

DAFTAR PUSTAKA

- Adamska, A., J. Stefanowicz-Hajduk, and J. R. Ochocka. 2019. Alpha-hederin, the active saponin of *Nigella sativa*, as an anticancer agent inducing apoptosis in the SKOV-3 cell line. *Molecules*. 24 (2958): 1-17.
- Agle, M., A. N. Hristov, S. Zaman, C. Schneider, P. M. Ndegwa, and V. K. Vaddella. 2010. Effect of dietary concentrate on rumen fermentation, digestibility, and nitrogen losses in dairy cows. *Journal of Dairy Science*. 93: 4211- 4222.
- Ali, Z., D. Ferreira, P. Carvalho, M. A. Avery, and I. A. Khan. 2010. Nigellidine-4-O-sulfate, the first sulfated indazole-type alkaloid from the seeds of *Nigella sativa*. *Journal of Natural Production*. 71 (6): 1111-1112.
- Angelidaki, I., L. Treu., P. Tsapekos., G. Luo., S. Campanaro., H. Wenzel., and P. G. Kougias. 2018. Biogas upgrading and utilization: Current status and prespectives. *Research Review Paper Biotechnology Advances Elsevier*.
- Annison, E.F., D.B. Lindsay, and J.V. Nolan. *Sheep Nutrition: Digestion and Metabolism*. Cabi Publishing. CSIRO Plant Industry. Canberra, Australia.
- Arora, S. P. 1995. *Pencernaan Mikroba pada Ruminansia*. Gadjah Mada University Press. Yogyakarta.
- Asanuma, N., M. Iwamoto., and T. Hino. 1999. Effect of the addition of fumarate on methane production by ruminal organisms *In Vitro*. *Journal of Dairy Science*. 82: 780-787.
- Aschenbach, J. R., G. B. Penner, F. Stumpff, and G. Gäbel. 2011. Ruminant nutrition symposium: role of fermentation acid absorption in the regulation of ruminal ph 12. *Journal of Animal Science*. 89: 1092-1107.
- Astuti, M. 2007. *Pengantar Ilmu Statistik untuk Peternakan dan Kesehatan Hewan*. Binasti Publisier. Bogor.
- Boycea, S. J. L., and W. F. Tinto. 2007. Steroidal saponins and sapogenins from the *Agavaceae* family a. *Natural Products Communications*. 2(1): 99-114.
- Burits, M., and F. Bucar. 2000. Antioxidant activity of *Nigella sativa* essential oil. *Phytotherapy Research*. 14 (5): 323-328.
- Calsamiglia, S., M. Busquet, P. W. Cardozo, L. Castillejos, A. Ferret, and I. Fandiño. 2007. The use of essential oils in ruminants as modifiers of rumen microbial fermentation. *Penn. State. Dairy Cattle Nutrition*

Workshop.

