RMRD SA

RESEARCH PROJECTS

VOLUME I

Executive summaries

APRIL 2011

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If you require any further information or are interested in applying for funding for research please contact the RMRD SA Administrator Prof Hettie Schonfeldt at: info@rmrdsa.co.za or on Tel: 012 348 6649 or Fax: 012 361 2333

PHOTO MISSING

1. Access to seed stock industry by communal farmer

Researcher: **Mr J Clayton / Dr G Scholtz**

Research Institute: **Animal Production Institute**

Animal Research Council

Total Funding: **R 65 000**

Final Approved: **2011**

INTRODUCTION

The main objectives of this project were twofold. Firstly, it is essential to demonstrate to rural livestock owners that the late winter/early summer fodder flow bottleneck is the largest constraint to livestock production in communal areas. This is an annual reality for most communal livestock farmers. The fact is however, that non-productive animals continue to consume valuable resources which could be better used by productive, high value animals. This project intended to show the Emoyeni Livestock Owners Association and many other surrounding livestock farmers how the results of forage quality analyses and seasonal herbage yield assessments impacted on animal condition scoring and how this affects animal performance. Secondly, the fact that the communal areas are host to outstanding Nguni genetics is widely recognized and this can be used as a tool to encourage communal livestock owners to concentrate their livestock farming efforts on high value, productive animals.

It is very unfortunate that three of the most prominent members of the Emoyeni Livestock Owners Association have passed away over the last six months. The demise of Harold Nxumalo in particular has had a crippling effect on the final desired outcome of this project. It has nonetheless been a more than useful exercise for a wider range of parties than just the Emoyeni Livestock Owners Association. A considerable number of neighbouring livestock owners have visited this project and have taken note of these two issues. Students from the University of Zululand have had valuable practical training on this project, and although the final objective of registering the selected group of 47 animals with the Nguni Breeders Society is now no longer feasible, this project has indeed been a valuable experience to many who were involved with it.

In terms of the desired outcomes, the nutritional aspects of the project have been clearly demonstrated. Communal livestock owners cannot afford to waste limited forage resources on unproductive animals. Further, if acceptable animal performance is to be achieved, this nutritional bottleneck has to be mitigated. In the light of the passing away of key participants in this project, the goal of registering a number of animals with the Nguni Breeders Society will not be achieved. The remaining livestock owners have however, been given the necessary information to be able to optimize their livestock production. The project has thus been worthwhile.

RESULTS

Data Collection

Data collection pertaining to forage quality and availability is complete. The purpose of collecting these data is to demonstrate to the livestock owners the bottleneck in forage quality and availability that occurs from late winter through to early summer and this situation is exacerbated by the unavoidable reality of arson fires in this area during the winter. A number of information days were held to impress upon the livestock owners the need to ensure that conserved forage is available to selected productive cows and their followers, as the need to purchase supplementary feed for unproductive animals cannot be justified. The expense of hiring winter and early spring grazing and/or providing supplementary feed could be justified if the value of these animals could be increased. To this end, a selected group of animals have been identified for Phase 1 registration with the Nguni Breeders Society.

Further technical details about the research progress

The table 1 below represents a summary of the data collected between February 2008 and February 2009 pertaining to an area of approximately 1300ha upon which some 225 head of Nguni and mixed Nguni cattle belonging to 9 livestock owners were grazed.

Table 1: Summary of data collected between February 2008 and February 2009

Date	DM (kg/ha)	Crude Protein	Neutral Detergent Fibre
Feb 08	850	6	82
Mar 08	1300	5.9	80
Apr 08	810	5	85.7
June 08	790	4	85.5
Aug 08	Nil	4.5*	84.5*
Sep 08	Nil	4.8*	81.5*
Nov 08	400	7.7	78
Feb 09	600	7.5	79.7

*samples taken from grazing closest to the burnt monitoring plots

Natural Resource

Emoyeni falls within the Bio Resource Group TUb3 - Magudu consisting of 3 Ecotypes (Camp 1999). Table 2 compares the relative abundance of the more common grass and woody species occurring within these Ecotypes against those occurring in Emoyeni.

Table 2: Relative abundance of common grass and woody species occurring within these Ecotopes against those occurring in Emoyeni.

Woody Species	Bio Resource Group TUb3	Emoyeni
Acacia karroo	fairly common	common
Acacia nilotica	Common	common
Euclea sp.	Common	very common
Dicrostachys cinerea	fairly common	fairly common
Schotia brachypetala	fairly common	rare
Acacia nigrescens	fairly common	rare
Grass species		
Themeda triandra	fairly common	rare
Panicum maximum	fairly common	rare
Bothriocloa insculpta	fairly common	fairly common
Hyperrhenia hirta	Common	common
Aristida congesta	fairly common	common
Eragrostis superba	Common	very common
Est. Carrying Capacity (Ha/LSU)	4.5	6.0

Animal Production

The implementation of an animal recording programme has facilitated sound baseline data from which management interventions can now be measured. Table 3 illustrates a comparison between the general Emoyeni herd and the average for Nguni performance recorded cattle.

Table 3: Comparison between the general Emoyeni herd and the average for Nguni cattle

Animal Category	Breed Average	Emoyeni (all animals)*
Birth Weight	26	25
205 Day Weight	155	100
12 Month Weight	178	135
12 Month Weight	239	180
Mature Female	353	320
Inter Calf Period	414	600
Age at 1st Calving (months)	34	48

*data from all animals belonging to the Emoyeni Livestock Owners Association – not just selected Ngunis

Presentations / Farmers / Information Days

Project meetings with the Emoyeni livestock owners are held at least once every eight weeks and these take the form of an information day once immediate project matters have been concluded. Subject matters discussed to date include:

- Strategic cattle dipping
- Strategies to manage the fodder quality and quantity bottleneck
- Animal condition scoring
- Desirable traits of the Nguni breed
- The theory and practise of artificial insemination
- Attendance at a Cedara animal recording information day
- Field trip to Mr Clive Bunting's beef operation to focus on veld management strategies
- Trip to ARC's Grobblersdal Nguni breeding station to select appropriate bulls

PUBLICATIONS

Popular articles:

SCHOLTZ, M M & CLAYTON, J, 2007. The Emoyeni Nguni project. *Nguni Journal,* 37.

Scientific articles

SCHOLTZ, M M, 2008. How livestock from rural keepers can access the seed stock industry. *Proceedigs: 7th RBI global conference on the conservation of Animal Genetic Resources.* Hanoi, Vietnam, 40 – 44
http://www.mgegodollo.hu/WEBSET_DOWNLOADS/526/Proceedings_7th%20RBI%20Global%20Conference_Hanoi_14_18_Sept_2008.pdf

Conferences, symposia

Presentation of a poster at the annual Grassland Society Congress entitled Livestock Production in Communal Rangelands – the Emoyeni Project by J. Clayton, J.M. Binedell and N. Kunene

Field Day at Clive Bunting's farm to discuss veld management issues

NO PHOTO

2. Analysis and quantification of value chains

Researcher: **Mr P Taljaardt**

Research Insitute: **Agricultural Economics**

University of the Free State

Total Funding: **R 464 000**

Final Approved: **2010**

Given the natural resource base of South Africa, livestock production is one of the most important farming practices in the country. Of the approximately 80 % of the land surface being utilised for agriculture, almost 70 % is suitable for raising livestock. The South African red meat sub-sector contributed 14.8 % to the total gross value of agricultural production during the 2008/2009 season with beef being the main contributor at 10.1 % during the same period (DAFF, 2010). The long-term average contribution of the red meat industry to the total gross value of agriculture production (from 1996/1997 to 2008/2009) accounts for 13.2 % and that of beef 9 % during the same period, (DAFF, 2010).

The South African primary red meat sub-sector is unique due to the dualistic nature of the country's agricultural situation. There is a clear distinction between the commercial (formal) sector of the industry and the emerging (informal) sector.

Within the ambit of the above the South African red meat sector also has to compete at a global level. For the South African red meat industry to be on par and potentially become a leader (at least in the Southern African region) it is necessary to understand the red meat value chain in detail in a holistic manner to (i) guide decision making in the public and private sector domains, (ii) identify challenges that the industry faces that impedes on its efficient functioning and (iii) create a foundation for the better understanding of the dynamic forces within the industry to allow stakeholders to internalise it in order for them to position themselves so that they can increase their profitability and competitiveness at each segment of the industry to the benefit of the entire industry.

With the growing importance of high-value agriculture in developing countries and its consequent complexity, efficient value chain management is crucial to deliver products in a safe and timely manner (Rich and Narrod, 2005). These value chains require various coordination mechanisms used to manage the flow of products between intermediaries and ensure that quality specifications are met. Consequently, analytical tools and frameworks that provide guidance into the functioning of such chains are important means to understand whether such developments have positive or negative impacts on producers and to what extent the poor can benefit from these developments and to assist governments with policy reform towards effective agricultural systems, regional integration, etc.

By merely providing a descriptive profile of a particular industry is not sufficient any more within a deregulated and liberalised environment. In order to make any normative judgments and through this process provide guidance on the re-engineering of a particular chain to be more competitive, an in depth value chain analysis is needed. This is exactly what this study is set out to achieve for the large (cattle/beef) and small stock (sheep/mutton-lamb) sub-sectors.

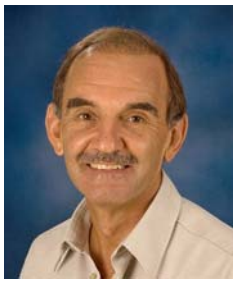
More specifically, this study set out to achieve the following:

- Analyse and quantify the total value chain for large and small stock sub-sectors in the Free State Province.
- Analyse the structure and operation of the large and small livestock industry, as well as the factors that affects it. This is done at a broader industry level, as well as at a more micro level in the Free State Province.
- Determine the factors that have the highest probability to enhance the competitiveness of the different value chains within the industry.

