

required for steers fed diets with 0 and 30 % of Napier to gain more weight due to the diets' high nutrient biomass. Hence, as the efficiency at which the nutrients are being utilized by the steers lowers, body weight gain thus growth is increases. Moreover, the FCR (5.21 kg/kg) of steers that were fed 30 % of Napier grass was comparable to that of steers reported by Mastika (2003), who obtained 5.08 kg/kg when feeding diet that contained 40 % Napier grass. The daily feed intake and final body weight of steers fed diet with 30 % of Napier grass were higher than that of steers fed the 60 % Napier grass diet, but comparable to that of those that were fed the control diet. Although the ADG of steers fed 60 % of Napier grass was low, it was rather high (0.17 kg/day), compared to the ADG of steers fed 60 % Napier grass recorded by Marsetyo *et al.* (2012). The ADG of the steers however, reduced to 0.31 kg/day when the 60 % Napier grass was supplemented with *Gliiricidia* (Marsetyo *et al.*, 2012). Antari *et al.* (2016) also reported low ADG of 0.18 kg, 0.26 kg and 0.11 kg/day on Ongole, Limousin-Ongole and Brahman, respectively, when fed sole Napier grass. Results in this study indicate that inclusion of Napier grass in fattening diets at 30 % did not perturb growth performance traits of the steers.

5.3. Rumen fermentation characteristics

Ruminal pH is influenced by the amount of fibre in the diet as well as the balance between the production of fermentation acids and the secretion of buffers (Krause *et al.*, 2002). The high pH in rumen digesta encourages the growth of cellulolytic microorganisms and the synthesis of acetate as a major product of fermentation with low proportions of propionate and butyrate. Rumen pH below 5.6 is regarded as a threshold for rumen acidosis (Nagaraja & Titgemeyer, 2007). The pH of the rumen digesta of steers in this study was similar across the treatment diets. The pH was between 6.6 and 6.7, which is considered optimum for the quality of cellulolytic microbes and VFA absorption (Kariuki *et al.*, 2001). Fibre digesting bacteria, better known as the cellulolytic bacteria, functions best at a pH of 6.2 – 6.8. Results in the current study show that inclusion of Napier grass in steers fattening diets did not affect the rumen pH negatively but enhanced the fiber-digesting bacteria. Our results are in concurrent with those of Kariuki *et al.* (2001) who reported rumen digesta pH that ranged from 6.6 to 6.8 in steers fed Napier grass with different inclusion levels (0%,10%, 20% and 30%) of *Desmodium*.

- Asizua, D. 2010. Effects of feeding system on performance of finishing Ankole cattle and Mubende goats. MSc, dissertation. Makerere University, Uganda.
- Aquino, D., Del Barrio, A., Trach, N.X., Hai, N.T., Khang, D.N., Toan, N.T. & Van Hung, N. 2020. Rice straw-based fodder for ruminants. In: Gummert, M., Hung, N., Chivenge, P., Douthwaite, B. (eds) Sustainable Rice Straw Management. Springer, Cham. pp. 111-129.
- Bajjalieh, N. 2012. Value proposition of soybean meal must grow. *Feedstuff.*, 84.
- Basson, A., Strydom, P.E., Marle-Koster, E., Webb, E.C & Frylinck, L. 2022. Sustained effects of muscle calpain system genotypes on tenderness phenotypes of South African beef bulls during ageing up to 20 days. *Anim.*, 12: 686.
- Baublits, R.T., Brown, A.H., Pohlman, F.W., Rule, D.C., Johnson, Z.B., Onks, D.O., Murrieta, C.M., Richards, C.J., Loveday, H.D., Sandelin, B.A. & Pugh, R.B. 2006. Fatty acid and sensory characteristics of beef from three biological types of cattle grazing cool-season forages supplemented with Soyhulls. *Meat Sci.*, 72: 100-107.
- Bayble, T., Melaku, S. & Prasad, N.K. 2007. Effect of cutting dates on nutritive value of Napier (*Pennisetum purpureum*) grass planted sole and in association with Desmodium (*Desmodium intortum*) or Lablab (*Lablab purpureus*). *Livest. Res. Rural Dev.*, 19: 27.
- Beauchemin, K.A., Jones, S.D.M., Rode, L. & Sewalt, V.J. 1997. Effects of fibrolytic enzyme in corn or barley diets on performance and carcass characteristics of feedlot cattle. *Can. J. Anim. Sci.*, 77: 645-653.
- Becker, T. 2000. Consumer perception of fresh meat quality: a framework for analysis. *Br. Food J.*, 102: 158 - 176.
- Beckett, L., Gleason, C.B., Bedford, A., Liebe, D., Yohe, T.T., Hall, M.B., Daniels, K.M. & White, R.R. 2020. Rumen volatile fatty acid molar proportions, rumen epithelial gene expression, and blood metabolite concentration responses to ruminally degradable starch and fibre supplies. *J. Dairy Sci.*, 104: 8857-8869.
- Berihun, M.L., Tsunekawa, A., Haregeweyn, N., Meshesha, D.T., Adgo, E., Tsubo, M., Masunaga, T., Fenta, A.A., Sultan, D. & Yibeltal, M. 2019. Exploring land use/land cover changes, drivers and their implications in contrasting agro-ecological environments of Ethiopia. *Land use Policy.*, 87: 1-15.

- Bogdan, A. V. 1977. Tropical pasture and fodder plants. Longman, pp. 475
- Bonvillani, A., Pena, F., De Gea, G., Gomez, G., Petryna, A. & Perea, J. 2010. Carcass characteristics of Criollo Cordobes kid goats under an extensive management system: Effects of gender and live weight at slaughter. *Meat Sci.*, 86: 651-659.
- Bosman, D.J. 2002. Cattle breeds and types for the feedlot. Chapter 6 in: Feedlot management. Ed Leeuw, K.J. Agricultural Research Council Animal Production Institute, Irene. pp. 84-90.
- Bowker, B. & Zhuang, H., 2015. Relationship between water-holding capacity and protein denaturation in broiler breast meat. *Poult. Sci. J.*, 94: 1657-1664.
- Braden, K.W. 2013. Converting muscle to meat: The physiology of rigor. In: The Science of Meat Quality; John Wiley Sons, Inc.: Hoboken, New Jersey, USA. pp. 79–97.
- Brewer, M.S., Jensen, A.A., Sosnicki, B., Fields, E., Wilson, M. & McKeith, F.K. 2002. The effect of pig genetics on palatability, colour and physical characteristics of fresh pork loin chops. *Meat Sci.*, 61: 249-256.
- Brogia, A. & Kapel, C. 2011. Changing dietary habits in a changing world: Emerging drivers for the transmission of foodborne parasitic zoonoses. *Vet. Paras.*, 182(1), 2-13.
- Brown, D., Ng`ambi, J.W. & Norris, D. 2016. Voluntary intake and palatability indices of Pedi goats fed different levels of *acacia karoo* leaf meal by cafeteria method. *Indian J. Anim. Res.*, 50: 41-47.
- Bureenok, S., Yuangklang, C., Vasupen, K., Schonewille, J.T. & Kawamoto, Y. 2012. The effects of additives in Napier grass silages on chemical composition, feed intake, nutrient digestibility and rumen fermentation. *Asian-Austral. J. Anim. Sci.*, 25:1248-1254.
- Christobal-Carballo, O. 2009. Management of heifer growth in dual-purpose cattle system in the low Huastreca region of Veracruz, Mexico. MSc, thesis. Cornell University.
- Casey, N.H. & Webb, E.C. 2010. Managing goat production for meat quality. *Small Rumin. Res.*, 89: 218-224.
- Castigliero, L., Armani, A., & Guidi, A. (2012). Meat color. *Handbook of meat and meat processing.*, 2: 81-106.