- Chaney, A.L. and E.P. Marbach. 1962. Modified reagents for determination of urea and ammonia. *Jurnal Clinical Chemistry*. 8: 130-132.
- Cheeke, P. R. 2000. Actual and potential applications of *Yucca schidigera* and *Quillaja saponaria* saponins in human and animal nutrition. *Journal of Animal Science* 77: 1-10.
- Cheeke, P. R. 2005. *Applied Animal Nutrition*. Volume 2, Feed and Feeding. Perntice Hall, Upper Saddle River. New Jersey.
- Danielsson, R. 2017. Evaluation of a gas in *in vitro* system for predicting methane production *in vivo*. *Journal of Dairy Science*. 100 (11): 8881-8894.
- Dehority, B. A. 2004. *Rumen Microbiology*. Nottingham University Press. Nottingham.
- Demeyer, D. and V, Fievez. 2000. Ruminants et environnement: la méthanogène`se. *Annales de Zootechnie*. 49 (2) : 95-112.
- Diaz, A., M. Avendro, and A. Escobar. 1993. Evaluation of sapindus saponaria as a defaunating agent and its effects on different ruminal digestion paramaters. *Jurnal Livestock research for Rural Development*. 5 (2):1-6.
- Elbandy, M., Kang, O., Kwon, D., and J. Rho. 2009. The new anti-inflammatory triterpene saponins from the egyptian medicine food black cummin (seed of *Nigella sativa*). *Bulletin of The Korean Chemical Society*. 30 : 1181-1185.
- Enemark, J. M. D. 2008. The Monitoring, Prevention and Treatment of Sub-Acute Ruminal Acidosis (SARA): a review. *Jourval Veterinary*. 176: 32-43.
- FAO. 2013. *Tackling Climate through Livestock: A Global Assessment of Emissions and Mitigation Opportunities*. Rome: FAO.
- Filípek, J., and R. Dvorák. 2009. Determination of the Volatile Fatty Acid Content in the Rumen Liquid: Comparison of Gas Chromatography and Capillary Isotachopheresis. *Acta Veterinaria Brno*. 78: 627-633.
- Francis, G., Z. Kerem, H. P. S. Makkar, K. Becker. 2002. The biological action of saponins in animal system: a review. *British Journal of Nutrition*. 88 : 587-605.
- Fraser, M. D., H. R. Fleming., V. J. Theobald., and J. M. Moorby. 2015. Effect of breed and pasture type on methane emissions from weaned lambs offered fresh forage. *Journal of Agricultural Science*. 153 (6) : 1128-1134.
- Gerber, P. J., H. Steinfeld., B. Henderson., A. Mottet., C. Opio., J. Djikman., A. Falcucci., and G. Tempio. 2013. *Tackling Climate Change*

Through Livestock – A Global Assessment of Emissions and Mitigation Opportunity. Food and Agriculture Organization of the United Nations (FAO). Rome.

- Ghobrini, K., L. Bendifallah, R. Belguendouz, M. Amrani, N. Razkallah, and M. Benhamana. 2016. Chemical analysis and biocidal properties of *Nigella sativa* L. (*Renunculaceae*) growing in northern region of Algeria. *Proceedings of Engineering and Technology*. 16: 116-119.
- Goel, G., H. P. S. Makkar., and K. Becker. 2008. Changes in Microbial Community Structure, Methanogenesis and Rumen Fermentation in Response to Saponin-rich Fractions from Different Plant Materials. *Journal Applied Microbiology*. 105: 770-777.
- Grenet, E. and J. M. Besle. 1991. Microbes and Fibre Degradation In Rumen Microbial Metabolism and Ruminant Digestion. Jouany, J. P. (eds). Institut National De La Recherche Agronomique. Rue De L'Universite. Paris.
- Hajhashemi, V., A. Ghannadi., and H. Jafarabadi. 2004. Black cumin seed essential oil, as a potent analgesic and anti-inflammatory drug. *Phytotherapy Research*. 18: 195-199.
- Hanim, C., L. M. Yusiati., and S. Alim. 2009. Effect of saponin as defaunating agent on *in vitro* ruminal fermentation of forage and concentrate. *Jurnal Pengembangan Peternakan Tropis*. 34 (4): 231-235.
- Hanim, C., L. M. Yusiati., dan I. M. Santo. 2007. Pengaruh daun ketepeng cina (*Casia alata* L.) sebagai sumber saponin pada pakan terhadap fermentasi rumput raja dan dedak halus di dalam rumen secara *in vitro*. *Prosiding Peternakan dan Pemberdayaan Masyarakat Pedesaan*. Fakultas Peternakan, Universitas Gadjah Mada, Yogyakarta. P: 70-76.
- Hapsari, N. S., D. W. Harjanti., dan A. Muktiani. 2018. Fermentabilitas pakan dengan imbuhan ekstrak daun babadotan (*ageratum conyzoides*) dan Jahe (*Zingiber officinale*) pada sapi perah secara *in vitro*. *Jurnal Agripet*. 18 (1) : 2.
- Hartadi, H., S. Reksohadiprodjo, dan A.D. Tillman. 1993. *Tabel Komposisi Pakan Ternak untuk Indonesia*. Gadjah Mada University Press. Yogyakarta.
- Hawley, Ts. and Hawley, R. G. 2004. *Flow Cytometry Protocols*. New York: Humana Press, Inc.
- Hess, H. D., M. Kreuzer., T. E. Diaz., C. E. Diaz., C. E. Lascano., J. E. Carulla., C. R. Soliva., and A. Machmuller. 2003. Saponin rich tropical fruits affect fermentation and methanogenesis in faunated and defaunated rumen fluid. *Animal Feed Science & Technology*. 109 (1-4) : 79-94.