The following are some of the main findings of the survey pertaining to developing producers:

- The average age of producers is 48 years and producers received an average of 3 years of schooling.
- The main contributor towards respondents' income during the past five years has been from livestock operations (84 % in 2009), followed by off-farm employment (10 % in 2009).
- On average, respondents employ 0.3 full-time male at an average monthly cost of R 300. Employees in this sector are mainly young (child) persons and or family members.
- In terms of beef breeds, the most popular breeds include crossbred cattle (73 %), followed by the Drakensberger (13 %). In terms of sheep, they breeds utilised include Dorper (57 %) and Merino (43 %).
- The calving percentage for this sector in the Free State Province is calculated at 29.8 %, which is relatively lower than that of the national average of 40 % (Clark *et al.* 2005). The average lambing percentage for this sector is calculated at 13 %.
- The off-take rate for cattle in the Free State Province is 11.8 % for the developing sector, while the off-take rate for the developing sheep sector is 2.3 %.
- The only production cost contributions in this sector included feeding expenses (43 %) and fuel cost (57 %).
- Animals are mainly marketed to the primary processing industry, and the local auction system. Animal sales are few and erratic.
- Main constraints in this sector includes access to credit (linked to this limited is limited access to inputs) and access to information, while risks include disease and availability of inputs which are again linked to the lack of access to credit, as well as climatic conditions (poor managing practices).

3. Arthrosis with lameness in cattle



Diere gesondheid: Navorsing werp nuwe lig op artrose

Researcher: **Prof L Prozesky**
Research Insitute: **Veterinarary Science**
University of Pretoria
Total Funding: **R 90 000**
Final Approved: **2011**

Daar is hoop vir boere wat skade ly weens die gewrigsiekte artrose by beeste. Die leier van ’n navorsingsprojek oor dié siekte vertel hier watter vordering reeds gemaak is.

Die toestand wat as artrose bekend staan, is ’n ontsteking van die gewrig wat ook die gewrigskraakbeen aantas. Diere kan klinies of subklinies aangetas word. By beeste is die letsels meestal in die kniegewrig teenwoordig. Klinies aangetaste diere is mank, met opvallende swelling van die gewrig. In subkliniese gevalle is letsels ook teenwoordig, die dier toon geen tekens van mankheid nie en die gewrig is ook nie geswel nie.

Sedert die eerste artikel oor artrose verskyn het (“Gewrigsprobleme kan beesbedryf lamlê”, LBW, 29 Mei 2009) is onverpoos navorsing gedoen met die klem op voorkoming van die probleem en die identifisering van die oorsaak.

Boere wil graag weet wat presies die oorsaak van artrose is. Artrose, ook bekend as osteochondrose, is nie tot beeste beperk nie, maar kom ook by verskeie ander spesies voor, insluitend varke, perde, honde en mense. Daar word vermoed dat die oorsaak en/of oorsake verskillend by verskillende spesies kan wees, hoewel daar ook duidelike ooreenkomste in die ontwikkeling van die letsels by verskillende spesies is.

Moontlike oorsake sluit in oorvoeding van diere (veral honde en varke), genetiese faktore, oormatige of te min kalsium en/of fosfaat of ’n kalsium/fosfaatwanbalans, ’n oormaat sink, ’n kopertekort, ander minerale in oormaat wat antagonistiese tekorte van seker minerale induseer, vitamien A-, D- en E-tekorte, hormonale faktore (byvoorbeeld manlike diere wat meer aangetas word as vroulike diere) en trauma.

Alle aanduidings is dat aangetaste diere op ’n baie jong stadium, selfs voor geboorte, letsels ontwikkel.

Identifisering

Wat die identifisering van die oorsaak kompliseer, is die tussenwerking tussen verskillende minerale, wat ’n baie komplekse aspek is. Die moontlikheid word ook ondersoek dat die oorsaak van artrose,

soos dit tans in Suider-Afrika voorkom, tussen geografiese areas kan verskil. So kan die oorsaak by diere in Namibië verskil van die oorsaak by diere in die Vryburg-omgewing weens onder meer verskille in die geologiese samestelling van die grond en derhalwe die weiding- en watersamestelling. Die meeste navorsers meen dat die toestand nie aan ’n enkele faktor toegeskryf kan word nie.

In die embrio ontwikkel beenweefsel nie totdat die weefsel wat ondersteun of beskerm moet word, soos die brein en spiere, ’n gevorderde stadium van ontwikkeling bereik het. Die funksie van been word eers deur kraakbeen verrig om onder meer by te bly met die vinnige groei van die embrio/fetus, waarna die kraakbeen geleidelik deur been vervang word. Die omskakeling van kraakbeen na been is ’n baie ingewikkelde proses waar verskillende boustowwe, insluitende minerale, aminosure, hormone en vitamiene, ’n rol speel.

Voldoende bloedvoorsiening is ook noodsaaklik. Baie navorsing word tans veral oor bloedvoorsiening gedoen, aangesien daar in ’n groot mate eenstemmigheid onder navorsers is dat, indien die bloedvoorsiening in die been ontoereikend is, letsels ontwikkel wat met artrose geassosieer word. Indien die omskakeling van kraakbeen na been nie normaal plaasvind nie, sterf die kraakbeen af en kan ’n sist (kavitasie of holtevorming) in die been ontwikkel. Indien die letsel onder die gewrigskraakbeen voorkom, vind afsterwing van die gewrigskraakbeen plaas omdat die onderliggende been nie die nodige ondersteuning aan die gewrigskraakbeen kan bied nie.

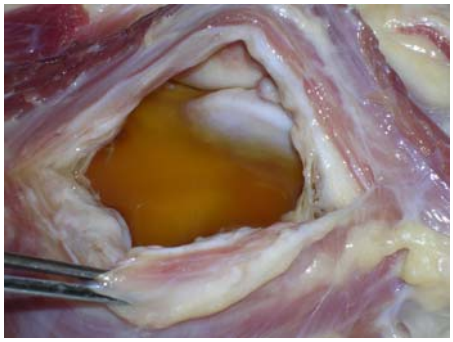


Fig 1: Oormatige vloeistof aansameling in die kniegewrig van ‘n bees met artrose.

Volgens die nuutste navorsing is veral vitamien A van kardinale belang vir die ontwikkeling van voldoende bloedvoorsiening vir die omskakeling van kraakbeen na been. Minerale word hoofsaaklik in die lewer en bene opgeberg; derhalwe word daar in die navorsing baie klem op die resultate van die lewer- en beenontledings van aangetaste diere gelê. Die resultate word met die minerale waardes van die kontrolegroep vergelyk.

Baie werk is gedoen om te verseker dat die resultate betroubaar is. Kontrolemonsters is onder meer uit Amerika ingevoer om te verseker dat die plaaslike data korrek is. Ongeveer 4 500 beeste was by die ondersoek betrokke. Die eerste doelwit was om te bepaal of artrose aansteeklik tussen beeste is. Monsters van aangetaste diere is aan verskeie toetse onderwerp en daar is onteenseglik bewys dat artrose soos dit tans in Suider-Afrika voorkom, nie aansteeklik is nie. Dit beteken dit kan nie deur middel van besmette materiaal van een dier na ’n ander een oorgedra word nie.

Dit is belangrik om daarop te let dat daar verskeie oorsake van gewrigsontsteking is wat aansteeklik is en klinies met artrose verwar kan word. Daar moet dus nie aanvaar word dat elke bees met ’n

geswelde gewrig aan artrose ly nie. In hierdie verband is dit nodig om die plaaslike veearts te raadpleeg om die teenwoordigheid van artrose in ’n kudde te bevestig.

Aangesien artrose nie aansteeklik is nie, word nou gefokus op die belangrikheid van ’n voedingwanbalans as moontlike oorsaak van die probleem. ’n Paneel voedingkundiges en ander navorsers is genader om by die navorsing betrokke te wees. Hulle is drr. Hinner Köster van Animate Animal Health, Hannes Viljoen van Animal Nutrition and Health, Heinz Meissner, voorheen van die Landbounavorsingsraad (LNR) se Instituut vir Dierevoeding en -produksie, Chris de Brouwer van Noordwes se departement van landbou, bewaring, omgewing en landelike ontwikkeling, en Frans Malan, ’n private veearts op Vryburg, asook mnr. Craig Shepstone, ’n nagraadse student wie se M.Sc.-verhandeling hoofsaaklik oor die ontledingsmetodiek van lewer- en beenmonsters gaan.

Sedert die eerste gevalle in 1982 deur Malan en dr. Jurie Kritzinger in die distrik Vryburg waargeneem is, het die voorkoms van artrose progressief toegeneem tot ’n punt waar pasgebore kalwers gewrigletsels toon. Dit wil dus voorkom of die voedingwanbalans progressief toegeneem het. Uiteindelik kan die dragtige koei met voedingsbehoeftes veel hoër as dié van ’n nie-dragtige koei nie in haar eie behoeftes voorsien nie en ly die fetus daaronder. By geboorte is dieselfde wanbalans dan in die kalf teenwoordig.

Die navorsingsinligting is gebruik om Arthrocur, ’n konsep-mineralevoormengsel wat ingevolge die Wet op Misstowwe, Veevoere, Landboumiddels en Veemiddels (Wet 36 van 1947) geregistreer is, saam te stel om te bepaal of die voorkoms van artrose noemenswaardig afneem as die voormengsel saam met vitamien A gebruik word en of nuwe gevalle op dié plase afneem.

Vir die doeleindes van hierdie studie moes die eerste konsep-voormengsel só saamgestel word dat alle moontlike gevolge weens die moontlike oormatige of ondervoorsiening van spoorminerale aanvanklik gedek word. Namate die studie vorder en navorsingsresultate en ontledings beskikbaar raak, word die voormengsel aangepas en verfyn om slegs die probleemminerale se balans te herstel, wat die koste van die Arthrocur-aanvulling vorentoe aansienlik sal verminder.

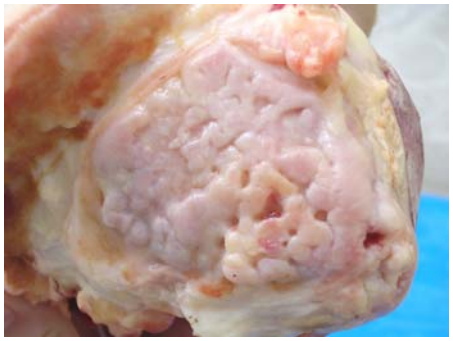


Fig 2: Uitgesproke kraakbeenletsels in ‘n volwasse aangetaste bees.

