

Improved production efficiency in beef cattle

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Research Institute: ARC-Animal Production Institute, University of the Free State

Research focus area: Livestock production with global competitiveness

Full Title of the project

Improved production efficiency to reduce the carbon footprint of beef.

Aims of the project

- To do a literature study
- To evaluate the use of a hand-held gas detector to measure methane production in young bulls under intensive feeding
- To establish if there is any relationship between methane production and growth and efficiency traits in young bulls under intensive feeding
- To estimate genetic variance components for residual feed intake and its correlations with other traits.
- To develop a trait that measures kg calf weaned per Large Stock Unit

Executive summary

Literature study

The literature study was completed and a number of presentations have been made at national congresses. The project also stimulated a number of related issues which have been addressed through presentations and articles that were published, e. g.

- (1) An overview of possible reasons for differences in residual feed intake,
- (2) A South African perspective on livestock production in relation to greenhouse gases and water usage in three related articles,
- (3) Livestock breeding for sustainability to mitigate global warming, with the emphasis on developing countries,
- (4) The effect of global warming on beef production in developing countries of the southern hemisphere,
- (5) Antagonism in the carbon footprint between beef and dairy production systems; and
- (6) Research and development on climate change and greenhouse gases in support of climate smart livestock production and a vibrant industry.

These articles added a lot of value to the initial research that was not anticipated.

Hand-held gas detector to measure methane

After the initial delay this handheld Lazer Methane Detector (LMD) has been successfully evaluated. It was found that the measurements were not affected by the operators, meaning that it can be operated by different operators without affecting the measurements. The data produced make biological sense. However it was difficult to use the equipment in direct sunlight because it was not possible to see the lazer beam.

The efficiency and results when using the LMD to measure methane (CH₄) production under grazing and feeding were evaluated. It seems that the LMD has the potential to measure enteric CH₄ emission from livestock under normal husbandry activities. This study was aimed to evaluate the efficiency and results when using the LMD to measure CH₄ production under normal production conditions. Twelve heifers, 4 each from the Bonsmara, Brahman, Nguni and Jersey breeds were subjected to grazing natural veld, forage sorghum under irrigation, oats grazing under irrigation or a total mixed ration. Significant differences were found between breeds and feeds. These results thus indicate that the LMD produce sensible and repeatable measurements that can be interpreted in respect of CH₄ production from cattle. Differences in methane production between animals of the same breed were found, indicating that it may be possible to identify genetic

differences between animals using the LMD and it is recommended that this is investigated.

The aim to establish any relationship between methane production and growth and efficiency traits in young bulls under intensive feeding did not materialize in this study.

The next phase will be to increase the number of breeds, numbers per breed, and feeding strategies over all seasons in order to validate and build up baseline data on the use of the LMD to measure CH₄ emissions from cattle under different grazing conditions.

THESIS: Estimation of genetic variance components for residual feed intake and its correlations with other traits

The THRIP student of 2011 (Ms Steyn) obtained her M.Sc degree from the University of Pretoria in 2012 with a thesis titled "Residual feed intake as a selection tool for feed efficiency in South African Bonsmara cattle" in which the genetic variance components for residual feed intake and its correlations with other traits in the Bonsmara breed were analysed.

In an additional study (published in S. Afr. J. Anim.Sci. 41: 18 – 24) indicated that Residual Feed Intake (RFI) and Residual Daily Gain (RDG) provide different rankings of candidates for selection. Selection for RFI on its own is therefore not a solution. The combination of RFI and RDG to form Residual Intake and Gain (RIG) appears to provide an effective harmonization of the former two biological measures of efficiency. It is recommended that genetic evaluation systems include analyses of Average Daily Gain (ADG) and daily Feed Intake (DFI) and breeders are advised to base selection decisions on the basis of multiple-trait selection indexes that incorporate feed intake and performance.

A second student (Mr J Hendriks) is finalizing his M.Sc study on data from South African Angus bulls tested at centralized growth test stations in which he calculated genetic parameters for seven post weaning growth- and feed efficiency traits. Unfortunately, many of the covariance estimates could not be determined; this could be due to the fact that the data set was too small. The study mentioned above found significant differences in ranking for RFI and RDG and this could be due to the fact that an antagonism exists between the component traits used to determine these residual traits. This supports the argument that it is more beneficial to base selection on the component traits used to determine ratio and feed efficiency traits. It is therefore recommended that ADG and DFI are included in a selection index rather than direct selection on RFI and RDG.

