भाकृअनुप
ICAR

वार्षिक प्रतिवेदन
ANNUAL REPORT
2010-11

राष्ट्रीय उष्ट्र अनुसंधान केन्द्र
(भारतीय कृषि अनुसंधान परिषद्)
जोड़बीड़,बीकानेर-334 001,राजस्थान,भारत

National Research Centre on Camel
(Indian Council of Agricultural Research)
Jorbeer, Bikaner-334 001, Rajasthan, India

Published by

Dr. N. V. Patil
Director

Published

July 2011

Printed by

R.G. Associates
Bikaner -334001
Mob. 9414603856

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निदेशक- डॉ. एन. वी. पाटिल
Director - Dr. N. V. Patil

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D G VISITS THE CENTRE

Preface

It gives me immense pleasure in presenting the progress and achievements of NRCC during the year 2010-11 in the form of Annual Report. The Centre has the mandate to undertake both basic and applied researches following the road map conceived in the recently prepared Vision 2030 and the recommendations of the Research Advisory Committee. The interactions held during the visits of dignitaries, brain storming sessions, meetings, preparation of result frame work document etc. laid the foundation of vibrant research in the field of camel nutrition, breeding and genetics, reproduction, health, physiology, biochemistry, products development, management, extension, farming and agro-forestry by the young and energetic team of scientists at the Centre.

Some of the glimpses of research achievement include microsatellite profiling of all four major camel breeds of India at 25 polymorphic loci. The existence of population structure, genic variation, genetic distance, phylogenetic relationship, consensus tree construction and individual identification was carried out successfully utilizing latest bioinformatics tools available in the public domain.The growth, reproduction and milk production had been satisfactory. The Mewari herd has been strengthened by the purchase of 6 more camels from the habitat.The work on Body Condition Score has been initiated for the first time in camel. The pre-seasonal and post-parturient breeding was successfully attempted and envisaged as a tool to reduce the calving interval in the species. The Chocolate *Barfi*, *Peda*, Lyophilized skim milk powder and *Rasogolla* were successfully prepared out of camel milk and assessed for commercial viability. Good work has been done on energy requirement of lactating camels, *in-vitro* fermentation studies of locally available feeds and fodders and strategic supplementation with area specific mineral mixture. Twelve colonies of cellulolytic rumen bacteria were isolated and purified.

The Centre had been instrumental in diagnosis of camel diseases in the north-west zone of the country. The Centre's camel health experts gave their best technical inputs during disease out-breaks in Rajasthan and Gujarat.

Fungal isolates from different skin infections in camel have been characterized. Schlafen-like protein gene of camel pox virus was successfully cloned and sequences. The full length gene sequence of topoisomerase gene of pseudocowpoxvirus isolates from camels was submitted to the NCBI database. Excellent work has been initiated in the clinico-pathological aspects of camel diseases. Contagious ecthyma infection and hemangiosaroma has been studied.

On the International front, the Centre has successfully completed the research project and training of the Sudanese scholar and the work of Italian and Egyptian scholar is in progress.

I feel happy that the dedicated efforts of all the scientists could make it possible to bring the report in present form for which I express my sincere appreciation. The efforts made by the publication committee, scientists, technical and administrative staff are also thankfully acknowledged. The constructive analytical suggestions from the Research Advisory Committee under the chairmanship of Dr. Nagendra Sharma, Ex-Vice Chancellor, Sher-e-Kashmir University of Agriculture & Technology, Jammu has been of great help in fine tuning the research programmes and activities of the Centre.

I am highly indebted to Dr. S. Ayyappan, Secretary, DARE and Director General, ICAR for visiting the Centre and having indepth discussion with the staff members of the Centre on all relevant issues. The valuable guidance, support and encouragement received will definitely be pivotal in the development of this Centre. I express my sincere gratitude to Dr. K. M. L. Pathak, DDG (AS) for especial attention, encouragement and advice for all-round development of the Centre. I sincerely acknowledge the timely cooperation and help received from Dr. C. S. Prasad, ADG(AN&P), Dr. Gaya Prasad, ADG(AH) and Dr. S.C. Gupta, ADG(AP&B).

I hope the information presented in this annual report will be useful for all the professionals and related institutions involved in camel research and development in the country.

N.V. Patil
Director

विशिष्ट सारांश

मेवाड़ी नस्ल में 41 माइक्रोसैटेलाइट लॉकाई का सफलतापूर्वक अध्ययन किया गया। मेवाड़ी ऊँट 21 लॉकाई पर बहुरूपी और 20 लॉकाई पर एकल रूपी पाए गए। इन लॉकाई पर एलीलों की संख्या 2 से 5 आंकी गई थी। अवलोकित व अपेक्षित विषमयुग्मजता 0.14 से 0.83 और 0.264 से 0.720 आंकी गई। बहुरूपी सूचना अंश 0.244 से 0.649 के मध्य था।

बीकानेरी, जैसलमेरी, कच्छी और मेवाड़ी नस्लों में प्रत्येक के 50 ऊँटों का माइक्रोसैटेलाइट जीनोटाइपिंग, स्वचालित डीएनए अनुक्रमक पर किया गया। विश्लेषण हेतु 25 बहुरूपी चिन्हकों को प्राप्त करने के लिए पूर्व मापित चिन्हकों में सीएमएस श्रंखला के 5 अत्यधिक बहुरूपी चिन्हकों को जोड़ा गया। बीकानेरी नस्ल में एलीलों की संख्या 2 से 16 तक आंकी गई। विषमयुग्मजता 0.06 से 0. 96 और नीज् जीनीक विविधता 0.351 से 0.904 आंकी गई। जैसलमेरी में एलीलों की संख्या 2 से 20 तथा विषमयुग्मजता 0.061 से 0.94 और नीज् जीनीक विविधता 0.386 से 0.906 आंकी गई। कच्छी में एलीलों की संख्या 2 से 18 थी तथा विषमयुग्मजता 0.18 से 0.92 तथा नीज् जीनीक विविधिता 0.481 से 0.896 आंकी गई। इसी प्रकार मेवाड़ी में एलीलों की संख्या 2 से 19, विषमयुग्मजता 0.209 से 0.854 और नीज् जीनीक विविधता 0.481 से 0.891 आंकी गई। समस्त नस्लों के समूह में एलीलों की संख्या 8.56 से 8.76 आंकी गई। विषमयुग्मजता 0.532 से 0.554 और नीज् जीनीक विविधता 0.741 से 0.759 आंकी गई।

जीनपॉप वी 4 द्वारा हार्डी वेनबर्ग समुचित संभाव्यता का परीक्षण मार्कोव श्रंखला ऐल्गोरिद्म को प्रयुक्त करते हुए निष्पादित की गई। विषमयुग्मजता की कमी कई लॉकाई पर आंकी गई और यह वेर एवं कोकरहम के एफआईएस अनुमान में भी परिलक्षित हुई। सभी चारों नस्लों में अधिकतर लॉकाई पर नस्ल संरचना पाई गई। भारतीय नस्लों के बीच दूरी की गणना हेतु फाईलिप 3.6 का प्रयोग किया गया। सभी नस्लों के मध्य नीज् दूरी, कवेली–सोर्ज कोर्ड दूरी एवं रेनोल्ड दूरी की गणना की गई। तीनों माप में बीकानेरी एवं जैसलमेरी तथा मेवाड़ी और कच्छी के बीच निकट सम्बन्ध प्रदर्शित हुए। फाईलिप पैकेज के ड्राग्राम प्रोग्राम द्वारा यूपीजीएमए विधि से क्लस्टरिंग कर वंश आनुवांशिक वृक्ष का निर्माण किया गया। भारतीय उष्ट्र नस्लों के सहमत वृक्ष के निर्माण हेतु कनसेंस वृक्ष प्रोग्राम का प्रयोग किया गया। 999 बूट स्ट्रैपिंग किए गए और सहमत वृक्ष का निर्माण किया गया। 999 वृक्षों में से कच्छी और मेवाड़ी 996 वृक्षों में साथ रहे तथा बीकानेरी एवं जैसलमेरी 600 वृक्षों में साथ रहे।

व्यक्तिगत निर्धारण और पहली पीढ़ी के प्रवासियों की पहचान का कार्य जीनक्लास 2 सॉफ्टवेयर द्वारा किया गया। रानाला और माउंटेन ऐल्गोरिद्म द्वारा व्यक्तिगत निर्धारण 67.5 प्रतिशत सही और गुणवता सूचकांक 65.20 प्रतिशत आंका गया। बडोइन और लेबरन (2001) ऐल्गोरिद्म द्वारा गुणवता सूचकांक और सही निर्धारण क्रमशः 64.02 प्रतिशत एवं 67 प्रतिशत और पीटकु व अन्य के एल्गोरिद्म द्वारा 64.

03 प्रतिशत एवं 65.5 प्रतिशत आंका गया। वर्तमान अन्वेषण में प्रयुक्त बहुरूपी चिन्हकों को व्यक्तिगत पहचान और पितृत्व परीक्षण में प्रयोग हेतु सर्वस 3.03 प्रोग्राम द्वारा भी परखा गया एवं पितृत्व परीक्षण के विकास हेतु इनके प्रयोग की अनुशंसा की गई हैं। उष्ट्र जीनोम के लिंकेज नक्शे के विकास सहित विविध आनुवांशिक अध्ययन हेतु इन माइक्रोसैटेलाइट चिन्ह्कों को काम में लिया जा सकता हैं।

उष्ट्र नस्लों में दैनिक औसत दुग्ध उत्पादन 3053.34±11.13 मिली रहा जिनमें बीकानेरी में 3108.41±17.30 मिली, कच्छी में 3205.24±17.23 और मेवाड़ी में 2846.36± 21.11 पाया गया। नस्ल का प्रभाव अत्यधिक महत्वपूर्ण था। दुग्ध उत्पादन सुबह के समय व पीछे के स्तनों में अधिक था। दुग्ध उत्पाद तीसरे दुग्धकाल में (3485 मिली) में अधिकतम पाया गया। इसके पश्चात् क्रमशः चौथे (3165 मिली), दूसरे (3006 मिली) एवं पहले (2809 मिली) दुग्धकाल में प्राप्त हुआ। विभिन्न महीनों में दुग्ध उत्पादन अलग–अलग पाया गया। कच्छी मादा के–117 में, उच्चतम दुग्ध उत्पादन आंका गया।

इस वर्ष के प्रारम्भ में उष्ट्र समूह में ऊँटों की संख्या 359 और वर्ष के अंत में 365 थी। इस वर्ष में 56 उष्ट्र बच्चों का जन्म हुआ। प्रजनन क्षेत्र से 6 मेवाड़ी नस्ल के ऊँट खरीद कर समूह में शामिल किए गए। समूह में 17 ऊँटों की मृत्यु हुई तथा 38 ऊँटों की नीलामी की गई। उष्ट्र समूह की वृद्धि क्षमता पिछले वर्षों से तुलनीय थी। जन्म, 6, 12 महीने एवं 4 वर्ष के शारीरिक भार का औसत क्रमश : 38.43±0.85, 168.01±5.00, 263.55±7.03 एवं 434.1± 21.6 किलोग्राम था। कुल 37 में से 12 ऊँटों को फार्म प्रजनन हेतु चयन किया गया। ग्रामीणों की मादा ऊँटों को प्रजनन सेवा देने के लिए 5 बीकानेरी नर ऊँटों को उपयोग में लेते हुए 108 ऊँटनियों को संसर्गित करवाया गया। केन्द्र में गर्भधारण दर 76 और वत्स जनन दर 73.2 प्रतिशत रही।

पांच से छह वर्ष की आयु के 9 नर ऊँटों, जिनका शारीरिक भार 583–692 किलोग्राम था, पर भार वहन क्षमता का प्रयोग किया गया। तीन प्रकार के प्रबंध सूत्रित किए गए। ऊँटों से बहुउद्देशीय संयंत्र संवाहक तब तक खींचवाया गया जब तक कि वे थके नहीं। तीनों प्रबंधों के बीच भारवाहकता और सहनशीलता में विशिष्ट भिन्नता नहीं देखी गई। तीनों प्रबंधों में कार्य से पहले और बाद में शारीरिक तापमान में उल्लेखनीय वृद्धि नहीं देखी गई। कार्य के पश्चात् नाड़ी दर में महत्वपूर्ण वृद्धि पाई गई जो कि टी 1, टी 2 और टी 3 में क्रमशः 5.15, 10.87 और 20.75 प्रतिशत थी। तीनों प्रबंधों में कार्य से पहले श्वसन दर में भिन्नता नहीं पाई गई। कार्य के बाद श्वसन दर टी1, टी2 और टी3 में क्रमशः 15, 17 और 19 थी जो कि एक दूसरे से भिन्न थी। दो घंटे के विश्राम के पश्चात शरीर क्रियात्मक प्रतिक्रिया अपने प्रारम्भिक स्तर पर पुनः लौट आई।

शारीरिक अवस्था अंक पर कार्य प्रारंभ किया गया। भिन्न–2 शरीर क्रियात्मक अवस्था पर शारीरिक अवस्था अंक 5 बिन्दुओं के पैमाने पर दर्ज किए गए। प्रजनन योग्य नर ऊँटों के शारीरिक अवस्था अंक मद के पूर्व और मद पश्चात् अभिलेखित किए गए। ग्याभिन मादा ऊँटों का ब्यांत से पहले एवं प्रसवोत्तर समय में शारीरिक अवस्था एवं शारीरिक भार संबंधी आकलन किया गया।

पाँच मादाओं के जननांगों का परीक्षण किया गया। उच्च परिष्कृत मानव जरायु गोनेडोट्रॉपिन इंजेक्शन (5000 अ.ई.) प्यूबरजन एचपी, बीजांडी कारक के रूप में प्रयुक्त किया गया। इन्जेक्शन के 30 व 45 घण्टों के बाद कृत्रिम गर्भाधान किया गया। पाँच में से तीन मादा ऊँट अंतरिम रूप से गर्भवती पाई गई। जैव उत्तेजना या यौन उत्तेजना का नर ऊँटों पर सकारात्मक प्रभाव पाया गया एवं इसका प्रयोग प्रजनन ऋतु के शुरू होने से पहले नर ऊँटों में मद संवर्धन के लिए प्रभावी रूप से किया जा सकता है। इस वर्ष प्रजनन ऋतु पूर्व प्रजनन के दौरान 32 में से 22 मादाओं में फोलिकल्स् पाए गए। 21 मादाओं को संसर्गित करवाया गया और इनमें 4 मादाएं गर्भित हुई। प्रसवोत्तर प्रजनन हेतु 15 मादाओं की जांच कर संसर्गित करवाई गई जिनमें 8 गर्भित हुई। इन मादाओं के त्वस जनन अन्तराल में 300 दिनों की कमी आएगी। बीकानेरी, जैसलमेरी और कच्छी नस्ल के ऊँटों के शुक्रीय प्लाज्मा में विभिन्न महत्वपूर्ण जैवरासायनिक घटकों की मात्रा का निर्धारण किया गया।

उष्ट्र दूध से निर्मित चॉकलेट बर्फी, पेड़ा, दुग्ध पाउडर और रसगुल्ले सफलतापूर्वक तैयार किए गए एवं इनकी व्यावसायिक व्यवहार्यता का आकलन किया गया। यह भी पाया गया कि उष्ट्र दूध वे–प्रोटीन, गाय दुग्ध वे–प्रोटीन की अपेक्षा अधिक तापक्रम स्थायी थी।

समाजार्थिक सूचना विस्तारपूर्वक एकत्रित की गई। लिकर्ट विधि का प्रयोग किया गया तथा यह पाया गया कि अधिकतर ऊँट पालक खेती में ऊँट के उपयोग के प्रति सकारात्मक सोच रखते हैं। तापमान आर्द्रता सूचकांक शाम की अपेक्षा सुबह उल्लेखनीय रूप से कम था। सुबह का तापमान आर्द्रता सूचकांक 60.26 से 81.03 तथा शाम का 67.02 से 88.87 था। अनुकूलनता का बेनेजरा गुणांक सुबह के समय की तुलना में सायं के समय विशिष्ट रूप से अधिक था।

नवजात उष्ट्र बच्चों पर प्रतिरक्षा वृद्धि नीम के तेल का प्रयोग कर प्रतिरक्षता पहलूओं का अध्ययन किया गया एवं देखा गया कि इन उष्ट्र बच्चों में औसत वृद्धि दर, कुल प्रोटीन, ग्लोब्यूलीन व आईजीजी के स्तर में उल्लेखनीय वृद्धि हुई हैं। नवजात उष्ट्र बच्चों जिनकों कि नीम बीजीय तेल दिया गया, में सामान्य उष्ट्र बच्चों की अपेक्षा शारीरिक भार एवं स्वास्थ्य स्तर बेहतर पाया गया।

ऊँटों की जीवाणु एवं फफूंद की बीमारियों का जानपदिक रोग विज्ञान के लिए किए गए सर्वेक्षणों में त्वचीय सक्रमण अत्यधिक पाया गया। त्वचीय संक्रमण सबसे अधिक 1 वर्ष के बच्चों में उसके पश्चात् 1–2 वर्ष के बच्चों में एवं सबसे कम दस वर्ष से अधिक उम्र के ऊँटों में पाया गया। थनैला रोग अधिक उम्र वाले ऊँटों में अधिक पाया गया। विभिन्न त्वचीय संक्रमण से प्राप्त फफूंदीय पृथकों में इपीडर्मोफाईटोन फ्लोकोसम, स्कोपुप्लेरियोप्सिस ब्रिवीकुलिस और आल्टरनेरिया प्रजाति के थे।

उष्ट्र पालन में परजीवी रोगों में ट्रिपेनोसोमोसिस एक बड़ा कारक है। जब तक इसकी पहचान नहीं होती है तो इसके कारण ऊँटों में अस्वस्थता व मृत्युदर अधिक पाई जाती हैं। इसके अतिरिक्त खुजली, चीचड़ संक्रमण, माइएसिंस, पेट व आंत में निमेटोडाएसिस व हाइडेटिडोसिस भी पाए गए। बीकानेर एवं इसके आस–पास के क्षेत्रों से एकत्रित स्टोमोक्सिस मक्खी के आरएनए से पीसीआर द्वारा ट्रिपेनोसोमा सफलतापूर्वक परिवर्धित किया गया जो कि इस क्षेत्र में उक्त संक्रमण की जानकारी देता है।

ऊँट पॉक्स विषाणु के सेलफेन की तरह के प्रोटीन के जीन को परिवर्धित किया गया तथा पीजीईएमटी वेक्टर में सफलतापूर्वक क्लोन किया गया। ऊँट पॉक्स विषाणु की (1510 बीपी) सेलेफेन की तरह के प्रोटीन जीन की संपूर्ण श्रंखला को एनसीबीआई के डाटाबेस में भेजा गया (अभिगमन संख्या जेएफ 975616)। जाति विकास संबंधी विश्लेषण यह दर्शाता है कि भारतीय ऊँट पॉक्स विषाणु उष्ट्र पॉक्स विषाणु स्ट्रेन सीएमएस तथा ऊँट पॉक्स विषाणु स्ट्रेन कजाकिस्तान से अधिक समानता रखता है। संक्रामक एक्थाइमा से प्रभावित ऊँटों से प्राप्त स्यूडोकाउपॉक्स विषाणु के टोपोआइसोमरेज जीन को परिवर्धित किया गया तथा पीजीईएमटी वेक्टर में क्लोन किया गया। ऊँटों से प्राप्त स्यूडोकाउपॉक्स विषाणु के ट्रोपोआइसोमरेज जीन की पूर्ण श्रंखला को एनसीबीआई के डाटाबेस में भेजा गया (अभिगमन संख्या एचक्यू 844268)। जाति विकास संबंधी विश्लेषण यह दर्शाता है कि ऊँटों से प्राप्त स्यूडोकाउपॉक्स विषाणु, रेनडियर पीसीपीवी व ओआरएफवी समूह से अलग पहचान रखता है।

जोधपुर, जैसलमेर, बाड़मेर, नागौर एवं उदयपुर जिलों के विभिन्न स्थानों पर मानसून एवं सर्दी के मौसम में स्वस्थ ऊँटों में आने वाले विभिन्न जैव रासायनिक/उपापचयी एवं सूक्ष्म खनिज स्तर में परिवर्तन मापा गया।

राष्ट्रीय उष्ट्र अनुसंधान केन्द्र के ऊँटों में होने वाली विभिन्न बीमारियां को अभिलेखित किया गया। इनमें मुख्यतः बुखार, भूख कम लगना, विभिन्न प्रकार के घाव, गर्भपात, डिस्टोकिया, संक्रामक एक्थायमा, थनैला, ब्रोनकोन्युमोनिया, दस्त, खाज–खुजली, एवं विभिन्न त्वचा रोग शामिल थे। इस वर्ष केन्द्र में कुल 16 जानवरों की मृत्यु हुई। मृत्यु के कारणों में निमोनिया (3), तापघात (1), कंजेस्टिव हृदयघात (1), लीवर सिरोसिस (2), रूमिनल इंपेक्शन (1), श्वसन तंत्र

विफलता (1), आंत्रशोथ (4), हृदय कैंसर (1), भूख कम लगना/कमजोरी/बुढ़ापा (1) तथा हीमोथोरेक्स (1) पाए गए। संक्रमित एक्थाइमा के क्लीनिको– पैथोलॉजीकल अध्ययन में पाया गया कि कुल सीरम प्रोटीन व ग्लोबुलीन की मात्रा सामान्य ऊँट की तुलना में बीमार ऊँट में कम थी और एमसीवी, एमसीएच और जीपीटी की मात्रा बढ़ी हुई थी। मौटे तौर पर एक्थाइमा में पैप्यूल आगे चल कर पुट्टिका बन जाता है और खुरचन के रूप में मुंह, नाक एवं होठों के आस–पास दिखाई देते हैं। उत्तकीय–विकृति अध्ययन में यह पाया गया कि केरेटीनोसाईट्स में विशेष तौर पर इंट्रासाइटोप्लाजमिक इओसिनोफिलिक इंक्लूजिन बॉडी पाई गई। हिमेन्जीओसारकोमा का एक दुर्लभ प्रकरण पाया गया जिसमें हृदय की बाहरी सतह पूरी तरह गोभी के फूल की तरह दिखाई दे रही थी। उक्त कैंसर, उत्तकीय–विकृति एवं एजीएनओआर स्टेन द्वारा जांचा व पहचाना गया।

जातिविकास संबंधी विश्लेषण में एक कुब्बडीय ऊँट की आईएल–2, आईएल–4, आईएल–6, आईएफएन–गामा और टीएनएफ–एल्फा एमीनो एसिड श्रंखला अन्य उष्ट्र प्रजातियों से मिलती–जुलती पाई गई।

दुधारू ऊँटनियों में ऊर्जा आवश्यकता के प्रयोग में यह पाया गया कि जिन दुधारू ऊँटनियों को 6.97 प्रतिशत पचनीय कच्चा प्रोटीन व 107.2 एमएफ एमजे युक्त सम्पूर्ण आहार ईंटे दी गई उनमें दूध की मात्रा शारीरिक भार रखरखाव व पोषक उपभोग बेहतर था। सात प्रकार के चारे में इनविट्रो किण्वन अध्ययन किया गया। बाजरा दाने में सबसे अधिक गैस उत्पादन पाया गया। ग्वार फलगटी, मूंगफली भूसा व ग्वार चूरी में गैस उत्पादन 94–97 मिली पाया गया। सम्पूर्ण आहार ईंटों के राशन 1 में गैस उत्पादन सबसे कम, 2 में उससे अधिक तथा 3 में अधिकतम देखा गया। पी.एच.का मान ग्वार फलगटी व मूंगफली भूसे में अधिक तथा बाजरा व ग्वारचूरी में कम था। मादा ऊँटनियों की जनन क्षमता में योजनाबद्ध अनुपूरक के प्रभाव के प्रयोगात्मक अध्ययन में यह देखा गया कि अंतिम गर्भाधान काल की ऊँटनियों के आहार में बाजरा दाने व क्षेत्रीय विशिष्ट खनिज मिश्रण केवल ग्वार कोरमा की तुलना में अधिक लाभकारी था। साथ ही क्षेत्रीय विशिष्ट मिश्रण के साथ बाजारा व ग्वार दाने का मिश्रण केवल चराई की अपेक्षा अधिक लाभकारी पाया गया। सूक्ष्म जीवों का अध्ययन का कार्य किया गया। सेल्यूलाईटिक रूमन जीवाणुओं की बारह कॉलोनियों को पृथक व परिष्कृत किया गया। सभी 12 प्रकार के जीवाणुओं में गैस उत्पादन क्षमता थी।

उष्ट्र पेप्टीडोग्लाइकन पहचान प्रोटीन का मुरमाईल डाईपेपटाईड के साथ पहला क्रिस्टल विन्यास, 2.5 ए रिजोल्यूशन पर निर्धारित किया गया। इसमें संक्रामक मूल की बीमारियां के विरूद्ध विशिष्ट औषधीय क्षमता पाई गई।

सूडान की उष्ट्र नस्लों का जीनोटाइपिंग 25 माइक्रोसैटेलाइट लॉकाई पर स्वचालित डीएनए अनुक्रमक पर किया गया। सूडान की नस्लों में एलीलों की संख्या 3.72 से 7.04, विषमयुग्मजता 0.516 से 0.689 एवं नीज् जीनीक विविधता 0.619 से 0.745 तक आंकी गई। यह देखा गया कि जिन नस्लों में कम ऊँटों के नमूनें थे, उनमें हार्डी वेनबर्ग संतुलन अधिकतर लॉकाई पर नहीं था। सभी नस्लों के मध्य नीज् दूरी, कवेली–सोर्ज कोर्ड दूरी एवं रेनोल्ड दूरी की गणना की गई एवं वंश आनुवांशिक वृक्ष का निर्माण किया गया। रानाला और माउंटेन ऐल्गोरिद्म द्वारा व्यक्तिगत निर्धारण 45.9 प्रतिशत सही और गुणवता सूचकांक 44.10 प्रतिशत आंका गया।

1. Executive Summary

The Mewari breed was successfully studied at 41 microsatellite loci. The Mewari camels were polymorphic at 21 loci and monomorphic at 20 loci. The number of alleles at these loci ranged from 2 to 5. The observed and expected heterozygosity ranged from 0.14 to 0.83 and 0.264 to 0.720. The polymorphic information content ranged from 0.244 to 0.649.

The microsatellite genotyping of 50 individuals in each of the Bikaneri, Jaisalmeri, Kachchhi and Mewari breed was carried out on automated DNA sequencer. Five highly polymorphic markers of CMS series were added to the previous tally to get 25 polymorphic markers for analysis. In Bikaneri the number of alleles ranged from 2 to 16, heterozygosity ranged from 0.06 to 0.96 and Nei's genic diversity ranged from 0.351 to 0.904. In Jaisalmeri the number of alleles ranged from 2 to 20, heterozygosity ranged from 0.061 to 0.94 and Nei's genic diversity ranged from 0.386 to 0.906. In Kachchhi the number of alleles ranged from 2 to 18, heterozygosity ranged from 0.18 to 0.92 and Nei's genic diversity ranged from 0.481 to 0.896. Similarly in Mewari the number of alleles ranged from 2 to 19, heterozygosity ranged from 0.209 to 0.854 and Nei's genic diversity ranged from 0.481 to 0.891. Pooled over loci the number of alleles ranged from 8.56 to 8.76, heterozygous proportion ranged from 0.532 to 0.554 and Nei's genic diversity ranged from 0.741 to 0.759.

Utilizing GenepopV4, the Hardy-Weinberg exact probability test using Markov chain algorithm was performed. The deficiency of heterozygotes was noticed at several loci and the same was reflected in Weir and Cockerham's estimate of F_{IS}. All four breeds showed existence of population structure at most loci. Phylip 3.6 was utilized for calculating the genetic distance among Indian camel breeds. Nei's distance (Ds), Cavalli-Sforza Chord distance (Dc) and Reynold's distance (Fst) were calculated. All the three measures revealed close relationship between Bikaneri & Jaisalmeri and between Mewari & Kachchhi.The phylogenetic tree was constructed from all the three measures of the genetic distance using the UPGMA method of clustering by DRAWGRAM program of PHYLIP package. The Consensus tree programme V 3.63 was utilized to construct the consensus tree of the Indian camel breeds. 999 boot-strappings were done and the consensus tree was constructed. Out of 999 trees, the Kachchhi and Mewari stayed together in 996 trees and Bikaneri and Jaisalmeri stayed together in 600 trees.

The individual assignment and detection of first generation migrants was done utilizing the GeneClass 2 software. Using Rannala and Mountain (1997) algorithm 67.5% individuals were correctly assigned and the quality index was

65.20%. The quality index and correct assignment with Baudouin and Labrun (2001) algorithm were 64.02% and 67 % and with Paetkau *et al*. (1995) 64.03% and 65.5% respectively. The polymorphic markers utilized in the present investigation were also tested using Cervus 3.0.3 programme and they were found extremely useful in individual identification and paternity testing. Development of a paternity test is therefore recommended. These microsatellite markers can be utilized for diverse genetic studies including the development of linkage map of the dromedary genome.

The average daily milk production was 3053.34±11.13 ml with 3108.41±17.30 ml in Bikaneri, 3205.24±17.23 ml in Kachchhi and 2846.36±21.11 ml in Mewari. The effect of breed was highly significant. The milk production was higher in morning and production from rear teat was higher. The production was highest in 3rd lactation (3485 ml) followed by 4th (3165 ml), 2nd (3006 ml) and 1st (2809 ml). The production in different months varied significantly. Highest milk production was of Kachchhi female K-117.