- Castillo-Gonzalez, A.R., Burrola-Barraza, M, E., Dominguez-viveros, J. & Chavez-Martinez, A. 2014. Rumen microorganism and fermentation. *Arch. Med. Vet.*, 46: 349-361.
- Cheema, U.B., Younas, M., Sultan, J.I., Virk, M.R., Tariq, M. & Waheed, A. 2011. Fodder tree leaves: an alternative source of livestock feeding. *Adv. Agric. Biotechnol.*, 2: 22-33.
- Chester-Jones, H. & DiCostanzo, A. 2012. Recommendations on nutrition and management of incoming feedlot cattle. Feedlot nutrition. Beef cattle. University of Minnesota, United State of America.
- Chilanga, F. 2020. Growth performance, carcass characteristics, meat quality and profitability of local Malawi goats under pen fattening conditions. MSc, thesis. Lilongwe University of Agriculture and Natural Resources.
- Chriki, S., Gardner, G.E., Jurie, C., Picard, B., Micol, D., Brun, J.P., Journaux, L. & Hocquette, J.F. 2012. Cluster analysis application identifies muscle characteristics of importance for beef tenderness. *BMC Biochem.*, 13: 29-39.
- Clayton, W.D., Govaerts, R., Harman, K.T Williamson, H. & Vorontsova, M., 2013. World checklist of Poacea. Richmond, UK: Royal Botanic Gardens, KEW.
- Cloete, S.W.P., Olivier, J.J., Sandenbergh, L & Snyman, M.A. 2014. The adaption of the South Africa sheep industry to new trends in animal breeding and genetics: A review. *South Afr. J. Anim. Sci.*, 44: 307-321.
- Cristobal-Carballo, O. 2009. Management of heifers and growth in dual-purpose cattle system in the low Huasteca region of Vegacruz, Mexico. MSc, thesis. Cornell University. Mexico.
- Chuang, W., Lin, L., Shih, H., Shy, Y., Chang, S. & Lee, T. 2021. The potential utilization of high-fiber agricultural by-products as monogastric animal feed and feed additives: A review. *Anim.*, 11: 2098.
- Cook, B.G., Pengelly, B.C., Brown, S.D., Donnelly, J.L., Eagles, D.A., Franco, M.A., Hanson, J., Mullen, B.F., Partridge, I.J., Peters, M. & Schultze-Kraft, R. 2005. Tropical forages ; An alternatives selection tool. CSIRO, PDI & F(Qld), CIAT and ILRI, Brisbane, Australia.
- Coyne, J.M., Evans, R.S. & Berry, D.P. 2019. Dressing percentage and the differential between the live weight and carcass weight in cattle are influenced by both genetic

and non-genetic factors. *J. Anim. Sci.* 97:1501-1512.

Culler, R.D., Parrish, F.C., Smith, G.C. & Cross, H.R. 1978. Relationship of myofibril fragmentation index to certain chemical, physical and sensory characteristics of bovine *longissimus* muscle. *J. Food Sci.*, 43: 1177-1180.

Delgado, C., Rosegrant, M., Steinfeld, H., Ehui, S. & Courbois, C. 2001. Livestock to 2020: The next food revolution. *Outlook on Agricul.*, 30: 27-29.

Department of Agriculture Forestry and Fisheries (DAFF). 2014. Abstract of agricultural statistics, department of agriculture, forestry and fisheries: Pretoria, South Africa.

Department of Agriculture Forestry and Fisheries (DAFF). Abstract of agricultural statistics, department of agriculture, forestry and fisheries: Pretoria, South Africa.

Devine, C.E., Wahlgren, M. & Tornberg, E. 1999. Effect of rigor temperature on muscle shortening and tenderization of restrained and unrestrained beef *m. longissimus thoracis et lumborum*. *Meat Sci.*, 51: 61-72.

de Veth, M.J. & Kolver, E.S. 2001. Digestion of ryegrass pasture in response to change in pH in continuous culture. *J. Dairy. Sci.*, 84: 1449-1457.

Dijkstra, J., Boer, H., Van Bruchem, J., Bruining, M. & Tamminga, S. 1993. Absorption of volatile fatty acids from the rumen of lactating dairy cows as influenced by volatile acid concentration, pH, and rumen liquid volume. *Br. J. Nutr.*, 69: 385-396.

Drake, D. 2004. Understanding and improving beef cattle carcass quality. University of California, Division of Agriculture and natural resource. ANR Publication No. 8130. pp 23.

Dreyer, J.H., Van Rensburg, A.J.J., Naude, R.T., Gouws, P.J. & Stiemie, S. 1979. The effect of chilling temperatures and mode suspension of beef carcasses on sarcomere length and meat tenderness. *S. Afr. J. Anim. Sci.*, 9: 1-9.

Duckett, S.K. 2001. Factors affecting the palatability of lamb meat. *Meat Sci.*, 49: 19-26.

Duckett, S.K., Neel, J.P.S., Lewis, R.M., Fontenot, J.P. & Clapham, W.M. 2013. Effects of forage species or concentrate finishing on animal performance, carcass and meat quality. *J. Anim. Sci.*, 91: 1454-1467.

- Duke, J.A. 1983. Handbook of energy crops. Centre for new crops and plant products, Purdue University. USA, West Lafayette, Indiana. pp1983.
- Eargerman, B.A., Clydesdale, F.M. & Francis, F.J. 1978. Determination of fresh meat colour by objective methods. *J. Food. Sci.*, 42: 707-710.
- Eikelenboom, G., Walstra, P., Huiskes, J.H. & Klont, R.E. 2004. Species of meat animals: Pigs. *Encycl. Meat Sci.*, 1284-1291
- Erdman, R.A. 1988. Dietary buffering requirements of the lactating cow: A review. *J. Dairy Sci.*, 71: 3246-3266.
- Esterhuizen, J., Groenewald, I.B., Strydom, P.E. & Hugo, A. 2008. The performance and meat quality of Bonsmara steers raised in a feedlot, on conventional pastures or on organic pastures. *S. Afr. J. Anim. Sci.*, 38: 303-314.
- Eyoh, G.D., Udo, M.D. & Edet, C.P. 2019. Growth performance and carcass characteristics of West African dwarf bucks fed different forms of processed Guinea grass (*Panicum Maximum*). *Curren. Agric. Res. J.*, 7: 254-260.
- Farrell, G., Simons, S.A. & Hillocks, R.J. 2002. Pests, diseases and weeds of Napier grass, *Pennisetum purpureum*: A review. *Int. J. Pest Manage.*, 48: 39-48.
- FAO. 2015. In Food and Agriculture organization of the United Nations online.
- FAO. 2019. Measuring and modelling soil carbon stocks and stock changes in livestock production systems – A scoping analysis for the LEAP work stream on soil carbon stock changes.
- Farghaly, M.M., Youssef, I.M.I., Radwan, M.A. & Hamdon, H.A. 2022. Effect of feeding *Sesbania sesban* and reed grass on growth performance, blood parameters, and meat quality for growing of lambs. *Trop. Anim. Health., Prod.* 54: 1-13.
- Faustman, C. & Suman, S.P. 2017. *The eating quality of meat: Color* In: Lawries Meat Science. Woodhead publishing, Cambridge, England.
- Fekede, F., Getnet, A., Lulseged, G., Tedesse, T.T. & Muluneh, M. 2004. Evaluation of Napier grass-vetch mixture to improve herbage yield in the Central highlands of Ethiopia. 13th ESAP proceedings, Ethiopian Society of Animal Production.

