

DAFTAR PUSTAKA

- Addawiyah, N. P., B. Ayuningsih, A. Budiman, dan I. Hernaman. 2021. Produksi gas pada ransum domba berbasis rumput gajah CV Mott dan leguminosa pohon. *Jurnal Sumber Daya Hewan*. 2(2): 31-34.
- Akhadiarto, S. dan M. N. Rofiq. 2017. Estimasi emisi gas metana dari fermentasi enterik ternak ruminansia menggunakan metode tier-1 di indonesia. *Jurnal Teknologi Lingkungan*. 18(1): 1-8.
- Al-Arif, M., L. T. Suwanti, A. T. S. Estoepongastie, and M. Lamid. 2017. The nutrients contents, dry matter digestibility, organic matter digestibility, total digestible nutrient, and NH₃ rumen production of three kinds of cattle feeding models. *Veterinary Medicine International Conference 2017, KNE life Sciences*. 338-343.
- Alves, J. P., S. S. Mendes, E. S. Galeano, M. A. P. O. Junior, T. Fernandes, M. Retore, A. C. A. Orrico, and L. D. S. Lopes. 2022. Forage Production and Quality of BRS Capi   as a Response of Cutting Age and Nitrogen Application. *Tropical Animal Science Journal*. 45(2): 179-186.
- Amanda, P. 2018. Evaluasi Kandungan Nutrisi, Produksi Gas dan Degradasi Pakan In Vitro dari Limbah Kelapa Sawit Yang Difermentasi Dengan *Aspergillus Niger* Iradiasi 500 Gy. Skripsi Fakultas Sains dan Teknologi. Universitas Islam Negeri Syarif Hidayatullah Jakarta.
- Antisa, A. A. Natsir, dan S. Syahrir. 2020. Daya cerna protein kasar, lemak kasar dan serat kasar ransum komplit mengandung bahan utama tumpi jagung fermentasi pada ternak kambing kacang. *bulletin Makanan Ternak*. 2(11): 1-13.
- AOAC. 2005. *Official Methods of Analysis of AOAC international*. 18th Ed. Assoc. Off. Anal. Chem. Arlington.
- Astuti, D., B. Suhartanto, N. Umami, dan A. Agus. 2018. pengaruh dosis pupuk urea dan umur panen terhadap hasil hijauan sorgum (*Sorghum bicolor* (L) Moench). *Agrinova*. 1(2): 45-51.
- Bachir, R. G. and M. Benali. 2012. Antibacterial activity of the essential oils from the leaves of *Eucalyptus globulus* against *Escherichia coli* dan *Staphylococcus aureus*. *Asian Pasific Journal of Tropical Biomedicine*. 2(9): 739-742.
- Boangmanalu, R., T. H. Wahyuni, dan S. Umar. 2016. Kecernaan bahan kering, bahan organik dan protein kasar ransum yang mengandung tepung limbah ikan gabus pasir (*Butis amboinensis*) sebagai substitusi tepung ikan pada broiler. *Jurnal Peternakan Integratif*. 4(3): 329-340.
- Burt, S. 2004. Essential oils: their antibacterial properties and potential applications in foods-a review. *International Journal of Food Microbiology*. 94(3): 223-253.

- Calsamiglia, S., M. Busquet, P. W. Cardozo, L. Castillejos, and A. Ferret. 2007. Invited review: essential oils as modifiers of rumen microbial fermentation. *Journal of Dairy Science*. 90(6): 2580-2595.
- Chatterjee, D. and P. Bhattacharjee. 2013. Comparative evaluation of the antioxidant efficacy of encapsulated and un-encapsulated eugenol-rich clove extracts in soybean oil: shelf-life and frying stability of soybean oil. *Journal of Food Engineering*. 117: 545-550.
- Chaves, A. V., M. L. He, W. Z. yang, A. N. Hristov, T. A. McAllister, and C. Benchaar. 2008. Effect of essential oils on proteolytic, deaminative and methanogenic activities of mixed ruminal bacteria. *Canadian Journal of Animal Science*. 117-122.
- Chounan, S., K. Sharma, and S. Guleria. 2017. Antimicrobial activity of some essential oils—present status and future perspectives. *Medicines*. 4(58): 1-21.
