

Rojas-Downing, M. M., Nejadhashemi, A. P., Harrigan, T., & Woznicki, S. A. (2017). Climate change and livestock: Impacts, adaptation, and mitigation. *Climate Risk Management*, 16, 145–163. <https://doi.org/10.1016/j.crm.2017.02.001>

Saeloh, D., Tipmanee, V., Jim, K. K., Dekker, M. P., Bitter, W., Voravuthikunchai, S. P., Wenzel, M., & Hamoen, L. W. (2018). The novel antibiotic rhodomyrtone traps membrane proteins in vesicles with increased fluidity. *PLoS Pathogens*, 14(2). <https://doi.org/10.1371/journal.ppat.1006876>

Sahoo, N., Pattnaik, S., Pattnaik, M., & Mohapatra, S. (2021). Methane emission and strategies for mitigation in livestock. *Environmental and Agricultural Microbiology: Advances and Applications*, 257–274. <https://doi.org/10.1002/9781119525899.ch12>

Saising, J., Ongsakul, M., & Voravuthikunchai, S. P. (2011). *Rhodomyrtus tomentosa* (Aiton) Hassk. ethanol extract and rhodomyrtone: a potential strategy for the treatment of biofilm-forming staphylococci. *Journal of*

Medical Microbiology, 60(12), 1793–1800.
<https://doi.org/10.1099/jmm.0.033092-0>

Sari, W. N., Safika, Darmawi, & Fahrimal, Y. (2017). Isolation and identification of a cellulolytic *Enterobacter* from rumen of Aceh cattle. *Veterinary World*, 10(12), 1515–1520. <https://doi.org/10.14202/vetworld.2017.1515-1520>

Saunois, M., Stavert, A. R., Poulter, B., Bousquet, P., Canadell, J. G., Jackson, R. B., Raymond, P. A., Dlugokencky, E. J., Houweling, S., Patra, P. K., Ciais, P., Arora, V. K., Bastviken, D., Bergamaschi, P., Blake, D. R., Brailsford, G., Bruhwiler, L., Carlson, K. M., Carrol, M., ... Zhuang, Q. (2020). The global methane budget 2000–2017. *Earth System Science Data*, 12(3), 1561–1623. <https://doi.org/10.5194/essd-12-1561-2020>

Shima, S., Huang, G., Wagner, T., & Ermler, U. (2020). Structural basis of hydrogenotrophic methanogenesis. *Annual Review of Microbiology*, 74(1), 713–733. <https://doi.org/10.1146/annurev-micro-011720-122807>

Sianglum, W., Saeloh, D., Tongtawe, P., Wootipoom, N., Indrawattana, N., & Voravuthikunchai, S. P. (2018). Early effects of rhodomyrtone on membrane integrity in Methicillin-Resistant *Staphylococcus aureus*. *Microbial Drug Resistance*, 24(7), 882–889. <https://doi.org/10.1089/mdr.2016.0294>

Sianglum, W., Srimanote, P., Wonglumsom, W., Kittiniyom, K., & Voravuthikunchai, S. P. (2011). Proteome analyses of cellular proteins in Methicillin-Resistant *Staphylococcus aureus* treated with rhodomyrtone, a novel antibiotic candidate. *PLoS ONE*, 6(2), e16628. <https://doi.org/10.1371/journal.pone.0016628>

Sinz, S., Marquardt, S., Soliva, C. R., Braun, U., Liesegang, A., & Kreuzer, M. (2019). Phenolic plant extracts are additive in their effects against in vitro ruminal methane and ammonia formation. *Asian-Australasian Journal of Animal Sciences*, 32(7), 966–976. <https://doi.org/10.5713/ajas.18.0665>

Sobanaa, M., Prathiviraj, R., Selvin, J., & Prathaban, M. (2023). A comprehensive review on methane's dual role: effects in climate change and potential as a carbon-neutral energy source. *Environmental Science and Pollution Research*. <https://doi.org/10.1007/s11356-023-30601-w>

Srisuwan, S., Mackin, K. E., Hocking, D., Lyras, D., Bennett-Wood, V., Voravuthikunchai, S. P., & Robins-Browne, R. M. (2018). Antibacterial activity of rhodomyrtone on *Clostridium difficile* vegetative cells and spores in vitro. *International Journal of Antimicrobial Agents*, 52(5), 724–729. <https://doi.org/10.1016/j.ijantimicag.2018.08.014>