- Firkins, J. L., W. P. Weiss, M. L. Eastridge, and B. L. Hull. 1990. Effects of feeding fungal culture extract and animal-vegetable fat on degradation of hemicellulose and on ruminal bacterial growth in heifers. *J. Dairy Sci.*, 73:1812–1822.
- Ferreira, D.J., Zanine, A.M., Lana, R.P., Ribeiro, M.D., Alves, C.R. & Mantovani, H.C. 2014. Chemical composition and nutrient degradability in elephant grass silage inoculated with *Streptococcus bovis* isolated from the rumen. *Annal. Brazil. Acad. Sci.*, 86: 465-473.
- Fitzhugh, H A. 1998. Competition between Livestock and Mankind for Nutrients: Let Ruminants Eat Grass', in J C Waterlow and others (ed.), *Feeding a World Population of More Than Eight Billion People: A Challenge to Science* (New York, 1998; online edn, Oxford Academic, 12 Nov. 2020), Accessed 20 Sept. 2022.
- Folch, J., Lees, M. & Sloane-Stanley, H. 1957. A simple method for the isolation and purification of total lipids from animal tissue. *J. Biol. Chem.*, 226: 497- 509.
- France, J. & Dijkstra, J. 2005. Volatile fatty acid production. in *Quantitative Aspects of Ruminant Digestion and Metabolism*. J. Dijkstra, J. M. Forbes, and J. France, ed. CAB International. pp. 157-175.
- Franco, D., Vazquez, J.A. & Lorenzo, J.M. 2014. Growth performance, carcass and meat quality of the Celta pig crossbred with Duroc and Landrace genotypes. *Meat Sci.*, 96: 195-202.
- Frylinck, L., & Heinze, P. H. 2003. Evaluation of meat tenderness of indigenous South African and other beef breeds. In *Consistency of quality: abstracts and proceedings of the 11th International Meat Symposium*, Centurion, South Africa, 29-30 January, 2003 pp. 28-47. Agricultural Research Council (ARC). Proc. 11th International Meat Symposium 3-13.
- Frylinck, I. 2013. Investigation into the optimum design of feedlot facilities to maximize profitability and functionality. University of Pretoria, South Africa.
- Fukagawa, S. & Ishii, Y. 2018. Grassland establishment of dwarf Napier grass (*Pennisetum purpureum* Schumach) by planting of cuttings in the winter season. *Agron.*, 8: 1- 10.
- Gandi, B.R., Muhammed, S.A., Makama, R.S., Aliyu, Z.I. & Ibrahim, Y. 2020. Sensory evaluation and microbial status of meat floss from West African Dwarf goats fed

- graded levels of broiler litter. *Sci. Wor. J.*, 15: 139-144.
- Gautam, D.P., Rahman, S., Borhan, M.S. & Engel, C. 2016. The effect of feeding high fat diet to beef cattle on manure composition and gaseous emission from a feedlot pen surface. *J. Anim. Sci. Technol.*, 58:22.
- Geay, Y., Bauchart, D., Hocquette, J.F. & Culioli, J. 2001. Effect of nutritional factors on biochemical, structural and metabolic characteristics of muscles in ruminants, consequences on dietetic value and sensorial qualities on meat. *Reprod. Nutr. Dev.*, 41: 1-26.
- Geletu, U.S., Usmael, M.A., Mummied, Y.Y. & Ibrahim, A.M. 2021. Quality of cattle meat and its composition constituents. *Vet. Med. Int.*, 2021:1-9.
- Gemechu, T., Girma, M. & Eshutu, M. 2021. Carcass and non-carcass yield characteristics of horro sheep fed elephant grass (*Pennisetum purpureum*) ensiled with different proportion of dolichos lablab (*lablab purpureus*). *Asian J. Sci. Technol.*, 12: 11553-11560.
- Genstat for Windows. 2000. Committee of the Statistic Department. Release 4.2 5th ed. Roth Amsted Experimental Station, Oxford, UK: Claredon Press.
- Getnet, A. & Gezahagn K. 2012. Seed Research and Development of Perennial Forage Crops in the Central Highlands. In: Getnet Assefa, Mesfin Dejene, Jean Hanson, Getachew Animut, Solomon Mengistu & Alemayehu Mengistu (ed). Forage Seed Research and Development in Ethiopia. Proceedings of workshop held on 12- 14 May, 2011 at EIAR, Addis Ababa, Ethiopia. ISBN: 978-99944-53-84-9.
- Ghimere, A., Frunzo, L., Pirozzi, F., Trably, E., Escudie, R., Lens, P.N.L. & Esposito, G. 2015. A review on dark fermentative biohydrogen production from organic biomass: process parameters and use of by-products. *Appl. Energ.*, 144: 73-95.
- Godde, C.M., Mason-D`Croz, D., Mayberry, D.E., Thornton, P.K. & Herrero, M. 2021. Impacts of climate change on the livestock food supply chain: a review of the evidence. *Global Food Secur.*, 28: 100488.
- Gigli, S., Failla, S., Iacurto, M., Contò, M., Sañudo, C., Olleta, J.L., Albertí, P., Panea, B., Hocquette, J.F., Ertbjerg, P. & Christensen, M., 2006. Performance at slaughter and beef quality characteristics of some Mediterranean beef breeds compared to Central

- and North European breeds (GemQual EU Project). In *Proceedings of Seminar of the Scientific Professional Network on Mediterranean Livestock Farming (RME)*. pp. 173-82).
- Giron, H.C. 1973. Comparison between dry ashing and wet digestion in the preparation of plan material for atomic absorption analysis. *Atomic absorption Newsletter*, 12: 28-29.
- Hamling, A. E., Jenschke, B. E. & Calkins, C. R. 2008. Effects of aging on beef chuck and loin muscles enhanced with ammonium hydroxide and salt. *J. Anim. Sci.*, 86: 1200-1204.
- Hamoen, J.R., Vollebregt, H.M. & van der Sman, R.G. 2013. Prediction of the time evolution of pH in meat. *Food Chem.*, 141: 2363–2372.
- Hattakum, C., Kanjanapruthipong, J., Nakthong, S., Wongchawalit, J., Piamya, P. & Sawanon, S. 2019. Pineapple stem by-product as a feed source for growth performance, ruminal fermentation, carcass and meat quality of Holstein steers. *S. Afr. J. Anim. Sci.*, 49: 147-155
- Hegarty, P.V.J. & Naude, R.T. 1970. The accuracy of measurement of individual skeletal muscle fibre separated by a rapid technique. *Lab. Pract.*, 19: 161-163.
- Heinze, P.H. & Bruggemann, 1994. Ageing of beef: Influence of two ageing methods on sensory properties and myofibrillar proteins. *Sci. Aliment.*, 14: 387–399
- Hernandez-Sanabria, E., Goonewardene, L.A., Wang, Z., Durunn, O.N., Moore, S.S. & Guan, L.L. 2012. Impact of feed efficiency and diet on adaptive variations in the bacterial community in the rumen fluid of cattle. *Appl. Environ. Microbiol.*, 78: 1203-1214.
- Hoffman, L. C., Muller, M., Cloete, S. W. P. & Schmidt, D. 2003. Comparison of six crossbred lamb types: sensory, physical and nutritional meat quality characteristics. *Meat Sci.*, 65: 1265- 274.
- Hughes, J.F., Clarke, P., Purslow, P. & Warner, R. 2017. High pH in beef *longissimus thoracis* reduces muscle fibre transverse shrinkage and light scattering, which contributes to the dark colour. *Food Res. Int.*, 101: 228-238.