- Hostettmann, K., dan A. Marston. 1995. Saponins. Cambridge. Cambridge University Press.
- Hu, W., J. Liu, J. Ye, Y. Wu, and Y. Guo. 2005. Effect of tea saponin on rumen fermentation *in vitro*. Journal of Animal Feed Science and Technology. 120: 333-339.
- Hubson, P. N., and C. S. Stewart. 1997. The Rumen Microbial Ecosystem. St Edmundsbury Press. Great Britain.
- Hungate, R. E. 1966. The Rumen and Its Microbes. Academic Press. London.
- Janssen, P. H. and M. Kirs. 2008. Structure of the archaeal community of the rumen. Applied and Environmental Microbiology. 74: 3619-3625.
- Jayanegara, A. dan A. Sofyan. 2008. Penentuan aktivitas biologis tanin beberapa hijauan secara *in vitro* menggunakan "Honheim Gas Test" dengan polietilen glikol sebagai determinan. Media Peternakan. 51: 44-52.
- Johnson, K. A. and D. E. Johnson. 1995. Methane emissions from cattle. Journal of Animal Science. 73 : 2483-2492.
- Jouany, J. P. 1991. Rumen Microbial Metabolism and Ruminant Digestion. Institut National De La Recherche Agronomique. Paris.
- Kamal, M. 1998. Bahan Pakan dan Ransum Ternak. Laboratorium Makanan Ternak. Fakultas Peternakan. Universitas Gadjah Mada. Yogyakarta.
- Kamra, D. N., P. N. Chatterjee., A. Patra., and R. Kumar. 2012. Effect of plant extracts on methanogenesis and microbial profile on the rumen of buffalo: A brief overview. Australian Journal of Experimental Agriculture. 48: 175-178.
- Kavanagh, S. 2011. Concentrate feeds Section 6. Teagasc : Agriculture and Food Development Authority. Diakses pada <https://www.teagasc.ie/media/website/animals/beef/concentrate-feeds.pdf> pada 9 September 2019 Pukul 12:56 WIB.
- Klita, P. T., G. W. Mathison., T. W. Fenton., and R. T. Hardin. 1996. Effect of Alfalfa Root Saponins of Digestive Function in Sheep. Journal of Animal Science. 74: 1144-1156.
- Knapp, J. R., G. L. Laur., P. A. Vadas., W. P. Weiss., and J. M. Tricarico. 2014. Enteric Methane in Dairy Cattle Production: Quantifying The Opportunities and Impact of Reducing Emissions. Journal Dairy Science. 97: 3231-3261.