Lekke van deelnemende maatskappye met voorgeskrewe makrominerale (fosfaat) en die Arthrocur-mineraalmengsel is die afgelope twee jaar by Vryburg, Reivilo en Stella op verskeie plase gebruik waarop artrose voorkom, saam met ’n kwartaallikse vitamien A-toediening. Die diere is gereeld klinies beoordeel en goeie lekbestuur is, sover dit in ekstensiewe toestande moontlik is, deur die deelnemende boere toegepas. Sonder die samewerking van dié boere – mnre. Jan Van Zyl, Christo Bosman, Johan Cloete en Theuns Coertzen – sou die projek nie moontlik gewees het nie.

Afname

Daar was ’n noemenswaardige afname in die aantal aangetaste diere en nuwe gevalle van artrose by jong diere op al die plase (sien die grafiek). Die voorkoms van klinies aangetaste diere het volgens die nuutste resultate van 1% tot 12% gewissel vergeleke met 15% tot 32% in 2008. Op die plaas met die hoogste voorkoms het dit van 32% tot 12% gedaal, en op die plaas met die laagste voorkoms was die afname van 14% tot 3%. Op een plaas is die huidige voorkoms 1% vergeleke met 20% in 2008.

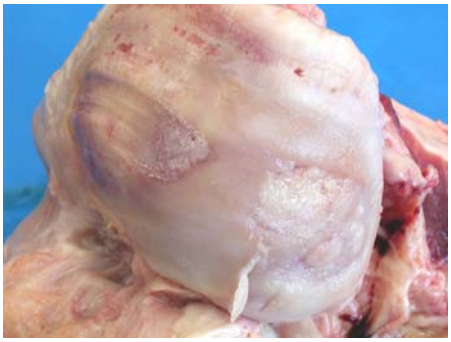
Dit is dus sonder twyfel bevestig dat artrose by beeste in Suid-Afrika die gevolg van ’n mineraalwanbalans met of sonder ’n vitamien A-tekort is.

Die navorsingspan se mineraalmengsel (Arthrocur A) is later met ’n B-mengsel aangevul. Soos die navorsingsinligting beskikbaar geraak het, is die samestelling aangepas. Daar is reeds besluit om produksie van die A- en B-mengsel te staak en net met ’n goedkoper C-mengsel aan te gaan.

Met die beskikbare inligting is dit nou vir boere moontlik om die voorkoms van artrose dramaties te verminder met die Arthrocur-lek, wat by deelnemende lekvervaardigers beskikbaar is. Om resultate te behaal, moet boere verseker dat die diere die korrekte hoeveelhede inneem. Dus is lekbakbestuur en die monitering van inname volgens voorskrif uiters noodsaaklik, asook die gereelde toediening (verkieslik ’n inspuiting) van vitamien A.

Daar is baie praktiese probleme verbonde aan navorsing wat op kommersiële plase gedoen word. Daarom word beheerde navorsingsproewe by Noordwes se landboudepartement in Potchefstroom beoog. Ongeveer 40 vroulike diere met klinies waarneembare artroseletsels is vir die proewe gekoop en die proewe sou in Desember verlede jaar (2010) begin het.

Twee afsonderlike proewe sal met speenkalwers en met beeste op die veld gedoen word. Die speenkalwers, wat deur die staat voorsien word, sal afsonderlik gehuisves en ’n volvoerrantsoen met en sonder sekere mineraalmengsels gevoer word. Laasgenoemde mengsel is saamgestel na aanleiding van resultate van been- en lewerontledings wat by die LNR se Instituut vir Grond, Klimaat en Water in Pretoria onder leiding van me. Nina van Vliet gedoen is.



Die tweede been is ’n veldproef waarin beeste met artroseletsels onder meer verskillende fosfaatbronne met of sonder mineraalmengsels sal ontvang. Dié proef sal waarskynlik twee tot drie jaar duur. Dié diere sal in ’n teelprogram ingeskakel word en navorsing sal ook op die nageslag gedoen word.

Fig 3: Tekens van herstel in die gewrigskaraakbeen van ‘n kalf wat artrose lek ontvang het.

Wetenskaplike publikasies waarin die resultate van die navorsingswerk uiteengesit word, word tans deur nagraadse studente onder leiding van toesighouers geskryf. Daar word beoog om die eerste twee publikasies vroeg vanjaar (2011) te publiseer.

Die samestelling van die Arthrocur-mineraalmengsel word in hierdie stadium nie bekend gemaak nie, aangesien die navorsing nog nie voltooi is nie en aanpassings voortdurend aan die samestelling gemaak word namate resultate bekend word.

Die noemenswaardige afname in die voorkoms van artrose op plase waar Arthrocur en vitamien A gebruik is, is ’n duidelike aanduiding dat die navorsers op die regte pad is. Die projek het nou ’n gevorderde stadium bereik waar die primêre oorsaak van die probleem die fokuspunt is. Hopelik sal daar in die volgende jaar of twee meer lig op die saak gewerp kan word.

Die totale koste van die projek beloop tot op datum ongeveer R11 miljoen. Boere en die staat – deur middel van die tegnologie- en menslikehulpbronneprogram (THRIP) wat deur die Nasionale Navorsingstigting bestuur word en onder die Departement van Handel en Nywerheid val – voorsien die meeste geld. Die probleem is van nasionale belang. Dus sal die navorsingsresultate in die vorm van publikasies en verhandelinge van nagraadse studente bekend gestel word.

Prof. Leon Prozesky is verbonde aan die departement parakliniese wetenskappe aan die Universiteit van Pretoria se fakulteit veeartsenykunde by Onderstepoort.

4. RT-PCR for bluetongue virus detection in sheep

Researcher: **Dr JJO Koekemoer**

Research Insitute: **ARC-Onderstepoort Veterinary Institute**

Total Funding: **R 150 000**

Final Approved: **2011**

INTRODUCTION

Large numbers of samples are routinely submitted for bluetongue virus (BTV) testing at the OVI. A lot is this is as a result of requirements of international trade in animals and animal products. Currently the diagnostic test that are used are either serological or a nested RT-PCR. Both these test take a long time to perform and although the nested RT-PCR is quicker than the ELISA it is still labour intensive and requires amplified BTV cDNA to be handled for both the nested amplification step and the subsequent gel electrophoretic analysis of results. By making use of real-time PCR the testing process can be streamlined. This is possible because real-time PCR is carried out in a closed system and the diagnostic signal is read as the target cDNA is being amplified. No post-PCR analyses are required to read results. As the first step in the development process, a new set of RT-PCR primers were designed based on multiple sequence alignments, generated as part of this project from 18 South African BTV strains. The primers were tested in a real-time RT-PCR format using dsRNA prepared from reference as well as field strains of BTV and the sensitivity of the test was determined. SYBR green I detection was selected to keep the cost of the real-time assay as low as possible. All serotypes and strains of BTV that were included, tested as positive and it was showed that related orbiviruses will not be amplified. Diagnostic sensitivity and sensitivity was determined to be 100% and the assay had a limit of detection of 14.8 fg of BTV dsRNA. The biggest advantage of this test lies in the short time (less than 2 hours) needed to complete the testing of large numbers (over 300 per run) of samples and its suitability to automated routine laboratory application. Once validation is completed and implemented, it could significantly improve the diagnostic capacity of the OIE reference laboratory for BTV.

High throughput detection of bluetongue virus in diagnostic samples.

Bluetongue (BT) is a viral disease of ruminants that is transmitted through the bite of blood feeding midges of the genus *Culicoides*. It is non-contagious and only causes symptoms in domestic sheep and rarely also in cattle. The severity of the symptoms vary significantly between species and breeds but in fully susceptible sheep the mortality rate can reach 30 % and animals usually die within 9 days. The highest incidence of the disease occurs during warm periods that follow the rainy season, as this results in high numbers of the insect vector that occur under these conditions. Most of sub-Saharan Africa is endemic for the disease but it has also spread to North and South America, Asia, the Middle East, Australia and it also re-emerged in Europe. Major outbreaks have occurred in Europe since 2001 and since then have re-occurred in parts of the continent up to now. Due to these sheep populations being totally naïve and the initial unavailability of any form of vaccination, outbreaks of BT in Europe have been very severe with a significant economic impact in countries like Italy, France and Holland.

As the seat of the OIE reference centre for BT, the Onderstepoort Veterinary Institute (OVI) has a two-fold responsibility. Firstly it is the regional centre for the performance of routine diagnostics. This includes diagnosis of the disease in clinical samples that are submitted for disease identification as well as screening of samples from animals that are intended for export or from which biological materials (ova, sperm, embryos) are exported to predominantly Australia, Argentina, Canada and Brazil. Secondly, the OVI is mandated to perform research aimed at delivering improved diagnostic methods and reagents through continuous application of modern technology. As part of the routine testing for the presence of BTV, the reference centre tests in the order of 2 000 samples per year just for export purposes, and these usually arrive in large batches. The rest of the samples are made up of clinical submissions from pathologists or veterinarians and numbers vary between seasons and with intensities of outbreaks.

Conventional gel-based assay of bluetongue-specific RT-PCR result. The last lane (lanes run from top to bottom) on the gel contains a positive result owing to the presence of a clear amplicon at the correct size as indicated by the arrow.

Classically, the only way to identify the virus that causes BT, the bluetongue virus (BTV), was to isolate it from clinical material using virological techniques, which would then be followed by amplifying the virus on cell culture and serological identification. This procedure is very time-consuming and requires specific expertise to isolate and culture the viruses. These methods have recently been augmented by the use of RT-PCR (reverse transcription – polymerase chain reaction). This is a molecular method that is used to identify the presence of virus genetic material (RNA) in a sample and it has the advantage that it can be done without the need for virus isolation. An RT-PCR with a nested step (a second round of amplification of the original RT-PCR product) is currently approved by the OIE as an international trade test and is implemented as such at the OVI. Although this method has the sensitivity and specificity to match that of virological techniques to identify BTV, it can be improved on in terms of speed and ease-of-use by applying the advantages of real-time PCR to the method. Real-time PCR is based on the same principle of amplifying a specific genetic target as conventional PCR. If the target is absent, there would be no amplification and hence the result will be negative and vice versa. The difference between the two techniques is in the way the amplification of target genetic material is detected. The result of a conventional PCR is read after electrophoresis of the amplified cDNA on an electrophoresis gel. To make and resolve the products on this gel requires more time and can give rise to contamination of the laboratory with amplified DNA. With a real-time PCR the amplification is measured as the reaction takes place in the tube without opening it, hence the name real-time PCR.