- Hughes, J., Clarke, F., Purslow, P. & Warner, R. 2018. A high rigor temperature, not sarcomere length, determines light scattering properties and muscle colour in beef *M sternomandibularis* meat and muscle fibres. *Meat Sci.*, 145:1-8.
- Hvelplund, T., & Madsen, J. 1990. A study of the quantitative nitrogen system in the gastro-intestinal tract, and the new protein evaluation system for ruminants. The AAT intestinal tract, and the new protein evaluation system for ruminants. The AAT PBV system. Institute of Animal Science. The Royal Veterinary and Agricultural University, Copenhagen. Publication name.
- Hwang, I.H. & Thompson, J.M. 2001. The interaction between pH and temperature decline early postmortem on the calpain system and objective tenderness in electrically stimulated beef *longissimus dorsi* muscle. *Meat Sci.*, 58: 167–174.
- Irie, M., Izumo, A. & Mohri, S. 1996. Rapid method of determining water-holding capacity in meat using video image analysis and simple formulae. *Meat Sci.*, 42: 95-102.
- Isah, O.A., Oguntuyo, S.A., Dawodu, R. O., Diya, O.O., Afolabi, M.O. & Omoniyi, L.A. 2013. Feed utilization, rumen parameters, and microbial profile of goats fed different tropical browse plants with *Pennisetum purpureum* as basal diet. *The Pacific J. Sci. Technol.*, 14: 397-405.
- Jama, N., Muchenje, V., Chimonyo, M., Strydom, P.E., Dzama, K. & Raats, J.G. 2008. Cooking loss components of beef from Nguni, Bonsmara and Angus steers. *Afr. J. Agric. Res.*, 3: 416-420.
- Jayanegara, A., Dewi, S.P. & Ridla, M. 2016. Nutrient content, protein fractionation, and utilization of some beans as potential alternatives to soybean for ruminant feeding. *Med. Peternak.*, 39: 195-202.
- Kabirizi, J., Muyekho, F., Mulaa, M., Msangi, R., Pallangyo, B., Kawube, G., Zziwa, E., Mugerwa, S., Ajanga, S. & Lukwago, G. 2015. Napier grass feed resource: production, constraints and implications for smallholder farmers in Eastern and Central Africa; the Eastern African agricultural productivity project: Naivasha, Kenya. EAAPP.
- Kadim I. T., Mahgoub O., Ai-Kindi A., Ai-Marzooqi W. & Ai-Saqri N. M. 2006. Effects of transportation at high ambient temperatures on physiological responses, carcass and meat quality characteristics of three breeds of Omani goats. *Meat Sci.*, 73: 626-634.

- Kaitho, R.J. & Kariuki, J.N. 1998. Effects of *Desmodium*, *Sesbania* and *Calliandra* supplementation on growth of dairy heifers fed Napier grass. *Asian-Australian J. Anim. Sci.*, 11: 680-684.
- Karuiki, J.N., Tamminga, S., Gachui, C.K., Gitau, G.K. & Muia, J.M.K. 1999. Performance of Sahiwal and Friesian heifers fed on Napier grass supplemented with graded levels of Lucerne. *S Afr. J. Anim. Sci.*, 29: 1-10.
- Kariuki, J.N., Tamminga, S., Gachui, C.K., Gitau, G.K. & Muia, J.M.K. 2001. Intake and rumen degradation in cattle fed Napier grass (*Pennisetum purpureum*) supplemented with various levels of *Desmodium intortum* and *Ipomoea batatas* vines. *S. Afr. J. Anim. Sci.*, 31: 149-157.
- Kandeepan, G., Mendiratta, S.K., Shukla, V. & Vishnuraj, M.R. 2013. Processing characteristics of buffalo meat: A review. *J. Meat Sci. Technol.*, 1: 01-11.
- Kellems, R.O & Church, D.C. 1998. Livestock feeds and feeding. 4th ed, Prentice-Hall Inc, New Jersey, USA. pp. 537.
- Krzywicki, K. 1979. Assessment of relative content of myoglobin, oxymyoglobin and metmyoglobin at the surface of beef. *Meat Sci.*, 3: 1-10.
- Koohmaraie M. & Geesink, G.H. 2006. Contribution of postmortem muscle biochemistry to the delivery of consistent meat quality with particular focus on the calpain system. *Meat Sci.*, 74: 34-43.
- Kumar, A., Kebede, E. & Kassaye, E. 2010. Evaluation of quality of beef produced and sold in parts of Tigray region of Ethiopia. *Trop. Anim. Health Prod.*, 42: 445-449.
- Kunene, N., Wilson, R.A.C. & Myeni, N.P. 2002. The use of trees, shrubs and herbs in livestock production by communal farmers in Northern KwaZulu-Natal, South Africa. *Afr. J. Rang. Forage Sci.*, 20: 271-274.
- Kisitu, B., 2010. Growing fodder for livestock: Calliandra and Elephant grass. TECA-FAO.
- Krause, K.M., Combs, D.K. & Beauchemin, K.A., 2002. Effects of forage particle size and grain fermentability in midlactation cows. I. Milk production and diet digestibility. *J. Dairy Sci.*, 85: 1936-1946.
- Krueger. C. 2021. Feeding supplemental fat to beef cattle. Is feeding supplemental fat to the different classes of cattle cost-effective? Beef solutions. Angus Beef Bulletin Extra, 14.

- Lamega, S.A., Komainda, M., Hoffmann, M.P., Odhiambo, J.J., Ayisi, K.K. & Isselstein, J. 2021. Closing feed gaps by winter forage production in Limpop: What is the potential? pp. 1-3.
- Latimori, N.J., Kloster, A.M., Garcia, P.T., Carduza, F.J., Grigioni, G. & Pensel, N.A. 2008. Diet and genotype effects on the quality index of beef produced in the Argentina Pampeana region. *Meat Sci.*, 79: 463-469.
- Lawrie, R.A. & Ledward, D. 2006. The conversion of muscle to meat. Lawrie`s meat science. 7th ed. Woodhead publishing Limited, Cambridge, UK. pp. 128-155.
- Lebret, B., Ecolan, P., Bonhomme, N., Meteau, K. & Prunier, A. 2015. Influence of production system in local and conventional pig breeds on stress indicators at slaughter, muscle and meat traits and pork eating quality. *Anim.*, 9:1404-1413.
- Lee, J.H., Kouakou, B. & Kannan, G. 2008. Chemical composition and quality characteristics of chevon from goats fed three different post-weaning diets. *Small Rumin. Res.*, 75: 177-184.
- Leng, R.A. 1990. Factor affecting the utilization of poor quality forages by ruminants particularly under tropical conditions. *Nutri. Res. Reviews.*, 3: 277-303.
- Lenne, J.M. & Thomas, D. 2006. Integrating crop-livestock research and development in Sub-Saharan Africa. Option, imperative or impossible. *Outlook on Agric.*, 35: 167-175.
- Leygonie, C., Britz, T.J. & Hoffman, LC. 2012. Impact of freezing and thawing on the quality of meat. *Meat Sci.*, 91: 93-98.
- Lindberg, E. 2014. Fiber effects in nutrition and gut health in pigs. *J. Anim. Sci. Biotech.*, 5: 15-23.
- Lima, N.L.L., Ribeiro, C.R.D.F., S.A, H.C.M.D., Leopoldino-Junior, I., Cavalcanti, L.F.L., Santana, R.A.V., Furusho-Garcia, I.F. & Pereira, I.G. 2017. Economic analysis, performance and feed efficiency in feedlot lambs. *Rev. Bras. Zootec.*, 46: 821-829.
- Lowe, A.J., Thorpe, W., Teale, A. & Hanson, J. 2003. Characterisation of germplasm accessions of Napier grass (*Pennisetum purpureum* and *P. purpureum* × *P. glaucum* hybrids) and comparison with farm clones using RAPD. *Genet Resour Crop Evol.*, 50: 121-132.