The opening camel herd strength was 359 and the closing strength was 365 heads. There were 56 calving in the year. 6 camels of Mewari breed were added by purchasing from the breeding tract. Seventeen camels died and 38 camels were auctioned in the year. The growth performance of the camel herd was comparable with the previous performance. The leastsquares means of body weights at birth, 6 months, 12 months and 4 years were 38.43±0.85, 168.01±5.00, 263.55±7.03 and 434.1±21.6 kg respectively. Out of 37 camels, 12 were selected for farm breeding. For service to the she camels of villagers, 5 Bikaneri male camels were used and 108 she camels were given service. The conception rate at the Centre was 76% and the calving was 73.2%.

The draught-ability experiment was carried out by using nine male camels of 5-6 years of age with an average body weight of 583 to 692 kg. Three treatments were formulated.The camels were made to pull multipurpose tool carrier in the farm area until fatigued. The draught and endurance did not differ significantly among the treatments. There was non-significant difference between treatments for rectal temperature before and after work. There was significant increase in pulse rate after work which was 5.15, 10.87 and 20.75%, respectively in T1, T2 and T3 over the values before work. There was non-significant difference between the treatments for respiration rate before work. The respiration rate after work was 15, 17 and 19, respectively in T1, T2 and T3 which differ significantly from each other. The physiological responses returned to their initial levels after two hours of rest.

The work on Body Condition Score has been initiated. The body condition score in different physiological states was recorded on five point scale. The breeding bulls were recorded pre and post rut for body condition score. Similarly females in late pregnancy and post parturition were scored for body conditions along with the body weights.

Five female camels were examined. 5000 I.U. of Highly Purified Human Chorionic Gonadotrophin (HPHCG) preparation, Injection Pubergen HP, was used as ovulating agent. Artificial insemination was done at 30 h and 45 h after the injection. Three camels out of five female camels were tentatively pregnant. The bio-stimulation or sexual stimulation was found to have positive effect on male reproduction and can be effectively used to augment rut before the onset of breeding season. This year out of 32 females examined for pre-seasonal breeding, follicles were observed in 22 females, 21 females were given service and finally 4 females conceived. 15 females were examined for post-parturient breeding and mated, out of which 8 were conceived. There would be a reduction of 300 days in the calving interval of

these females. The concentrations of various biologically important biochemical constituents in the seminal plasma of Bikaneri, Jaisalmeri and Kachchhi breeds of camel were determined

The Chocolate *Barfi*, *Peda*, Lyophilized skim milk powder and *Rasogolla* were successfully prepared out of camel milk and assessed for commercial viability. It was also observed that camel milk whey proteins are more heat stable than the cow milk whey proteins

The socioeconomic information was collected extensively. The Likert method of scoring was utilized and it was observed that most of respondents were having favorable attitude for the use of camel for cultivation purpose. The Temperature Humidity Index (THI) was significantly lower during morning as compared to evening hours. The morning THI varied from 60.26 to 81.03 whereas evening THI varied from 67.02 to 88.87. The Benezara coefficient of adaptability was significantly higher during evening time as compared to morning time.

Studies on immunity aspects in neonatal camel calves with herbal immune potentiator, Neem seed oil, revealed significant increase in the average growth rate, total protein, globulin and IgG levels. An improvement in the bodyweight as well as better health status was also noticed in camel calves given Neem seed oil compared to control calves.

The survey work for the epidemiology of bacterial and fungal diseases of camels revealed higher incidence of skin infections. Camel calves up to 1 year of age were observed to be most susceptible to skin infections followed by 1-2 years' age group and old age (>10 year) group. Mastitis was more in case of older animals. Fungal isolates from different skin infections were found be of Epidermophytonf loccosum, Scopulariopsis brevicaulis and *Alternaria* spp. Amongst the parasitic diseases trypanosomosis put forth a constant threat to the camel husbandry leading to both morbidity and mortality when it remained undiagnosed. Besides this, mange, tick infestations, myiasis, GI nematodiasis, hydatidosis were also observed. PCR amplification was detected for Trypanosoma evansii in DNA samples from Stomoxys fly collected from Bikaner and its peripheral areas suggesting that the infection might have been present in this area.

Schlafen-like protein gene of camel pox virus (CMLV) was amplified and successfully cloned in pGEM-T vector. The full length gene sequence of the schlafen-like protein gene of camel pox virus (1510bp) was submitted to the NCBI database (Accession Number JF975616). Phylogenetic analysis revealed that Indian camel pox virus isolates were clustered with camel pox virus strain CMS and camel pox virus isolates from Kazakhstan.Topoisomerase gene of pseudocow-poxvirus isolates from the camels infected with contagious ecthyma was amplified and cloned in pGEM-T vector. The full length gene sequence of topoisomerase gene of pseudocowpoxvirus isolates from camels was submitted to the NCBI database (Accession Number HQ844268). Phylogenetic analysis revealed that pseudocowpoxvirus isolates from camels represent a separate entity with regard to topoisomerase gene of ORFV and PCPV from Reindeer.

The data for different biochemical/ metabolic and macro mineral profile changes in healthy camels from different places in Jodhpur, Jaisalmer, Barmer, Nagaur and Udaipur districts in monsoon and winter season was established.

Different clinical conditions reported during this year from NRCC farm were fever, anorexia, miscellaneous injuries, abortions, dystokia, contagious ecthyma, mastitis, bronchop-neumonia, diarrhoea, mange, dermatophytosis, and skin candidiasis.

A total of 16 camels from NRCC farm died

during the year. The causes of mortality were pneumonia (3), heat stroke (1), congestive heart failure (1), liver cirrhosis (2), impaction (1), respiratory failure (1), gastro-enteritis (calf scour) (4), haemangiosarcoma of heart (1), inanition due to senility (1) and haemothorax (1). Clinico-pathological study conducted in contagious ecthyma infections revealed significantly decreased values for total serum protein and globulin and significantly increased values for MCV, MCH and GPT in contagious ecthyma affected camels as compared to normal camels. Grossly the lesions of erythema, papule which later progresses into vesicles, pustules and scab formation were observed in and around mouth, lips, nostrils, eyes, face and neck region in contagious ecthyma affected camels. Histopathological changes in infected camels were studied at different stages of infection and typical intra-cytoplasmic eosinophilic inclusion bodies were observed in keratinocytes. One rare case of hemangiosaroma was observed which was found completely covering the outer surface of heart, and having cauliflower like appearance. The tumour was further confirmed by histopathology and its malignancy was assessed by AgNOR stain.

The phylogenetic analysis based on the amino acid sequences of IL-2, IL-4, IL-6, IFN-Gamma and TNF-alpha in dromedarian camel and other animal species showed the expected clustering of all camelids.

The experiment on energy requirement of lactating camels indicated that lactating camels given completed feed block containing 6.97% DCP and 107.21 ME MJ performed better in terms of milk yield, body weight maintenance and nutrient utilization. *In-vitro* fermentation study of seven feeds and fodders was done. Maximum gas production was observed in case of Bajra grain. Gas production varied between 94 to 97 ml in case of guar phalgati, groundnut hualms and guar churi. Gas production was lower in complete feed block ration (CFB) 1 and increased to CFB 2 and was maximum in CFB 3. The pH was higher in guar phalgati and GN haulms and lower in Bajra and Guar churi. The experiment on the effect of strategic supplementation on reproductive performance in female camels revealed that strategic supplementation of Bajra grain with area specific mineral mixture in diet of camels in late pregnancy was beneficial over feeding of guar korma. Also, the feeding of Bajra and guar grains along with area specific mineral mixture was found beneficial over grazing alone. The study on rumen microbes was carried out. Twelve colonies of cellulolytic rumen bacteria were isolated and purified. All 12 isolates gave positive test for gas production.

The first crystal structure of Camel Peptidoglycan recognition proteins (CPGRP-S) in complex with muramyl dipeptide (MDP) was determined at 2.5Å resolution. It was found to have excellent therapeutic potential in various diseased conditions of infectious origin

The microsatellite genotyping of 17 types and sub types of Sudanese camel was carried out on automated DNA sequencer at 25 polymorphic loci.In Sudanese populations mean number of alleles ranged from 3.72 to 7.04, mean heterozygosity ranged from 0.516 to 0.689 and Nei's genic diversity ranged from 0.619 to 0.745. It was observed that most of the populations having less number of samples were not in Hardy Weinberg equilibrium at most of the loci. Nei's distance (Ds), Cavalli-Sforza Chord distance (Dc) and Reynold's distance (Fst) were calculated. The phylogenetic tree was constructed from all the three measures of the genetic distance. Using Rannala and Mountain (1997) algorithm 45.9% individuals were correctly assigned and the quality index was 44.10%.

2. Introduction

Brief History

On the recommendation of National Commission of Agriculture (1976) the Government of India approved a Project Directorate on camel under the auspices of Indian Council of Agricultural Research during the last phase of VI Plan. The Project Directorate on Camel came in to existence on July 5, 1984 utilizing the physical facilities (149 camels of Bikaneri breed and around 824 ha land) of erstwhile Camel Breeding Farm of Sukhadia University, Udaipur. The physical facilities were transferred by Government of Rajasthan. Later on it was upgraded to National Research Centre on Camel on September 20, 1995.

Location

The Centre is located in the Jorbeer area of Bikaner city. The soil type is mostly loose and sandy. The climate is mostly dry and hot with an average annual rainfall of around 250 mm. The temperature ranges between 30 to 46 ^{0}C in summer and between 4 to 28 ^{0}C in winter season.

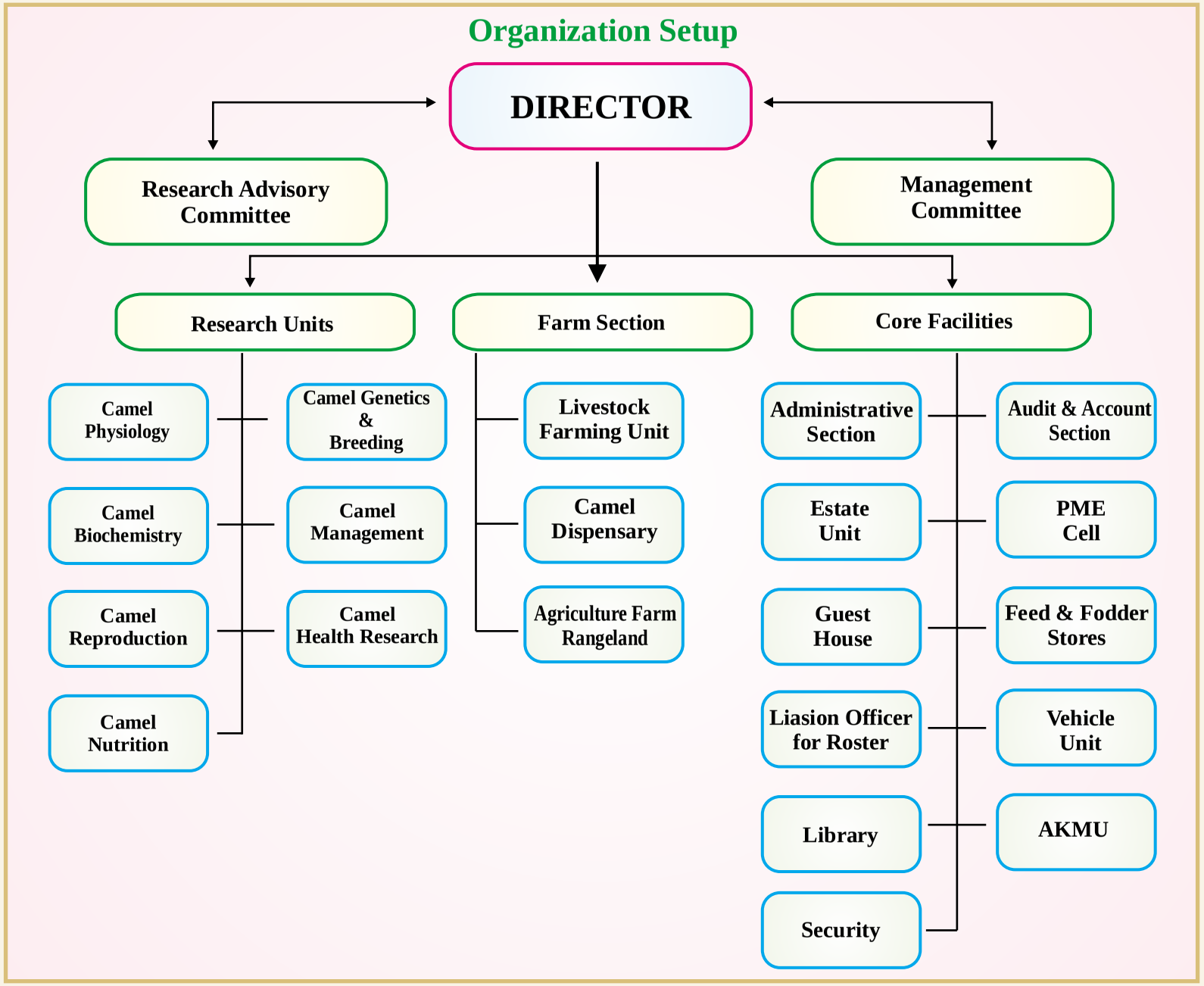
Mandate

The Centre was established with the mandate of conservation and preservation of existing breeds of camel and to generate baseline research data on camel. The mandate was revised from time to time taking into consideration the achievements done by the scientists of the Centre and development in the field across the globe. The existing mandate is :

- To undertake basic and applied research for improvement of camel.
- To provide leadership and coordinate camel research and training nationally and act as a national repository of information.
- To collaborate with national and international agencies for camel research and development.

The work of the Centre is being carried out by the camel breeding and genetics, camel physiology, camel biochemistry, camel reproduction, camel health, camel nutrition, camel management and extension, camel products technology, camel farming and agro-forestry units and AKMU and PME cell.

Organization Setup



Infrastructure

Over the years, NRCC has developed excellent infrastructural facilities including modern laboratories, library, visitors' room, museum and a feed plant.

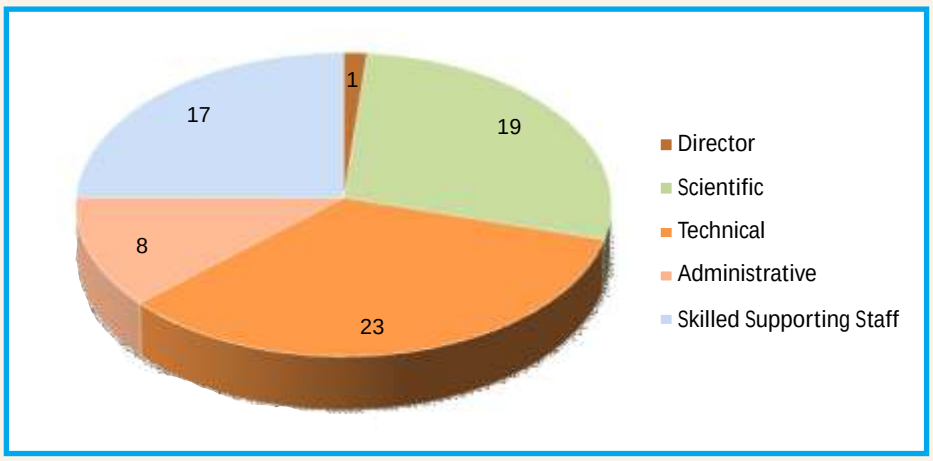
The NRCC has modern laboratories situated in three complexes. The laboratories are fully equipped to handle modern research in the field of camel physiology, reproduction, biochemistry, genetics and breeding, health, nutrition, camel managementand milk products technology.

The camel farm maintains an elite herd of about 365 camels comprising of Bikaneri, Jaisalmeri, Kachchhi and Mewari breeds. An area of about 650 ha of farm land has been fenced and 45 ha of land have been brought under perennial silvi pasture comprising of grasses, shrubs and trees. The library subscribes to about 22 Indian and 11 foreign journals and has collection of 7717 reference books.

The Centre is recognized as one of the important tourist place of India. The camel museum at the Centre depicts historical, cultural, social, economical and scientific aspects of camel and attracts the attention of national and international researchers and tourists. The camel milk parlour at the Centre serves different products like flavoured milk, lassi, kulfee, tea and coffee to the tourists and visitors.

Staff position (March 31, 2011)

Cadre	Number of posts sanctioned	Number of posts filled
Director	1	1
Scientific	20	19
Technical	24	23
Administrative	12	8
Skilled Supporting Staff	18	17
Total	**75**	**68**



Staff position at the Centre on March 31, 2011

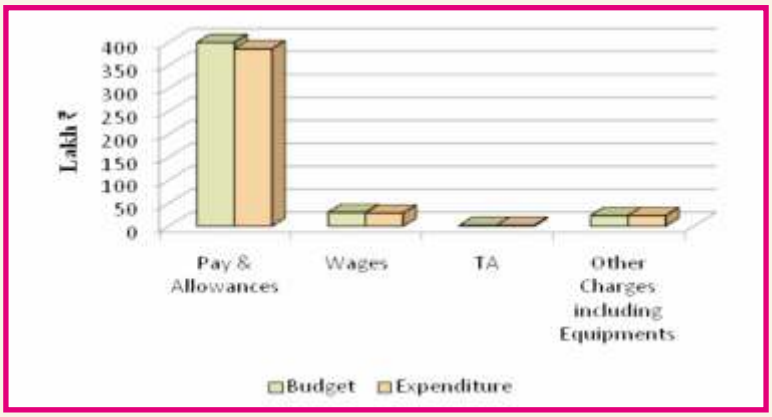
***Financial statement* (2010-11)**

Through regular monitoring optimal utilization of funds allocated to the Centre was ensured. The actual utilization of the budget under plan and non- plan head was as under :

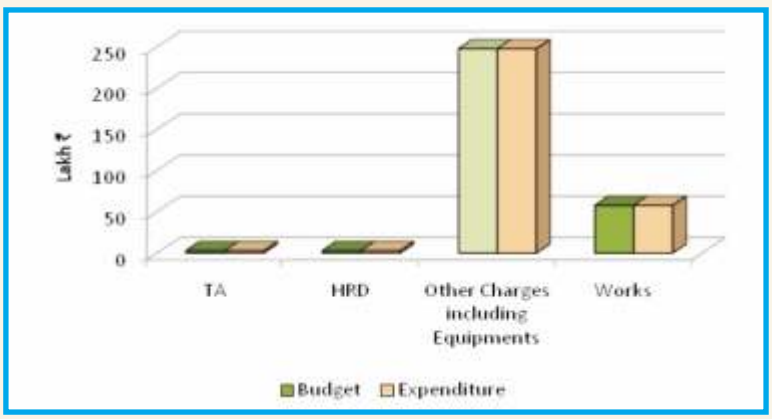
Financial Statement and revenue receipt (2010-11)

(₹in Lakh)

Head of Account	PLAN		NON PLAN	
	Budget	Expenditure	Budget	Expenditure
Pay & Allowances	-	-	400.00	386.00
Wages	-	-	30.00	28.75
T.A.	3.00	3.00	2.00	2.00
H.R.D.	3.00	3.00	-	-
Other Charges including Equipment	248.00	248.00	23.00	22.98
Works	58.00	58.00	-	-
Total	**312.00**	**312.00**	**455.00**	**439.73**
Revenue Received : 39.30				



Budget utilization under non-plan head in the year 2010-11



Budget utilization under plan head in the year 2010-11

3. Research Achievements

The research targets set by the Institute Research Council (ARC) in discussion with the Research Advisory Committee (RAC) were implemented in the respective projects.

Unit : Camel Genetics and Breeding

AGB-2.Project : Molecular genetic studies in Indian camel : Microsatellite markers for genetic characterisation of Bikaneri, Jaisalmeri, Kachchhi and Mewari camel

Project Leader : S . C. Mehta

Polymorphism in Mewari breed : Blood samples of Mewari breed were collected from farm and field. The DNA was isolated as per established procedure. A minimum of 50 unrelated individuals were selected for microsatellite analysis study. 45 microsatellite primers known to be polymorphic either in the old or new world camelids were procured. Using these primers, 41 microsatellite loci were successfully amplified in the Mewari breed. Mewari camels were polymorphic at 21 loci and monomorphic at 20 loci (Table 1 & 2). The number of alleles at these loci ranged from 2 to 5. The observed and expected heterozygosity ranged from 0.14 to 0.83 and 0.264 to 0.720. The polymorphic information content ranged from 0.244 to 0.649.

Microsatellite profiling in Indian dromedary breeds : The microsatellite genotyping of 50 individuals in each of the Bikaneri, Jaisalmeri, Kachchhi and Mewari breeds was carried out on automated DNA sequencer ABI 3730 (Applied Biosystems). Five highly polymorphic markers of CMS series were added to the previous tally to get 25 polymorphic markers for analysis. The PCR amplifications were carried out using AmpliTaq Gold Kit using 50 ng template, 1X PCR buffer, 5pmol each of forward and reverse primers, 2.0 mM $MgCl_2$ in 15 µl total reaction volume. The PCR amplification program comprised initial denaturation at 95°C for 5 min followed by 35 cycles of denaturation at 94°C for 45 sec, annealing at 55°C for 45 sec and extension at 72°C for 1min, final extension was carried out at 72°C for 10 min, The multiplex PCR were performed as per the details presented in Table 3.

Genic diversity among Indian dromedary breeds : The microsatellite statistics derived by utilizing Gene Class2 software has been presented in Table 4. In Bikaneri the number of alleles ranged from 2 to 16, heterozygosity ranged from 0.06 to 0.96 and Nei's genic diversity ranged from 0.351 to 0.904. In Jaisalmeri the number of alleles ranged from 2 to 20, heterozygosity ranged from 0.061 to 0.94 and Nei's genic diversity ranged from 0.386 to 0.906. In Kachchhi the number of alleles ranged from 2 to 18,

heterozygosity ranged from 0.18 to 0.92 and Nei's genic diversity ranged from 0.481 to 0.896. Similarly in Mewari the number of alleles ranged from 2 to 19, heterozygosity ranged from 0.209 to 0.854 and Nei's genic diversity ranged from 0.481 to 0.891. Pooled over loci the number of alleles ranged from 8.56 to 8.76, heterozygous proportion ranged from 0.532 to 0.554 and Nei's genic diversity ranged from 0.741 to 0.759 (Table 5).

Existence of population structure: Utilizing GenepopV4, the Hardy-Weinberg exact probability test using Markov chain algorithm was performed. Except LCA90 loci in Jaisalmeri all the loci were in Hardy Weinberg equilibrium. The deficiency of heterozygotes was noticed in several loci and the same was reflected in Weir and Cockerham's estimate of F_{IS}. All four breeds showed existence of population structure at most loci (Table 6)

Genetic distance and phylogenetic tree : Phylip 3.6 was utilized for calculating the genetic distance among Indian camel breeds. Nei's distance (Ds), Cavalli-Sforza Chord distance (Dc) and Reynold's distance (Fst) were calculated. The genetic distances have been presented in Table 7 and 8. All three measures revealed close relationship between Bikaneri & Jaisalmeri and between Mewari and Kachchhi. The phylogenetic tree was constructed from all the three measures of the genetic distance using the UPGMA method of clustering by DRAWGRAM program of PHYLIP package (Fig 1).

Consensus tree :The Consensus tree programme V 3.63 was utilized to construct the consensus tree of the Indian camel breeds. 999 boot-strappings were done and the consensus tree was constructed. Out of 999 trees, the Kachchhi and Mewari stayed together in 996 trees and Bikaneri and Jaisalmeri stayed together in 600 trees (Fig. 2). The Jaisalmeri breed stayed with Kachchhi and Mewari in 398 trees but the same was excluded from the consensus tree.

Individual assignment : The individual assignment and detection of first generation migrants was done utilizing the GeneClass 2 software. Using Rannala and Mountain (1997) algorithm 67.5% individuals were correctly assigned and the quality index was 65.20%. The quality index and correct assignment with Baudouin and Labrun (2001) algorithm were 64.02% and 67 % and with Paetkau *et al*. (1995) were 64.03% and 65.5% respectively (Table 9). The following conclusions were drawn :-

- There exists population structure in each of the Indian dromedary breeds.
- There exists enough genic variation with in each Indian dromedary breed as envisaged from number of alleles and Nei's genic diversity.
- Close phylogenetic relationship between Bikaneri and Jaisalmeri & Mewari and Kachchhi was observed.
- Deficiency of heterozygotes, 67.5% correct assi-gnment of individuals to respective populations further strengthened the existence of population structure and the purity of populations studied. The percent correct assignment further increased to >90% when probability computation was enabled and number of simulated individuals were10000.
- The polymorphic markers utilized in the present investigation were also tested using Cervus 3.0.3 programme and they were found extremely useful in individual identification and paternity testing. Development of a paternity test is hence recommended.
- These microsatellite markers can be utilized for diverse genetic studies including the development of linkage map of the dromedary genome.

Table 1. Amplification of microsatellite loci in Mewari breed of camel

S.No.	Locus (5'-3')	Alleles(n)	Size (bp)	Temp (°C)	H_o	H_e	PIC
1.	VOLP – 03	5	144-168	64	0.36	0.423	0.371
2.	VOLP-08	3	142 –146	50	0.29	0.311	0.269
3.	VOLP–10	3	250-264	55	0.62	0.639	0.563
4.	VOLP – 67	4	151-195	53	0.30	0.470	0.450
5.	LCA - 90	3	221-259	55	0.60	0.464	0.418
6.	YWLL-09	2	160-162	53	0.41	0.480	0.365
7.	YWLL–38	3	180-186	55	0.57	0.503	0.424
8.	YWLL-44	3	104-106	55	0.31	0.339	0.351
9.	YWLL-58	2	173-177	51	0.58	0.500	0.375
10.	YWLL-59	2	115-117	53	0.60	0.455	0.351
11.	LCA – 56	2	134-138	55	0.36	0.556	0.281
12.	LCA – 63	5	210-222	58	0.23	0.664	0.608
13.	LCA – 66	3	234-238	58	0.83	0.646	0.573
14.	CVRL – 01	3	208-240	58	0.14	0.264	0.244
15.	CVRL – 03	4	182-215	58	0.54	0.720	0.649
16.	CVRL – 04	3	180-194	54	0.67	0.573	0.499
17.	CVRL – 05	4	155-174	59	0.59	0.671	0.611
18.	CVRL – 07	3	284-304	59	0.42	0.553	0.482
19.	LCA – 18	3	224-230	54	0.56	0.488	0.431
20.	LCA – 22	4	170-180	60	0.60	0.668	0.616
21.	LCA -33	3	122-130	60	0.55	0.502	0.437

$H_{o,}$ observed heterozygosity; $H_{e,}$ expected heterozygosity

Table 2. Monomorphic microsatellite loci in Mewari breed of camel

S.No.	Locus (5'-3')	Alleles (n)	Size (bp)	Temp (°C)
1.	YWLL-29	1	208	55
2.	YWLL-36	1	136	55
3.	YWLL-40	1	173	55
4.	YWLL-43	1	135	60
5.	YWLL-46	1	110	55
6.	CVRL – 02	1	205	53
7.	CVRL – 06	1	196	60
8.	CVRL – 08	1	205	55
9.	LCA - 08	1	230	58
10.	LCA - 19	1	100	58
11.	LCA – 24	1	110	58
12.	LCA – 30	1	230	60
13.	LCA – 36	1	209	61
14.	LCA – 65	1	170	58
15.	LCA – 68	1	200	61
16.	LCA - 05	1	202	55
17.	LCA - 37	1	148	64
18.	LCA - 77	1	235	55
19.	VOLP - 32	1	260	55
20.	VOLP - 77	1	250	57

$H_{o,}$ observed heterozygosity; $H_{e,}$ expected heterozygosity

Table 3. PCR-Multiplex groups and dye used

Multiplex-Gp1		TAG
1	YWLL08	FAM
2	YWLL38	HEX
3	LCA18	FAM
4	CVRL04	FAM
Multiplex-Gp2		**TAG**
1	VOLP08	FAM
2	YWLL58	FAM
3	LCA66	FAM
4	CVRL01	VIC
5	CVRL05	NED
Multiplex-Gp3		**TAG**
1	VOLP03	FAM
2	CVRL03	HEX
Multiplex-Gp4		**TAG**
1	YWLL59	FAM
2	YWLL09	FAM
3	LCA90	FAM
4	VOLP67	HEX
5	CMS121	NED
6	CMS13	NED
Multiplex-Gp5		**TAG**
1	CMS15	FAM
2	CVRL07	FAM
3	VOLP10	HEX
4	LCA33	NED
5	CMS50	NED
Multiplex-Gp6		**TAG**
1	LCA22	FAM
2	LCA63	NED
Multiplex-Gp7		**TAG**
1	CMS16	NED

Fig. 1 : Nei's distance (Ds) among Indian dromedary breeds

Figure 2: Consensus tree

Species in order:

1. Kachchhi
2. Mewari
3. Jaisalmeri
4. Bikaneri

Sets included in the consensus tree

Set (species in order) How many times out of 999.00

**..	996.00
..**	600.00

Sets NOT included in consensus tree:

Set (species in order) How many times out of 999.00

***.	398.00
..	3.00
**.*	1.00

Extended majority rule consensus tree

CONSENSUS TREE:the numbers forks indicate the numberof times the group consisting of the specieswhich are to the right of that fork occurredamong the trees, out of 999.00 trees

```
          +------Jaisalmeri
+600.0-|
    |     +------Bikaneri
    |
    |     +------Mewari
+996.0-|
          +------Kachchhi
```

Table 4. Microsatellite statistics as per loci and population

Micro-Satellite	Bikaneri			Jaisalmeri			Kachchhi			Mewari		
	No. of Alleles	Heterozygotes	Nei's genic Diversity	No. of Alleles	Heterozygotes	Nei's genic Diversity	No. of Alleles	Heterozygotes	Nei's genic Diversity	No. of Alleles	Heterozygotes	Nei's genic Diversity
CVRL 04	12	0.347	0.904	11	0.417	0.874	12	0.46	0.901	12	0.429	0.873
CVRL 05	8	0.66	0.772	10	0.51	0.831	10	0.62	0.801	10	0.6	0.818
LCA 18	6	0.34	0.816	6	0.4	0.813	7	0.38	0.746	6	0.42	0.718
VOLP 03	10	0.4	0.638	6	0.44	0.665	7	0.306	0.798	7	0.48	0.759
YWLL 38	5	0.375	0.734	4	0.417	0.702	4	0.26	0.683	4	0.458	0.637
CVRL 01	16	0.96	0.852	20	0.86	0.902	18	0.918	0.893	19	0.776	0.891
LCA 66	8	0.86	0.744	9	0.51	0.839	7	0.735	0.757	9	0.66	0.802
YWLL 08	10	0.94	0.869	10	0.94	0.871	10	0.82	0.851	9	0.78	0.861
CVRL 03	6	0.327	0.624	5	0.38	0.624	5	0.26	0.538	6	0.25	0.622
VOLP 08	7	0.959	0.743	8	0.88	0.786	10	0.92	0.846	9	0.854	0.833
YWLL 58	8	0.449	0.766	8	0.478	0.739	4	0.333	0.581	7	0.209	0.687
CMS 121	9	0.6	0.799	8	0.54	0.799	10	0.74	0.864	9	0.612	0.838
CMS 13	8	0.604	0.759	9	0.408	0.65	9	0.51	0.809	8	0.435	0.806
CMS 15	7	0.674	0.68	8	0.592	0.773	7	0.729	0.688	7	0.8	0.777
CMS 50	8	0.56	0.814	9	0.702	0.829	7	0.8	0.811	9	0.694	0.843
CVRL 07	9	0.191	0.86	10	0.128	0.848	10	0.261	0.77	10	0.227	0.762
LCA 22	5	0.5	0.606	5	0.682	0.656	5	0.708	0.638	4	0.792	0.58
LCA 33	13	0.694	0.806	13	0.674	0.861	13	0.551	0.896	14	0.609	0.91
LCA 63	12	0.62	0.795	11	0.604	0.847	12	0.714	0.873	11	0.702	0.87
LCA 90	9	0.44	0.679	4	0.542	0.66	7	0.5	0.748	9	0.571	0.713
VOLP10	9	0.457	0.763	8	0.596	0.703	11	0.48	0.839	10	0.542	0.824
VOLP67	16	0.638	0.891	18	0.66	0.906	16	0.755	0.859	15	0.694	0.89
YWLL 09	5	0.06	0.351	5	0.061	0.386	5	0.18	0.658	6	0.245	0.543
YWLL 59	2	0.34	0.505	2	0.457	0.505	2	0.46	0.481	2	0.46	0.481
CMS 16	11	0.522	0.758	7	0.417	0.62	7	0.46	0.652	5	0.311	0.586

Table 5. Basic microsatellite statistics

Breeds	Bikaneri	Jaisalmeri	Kachchhi	Mewari
Mean alleles number	8.76	8.56	8.6	8.68
Number of alleles standard deviation	3.32	4.073	3.786	3.705
Mean heterozygotes proportion	0.541	0.532	0.554	0.544
Heterozygotes proportion standard deviation	0.231	0.204	0.22	0.197
Mean Nei's genic diversity	0.741	0.748	0.759	0.757
Nei's genic diversity standard deviation	0.125	0.129	0.117	0.121

Table 6. Hardy-Weinberg exact probability test (Markov chain algorithm) and Weir & Cockerham's estimate of F_{IS}

Micro -	Bikaneri		Jaisalmeri		Kachchhi		Mewari	
satellite	P-val	F_{IS}	P-val	F_{IS}	P-val	F_{IS}	P-val	F_{IS}
CVRL04	0.0000	0.6186	0.0000	0.5259	0.0000	0.4920	0.0000	0.5119
CVRL05	0.000	0.1467	0.0000	0.3888	0.0000	0.2278	0.0000	0.2683
LCA18	0.0000	0.5856	0.0000	0.5106	0.0000	0.4933	0.0000	0.4177
VOLP03	0.0000	0.3758	0.0000	0.3411	0.0000	0.6189	0.0000	0.3701
YWLL38	0.0000	0.4914	0.0000	0.4090	0.0000	0.6216	0.0029	0.2822
CVRL01	0.0000	-0.1283	0.0000	0.0470	0.0000	-0.0288	0.0000	0.1312
LCA66	0.0013	-0.1574	0.0000	0.3947	0.0007	0.0303	0.0000	0.1786
YWLL08	0.0018	-0.0830	0.0000	0.0807	0.0001	0.0369	0.0026	0.0954
CVRL03	0.0000	0.4790	0.0000	0.3939	0.0000	0.5189	0.0000	0.6007
VOLP08	0.0000	-0.2954	0.0000	-0.1212	0.0000	-0.0878	0.0000	-0.0253
YWLL58	0.0000	0.4166	0.0000	0.3557	0.0000	0.4291	0.0000	0.6977
CMS121	0.0000	0.2510	0.0000	0.3262	0.0031	0.1444	0.0000	0.2718
CMS13	0.0073	0.2055	0.0011	0.3742	0.0000	0.3714	0.0000	0.4630
CMS15	0.0056	0.0096	0.0007	0.2360	0.0084	-0.0606	0.0000	-0.0294
CMS50	0.0000	0.3142	0.0056	0.1543	0.0038	0.0141	0.0013	0.1780
CVRL07	0.0000	0.7793	0.0000	0.8505	0.0000	0.6639	0.0000	0.7042
LCA22	0.0027	0.1769	0.0090	-0.0399	0.0025	-0.1120	0.0177	-0.3691
LCA33	0.0000	0.1399	0.0000	0.2196	0.0000	0.3874	0.0000	0.3335
LCA63	0.0000	0.2218	0.0004	0.2890	0.0010	0.1831	0.0000	0.1949
LCA90	0.0000	0.3543	0.2313	0.1812	0.0002	0.3337	0.0001	0.2005
VOLP10	0.0000	0.4045	0.0068	0.1537	0.0000	0.4305	0.0000	0.3449
VOLP67	0.0000	0.2855	0.0000	0.2733	0.0000	0.1217	0.0000	0.2223
YWLL09	0.0000	0.8304	0.0000	0.8426	0.0000	0.7286	0.0000	0.5516

Table 7. Genetic distance among Indian dromedary breeds :upper triangle Nei's distance(Ds) and lower triangle Cavalli - Sforza Chord distance (Dc)

Genetic Distance	Bikaneri	Jaisalmeri	Kachchhi	Mewari
Bikaneri	0.000000	0.117825	0.193852	0.220170
Jaisalmeri	0.033834	0.000000	0.124717	0.159476
Kachchhi	0.044426	0.033486	0.000000	0.060200
Mewari	0.048905	0.037356	0.025708	0.000000

Table 8. Reynold's distance(Fst) between Indian dromedary breeds.

Genetic Distance	Bikaneri	Jaisalmeri	Kachchhi	Mewari
Bikaneri	0.000000	0.038241	0.057759	0.064630
Jaisalmeri	0.038241	0.000000	0.038536	0.048207
Kachchhi	0.057759	0.038536	0.000000	0.019078
Mewari	0.064630	0.048207	0.019078	0.000000

Table 9. Individual Assignment and first generation migrants

Breed	Algorithm	Quality Index (%)	Correctly Assigned (%)	Bikaneri	Jaisalmeri	Kachchhi	Mewari
Bikaneri	Ranalla and mountain	65.20	67.5	**40**	6	2	2
	Baudouin and lebrun	64.02	67.0	**40**	6	3	1
	Paetkau et al	64.03	65.5	**38**	7	3	2
Jaisalmeri	Ranalla and mountain	65.20	67.5	7	**31**	7	5
	Baudouin and lebrun	64.02	67.0	7	**34**	3	6
	Paetkau et al	64.03	65.5	10	**31**	4	5
Kachchhi	Ranalla and mountain	65.20	67.5	0	6	**34**	10
	Baudouin and lebrun	64.02	67.0	0	8	**31**	11
	Paetkau et al	64.03	65.5	0	8	**32**	10
Mewari	Ranalla and mountain	65.20	67.5	1	5	14	**30**
	Baudouin and lebrun	64.02	67.0	1	6	12	**31**
	Paetkau et al	64.03	65.5	1	4	15	**30**

AGB 7. Project : Genetic improvement of milk production potential of Indian Dromedary

Project Leader : S.C. Mehta

Associates : U.K. Bissa and Sajjan Singh

Milk Production : Breeds, Individuals, Months & Parity

Two teat milking was followed to allow proper let down of milk. Two teats (one front and one rear) were milked and the other two were left for the calf. The milking females were offered concentrate ration, Saras Gold (high energy ration) @ 3 kg / day. The recording commenced from day 15th after calving. Three times milking was followed till the calf attains an age of 3 months.

Year 2009-10: The average daily milk production was 2887.12±16.08 ml with 2853.58±23.69 ml in Bikaneri, 3125.48±21.87 ml in Kachchhi and 2682.29±35.86 ml in Mewari. The effect of breed was highly significant (P<0.01). The milk production was higher in morning and production from rear teat was higher (Table 10). The production was highest in 3rd lactation (3027 ml) followed by 2nd (2993 ml), 1st (2715 ml) and 4th (1965 ml). The production in different months varied significantly (P<0.01) (Table 11). The production of individual animal has been presented in Tables 12 A to C. Of the 7 selected females of Bikaneri breed only 5 could continue till 16th month of lactation. B-455 and B-497 died respectively in the 9th and 5th month of lactation. Mewari female M-7 ceased producing milk in 12th month of lactation. Highest milk production was of Mewari female M-1 (Table 12C).

Year 2010-11: The average daily milk production was 3053.34±11.13 ml with 3108.41±17.30 ml in Bikaneri, 3205.24±17.23 ml in Kachchhi and 2846.36±21.11 ml in Mewari. The effect of breed was highly significant (P<0.01). The milk production was higher in morning and production from rear teat was higher (Table 13). The production was highest in 3rd lactation (3485 ml) followed by 4th (3165 ml), 2nd (3006 ml) and 1st (2809 ml). The production in different months varied significantly (P<0.01) (Table 14). The production of individual animal has been presented in Tables 15 A to C. Of the 6 selected females of Kachchhi breed K-105 ceased producing milk after 10th month because it was bred under reproduction project. Highest milk production was of Kachchhi female K-117 (Table 15 B). Milk production in dromedary breeds and lactations in the year 2009-10 and 2010-11 have been compared in the Fig. 3 & 4.

Year 2011-12 : Eight Bikaneri, 7 Kachchhi and 15 Mewari females were selected for the project. The purchased females were allotted tentative parity (Table 16). The selection for the milking experiment was based on their lactation and availability for the project. Ten females were dropped due various reasons specified in the Table 16. The tentative production figures have been presented in Table 17. The pooled average of per day milk production from 2 teats was 1811 ml which was significantly lower than the previous performances. The reasons envisaged were change in management practice, kind of fodder supplied and irregular supply of concentrate ration to the milking females.

Table 10. Average daily milk production of dromedary breeds (2009-2010)

(Two teat milking, milk yield in ml)

Breed	Morning		Evening		Total
	Front	Rear	Front	Rear	
Pooled	746 (7198)	871 (7198)	498 (7137)	626 (7137)	2887 (7100)
Breed	**	**	**	**	**
Bikaneri	733 (2760)	865 (2760)	491 (2737)	626 (2737)	2854 (2721)
Kachchhi	837 (3235)	965 (3235)	516(3214)	651 (3214)	3125 (3193)
Mewari	669 (1203)	781 (1203)	488 (1106)	603 (1186)	2682 (1186)

Table 11. : Average daily milk production in different lactations (2009-2010)

(Two teat milking, milk yield in ml)

	Lactations			
	1st	2nd	3rd	4th
Over all	2715.30±57.29 (3009)	2993.42±15.81 (2454)	3026.86±67.10 (1182)	1965.33±14.48 (455)
Month	**	**	**	**
1	2763.68±91.85	3217.64±52.88	3586.90±112.43	2957.14±57.38
2	3261.43±89.86	3675.98±51.54	3125.00±107.43	3017.24±56.38
3	3367.94±90.78	3524.29±51.83	2921.59±.109.84	2660.00±55.43
4	3365.37±90.95	3502.34±52.73	3450.00±109.84	2153.57±57.38
5	3417.70±90.08	3572.08±55.57	3537.93±110.47	2078.57±57.38
6	3308.06±89.65	3766.90±57.26	3608.70±107.43	1896.67±55.43
7	3430.11±93.02	3881.51±57.07	3517.05±109.85	1876.67±55.43
8	3345.45±95.23	3894.61±56.86	3200.01±111.12	1785.71±57.38
9	3268.27±90.29	3667.78±56.49	3659.68±130.87	1825.81±54.53
10	2971.01±90.51	3534.67±56.30	3273.33±133.03	1640.00±55.43
11	2636.89±90.73	3242.18±56.87	2988.33±133.03	1643.33±55.43
12	2287.75±93.02	2921.92±87.07	2624.56±136.49	1975.86±56.38
13	1924.86±97.88	2404.73±56.30	2581.67±133.03	1680.00±55.43
14	1778.53±97.88	1962.91±56.12	2303.33±133.03	1713.33±55.43
15	1681.77±125.89	1643.16±58.49	1940.00±133.03	1620.00±55.43
16	1773.24±154.55	1420.91±65.75	1638.60±136.49	921.43±81.14

Table 12 A. Average daily milk production of Bikaneri females in different months of lactation: Bikaneri (2009-10)

(Two teat milking, milk yield in ml)

Month	Bikaneri						
	455	**473**	**477**	**493**	**497**	**525**	**529**
Pooled	1951 (238)	2976 (486)	1965 (455)	3079 (466)	3754 (123)	2536 (474)	3705 (476)
Month	**	**	**	**	**	**	**
1	2148	4346	2957	3380	4519	3083	4330
2	2181	3855	3017	4438	3893	2827	3347
3	2107	3453	2660	4470	3280	2454	3150
4	2059	3800	3154	3443	4046	2850	4479
5	2079	3703	2079	3592	3033	2641	4831
6	1981	4310	1897	3596		2755	4558
7	1841	4343	1877	3341		2870	4338
8	1531	3586	1786	3433		3053	4497
9	1633	3052	1826	3383		2850	4450
10		2297	1640	3147		2713	4250
11		2077	1643	2910		2810	3900
12		1864	1976	2657		2889	3358
13		1953	1680	2158		2610	3210
14		1993	1713	1913		2107	2613
15		1777	1620	1503		1900	2103
16		1186	921	1600		1593	2076

Table 12 B. Average daily milk production of individuals in different months of lactation: Kachchhi (2009-10)

(Two teat milking, milk yield in ml)

Month	Kachchhi						
	109	**123**	**125**	**135**	**153**	**155**	**159**
Pooled	3487 (465)	3477 (437)	2814 (489)	2483 (469)	3234 (486)	2939 (449)	3062 (414)
Month	**	**	**	**	**	**	**
1	2886	2693	2862	2331	2862	3289	3324
2	3997	2680	3247	3343	3400	3143	3763
3	3603	4193	3077	3113	3523	2647	4067
4	3879	3810	2678	2600	3828	3466	4017
5	4297	4220	3243	2673	4127	3480	4247
6	4543	4460	3423	2777	4143	3267	4147
7	4821	4524	3886	2936	4334	3043	4617
8	4677	4633	3660	2860	4020	2652	4643
9	4420	4277	3400	2917	4137	3717	3717
10	4173	4153	3487	3007	3603	3673	2972
11	3659	3348	3490	2689	3627	2848	2538
12	3157	2817	3100	2174	3255	3043	1630
13	2683	2117	2461	1729	2623	2680	748
14	2077	1867	1855	1613	2380	2447	518
15	1600	1377	1762	1430	2103	2090	983
16	1314		1150	1536	2052	1671	

Table 12 C. Average daily milk production of individuals in different months of lactation: Mewari (2009-10)

(Two teat milking, milk yield in ml)

Month	Mewari		
	1	5	7
Pooled	4502 (416)	2290 (432)	728 (343)
Month	**	**	**
1	3772	2166	1638
2	5568	2310	1193
3	7062	2303	983
4	6337	2510	787
5	5957	2643	707
6	5570	2690	580
7	5755	2847	477
8	5310	2976	470
9	4813	3053	445
10	3903	3087	500
11	3623	2623	517
12	2623	2076	441
13	2573	1143	
14	2459	1193	
15	2200	735	

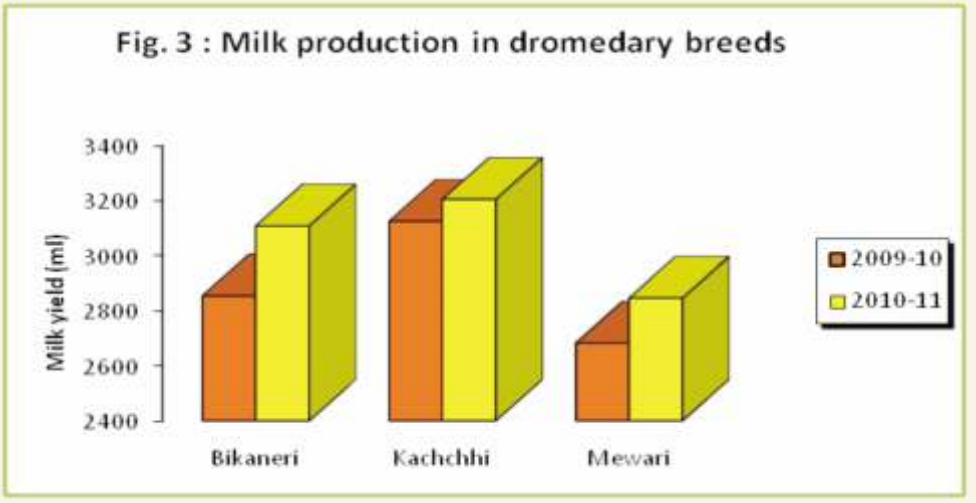


Table 13. Average daily milk production of dromedary breeds (2010-2011)

(Two teat milking, milk yield in ml)

Breed	Morning		Evening		Total
	Front	Rear	Front	Rear	
Pooled	806	935	512	635	3053
	(7417)	(7417)	(7339)	(7339)	(7286)
Breed	**	**	**	**	**
Bikaneri	826	953	521	643	3108
	(2994)	(2994)	(2959)	(2959)	(2939)
Kachchhi	851	982	536	661	3205
	(2416)	(2416)	(2401)	(2401)	(2377)
Mewari	740	871	478	599	2846
	(2007)	(2007)	(1979)	(1979)	(1972)

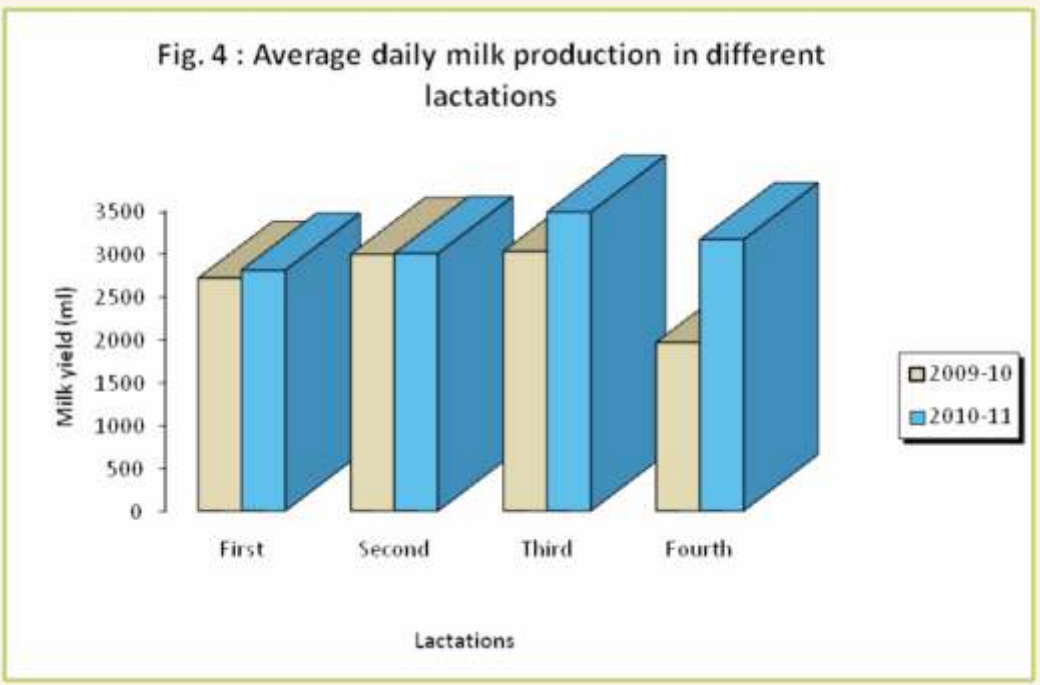


Table 14. Average daily milk production indifferent months of lactation (2010-2011)

(Two teat milking, milk yield in ml)

Month	Lactations			
	1st	2nd	3rd	4th
Over all	2809.17±11.08 (4474)	3005.61±18.91 (894)	3484.85±44.36 (1263)	3165.11±40.54 (657)
Month	**	**	**	**
1	2428.93±38.14	3115.00±69.82	2586.52±86.92	2641.67±129.08
2	2872.72±38.08	2856.67±69.82	3794.57±68.53	3611.67±129.08
3	3454.57±38.20	3160.00±69.82	4602.33±.68.53	3581.35±130.17
4	3600.00±38.43	3561.67±69.82	4247.73±69.31	3437.29±130.17
5	3625.00±38.43	3996.55±71.02	4447.19±68.92	3794.83±131.29
6	3389.87±38.61	2471.67±69.82	4282.22±68.54	3534.54±134.82
7	3165.36±39.55	3175.00±69.82	4132.22±68.54	3266.67±129.08
8	3082.21±40.07	3188.13±70.41	4216.67±68.54	2985.45±134.82
9	3031.23±38.85	3513.33±69.82	4135.52±74.58	2706.78±130.17
10	2898.74±38.79	3726.78±72.27	3496.70±69.31	3146.34±156.15
11	2749.38±38.55	3320.00±69.82	3102.30±69.31	3006.45±179.58
12	2392.74±38.88	2827.12±70.41	2574.16±68.92	2866.67±182.55
13	2219.69±38.98	1926.32±71.63	2627.78±68.54	2566.67±182.55
14	1812.10±43.93	2498.00±76.49	2618.23±70.52	
15	1422.08±78.84	2070.17±71.64	1793.54±116.78	
16		1683.33±127.48		

Table 15 A. Average daily milk production of Bikaneri females in different months of lactation (2010-11)

(Two teat milking, milk yield in ml)

Month	Bikaneri						
	483	**515**	**545**	**569**	**575**	**579**	**581**
Over all	3675 (390)	3022 (451)	3195 (465)	2675 (456)	3336 (434)	2559 (413)	2453 (405)
Month	**	**	**	**	**	**	**
1	2817	2357	3040	3190	2650	2487	2543
2	4447	2867	2973	2740	3140	2980	2846
3	4433	3670	3260	3060	4003	3917	3530
4	3883	4000	3587	3537	3820	3255	3717
5	4000	3927	4017	3710	3953	3290	3650
6	3333	3590	3497	3447	3203	3237	3020
7	4647	3530	3527	2823	3873	3273	2210
8	3927	3490	3710	2560	3807	2850	2143
9	3967	3823	4213	2813	4153	2289	2340
10	3813	3067	3763	3193	3737	2500	2313
11	3073	2593	3580	3060	3523	2329	2477
12	2867	2383	3307	2253	2343	1392	1917
13	2567	1947	2200	1533	3163	1777	1013
14		2297	1726	1347	2534	1230	627
15		1794	2135	1603	2133	886	
16			1585	1940			

Bikaneri Male

Bikaneri Female

Table 15 B. Average daily milk production of Kachchhi females in different months of lactation (2010-11)

(Two teat milking, milk yield in ml)

Month	Kachchhi					
	105	**117**	**119**	**133**	**139**	**157**
Over all	2060 (306)	4004 (419)	3502 (417)	2223 (449)	2614 (458)	3207 (436)
Month	**	**	**	**	**	**
1	2467	2940	2377	2430	3050	2787
2	2777	4663	3854	2980	2727	3063
3	2610	5390	4747	2470	2887	3413
4	2877	4653	3807	3340	3470	3627
5	3337	4653	3893	3793	3723	4073
6	3147	5373	4220	3427	3503	3840
7	1887	5036	4137	2130	2520	4120
8	1547	4730	4283	1910	1860	4277
9	1357	4876	2133	1897	2820	4513
10	487	4520	3723	1893	2863	4170
11	167	3466	3357	2690	3210	3863
12		3046	3013	2333	3297	3567
13		2240	2890	1750	1960	2209
14		2992	2598	1787	2533	700
15				736	1393	

Kachchhi Male

Kachchhi Female

Table 15 C. Average daily milk production of Mewari females in different months of lactation (2010-11)

(Two teat milking, milk yield in ml)

Month	Mewari				
	19	21	27	35	81
Over all	3188 (402)	2791 (417)	2740 (416)	2662 (430)	2159 (391)
Month	**	**	**	**	**
1	2003	2193	2303	2387	1804
2	3343	3070	2606	2316	2530
3	4153	3617	3236	3233	3310
4	3597	3680	3170	3670	3063
5	3857	3617	3256	3387	2550
6	3600	3377	3460	2980	2550
7	3533	3357	2896	3037	1337
8	3403	3267	2596	2937	1757
9	3200	2733	3140	2783	2300
10	3177	2087	3116	2883	2070
11	2477	1920	2723	2750	1703
12	3280	2003	1730	1920	1733
13	2906	2383	2463	2290	
14	2100	1774	1661	1387	
15				1562	

Mewari Male

Mewari Female

Table 16. Selection of Female for milking (2011-12)

S.No.	Breed	Animal No.	Allotted Parity	Status
1	Bikaneri	561		Still Birth
2	Bikaneri	543		In milk
3	Bikaneri	541		In milk
4	Bikaneri	509		In milk
5	Bikaneri	523		In milk
6	Bikaneri	481		In milk
7	Bikaneri	473		In milk
8	Bikaneri	529		In milk
1	Kachchhi	143		Calf died- dropped
2	Kachchhi	181		In milk
3	Kachchhi	189		Transferred to Dr.Sumant
4	Kachchhi	141		In milk
5	Kachchhi	155	2	In milk
6	Kachchhi	159		In milk
7	Kachchhi	153	3	dropped
1	Mewari	01	3	In milk
2	Mewari	07	3	Aborted -dropped
3	Mewari	13	3	No milk-dropped
4	Mewari	15	3	In milk
5	Mewari	17	2	In milk
6	Mewari	29	3	In milk
7	Mewari	33	2	Calf died -dropped
8	Mewari	39	1	In milk
9	Mewari	41	1	No milk-dropped
10	Mewari	45	2	In milk
11	Mewari	47	2	In milk
12	Mewari	49	2	Dystokia-dropped
13	Mewari	53	2	In milk
14	Mewari	63	3	In milk
15	Mewari	77	2	Not pregnant-dropped

Table 17: Average daily milk production of dromedary breeds (2011-12) (Tentative)

(Two teat milking, milk yield in ml)

Breed	No. of Animals	Milk Yield
Pooled	20	1811.76±83.26(1247)
Breed		**
Bikaneri	7	1828.91±197.35(473)
Kachchhi	4	1555.85±188.04(294)
Mewari	9	2050.53±208.51(480)

AGB-8.Project :Genetic evaluation of performance of Indian camel

Project Leader: U. K. Bissa

Associate: Kashi Nath

Herd strength :The opening camel herd strength during 2010-11 was 359 and the closing strength was 365 heads. There were 56 calving in the year. 6 camels of Mewari breed were added by purchasing from the breeding tract. Seventeen camels died and 38 camels were auctioned in the year (Table-18, Fig. 5 and 6).

Growth performance : Growth data was analyzed for the body weight at birth, 6 months, 12 months and 4 years' age. The leastsquares means of body weights at birth, 6 months, 12 months and 4 years were 38.43±0.85, 168.01±5.00, 263.55±7.03 and 434.1±21.6 kg respectively. The effect of breed and sex was non-significant. The effect of year was found highly significant from birth to one year of age ($P<0.01$). The birth weights in the year 2010 and 2011 were comparatively lower in comparison to the previous years. Similarly the body weights at 6 months and 12 months' age were also low (Table 19).

Breeding plan : In the month of September biometry of 37 adult male camels was done for body length, heart girth and height at withers. For preparation of breeding plan the criteria of selection was body length. Independent culling levels were fixed for heart girth and height at wither. Out of 37 camels, 12 were selected for farm breeding. For service to the she camels of villagers, 5 Bikaneri male camels viz. B-620, B-624, B-622, B-602 and B-694 were used. During the period 108 she camels of the nearby villages were given service (Table 20 &21).