Suwignyo, B., Kurniawati, A., Yebron, M. G. N., & Angeles, A. A. (2022). Legume and methane emission reduction in livestock. *Proceedings of the 6th International Seminar of Animal Nutrition and Feed Science (ISANFS 2021)*, 21(Isanfs 2021), 128–133. <https://doi.org/10.2991/absr.k.220401.027>

Takizawa, S., Asano, R., Abe, K., Fukuda, Y., Baba, Y., Sakurai, R., Tada, C., &

- Nakai, Y. (2023). Relationship between rumen microbial composition and fibrolytic isozyme activity during the biodegradation of rice straw powder using rumen fluid. *Microbes and Environments*, 38(3), ME23041. <https://doi.org/10.1264/jsme2.ME23041>
- Theodorou *a, M. K., Williams, B. A., Dhanoa, M. S., Mcallan, A. B., & France, J. (1994). A simple gas production method using a pressure transducer to determine the fermentation kinetics of ruminant feeds. *Animal Feed Science and Technology*, 48, 185–197.
- Tiago, N. P. V., Erico, da S. L., Wallacy, B. R. dos S., Andr eacute ia, S. C. aacute rio, C aacute ssio, J. T., Iacute talo, L. F., & Marco, A. ocirc nio M. de F. (2016). Ruminal microorganism consideration and protein used in the metabolism of the ruminants: A review. *African Journal of Microbiology Research*, 10(14), 456–464. <https://doi.org/10.5897/AJMR2016.7627>
- Tomkins, N. W., Denman, S. E., Pilajun, R., Wanapat, M., McSweeney, C. S., & Elliott, R. (2015). Manipulating rumen fermentation and methanogenesis using an essential oil and monensin in beef cattle fed a tropical grass hay. *Animal Feed Science and Technology*, 200, 25–34. <https://doi.org/10.1016/j.anifeedsci.2014.11.013>
- Tseten, T., Sanjorjo, R. A., Kwon, M., & Kim, S. W. (2022). Strategies to mitigate enteric methane emissions from ruminant animals. *Journal of Microbiology and Biotechnology*, 32(3), 269–277. <https://doi.org/10.4014/jmb.2202.02019>
- Ungerfeld, E. M. (2020). Metabolic hydrogen flows in rumen fermentation: principles and possibilities of interventions. *Frontiers in Microbiology*, 11. <https://doi.org/10.3389/fmicb.2020.00589>
- Valente, T. N. P., Sampaio, C. B., Lima, E. da S., Deminicis, B. B., Cezário, A. S., & Santos, W. B. R. dos. (2017). Aspects of acidosis in ruminants with a focus on nutrition: A review. *Journal of Agricultural Science*, 9(3), 90. <https://doi.org/10.5539/jas.v9n3p90>
- Vo, T., & Ngo, D. (2019). The health beneficial properties of *Rhodomyrtus tomentosa* as potential functional food. *Biomolecules*, 9(2), 76. <https://doi.org/10.3390/biom9020076>
- Wang, Q. Q., Wang, X. D., Wu, L. Z., Fang, Q. Q., Liu, Y. N., Jiang, K., Qu, S. J., & Tan, C. H. (2020). Polyphenylated acylphloroglucinols as deubiquitinating protease USP7 inhibitors from *Hypericum hookerianum*. *Fitoterapia*, 146(April), 104678. <https://doi.org/10.1016/j.fitote.2020.104678>
- Wang, Y. J., Xiao, J. X., Li, S., Liu, J. J., Alugongo, G. M., Cao, Z. J., Yang, H. J., Wang, S. X., & Swanson, K. C. (2017). Protein metabolism and signal pathway regulation in rumen and mammary gland. *Current Protein & Peptide Science*, 18(6), 636–651. <https://doi.org/10.2174/1389203717666160627075021>
- Watanabe, Y., Suzuki, R., Koike, S., Nagashima, K., Mochizuki, M., Forster, R.