- Cleslak, A. M. S. Strabel, A. Stochmal, and W. Oleszek. 2013. Plant components with specific activities against rumen methanogens. *Animal*. 7: 253-265.
- Cobellis, G., M. T. Marinucci, and Z. Yu. 2016. Critical evaluation of essential oils as rumen modifiers in ruminant nutrition: a review. *Science of the Total Environment*. 545-546: 556-568.
- Cobellis, G., M. T. Marinucci, M. C. Marcotullio, and Z. Yu. 2016. Evaluating of different essential oils in modulating methane and ammonia production, rumen fermentation, and rumen bacteria *in vitro*. *Animal Feed Science and Technology*. 215: 25-36.
- Dang, Q., X. Zhao, Y. Li, and B. Xi. 2023. Revisiting the biological pathway for methanogenesis in landfill from metagenomic perspective—A case study of county-level sanitary landfill of domestic waste in North China plain. *Environmental Research*. 222: 1-10.
- Darwin, Yusmanizar, M. Ilham, A. Fazil, S. Purwanto, Sarbaini, F. Dhiauddin. 2016. Aplikasi thermal pre-treatment limbah tanaman jagung (*zea mays*) sebagai CO-substrat pada proses anaerobik digesti untuk produksi biogas. *AGRITECH*. 36(1): 79-88.
- Daryono, E. D. 2015. Sintesis α -pinene menjadi α -terpinol menggunakan katalis H_2SO_4 dengan variasi suhu reaksi dan volume etanol. *Jurnal Teknik Kimia*. 4(2): 1-6.
- Dhifi, W., S. Bellili, S. Jazi, N. Bahloul, and W. Mnif. 2016. Essential oils' chemical characterization and investigation of some biological activities: A Critical Review. 3(25): 1-16.
- Efruan, G. K., M. Martosupomo, and F. S. Rondonuwu. 2016. Review: bioaktivitas senyawa 1,8-sineol pada minyak atsiri. *Seminar Nasional Pendidikan Saintek*. 171-181.

- Ferry, J. G. 1999. Enzymology of one-carbon metabolism in methanogenic pathways. *FEMS Microbiology Reviews*. 23: 13-38.
- Fitri, M. A. and T. K. Dhaniswara. 2018. Pemanfaatan kotoran sapi dan sampah sayur pada pembuatan biogas dengan fermentasi sampah sayuran. *Journal of Research and Technology*. 4(1): 47-54.
- Gurawal, I., R. Rawendra, A. Waraen, dan A. K. jaliyah. 2022. Pertumbuhan dan kandungan nutrisi fodder jagung (*Zea mays*) dengan penyiraman *biourine* sapi. *Jurnal Peternakan Indonesia*. 24(1): 21-27.
- Golmakani, M. T., M. Zare, and S. Razzaghi. 2017. Eugenol enrichment of clove bud essential oil using different microwave-assisted distillation methods. *Food Science and Technology Research*. 23(3): 385-394.
- Gustiar, F., R.A. Suwignyo, Suberyanto, dan Munandar. 2014. Reduksi gas metan (CH₄) dengan meningkatkan komposisi konsentrat dalam pakan ternak sapi. *Jurnal Peternakan Sriwijaya*. 3(1): 14-24.
- Hardiyanti dan K. Nisah. 2019. Analisis kadar serat pada bakso bekatul dengan metode gravimetri. *AMINA*. 1(3): 103-107.
- Haryanto, B. and Thalib. 2009. Emisi metana dari fermentasi enterik: kontribusinya secara nasional dan faktor-faktor yang mempengaruhinya pada ternak. *Wartazoa*. 19(4): 157-165.
- Herman, E. M., and B. A. Larkins. 1999. Protein storage bodies and vacuoles. *The Plant Cell*. 11: 601-613.
- Hyldgaard, M., T. Mygind, and R. L. Meyer. 2012. Essential oils in food preservation: mode of action, synergies, and interactions with food matrix components. *Frontier in Microbiology*. 3: 1-24.