Reproductive performance : The conception rate at the centre was 76%, out of 72 females 55 were conceived. Last year 76 females were given service, out of them 71 were conceived (92.2%) and 52 calves were born (73.2%). In addition to these 9 calves were born out of the females of reproduction experiment(Table22).

Mortality analysis : This year 17 camels died at the farm. Out of these, 5 camels each belonged to Bikaneri, Jaisalmeri and Kachchhi breed whereas 2 camels belonged to Mewari breed. One Jaisalmeri male camel was euthanized due to fracture. The breed wise, age group wise and system wise mortality has been presented in Table 23-25 and Figure 7.

The following databases were updated :

1. **Inventory :** Pedigree information of all available camels.
2. **Biometry :** Biometry of adult male camels.
3. **Reproduction:** Reproductive performance of all available camels.
4. **Health :** Mortality of animals at the Centre.

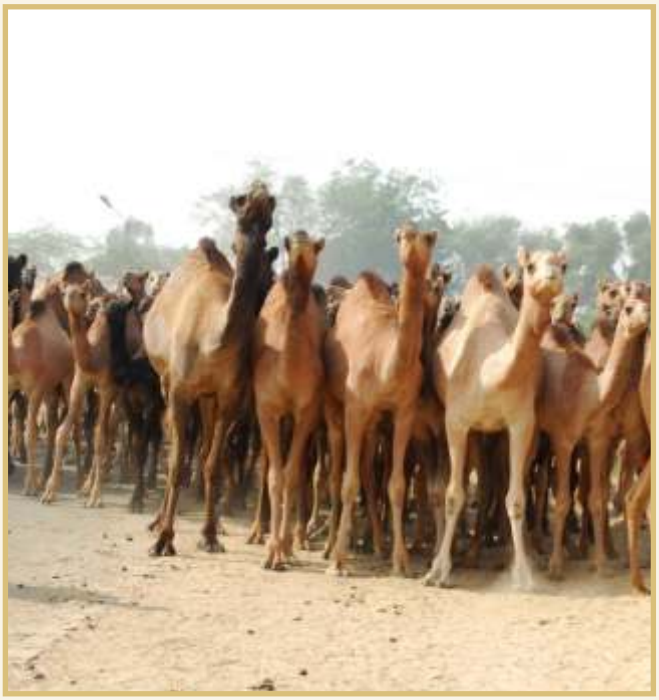


Table 18. Camel herd strength (2010-2011)

Breed Age	Opening 1-04-10		Calving		Purchased		Died		Auction		Closing 31.03.11	
Bikaner	M	F	M	F	M	F	M	F	M	F	M	F
0-1 Yr	8	5	13	9			1	1			12	8
1-2 Yr	11	7							3	1	8	5
2-3 Yr	4	5									8	6
3-4 Yr	5	5							1	-	4	5
>4Yr	19	49					-	3	2	4	21	47
Total	47	71	13	9			1	4	6	5	53	71
Jaisalmeri												
0-1 Yr	9	4	3	4			1	1			2	3
1-2 Yr	8	3							1	-	9	4
2-3 Yr	7	4					1	-			7	3
3-4 Yr	8	4							3	1	6	4
>4Yr	15	39					-	2	7	7	13	33
Total	47	54	3	4			2	3	11	8	37	47
Kachchhi												
0-1 Yr	3	3	6	5			-	1			6	4
1-2 Yr	8	2							1	-	3	3
2-3 Yr	3	8									7	2
3-4 Yr	4	10					1	-			3	8
>4Yr	15	30					1	2	5	2	12	36
Total	33	53	6	5			2	3	6	2	31	53
Mewari												
0-1 Yr	1	4	7	9			1	1			6	9
1-2 Yr	3	3									1	3
2-3 Yr	-	-									3	3
3-4 Yr	-	1									-	-
>4Yr	4	34			2	4					6	39
Total	8	42	7	9	2	4	1	1			16	54
A*B												
0-1 Yr	-	-									-	-
1-2 Yr	-	-									-	-
2-3 Yr	-	3									-	-
3-4 Yr	-	-									-	3
>4Yr	-	1							-	1	-	-
Total	-	4							-	1	-	3
Grand	**135**	**224**	**29**	**27**	**2**	**4**	**6**	**11**	**23**	**16**	**137**	**228**

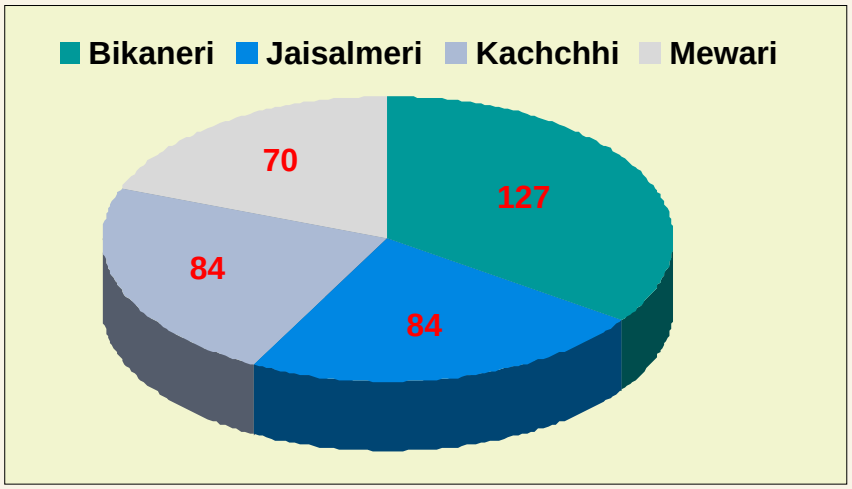


Fig. 5: Breed wise herd strength of farm (2010-11)

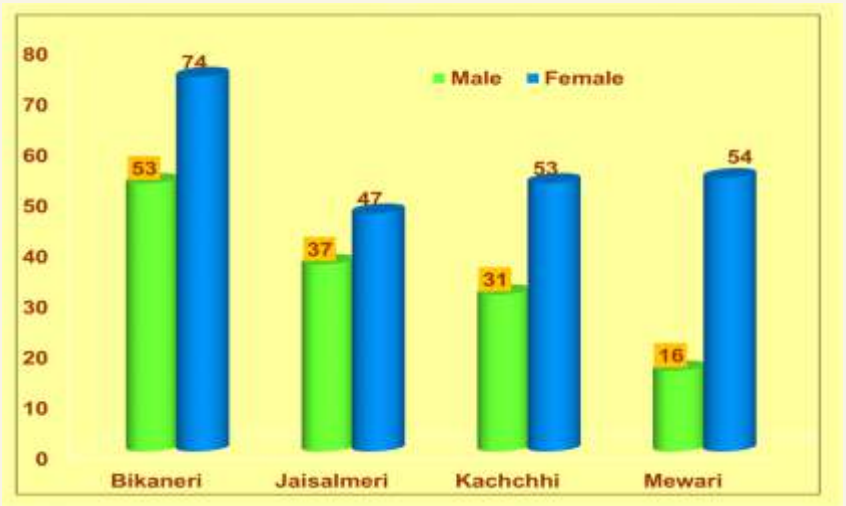


Fig. 6: Breed wise and sex wise herd strength of farm (2010-11)

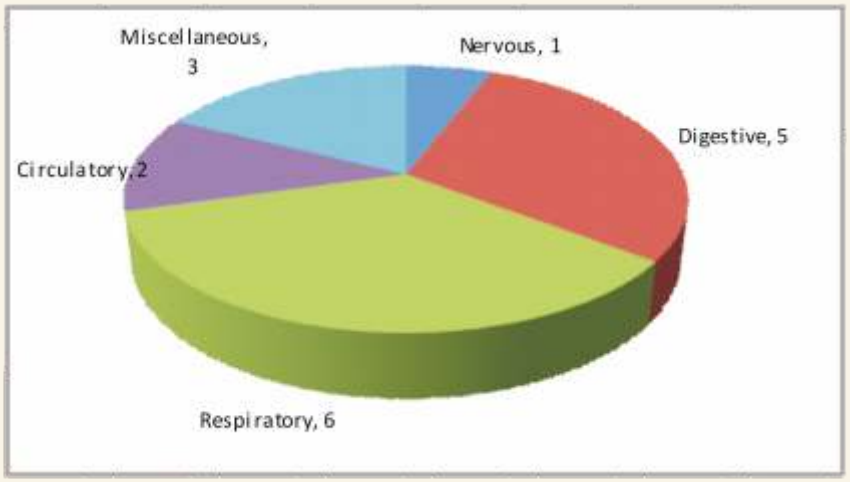


Fig. 7: System wise mortality (2010-11)

Table 19. Growth performance of camels at the centre (2010-11)

(in kg.)

	Birth	6 months	12 months	4 years
Overall	38.43±0.85 (203)	168.01±5.00 (114)	263.55±7.03 (132)	434.1±21.6 (24)
Breed	NS	NS	NS	NS
Bikaneri	39.74±0.64 (75)	166.72±5.59 (44)	263.30±5.74 (52)	435.7±26.1(11)
Jaisalmeri	39.29±0.76 (56)	175.74±6.08 (37)	272.42±6.45 (41)	446.3±28.4 (8)
Kachchhi	38.03±0.86 (43)	174.07±7.06 (25)	275.78±7.89 (29)	420.4±26.4 (5)
Mewari	37.85±1.15 (27)	155.52±11.70 (8)	283.08±15.06 (8)	-
Sex	NS	NS	NS	NS
Male	38.63±0.97 (116)	164.32±5.85 (70)	260.93±8.34 (76)	434.1±21.6(12)
Female	38.249±0.93 (87)	171.70±5.86 (44)	266.17±7.61 (56)	434.1±21.6(12)
Year	**	**	**	**
2007	39.54±1.18 (45)	141.75±5.98 (33)	249.62±10.12(30)	529.9±11.6 (21)
2008	40.34±1.18 (29)	181.19±15.40 (4)	291.74±9.38 (26)	444.2±37.0 (2)
2009	39.88±1.11 (53)	190.09±4.55 (54)	285.46±8.33 (53)	328.3±54.3 (1)
2010	36.50±1.27 (32)	159.00±6.75 (23)	227.40±10.77(23)	-
2011	35.90±1.18 (44)	-	-	-

** (P<0.01), NS-non significant

Table 20. Means and selection differential of adult male camels

(in cm.)

Breed	Selection	N	Body Lenght	Heart Girth	Height of Wither
Overall	Selected	12	166.08±1.22	221.25±2.15	209.41±2.14
	Unselected	25	154.32±1.26	210.96±1.60	204.08±1.03
	Significance		**	**	**
Bikaneri	Selected	4	168.75±0.75	226.50±2.36	208.00±3.34
	Unselected	9	157.22±1.40	211.66±1.29	203.77±1.94
Jaisalmeri	Selected	3	164.33±2.33	224.33±2.18	212.00±4.72
	Unselected	5	152.40±0.81	208.60±1.56	203.20±2.17
Kachchhi	Selected	3	166.33±2.96	216.33±4.09	213.66±4.80
	Unselected	9	155.44±2.19	214.00±3.75	205.55±1.50
Mewari	Selected	2	163.00±5.00	213.50±6.50	202.00±2.00
	Unselected	2	141.00±1.00	200.00±0.00	201.00±6.00

Table 21. Breeding plan for the year 2010-11

Breed	Available Females	Studs for breeding	Sire	Dam
Bikaneri	20	600	418	255
		480	47	78
		692	Purchased	
		592	526	443
Jaisalmeri	22	218	Purchased	
		242	154	55
		244	154	65
Kachchhi	17	166	Purchased	
		204	Purchased	
		136	114	105
Mewari	17	02	Purchased	
		04	Purchased	

Table 22. Reproductive performance of the herd

Year	Trait	Bikaneri	Jaisalmeri	Kachchhi	Mewari	Pooled
2010	Mating	27	12	12	26	76
	Conception	27	11	11	22	71
						92.2%
	Calving	19	8	7	18	52+9
						73.2%
2011	Mating	17	20	18	17	72
	Conception	13	18	13	11	55
						76%

Table 23. Breed, sex and age group wise mortality at the centre (2010-11)

Breed	Sex		Age Group (years)			Pooled
	M	F	0-1	1-3	> 3	
Bikaneri	1	4	2	-	3	5
Jaisalmeri	2	3	2	1	2	5
Kachchhi	2	3	1	-	4	5
Mewari	1	1	1	1	-	2
Total	6	11	6	2	9	17

Table 24. Breed wise specific death rate (2010-11)

Breed	No. of died animals	Available animals	Camel days of died animals	S D R %
Bikaneri	5	127	561	3.89 %
Jaisalmeri	5	84	575	5.84 %
Kachchhi	5	84	427	5.87 %
Mewari	2	70	409	2.81 %
Pooled	17	365	1972	4.58 %

Table 25. Age group wise specific death rate (2010-11)

Age group	No. of died Camels	Available camels	Camel days of died camels	SDR %
0-1 yr	6	50	73	11.95
1-3 yr	2	75	623	2.61
> 3 yr	9	237	1276	3.74
Pooled	17	365	1972	4.58 %

Unit : Camel Physiology

AP-2. Project: Efficient utilization of camel energy during cart pulling and agricultural operations by camels

Project Leader: A. K. Roy

Associates: C. Bhakat, A. K. Nagpal and G. S. Tiwari

Draught-ability: The draught ability experiment was carried out by using nine male camels of 5-6 years of age with an average body weight of 583 to 692 kg. The basal roughages offered to camels were groundnut haulms and cluster bean straw. Apart from roughages, camels were provided with concentrate mixture formulated on the farm by using *Arachis hypogaea* cake (12%), *Hordeum vulgare* (45%), *Triticum aestivum* bran (30%), *Phaseolus aconitifolius* meal (10%), salt (2%) and mineral mixture (1%). The experiment was conducted in completely randomized design for a period of 60 days. The camels were randomly divided into 3 groups of 3 animals each on the basis of nearness in their body weight and age. Three treatments were formulated *viz.*, T_1: groundnut haulms and cluster bean straw in 75:25 proportion; T_2: groundnut haulms and cluster bean straw in 50:50 proportion and T_3: groundnut haulms and cluster bean straw in 25:75 proportion. In all treatments, concentrate mixture was fed as per requirement of the camels.

Feeding was done twice daily *i.e.* in the morning as well as in the evening and feed refusal was weighed once daily prior to morning feeding. The amount of concentrate fed was calculated on the basis of estimated requirement of camels as per Indian Council for Agricultural Research (1985). The feed intake data comprising the intake of roughage and concentrate of each camel in various treatments was recorded on two consecutive days at weekly intervals. The dry matter of feed offered and that of refused were determined by keeping the samples in oven at 90° C for 24 hours. After 53 days of experimental period, seven days metabolic trial was conducted. Faeces voided by the camels were collected every day during collection period to determine the digestibility of feed nutrients. The blood samples were drawn during the metabolic period from the jugular vein of camels. The serum was separated and used for the assay of certain biochemical attributes with standard analytical procedures. The reagent kits supplied by Chemelex S.A. Barcelona, Spain were utilized for the analysis of biochemical attributes with Biotron (BTR-830) photometer. The experiment was conducted in completely randomized design and data was analyzed statistically by standard procedure.

Draught performance and physiological responses : The camels were made to pull multipurpose tool carrier in the farm area until fatigued. The draught and endurance did not differ significantly among the treatments. The rectal temperature, pulse rate and respiration rate of camel maintained under different treatments groups have been presented in Table 26. There was non-significant difference between treatments for rectal temperature before and after work. There was significant increase in pulse rate after work which was 5.15, 10.87 and 20.75%, respectively in T_1, T_2 and T_3 over the values before work. There was non-significant difference between the treatments for respiration rate before work. The respiration rate after work was 15.00, 17.00 and 19.00, respectively in T_1, T_2 and T_3 which differ significantly from each other. The effects of treatments and exercise on blood biochemistry have been presented in Table 27. The physiological responses returned to their initial levels after two hours of rest.

Table 26. Physiological responses in camels before and after work

Attributes	Treatments			SE M
	T_1	T_2	T_3	
Rectal Temperature				
Before work	37.06	36.43	36.93	0.444
After work	38.30	38.87	39.03	0.379
% Increase	3.33	6.68	5.69	-
Pulse rate				
Before work	45.33	46.00	45.00	1.186
After work	47.67^{c}	51.00^{b}	54.33^{a}	1.217
% Increase	5.15	10.87	20.74	-
Respiration rate				
Before work	8.66	9.00	8.34	0.769
After work	15.00^{c}	17.00^{b}	19.00^{a}	0.816
% Increase	73.08	88.89	128.00	-

Figures with different superscripts in a row differ significantly (P<0.05)

Table 27. Effect of treatments and exercise on blood biochemistry of camels

Attributes	Treatments		
	T_1	T_2	T_3
Glucose (mg/dl)			
Before work	99.60^{a}±3.94	89.22^{b}±3.86	80.82^{c}±3.39
After work	129.87^{a}±20.43	171.10^{b}±24.06	213.83^{c}±15.87
Lactate (mg/dl)			
Before work	17.69±2.66	20.99±10.02	21.04±4.28
After work	24.29^{a}±3.96	52.21^{b}±5.98	`91.37^{c}±9.81
Triglycerides (mg/dl)			
Before work	27.87±3.93	24.99±1.28	22.77±1.90
After work	33.90±5.47	35.54±2.19	35.77±2.93
Cholesterol (mg/dl)			
Before work	48.74^{a}±2.40	40.03^{b}±1.85	35.36^{c}±1.41
After work	36.76^{a}±3.68	35.50^{ab}±2.67	30.40^{b}±1.33
Urea (mg/dl)			
Before work	43.70^{a}±2.93	37.50^{b}±1.13	28.75^{c}±2.75
After work	48.80^{a}±1.29	38.50^{b}±0.59	30.32^{c}±2.52
Aspartate Transaminase (I.U./L)			
Before work	89.64^{a}±4.35	75.45^{b}±7.08	59.67^{c}±3.39
After work	93.85±10.41	79.54±10.00	72.11±23.93
Creatinine (mg/dl)			
Before work	2.21^{a}±0.26	1.93^{ab}±0.11	1.77^{b}±0.14
After work	2.39^{ab}±0.32	2.18^{b}±0.13	2.60^{a}±0.06
Phosphorus (mg/dl)			
Before work	9.90±1.01	8.15±1.39	8.37±0.60
After work	10.10±0.99	9.22±0.76	9.52±1.03
Calcium (mg/dl)			
Before work	8.82±0.53	8.62±0.97	8.11±0.59
After work	8.84±1.22	9.02±0.11	8.54±0.23

Figures with different superscripts in a row differ significantly (P<0.05)

AP-3.Project : Physiological and performance adaptability of camel under hot arid environment having different Body Condition Scores (BCS)

Project Leader : Sajjan Singh

Associates : N.V.Patil, A.K.Roy, S.Vyas, and Kashi Nath

BCS of breeding bulls : The Body Condition Score in different Physiological states was recorded on five point scale. The breeding bulls were recorded pre and post rut for body condition score and body weights and biometry of these animals were recorded. Blood samples were collected. The results have been presented in the Table 28.

BCS of adult females : Animals in late pregnancy and post parturition were scored for body

Table 28. Score card of male camels based on qualitative and quantitative measurements

(Body weight in kg.)

S.No.	Animal No.	Date of Birth/ Purchase	Body weight		Difference in Weight	BCS	
			Pre	Post		Pre Rut	Post Rut
1	M-18	23/04/2010 Purchased	547	551	+4	4	4
2	M-02	7/11/2007 Purchased	532	532	0	2	1
3	M-04	10/01/08 Purchased	585	541	44	3.5	3
4	K-166	29/04/2006	741	709	32	3.5	3
5	K-204	1/10/2009 Purchased	559	595	+36	3.5	3.5
6	K-136	21/1/2004	671	762	+91	3.5	4
7	K-142	6/3/2004	764	721	43	4	3
8	J-218	31/03/2001	728	633	95	4	3
9	J-242	21/01/2004	727	656	71	4	3
10	J-244	26/01/2004	540	621	+81	4	4
11	B-480	23/02/1995	675	585	90	3.5	2
12	B-620	29/09/2004 Purchased	871	731	140	3.5	2
13	B-622	29/09/2004 Purchased	796	699	97	3.5	2
14	B-624	29/09/2004 Purchased	690	620	70	3.5	3
15	B-692	06/02/2009 Purchased	640	595	45	3	2
16	B-694	07/02/2009 Purchased	690	597	93	3.5	2
17	B-696	30/01/2004 Purchased	570	643	+73	3	3
18	B-592	08/03/2002	792	635	157	4	3
19	B-600	08/02/2003	678	627	51	3.5	3
20	B-602	23/02/2003	684	632	52	3.5	3

conditions along with body weight and the results have been presented in Table 29. Blood samples were collected and analyzed in collaboration with nutrition unit. Data related to biometry of these animals have also been summarized.

Table 29. Pre parturition body condition score of females

Animal	Score	Age(year)	Date of Service	Animal	Score	Age(year)	Date of Service
K-159	3	8-9	23.10.09	B-505	4	8-9	3.02.10
K-141	3.5	6-7	18.11.09	K-121	4	9-10	3.02.10
B-509	3.5	9-10	27.11.09	K-109	3.5	14-15	4.02.10
M-1	3.5	7-8	2.12.09	K-125	3	8-9	3.02.10
J-89	3	13-14	3.12.09	B-481	3.5	10-11	4.02.10
B-597	3	13-14	5.12.09	J-221	3	6-7	5.02.10
B-591	2.5	13-14	5.12.09	J-151	2.5	5-6	5.02.10
M-39	3.5	4-5	5.12.09	K-115	3	14-15	5.02.10
M-53	3	5-6	17.12.09	B-571	4	4-5	7.02.10
J-113	3	9-10	19.12.09	B-571		4-5	7.02.10
B-605	3	7-8	22.12.09	B-561	3	4-5	8.02.10
B-603	3.5	9-10	26.12.09	K-189	3	4-5	10.02.10
K-143	2.5	5-6	28.12.09	K-7		6-7	19.02.10
M-15	4	7-8	29.12.09	M-29	3.5	7-8	19.02.10
B-585	4	4-5	2.01.10	K-155	3.5	8-9	19.02.10
B-457	2.5	12-13	5.01.10	J-83	4	13-14	20.02.10
K-123	3	8-9	6.01.10	K-135		6-7	20.02.10
M-13	3	8-9	6.01.10	B-537	4	6-7	21.02.10
M-41	3.5	4-5	7.01.10	B-573	3.5	4-5	22.02.10
B-463	4	13-14	9.01.10	J-127	3	9-10	22.02.10
B-477	3.5	11-12	9.01.10	M-49	2.5	5-6	24.02.10
B-529	4	7-8	10.01.10	M-63	3	6-7	24.02.10
M-43	3	7-8	10.01.10	J-167	3.5	8-9	27.02.10.
M-45	4	5-6	11.01.10	B-541	3.5	6-7	25.02.10
J-223	3	5-6	11.01.10	B-599	3.5	4-5	5.03.10
K-181	4	4-5	14.01.10	B-509	4	8-10	5.03.10
M-47	3.5	5-6	14.01.10	B-495	4	9-10	5.03.10
B-473	3.5	12-13	16.01.10	B-549		5-6	12.03.10
M-65	3	6-7	20.01.10	M-17	3.5	7-8	13.03.10
K-105	3.5	16-17	22.01.10	M-77		5-6	13.03.10
K-543	4	5-6	26.01.10	J-147	4	8-9	6.04.10
M-69	3.5	5-6	26.01.10	M-33	3.5	6-7	12.04.10
B-425	3.5	17-18	28.01.10	K-153	2.5	9-10	22.04.10
M-31	3.5	6-7	2.02.10	J-161	3.5	11-12	23.04.10
B-523	4	8-9	3.02.10	K-83	3.5	14-15	13.05.10

Unit : Camel Reproduction

AR-5.Project: Improving the efficiency of artificial insemination in camel using existing and emerging technologies

Sub-project : To study the time of insemination in camel with use of hCG preparations

Project Leader: S. Vyas

Asociates: G. Mal

Five female camels were examined per rectum as per schedule for ovarian status before giving hormonal treatment for ovulation. In all 20 rectal examinations were performed. 5000 I.U. of Highly Purified Human Chorionic Gonadotrophin (HPHCG) preparation, Injection Pubergen HP (UNI-SANKYO Ltd.), was used as ovulating agent. It was administered intra muscular when at least one follicle with a diameter of 1- 2 cm was available on either of the ovaries.

The male camels were selected and semen was collected not more than twice a week per male camel. The quality of semen was assessed for volume, colour, thickness of gel and sperm concentration. The semen was extended immediately after collection using freshly prepared Tris egg yolk citrate. Artificial insemination gun and sheath of bovine was utilized for inseminating the camel semen in the uterine body. The insemination was done at 30 h and 45 h after the injection of Pubergen HP. The blood was collected at 0, 7, 9, 15 and 30 days of hCG administration for progesterone assay. Three camels out of five female camels were tentatively pregnant. The detailed results have been presented in Table 30.

AR-6.Project:Role of sexual and bio-stimulation in camel reproduction

Sub-project: To study the effect of sexual and bio-stimulant in camel reproduction

Project Leader: S. Vyas

Associates: G. Mal and U.K. Bissa

The males were tied near the corral in early morning during 6 to 8 AM where adult non-lactating non-pregnant female camels were kept and /or brought inside the corral for 15 minutes on alternate days starting from September 10. In all fifteen male camels were taken for the study. There were five Bikaneri (B692, 694, 600, 622, 620), four Jaisalmeri (J 218, 242, 228, 128), four Kachchi (K 126, 166, 142, 116) and two Mewari (M 04, 02) camels. The camels were observed for behavioural signs like, (i) grunting and gurgling sound, (ii) secretion of salivary glands (froth from mouth), (iii) ejection of soft palate (iv) standing posture (v) tail movements (vi) micturition (vii) mounting and (ix) copulation.The camels were considered to be in rut when they performed copulation successfully.

Table 30. The results of artificial insemination (double insemination) at 30 h & 45h

S.N.	Animal	Date	Stud	Tentative Status
1	J 129	13/1/11	J 218	Not Pregnant
		17/2/11	J 218	Pregnant
2.	B 467	4/2/11	B 602	Pregnant
3.	B 525	4/2/11	B 602	Not Pregnant
		23/3/11	B 602	Not Pregnant
4.	B 503	17/3/11	B 624	Pregnant
5.	K 107	25/3/11	K 138	Not Pregnant

Table 31: Effect of Biostimulation on male camels

Days after biostimulation	Camels achieved rut
10 Sept-20 Sept	Nil
21 Sept–30 Sept	Five (K 166,142, J 218, B 692, 694)
1 Oct- 10 Oct	Four (M 04, J 242, B 600, K126))
No rut	Five (B 622, 620, J 228, 128, K 116, M02)

It was concluded that bio-stimulation or sexual stimulation had positive effect on male reproduction and can be effectively used to augment rut before the onset of breeding season. Due to this, unorthodox breeding in the month of September and October was successfully attempted.

AR-4. Project : Identification of factors responsible for reproductive disorders and development of technology for countering the same

Sub-project : To study the reproductive status of female camels beyond the traditional limits of breeding season and during early post parturient period

Project leader: S. Vyas

Associates: U.K. Bissa

Non-traditional breeding ahead of breeding season : The female camelswhich did not conceive in the previous breeding season (2009-10) were examined for follicular presence in the month of September, October and November, 2010 (Table 32). These females were separated from males and maintained under extensive system of management as in field. Twenty one females were mated upon finding the follicle of ovulating size. Initially 9 females were tentatively diagnosed as pregnant but on 25/2/11 only four females viz. B 493 (date of mating 23/9/2010), J 141 (DOM-25/10/10) J 219 (DOM-23/10/2010), J 107 (DOM- 11/11/10) were pregnant. In these 4 females the calving interval will reduce from 28 to 78 days as compared to regular start of breeding from 10/12/2010. Also these females will be readily available for early post-parturient breeding in the next year.

Table 32: Reproductive status of female camels prior to breeding season

S. No.	Breed	Number of Camels				
		Examined	With Follicle	Mated	Pregnant	
					10/12/10	25/2/11
1	Bikaneri	8	6	6	4	1
2.	Jaisalmeri	16	10	9	4	3
3.	Kachchi	4	3	3	1	-
4.	Mewari	4	3	3	-	-
	Total	32	22	21	9	4

Post-parturient breeding : She camels were mated during 30-70 days after calving in the same breeding season. This year 15 females were examined and mated, out of which 8 were conceived (Table 33). There would be a reduction of 300 days in the calving interval of these females. The results of post- parturient breeding of the year 2009-10 have been presented in Table 34.

Treatment of ovarian cyst : The Inj. Suprefact of Sanofi, Italy was tried as 0.5% in NSS and 4 ml (containing 0.005 mg of Buserelin acetate/ ml) was injected epidurally at 1st-2nd coccygeal space under aseptic conditions in one female camel having ovarian cyst of 5 cm diameter. The ovarian cyst regressed after 72 hours. of the injection. The epidural route was tried for the first time in camel.