- Makesha, Y., Tegegne, A., Yami, A. & Umunna, N.N. 2002. Evaluation of non-conventional agro-industrial by-products as supplementary feeds for ruminants: in vitro and metabolism study with sheep. *Small Rumin. Res.*, 44: 25-35.
- Makkar, H.P.S. 2018. Feed demand landscape and implications of foot-not feed strategy for food security and climate change. *Anim.*, 12: 1744-1754.
- Malebana, I.M.M., Nkosi, B.D., Erlwanger, H.H. & Chivandi, E. 2018. A comparison of the proximate, fibre, mineral content, amino acid and the fatty acid profile of marula (*Sclerocarya Birrea Caffra*) nut and soybean (*Glycine max*) meals. *J. Sci. Food Agric.*, 98:1381-1387.
- Maleko, D., Mwilawa, A., Msalya, G., Pasape, L. & Mtei, K. 2019. Forage growth, yield and nutritional characteristics of four varieties of Napier grass (*Pennisetum purpureum* Schumach) in the West Usambara highlands, Tanzania. *Sci. Afr.*, 6 e00214.
- Mancini, R.A., Hunt, M.C. & Kropf, D.H. 2003. Reflectance at 610 nanometers estimates oxymyoglobin content on the surface of ground beef. *Meat Sci.*, 64: 157-162.
- Mancini, R.A. 2013. The science of meat quality. Meat color. pp. 177-198.
- Mapiye, C., Chimonyo, M., Dzama, K., Muchenje, V. & Strydom, P.E. 2009. Meat quality of Nguni steers supplemented with *Acacia Karoo* leaf meal. *Meat Sci.*, 84: 621-627.
- Mapiye, C., Chimonyo, M. & Marufu, M.C. 2011. Utility of *Acacia karoo* for beef production in Southern African smallholder farming systems: A review. *Anim. Feed Sci. Technol.*, 164: 135-146.
- Mastika, I.M. 2003. Feeding strategies to improve the production performance and meat quality of Bali cattle (*Bos sondaicus*). In: Entwistle, K., Lindsay, D. ed. Strategies to improve Bali cattle in Eastern Indonesia. Proceedings of a workshop 4-7 February 2002, Bali, Indonesia. ACIAR Proceedings No. 110. pp. 10-13.
- Maragoni, F., Corsello, G., Gricelli, C., Ferrara, N., Ghiselli, A., Lucchin, L. & Poli, A. 2015. Role of poultry meat in in a balanced diet aimed at maintaining health and wellbeing: An Italian consensus document. *Food Nutri. Res.*, 59:1-11.
- Marais, J.P. 2001. Factors affecting the nutritive value of kikuyu grass (*Pennisetum clandestinum*) – a review. *Trop. Grassl.*, 35: 65-84.

- Marais, G. L. 2007. Evaluation of genetic and physiological parameters associated with meat tenderness in South African feedlot cattle. MSc, thesis. University of Pretoria, South Africa.
- Marris, P.D. 2020. Meat science. An introductory text. CABI publishers, Bristol. pp. 20-37.
- Marsetyo, D.S., Quigley, S.P., McLennan, S.R. & Poppy, P. 2012. Live weight gain and feed intake of weaned Bali cattle fed a range of diets in Central Sulawesi, Indonesia. *Anim. Prod. Sci.*, 52: 630-635.
- Mbatha, C.N. 2021. Livestock production and marketing for small emerging farmers in South Africa and Kenya: Comparative lessons. *S. Afr. J. Agric. Ext.*, 49: 141-161.
- McCann, J.C., Wickersham, T.A. & Looor, J.J. 2014. High-throughput Methods Redefine the Rumen Microbiome and Its Relationship with Nutrition and Metabolism. *Bioinform. Biol. Insights.*, 8: 109-125.
- McDonald, P., Edwards, R.A., Greenhalgh, J.F.D., Morgan, C.A. & Wilkinson, R.G. 2010. Animal Nutrition. 7th ed. Harlow, UK, Pearson Education. pp. 405-460.
- Meissner, H.H., Scholtz, M.M. & Palmer, A.R. 2013. Sustainability of the South African Livestock Sector towards 2050 Part 1: Worth and impact of the sector. *S. Afr. J. Anim. Sci.*, 43: 292–297.
- Meng, J., Ntambo, M., Luo, L., Huang, M., Fu, H. & Gao, S. 2019. Molecular identification of *Xanthomonas albilineans* infecting elephant grass (*Pennisetum purpureum*) in China. *Crop Protect.*, 124. 104853.
- Miegoue, E., Tendonkeng, F., Ngouopo, N.M., Ntsafack, P., Mouchili, M., Nkana, J.G.K. & Pamo, T.E. 2018. Reproductive and pre-weaning growth performance of Guinea Pigs (*Cavia Porcellus* L.) fed on *Panicum Maximum* or *Pennisetum Purpureum*. *Int. J. Anim. Sci.*, 2: 1-6.
- Minson, D.J. & Milford, R. 1967. The voluntary intake and digestibility of diets containing different proportions of legume and mature pangola grass (*Digitaria decumbens*). *Austr. J. Exper. Agric. Anim. Husb.*, 7: 545-551.
- Miller, M.F., Carr, M.A., Ramsey, C.B., Crockett, K.L. & Hoover, L.C. 2001. Consumer thresholds for establishing the value of beef tenderness. *J. Anim. Sci.*, 79: 3062–3068.

- Mirón, I.J., Linares, C. & Diaz, J. 2023. The influence of climate change on food production and food safety. *Environ. Res.*, 216: 114674.
- Modika, K.Y. 2019. Visual assessment of meat surface structure and meat colour to predict beef tenderness between five South African beef breeds. PhD, thesis. University of Pretoria, South Africa.
- Mohamed, R. & Chaudhry, S. 2008. Methods to study degradation of ruminant feeds. *Nutr. Res. Rev.*, 21: 68-81.
- Mogotsi, K, M. Koobonye, M., Galesekwe, K. & Odubeng, M. 2020. Adoption of Napier Grass [*Cenchrus purpureus* (Schumach.) Morrone] among livestock farmers in Botswana: Challenges and Future Prospects. *J. Agric. Ecol. Res. Int.*, 21: 16-28.
- Moholisa, E., Strydom, P.E. & Hugo, A. 2018. The effect of beef production system on proximate composition and fatty acids profile of three beef muscles. *S. Afr. J. Anim. Sci.*, 48: 295-306.
- Molefe, K. & Mwanza, M. 2020. Effects of mineral supplementation on reproductive performance of pregnant crossbreed Bonsmara cows: An experimental study. *Reprod. Domes. Anim.*, 55: 301-308.
- Morton, J.D., Bickerstaffe, R., Kent, M.P., Dransfield, E. & Keeley, G.M. 1999. Calpain-calpastatin and toughness in M. longissimus from electrically stimulated lamb and beef carcasses. *Meat Sci.*, 52: 71–79.
- Mosimanyana, K.G. 2016. The effect of freezing and post mortem ageing on beef quality. MSc, Dissertation. University of Pretoria, South Africa.
- Moyo, M., Adebayo, R.A. & Nsahlai, I.V. 2019. Effects of diet and roughage quality, and period of the day on diurnal feeding behavior patterns of sheep and goats under subtropical conditions. *Asian-Australas. J. Anim. Sci.*, 32: 675.
- Mpala, B. 2020. Investigating carcass characteristics, meat quality and ageing effects on physicochemical attributes, lipid oxidation, and degradation of muscle proteins in mature beef and dairy cull cows. MSc, dissertation. University of Fort Hare, South Africa.