The research that was carried out in this project aimed to develop a real time RT-PCR method for the specific and sensitive detection of BTV which will improve on the time and man-hours required to perform large numbers of BTV diagnostics tests. Such a method was developed and tested using all the BT viruses that are known to occur in South Africa, both using reference viruses as well as viruses isolated from field cases. The results indicated that the specificity and sensitivity of the real-time RT-PCR test are the same as that of the conventional RT-PCR. The main advantage of this test, however, is in the automation of both the reading and interpretation of the results. This saves time and money and removes any human error that might results from the inaccurate calling of PCR test results. In addition, the closed system approach is ideal for use in a routine diagnostic lab as it can totally prevent contamination of working areas with cDNA. What remains now is to validate the new method in a diagnostic setup by comparing it with a golden standard test using a panel of samples as prescribed by the OIE. The ultimate goal would then be to replace the conventional RT-PCR with the

real-time test, saving a lot of time and making BTV screening by PCR much more efficient.

5. Genetic characterisation in FMD and ASF viruses

Improving detection and characterisation methods for FMDV and ASFV for cattle and pigs in the SADC region

Researcher:	**Dr J van Heerden, Ms B Blignaut**
Research Insitute:	**Agricultural Research Council**
	Onderstepoort Veterinary Institute
Total Funding:	**R 406 600**
Final Approved:	**2011**

Real-time Polymerase chain reaction for African swine fever virus (ASFV)

The detection of ASF viral DNA is achieved by use of the PCR technique that has been developed to target highly conserved regions of the genome. This allows for the detection and identification of a wide range of isolates belonging to all the known virus genotypes, including both non-haemadsorbing viruses and isolates of low virulence. It is useful for identifying virus DNA in pig tissues that are unsuitable for virus isolation or antigen detection because they have undergone putrefaction, or when it is suspected that the virus may have been inactivated during transport or at any time before samples arrive in the laboratory. Results suggest that the real-time PCR can be used to replace the conventional PCR assays that currently in use at TADP.

Real-time PCR for Foot and mouth disease virus (FMDV)

Recent events in the spread of FMD around the world have highlighted its extremely contagious nature and the disease remains a constant threat to trade and the economies of countries in SADC. Rapid and sensitive laboratory diagnostic tools that can recognise infected animals are imperative for the effective control and elimination of the disease. Automated real-time PCR has become a valuable diagnostic tool for FMD with a diagnostic sensitivity superior to that of Virus isolation/antigen ELISA combined. Results suggest that this real-time can be implemented for fast identification of possible outbreaks.

Genetic diversity of FMD viruses

FMDV evolved separately in geographical regions giving rise to topotypes. Due to the great amount of genetic and antigenic diversity within the SAT types, vaccines prepared from one strain may not provide protection against other strains. FMD molecular epidemiological studies for the SAT type viruses have concentrated on the 1 D-coding region to determine genetic relatedness of isolates. Data on the complete capsid-coding region is inadequate due to the restricted numbers and the fact that the majority are historic isolates that do not shed much light on the current epidemiological

situation. Characterisation of the external capsid-coding region allows for addressing the lack of knowledge for the SAT type viruses addressing the characterisation of possible epitopes which may be important for vaccination. Therefore the genetic variability of the SAT types in Africa was investigated to evaluate the characteristics of recent field isolates from wildlife, as well as livestock. The latest outbreaks of FMD were determined for the whole of Africa, with emphasis on southern Africa. The viruses were chosen to be representative of what is currently in the field and to cover the 3 topotypes found within southern Africa (South Africa, Namibia, Zimbabwe, Botswana, Zambia and Malawi). The viral RNA was amplified by reverse transcriptase-PCR, purified and used for sequencing. The nucleotide and deduced amino acid data was analysed for genetic and phylogenetic comparisons.

6. Genetic predictions for beef cattle by Dr A Maiwashe, ARC API

Researcher: **Mr N Maiwashe**

Research Insitute: **Agricultural Research Council**

Animal Production Institute

Total Funding: **R 188 000**

Final Approved: **2010**

Continuous improvement of methods to estimate breeding values is a necessary for sustainable genetic improvement. In the current project we conducted a research to develop a new breeding value for tolerance to ticks. We also investigated the feasibility of implementing more accurate methods for genetic analysis of stayability and post-weaning performance in intensively fed beef bulls.

The development of a new breeding value for tolerance to ticks was conducted using tick count data collected by ten seedstock Bonsmara farmers. The development of the new breeding value was carried out in two steps. In the first step, environmental and genetic factors that underly the differences in tolerance to ticks among animals were identified using statistical methods. This step is commonly known among academic animal breeders as the “model development step”. The environmental factors found to be important were the farm and date on which tick load was assessed, sex and age of the animal. Only one genetic factor was found to be important. This genetic factor is due to genes influencing tolerance to ticks that are passed on to the offspring and is technically called direct additive genetic factor. In the second step, the heritability for tolerance to ticks were estimated using the factors identified in step one. The heritabilities found in the current study indicate that 13% of the differences in tolerance to ticks in the Bonsmara breed are attributable to differences among breeding values.

The feasibility of using more accurate methods for estimation of breeding values for stayability and post-weaning weekly feed intake and weight gain were conducted separately. For stayability calving records on Angus cows participating in the National Beef Improvement Scheme were considered. In this study we used a statistical method called the “threshold model” to analyse stayability and heritabilities found in the current study are similar to those reported in similar research from other countries.

The Bonsmara data was used for post-weaning weekly feed intake and weight gain in intensively fed beef bulls. Genetic analysis of these traits was conducted using a statistical method called Random Regression Model. We successfully implemented the Random Regression model in the current study. The heritabilities obtained in the current study were similar to those reported in countries were this method has already been implemented.

Practical implications

A method to estimate breeding values for tolerance to ticks was developed. This new breeding value provides an opportunity to Bonsmara beef producers to improve tolerance to ticks through selection. Improved tolerance to ticks will lead to reduction in costs associated with use of acaricides to control ticks. The method developed in this study can be adapted for other beef cattle breeds. Successful implementation of methods for estimation of breeding values for stayability and post-weaning feed intake and weight gain indicates the feasibility of using these methods in South Africa. Implementation of these methods in the routine estimation of breeding value should be preceded by education of farmers in using breeding values from these methods.

PUBLICATIONS

Popular articles:

Scientific Articles:

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Maiwashe, A, Nephawe, KA and Theron, HE. 2009. Analysis of stayability in South African Angus cattle using a threshold model. South African Journal of Animal Science, 39 (1): 55-60.

Selapa, NW, Nephawe, KA, Maiwashe, A, Norris, D, Ngambi, JW. 2009. Analysis of Feed Intake of Individually Fed Beef Bulls Using Random Regression Models. J. Appl. Anim. Res. 36 : 223-226.

7. Laboratory tick challenge for heartwater vaccine development

Researcher: **Dr HC Steyn**

Research Insitute: **Onderstepoort Veterinarary Institute**

Agricultural Research Council

Total Funding: **R 240 000**

Final Approved: **2011**

Heartwater is one of the major tick born diseases that severely hamper improvement of livestock productivity in the developing world. The only available heartwater vaccine is a live blood vaccine that has numerous disadvantages and inefficiencies. Development of a simple, safe and effective vaccine would have a tremendous positive economic and social impact on rural and per-urban communities. The experimental animals used in our vaccine development studies are currently artificially challenged by intravenous injection with a virulent blood stabilate. A final evaluation of a promising new heartwater vaccine is then required in the field. During field testing we experience variable tick burdens and various E. ruminantium isolates of variable virulence present in the field during the same and different seasons. Thus each experimental animal or group receives a different challenge making interpretation and repeating of the results impossible. Establishing a laboratory tick challenge regime will eliminate these variables and thus improve initial vaccine screening and evaluations.

Simulating natural tick challenge in the laboratory during vaccine development studies will also have the advantage of more closely resembling a natural field tick challenge. We successfully established and maintained A. hebraeum ticks in the laboratory. It was determined that 100% of ticks can be artificially infected with heartwater by feeding them on an infected sheep and subsequently successfully transmitted the disease to naïve sheep. It was also determined that one Welgevonden infected tick can cause fatal heartwater in a sheep. Comparison of the needle challenge and tick challenge indicated that they both induce similar disease symptoms and pathology. An experimental DNA heartwater vaccine that was previously shown to fully protect against a needle challenge but only partially protect against field tick challenge did not protect against a laboratory tick challenge, even when the vaccine dose was increased by tenfold. However preliminary results indicate that a new DNA cocktail partially protected sheep from a laboratory tick challenge and thus shows promise for further investigation. This confirms the importance of testing potential new heartwater vaccines with a laboratory tick challenge rather than needle challenge

AN IMPROVED METHOD TO TEST HEARTWATER VACCINES

Helena Steyn, New Generation Vaccines, Onderstepoort Veterinary Institute

Heartwater (Figure 1) is one of the most important diseases of cattle, sheep and goats in areas of South Africa suited to the bont tick (Figure 2 and 3) and is a severe limitation on the production potential of these regions. Since it only occurs in Africa (apart from a few Caribbean islands) control

measures have to be researched and developed in Africa and therefore the Red Meat Research and Development Trust (RMRDT) has funded many research projects over the years.