Examination of camel herd at a village : A camel herd of village Gadwala was examined for the reproductive status during the month of October, 2010. Five non-pregnant dry female camels were examined per rectum. The owner was advised to provide mating to two of the females examined as they were found to possess ovulating size follicle upon reco-genital examination.

Table 33: Post-parturient breeding performance (2010-11)

S.No.	Animal	Date of Parturition	Date of Service	Stud	Pregnancy
1.	B 595	26/12/10	2/2/11	B 692	P
2.	B 549	27/12/10	2/2/11	B 592	P
3.	J 127	12/1/11	2/2/11	J 242	NP
4.	M 07	14/12/11	2/2/11	M 04	NP
5.	B 463	2/1/11	25/2/11	B 600	P
6.	J 89	3/1/11	22/2/11	J 244	P
7.	J 113	11/1/11	22/2/11	J 242	P
8.	B 495	24/1/11	5/4/11	B 692	NP
9.	M-13	26/1/11	31/3/11	M 04	P
10	B 477	6/2/11	19/3/11	B 692	P
11.	J 223	1/2/11	19/3/11	J 218	NP
12	B 425	17/2/11	26/3/11	B 694	NP
13	M 91	14/12/11	29/3/11	M 02	NP
14	B 573	2/2/11	28/3/11	B 600	P
15	M 43	3/2/11	28/3/11	M 02	NP

Table 34: Post-parturient breeding performance (2009-10)

S.No.	Animal	Date of I parturition	Date of Conception	Date of II parturition
1.	B 457	19/10/09	5/1/2010	29/12/10
2.	B 573	6/10/09	26/1/10	2/2/11
3.	B 561	3/11/09	16/4/10	19/4/11
4.	K 105	14/12/09	22/1/10	6/2/11
5.	J 127	16/10/09	26/2/10	12/1/11
6.	J 161	23/1/10	26/4/10	awaited

Unit : Animal Biochemistry

AR-2. Project: Studies on the biochemical parameters of semen for increasing its efficacy

Project Leader: Gorakh Mal

Associates: S. Vyas and D. S. Sena

Biochemical analysis of seminal plasma: The concentrations of various biologically important biochemical constituents in the seminal plasma of Bikaneri, Jaisalmeri and Kachchhi breeds of camel were determined. Seminal plasma samples were analyzed for glucose, total protein, aspartate aminotransferase (AST), alanine aminotransferase (ALT), lactate dehydrogenase (LDH), alkaline phosphatase (ALP), acid phosphatase (ACP), cholesterol and total lipids. The concentrations of glucose, cholesterol and total lipids were found to range between 1.91-2.22, 13.47-13.83 and 54.38-54.89 mg/dl respectively. Total protein in the seminal plasma was 0.86-1.24 g/dl. The concentrations of AST, ALT, LDH, ALP, ACP (total) and ACP (non prostatic) were 17.07-19.75, 5.04-6.93, 126.35-141.55, 1975.60-2074.00, 84.37-92.31 and 29.81-35.39 U/L respectively (Table 35). The effect of breed was non-significant in the biochemical parameters studied.

Table 35. Breed wise average concentrations of various parameters in the seminal plasma samples

Parameters	Breeds		
	Bikaneri	Jaisalmeri	Kachchhi
Total Protein (g/dl)	0.86±0.18	1.24±0.16	0.95±0.20
Glucose (mg/dl)	1.91±0.21	2.22±0.36	1.92±0.36
Cholesterol (mg/dl)	13.47±0.75	13.65±0.66	13.89±0.86
Total lipids (mg/dl)	54.38±4.00	54.79±3.05	54.89±5.03
AST (U/L)	17.07±4.32	19.75±4.36	19.56±4.68
ALT (U/L)	6.32±1.10	5.04±1.21	6.93±1.40
LDH (U/L)	135.71±11.43	141.55±12.59	126.35±19.11
ALP (U/L)	1994.80±200.20	2074.00±239.60	1975.60±306.75
ACP total (U/L)	84.79±16.07	84.37±16.35	92.31±19.91
ACP non prostatic (U/L)	29.81±6.84	30.45±7.53	35.39±9.82

AP-3. Project: Processing, value addition and commercialization of different camel products and by-products

Project Leader: Gorakh Mal

Associates: C. Bhakat, D. Sena and D. Kumar

Chocolate Barfi: It was prepared from camel milk *mawa* and sugar by mixing them in 4:1.5 ratios along with 10-15% chocolate powder (Figure 8). Moisture and fat contents in *barfi* were 5-6% and 10-12% respectively.

Figure 8. Camel milk chocolate burfi

Camel milk *peda*: The *mawa* made up of camel milk was mixed with well powdered sugar in 3:1 ratio. The mixture was given different shapes (Figure 9). Moisture and fat contents in *peda* were 6-7% and 10-11% respectively.

Figure 9. Camel milk *peda*

Lyophilized skim milk powder: It was prepared from the raw, pasteurized and boiled camel milk. It was white in color with normal odor and salty taste (Figure 10). The percent value of moisture and fat in skim milk powder were 5-6% and 1-1.5% respectively. A yield of 6.8-7.6 % was observed by this method.

Figure 10. Camel skim milk powder

Rasogolla: Pure camel milk, camel milk plus cow milk and camel milk plus buffalo milk in different ratios were boiled for 5 minutes and cooled to 76-80°C. Then 1% citric acid boiled and kept at 70-74°C was added to it. The coagulum was allowed to settle down and contents were hanged in muslin cloth to allow the whey to drain out. Manual kneading and ball formation of *chhana* was done. 1-2% *maida* was added into the *channa* to avoid cracks in the ball. *Chhana* balls were boiled in the sugar syrup for 20-25 minutes. *Chhana* balls were transferred to hot water for 10-15 minutes for texture stabilization and color improvement. Finally, *channa* balls were put into the sugar syrup with rose essence (Figure 11). *Chhana* balls made from the pure camel milk developed cracks and could not be boiled due to loose binding. Similar types of observations were made with camel milk and cow milk used in 1.5:1 ratios. *Chhana* made from camel milk plus cow milk (1:1 ratio) and camel milk plus buffalo milk (1:1; 1.5:1 ratios) showed good binding.

Figure 11. Camel milk rasogolla

Assessment of commercial viability of camel milk and its value added products: Camel milk and milk products *viz*., *kulfi*, flavored milk, *lassi*, tea and coffee were prepared and sold at the camel milk parlour of the Centre. Sale and profit from the camel milk and its products was highest in October 2010 (Figure12). Camel milk and its products were sold for ` 2,96,161/- during the year and net profit

of ` 1,47,159/- was realized (Figure 13). Raw camel milk was also sold through milk parlour for ` 2,16,150/- to NGO "Baba Farid Centre for Special Children, in Faridkot and Bhatinda -Punjab.

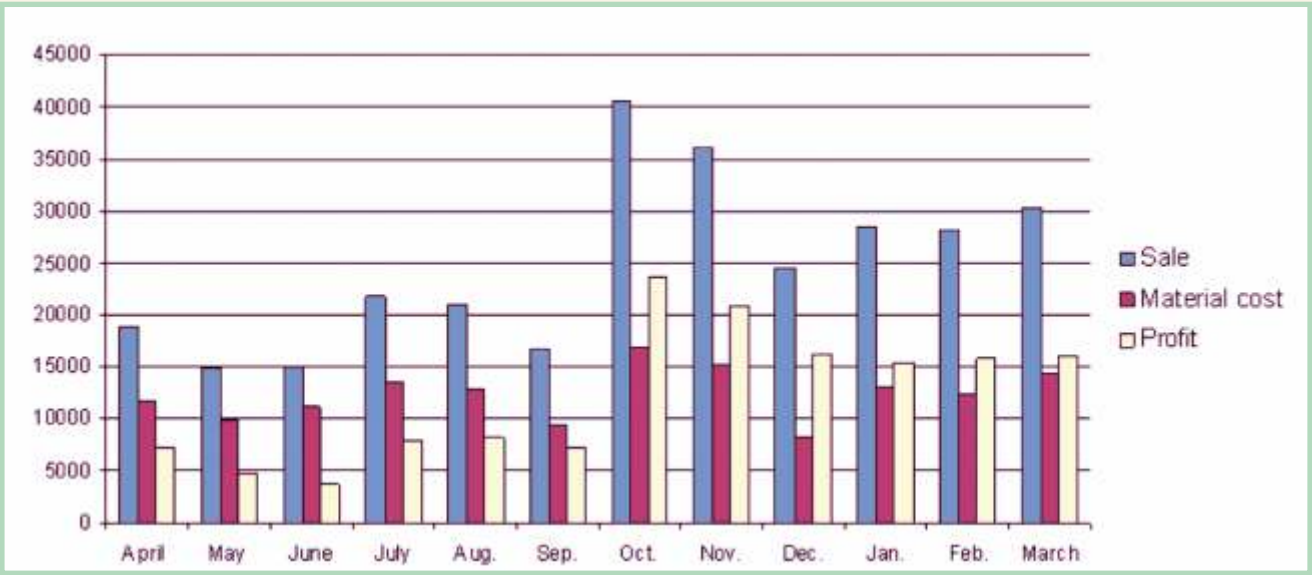


Figure 12: Month-wise sale, material cost and profit from camel milk parlour

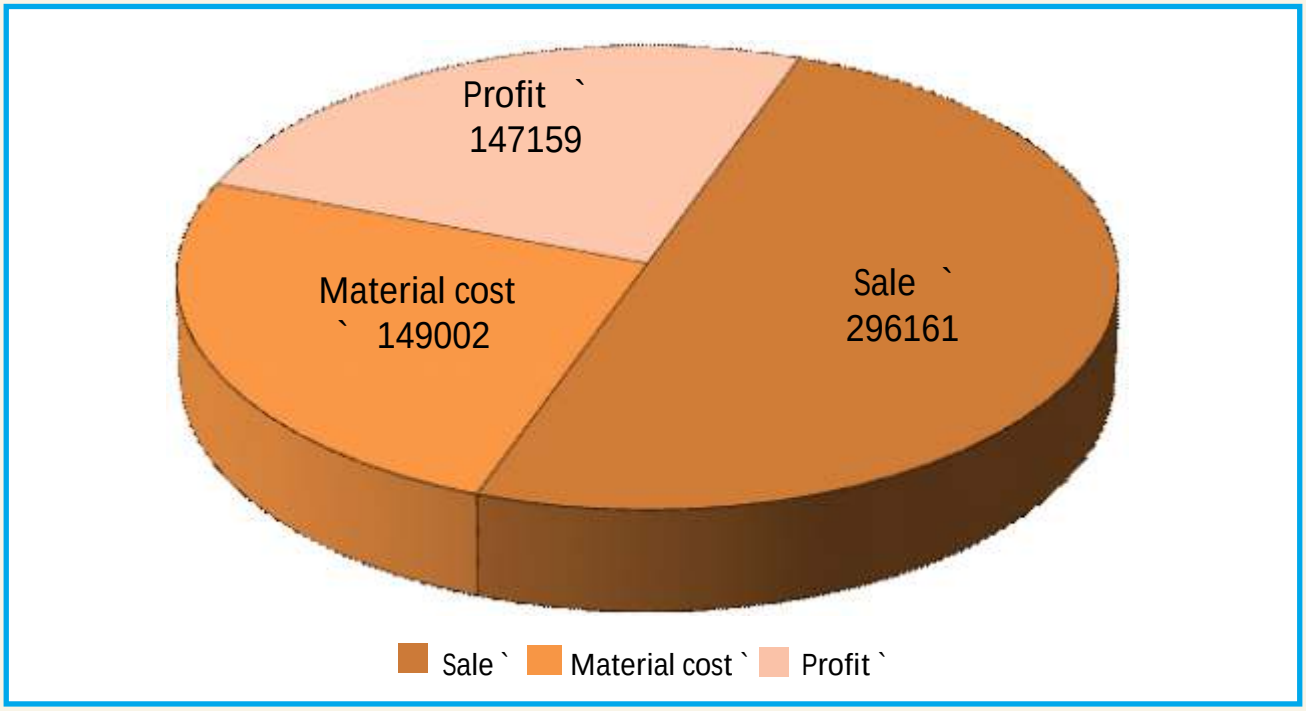


Figure 13: Net profit from camel milk and its products from April 2010-March 2011

AP-5. Project: Evaluation of camel milk for its therapeutic value and its exploitation as functional food

Project Leader: Gorakh Mal

Associate: D. Sena

The effect of heat treatment on camel milk whey proteins during mid and late lactation from Bikaneri, Jaisalmeri, Mewari and Kachchhi camels was studied. Milk samples were heated at different temperatures (63^{0}C, 70^{0}C, 80^{0}C, 90^{0}C and boiled) for 30 minutes. Whey was separated from the heated/boiled and raw milk samples. Simultaneously, whey from the cow milk was separated.

The whey samples were subjected to SDS-PAGE. In camel milk, the whey proteins showed pronounced effect of heat only in the sample heated for =90^{0}C, where the intensity of the bands decreased. No visible effect of heat was observed on camel milk whey proteins of pasteurized and 80^{0}C samples. For the sake of comparison pasteurization of cow milk was carried out at 63^{0}C and no visible change in whey proteins was observed. But, when the cow milk was heated at 80^{0}C, the 66kDa proteins

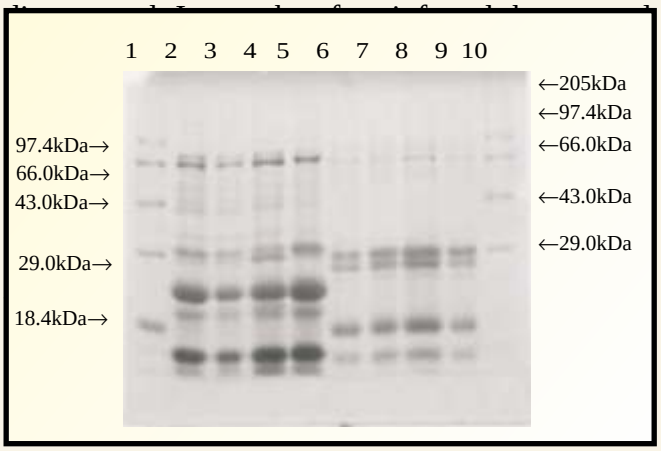


Figure 14: Comparisons of camel (B-455) and cow milk whey proteins denaturation during mid lactation. Lanes 1 and 10: Marker; Lanes 2-5 of B-455 (lane 2: raw; lane 3: 63°C, lane 4: 80°C, lane 5: 90°C.) Lanes 6-9 of cow (lane 6: raw; lane 7: 63°C, lane 8: 80°C, lane 9: 90°C)

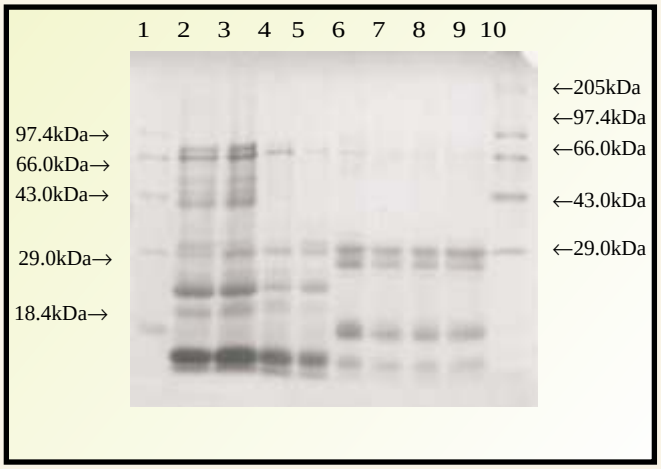


Figure 15: Comparisons of camel (J-65) and cow milk whey proteins denaturation during mid lactation. Lanes 1 and 10: Marker; Lanes 2-5 of J-65 (lane 2: raw; lane 3: 63°C, lane 4: 80°C, lane 5: 90°C.) Lanes 6-9 of cow (lane 6: raw; lane 7: 63°C, lane 8: 80°C, lane 9: 90°C)

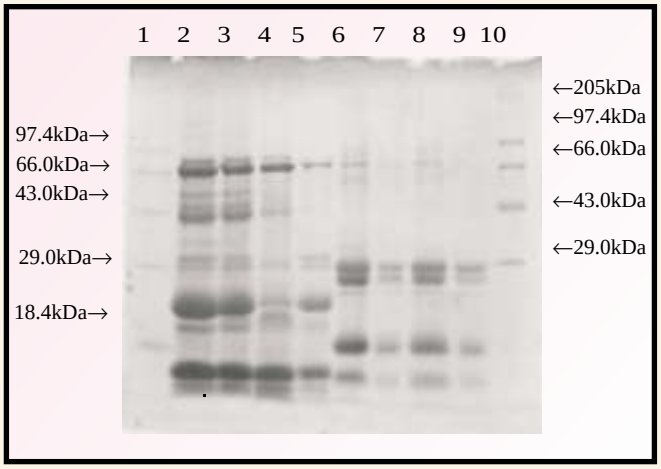


Figure 16: Comparisons of camel (M-13) and cow milk whey proteins denaturation during mid lactation. Lanes 1 and 10: Marker; Lanes 2-5 of M-13 (lane 2: raw; lane 3: 63°C, lane 4: 80°C, lane 5: 90°C.) Lanes 6-9 of cow (lane 6: raw; lane 7: 63°C, lane 8: 80°C, lane 9: 90°C)

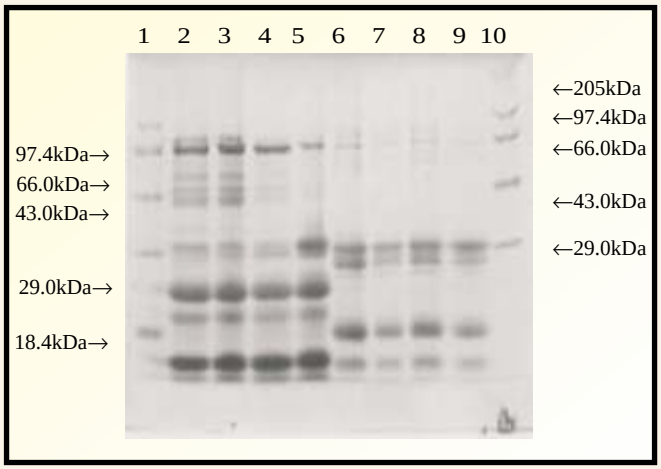


Figure 17: Comparisons of camel (K-123) and cow milk whey proteins denaturation during mid lactation. Lanes 1 and 10: Marker; Lanes 2-5 of K-123 (lane 2: raw; lane 3: 63°C, lane 4: 80°C, lane 5: 90°C). Lanes 6-9 of cow (lane 6: raw; lane 7: 63°C, lane 8: 80°C, lane 9: 90°C)

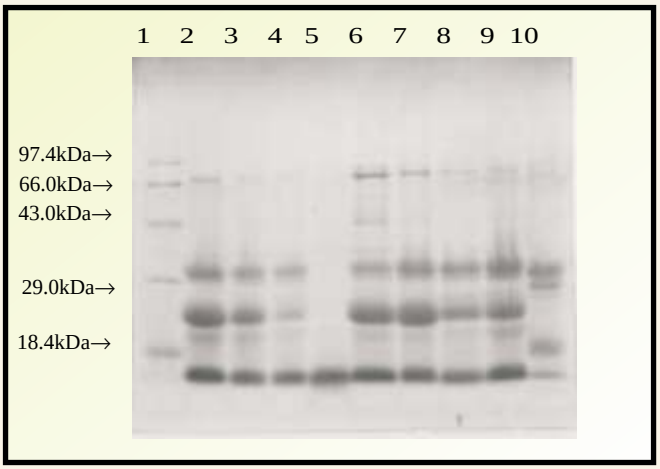


Figure 18: Comparisons of camel and cow milk whey proteins in boiled milk (100°C) during mid lactation. Lane 1: Marker; Lanes 2-9 of camels (lane 2: B-455; lane 3: B-493, lane 4: J-65, lane 5: J-221, lane 6: M-13; lane 7: M-15, lane 8: K-79, lane 9: K-123) and lane 10: cow

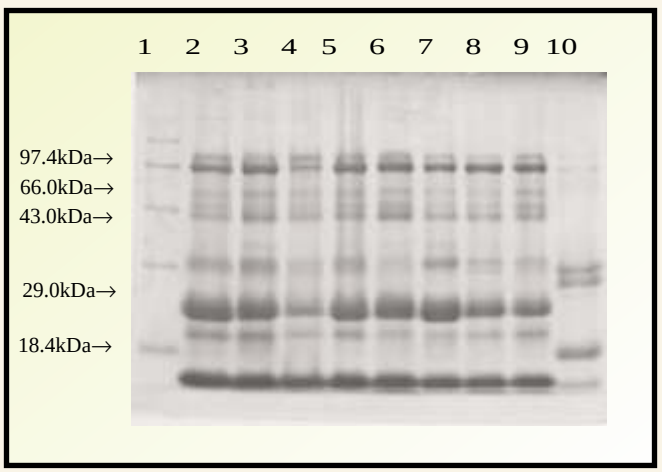


Figure 19: Comparisons of camel and cow milk whey proteins in raw milk during mid lactation. Lane 1: Marker; Lanes 2-9 of camels (lane 2: B-455; lane 3: B-493, lane 4: J-65, lane 5: J-221, lane 6: M-13; lane 7: M-15, lane 8: K-79, lane 9: K-123 and lane 10: cow

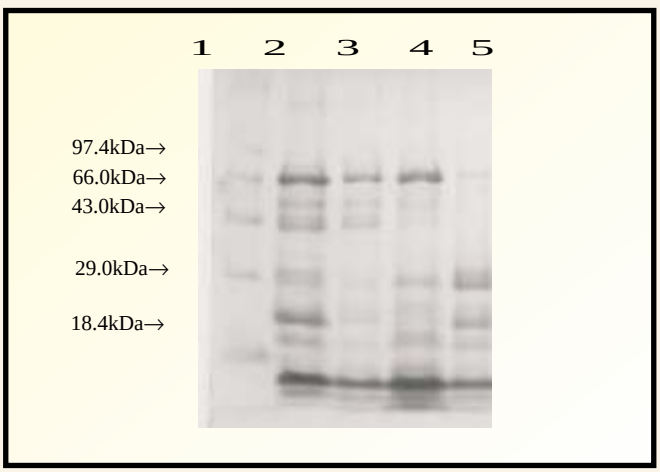


Figure 20: Camel (B-455) milk whey proteins denaturation during late lactation. Lanes 1: Marker; Lanes 2-5 of B-455 (lane 2: raw; lane 3: 63°C, lane 4: 80°C, lane 5: 90°C).

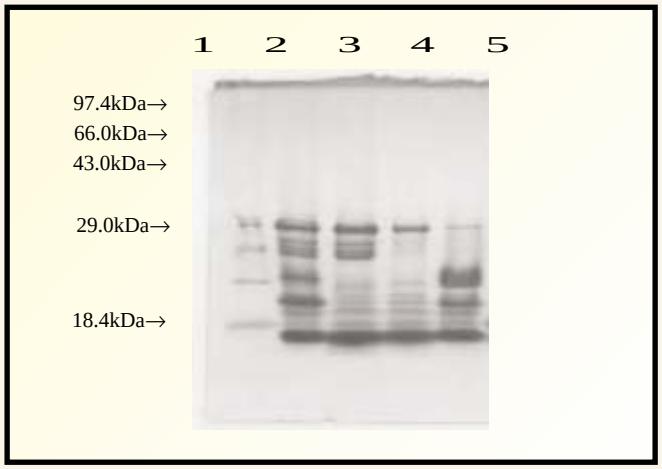


Figure 21: Camel (J-65) milk whey proteins denaturation during late lactation. Lanes 1: Marker; Lanes 2-5 of J-65 (lane 2: raw; lane 3: 63°C, lane 4: 80°C, lane 5: 90°C).

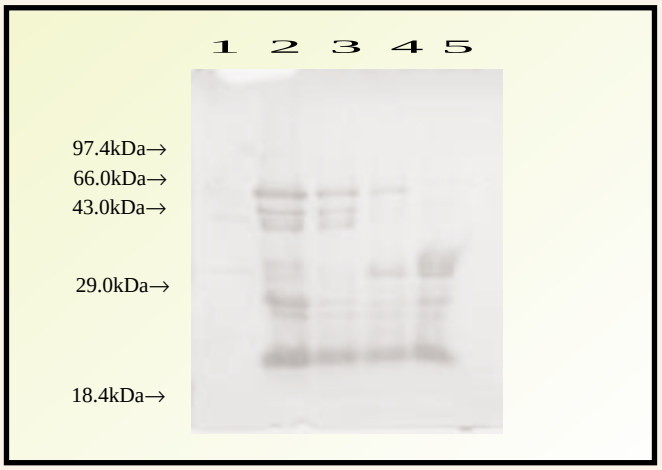


Figure 22: Camel (M-13) milk whey proteins denaturation during late lactation. Lanes 1 : Marker; Lanes 2-5 of M-13 (lane 2: raw; lane 3: 63°C, lane 4: 80°C, lane 5: 90°C).

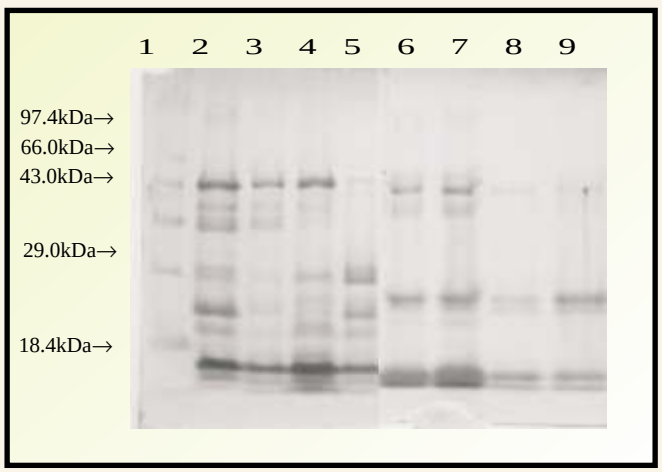


Figure 23: Comparisons of camel (K-123) and cow milk whey proteins denaturation during late lactation. Lanes 1 : Marker; Lanes 2-5 of K-123 (lane 2: raw; lane 3: 63°C, lane 4: 80°C, lane 5: 90°C) Lanes 6-9 of cow (lane 6: raw; lane 7: 63°C, lane 8: 80°C, lane 9: 90°C).

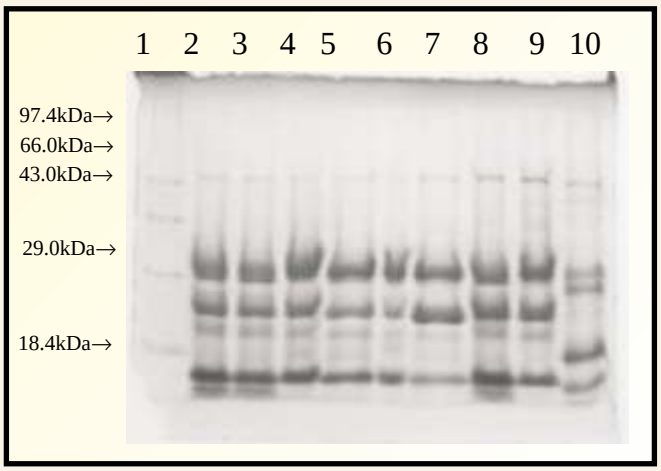


Figure 24: Comparisons of camel and cow milk whey proteins in boiled milk (100°C) during late lactation. Lane 1: Marker; Lanes 2-9 of camels (lane 2: B-455; lane 3: B-493, lane 4: J-65, lane 5: J-221, lane 6: M-13; lane 7: M-15, lane 8: K-79, lane 9: K-123) and lane 10: cow

LPT-1. Project : Standardization of membrane process for development of functional camel milk food

Project Leader : D. Kumar

Associate : G. Mal

The protocol based on spectrophotometry was standardized for lactose estimation in milk. The lactose content ranges between 3.2 to 3.8 in the camel milk samples collected from the Centre's herd.