- Msiza, N.H., Ravhuhali, K.E., Mokoboki, H.K., Mavengahama, S. & Motsei, L.E. 2020. Ranking Species for Veld Restoration in Semi-Arid Regions Using Agronomic, Morphological and Chemical Parameters of Selected Grass Species at Different Developmental Stages under Controlled Environment. *Agron.*, 11: 52.
- Mthethwa, N. 2018. Response in antioxidant activity and shelf life of meat from broilers fed on incremental levels of *Vachellia tortilis* leaf meal. MSc, dissertation. University of KwaZulu-Natal, South Africa.
- Muchenje, V., Dzama, K., Chimonyo, M., Raats, J.G. & Strydom, P.E. 2008. Meat quality of Nguni, Bonsmara and Aberdeen Angus steers raised on natural pasture in the Eastern Cape, South Africa. *Meat Sci.*, 79: 20–28.
- Muchenje, V., Dzama, K., Chimonyo, M., Strydom, P.E., Hugo, A. & Raats, J.G. 2009. Some biochemical aspects pertaining to beef eating quality and consumer health: A review. *Food Chem.* 112: 279–289.
- Muia, J.M.K , Tamminga, S. & Mbugua, P.N., 2000. Effect of supplementing napier grass (*Pennisetum purpureum*) with sunflower meal or poultry litter-based concentrates on feed intake, live-weight changes and economics of milk production in Friesian cows. *Livest. Prod. Sci.*, 67: 89-99.
- Muktar, M.S., Teshome, A., Hanson, J., Negawo, A.T., Habte, E., Entfellner, J.D., Lee, K. & Jones, C.S. 2019. Genotyping by sequencing provides new insights into the diversity of Napier grass (*Cenchrus purpureus*) and reveals variation in genome-wide LD patterns between collections. *Sci. Rep.*, 9:6936.
- Mulaudzi, A. 2019. Assessment of growth performance, haemo-biochemistry and meat quality of Japanese quails fed on *Moringa oleifera*. MSc, dissertation. North West University, South Africa.
- Mummed, Y.Y. & Webb, E.C. 2019. Carcass weights, meat yield and meat cuts from Arado, Boran, Barka, Raya cattle breeds in Ethiopia. *J. Agric. Sci.*, 11: 45-51.
- Mutumura, M., Ebong, C., Rao, I.M. & Nsahlai, I.V. 2018. Effects of supplementation of *Brachiaria brizantha* cv. Piata and Napier grass with *Desmodium distortum* on feed intake, digesta kinetics and milk production in crossbred dairy cows. *Anim. Nut.*, 4: 222-227.

- Murray, A.C. 2001. Reducing losses from farm gate to packer: A Canadian's perspective. In: Proceedings of the first International virtual conference on pork quality, Concordia, Brazil, 72-84.
- Mwangi, F.W., Charmley, E., Gardiner, C.P., Malau-Aduli, B.S., Kinobe, R.T. & Malau-Aduli, A.E.O. 2019. Diet and genetic influence beef cattle performance and meat quality characteristics. *Foods.*, 8: 648.
- Myer, R.O. 2003. Alternative feeds for beef cattle. University of Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, EDIS. Gainesville. pp. 1-6.
- Nagaraja, T.G. & Titgemeyer, E.C. 2007. Ruminant acidosis in beef cattle: The current microbiological and nutritional outlook. *J. Dairy Sci.*, 90:17-38.
- National Research Council (NRC). 2001. Nutrient requirements of dairy cattle, 7th ed. National Academic Press, Washington, D.C. pp. 1-347.
- National Research Council (NRC). 2007. Nutrient requirements of small ruminants: Sheep, goats, cervids and new world camelids. National Academy Press. Washington DC. USA. pp. 246
- Negawo, A.T., Teshome, A., Kumar, A., Hanson, J. & Jones, C.S. 2017. Opportunities for Napier grass (*Pennisetum purpureum*) improvements using molecular genetics. *Agron.*, 7: 1-21.
- Neethling, N.E., Suman, S.P., Sigge, G.O. & Hoffman, L.C. 2017. Muscle specific colour stability of blesbok (*Damaliscus pygargus phillipsi*) meat. *Meat Sci.*, 119:69-79.
- Nguyen, H.Q. 2014. Productive performance, rumen indices and meat quality of concentrate-supplemented goats in Vietnam. PhD, thesis. University of Tasmania, Vietnam.
- Nguyen, D.V., Nguyen, O.C. & Malau-Aduli, A.E.O. 2021. Main regulatory factors of marbling level in beef cattle. *Vet. Anim. Sci.*, 14: 100219.
- Ningal, N.L. 2020. Napier Grass Rumen Degradability in Sacco in Goats (*Capra hircus aegagrus*) Supplemented with Different Sources and Amount of Dietary Fats. *J. Agric. Chem. Environ.*, 9: 177-194.
- Njoka-Njiru, E. N., Njarui, M. G., Abdulrazak, S. A. & Mureithi, J. G. 2006. Effect of intercropping herbaceous legumes with Napier grass on dry matter yield and nutritive value of the feedstuffs in semi-arid region of eastern kenya. *Agric. trop. subtrop.*, 39:

255-267.

- Nkosi, B.D., Phenya, J.S.M., Malebana, I.M.M., Muya, M.C. & Motiang, M.D. 2019. Nutrient evaluation and ruminal degradation of dry matter and protein from amarula (*Sclerocarya birrea*), macadamia (*integrifolia*) and baobab (*Adansonia digitate L.*) oilcakes as dietary supplements for ruminants. *Trop. Anim. Health Prod.*, 51:1981-1988.
- Nkosi, B.D., Seshoka, M.L., Fourie, P.J., Kanengoni, A.T., Malebana, I.M.M. & Thomas, R.S. 2020. Dietary enzyme addition on the growth performance and carcass characteristics of pig fed diets containing avocado oil cake silage. *Trop. Anim. Health Prod.*, 52: 2945-2953.
- Novakovic, S. & Tomasevic, I. 2017. A comparison between Warner-Bratzler shear force measurement and texture profile analysis of meat and meat products: A review. *Earth Environm. Sci.*, 85:1-6.
- Nurhayu, A., Saenab, A., Ella, A., Ishak, A.B.L. & Qomariyah, N. 2021. The effects of elephant grass silage combined with indigofera sp. on the performance of Bali cattle. *J. Anim. Health. Prod.*, 9: 229-235.
- Nyambati, E.M., Muyekho, F.N., Onginjo, E. & Lusweti, C.M. 2010. Production characterization and nutritional quality of Napier grass (*Pennisetum purpureum* (Schum)) cultivars in Western Kenya. *Afr. J. Plant Sci.*, 4: 496-502.
- Okoruwa, M.I. & Okunlola, D. 2017. Performance, carcass traits and meat quality evaluation of sheep fed diets containing Napier grass and graded levels of cocoa pod husk with soursop pulp meals. *J. Agric. Sci.*, 5: 74.
- Orekele, C.O., Ukachukwu, S.N. & Umesiobi, D.O. 2008. Effect of dietary inclusion of composite cassava (*Manihot esculanta*) meal on egg production characteristics of laying hens. *J. Appl. Anim. Sci.*, 33: 68-72.
- Pandit, N.P., Shrestha, M.K., Yi, Y., Diana, J.S. & Rampur, C. 2004. Polyculture of grass carp and Nile tilapia with Napier grass as the sole nutrient input in the subtropical climate of Nepal. In Proceedings of the 6th ed. Symposium on Tilapia in Aquaculture, Manila, Philipines. pp. 1-16.

- Pearce, K.L., Rosenvold, K., Andersen, H.J. & Hopkins, D.L. 2011. Water distributions and mobility in meat during the conversion of muscle to meat and ageing and the impacts on fresh meat quality attributes. A review. *Meat Sci.*, 89: 111-124.
- Pophiwa, P., Webb, E. C. & Frylinck, L. 2017. Carcass and meat quality of indigenous and Boer goats of South Africa under electrical stimulation or delayed chilling conditions. *J. Anim. Sci.*, 47:107-114.
- Premaratne, S. & Premalal, G.G.C. 2006. Hybrid Napier (*Pennisetum purpureum* X *Pennisetum americanum*) VAR. CO-3: A resourceful fodder grass for dairy development in Sri Lanka. *J. Agri. Sci.*, 2: 22-33.
- Preston, T.R. & Leng, R.A. 1987. Matching ruminant production systems with available resources in the tropics and sub-tropics. Penambul books, Australia. pp. 265.
- Purbowati, E., Lestari, C.M.S., Adiwintarti, R., Restitrisnani, V., Mawati, S., Purnomoadi, A. & Rianto, E. 2021. Productivity and carcass characteristics of lambs fed fibrous agricultural wastes to substitute grass. *Vet. World.*, 214: 1559-1563.
- Ra, K., Shiotsu, F., Abe, J. & Morita, S. 2012. Biomass yield and nitrogen use efficiency of cellulosic energy crops for ethanol production. *Biom. Bioener.*, 37: 330-334.
- Ragni, M., Colona, M.A., Lestingi, A., Tarricone, S., Giannico, F., Marsico, G & Facciolongo, A.M. 2018. Effects of protein sources on performance, carcass composition, blood parameters and meat quality in Charolais heifers. *S. Afr. J. Anim. Sci.*, 48: 683-694.
- Rahman, M.M., Abdullah, R.B., Khadijah, W.E.W., Nakagawa, T. & Akashi, R. 2015. Feed intake and growth performance of goats fed with Napier grass and oil palm frond supplemented with soya waste. *J. Appl. Anim. Res.*, 43: 256-260.
- Rambau, M.D., Fushai, F. & Baloyi, J.J. 2016. Productivity, chemical composition and ruminal degradability of irrigated Napier grass leaves harvested at three stages of maturity. *S. Afr. J. Anim. Sci.*, 46: 398-408.
- Rambau M.D., Fushai F, Callaway T.R. & Baloyi J.J. 2022. Dry matter and crude protein degradability of Napier grass (*Pennisetum purpureum*) silage is affected by fertilization with cow-dung bio-digester slurry and fermentable carbohydrate additives at ensiling. *Transl. Anim., Sci.* 6: 1-8.