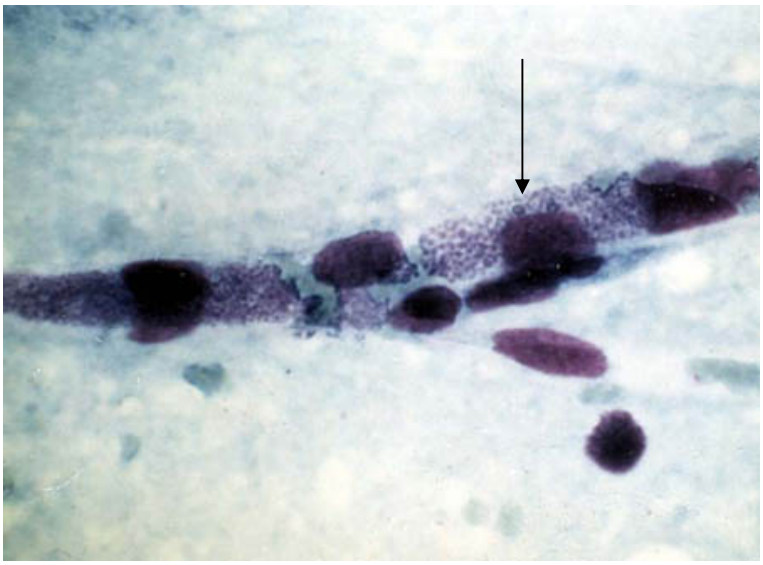

Figure 1. Heartwater parasites (fine particles around the cell nuclei) of a sheep brain

Figure 2. Male and female *A. hebraeum* (bont) ticks

***Amblyomma hebraeum* (Bont) tick**

The tick (Figure 2) is well known to farmers and is distributed in the endemic regions of South Africa (see Figure 3). The tick is absent in the colder highveld areas and semi desert areas. However, the tick can be introduced to non heartwater areas during the summer by purchasing tick infected ruminants and especially game from heartwater endemic areas and moving them to bont tick free areas.

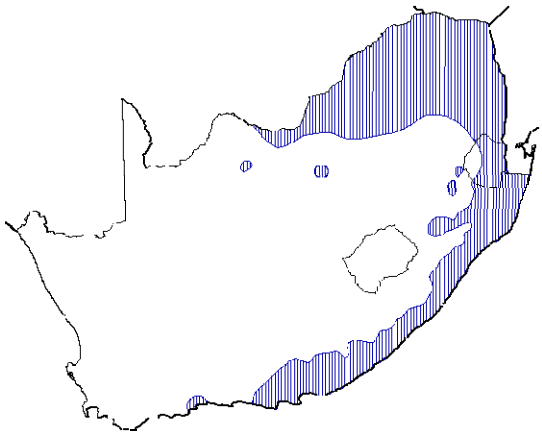

Figure 3. Heartwater endemic regions in South Africa

Previous research has proven that there are several different strains or types of the heartwater organism and that they vary in their ability to cause disease. Agricultural Research Council-Onderstepoort Veterinary Institute (ARC-OVI) has also shown that there is some cross-protection between strains and that one of these strains protects against more strains than the one used in the current frozen blood “vaccine”.

Previously, the ability of new heartwater vaccines to protect animals were tested by injecting heartwater infected blood some time after vaccination. However this method is artificial and a more natural infection by ticks is preferred. Unfortunately we found that natural tick challenges in a tick infested field have drawbacks that make the field tests unpredictable and thus unreliable:

1. tick burdens can vary considerably between animals, camps, farms and seasons
2. different strains of the organism may be present and these may therefore vary severity of disease caused.

To overcome these drawbacks we have developed a system of carefully controlled tick infection of sheep in the laboratory to remove these inconsistencies while still testing new vaccines against tick borne infection. We established and maintained all three stages of the bont tick in the laboratory. The nymphal stage of the bont tick was infected with heartwater by allowing it to feed on a sheep that had a temperature reaction due to heartwater. Thereafter the ticks are left to moult to the adult stage. These infected adults were then fed on uninfected sheep to determine the minimum number of ticks required to infect them with heartwater. From these results we determined that one tick can cause fatal heartwater.

This brings us a step closer to evaluating vaccines under standard conditions that closely resembles conditions on farms and will be used to test the current very promising attenuated (weekened) vaccine developed by the heartwater team at OVI (Dr E P Zweygarth) and reported in the September 2010 issue of Red Meat (Vol 1 No 3, P. 39).

An effective, practical, reliable and safe vaccine that cross-protects against many strains of heartwater remains the chief goal of heartwater research and OVI is grateful for the continuing support from RMRDT towards this goal.

8. Nutrients in Cattle offal

Researcher: **Dr L Hoffman**

Research Insitute: **Animal Science**

University of Stellenbosch

Total Funding: **R 65 000**

Final Approved: **2010**

INTRODUCTION

It was found that the beef organs (thin intestine, tongue, rumen, liver, heart, lungs, spleen, and kidneys) differ from each other with regards to their proximate composition, cholesterol and fatty acid contents as well as their amino acid and mineral contents. However, it also appears that production system may also have an influence on these attributes which is most likely due to factors such as differences in diet, the age of the animals, exercise etc. The organs from the feedlot animals were on average more fat than that from the free range animals. The value derived in this investigation will be of value to human nutritionists who will be able to use the information when giving dietary advice to patients.

In South Africa, the so called fifth quarter of a carcass is traditionally seen as being of limited value. However, its value is on the increase with some offal products becoming delicacies in niche markets (particularly in restaurants). Currently, there is very limited scientific literature available on the nutritional values for offal, especially for animals reared in South Africa. Research findings reported in the public domain often only include selected chemical analyses of a few organs, for example proximate composition, cholesterol and fatty acids of brain, heart, liver and tongue of sheep. In this project funded by the RMRDT the nutritional value of cattle offal was determined. Another aspect that was also investigated was to determine whether the finishing off of the animals under feedlot or natural pastures would influence this composition.

Twenty animals (10 finished in a local feedlot and 10 finished on a free-range farm) of mixed breed were slaughtered at Groenland Meat Traders (PTY) LTD in Grabouw, Western Cape, South Africa. The thin intestine, tongue, rumen, liver, heart, lungs, spleen, and kidneys were removed for analysis immediately after slaughter. At the laboratory, the samples were defrosted and cooked inside a plastic bag within a water bath set at 60˚C for 60 minutes. It was decided to cook the organs as nutritional values of cooked organs/meat are of more value to dieticians than nutrient composition tables of raw organs/meat.

The moisture, protein, fat and ash content (g/100 g meat) of the organs were determined. For a more detailed profile of the fat, the individual fatty acids were also determined. Similarly, the amino acid content and mineral profile of the organs were also analysed.

Comparison of nutritional composition of foodstuffs between laboratories is always difficult due to differences in the method of sample preparation. In the present investigation, samples were cooked in a sealed bag thereby limiting the moisture loss that is normally experienced during the cooking, grilling or barbequing of the meat. This method was followed as it is frequently the practice in South Africa to cook organ meat in a pot as a stew thereby retaining most of the leached nutrients. It could thus be argued that the amounts of the nutrients reported may be closer to that of raw samples rather than cooked samples.

The proximate composition of the eight cooked organs is depicted in table 1. Similar moisture and fat values for raw cattle heart, liver and kidney have been noted by other scientists in other countries. In the present investigation, beef liver had the highest protein content. It is interesting to note that the free range beef tongue also had a much higher protein content than that from the feedlot animals. The highest fat levels were found in the small intestine. It is noteworthy that the organs originating from the feedlot cattle tended to have higher fat contents.

Table 1: The proximate composition (g/100 g as is) of eight organs from feedlot and free-range cattle

Origin	Proximate composition	Heart	Kidney	Liver	Lung	Small Intestine	Spleen	Stomach	Tongue
Feedlot	Moisture	76.1	76.9	72.4	77.7	74.2	77.2	76.2	77.5
	Protein	17.9	17.8	21.3	17.6	19.7	18.7	18.9	18.8
	Fat	2.4	1.7	1.6	2.3	3.8	2.0	2.4	1.9
	Ash	0.9	1.3	2.7	1.1	1.2	1.4	0.9	1.1
Free-range	Moisture	79.0	76.6	69.6	78.6	72.5	76.9	80.1	74.6
	Protein	16.7	17.5	21.9	15.8	19.1	19.8	17.8	23.4
	Fat	2.3	2.8	2.4	3.9	3.6	2.8	1.3	1.4
	Ash	1.3	1.3	3.1	1.2	1.1	1.5	1.0	1.0

The fatty acid profiles and cholesterol content of the different organs are depicted in table 2. The cholesterol content of the heart, liver, kidney and tongue are much lower than those normally reported. Cholesterol content differed between all the organs, with the lung having the highest content and the tongue having the lowest.

The small intestine also had the highest SFA content. Since SFA's and polyunsaturated PUFA's are consumed together, their ratio (the P:S ratio) is an important measure of the relative risk factor of the cholesterol content in foodstuff. The higher the P:S ratio, the healthier a foodstuff is considered with a recommended daily allowance of 0.45 or higher. The P:S ratio in the current investigation ranged from 0.02 to 0.59. It is known that the P:S ratio is inversely related to the fat level in

ruminant meat with similar findings being found in the current investigation (the fatter the organ, the more saturated the fat is and the lower the ratio).

The ratio of n-3: n-6 fatty acids is also considered important to human health since these represent two groups of essential fatty acids in the human diet. In the current investigation, organs from feedlot animals had consistently higher n-6:n-3 ratios than those from free-range animals, which is consistent with similar findings in meat derived from feedlots. The recommended value for the n-6:n-3 ratio of foodstuffs is less than 5, which is lower than any of the values found for the organs in this investigation.