- J., & Kobayashi, Y. (2010a). In vitro evaluation of cashew nut shell liquid as a methane-inhibiting and propionate-enhancing agent for ruminants. *Journal of Dairy Science*, 93(11), 5258–5267. <https://doi.org/10.3168/jds.2009-2754>
- Watanabe, Y., Suzuki, R., Koike, S., Nagashima, K., Mochizuki, M., Forster, R. J., & Kobayashi, Y. (2010b). In vitro evaluation of cashew nut shell liquid as a methane-inhibiting and propionate-enhancing agent for ruminants. *Journal of Dairy Science*, 93(11), 5258–5267. <https://doi.org/10.3168/jds.2009-2754>
- Wenner, B. A., Wagner, B. K., St-Pierre, N. R., Yu, Z. T., & Firkins, J. L. (2020). Inhibition of methanogenesis by nitrate, with or without defaunation, in continuous culture. *Journal of Dairy Science*, 103(8), 7124–7140. <https://doi.org/10.3168/jds.2020-18325>
- Woodruff, K. L., Hummel, G. L., Austin, K. J., Lake, S. L., & Cunningham-Hollinger, H. C. (2022). Calf rumen microbiome from birth to weaning and shared microbial properties to the maternal rumen microbiome. *Journal of Animal Science*, 100(10), 1–11. <https://doi.org/10.1093/jas/skac264>
- Wu, J. J., Zhu, S., Tang, Y. F., Gu, F., Liu, J. X., & Sun, H. Z. (2022). Microbiota-host crosstalk in the newborn and adult rumen at single-cell resolution. *BMC Biology*, 20(1), 1–21. <https://doi.org/10.1186/s12915-022-01490-1>
- Wunnoo, S., Bilhman, S., Amnuaikit, T., Ontong, J. C., Singh, S., Auepemkiate, S., & Voravuthikunchai, S. P. (2021). Rhodomyrtone as a new natural antibiotic isolated from rhodomyrtus tomentosa leaf extract: A clinical application in the management of acne vulgaris. *Antibiotics*, 10(2), 1–12. <https://doi.org/10.3390/antibiotics10020108>
- Wunnoo, S., Saising, J., & Voravuthikunchai, S. P. (2017). Rhodomyrtone inhibits lipase production, biofilm formation, and disorganizes established biofilm in *Propionibacterium acnes*. *Anaerobe*, 43, 61–68. <https://doi.org/10.1016/j.anaerobe.2016.12.002>
- Xue, M.-Y., Sun, H.-Z., Wu, X.-H., Liu, J.-X., & Guan, L. L. (2020). Multi-omics reveals that the rumen microbiome and its metabolome together with the host metabolome contribute to individualized dairy cow performance. *Microbiome*, 8(1), 64. <https://doi.org/10.1186/s40168-020-00819-8>
- Xue, M. Y., Wu, J. J., Xie, Y. Y., Zhu, S. L., Zhong, Y. F., Liu, J. X., & Sun, H. Z. (2022). Investigation of fiber utilization in the rumen of dairy cows based on metagenome-assembled genomes and single-cell RNA sequencing. *Microbiome*, 10(1), 1–17. <https://doi.org/10.1186/s40168-021-01211-w>
- Zhang, Y.-B., Li, W., Jiang, L., Yang, L., Chen, N.-H., Wu, Z.-N., Li, Y.-L., & Wang, G.-C. (2018). Cytotoxic and anti-inflammatory active phloroglucinol derivatives from *Rhodomyrtus tomentosa*. *Phytochemistry*, 153, 111–119. <https://doi.org/10.1016/j.phytochem.2018.05.018>
- Zhang, Y.-L., Chen, C., Wang, X.-B., Wu, L., Yang, M.-H., Luo, J., Zhang, C., Sun, H.-B., Luo, J.-G., & Kong, L.-Y. (2016). Rhodomyrtals A and B, Two

Meroterpenoids with a Triketone-Sesquiterpene-Triketone Skeleton from
Rhodomyrtus tomentosa: Structural Elucidation and Biomimetic Synthesis.
Organic Letters, 18(16), 4068–4071.
<https://doi.org/10.1021/acs.orglett.6b01944>

Zhang, Y.-L., Zhou, X.-W., Wu, L., Wang, X.-B., Yang, M.-H., Luo, J., Luo, J.-G.,
& Kong, L.-Y. (2017). Isolation, structure elucidation, and absolute
configuration of syncarpic acid-conjugated terpenoids from *Rhodomyrtus*
tomentosa. *Journal of Natural Products*, 80(4), 989–998.
<https://doi.org/10.1021/acs.jnatprod.6b01005>

Zhang, Z., Wei, W., Yang, S., Huang, Z., Li, C., Yu, X., Qi, R., Liu, W., Loo, J. J.,
Wang, M., & Zhang, X. (2022). Regulation of dietary protein solubility
improves ruminal nitrogen metabolism in vitro: Role of bacteria–protozoa
interactions. *Nutrients*, 14(14), 2972. <https://doi.org/10.3390/nu14142972>