- Irvan, M., P. B. Manday, and J. Sasmitra. 2015. Ekstraksi 1,8-cineole dari minyak daun eucalyptus urophylla dengan metode soxhletasi. *Jurnal Teknik Kimia USU*. 4(3): 52-57.
- Ispitasari, R. dan Haryanti. 2022. Pengaruh waktu destilasi terhadap ketepatan uji protein kasar pada metode kjeldahl dalam bahan pakan ternak berprotein tinggi. *Indonesian Journal of Laboratory*. 5(1): 39-43.
- Jayasena, D. D. and C. Jo. 2013. Essential oils as potential antimicrobial agent in meat and meat products: a review. *Trends in Food Science & Technology*. 34(2): 96-108.
- Jenny, I., Surono, dan M. Christiyanto. 2012. Produksi amonia, undegraded protein dan protein total secara in vitro bungkil biji kapuk yang diproteksi dengan tanin alami. *Animal Agricultural Journal*. 1(1): 277-284.
- Jeyanathan. J., C. Martin, and D. P. Morgavi. 2014. The use of direct-fed microbials for mitigation of ruminant methane emissions: a review. *Animal*. 8(2): 250-261.

- Kamalak, A., A. I. Atalay, C. O. Ozkan, A. Tatliyer, and E. Kaya. 2011. Effect of essential orange (*Citrus sinensis* L.) oil on rumen microbial fermentation using *in vitro* gas production technique. The Journal of animal & Plant sciences. 21(4): 764-769.
- Kamra, D. N. 2005. Rumen microbial ecosystem. Current Science Association. 89(1): 124-135.
- Kementerian Pertanian. 2020. Statistik Ketenagakerjaan Sektor Pertanian Agustus 2020. Pusat Data dan Sistem Informasi Pertanian Sekretariat Jenderal-Kementerian Pertanian. Jakarta.
- Kheyrodin, H., R. Jami, and F. U. R. Rehman. 2022. Cellular structure and molecular functions of plants, animals, bacteria, and viruses. Cell. Mol. Biomed. Rep. 2(1): 33-41.
- Klau, M. Y., F. Pendong, R. A. V. Tuturoong, and M. R. Waani. 2020. Kecernaan energi dan kecernaan nutrien total pada ternak sapi perah yang diberikan pakan lengkap berbasis tebon jagung. Zootec. 40(2): 561-569.
- Koten, B. B., R. D. Soetrisno, N. Ngadiyono, dan B. Soewignyo. 2014. Perubahan nilai nutrien tanaman sorgum (*Sorghum bicolor* (L.) Moench) varietas lokal rote sebagai hijauan pakan ruminansia pada berbagai umur panen dan dosis pupuk urea. Pastura. 3(2): 55-60.
- Kurniawati, A., D.N. Wigati., C. Hasanah, dan L.M. Yusiati. 2020. Improvement of ruminal feed fermentation by addition of *eucalyptus based mix essential oil*. In IOP Conference Series: Earth and Environmental Science. 425(1): 01286.
- Kurniawati, A., Widodo, W. T. Artama, and L. M. Yusiati. 2018. Effects of four essential oils on nutrients digestibility of *in vitro* ruminal fermentation. Bulletin of Animal Science. 42(2): 122-126.
- Kusuma, H. S., A. Altway, and M. Mahfud. 2018. Solvent-free microwave extraction of essential oil from dried patchouli (*Pogostemon cablin* Benth) leaves. Journal of Industrial and Engineering Chemistry. 58: 343-348.
- Li, L., Z. W. Li, Z. Q. Yin, Q. Wei, R. Y. Jia, L. J Zhou, J. Xu, X. Song, Y. Zhou, Y. H. Du, L. C. Peng, S. Kang, and W. Yu. 2014. Antibacterial activity of leaf essential oil and its constituents from *Cinnamomum longepaniculatum*. Int J Clin Exp Med. 7(7): 1721-1727.
- Lin, B., Y. Lu, A. Z. M. Salem, J. H. Wang, Q. Liang, and J. X Liu. 2013. Effects of essential oil combinations on sheep ruminal fermentation and digestibility of a diet with fumarate included. Animal Feed Science and Technology. 184: 24-32.