Table 2: Fatty acid composition (%) and cholesterol content (mg/100g) of organs from free-range and feedlot cattle

Origin	Fatty acid	Heart	Kidney	Liver	Lung	Small Intestine	Spleen	Stomach	Tongue
Feedlot (Total)	SFA	51.30	53.13	53.99	50.53	65.12	58.59	60.90	45.46
	MUFA	23.40	21.16	13.49	25.34	25.30	18.23	27.44	31.26
	PUFA	23.43	23.30	31.68	22.70	6.98	21.88	8.70	21.89
	PUFA:SFA	0.46	0.44	0.59	0.45	0.11	0.37	0.14	0.48
	(n-6)/(n-3)	32.94	10.99	6.86	5.04	13.85	8.95	9.54	15.32
Feedlot	Cholesterol (mg/100g)	56.41	185.26	145.74	204.75	99.93	168.84	65.26	52.76
Free-range (Total)	SFA	55.06	65.26	62.12	59.26	81.81	61.33	55.98	45.77
	MUFA	25.80	21.85	16.66	23.20	15.73	17.73	31.16	31.05
	PUFA	17.44	10.99	20.46	16.33	1.69	19.82	11.55	21.98
	PUFA:SFA	0.32	0.17	0.33	0.28	0.02	0.32	0.21	0.48
	(n-6)/(n-3)	24.74	6.05	6.53	3.58	12.50	6.77	5.60	12.06
Free-range	Cholesterol (mg/100g)	50.92	147.88	113.78	178.95	102.06	166.84	78.55	39.29

The amino acid profiles of the different organs are given in table 3. Proline levels were the lowest and methionine levels the highest in the heart when compared to the other organs. The stomach had the highest levels of proline and glycine. The tongue had the highest levels of tyrosine, leucine and phenylalanine. As expected, those organs, especially the stomach, containing high levels of collagen also had the higher levels of proline.

The mineral compositions of the various organs are given in table 4. There is considerable variation between organs in the concentration of minerals. In general, sodium levels were higher than any other mineral, with the exception of iron, which was very high in the spleen. Calcium and magnesium levels were much lower than any of the other minerals, followed by phosphorous and potassium levels. Copper and zinc levels were much higher in the liver than any other organs.

Origin	Amino acid	Heart	Kidney	Liver	Lung	Small Intestine	Spleen	Stomach	Tongue
Feedlot	Threonine	2.55	3.08	3.07	2.57	3.12	2.91	2.77	3.86
	Valine	3.25	3.28	3.70	3.02	2.85	3.99	2.86	3.46
	Histidine	1.67	1.64	1.70	1.27	1.48	1.64	1.28	1.92
	Lysine	4.44	5.11	3.87	4.65	5.91	3.99	5.26	5.34
	Methionine	1.83	1.42	1.61	1.00	1.32	1.26	1.37	1.72
	Proline	3.19	3.57	3.48	4.19	4.81	4.25	5.32	4.17
	Tyrosine	2.68	2.92	2.81	2.26	2.85	2.54	2.63	3.34
	Isoleucine	2.83	2.66	2.95	2.01	2.64	4.55	2.59	3.92
	Phenylalanine	2.82	2.87	3.23	2.37	2.68	3.00	2.45	3.24
	Glycine	2.84	3.66	3.19	4.63	5.80	4.74	6.27	5.37
	Leucine	6.76	6.81	6.93	5.72	6.08	6.64	6.02	7.47
Free-range	Threonine	3.32	3.45	2.84	2.12	1.71	2.89	2.10	3.17
	Valine	2.90	3.72	3.12	2.91	2.52	3.44	2.64	2.89
	Histidine	1.61	1.66	1.52	1.35	0.80	1.87	1.17	1.68
	Lysine	4.97	4.11	4.09	3.92	2.93	4.63	4.29	5.60
	Methionine	2.02	1.50	1.55	1.05	0.98	1.38	1.45	1.62
	Proline	2.84	4.09	3.39	4.06	3.52	3.86	4.79	3.95
	Tyrosine	3.03	2.86	2.93	2.34	1.71	2.96	2.61	3.77
	Isoleucine	2.99	3.22	2.66	1.87	1.88	2.38	2.40	3.14
	Phenylalanine	2.98	3.14	3.17	2.49	1.83	3.10	2.53	3.32
	Glycine	3.03	4.45	2.77	4.35	4.55	3.88[a]	5.35	4.31
	Leucine	5.89	7.15	6.10	5.16	4.43	6.05	5.25	7.52

From the current investigation, it is evident that beef organs differ from each other with regards to their proximate composition, cholesterol and fatty acid contents as well as their amino acid and mineral contents. However, it also appears that production system may also have an influence on these attributes which is most likely due to factors such as differences in diet, the age of the animals, exercise etc. The value derived in this investigation will be of value to human nutritionists who will be able to use the information when giving dietary advice to patients

Origin	Mineral	Heart	Kidney	Liver	Lung	Small Intestine	Spleen	Stomach	Tongue
Feedlot	Phosphorous	0.014	0.020	0.025	0.019	0.020	0.019	0.009	0.013
	Potassium	0.012	0.014	0.020	0.016	0.021	0.020	0.013	0.016
	Calcium	0.001	0.002	0.001	0.001	0.002	0.001	0.001	0.001
	Magnesium	0.002	0.002	0.002	0.001	0.002	0.002	0.001	0.002
	Sodium	3.217	8.464	4.391	7.946	9.225	4.549	6.357	4.489
	Iron	4.096	6.313	2.881	10.409	3.062	31.225	3.538	2.262
	Copper	0.370	0.381	1.693	0.125	0.194	0.133	0.146	0.104
	Zinc	2.220	2.365	5.022	1.899	3.058	2.494	2.748	3.432
	Manganese	0.034	0.114	0.277	0.022	0.093	0.027	0.065	0.017
	Boron	0.016	0.008	0.021	0.020	0.025	0.024	0.012	0.011
	Aluminium	4.356	4.536	3.337	5.568	3.250	3.901	0.912	2.407
Free-range	Phosphorous	0.013	0.016	0.024	0.014	0.019	0.015	0.010	0.014
	Potassium	0.010	0.012	0.020	0.012	0.020	0.013	0.014	0.016
	Calcium	0.001	0.002	0.001	0.001	0.002	0.003	0.005	0.002
	Magnesium	0.002	0.002	0.002	0.001	0.002	0.002	0.001	0.002
	Sodium	2.594	7.190	4.073	7.809	7.922	3.308	6.702	4.506
	Iron	4.450	7.909	4.902	12.429	3.955	31.261	2.949	2.894
	Copper	0.285	0.270	0.977	0.140	0.198	0.103	0.111	0.154
	Zinc	2.005	2.033	4.398	1.718	2.527	2.315	2.526	3.740
	Manganese	0.038	0.097	0.260	0.025	0.104	0.033	0.631	0.031
	Boron	0.012	0.014	0.022	0.014	0.027	0.025	0.012	0.015
	Aluminium	2.189	2.641	2.417	3.879	8.219	1.079	0.537	2.773

9. Nutrients in Sheep offal

Researcher: **Dr L Hoffman**

Research Insitute: **Animal Science**

University of Stellenbosch

Total Funding: **R 97 400**

Final Approved: **2010**

INTRODUCTION

Proximate composition differed between organs and breeds while very few differences were noted in total SFA and MUFA between organs and breed. Merino heart had significantly higher (7.27%) total PUFA than Dorper heart (1.78%). All the organs showed favourable P: S ratios, with the exception of the tongue, heart and stomach. Dorper and Merino brain, lungs and testicles had favourable (n-6)/(n-3) ratios below 5. Cholesterol content differed between both organs and breeds. Calcium (0.001-0.005 mg/100g) and magnesium (0.001-0.002 mg/100g) were found in the lowest concentrations while sodium (24.325-72.238 mg/100g) and iron (1.674-17.517 mg/100g) were found in the highest concentrations. Liver was found to be a good source of iron and zinc. These values will be of value to human dieticians during the formulation of human diets.

Proximate composition differed between organs and breeds while very few differences were noted in total SFA and MUFA between organs and breed. Merino heart had significantly higher (7.27%) total PUFA than Dorper heart (1.78%). All the organs showed favourable P: S ratios, with the exception of the tongue, heart and stomach. Dorper and Merino brain, lungs and testicles had favourable (n-6)/(n-3) ratios below 5. Cholesterol content differed between both organs and breeds. Calcium (0.001-0.005 mg/100g) and magnesium (0.001-0.002 mg/100g) were found in the lowest concentrations while sodium (24.325-72.238 mg/100g) and iron (1.674-17.517 mg/100g) were found in the highest concentrations. Liver was found to be a good source of iron and zinc.

In South Africa, the so called fifth quarter of a carcass is traditionally seen as being of limited value. However, its value is on the increase with some offal products becoming delicacies in niche markets (particularly in restaurants). Currently, there is very limited scientific literature available on the nutritional values for offal, especially for animals reared in South Africa. Research findings reported in the public domain often only include selected chemical analyses of a few organs, for example proximate composition, cholesterol and fatty acids of brain, heart, liver and tongue of sheep .

Twenty sheep (10 Dorper and 10 Merino) were reared in a free-range system in South Africa and slaughtered using standard South African techniques at LAV abattoir. The sheep sampled were all A2 or A3 carcass grades. The brain, tongue, stomach, liver, heart, lungs, spleen, kidneys and testicles were removed immediately after slaughter. Each of the organs were individually labeled, frozen and

transported to the Stellenbosch University meat laboratory for further analyses. At the laboratory, the samples were defrosted and cooked inside a plastic bag within a water bath set at 60˚C for 60 minutes.

Proximate analysis was conducted on minced (three times through 2 mm sieve) organ samples of all the animals. The moisture, protein, fat and ash content (g/100 g meat) were determined according to standard laboratory procedures.

For fatty acid analysis, a lipid extraction was used whilst a sub-sample was used for cholesterol determination by Gas Liquid Chromatography. The amino acid composition (essential amino acids) and mineral profile were also determined.

The proximate compositions of the nine organs are given in table 1. Differences were noted between both organs and breeds. The moisture content of the brain, kidney and liver are similar to those reported in the literature for raw and cooked mutton brain, kidney and liver. However, lower moisture values for mutton tongue have been reported and it was also found that cooking significantly reduced the moisture content of mutton heart, which was reported as being 80.17% in raw heart and 67.94% in cooked heart. Similar moisture values (67.9% and 69.5%, respectively) have been reported for raw lamb tongue. Similar fat values to that reported in this investigation for brain have been reported overseas but the fat content of the heart, liver and kidney was much lower overseas than reported in this study. The fat content of raw and cooked tongue was reported as 26.23% and 22.76%, respectively, which is considerably higher than those found in the current study. In North Africa, similar protein and ash values to the current findings for sheep liver, spleen and heart have been reported. Similar moisture contents for liver, spleen, heart and kidney to that in the current study were also reported although considerably lower fat contents for sheep liver (3.20%) and heart (6.60%) were reported.