Unit : Camel Management

AP- 6. Project: Adaptation of camel to climate change in relation to temperature humidity index

Project Leader: C Bhakat

Associates : G Nagarajan, N.V Patil and A.K Patel, CAZRI, Jodhpur

The socioeconomic information was collected from different villages viz. Meghasar, Palana, Bajju, Akusar, Chattargarh, Samarada, Mohangarh, Shivnagar, 8KYD chak, Khajuwala, Lunkaransar, Mahajan, Morkhana, Mukam, Bana, Ridi of Bikaner district, Gogamedi of Hanumangarh district, Jhalarapatan of Jhalawar district in Rajasthan and Bhuj, Chariadanda of Kutch district in Gujarat. For experimentation at farm, nine male camels, 3 to 4 year age groups were taken. All camels were kept under asbestos roofed shed at farm and they were stall fed. Watering was done once daily.The data was recorded at fortnightly interval. To study the climatic variables, maximum thermometer, minimum thermometer, dry bulb thermometer and wet bulb thermometer were installed in the camel shed. Relevant climatic parameters were recorded daily in morning and evening.The investigation on socioeconomic status of farmers indicated that most of respondents were of old and middle age categories (Table 36). 29 % of the respondents were literate. Most of the respondents were having medium type house hold followed by large, very large and small type. Maximum farmers involved themselves in agriculture operation and camel carting activities. Majority of the male camels were being used for agriculture operation and carting. Most of the respondents were having medium and small land holding. Most of them were having nuclear type of household and mixed farming was the major occupation. Generally after 4 years' age, the camels were put for agriculture operation and carting activities. Several advantages of camel system in comparison to tractor system were recorded in various agriculture operations viz. camel requires comparatively less maintenance cost, land fertility can be maintained for longer duration, suitable for all kinds of work and for all types of lands, comparatively less cost involvement in ploughing, whenever needed, it is available & work can be done, in dry moisture soli; single attempt seeding is successful, so repeated seeding is not needed, cost of cultivation become less, camel manure is pivotal during cultivation activities etc. Whereas only three demerits of camel in comparison to tractor were recorded viz. it consumes more time, labour and shrinkage of grazing land. The assessment of attitude of farmers towards utilization of camel system for cultivation purpose (Likert method of scoring) revealed that most of respondents were having favorable attitude (Table 37), a few were not decisive whereas very few were having negative attitude and they were mostly having large land holdings. Investigation on camel keeping pattern on feeding management practices indicated that the 88.64% farmers having only one camel fed their camels at household level, the farmers having 2-4 camel adopted semi-intensive management where as farmers having > 4 camels adopted extensive

management. The Chi-square test indicated that the camel keeping pattern significantly (P<0.01) influenced feeding management practices.The study on use of type of feed material revealed that in west, north, east and south zones of Bikaner district, farmers predominantly use Moth-*chara*, Guar-*phalgati* and Groundnut-*chara*. In Hanumangarh district most of the respondents were predominantly using Guar-phalgati and *Channe-ki-khar* where as in Jhalawar district majority of respondents were providing Neem leaves, Soyabean and Maize residue as predominant feed material at household level. In Kutch district of Gujarat camel were commonly fed on Mangroves mainly in costal zone (Mundra, Lakhpat, Bhachau taluks). In Charaidhanda, Bhuj region camel were reared in extensive system and commonly using trees, bushes, grasses viz: Khejri, Babool, Pala, Phog, Neem, Seven, Anjan etc. Some of farmers were also keeping 1 or 2 camels at household for work, majority of them were providing dried leaves of Khejri, *Pala*, Phog, Bajara flour, Moth-*chara*, Guar-*phalgati* and Groundnut fodder.

At farm, the rectal temperature (°C), pulse rate (beats / minute) and respiration rate (beats / minute) of all experimental camels were recorded during from April, 2010 to March, 2011. The analysis of data revealed that average rectal temperature of camel (Table 38) was minimum during morning and maximum during late afternoon and the variation was significant (P < 0.01) for all camels and months of 3 climatic conditions viz. hot dry, hot humid and cold dry. The average pulse rate (beats / minute) of camels were found to be higher during evening period but it was lower during morning time for all camels and months. This diurnal variation was significant (P < 0.01) in hot dry, hot humid and cold dry climate. The average respiration rate (beats / minute) of camels was lowest during morning time. Whereas it was higher during late afternoon period. The morning evening variation was significant (P < 0.01) for all camels in hot dry, hot humid and cold dry condition.

Analysis of recorded data of climatic parameters during different period and months revealed that mean value of maximum temperature was higher during June, 2010 month (44.57 °C). It dropped at lowest level during January, 2011 (17.16 °C) and it rose during March, 2011 (31.05 °C). The average value of minimum temperature was lowest during January, 2011 (4.77 °C) and highest during June, 2010 (31.48 °C). Dry bulb temperature and wet bulb temperature were recorded during morning and evening time and based on them relative humidity was calculated. The relative humidity varied greatly among different months. It ranged from 36.56 % to 66.37% during morning hours whereas during evening period it ranged from 6.42 % to 42.47 % from April, 2010 to March, 2011. The relative humidity was significantly (P < 0.01) higher during morning as compared to evening period for all months. Based on these variations the climate was categorized into 3 broad categories viz. hot dry, hot humid, cold dry climate.The THI was significantly (P < 0.01) lower during morning as compared to evening hours. The morning and evening variation was significant (P < 0.01) for all months in different climate from April, 2010 to March, 2011. The morning THI varied from 60.26 to 81.03 whereas evening THI varied from 67.02 to 88.87. The Benezara Coefficient of adaptability (BCA) of camel was worked out for all camels for different months and climate. The analysis of coefficient value revealed that BCA was significantly (P < 0.01) higher during evening time as compared to morning time. The ranking of camels was done as per their best, moderate, poor adaptation to these climatic variations.

Table 36. Socioeconomic profile of camel keepers

Parameters	Categories	Proportion (%)
Age	Old (56 yr)	45
	Middle (36-55 yr)	39
	Young (< 35 yr)	16
Education	Illiterate	36
	Literate	29
	Functionally Literate	35
Type of household	Small (1 - 3 m)	7
	Medium (4-6m)	64
	Large (7 – 9 m)	17
	Very large (>10 m)	12
Involvement in agriculture operation / carting	Self	91.13
	Hired	8.87
Sex of camel	Male	78.32
	Female	21.68
Land holding of camel keepers	Small (1 – 30 B)	31
	Medium (31 – 100 B)	62
	Large (>101 B)	7
1st age of camel used for farming / carting	3 yr	22.13
	4 yr	77.87
Family type,	Nuclear	72.83
	Joint	27.17
Major occupation	Mixed farming	51.08
	A H	48.91
Parameters	**Categories**	**Amount**
Income from camel carting (` / d)	Village region	` 500 – 900 /-
	Surrounding city	` 1000 – 1500 /-
Cost of camel (`) (4 – 8 yr)	Male	` 30,000 – 40,000 /-
	Female	` 15,000 – 25,000 /-
Cost of camel cart (` / cart)	Two wheeled wooden	` 12,000 – 15,000 /-

Table 37. Attitude of farmers towards the utilization of camel system for cultivation purpose

Attitude (Average score)	Farmer			
	Small (%)	Medium (%)	Large (%)	Overall (%)
Favourable (45 – 60)	97.83	89.13	86.95	91.30
Undecided (35 – 44)	2.17	10.87	7.62	6.89
Unfavourable (20 -34)	0	0	5.43	1.81

Table 38. Average ± SE values of CPR during different climatic conditions

Period	Climate					
	Hot dry	Hot dry	Hot humid	Hot humid	Cold Dry	Cold Dry
	Morning	Evening	Morning	Evening	Morning	Evening
Significance	**		**		**	
RT (^{o}C)	36.34±0.08	38.68±0.09	36.70±0.07	38.85±0.08	35.93±0.09	38.48±0.10
PR (b/m)	44.35±0.69	54.55±0.77	49.46±0.73	59.79±0.75	43.04±0.78	50.59±0.89
RR (b/m)	12.86±0.41	15.14±0.42	14.91±0.41	18.12±0.49	11.31±0.39	14.16±0.45

** Significant at 1% level, M: morning, E: evening

Unit: Camel Health

VM-4. Project : Immunity aspects in neonatal camel calves

Project Leader : D. S. Sena

Associate : G. Mal

Feeding Neem seed oil to camel calves: An experimental trial was conducted in two groups of 6 neonatal camel calves till 3 months of age. Group I was fed with herbal immune-potentiator i.e.Neem seed oil @ 10 ml orally once daily at 3 days interval from day 10 onwards till 3 months of age. Group II was maintained as control and was not given any immune-potentiator. Blood samples were collected before the start of experiment and at 15 days interval till 3 months of age for the biochemical estimations viz. glucose, protein profile, Ig G, Ig M, bilirubin, ALT, urea, creatinine and AST. The body weights were recorded at the above mentioned periods in both the groups. The health status of camel calves was also recorded. The data was analysed statistically using SPSS 10.0 software.

No significant change was noticed in liver function (bilirubin, ALT) and kidney function (AST, urea and creatinine) parameters indicating Neem seed oil feeding at the above dose levels does not have any deleterious effects. There was a significant change in the average growth rate, total protein and globulin levels between groups. Significant change in the Ig G level was noticed from day 30 onwards between groups. There was no significant change in Ig M level. No mortality was noticed in both the groups. In Group I, there was no morbidity while in Group II there was enteritis in 2 camel calves below 2 months of age. An improvement in the bodyweight as well as better health status was noticed in Group I compared to

Table 39: Bodyweights and average growth rate in the camel calves of the two groups

Days	Body Weight (kg)		Average Growth Rate* (kg)	
	Group I	Group II	Group I	Group II
0	43.50±3.09	43.66±2.94	--	--
15	59.33±4.60	53.16±3.31	15.83±1.86	9.50±2.20
30	73.33±4.67	61.16±3.39	29.83±2.25	17.50±2.23
45	83.66±4.73	71.50±3.60	40.16±2.46	27.83±2.50
60	94.50±4.24*	82.33±2.38*	51.00±2.79	38.66±2.09
75	106.33±3.09*	91.00±1.87*	62.83±1.57	47.33±3.04
90	116.50±2.51*	101.83±1.90*	73.00±3.03	58.16±2.60

* ($P<0.05$)

Table 40. Mean changes in the protein profile of camel calves of both groups

Parameter	Groups	Days						
		0	15	30	45	60	75	90
Total Protein(g/dl)	I	4.78±0.11	5.19± 0.14	**5.44± 0.07**	**5.68± 0.06**	**5.83± 0.06**	**5.89± 0.04**	**6.12± 0.04**
	II	4.79±0.06	4.83± 0.14	**5.02± 0.05**	**5.27± 0.04**	**5.50± 0.06**	**5.59± 0.05**	**5.90± 0.03**
Albumins (g/dl)	I	2.58±0.05	2.68± 0.04	2.80± 0.03	2.82± 0.03	2.90± 0.02	2.93± 0.03	3.02± 0.02
	II	2.61±0.03	2.62± 0.03	2.72± 0.01	2.75± 0.02	2.84± 0.02	2.85± 0.02	2.98± 0.01
Globulins (g/dl)	I	2.19±0.12	2.50± 0.15	**2.64± 0.07**	**2.86± 0.08**	**2.93± 0.08**	**2.96± 0.07**	**3.10± 0.05**
	II	2.18±0.04	2.21± 0.12	**2.30± 0.03**	**2.52± 0.04**	**2.65± 0.06**	**2.73± 0.04**	**2.92± 0.03**
A:G ratio	I	1.20±0.09	1.09± 0.07	**1.06± 0.03**	**0.99± 0.03**	0.99± 0.03	0.99± 0.03	0.99± 0.02
	II	1.20±0.02	1.20± 0.06	**1.18± 0.01**	**1.09± 0.01**	1.07± 0.2	1.04± 0.02	1.02± 0.01

Figures in bold show significant difference between groups on different days

Table 41. Mean changes in the serum glucose, Ig G and Ig M levels of camel calves of both groups

Parameter	Groups	Days						
		0	**15**	**30**	**45**	**60**	**75**	**90**
Serum glucose (mg/dl)	I	42.95±0 .90	**52.55± 0.90**	57.44± 0.55	58.41± 0.72	58.39± 0.49	58.52± 0.74	59.87± 0.60
	II	43.68±1 .02	**49.84± 0.27**	54.83± 1.11	54.97± 0.69	56.69± 0.80	57.93± 0.79	59.25± 1.10
Ig G (mg/ml)	I	7.70±0. 42	12.52± 0.23	**13.16± 0.18**	**13.48± 0.17**	**13.58± 0.13**	**13.95± 0.09**	**14.29± 0.08**
	II	7.86±0. 39	12.02± 0.32	**12.22± 0.26**	**12.51± 0.19**	**12.70± 0.16**	**12.84± 0.16**	**13.19± 0.11**
Ig M (mg/ml)	I	0.14±0. 01	0.27± 0.01	0.47± 0.02	0.74± 0.02	0.96± 0.03	1.17± 0.02	1.54± 0.03
	II	0.13±0. 01	0.25± 0.01	0.42± 0.02	0.70± 0.02	0.90± 0.03	1.07± 0.03	1.47± 0.03

Figures in bold show significant difference between groups on different days

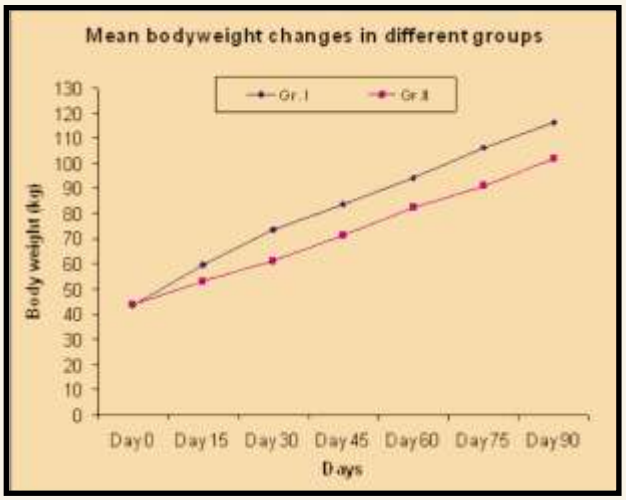


Fig. 25 : Mean body weight in the two groups

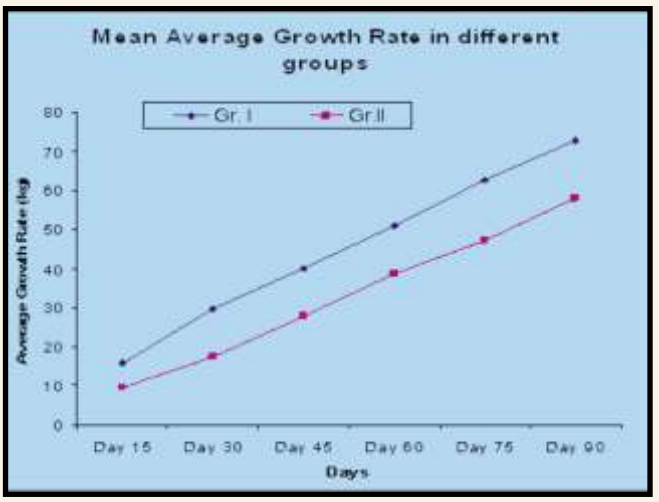


Fig.26 : Average growth rate in the two groups

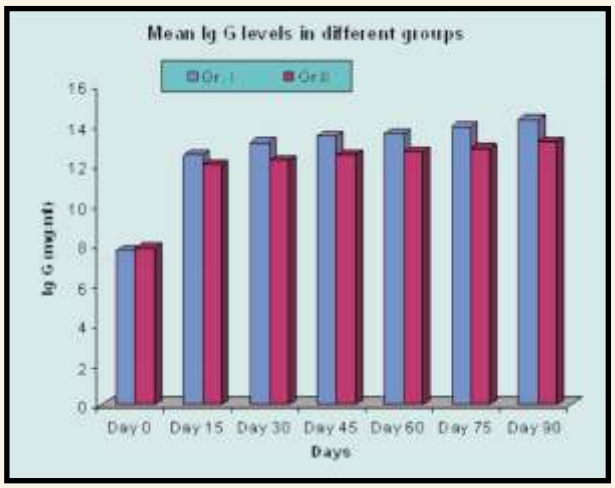


Fig. 27: Mean Ig G levels in the two groups

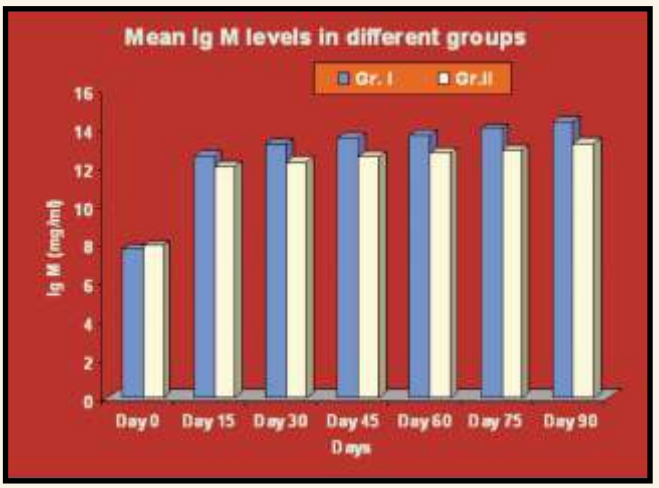


Fig. 28: Mean Ig M levels in the two groups

VM-7. Project: Investigations on digestion fermentation disorders with particular reference to indigestion and impaction

Project Leader : D.S. Sena

Associates : G. Mal and N. Sharma

A total of 4 camels (3-6 years) were considered for the present study. Deworming was done in all of them. These camels were healthy. They were maintained on Ground nut *chara* for a period of 20 days. The blood samples for serum biochemical estimations and the rumen fluid samples, using motor operated rumen fluid extraction unit, for enzymatic estimations were collected. The fractionation of rumen fluid (bacterial rich fraction, protozoa rich fraction and cell free rumen fluid) was done for enzymatic estimation of fibre degrading enzymes (carboxy methyl cellulose, alpha amylase, alpha glucosidase, beta glucosidase), protein and NPN degrading enzymes (urease, proteases, transaminases both GOT and GPT). These results were considered as control. In all 4 camels acid indigestion was induced by giving jaggery 50% w/v orally @ 15 g/ kg body weight. Within a span of 24 hours acidosis was induced. The clinical signs were recorded which were suggestive of acute acid

indigestion. The rumen fluid was collected and all the animals showed pH <5.0 which indicated severe acidosis. In this group of animals prior to therapy and after completion of the treatment, blood samples for serum biochemical estimations and the rumen fluid samples for the physico-chemical, biochemical and enzymatic estimations were collected. All the camels were successfully treated without any mortality. The physico-chemical and certain biochemical examination in the freshly collected rumen fluid were done as well as fractionation of rumen fluid for enzymatic

Table 42. Physico-chemical changes of rumen fluid in different animals

S.No	Parameters	Groups	Animal 1	Animal 2	Animal 3	Animal 4
1.	Odour	Control (BI) Experimental (BT) Experimental (AT)	Aromatic Pungent, sour Slightly aromatic	Aromatic Pungent, sour Slightly aromatic	Aromatic Pungent, sour Slightly aromatic	Aromatic Pungent, sour Slightly aromatic
2.	Colour	Control (BI) Experimental (BT) Experimental (AT)	Brownish grey Milky grey Yellowish grey	Brownish grey Milky grey Yellowish grey	Brownish grey Milky grey Yellowish grey	Brownish grey Milky grey Yellowish grey
3.	Consistency	Control (BI) Experimental (BT) Experimental (AT)	Slightly viscous Porridge Slightly watery & viscous	Slightly viscous Porridge Slightly watery & viscous	Slightly viscous Porridge Slightly watery & viscous	Slightly viscous Porridge Slightly watery & viscous
4.	Cellulose Digestion Time (Hours)	Control (BI) Experimental (BT) Experimental (AT)	< 30 >48 < 36	< 30 >48 < 36	< 30 >48 < 36	< 30 >48 < 36
5.	Sedimentation Activity Time (minutes)	Control (BI) Experimental (BT) Experimental (AT)	6 18 10	4 20 8	6 22 8	5 15 9
6.	Methylene Blue Reduction Time (minutes)	Control (BI) Experimental (BT) Experimental (AT)	5 3 5	8 4 6	6 3 6	6 2 5
7.	Volume % (Solid phase, liquid phase)	Control (BI) Experimental (BT) Experimental (AT)	2.5/7.5 1.3/8.7 2.1/7.9	2.6/7.4 1.5/8.5 2.0/8.0	2.8/7.2 1.5/8.5 2.1/7.9	2.5/7.5 1.2/8.8 2.3/7.7

estimations of fibre degrading enzymes (carboxy methyl cellulase, amylase, alpha glucosidase, beta glucosidase), protein and NPN degrading enzymes (urease, proteases, transaminases both GOT, GPT) was done and preserved at 80^{o}C for further analysis. In the control group samples and samples before and after therapy of acid indigestion induced camels haematological (Hb, PCV, TLC and DLC) and serum biochemical profile (glucose, protein profile) was estimated.

The results of physico-chemical and biochemical parameters of rumen fluid have been presented in Table 42 and 43. The mean of all the haemato-biochemical parameters has been presented in Table 44. The results of the enzymatic estimations have been presented in Table 45. The symptoms of acidosis included off feed, mild to moderate bloat, vomiting, depression, and recombancy. Watery faeces was noticed in three camels while one of the camel showed constipated stools. All the camels were treated with standard therapy for systemic acidosis and for the camel showing constipation, tumba root powder @ 10g/100 kg b.wt was given instead of laxative and was found effective.

Table 43. Biochemical and microbial changes of rumen fluid in different animals

S.No.	Parameters	Groups	Animal 1	Animal 2	Animal 3	Animal 4
1.	pH	Control (BI)	7.3	7.0	7.2	7.2
		Experimental (BT)	5.2	4.8	5.0	5
		Experimental (AT)	6.8	7.0	7.2	7.0
2.	Total acidity (Units)	Control (BI)	32	30	30	28
		Experimental (BT)	68	72	66	65
		Experimental (AT)	40	42	38	40
	Microbial Count					
3.	Motility of rumen protozoa	Control (BI)	+++	+++	+++	+++
		Experimental (BT)	-	-	+	-
		Experimental (AT)	++	++	+++	+++
4.	Total protozoal count (x 10^5/ml)	Control (BI)	2.20	2.22	1.99	2.30
		Experimental (BT)	0.6	0.48	0.8	0.74
		Experimental (AT)	1.86	1.82	1.65	1.68
5.	Iodophilic activity of rumen protozoa	Control (BI)	+++	+++	+++	+++
		Experimental (BT)	-	-	+	-
		Experimental (AT)	++	++	+++	+++
6.	Total bacterial count (x 10^8/ml)	Control (BI)	5.8	5.6	6.2	7
		Experimental (BT)	7.8	7.4	6.8	7.4
		Experimental (AT)	5	4.8	5	5.4

Table 44. Haemato-biochemical changes in camels

S.No.	Parameters	Groups	Animal 1	Animal 2	Animal 3	Animal 4
1.	PCV (%)	Control (BI)	34	32	32	34
		Experimental (BT)	40	42	38	38
		Experimental (AT)	36	36	34	36
2.	Haemoglobin (g/dl)	Control (BI)	12.2	13.4	13.0	11.8
		Experimental (BT)	11.8	12.6	12.4	11.4
		Experimental (AT)	12	12.8	13.0	12.0
3.	TLC (thousands/cmm)	Control (BI)	9.9	10.2	10.3	10.2
		Experimental (BT)	11	11.8	12.2	11.6
		Experimental (AT)	10.8	11.2	11.4	10.8
4.	Glucose (mg/dl)	Control (BI)	62.44	64.68	64.08	66.96
		Experimental (BT)	58.36	52.34	48.86	50.46
		Experimental (AT)	60.24	61.24	56.32	62
5.	Total Protein (g/dl)	Control (BI)	6.14	6.44	6.06	5.98
		Experimental (BT)	6.96	7.02	6.84	6.88
		Experimental (AT)	5.96	6.12	5.9	6.08
6.	Albumin (g/dl)	Control (BI)	3.05	3.2	3.01	2.98
		Experimental (BT)	3.38	3.42	3.36	3.34
		Experimental (AT)	2.96	3.01	2.92	2.99
7.	Globulin (g/dl)	Control (BI)	3.09	3.24	3.05	3
		Experimental (BT)	3.58	3.6	3.48	3.54
		Experimental (AT)	3	3.11	2.98	3.09
8.	A:G ratio	Control (BI)	0.98	0.98	0.98	0.99
		Experimental (BT)	0.94	0.95	0.96	0.94
		Experimental (AT)	0.98	0.96	0.97	0.96

Table 45. Mean enzyme levels in control and experimental groups

S.No.	Parameters	Group	CFRF	PRF	BRF
A.	**Fibre degrading enzymes (Units/100 ml SRL)**				
1.	CMC	Control (BI)	31.10±2.24	170.01±5.97	482.90±7.88
		Experimental (BT)	53.86±2.19	66.51±5.40	196.42±19.34
		Experimental (AT)	32.07±2.71	129.35±0.98	460.98±11.35
2.	Alpha- amylase	Control (BI)	0.04±0.00	0.32±0.02	1.16±0.03
		Experimental (BT)	0.07±0.00	0.11±0.02	0.71±0.08
		Experimental (AT)	0.05±0.00	0.21±0.02	1.24±0.04
3.	Beta-glucosidase	Control (BI)	23.63±1.77	87.08±3.44	120.45±5.52
		Experimental (BT)	53.87±2.61	87.92±2.07	182.68±12.16
		Experimental (AT)	21.72±0.74	81.31±5.45	122.72±6.08
4.	Alpha-glucosidase	Control (BI)	1.82±0.06	8.64±0.36	17.26±2.27
		Experimental (BT)	2.60±0.14	7.97±0.41	9.98±0.72
		Experimental (AT)	1.38±0.05	8.62±0.35	17.27±2.42
B.	**NPN and Protein degrading enzymes (Units/100 ml SRL)**				
5.	Urease	Control (BI)	1.18±0.05	5.99±0.07	
		Experimental (BT)	0.53±0.04	1.83±0.25	22.69±1.58
		Experimental (AT)	0.29±0.03	5.9±0.13	60.09±3.80
6.	Protease	Control (BI)	0.20±0.03	0.66±0.04	2.2±0.05
		Experimental (BT)	0.07±0.00	0.35±0.04	1.36±0.10
		Experimental (AT)	0.13±0.02	0.57±0.01	2.03±0.05
7.	GOT	Control (BI)	28.25±1.43	163.75±2.56	15.47±1.16
		Experimental (BT)	39.5±2.21	179.75±7.23	34.82±3.75
		Experimental (AT)	23±2.08	147.75±3.01	22.25±1.75
8.	GPT	Control (BI)	28.5±1.32	84.75±3.35	16.75±1.31
		Experimental (BT)	20.5±1.84	109.5±4.78	17.0±1.95
		Experimental (AT)	19.0±1.29	79.0±2.08	11.75±1.54

CFRF: Cell free rumen fluid fraction; PRF: Protozoa rich fraction; BRF: Bacteria rich fraction; BI: Before Induction; BT: Before therapy; AT: After Therapy; CMC: Carboxy Methyl Cellulose; GOT: Glutamate Oxaloacetate transaminase; GPT: Glutamate Pyruvate transaminase

VM-8. Project: Epidemiology of infectious diseases of camel.

a. Sub-project: Epidemiology of bacterial and fungal diseases of camel.

Sub-project Leader : F.C. Tuteja

Associates : S.D. Narnaware and S.S. Dahiya

Survey was carried out in the villages viz. Jai Pahari (Jhunjhnu), Dingri, Sarara (Udaipur), Gadhwala (Bikaner), Gogameri (Hanumangarh), Akkusar, Bajju (Bikaner), Baggar (Pali), Morkhana, Nokha (Bikaner), Palana (Bikaner), Charanwala, Bajju (Bikaner), Gigasar, Meghasar, Husansar, Jaimalsar (Bikaner) and relevant biological samples and related information was collected. Higher incidence of skin infection (Fig. 29) and pasturellosis was probably due to preceding rainy season. Camel calves upto 1year of age were observed to be most susceptible to skin infections followed by 1-2 years' age group and old age (>10 year) group. Mastitis was more in case of older animals (Table 46 and 47).The samples were cultured for bacterial and fungal isolations (Table 48).

Table 46. Seasonal variations in occurrence of diseases

S. No.	Ailment	March -June	July-Oct	Nov -Feb
1	Skin infection	3	18	64
2	Mastitis	1	-	15
3	Actinobacillosis	-	1	1
4	Diarrhoea	-	-	3
5	History of abortion	-	-	1
6	Pasturellosis	-	-	12+mortality 14
	Total	50	111	337

Table 47 . Age wise variations in occurrence of diseases

S. No.	Ailment		<1 year	1-2 year	2-5 year	5-10	>10 year
1	Skin infection		27	9	13	15	21
2	Mastitis		-	-	1	6	9
3	Actinobacillosis		-	-	1	1	-
4	Diarrhoea		1	1	1	-	-
5	History of abortion		-	-	1	-	-
6	Pasturellosis	Sick	-		4	8	-
		Mortality	-	2	4	5	3
Total			53	36	114	175	120

Table 48. Identification and characterization of pathogens

S. No.	Ailment		No. of cases	Sample		Bacterial isolates	Fungal isolates
				Type	No.		
1	Skin infection		85	Skin scrapings	42	*Staph aureus* (4), *Staph epidermidis* (10), *Corynebacterium* sp (8)	*Epidermophyton floccosum* (8), *Scopulariopsis brevicaulis* (10) *Alternaria* sp (2)
2	Pasturellosis	Sick	12	Lung, Liver, Spleen (PM) Blood (live)	3+ 8	*Pasturella* sp. (11)	-
		Died	14				
3	Mastitis		16	Milk samples	6	*Staph aureus* (3) *Corynebacterium* sp (3)	-
4	Diarrhoea		3	Fecal sample	1	*Corynebacterium* sp (1)	-
5	Actinobacillosis		2	-	-	-	-
6.	History of abortion		1	-	-	-	-
	Total number of animals 498						

Fungal isolate1 :*Epidermophyton floccosum* was isolated from skin lesions of the camels of Charanwala (Bajju) village (Fig. 30-31). The lesions were peculiar and fast spreading. The lesions appeared as if hairs were burnt with fire leaving ash deposit over the skin. Out of 50 animals 16 animals were infected with such lesions. Cultural examination of skin samples from 10 animals of the same herd revealed 8 animals positive for isolation of the same fungi.