- Madhu, C., K. M. Krishna, K. R. Reddy, P. J. Lakshmi, and E. K. Kelari. 2017. Estimation of crude fibre content from natural food stuffs and its

- laxative activity induced in rats. *International Journal of Pharma Research and Health Science*. 5(3): 1703-1706.
- Masruri, M.F. Rahman, dan T.I Prasodjo. 2007. Identifikasi dan uji aktivitas antibakteri senyawa volatil terpenoid minyak terpenin. *Jurnal Ilmu-Ilmu Hayati*. 19(1): 32-35.
- McDonald, P., R. Edwards, J. F. D. Greenhalgh, C. Morgan, L. Sinclair, and R. Wilkinson. 2011. *Animal Nutrition*, 7th edition. Pearson. New York.
- McIntosh, F. M., P. Williams, R. Losa, R. J. Wallace, D. A. Beever, and C. J. Newbold. 2003. Effects of essential oils on ruminal microorganisms and their protein metabolism. *Applied and Environmental Microbiology*. 69(8): 5011-5014.
- Menke, K. K. dan H. Steingass. 1988. Estimasi of energetic feed value obtained from chemical analysis in vitro gas production using rumen fluid. *Animal Research Development*. 28(2): 7-55.
- Mirella, Fo. M., M. A. Martoprawiro, and V. L. Allo. 2022. Struktur molekul dan sifat elektronik eugenol dan turunannya menggunakan DFT. *Jurnal Kimia Mulawarman*. 19(2): 58-62.
- Moningkey, A. F., F. R. Wolaayan, C. A. Rahasia, dan M. N. Ragar. 2019. Kecernaan bahan organik, serat kasar, dan lemak kasar pakan ayam pedaging yang diberi tepung limbah labu kuning (*Curcubita moschata*). *Zootec*. 39(2): 257-265.
- Monzote, L., A. M. Scherbakov, R. Scull, P. Satyai, P. Cos, A. E. Shchekotikhin, L. Gille, and W. M. Setzer. 2020. Essential oil form *Melaleuca leucadendra*: antimicrobial, antikinoplastid, antiproliferative and cytotoxic assesment. *Molecules*. 25(5514): 1-13.
- Moss, A. R., J. P. Jouany, and J. Newbold. 2000. Methane production by ruminants: its contribution to global warming. *Ann Zootech*. 49: 231-253.
- Mulyawan, M., E. Setyowati, dan A. Widjaja. 2015. Surfaktan sodium ligno sulfonate (SLS) dari debu sabut kelapa. *Jurnal Teknik ITS*. 4(1):1-3.
- Nuñez, L., & M. D'Aquino. 2012. Microbicide activity of clove essential oil (*Eugenia caryophyllata*). *Brazilian Journal of Microbiology*. 43(4): 1255– 1260.
- Nur, K., A. Atabany, Muladno, A. Jayanegara. 2015. Produksi gas metan ruminansia sapi perah dengan pakan berbeda serta pengaruhnya terhadap produksi dan kualitas susu. *Jurnal Ilmu Produksi dan Teknologi Hasil Peternakan*. 3(2): 65-71.
- Nurjannah, S., B. Ayuningsih, dan I. Hernaman. 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-Journals*. 5(2): 1-15.
- Ornaghi, M. G., R. A. C. Passetti, J. A. Torrecilhas, C. Mottin, A. C. P. Vital, A. Guerrero, C. Sanudo, M. del Mar Campo, and I. N. Prado. 2017. Essential oils in the diet of young bulls: effect on animal performance, digestibility, temperament, feeding behaviour and carcass characteristics. *Animal Feed Science and Technology*. 234: 274-283.
- Patra, A. K. and J. Saxena. 2010. A new perspective on the use of plant secondary metabolites to inhibit methanogenesis in the rumen. *Phytochemistry*. 71: 1198-1222.
- Patra, A. K. and Z. Yu. 2012. Effect of essential oils on methane production and fermentation by, and abundance and diversity of, rumen microbial populations. *Applied and Environmental Microbiology*. 78(12): 4271-4280
- Pereira, A.M., M. de. L.N.E. Dapkevicius, & A.E.S. Borba. 2022. Alternative pathways for hydrogen sink originated from the ruminal fermentation of carbohydrates: which microorganisms are involved in lowering methane emission?. *Animal Microbiome*. 4(1): 1-12.