- Ravhuhali, K.E., Msiza, N.H. & Mudau, H.S. 2022. Seasonal dynamics on nutritive value, chemical estimates and in vitro dry matter degradability of some woody species found in rangelands of South Africa. *Agrofores. Syst.*, 96: 23-33.
- Reddy, K.O., Mahaswari, C.U., Shukla, M. & Muzenda, E. 2014. Preparation, chemical composition, characterization and properties of Napier grass paper sheets. *Separat. Sci. Techno.*, 49: 1527-1534.
- Rhee, M.S., Wheeler, T.L., Shackelford, S.D. & Khoomaraie, M. 2004. Variation in palatability and biochemical traits within and among eleven beef muscles. *J. Anim. Sci.*, 82: 534-550
- Rim, J.S., Lee, S.R., Cho, Y.S., Kim, E.J. & Ha, J.K. 2008. Predictions of dry matter intake in lactating Holstein dairy cows offered high levels of concentrate. *Asian-Australian J. Anim. Sci.*, 21: 677-684.
- Rimal, A. 2005. Meat labels: consumer attitude and meat consumption pattern. *Int. J. Cons. Stud.*, 29: 47-54.
- Roberts, J., Florentine, S., Etten, E. & Turville, C. 2021. Germination biology, distribution and control of the invasive species *Eragrostis curvula* [Schard. Nees] (African Lovegrass): A global synthesis of current and future management challenges. *Weed Res.*, 61: 154-163.
- Rosenvold, K. & Andersen, H.J. 2003. The significance of pre-slaughter stress and diet on colour and colour stability of pork. *Meat Sci.*, 63: 199-209.
- Sales, J. & Mellett, F.D. 1996. Post-mortem pH decline in different ostrich muscles. *Meat Sci.*, 42: 235-238.
- Rusdy, M. 2018. A review of the effects of quality forage supplementation on growth performance of cattle and goats fed elephant grass basal diet. *Livest. Res. Rural Dev.*, 30: 203.
- Rusdy, M., Baba, S., Garantjang, S. & Syarif, I. 2019. Effects of supplements with *Gliricidia sepium* leaves on performance of Bali cattle fed elephant grass. *Livest. Res. Rural Dev.*, 31: 84.
- SAAFMAR. 2019. South African animal feeds market analysis report. pp.1-23.

- Sammel, L.M., Hunt, M.C., Kropf, D.H., Hachmeister, K.A. & Johnson, D.E. 2002. Comparison of assays for metmyoglobin reducing ability in beef inside and outside semimembranosus muscle. *J. Food Sci.* 67: 978-984.
- Salem, H.B., Makkar, H.P.S. & Nefzaoui, A. 2004. Towards better utilisation of non-conventional feed sources by sheep and goats in some African and Asian countries. *Opt. Mediterr.*, 59: 177-187.
- Saldias, B. 2014. The impact of rumen function on neutral detergent fibre degradation across the diurnal period in grazing dairy cows in a pasture based system. PhD, Thesis. Lincoln University. England.
- Schilling, B.J. 2005. Performance evaluation, carcass characterization, and palatability assessment of hair sheep. MSc, Thesis. Texas Tech, University, United State of America.
- Schilling, M.W., Daigle, S.P., Alvarado, C.Z., Marriott, N.G. & Wang, H. 2005. Effects of collagen addition on the functionality of PSE-like and normal broiler breast meat in chunked and formed Deli roll. *J. Muscle foods.*, 16: 46-53.
- Sebsibe, A. 2008. Sheep and goat meat characteristics and quality. Sheep and Goat Production Handbook for Ethiopia. A. Yami and RC Markel, Eds. Addis Ababa, Ethiopia. pp. 325-340.
- Sekali, M., Marume, U., Mlambo, V. & Strydom, P.E. 2016. Growth performance, hematology, and meat quality characteristic of Mutton Merino lambs fed Canola-based diets. *Trop. Anim. Health Prod.*, 48, 1115-1121
- Shrestha, M. & Yadav, C. 1998. Feeding Napier (*Pennisetum purpureum*) to grass carp in polyculture: A sustainable fish culture practice for small farmers. *Asian Fish. Sci.*, 11: 287-294.
- Singh, B. 2013. Physiology and genetics of biofuels crop yield. Biofuel Crops: Production Physiology and Genetics. Fort Valley State University, Georgia, USA. pp. 102-104.
- Smulders F.J.M., Marsh, B.B., Swartz, D.R., Russell, R.L. & Hoenecke, M.E. 1990. Beef tenderness and sarcomere length. *Meat. Sci.*, 28, 349–363.

- Skerman, P.J. & Riveros, F. 1990. Tropical Grasses; FAO Plant Production and Protection Series; Food and Agriculture Organization of the United Nations; UNIPUB: Rome, Italy; Laham, MD, USA. pp. 148.
- Smit, M.N. & Beltranena, E. 2017. Increasing dietary inclusion of camelina cake fed to pigs from weaning to slaughter: safety, growth performance, carcass trait, and n-3 enrichment of pork. *J. Anim. Sci.*, 95: 2952-2967.
- Semuguruka, Y.D., Msalya, G., Nguluma, A.S. & Chenyambuga, S.W. 2020. Characterization of carcass and preference of consumer for meat from four strains of the Tanzania small East African goats. *African J. Food, Agric. Nutr. Develop.*, 20: 15455-15473.
- Smulders, F.J.M., Toldra, F., Flores, J. & Prieto, M. 1992. New technologies for meat and meat products. Audet Tijdschriften, Utrecht, The Netherlands. pp. 186-188.
- South African National Standard (SANS). 2008. The care and use of animals for scientific purposes. 1st ed. SABS Standards Division. ISBN 978-0-626-22296-3. pp. 1-225.
- Stroebel, A. 2004. Socio-economic complexities of smallholder ruminant livestock production system in Sub-Saharan Africa. PhD, dissertation, University of Free State, South Africa.
- Strydom, P., Luhl, J., Kahl, C. & Hoffman, L.C. 2016. Comparison of shear force tenderness, drip and cooking loss, and ultimate muscle pH of the loin muscle among grass-fed steers of four major beef crosses slaughtered in Namibia. *S. Afr. J. Anim. Sci.*, 46: 348-359.
- Sturaro, E., Quassolo, M. & Ramanzin, M. 2005. Factors affecting growth performance in beef production: an on farm survey. *Ital. J. Anim. Sci.*, 4: 128-131.
- Sudarman, A., Listiawan, G.B. & Khodijah, L. 2019. The use of coffee husk as Napier grass substitution and its effect on Madura cattle performance. *J. Ilmu Ternak dan Vet.*, 24: 166-172.
- Swatland, H.J. 1984. Structure and development of meat animals. Prentice Hall, Inc. New Jersey, USA. pp. 436.
- Tejeda, J.F., Pena, R.E. & Andres, A.I. 2008. Effect of live weight and sex on physico-chemical and sensorial characteristics of Merino lamb meat. *Meat Sci.*, 80: 1061- 1067.