Table 1: Proximate composition (%) of Merino and Dorper organs

Breed	Proximate composition	Brain	Heart	Kidney	Liver	Lung	Spleen	Stomach	Testicle	Tongue
Dorper	Moisture	77.8	66.8	76.7	66.7	77.9	75.3	82.7	81.5	66.2
	Protein	10.1	15.2	16.2	18.8	15.6	20.4	14.8	12.9	15.2
	Fat	10.1	16.4	5.2	11.8	4.6	2.9	1.7	4.2	11.8
	Ash	2.0	0.9	1.7	1.9	1.1	1.7	0.9	1.1	0.9
Merino	Moisture	78.0	68.9	77.1	66.9	76.0	77.2	79.8	83.7	66.3
	Protein	8.7	13.5	14.9[b]	20.9	17.6	16.1	15.5	11.1	15.1
	Fat	11.9	16.4	6.2	9.7	4.6	4.3	3.1	3.8	16.0
	Ash	2.0	0.9	1.2	1.6	1.1	1.4	0.7	1.1	0.9

The fatty acid profiles and cholesterol contents of the different organs are shown in table 2. With the exception of the Dorper brain, heart and kidney, no differences between organs were found for total saturated fatty acids (SFA) or total monounsaturated fatty acids (MUFA). Total polyunsaturated fatty acids (PUFA) differed between organs with the tongue having the lowest level of PUFA. Total PUFA levels ranged between organs from 2.22% to 24.01%. Internationally, PUFA values of 28.5%, 23.0% and 26.9% for raw goat liver, kidney and heart, respectively have been reported which is higher than any of the values found in the current study. Although the international values were reported for raw samples, other researchers have found that cooking had a minimal effect on the fatty acid composition of meat and that drippings collected after cooking contained mainly triglycerides.

Table 2: Fatty acid composition (%) and cholesterol content (mg/100g) of Dorper and Merino organs

Breed	Fatty Acid	Brain	Heart	Kidney	Liver	Lung	Spleen	Stomach	Testicle	Tongue
Dorper	SFA	46.81	69.95	46.52	50.95	51.88	53.93	50.15	52.52	51.90
	MUFA	29.89	26.75	30.24	24.05	27.72	28.21	37.60	30.49	43.51
	PUFA	22.90	1.78	21.22	24.01	18.14	14.94	8.04	14.82	2.22
	PUFA:SFA	0.49	0.03	0.46	0.47	0.35	0.28	0.16	0.28	0.04
	(n-6)/(n-3)	0.43	9.00	11.44	5.95	4.10	7.44	9.50	1.13	7.83
	Cholesterol (mg/100g)	5238.29	56.47	226.19	168.19	201.84	188.19	30.90	89.15	46.63
Merino	SFA	45.52	68.24	45.37	47.16	47.68	52.33	51.54	48.16	44.52
	MUFA	32.51	21.09	31.75	32.97	28.68	30.56	38.86	31.79	50.57
	PUFA	21.35	7.27	20.22	18.87	21.50	14.62	8.38	18.06	3.65
	PUFA:SFA	0.47	0.11	0.45	0.40	0.45	0.28	0.16	0.38	0.08
	(n-6)/(n-3)	0.48	20.36	10.19	7.28	4.10	7.48	13.44	1.49	18.89
	Cholesterol (mg/100g)	5638.28	48.59	155.57	205.54	175.74	177.39	35.77	98.90	51.26

Since SFA's and polyunsaturated PUFA's are consumed together, their ratio (the P:S ratio) is an important measure of the relative risk factor of the cholesterol content in foodstuff. The higher the P:S ratio, the healthier a foodstuff is considered and the recommended daily allowance of P:S for humans is around 0.45. The P:S ratio of the Merino and Dorper organs showed considerable variation with Dorper hearts and tongues having the lowest ratio, 0.03 and 0.04 respectively. Merino and Dorper brains had the highest levels of 0.47 and 0.49, respectively.

The n-6 and n-3 fatty are considered essential fatty acids in the human diet since the human body is unable to synthesize these itself. The (n-6)/ (n-3) ratio is often used as a measure of the health value of foodstuff and a value of <5 is recommended. Only the heart and the testicles had ratios of <5 while the remaining organs, for both breeds, had values above 5. The (n-6)/ (n-3) ratio of lamb

muscle has been reported as ranging from 1.29 to 2.45, depending on diet. These values are lower than those found in the current investigation, suggesting that, with the exception of the heart and the testicles, Dorper and Merino organs have a less favourable (n-6)/ (n-3) ratio.

Table 3: Amino acid composition (mg/100g) of Dorper and Merino organs

Breed	Amino acid	Brain	Heart	Kidney	Liver	Lung	Spleen	Stomach	Testicle	Tongue
Dorper	Threonine	2.76	2.22	2.11	3.28	3.02	2.75	2.79	2.63	2.25
	Valine	2.74	2.14	3.26	3.74	3.57	3.52	2.79	2.48	2.50
	Histidine	1.60	1.25	1.58	2.19	2.09	2.29	1.27	1.18	1.17
	Lysine	4.73	3.47	4.34	5.60	5.57	5.29	5.08	4.75	4.85
	Proline	2.66	2.58	3.54	4.04	4.53	3.97	4.90	5.50	3.30
	Methionine	1.21	1.07	1.37	1.35	1.24	1.31	1.30	1.09	1.15
	Tyrosine	2.45	1.72	3.24	3.84	2.81	2.87	2.37	2.20	1.99
	Isoleucine	2.06	1.75	2.59	3.19	2.15	2.19	2.17	2.09	1.89
	Phenylalanine	2.81	1.93	3.06	4.08	3.10	3.28	2.44	2.36	2.14
	Leucine	5.84	4.70	6.92	8.22	7.43	7.29	5.83	5.58	5.18
	Glycine	2.70	2.65	2.63	3.29	4.70	4.07	6.05	6.12	4.18
Merino	Threonine	2.95	2.49	3.08	2.99	3.54	2.79	2.56	2.90	2.31
	Valine	3.01	2.37	3.57	3.40	3.91	3.38	2.58	2.71	2.32
	Histidine	1.59	1.37	2.03	2.10	2.49	2.14	1.23	1.40	1.15
	Lysine	4.68	4.01	4.96	5.32	5.87	5.42	5.01	5.40	5.12
	Proline	2.87	2.77	4.12	3.75	4.55	4.33	4.84	5.08	3.14
	Methionine	1.31	1.17	1.52	1.33	1.28	1.28	1.22	1.37	1.10
	Tyrosine	2.65	1.94	3.53	3.35	2.76	3.19	2.36	2.85	2.09
	Isoleucine	2.25	2.12	2.92	2.81	2.00	2.46	2.04	2.55	1.85
	Phenylalanine	3.03	2.09	3.51	3.65	3.43	3.40	2.42	2.85	2.25
	Leucine	6.19	5.32	7.72	7.43	8.15	7.26	5.76	6.43	5.18
	Glycine	3.10	2.80	3.79	3.16	4.70	4.36	6.08	5.33	3.75

Cholesterol levels were much higher in the heart than any of the other organs. This is in agreement with other findings where cholesterol contents of 1408.05 mg/100g in cooked mutton brain and 1352 mg/100g in lamb brain have been reported.

The amino acid compositions of the various organs are shown in table 3. Histidine and methionine levels are similar to those reported internationally for dried lamb organ samples. The liver showed high levels of leucine when compared to the other organs, which is in agreement with the findings of international reports.

Table 4: The mineral composition (mg/100g) of Dorper and Merino organs

Breed	Mineral	Brain	Heart	Kidney	Liver	Lung	Spleen	Stomach	Testicle	Tongue
Dorper	P	0.012	0.011	0.015	0.016	0.012	0.018	0.010	0.011	0.009
	K	0.010	0.012	0.010	0.013	0.010	0.015	0.009	0.010	0.009
	Ca	0.003	0.001	0.001	0.001	0.001	0.001	0.005	0.001	0.001
	Mg	0.002	0.002	0.002	0.002	0.001	0.002	0.002	0.001	0.002
	Na	34.516	44.286	59.703	24.325	71.613	32.933	35.686	39.662	26.115
	Fe	9.106	8.567	12.315	7.862	11.585	8.169	13.624	17.517	11.825
	Cu	0.443	0.193	0.318	3.493	0.355	0.080	0.255	1.161	0.197
	Zn	1.563	1.704	2.009	3.596	1.336	1.403	2.281	2.219	1.837
	Mn	0.243	0.121	0.378	0.439	0.054	0.064	0.701	0.458	0.407
	B	0.030	0.029	0.016	0.071	0.032	0.026	0.040	0.021	0.043
	Al	1.725	0.817	1.947	0.782	2.459	0.958	0.39	0.792	0.974
Merino	P	0.011	0.009	0.015	0.015	0.014	0.018	0.008	0.011	0.014
	K	0.015	0.010	0.010	0.011	0.010	0.015	0.009	0.011	0.015
	Ca	0.003	0.001	0.002	0.001	0.001	0.002	0.001	0.001	0.006
	Mg	0.002	0.002	0.002	0.001	0.001	0.002	0.001	0.001	0.002
	Na	62.637	38.037	64.027	25.245	72.238	33.626	41.056	39.370	69.130
	Fe	2.244	3.882	4.718	2.868	10.101	6.933	1.674	1.794	2.221
	Cu	0.254	0.152	0.292	10.163	0.172	0.060	0.112	0.076	0.067
	Zn	1.352	1.476	2.507	4.286	1.362	1.552	2.223	1.618	1.970
	Mn	0.047	0.024	0.098	0.242	0.008	0.017	0.060	0.022	0.032
	B	0.020	0.016	0.015	0.016	0.031	0.022	0.014	0.009	0.012
	Al	0.964	0.853	3.392	0.969	2.687	0.907	0.902	1.387	1.096

The mineral profiles of the various organs are shown in table 4. Calcium and magnesium were found in the lowest concentrations while sodium and iron were found in the highest concentrations. Liver had the highest concentration of copper and zinc. These are important since they are considered as

essential minerals. Lung had the highest sodium and aluminium concentrations but also the lowest zinc and manganese levels. The tongue had the lowest phosphor, sodium and copper levels. Both spleen and lung had lower levels of zinc and manganese when compared to the other organs.