- Prasetyo, A. B., B. I. M. Tampoebolon, dan L. K. Nuswantara. 2022. Kandungan serat kasar, pencernaan serat kasar, dan fermentabilitas bonggol singkong yang difermentasi menggunakan *Aspergillus niger*. *Jurnal Agripet*. 22(2): 204-212.
- Prawitasari, R. H., V. D. Y. B. Ismadi, dan I. Estiningdriati. 2012. Kecernaan protein kasar dan serat kasar serta laju digesta pada ayam arab yang diberi ransum dengan berbagai level *Azolla microphylla*. *Animal Agriculture Journal*. 1(1): 471-483.
- Purbowati, E., E. Rianto, W.S. Dilaga, C.M.S. Lestari, dan R. Adiwanti. 2014. Karakteristik cairan rumen, jenis, dan jumlah mikrobial dalam rumen sapi jawa dan peranakan ongole. *Buletin Peternakan*. 38(1): 221-26.
- Rasgalde, S. W. 2008. Enzymology of the wood-ljungdahl pathway of acetogenesis. *Ann N Y Acad Sci*. 1125: 129-136.
- Riswandi, A. I. M. Ali, Muhakka, Y. Syaifudin, and I. Akbar. 2015. Nutrient digestibility and productivity of bali cattle fed fermented *Hymenachne amplexicaulis* based rations supplemented with *Leucaena leucocephala*. *Media Peternakan*. 38(3): 156-162.
- Rustiyana, E., Liman, dan F. Fathul. 2016. Pengaruh substitusi rumput gajah (*Pennisetum purpureum*) dengan pelepah daun sawit terhadap pencernaan protein kasar dan pencernaan serat kasar pada kambing. *Jurnal Ilmiah Peternakan Terpadu*. 4(2): 161-165.

- Sari, N.F. 2017. Mengenal keberagaman mikroba rumen pada perut sapi secara molekuler. *BioTrens*. 8(1): 5-9.
- Sikkema, j., j. A. de Bont, and B. Poolman. 1994. Interactions of cyclic hydrocarbons with biological membranes. *The Journal of Biological Chemistry*. 269(11): 8022-8028.
- Silva, A. C. R. D, P. M. Lopes, M. M. B. D. Azevedo, D. C. M. Costa, C. S. Alviano, and D. S. Alviano. 2012. Biological activities of α -pinene dan α -pinene enantiomers. *Molecules*. 17: 6305-6316.
- Smeti, S., N. Atti, M. Mahouachi, and F. Munoz. 2013. Use of dietary rosemary (*Rosmarinus officinalis* L.) essential oils to increase the shelf of barbarine light lamb meat. *Small Ruminant Research*. 113(2-3): 340-345.
- Sobari, M., I. M. Mudita, dan I. G. L. O. Cakra. 2018. Kecernaan nutrien pada sapi bali yang diberi ransum terfermentasi inokulan bakteri lignoselulolitik kolon sapi dan sampah organik. *Journal of Tropical Animal Science*. 6(2): 318-334.
- Soltan, Y. A., A. S. Natel, R. C. Araujo, A. S. Morsy, and A. L. Abdalla. 2018. Progressive adaptation of sheep to a microencapsulated blend of essential oils: ruminal fermentation, methane emission, nutrient digestibility, and microbial protein synthesis. *Animal Feed Science and Technology*. 237: 8-18.
- Sondakh, E. H. B., M. R. Waani, and J. A. D. Kalele. 2017. Changes in *in vitro* methane production and fatty acid profiles in response to *cakalang* fish oil supplementation. *Media Peternakan*. 40(3): 188-193.
- Souza, K. A., J. de Oliveira Monteschio, C. Mottin, T. R. Ramos, L. A. de Moraes Pinto, C. E. Eiras, A. Guerrero, and I. N. do Prado. 2019. Effect of diet supplementation with clove and rosemary essential oils and protected oils (eugenol, thymol and vanillin) on animal performance, carcass characteristics, digestibility, and ingestive behavior activities for Nellore heifers finished in feedlot. *Livestock Science*. 220: 190-195.