- Tesfaye, M., Mengistu, U. & Getachew, A. 2016. Effects of different proportions of Pennisetum purpureum silage and natural grass hay on feed utilization, milk yield and composition of crossbred dairy cows supplemented with concentrate diet. *J Biol. Agric. Healthc.*, 6: 59-71.
- Tesfayohannes, S.T., Nsahlai, I.V. & Bengaly, K. 2013. Effect of Urea Treatment and Concentrate Proportions on Dry Matter Degradation of Different Roughages in the Rumen of Jersey Cows. *Global J. Sci. Frontier Res., (D)*. 13.
- Tessema, Z., Baars, R.M.T. & Alemu, Y. 2002. Effect of plant height at cutting and fertilizer on growth of Napier grass (*Pennisetum purpureum*). *Trop. Sci.*, 43: 57– 61.
- Thornton, P. K. (2010). Livestock production: recent trends, future prospects. *Philos. Trans. R. Soc. Lond. B Biol. Sci.*, 365: 2853-2867.
- Van Den Berg, J. & Van Hamburg, H. 2015. Trap cropping with Napier grass *Pennisetum purpureum* (Schumach), decreases damages by maize stem borers. *Int. J. Pest Manag.*, 61: 73-79.
- Van Soest, P.J., Robertson, J.B. & Lewis, B.A., 1991. Methods for dietary fibre, neutral detergent fibre and non-starch polysaccharides in relation to animal nutrition. *J. Dairy Sci.*, 74: 3583-3597.
- Van Soest, P.J. 1994. Nutritional ecology of the ruminant. Comstock Publishing Associates. A division of Cornell University Press, Ithaca and London.
- Van Wyngaard, B.E. Strydom, P.E. & Hugo, A. 2023. A South African beef quality survey. *Meat Sci.*, 198: 109109.
- Vargas, L.H., Lana, R.D.P., Jham, G.N. & Santos, F.L.2002. Addition of lipids in dairy cows ration: ruminal fermentative parameters, milk production and consumption. *Rev. Br. De Zootec.*, 31: 522-529.
- Viljoen, C., Van Der Colf, J. & Swanepoel, P.A. 2020. Benefits are limited with high nitrogen fertilizer rates in kikuyu-ryegrass pasture systems. *Land.*, 9: 173.
- Visser, C., Van Marle-Köster, E., Myburgh, H.C. & De Freitas, A. 2020. Phenomics for sustainable production in the South African dairy and beef cattle industry, *Anim. Front.*, 10: 12–18.

- Wadi, A., Ishii, Y. & Idota, S. 2004. Effect of cutting interval and cutting height and dry matter yield and overwintering ability at the established year in *Pennisetum* species. *Plant Prod. Sci.*, 7: 88–96.
- Wanapat, M., Polyorach, S., Boonnop, K., Mapato, C. & Cherdthong, A. 2009. Effects of treating rice straw with urea or urea and calcium hydroxide upon intake, digestibility, rumen fermentation and milk yield of dairy cows. *Lives. Sci.*, 125: 238-243.
- Wang, H., Shi, W. & Wang, X. 2022. Effects of different thawing methods on microstructure and on the biochemical properties of tilapia (*Oreochromis niloticus*) fillets during frozen storage. *Int. J. Food Sci. Technol.*, 57: 224-234.
- Warner, R. D., Greenwood, P.L., Pethick, D.W. & Ferguson, D.M. 2010. Genetic and environmental effects on meat quality. *Meat Sci.*, 86: 171–183.
- Warris, P.D. 2000. Meat science: An introductory Text. CABI Publishing, New York, USA. pp. 310.
- Webb, E.C. 1994. Synthesis of long chain fatty acids in ruminants and their effects on meat quality. PhD, thesis. University of Pretoria, South Africa.
- Webb, E.C., Casey, N.H. & Simela, L., 2005. Goat meat quality. *Small Rumin. Res.*, 60, 153-166.
- Webb, E.C. & O`Neil, H.A. 2008. The animal fat paradox and meat quality. *Meat Sci.*, 80: 28-36.
- Webb, E.C. 2014. Goat meat production, composition, and quality. *Anim. Front.*, 4: 33- 37.
- Weimer, P.J., Stevenson, D.M., Mantovani, H.C. & Man, S.L.C. 2010. Host specifically of the ruminal bacterial community in the dairy cow following near-total exchange of ruminal contents. *J. Dairy Sci.*, 93: 5902-5912.
- Welty, J. 2007. Humane slaughter laws. *Law & Comtemp. Probs.*, 70, 175-206.
- Wilkinson, J.M. 2011. Re-defining efficiency of feed use by livestock. *Anim.*, 5: 1014-1022.
- Wu, S., Choct, M. & Pesti, G. 2020. Historical flaws in bioassays used to generate metabolizable energy values for poultry feed formulation: a critical review. *Poult. Sci.*, 99: 385-406.

- Yan, Q., Li, J., Gao, L., Lai, D., Yao, N., Yi, X., Wu, Z., Lai, Z. & Zhang, J. 2021. Integrated analyses of phenotype, phytohormone, and transcriptome to elucidate the mechanism governing internode elongation in two contrasting elephant grass (*Cenchrus purpureus*) cultivars. *Ind. Crops Prod.*, 170: 113693.
- Yan, Q., Wu, F., Xu, P., Sun, Z., Li, J., Gao, L., Lu, L., Chen, D., Muktar, M., Jones, C., Yi, X. & Zhang, J. 2020. The elephant grass (*Cenchrus purpureus*) genome provides insights into anthocyanidin accumulation and fast growth. *Mol. Ecol. Resour.*, 21: 526-542.
- Yancey, J.W.S., Apple, J.K., Meullenet, J.F. & Sawyer, J.T. 2010. Consumer responses for tenderness and overall impression can be predicted by visible and near-infrared spectroscopy, Meullenet–Owens razor shear, and Warner–Bratzler shear force. *Meat Sci.*, 85: 487–492.
- Yayneshet, T. 2010. Feed resources availability in Tigray Region, northern Ethiopia, for production of export quality meat and Livestock. Ethiopian Sanitary and Phytosanitary Standards and Livestock and Meat Marketing Program (SPS-LMM), Mekelle University, Ethiopia.
- Yesihak, Y. 2015. Beef carcass quality, yield and cause of condemnation in Ethiopia. PhD, thesis. University of Pretoria, South Africa.
- Young, O., Priolo, A., Simmons, N. & West, J. 1999. Effects of rigor attainment temperature on meat blooming and colour on display. *Meat Sci.*, 52: 47–56.
- Zailan, M.Z., Yaakub, H. & Jusoh, S. 2016. In vitro digestibility and gas production characteristics of four Napier (*Pennisetum purpureum*) cultivars as fresh fodder. *Malaysian J. Anim. Sci.*, 19: 95 -105.
- Zewdie, W. 2010. Livestock production systems in relation with feed availability in the highland sand central rift valley of Ethiopia. MSc, dissertation. Haramaya University. Ethiopia.
- Zhang, S.X., Farouk, M.M., Young, O.A., Weliczko, K.L. & Podmore, C. 2005. Functional stability of frozen normal and high pH beef. *Meat Sci.*, 69: 765-772.
- Zhang, R., Yoo, M.J.Y., Ross, A.B. & Farouk, M.M. 2022. Mechanisms and strategies to tailor dry-aged meat flavour. *Trends Food Sci. Technol.*, 119: 400-411.