Fig. 29: Animal showing fast spreading skin lesions

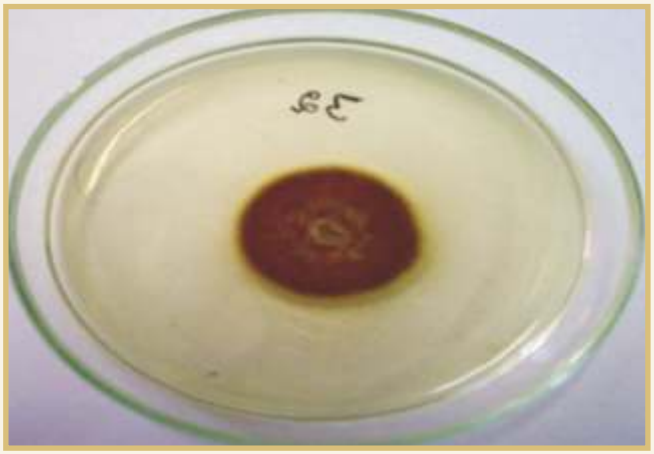


Fig.30: Colony of *Epidermophyton floccosum*

Fungal Isolate 2: *Scopulariopsis brevicaulis*was isolated from a camel herd of Jhunjhnu. Out of 147 camels, 40 camels had patchy skin necrosis. Examination of skin scrapings of 12 animals revealed 10 animals positive for this isolated fungi (Fig 32-34).

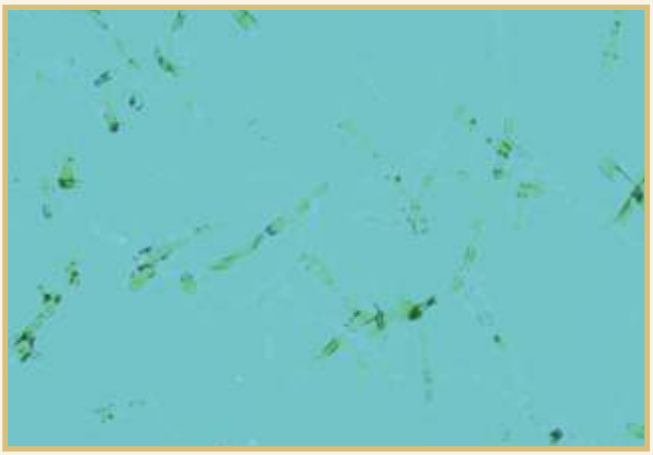


Fig.31: Microscopy of *E. floccosum*,Calcofluor white stain

Fig.32: Animal showing patchy skin necrosis

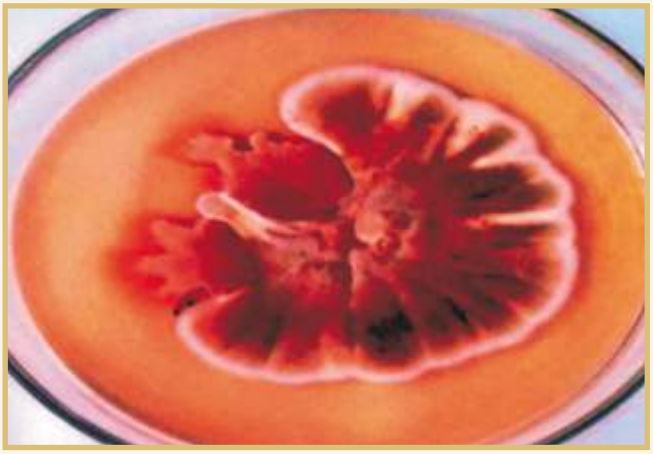


Fig. 33: Colony of *Scopulariopsis brevicaulis*

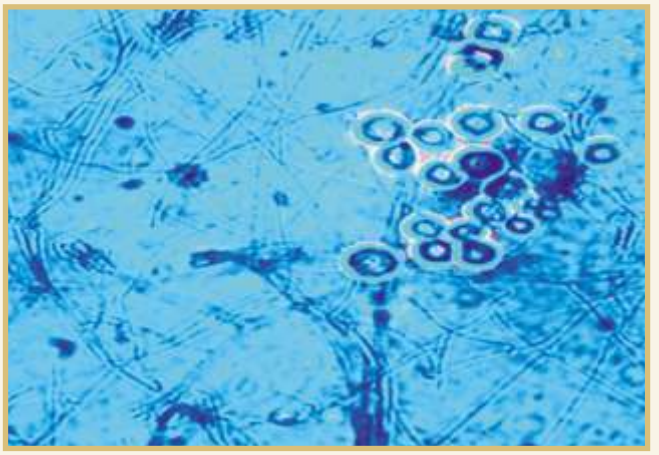


Fig.34 : Microscopy of *S. brevicaulis,* lactophenol cotton blue stain

Pasturellosis in camels: In a herd of 47 camels in Pali district of Rajasthan, 14 camels died after a heavy rain of about 150 mm in the month of November, 2010. Twelve animals were sick with the signs and symptoms of initial constipation for 2-3 days followed by watery diarrhea for 2-3 days then developing oedematous swelling on the abdomen, thighs and brisket region accompanied by colic, leading to death within 2-3 days of onset of oedema. Other clinical signs observed were lacrimination, depression, partial anorexia and mild fever 103-105°F. Successions of oedematous swelling with syringe revealed a straw-coloured serous fluid. Post mortem examination revealed enteritis, hardness of the liver and splenomegaly. The oedema of musculature and subserous petechial haemorrhages. Cultural examination of blood samples from sick animals and liver, spleen and lung samples from carcass lead to isolation of *Pasturella sp.*. All the sick animals responded well to treatment with enrofloxacin. History revealed non vaccination of the herd and occurrence of the disease in the previous year in the camel in nearby areas. Majority of the animals in the herd were in weak body condition as reflected by the deep inter costal spaces and temporal fossa and low fat deposition in the hump region.

b. Sub Project : Epidemiology of major parasitic diseases of camels

Sub Project Leader : S.K. Ghorui

Associates : G.Nagarajan and S. Kumar

Visits were made or camel health camps were organized in the Bikaner, Jaisalmer, Udaipur,Pali, Hanumangarh and Jhunjunu districts to collect different biological samples from camels. State animal fair of Gogamedi (Hanumangarh) was also attended. A visit to Kuchchh area of Gujarat State was made. It was observed that amongst the parasitic diseases trypanosomosis put forth a constant threat to the camel husbandry leading to both morbidity and mortality when it remained undiagnosed. Besides this, mange, tick infestation, myiasis, GI nematodiasis, hydatidosis were also obsrved.

Trypanosomosis in camel: The blood samples were collected from different parts of Rajasthan State and Gujarat. The occurrence of *T. evansi* infection in camel which were otherwise not showing any typical clinical signs of surra has been summarized in Table 49. Considering the overall limitation of parasitological techniques and detection of either antigen or antibodies specific to Trypanosomes, polymerase chain reaction exploiting a set of ribosomal RNA based primer were amplified for this detection of active carrier state of infection in camel.

Detection of Trypanosome in vector: Present study took place in the camel habitats in Bikaner and its peripheral areas during the wet monsoon and post monsoon period. Flies were collected and identified as *Stomoxys* and *Musca* spp. mostly.

These were preserved separately in ethanol (70%) until examined for trypanosome infection using PCR technique. The fixed flies were left to dry and then crushed in hand held micro homogenizer in standard proteinase K buffer followed by phenol chloroform extraction of DNA. The oligonucleotide primers used to amplify the trypanosome specific target included DNA sequences of ITS gene. No amplification was detected in target DNA supplied from *Musca* sp. whereas, there was clear indication of the presence of trypanosome infection in *Stomoxys* fly. The present result indicate that *Stomoxys* spp. found in Bikaner were infected with *Trypanosoma evansi*. The visual examination of different parts of flies under microscope is laborious and it limits the detection of such infection in lower concentration. This also suggests that the infection might have been present in the area but had been overlooked due to inefficient diagnostic technique in vector and its concerned host like camel.

Coccidiosis in camel : Faecal samples from camels having diarrhoea were collected (Table 50). After examination under microscope and further incubation of faecal material in 2.5% potassium di chromate solution for 12 -16 hours revealed coccidian infection as appeared with well-developed cyst wall and developing sporocysts inside.

Table 49. Detection of *Trypanosoma evansi* in camel by blood smear and PCR

S. No.	Place (Districts)	No. of samples	No. of positive samples and (%)	
			Blood smear	PCR
1.	Bikaner	163	5(3.0)	13(7.9)
2.	Hanumangarh	90	3(3.3)	7(7.7)
3.	Jaisalmer	56	3(5.3)	11(19.6)
4.	Pali	35	0	3(8.5)
5.	Jhunjunu	45	5(11.1)	7(15.5)
6.	Udaipur	94	2(2.1)	8(8.5)
7.	Kuch-Bhuj	29	7(24)	99(31)
	Total	512	22(4.2)	52(10.1)

Table 50. Details of faecal samples examined for Coccidiosis in camel

Place	No. of samples	No. of sample /positive samples		
		< 1 year	1 -3 years	>3 years
Jaisalmer	13	2/0	10/1	1/0
Bikaner	28	4/1	6/2	18/0
Jhunjunu	5	0/0	5/1	0/0
Total	46	6/1	21/4	19/0

Ectoparasite infestation in camel: Mange (*Sarcoptes scabeii*. var. *camelii*) has been considered to be second most important disease of camel. The younger camels of 1 to 3 years of age were mainly affected (Table 51). There was no significant variation of infection pattern in terms of sex of camel. Overall poor conditioned camels appeared to be most susceptible to infection. Over crowding, poor feeding and management appeared to be main cause of mange among camel. Only one species i.e *Sarcoptic scabei* was identified. After species identification the cases were treated with Ivermectin along with Levamisole Hydrochloride.

Table 51. Prevalence of mange infection in camels of different regions of Rajasthan

Place of sample collection	No. of samples	No. of skin scrapping examination/ samples positive for mange infestation		
		< 1 year	1 -3 years	>3 years
Bikaner	31	3/0	13/3	15/4
Jaisalmer	12	4/0	2/1	6/1
Jhunjunu	5	0/0	2/0	3/2
Udaipur	15	3/0	5/1	7/2
Total	63	10/0	22/5	31/9

Tick and Fly infestation: Tick and fly infestation has been considered to be one of the neglected aspect and may be a major constraint in camel husbandry. Continuous infestation with different species of ticks and flies lead to continuous irritation, off feed, poor body condition, anaemia, loss of productivity and also succumb to several unidentified protozoan, rickettsial and viral diseases to camel. Camels examined under the study were selected randomly from different parts of Rajasthan. Ticks were spotted on camel by direct observation and removed or hand-picked by placing chloroform swab on the site of attachment. Isolated ticks were stored in 70% alcohol. Engorged ticks were kept aside for bionomics study. Flying insects, which pestered, perched or hovered about the examined camels were trapped with hand swoop net and examined under microscope.The results showed that 311 out of 373 camels examined were infested with various ecto-parasites.

Two hundred and eighty seven (92.2%) of the infested camel harbored ticks, while 4.5% had mites and 3.2% were pestered by flies (Table 52). Ticks were the most prevalent of the ecto-parasites seen and these occurred in 92.2% of the infested camel irrespective of the sex. *Hyalomma* sp. was found to be the most prevalent tick population followed by Boophilus sp. This observation underlined the potential of this ecto-parasite to multiply and spread promptly in large number among host animals irrespective of the adverse consequence of environment. Another important aspect of all the ticks encountered in this study is that they had wide variety of host animals for development. This nature may enhance the role of tick as vector of many pathogenic diseases.

Dipterous flies were also encountered as ectoparasites of camels. They were found perching, hovering or pesting of 3.2% infested camels (Table 52). The flies were identified mostly as *Stomoxys* and *Tabanus* sp. Other fly recovered were *Hippobosca* sp .

Myiasis due to Dipteran fly by the deposition of eggs in the wounds in nostrils and nearby sites where they molt twice and attached to the deep mucosa. It was recorded in 10 (3.2%) camels examined. Most cases developed no obvious signs. In 2 cases, there were nasal discharge, restlessness, frequent sneezing and snoring on inspiration and examination further revealed congestion and dark mucus entangled with numerous larval stages of Dipterous flies.

Gastrointestinal helminth infection : A total of 154 faecal samples from NRCC farm of either sex of camel were examined for the presence of any nematode load. 15 were found positive for *Haemonchus* infection, 2 for *Nematodirus*, 2 samples were positive for mixed infection of *Haemonchus, Strongyloides* and *Trichuris* and one sample was positive for mixed infection of *Haemonchus and Strongyloides* (Table 53).

Table 52: Distribution of ecto-parasites on camel

Number of camels		Number of camels infested with e cto-parasites		
Examined	Infested	Ticks	Mites	Flies
373	311(83.3%)	287(92.2%)	14(4.5%)	10(3.2%)

Table 53 : Prevalence of GI nematodes infection in camels of different regions of Rajasthan

Place	No. of samples collected	No. of faecal examination/ No. of samples positive		
		< 1 year	1 -3 years	>3 years
Bikaner	175	3/0	127/47	45/12
Jaisalmer	63	0/0	12/4	51/8
Jhunjunu	55	0/0	7/1	48/21
Udaipur	33	3/0	12/4	18/2
Pali	29	0/0	1/0	28/5
Hanumangarh	48	0/0	3/3	45/9
Bhuj	15	0/0	1/1	14/6
Total	418	6/0	163/60	249/72

Different types of infection recorded were mostly *Strongyles*, like *Haemonchus, Trichostrongylus*, etc. Besides, *Strongyloides, Trichuris* infection was also noticed with lesser prevalence rate. Very rare incidence of *Monezia* infection was also observed. It was also evident that the co-existence of camel with other livestock species like sheep and goat in these areas and wide migratory behavior of these animals leads to much varied helminth infection in field conditions.

Hydatidosis in camel : The cestode *Echinococcus granulosus* is the causative agent of cystic hydatid disease, or hydatidosis, which is recognized as one of the major zoonoses, affecting both humans and domestic animals in various parts of the world. The disease is due to the pressure exerted on the viscera of the intermediate hosts by hydatid cysts. The inner germinal layer of these cysts is cellular, and the protoscolex, the larval form of the parasite, is developed from those cells. Mature protoscoleces

are liberated into the cyst lumen.

The camels died at NRCC farm were examined and the incidence of Hydatidosis was recorded. Out of 11 camels examined through postmortem, 3 were found infected with Hydatid cyst. *E. granulosus* hydatid cysts were obtained from livers or lungs of camel. No cysts were found in spleen or other vital organs like kidney or brain. Cyst fertility was determined by the presence of free protoscoleces in the hydatid fluid and of growing protoscoleces attached to the germinal layer. Germinal layers joined to laminated layers were dissected from open cysts. When needed, protoscoleces were decanted by gravity from the hydatid fluid, washed in PBS pH 7.2 at room temperature. All the cysts either collected from liver (3) or lungs (2) were found fertile in the present study. The hydatid cysts in camel irrespective of their organ involvement were found to be multi-vesicular with several communicating chambers or loculi.The protoscolex of *E. granulosus* is central in the biological cycle of that parasite and is of particular interest in primary and secondary infections.

c. Sub-project: Epidemiology of viral diseases of camels

Sub-project Leader: G. Nagarajan

Associates: S. S. Dahiya

Camelpox: Schlafen-like protein gene of camelpoxvirus (CMLV) was amplified and cloned in pGEM-T vector. Successful amplification and subsequent confirmation of the recombinant clone of schlafen-like protein gene of camelpoxvirus using restriction enzyme digestion with *Eco*RI has been shown in Fig. 35. The full length gene sequence of the schlafen-like protein gene of camelpoxvirus (1510bp) was submitted to the NCBI database (Accession Number JF975616). Phylogenetic analysis revealed that Indian camelpoxvirus isolates were clustered with camelpoxvirus strain CMS and camelpoxvirus isolates from Kazakhstan (Fig. 36)

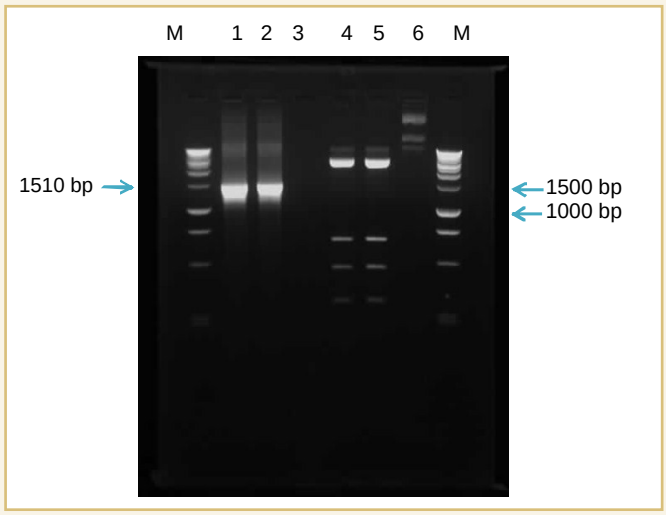


Fig.35:PCR amplification of Schlafen-like protein Gene of Camelpoxvirus. Lane M - 1Kb DNA ladder; Lane 1 & 2 - positive amplicons; Lane 3 - Contagious Ecthyma positive scabs (negative control); Lane 4 & 5- Positive recombinants showing the release of gene of interest; Lane 6- Undigested recombinant plasmid.

Fig. 36:Phylogenetic tree for schlafenlike protein gene of CMLV

Contagious ecthyma: Scab materials were collected from the camels infected with contagious ecthyma from the areas of Pali (in the month of July 2010-three samples, (Udaipur District) in the month of July 2010-15 samples), (Morkhana village of Bikaner District) in the month of August 2010-five samples) and NRCC herd, Bikaner (in the month of August 2010-30 samples). Topoisomerase gene of pseudocowpoxvirus isolates from the camels infected with contagious ecthyma was amplified and cloned in pGEM-T vector.) Successful amplification and subsequent confirmation of the recombinant clone of topoisomerase gene of pseudocowpoxvirus (PCPV) using restriction enzyme digestion with *Eco*RI are shown in Fig.37. The full length gene sequence of topoisomerase gene of pseudocowpoxvirus isolates from camels was submitted to the NCBI database (Accession Number is HQ844268). Phylogenetic analysis revealed that pseudocowpoxvirus isolates from camels represent a separate entity with regard to topoisomerase gene of ORFV and PCPV from Reindeer (Fig.38).

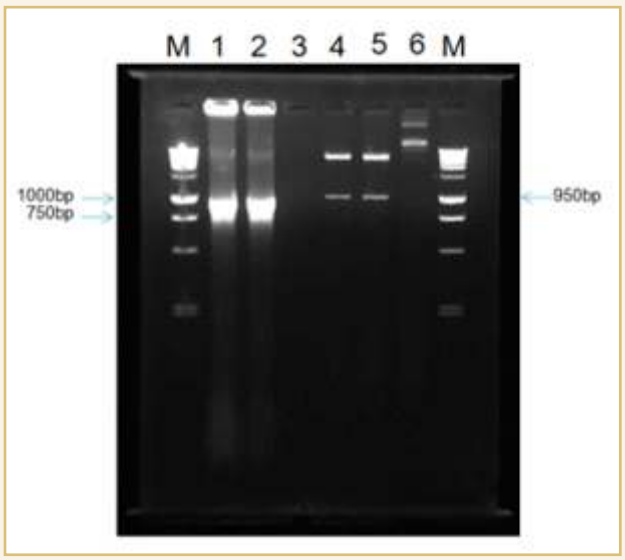


Fig.37: PCR amplification of Topoisomerase Gene of PCPV Lane M - 1Kb DNA ladder; Lane 1 & 2 - contagious ecthyma positive scabs; Lane 3 - camelpox positive scabs (negative control); Lane 4 &5- Positive recombinants showing the release of gene of interest; Lane 6- Undigested recombinant plasmid.

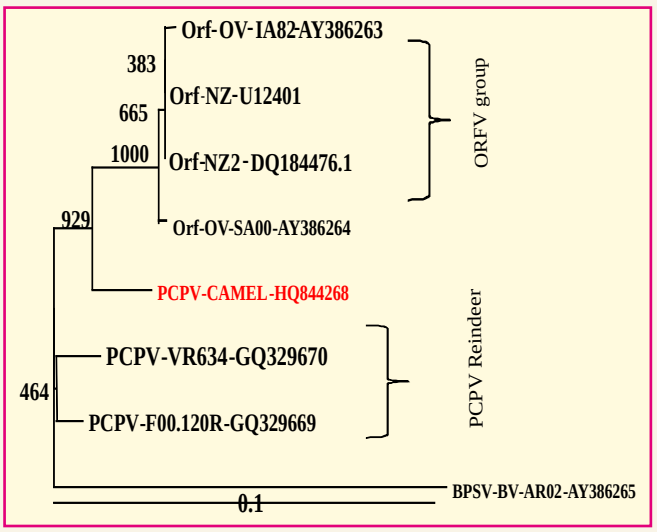


Fig. 38 : Phylogenetic tree based on amino acid sequences of topoisomerase gene of different para-pox viruses

VM- 10. Project : Epidemiology of deficiency and metabolic diseases in dromedary camel

Project Leader : D. S. Sena

Associate : N. Sharma

Survey work was conducted in Jodhpur, Jaisalmer, Barmer, Nagaur and Udaipur districts in monsoon and winter season and blood samples were collected (Table 54). The biochemical estimations viz. blood glucose, urea, creatinine, protein profile were done. The macromineral estimations were conducted. For the micromineral estimation digestion of samples was done and kept for further estimations by AAS.

The mean and standard error of the results of metabolic profile parameters of 20 healthy camels during different seasons have been presented in Table 55. The results of macro minerals viz. sodium, potassium, calcium, phosphorus and magnesium have been presented in Table 56. The number of clinical disorders noticed in each district have been presented in Table 57. Apart from these, samples were also collected from healthy and clinically ill camels of Churu district (49) and Gogamaedi mela (42) during monsoon season.

The commonly noticed digestive disorders were indigestion and enteritis. The commonly

noticed ectoparasitic infections were mange and fungal infection. The endoparasitic infection noticed was nematodiasis. Few reproductive disorders of infertility, abortions during late pregnancy were reported. Surgical affections involved injuries at different parts. Apart from this, in neonatal calves pneumonia was reported. At Gogamaedi fare reports of trypanosomiasis were there.

Table 54. Samples collected during survey in different districts

S.No.	Name of Places	No. of samples	
		Monsoon	Winter
1.	Jodhpur district (Bera, Keru, Saav, Jogyasani, Jhanwar, Modathali, Bhopalgarh)	65	28
2.	Jaisalmer district (Nokh, Dhodia, Raikon ka dhani, Dabla, Danval, Sultana)	40	38
3.	Barmer district (Sonadi, Thumbli, Shiv, Ramsar, Aerookotla, Jalela and Talonkapul)	34	28
4.	Nagaur district (Hanclav, Loon, Thambodia, Gottan, Kharnal, Kheemsar, Tansar)	34	22
5.	Udaipur district (Balicha, Jagat, Maoli, Jawad, Peepalva, Raikon ka dhani, Dabol)	25	35

Table 55. Mean biochemical/metabolic profile changes in healthy camels

S.No	Parameters	Season	Jodhpur	Jaisalmer	Barmer	Nagaur	Udaipur
1.	Blood glucose (mg/dl)	Monsoon	66.85±1.33	62.85±1.48	60.05±1.40	68.95±1.52	62.80±1.28
		Winter	64.05±1.59	54.50±1.22	60.70±1.41	68.20±1.34	62.95±1.29
2.	Urea (mg/dl)	Monsoon	23.45±0.79	20.92±1.12	21.34±1.26	24.60±0.98	21.15±0.83
		Winter	27.79±0.71	22.02±0.84	23.09±0.97	25.43±1.19	24.57±1.65
3.	Creatinine (mg/dl)	Monsoon	1.57±0.06	1.32±0.08	1.52±0.06	1.51±0.05	1.51±0.07
		Winter	1.47±0.08	1.31±0.10	1.48±0.07	1.55±0.05	1.50±0.07
4.	Total protein (g/dl)	Monsoon	6.86±0.18	6.10±0.10	6.05±0.08	6.42±0.17	6.36±0.14
		Winter	6.26±0.12	5.72±0.16	5.80±0.14	5.92±0.07	5.94±0.13

Table 56. Mean macro-mineral profile changes in healthy camels

S.No.	Parameters	Season	Jodhpur	Jaisalmer	Barmer	Nagaur	Udaipur
1.	Sodium (mmol/L)	Monsoon	131.35±3.39	127.55±2.53	131.10±3.25	130.10±2.80	131.50±4.21
		Winter	130.20±2.49	124.45±2.79	130.65±3.07	128.15±2.97	130.70±3.14
2.	Potassium (mmol/L)	Monsoon	5.06±0.16	4.63±0.20	4.82±0.16	5.10±0.15	4.93±0.15
		Winter	4.85±0.15	4.49±0.20	4.79±0.19	5.05±0.15	4.86±0.20
3.	Calcium (mg/dl)	Monsoon	10.60±0.25	8.92±0.16	9.62±0.27	9.97±0.21	10.13±0.28
		Winter	9.66±0.17	9.70±0.21	9.68±0.19	9.73±0.18	10.10±0.17
4.	Phosphorus (mg/dl)	Monsoon	5.57±0.28	4.70±0.20	5.45±0.09	5.47±0.14	5.54±0.15
		Winter	5.43±0.13	4.88±0.13	5.22±0.11	5.35±0.17	5.30±0.08
5.	Magnesium (mg/dl)	Monsoon	2.62±0.19	1.56±0.13	2.29±0.12	2.50±0.08	2.36±0.27
		Winter	2.45±0.18	1.70±0.08	2.16±0.18	2.46±0.14	2.23±0.15

Table 57. Number of clinical cases noticed in each district

S.No.	Parameters	Season	Jodhpur	Jaisalmer	Barmer	Nagaur	Udaipur	Total
1.	Digestive disorders	Monsoon Winter	6 8	12 9	7 5	4 6	3 4	32 32
2.	Ectoparasitic infections	Monsoon Winter	10 12	16 14	5 9	6 6	4 8	41 49
3.	Endoparasitic infections	Monsoon Winter	8 9	6 10	5 6	3 4	4 3	26 32
4.	Reproductive disorders	Monsoon Winter	2 2	2 3	4 3	3 2	5 8	16 19
5.	Surgical affections	Monsoon Winter	2 3	- -	1 -	2 1	1 3	6 7

VPH-1 . Project: Investigations on clinical cases for overall health improvement of camel herd

Project Leader: S. D. Narnaware

Associates : N.V. Patil, F.C. Tuteja, S.K. Ghorui, G.Sivkumar, A.K. Nagpal, S.Vyas, N. Sharma, B. L. Chiraniya, G. Mal and C. Bhakat

Routine monitoring was done in camels of NRCC farm to investigate any clinical abnormality in the herd. Different clinical samples collected from camels exhibiting any diseased symptoms, and relevant samples also collected from dead camels to investigate the cause of morbidity and mortality in NRCC farm. Different clinical conditions reported were fever, anorexia, miscellaneous injuries, abortions, dystokia, contagious ecthyma, mastitis, bronchopneumonia, diarrhoea, mange, dermatophytosis and skin candidiasis. A total of 16 camels died during the year. The causes of mortality were found to be pneumonia (3), heat stroke (1), congestive heart failure (1), liver cirrhosis (2), impaction (1), respiratory failure (1), gastro-enteritis (calf scour) (4), haemangiosarcoma of heart (1), inanition due to senility (1) and haemothorax (1). Following studies were done in camels exhibiting different pathological conditions.

Contagious ecthyma: An outbreak of contagious ecthyma in camels occurred in the month of August (monsoon season) in NRCC farm and villages adjoining to Bikaner. Goat population also got affected with contagious ecthyma in these villages which were grazing in the same pasture as camels (Fig 39). In camel farm of the centre, total 42 camels

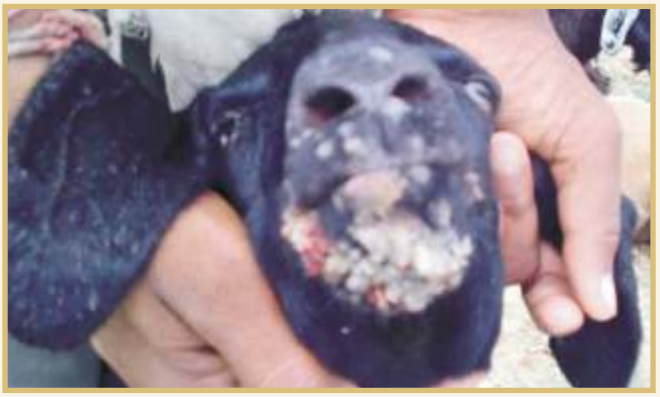


Fig. 39: Goat from the village Morkhana showing contagious ecthyma lesions

were affected. Morbidity rate of 100 per cent was reported in camels between age group of 6 months to 1 year with no mortality. The total course of the disease was found to be of 10 weeks with the involvement of secondary bacterial infection of the lesions during middle phase of the disease by staphylococcus organisms. After recovery lesions were found completely healed with no scar formation.