- Kumara, S. S. M. and B. T. K. Huat. 2001. Extraction, isolation and characterisation of antitumor principle, alpha-hederin, from the seeds of *Nigella sativa*. *Planta Medica*. 67: 29-32.
- Kurniawati, A., and N. Umami. 2010. *Hibiscus schizopelatus* as saponin source, reduce protozoa number and increase microbial protein synthesis on *in vitro* sheep rumen fermentation. The 5th International Seminar on Tropical Animal Production. P: 177-182.
- Lila, Z. A., N. Mohammed., S. Kanda., T. Kamada. and H. Itabashi. 2003. Effect of sarsaponin on ruminal fermentation with particular reference to methane production *in vitro*. *Journal Dairy Science*. 86: 3330-3336.
- Liu, L., T. Ma., D. Chen., N. Zhang., B. Si., K. Deng., Y. Tu., and Q. Diao. 2019. Effect of tea saponin supplementation on nutrient digestibility, methanogenesis, and ruminal microbial flora in dorper crossbred ewe. *Journal MDPI Animals*. 29: 1-11.
- Maghmipour, E. and S. Handali. 2015. Saponin: properties, methods of evaluation and applications. *Annual Research & Review in Biology*. 5 (3) : 207-220.
- Martin, C., D. P. Morgavi., and M. Doreau. 2010. Methane mitigation in ruminants: from microbe to the farm scale. *The Animal Consortium*. 4 (3) : 351-365.
- Maynard L., A. and J. K. Loosli. 1969. *Animal Nutrition*. Sixth Edition. Tata Mc. Graw Hill Publishing Company Ltd., New Delhi.
- McAllister, T. A. and C. J. Newbold. 2008. Redirecting rumen fermentation to reduce methanogenesis. *Aus. Journal of Experimental Agriculture*. 48: 7-17.
- McDonald, P., R.A. Edwards, J.F.D. Greeshalgh, and C.A. Morgan. 2002. *Animal Nutrition Sixth Edition*. England: Pearson Education Limited.
- Menke, K. H. and H. Steinngas. 1988. Estimation of energetic feed value obtained from chemical analysis and *in vitro* gas production using rumen fluid. *Animal Research and Development*. 28 : 7 - 55.
- Michel, C. G., N. S. El-Dine., S. M. Fahmy., S. M. Ezzat., D. I. Nasseem., and T. S. El-Alfy. 2010. Phytochemical and biological investigation of the extracts of *Nigella sativa* L. seed waste. *Drug. Test. Analysis*.
- Millen, D. D., M. D. B. Arrigoni., and R. D. L. Pacheco. 2016. *Rumenology*. Spinger International Publishing. Switzerland.
- Miresan, V., C. Raducu., and G. H. Stetca. 2006. The effect of ruminal defaunation establishing the role of the infusores in ruminal physiology. *Bulletin USAMV-CN*. 63: 88-92.

- Morgavi, D. P., E. Forano, C. Martin, and C. J. Newbold. 2010. Microbial ecosystem and methanogenesis in ruminants. *Journal of Animal Science*. 4 : 1024-1036.
- Moss, A.R., J.P. Jounany, and J. Neevbold. 2000. Metane production by ruminants: its contribution to global warming. *Annales de Zootechnie*. 49: 231-253.
- Nadkarni, A. K. 1976. *Indian Materia Medica: Volume 2: Third Edition*. Rhamdas Bhatkal. Mumbai.
- Nergiz, C., and Ötles, S. 1993. Chemical Composition of *Nigella Sativa* L. seeds. *Journal Food Chemistry*. 48:259-261.
- Newbold, C. J., B. Lassalas., and J. P. Jouany. 1995. The importance of methanogens associated with ciliate protozoa in rumen methane production *in vitro*. 21 (4): 230-234.
- Niba, A. T., J. D. Beal., A. C. Kudi., and P. H. Brooks. 2009. Potential of bacterial fermentation as a biosafe method of improving feeds for pigs and poultry. *African Journal of Biotechnology*. 8 : 1758-1767.
- Ørskov, E. R. 1992. *Protein Nutrition in Ruminants*. 2nd Ed. Academic Press Ltd, London. P. 21.
- Owens, F. N. dan R. Zinn. 1988. Protein metabolism of ruminant animals. In: D.C. Church (Ed), *The Ruminant Animal Digestive Physiology and Nutrition*. Reston Book Prentice Hall, Englewood Cliffs, New Jersey.
- Patra, A. K., and Saxena, J. 2009. The effect and mode of action of saponins on the microbial populations and fermentation in the rumen and ruminant production. *Nutrition Research Review*. 22: 204–219.
- Plummer, D.T. 1987. *An Introduction to Practical Biochemistry*. Third Edition. Mc. Graw-Hill Book Company. Publ. New Delhi.
- Ranilla, M. J., J. P. Jouany., and D. P. Morgavi. 2007. Methane production and substrate degradation by rumen microbial communities containing single protozoal species *in vitro*. *Letters in Applied Microbiology*. 45 : 675-680.
- Reay, D., P. Smith, and A. V. Amstel. 2010. *Metane and Climate Change*. Earthscan. UK.
- Resti. 2016. Suplementasi Daun Pandan Wangi (*Pandanus amaryllifolius* Roxb.) dalam Pakan sebagai Upaya Pengurangan Emisi Gas Metan Hasil Fermentasi Rumen. Skripsi. Fakultas Peternakan Universitas Gadjah Mada.
- Sairullah, P., S. Chuzaemi., and H. Sudarwati. 2016. Effect of flour and papaya leaf extract (*Caricapapaya* L) in feed to ammonia