- Sukaryana, Y., Zairiful, Y. Priabudiman, dan I. Panjaitan. 2019. Kecernaan pakan wafer berbasis bungkil inti sawit pada sapi peranakan ongole dewasa. *Prosiding Seminar Nasional Pengembangan Teknologi Pertanian*. November. Lampung.
- Suningsih, N. dan Sadjadi. 2020. Efek penambahan tepung daun sirsak (*Annona muricata* L) dalam ransum berbasis jerami padi fermentasi terhadap kecernaan bahan kering dan bahan organik secara in vitro. *Jurnal Sains Peternakan Indonesia*. 15(2): 173-179.
- Tekippe, J. A., A. N. Hristov, K. S. Heyler, V. D. Zheljazkov, J. F. S. Ferreira, C. L. Cantrel, and G. A. Varga. 2012. Effects of plants and essential oils on ruminal in vitro batch culture methane production and fermentation. *Canadian Journal of Animal Science*. 92: 395-408.

- Theodorou, M.K., B.A. Williams, M.S. Dhanoa, A.B. McAllan, and J. France. 1994. A simple production method using a pressure transducer to determine the fermentation kinetics of ruminant feeds. *Animal Feed Science and Technology*. 48: 185-197.
- Usman, Y. 2013. Pemberian pakan serat sisa tanaman pertanian (jerami kacang tanah, jerami jagung, pucuk tebu) terhadap evolusi pH, N-NH₃ dan VFA di dalam rumen sapi. *Agripet*. 13(2): 53-58.
- Vedramini, T. H. A., C. S. Takiya, T. H. Silva, F. Zanferari, M. F. Rentas, J. C. Bertoni, C. E. C. Cosentini, R. Gardinal, T. S. Acedo, and F. P. Renno. 2016. Effect of a blend of essential oils, chitosan or monensin on nutrient intake and digestibility of lactating dairy cow. *Animal Feed Science and Technology*. 214: 12-21.
- Watkins, D., Md, Nuruddin, M. Hosur, A. T. Narteh, and S. jaelani. 2015. Extraction and characterization of lignin from different biomass resources. *Journal of Materials research and Technology*. 4(1): 26-32.
- Wang, L., G. Zhang, Y. Li, & Y. Zhang. 2020. Effects of high forage/concentrate diet on volatile fatty acid production and the microorganisms involved in vfa production in cow rumen. *Animals*. 10(223): 1-12.
- Widyawati, S. D. 2008. Efek perbedaan sumber protein dan rasio urea-molases dalam pakan suplemen yang ditambahkan dalam ransum terhadap produksi mikroba rumen secara *in vitro*. *Sains Peternakan*. 6(1): 34-41.
- Wijayanti, E. F. Wahyono, dan Surono. 2012. Kecernaan nutrien dan fermentabilitas pakan komplit dengan level ampas tebu yang berbeda secara *in vitro*. *Animal Agricultural Journal*. 1(1): 167-179.
- Yuliana, P., E.B. Laconi, A. Jayanegara, S.S. Achmadi, dan A.A. Samsudin. 2019. Modulasi pola fermentasi rumen dan emisi gas metana dari penambahan ekstrak lerak pada silase gamal. *Jurnal Veteriner*. 20(2): 202-210.
- Zabranska, J. and D. Pokorna. 2018. Bioconversion of carbon dioxide to methane using hydrogen and hydrogenotrophic methanogens. *Biotechnology Advances*. 36: 707-720.
- Zhou, R., J. Wu, X. Lang, L. Liu, D. P. Casper, C. Wang, L. Zhang, and S. Wei. 2020. Effects of oregano essential oil in vitro ruminal fermentation, methane production, and ruminal microbial community. *Journal of Dairy Science*. 103(3): 2303-2314.
- Zulfa, I. H., Z. Bachruddin, and A. Kurniawati. 2019. Effects of lemongrass leaves as essential oil sources on rumen microbial ecology and nutrient digestibility in an *in vitro* system. *Pakistan Journal of Nutrition*. 18(3): 254-259.