The organs in this study all differed in proximate composition, fatty acid profiles, cholesterol content and mineral content. Breed differences were also noted. This can be expected since similar findings have been reported internationally. No differences between organs or breed were found for total saturated fatty acids (SFA) or total monounsaturated fatty acids (MUFA), while total polyunsaturated fatty acids (PUFA), differed between the two breeds with Merino hearts having a significantly higher PUFA level than Dorper hearts. All the organs showed favourable P: S ratios, with the exception of the tongue, heart and stomach. Both Dorper and Merino brain, lungs and testicles had favourable (n-6)/(n-3) ratios below five. Calcium and magnesium were found in the lowest concentrations in the organs while sodium and iron were found in the highest concentrations. Liver was found to be a good source of iron and zinc. It would be of interest to research the manipulation of this composition through various other factors such as nutrition and supplementation.

10. Stocking rate model development for cattle

Researcher: **Dr B Westfall**

Research Institute: **Animal Production Institute**

Agricultural Research Council

Total Funding: **R 808 000**

Final Approved: **2010**

EXECUTIVE SUMMARY

This report presents the final results of the stocking rate model. The motivation for this development is that stocking rate is the most important variable influencing animal production and productivity of vegetation. The PHYTOTAB-PC programme package was used to determine the grass phytomass in terms of kg/ha based on means of the entire plant community. It was, therefore, hypothesized that a single or relatively few samples in a camp could indicate the total aboveground phytomass and available phytomass.

Results of the survey showed that the model was able to detect animal preference of some sites over the other during grazing, which was according to expectation. In three out of four occasions, the model was able to accurately estimate the number of days.

The Google imagery processing development was tested on several farms which has culminated in a publication in *Koedoe*. The publication describes how the floristic data sampled on a farm, Evelyn in Limpopo Province, to determine relatively homogeneous vegetation units, correlated with the processed Google imagery. A very high correlation was obtained.

Notwithstanding the invaluable use of the model to estimate stocking rate, data collection for the model is cumbersome and may render the model less practical as a tool at farm level. It is recommended that future work concentrate on alternative veld sampling procedure to apply the model.

1. INTRODUCTION

Stocking rate is the most important variable influencing animal production and vegetation productivity, where:

- Vegetation productivity can be expressed as the quantity and quality of forage per mm rainfall;
- Vegetation condition is directly proportional to the quantity of forage produced; and
- Vegetation condition is inversely proportional to the effect of rainfall variation.

The PHYTOTAB-PC program package includes grass phytomass determinations in terms of kg/ha based on means for an entire plant community at 1:12 000 scale. This has been achieved using grass clippings which were related to mean species cover and mean species spacing. Regressions showed a linear relationship. The means used were those for all the samples in a communit.

Furthermore, analysis of cover to frequency ratios can indicate strong and weak competitors within a growth form class such as the grasses. Generally grasses form a palatability gradient from strong to weak competitors thereby permitting an objective assessment of palatability. Camps are generally far more homogeneous than the plant communities of which they are a part. It was, therefore, hypothesized that a single or relatively few samples in a camp could indicate the total aboveground phytomass and available phytomass.

A single camp sample would consist of the grass species present in a 10 X 20 m representative quadrat together with the mean canopy diameter and cover count for each of the recorded grass species. This is a very simple and objective manner of determining available grass phytomass. Stocking rate determination is inhibited by:

- The lack of a quick and reliable method of determining forage quantity and quality at any given time; and
- Quantification of the relationship between stocking rate and vegetation quantity and quality.

However, certain assumptions have been made in the model which should be tested, namely:

1. Will precision be acceptable for the reduced species number found in a camp sample in comparison with the plant community?
2. Will the regression be valid for the reduced species number?
3. Will the palatability rating based on cover to frequency ratios be valid?
4. Will simple adjustments to the model improve output?
5. Will the output be sensitive enough to determine optimal stocking rates for beef production?

5.1 The quality difference in DM intake can be estimated from the amount of time a herd spends in a camp to utilise 1/4, 1/2, 3/4 of the available dry matter which should correspond to production differences in the animals.

5.2 Animal performance can be estimated by monitoring:

- ADG (average daily gain)
- Number of offspring
- Growth of offspring; and

6. Will the model be able to differentiate between optimal beef production and optimal vegetation condition?

Aims

The aim of the project was to develop a model suitable for farm use to determine:

1. Total aboveground grass phytomass (kg/ha)
2. Total grass phytomass available for grazing (kg/ha)

3. Camp stocking rate in terms of number of livestock units/ha/day

2. Materials and methods

The PHYTOTAB-PC program package includes grass phytomass determinations in terms of kg/ha based on means for an entire plant community at 1:12 000 scale. Field data for developing the model was collected from the Roodeplaat farm of the Agricultural Research Council. This has been achieved using grass clippings which were related to mean species cover and mean species spacing. Regressions showed a linear relationship. The means used were those for all the samples in a community.

A single camp sample consisted of the grass species present in a 10 X 20 m representative quadrat together with the mean canopy diameter and cover count for each of the recorded grass species. This is a very simple and objective manner of determining available grass phytomass.

As part of stocking rate model validation, vegetation surveys were conducted before and after the animals have been moved in and out of the camp. During the vegetation survey, the following vegetation parameters were recorded as inputs to the PHYTOTAB PC- PROGRAMME Package;

- Species Name
- Mean crown diameter
- Frequency

The animal parameters to be inputs to the Model were;

- Animal numbers
- Average herd weight

The model will then estimate 1) Total above ground dry phytomass (kg/ha), 2) Total available dry phytomass for grazers (kg/ha) and lastly the stocking rate (Ha/LSU).

Model output was correlated with detailed plot data to determine model efficacy at camp scale and minimum sample size and,

Model output was correlation with large livestock production over an extended period to determine optimum stocking rates based on vegetation condition, quality and animal performance.

3. Results

Four camps were selected and in each camp 4 sampling site were chosen, representing different plant communities or homogenous veld type units. Data from both cattle and vegetation was then captured using the procedure mentioned above and programme output will then give the stocking rate in terms of the number of days. This procedure was followed after the animals has left the camp to see if there was a correlation between the vegetation and animal inputs and the output from the programme (i.e. stocking rate in terms of the number of the days). During the survey the model was 1) able to detect animal preference of some sites over the other during grazing, which was according to our expectation. 2) In three out of four occasions, the model was able to accurately estimate the

number of days left (i.e when we were subtracting the initial days from the days animals spend in the camp).

Mr. Mike Zingel was able to test the Google imagery processing development on several farms which has culminated in a publication in *Koedoe*. The publication describes how the floristic data sampled on a farm, Evelyn in Limpopo Province, to determine relatively homogeneous vegetation units, correlated with the processed Google imagery. A very high correlation was obtained. Mr. Zingel intends registering for a M.Sc. for this study. Mr Gilbert Pule also intended registering an MSc as part of validating this model but he registered an MSc for a different subject. The results show that the image processing procedure can be used on any farm to ensure that camps are not too heterogeneous, floristically, for the model.

A further development has arisen out of the alliance between Dr Westfall and HotGroup relating to precision farming techniques which was not originally planned. Fitting a herd of cattle with tracking collars will allow mean animal movement per day to be determined in a camp. This can be expressed as km per animal per day or total km travelled by the herd in the camp. It is anticipated that such data could very well correlate with the model as it is hypothesized that animal movement will increase as the grass becomes less Of cardinal importance would be the occurrence of a spike in movement at a certain stage of grass utilization. Should this occur the model could become redundant for farm applications. It would, however, be critical for calibratory purposes

Collar development relates to collar webbing with inbuilt aerials and electric conductors as well as a redesigned and lighter container for the electronics. The electronics for tracking work well with a high degree of precision. Other collar developments for which the electronics are being developed are animal health and behaviour as well as an acoustic/impulse collar for fenceless camp systems.

In the development of the project *"Innovative Management for Improved Productivity: Beef",* also funded by RMRD SA a component was developed that was supposed to piggy-back on the project *"Stocking rate model development for cattle",*, that was already funded by the RMRD SA, by integrating the aspects of breeding and genetics, fertility manipulation and grazing management. In the *"Innovative Management for Improved Productivity: Beef"* project, the herd was to be subjected to one of two grazing strategies viz high and low quality grazing, related to the use of 30% or 60% of the available grass dry matter as determined by the application of the stocking rate model.

According to the stocking rate model, veld evaluations must be done before and after animals are moved from one camp to another. At least 2 representative vegetation samples of 10 x 20m per camp must be surveyed. The following must then be recorded: grass species present in the quadrants, mean canopy diameter and cover count for each of the recorded grass species. The PHYTOTAB-PC program package should then be used to determine grass phytomass in kg/ha and can be used to indicate when animals must move from one camp to another.

4. Discussions of results

The use of the PHYTOTAB-PC program package proposed for the pasture evaluation of the project *"Innovative Management for Improved Productivity: Beef"* has proofed to be extremely time consuming and impractical for the commercial farmer. Therefore a new streamlined evaluation system was put in place and the PHYTOTAB-PC program was not used in the above mentioned

project although it was suggested in the development phase of the project. A vegetation evaluation system was proposed by Mr Breytenbach, veld ecologist at Roodeplaat. Five different plant communities are present on the Roodeplaat research farm. These plant communities present on the farm will be evaluated during each consecutive growing season (October/November) to determine stocking rate. The animals will then be moved from one camp to another according to each year's established stocking rate, camp size and group size as stipulated in the project protocol.

5. Conclusions

It can be concluded that although the stocking rate model that has been developed is extremely useful for veld evaluation and research and development purposes, it is not a practical tool that can be used by farmers routinely. Its importance as a tool for proper pasture evaluation has however, been proved beyond doubt.

6. Implications

The PHYTOTAB-PC has great potential for adaptation to farm use if alternative sampling procedures could be identified to overcome the high intensity of field work required in the current protocols.

7. Recommendations

A less cumbersome veld sampling procedure should be identified to improve the applicability of the PHYTOTAB-PC routine farm practices.