Development of a trait that measures kg calf weaned per Large Stock Unit

This trait was developed along the same lines as the trait “defined as total weight of lamb weaned per ewe joined”, that was developed some years ago. It was also demonstrated this ewe trait can be genetically improved by either direct or indirect selection. This suggests that in beef cattle, selection for weight of calf weaned per large stock unit (LSU) should be investigated as a means for improving cow efficiency. In a comparison of between-breed averages of 30 beef and dual purpose breeds in South Africa, it was found that kilogram calf weaned per Large Stock Unit (KgC/LSU) is independent of cow weight, which is contrary to the calf/cow weight ratio which favours smaller cows.

This stimulated an investigation into the use of KgC/LSU and weaning weight (K205), both as traits of the dam, as breeding objectives to improve efficiency in extensive cow-calf production systems. A Bonsmara dataset was used in this study. The results indicated that selection for KgC/LSU may reduce cow size and that selection for K205 may increase cow size slightly. The recommendation is therefore that a combination of K205 and cow weight expressed in LSU's in a selection index should be investigated as a feasible option to improve cow productivity and reduce the carbon footprint of beef. A student (Ms M C Mokolobate) is finalizing her M.Sc study on these results.

- Technology Transfer Occasions
 - Doeltreffendheid van koeie met Afrikaner genetica (Efficiency of cows with Afrikaner genetics) – M M Scholtz, Afrikaner Cattle Breeder's Society Farmers Day and AGM, 6 March 2013, Standerton, South Africa.
 - General introduction and discussion of breeding objectives – M M Scholtz, Simmentaler Beef Information Nucleus Workshop, 8 May 2013, Irene, South Africa.
 - Report on a breeding objective that may improve cow efficiency of extensive cow-calf production systems – M C Mokolobate, Simmentaler Beef Information Nucleus Workshop, 8 May 2013, Irene, South Africa.
 - Possible reasons for differences in residual feed intake – Jurgen Hendriks, Simmentaler Beef Information Nucleus Workshop, 8 May 2013, Irene, South Africa.
 - Scholtz, M M, 2013. Climate change and beef production. Beef Farmer's Day, Vryburg, 13 August, 2013.
 - Hendriks, H, 2013. Alternative measures of efficiency: Residual feed intake and residual daily gain, Vryburg, 13 August, 2013.
 - Scholtz, M M, 2013. Climate change and beef production. Beef Farmer's Day, Western Cape, 22 August, 2013.
 - Hendriks, H, 2013. Alternative measures of efficiency: Residual feed intake and residual daily gain, Western Cape, 22 August, 2013.
 - Scholtz, M M & M C Mokolobate, 2014. Climate change and beef production, Beef Improvement Day, KwaZulu-Natal, 27 February 2014.
- Reports to Industry

- Improved production efficiency to reduce the carbon footprint of beef – M C Mokolobate, RMRD SA Climate Change Workshop, 30 January 2013, Pretoria, South Africa.
- Popular articles and media
 - SCHOLTZ, M M, 2012. Livestock and climate change: A balanced perspective. Farmlink. Vol 2 No 1, 46 - 47.
 - SCHOLTZ, M M, 2012. Climate change and breeding for adaptation under South African conditions. Brangus Journal, 15 – 16.
 - MOKOLOBATE, M C & SCHOLTZ, M M, 2013. A breeding objective that may reduce the carbon footprint of extensive cow-calf production systems. National Beef Recording and Improvement Scheme Newsletter, 102, 27.
 - SCHOLTZ, M M & HENDRIKS, J, 2013. Alternatiewe maatstawwe van doeltreffendheid soos residuele voerinnome (residual feed intake). Simbra Joernal, 88-89.
 - SCHOLTZ, M M, MOKOLOBATE, M C, HENDRIKS, J, THEUNISSEN A & NESER, F W C, 2013. Breeding strategies to improve production efficiency and reduce the carbon footprint from beef cattle. National Beef Recording and Improvement Scheme Newsletter, 102, 24 – 25.
 - SCHOLTZ, M M, 2013. Climate change and breeding for adaptation under Southern African conditions. Simbra Journal, 24-25.
 - MOKOLOBATE, M C and SCHOLTZ, M M, 2014. A breeding objective that may reduce the carbon footprint of extensive cow-calf production systems. Nguni Journal, 55-57.
 - SCHOLTZ, M M, MOKOLOBATE, M M and HENDRIKS, J, 2014. Breeding strategies to reduce carbon footprint. Red Meat / Rooivleis, April 2014, 46-49.
- Scientific articles
 - SCHOLTZ, M M, STEYN, Y, VAN MARLE-KOSTER, E & THERON H E, 2012. Improved production efficiency in cattle to reduce their carbon footprint for beef production. South African Journal of Animal Science 42: 450-453.
 - HENDRIKS, J, SCHOLTZ, M M, NESER, F W C, 2013. Possible reasons for differences in residual feed intake: An overview. South African Journal of Animal Science, 2013, 43, S103 – S105.
 - MACNEIL, M D, SCHOLTZ, M M & MAIWASHE, A, 2013. Estimates of variance components for postweaning feed intake and growth in Bonsmara bulls and evaluation of alternative measures of feed efficiency. South African Journal of Animal Science, 41: 18 – 24.
 - LEEUW, K, J & SCHOLTZ, M M, 2013. Cation-anion balance in supplementary feed to mitigate heat stress in grazing beef cattle. Applied Animal Husbandry & Rural Development 6, 28 – 31.
 - MOKOLOBATE, M C, SCHOLTZ, M M, MULUGETA, S & NESER, F W C, 2013. Report on a breeding objective that may reduce the carbon footprint of extensive cow-calf production systems. Natural Science, 5: 167 – 171.
 - SCHOLTZ, M M, AGHDASI, F & ZHOU, L, 2013. Climate change and animal science – outcome of a panel discussion between animal scientists. Applied Animal Husbandry & Rural Development, 6, 1 – 3.