- concentration, volatile fatty acids and microbial protein synthesis in vitro. *Jurnal Ternak Tropika*. 17 (2) : 66-73.
- Schiegel, H. G. 1994. *Mikrobiologi Umum*. Penerjemah: T. Baskoro. Universitas Gadjah Mada Press. Yogyakarta.
- Seijan, V., I. Hyder., T. Ezeji., J. Lakritz., R. Bhatta., J. P. Ravindra., C. S. Prasad., and R. Lal. 2015. *Global Warming : Role of Livestock*. Research Gate. 141-169.
- Siregar, M. E. 1994. *Ransum Ternak Ruminansia*. Penebar Swadaya. Jakarta.
- Sparg, S. G., M. E. Light., and J. Van Staden. 2004. Biological activities and distribution of plant saponins. *Journal Ethnopharmacol*. 94: 219-243.
- Subrata, A., L. M. Yusiati., dan A. Agus. 2005. Pemanfaatan tanin ampas teh terhadap efek defaunasi, parameter fermentasi rumen dan sintesis protein mikrobial secara *in vitro*. *Agrosains*. 18 (4) : 473-487.
- Tavendale, M. H., L. P. Meagher, D. Pacheco, N. Walker, G. T. Attwood, and S. Sivakumaran. 2005. Methane production from *in vitro* rumen incubations with *Lotus pedunculatus* and *Medicago sativa*, and effects of extractable condensed tannin fractions on methanogenesis. *Anim. Journal of Feed Animal Technology*. 123: 403-419.
- Thauer, R. K., A. K. Kaster, H. Seedorf, W. Buckel, and R. Hedderich. 2008. Methanogenic archaea: ecologically relevant differences in energy conservation. *Nature Reviews Microbiology*. 6: 579-591.
- Tillman, A. D., H. Hartadi., S. Reksohadiprojo., S. Prawirokusumo., and S. Lebdoesoekojo. 1998. *Ilmu Makanan Ternak Dasar*. Gadjah Mada University Press.
- Ushida, K., and J. P. Jouany. 1996. Methane Production associated with rumen-ciliated protozoa and its effect on protozoan activity. *Letters in Applied Microbiology*. 23: 129-132.
- Vincken, J. P., L. Heng., A. De Groot., and J. H. Gruppen. 2007. Saponins, and occurrence in the plant kingdom. *Phytochem*. 68: 275-297.
- Wallace, R. J., N. R. McEwan., F. M. McIntosh., B. Teferedegne., and C. N. Bold. 2002. Natural Product as manipulators of Rumen Fermentation. *Asian-Aus. J. Anim. Journal Feed Science and Technology*. 15 : 1458- 1468.
- Wang, Y., T.A. McAlliser, I. J. Yanke, Z. J. Xu, P. R. Cheeke and K.J. Cheng. 2011. In Vitro Effect Of Steroidal Saponins From *Yucca Schidigera* Extract On Rumen Microbes. *Journal Applied Microbiology*. 88 : 887-896.

- Wina, E., S. Muetzel., and K. Becker. 2005a. The impact of saponin containing plants materials on tuminant production. A Reviews Jurnal Agriculture Food Chemistry. 53 : 8093-8105.
- Wiseman, J., and W. J. A. Cole. 1990. Feed Stuff Evaluation. Butterworth. London.
- Yokoyama, M. T., and K. A. Johnson. 1993. Microbiology of the Rumen and Intestine in the Ruminant Animal: Digestive Physiology and Nutrition. D. C. Church, Edited by Prentice Hall. Englewood Cliffs.