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 - SCHOLTZ, M M, MAIWASHE, A, NESER, F W C, THEUNISSEN, A, OLIVIER, W J, MOKOLOBATE, M,C & HENDRIKS, J, 2013. Livestock breeding for sustainability to mitigate global warming, with the emphasis on developing countries. *South African Journal of Animal Science*, 43, 269 - 281.
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 - SCHOLTZ, M M, MOKOLOBATE, M C, HENDRIKS, J, THEUNISSEN, A & NESER, F W C, 2013. Breeding strategies to reduce the carbon footprint from beef in developing countries. *Proc. 11th World Conference on Animal Production*. 15 – 20 October 2013, Beijing, China, 68 - 69.
 - SCHOLTZ, M M, MEISSNER, H H & LAKER, M C, 2013. Perspective on the water usage of beef production systems in South Africa. *Proc. 11th World Conference on Animal Production*. 15 – 20 October 2013, Beijing, China, 142 – 143.
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 - SCHOLTZ, M M, DU TOIT, J & NESER, F W C, 2014. Antagonism in the carbon footprint between beef and dairy production systems. *South African Journal of Animal Science* (in press).
 - SCHOLTZ, M M, SCHÖNFELGT, H C. NESER, F W C, & SCHUTTE, G M, 2014. Research and development on climate change and greenhouse gases in support of climate smart livestock production and a vibrant industry. *South African Journal of Animal Science* (in press).
- Theses
 - STEYN, Y, 2012. Residual feed intake as a selection tool for feed efficiency in South African Bonsmara cattle. M.Sc. Agric. University of Pretoria.
 - MOKOLOBATE, M C. Novelty traits to improve cow-calf efficiency in climate smart beef production. Will be submitted October 2014. M.Sc University of the Free State
 - HENDRIKS, J. Investigation of genetic parameters for feedlot traits of Angus cattle in South Africa. Will be submitted October 2014. M.Sc University of the Free State
 - Conferences, symposia
 - SCHOLTZ, M M, THERON, H E, MAIWASHE, A & STEYN, Y, 2011. Improved production efficiency in cattle to reduce the carbon footprint of beef. 44 th SASAS Congress, 11 - 14 July.

- SCHOLTZ, M M, VAN RYSSSEN, J B J & MEISSNER, H H, 2012. A perspective on livestock production and greenhouse gasses. 45th SASAS Congress, 9 – 12 July 2012, East London, South Africa.
- MOKOLOBATE, M C, SCHOLTZ, M M & MULUGETA, S D, 2012. A study to estimate kilogram calf produced per Large Stock Unit. 45th SASAS Congress, 9 – 12 July 2012, East London, South Africa.
- PHOKO, M E, SCHOLTZ, M M, NENGOVHELA, N B & GROBLER, S M, 2012. Measurement of enteric methane output in cattle without any disturbance. 45th SASAS Congress, 9 – 12 July 2012, East London, South Africa.
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- LEEUW, K-J & SCHOLTZ, M M, 2012. Can heat stress in beef cattle be mitigated through supplementary feeding? 45th SASAS Congress, 9 – 12 July 2012, East London, South Africa.
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- Literature reviews
 - HENDRIKS, J, SCHOLTZ, M M, NESER, F W C, 2013. Possible reasons for differences in residual feed intake: An overview. South African Journal of Animal Science, 2013, 43, S103 – S105.

- General
 - RSG Landbousake. Discussion on “The effect of climate change on livestock production”, 2 December 2012.
 - RSG Loslip. Contribution to the discussion on “Meat and Methane”, 5 December 2012.
 - RSG Landbousake. Discussion on “Methane production by cattle”, 9 December 2012.
 - Global Conference on Agriculture, Food Security and Climate Change – Challenges for Africa. TV, NCBC Africa in the program Beyond Markets, 5 December 2013.