Lesions of the disease: The initial lesions started with the formation of erythema and papule on and around mouth, lips and nostrils of three camels (Fig. 40). After one week hard swelling on face and jaw

muscles (Fig. 41) occurred in these camels and six other camels also started showing the initial skin lesions of erythema and papule formation. After two weeks severe lesions of vesicles and pustules (Fig. 42 and 43) occurred and all camels in the herd were found to be affected despite topical treatment with potassium permanganate solution. The nodular lesions also occurred around eyes, face and neck region and were remained upto 4-5 weeks. At this stage some camels were having pus formation in the lesions (Fig. 44) and maggot infestation which lead to delayed healing of the lesions. The pus samples from the lesions cultured on nutrient agar revealed presence of staphylococcus organisms (Fig. 45). The results of antibiotic sensitivity test revealed high sensitivity for sulphatriad while moderate sensitivity for oxytetracycline, streptomycin, penicillin G, chloramphenicol and ampicillin.

At this stage antibiotic treatment was started with long acting oxytetracycline. The lesions then progresses to drying and scab formation and remained for upto another 2 weeks. After this stage camels showed improvement and healing of lesions. All the camels showed complete healing of the lesions with no scar formation after 10 weeks of infection (Fig. 46). Histopathological studies in contagious ecthyma revealed hyperplasia of epidermis with vacuolations, ballooning and degeneration and leucocyte infiltration in dermis (Fig. 47 and 48) and initial lesions of erythema and papule which later progresses to vesiculation and pustule formation (Fig.49).Papillomatous proliferation of epidermis was seen due to secondary bacterial infection of the lesions (Fig. 50) Typical eosinophilic intracytoplasmic inclusion bodies were also seen in keratinocytes (Fig. 51).

Haemato-biochemical studies on contagious ecthyma cases revealed no significant change in Hb, DLC, TLC, TEC, PCV, serum albumin, cholesterol, creatinine, iron, urea, magnesium, calcium, triglycerides and bilirubin while significantly decreased values were observed for total serum protein and globulin and significantly increased values were observed for MCV, MCH and GPT in contagious ecthyma affected camels as compared to normal camels (Table 58 and 59).

Table 58: Hematological parameters in normal and contagious ecthyma affected camels

Hematology Parameters	Contagious ecthyma effected camels	Normal camels
TLC (per µl)	10800± 1189.67	12267± 1158.06
TEC (million/µl)	7.27±0.77	8.85±0.46
Hemoglobin (g/dl)	12.73±0.49	11.76±0.40
Neutrophil (%)	53±2.12	50±2.97
Lymphocyte (%)	37.83±1.42	37.16±1.66
Monocyte (%)	3.5±0.67	4.5±0.76
Eosinophil (%)	5.66±0.76	7.83±1.88
PCV (%)	29.16±0.7	28.66±0.66
MCV (fl)	43.27±6.16*	32.82±1.83*
MCH (pg)	19.02±2.99*	13.55±1.05*
MCHC (g/dl)	43.65±1.31	41.06±1.23

*Results are significant (P<0.05)

Fig. 40: Initial lesions of erythema and papule around mouth and lips

Fig. 41: Hard swelling on face and jaw muscles after one week of infection

Fig. 42: Severe lesions on lips, around mouth, eyes and on neck region

Fig. 43: Lesions progresses into vesicle and pustule formation after 2 weeks of infection

Fig. 44: Secondary bacterial infection leading to pus formation and few cases have maggot infestation

Fig. 46: Complete healing of the lesions with no scar formation

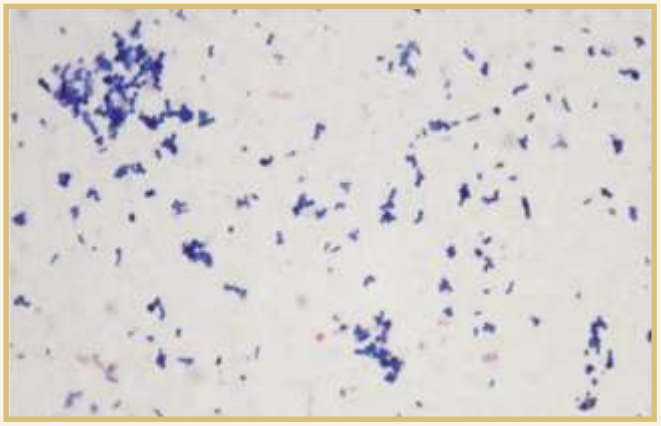


Fig. 45: Staphylococcus organisms on grams staining

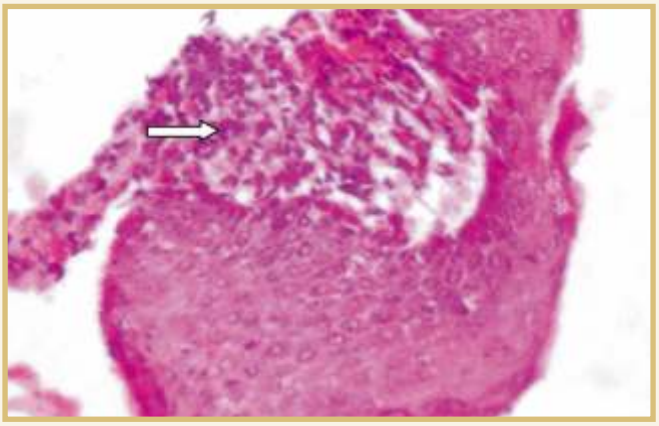


Fig. 47: Hyperplasia of epidermis with leucocyte infiltration in dermis. H&E 10X

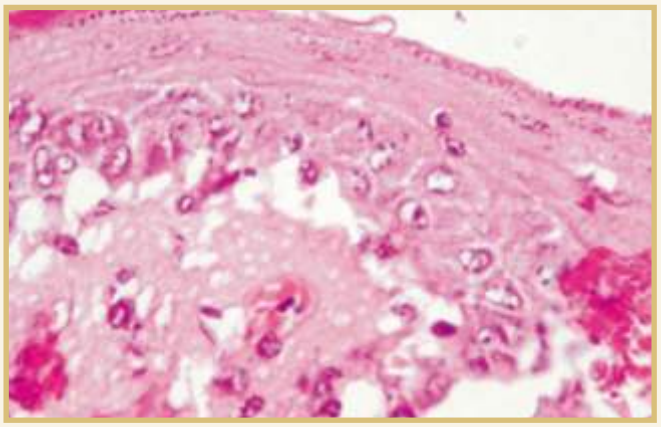


Fig.48:Degenerative changes in epidermis with vacuolations and ballooning. H&E 40X

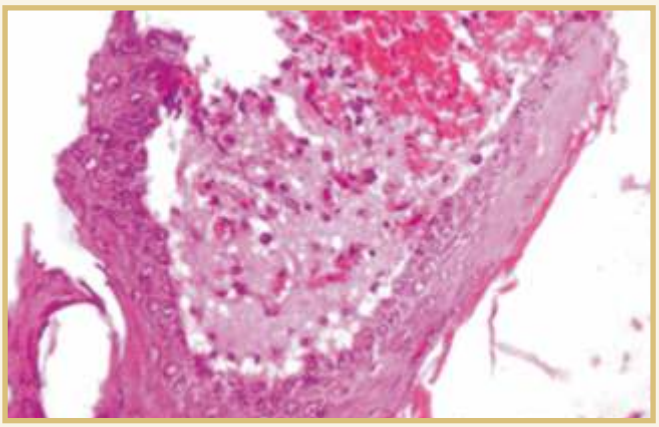


Fig. 49 :Pustule formation in epidermis with presence of proteinous fluid and RBC's. H&E 10X

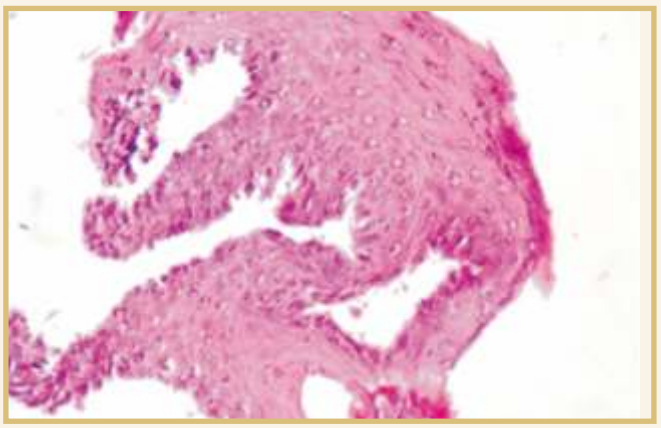


Fig. 50: Papillomatous proliferation of epidermis. H&E 10X

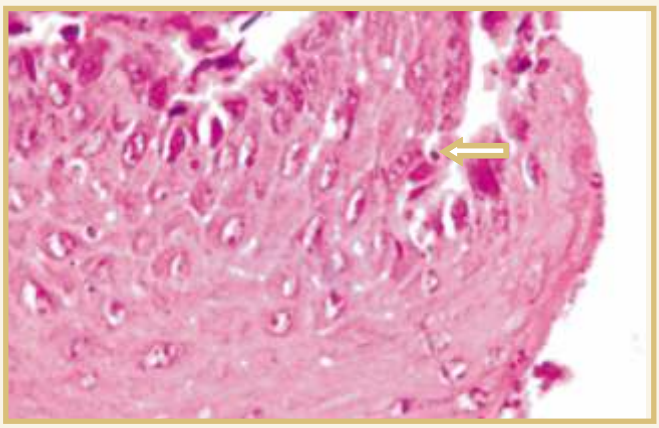


Fig. 51: Intracytoplasmic eosinophilic inclusion bodies inside keratinocytes. H&E 40X

Table 59: Serum Biochemical parameters in normal and contagious ecthyma affected camels

Serum Parameters	Contagious ecthyma effected camels	Normal camels
Total Protein (g/dl)	5.62±0.41*	7.5±0.45*
Albumin (g/dl)	3.86±0.19	4.26±0.11
Globulin (g/dl)	2.05±0.12*	3.2±0.4*
Cholesterol (mg/dl)	237.13±30	240.35±13.33
Creatinine (mg/dl)	1.07±0.15	0.89±0.12
Iron (µg/dl)	98.14±22.44	85.18±8.92
Urea (mg/dl)	39.37±4.71	34.98±1.2
Magnesium (mg/dl)	0.35±0.1	0.26±0.08
Calcium (mg/dl)	15.89±0.84	15.35±1.1
Triglycerides (mg/dl)	199.68±18.6	220.95±11.69
GPT(Glutamatepyruvatetransaminase) (U/L)	18.22±5.56*	4.23±1.45*
Bilirubin (mg/dl)	0.45±0.18	1.36±0.35

*Results are significant (P<0.05)

Hemangiosarcoma: One adult female camel was presented for post mortem with the history of dull, depression and anorexia for last 10 days. The post mortem examination revealed presence of subcutaneous gelatinized fat. Abdominal cavity also contained large amount of gelatinized omental fat (Fig. 52). Heart was found to be very much enlarged in size and contained large amount of bloody thick fluid inside pericardial cavity. Heart outer surface was found completely covered by cauliflower like unencapsulated, reddish colored vegetative tumour outgrowths (Fig. 53). The adhesions were not found with the tumour growth and pericardium. Cutting of the tumour growths oozed blood. The impression smear made from the tumour growths and stained by Giemsa stain revealed many mitotic, pleomorphic, elongated, spindle shaped tumour cells and RBCs. The nuclei of the cells were found to be hyperchromatic, vacuolated and fragmented (Fig. 54 and 55). Histologically the heart showed presence of many sarcocysts i.e. intermediate stage of *Sarcocystis* spp. inside heart muscles causing eosinophilic myocarditits with degeneration and swelling of cardiac muscles cells (Fig. 56). Fatty tissue depositions were also seen in between heart muscles. Histopathology of tumour tissue revealed presence of rich vascular tissue with unencapsultaed and infiltrative tumour growth and hemorrhages (Fig. 57). Irregular shaped and sized blood vessels were seen with plump endothelial cells lining and filling trabeculae between lumens (Fig. 58). Sheets of neoplastic endothelial cells were also seen often forming vascular channels variably filled with erythrocytes. Neoplastic cells were seen with variable mitotic figures and large pleomorphic vesicular nuclei (Fig. 59 and 60). The argyrophilic nucleolar organizing region (AgNOR) staining showed presence of numerous black or brown AgNOR positive dots of variable size and

shape inside nuclei of tumour cells (Fig. 61). The mean number of AgNORs per nucleus of tumour cells was counted and it was found to be 3.93. Also, the mean number of AgNORs inside nucleus of tumour cells in impression smear was calculated and found to be 6.20. Nucleolar organizer regions (NORS) are chromosomal segments, which contain ribosomal genes. These argyrophilic proteins are selectively stained by silver stains as black dots. There is close correlation of AgNOR number and tumour proliferartion rate. The rapidly proliferating high grade malignant tumour cells have higher AgNOR counts as compare to normal cells. In this case metastasis of hemangiosarcoma to other organs was not observed. This may be because of enclosed anatomical location, since the tumour growth was limited only in the pericardial cavity. Hemangiosarcoma can be further confirmed by immunohistochemistry by detecting positive expression of factor VII related antigen. This is the rare report of hemangiosarcoma in which entire heart was covered by vegetative tumour tissue growth with haemorrhages causing life threatening cardiac tamponade.

Fig.52: Large amount of yellow gelatinized fat deposit in peritoneal cavity

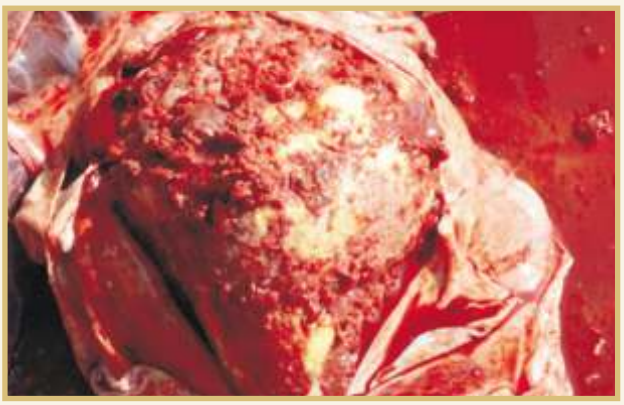


Fig. 53. Heart completely covered by cauliflower like vegetative tumour growth

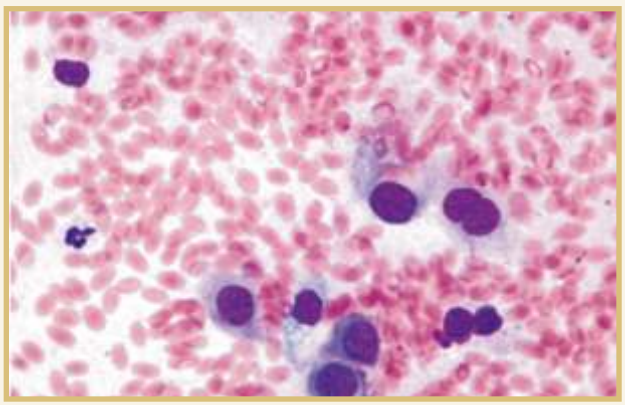


Fig. 54: Impression smear showing many mitotic tumor cells. Giemsa stain 100X

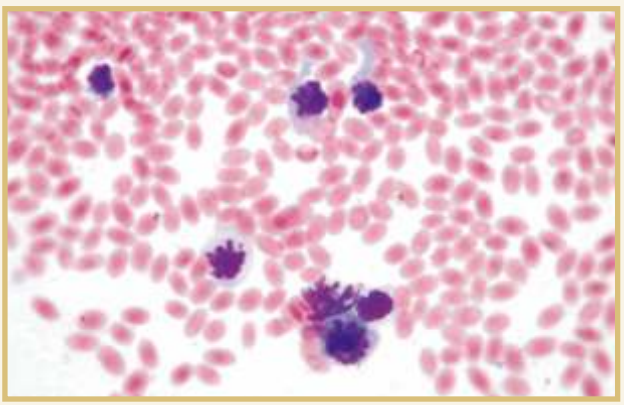


Fig. 55: Impression smear showing anaplastic tumor cells having pleomorphism and hyperchromasia of nucleus. Giemsa stain 100X

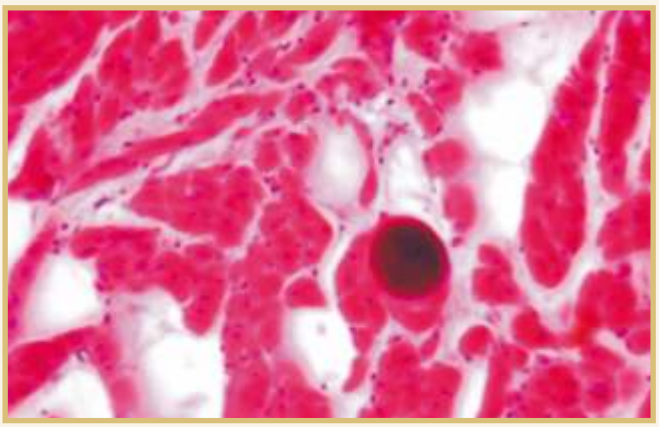


Fig. 56: Sarcocyst inside heart muscle causing eosinophilic myocarditis. H&E 40X

Fig. 57 : Hemangiosarcoma showing tumour growth with rich vascular tissue. H&E 10X

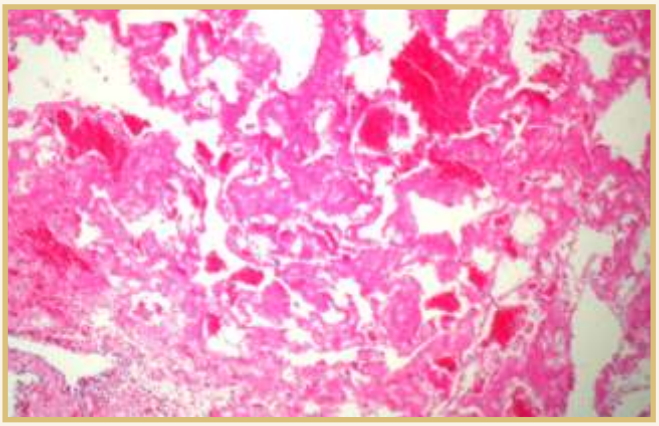


Fig. 58: Irregular shaped and sized vessels with plump endothelial cells lining and filling trabeculae between lumens. H&E 10X

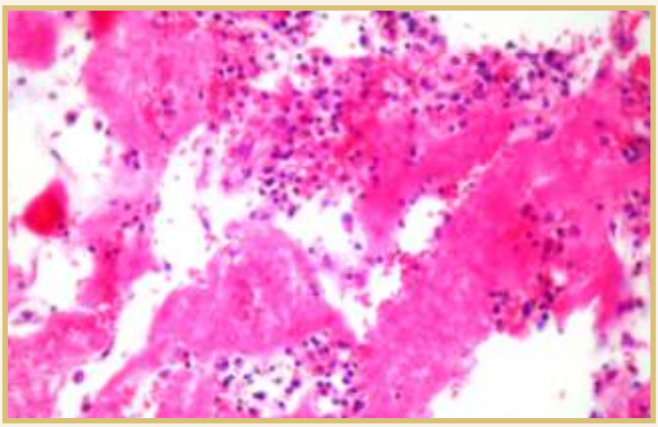


Fig. 59 :Hemangiosarcoma showing anaplastic mitotic tumour cells. H&E 40X

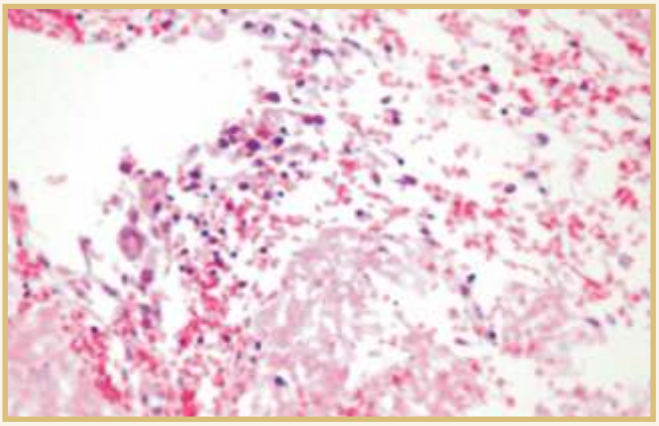


Fig. 60: Tumour cells having large pleomorphic vesicular nuclei and mitotic figures. H&E 40X

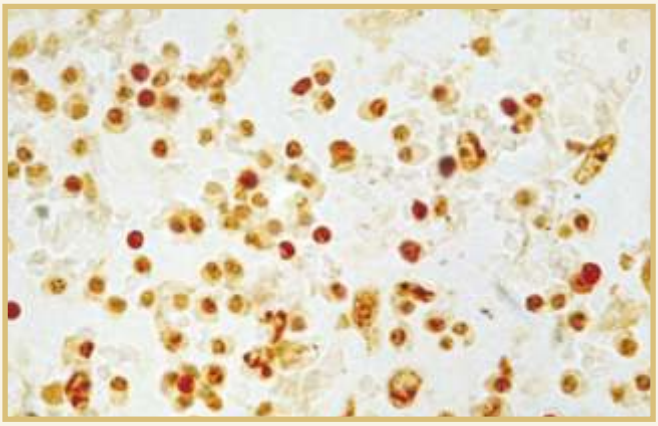


Fig. 61: Numerous AgNOR positive dots inside nuclei of tumour cells. AgNOR stain. 100X

Calf Scour: Four mortalities were reported in new born calves of below 10 days age due to calf scour (Fig. 62 and 63). Among these three calves showed the symptoms of diarrhoea with mucoid yellowish

Fig. 62 : Weak and emaciated 2 days' old calf

pasty feces and one calf died without showing any symptoms of diarrhoea. Faecal samples collected from these cases of calf diarrhea revealed presence of lactose fermenting pink colonies of *E. coli* on MacConkeys agar (Fig. 64). Anitibiotic sensitivity test revealed moderate sensitivity for cephotaxime, chloramphenicol, poor sensitivity to streptomycin, tetracyclin and resistance to penicillin G, ampicillin, sulphatriad, cotrimoxazole, cloxacillin, lincomycin and cefuroxime. The morbidity in calf scour was attributed to weak immune status of calves since these calves were deprived of colostrum due to agalactia syndrome in dams.

Congestive heart failure: The clinical signs of congestive heart failure usually develop slowly over several weeks. One case of congestive heart failure was reported in a male camel of 3 years old. The general body condition was found to be normal. The postmortem revealed presence of large amount of clear straw coloured fluid inside thorasic cavity and pericardium. The heart was found to be compressed due to pressure from large amount of pericardial fluid. Liver was enlarged, hard and slightly congested. Intestines were slightly congested and corrugated. Histopathology revealed presence of many sarcocysts in between heart muscle fibres and eosinophilic myocarditis (Fig. 65 and 66). Degenerative and necrotic changes were also evident in heart muscle cells. Microscopically liver showed fatty infiltration with centrilobular necrosis (Fig. 67). Intestine showed presence of many transverse cut sections of parasites at different stages inside villi and crypt region of mucosa (Fig. 68). Eosinophil infiltration was seen around these parasites (Fig. 69).

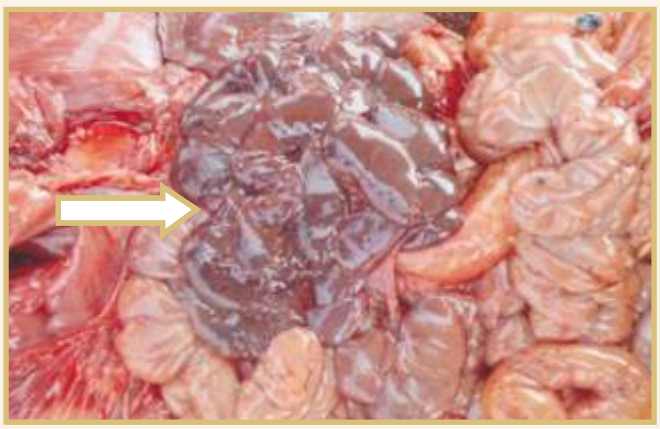


Fig. 63: Haemorrhagic enteritis in 2 days' old calf

Fig. 64 :*E coli* organisms on Grams staining

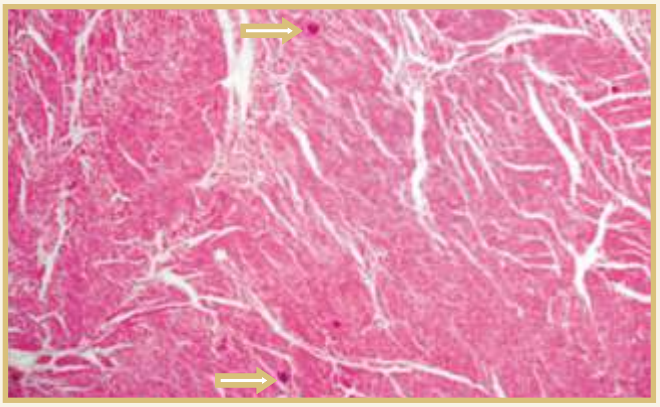


Fig. 65: Sarcocysts in heart muscle. H & E 10X

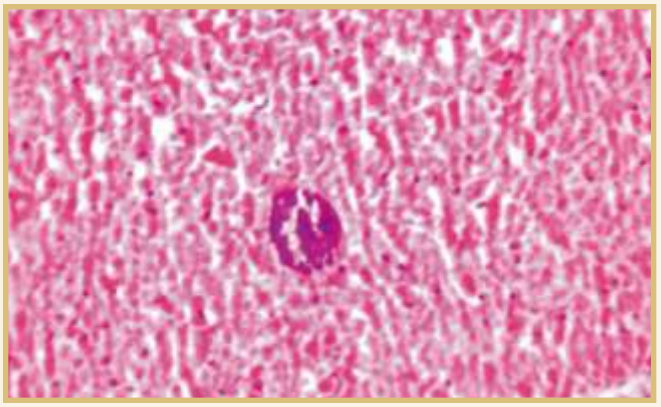


Fig. 66: Sarcocysts in heart muscle with degenerative changes and necrosis. H & E 40X

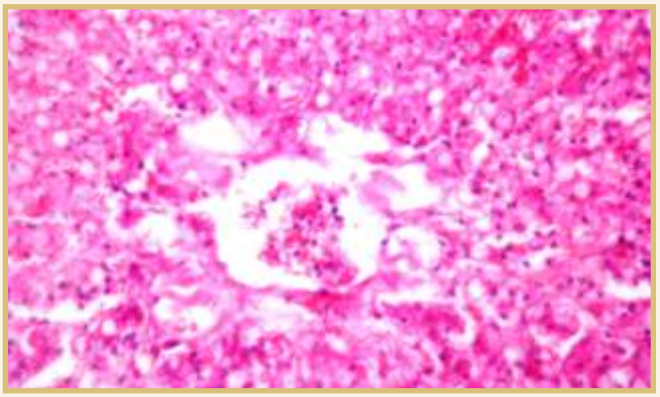


Fig.67: Liver showing fatty degeneration and centrilobular necrosis H & E 40X

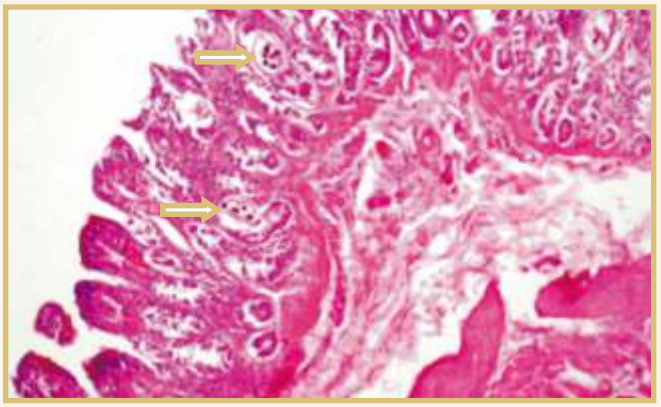


Fig.68: Small intestine showing numerous transverse sections of parasite inside villi and crypt region. H & E 10X

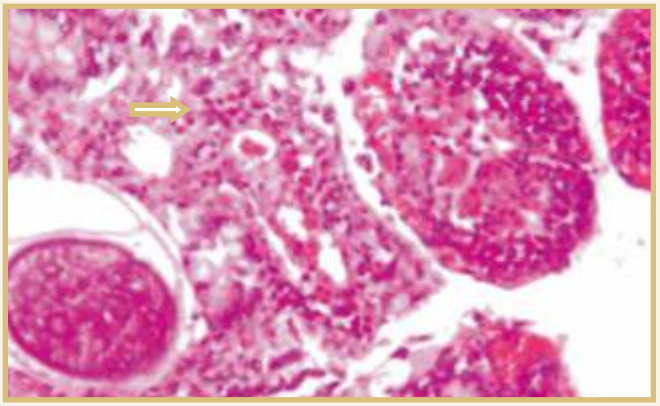


Fig. 69 : Small intestine showing eosinophil infiltration around parasite. H & E 40X

Hydatidosis: A case of hydatidosis was reported during the postmortem of one adult camel. The variable sized hydatid cysts were found inside lung tissue. The size varied from lemon to tennis ball size. The cysts revealed presence of clear fluid and brood capsules attached to the thick cyst wall (Fig. 70). The fluid was removed carefully with a syringe and washing of cyst was done with normal saline solution which revealed many protoscolices of echhinococcus parasite (Fig. 71 and 72). Histopathology of hydatid cyst from lung tissue revealed presence of thick connective tissue wall of hydatid cyst (Fig. 73). The blood vessels near to cyst showed congestion and alveoli showed emphysematous changes (Fig. 74).

Fig. 70 :Hydatid cyst inside lung tissue

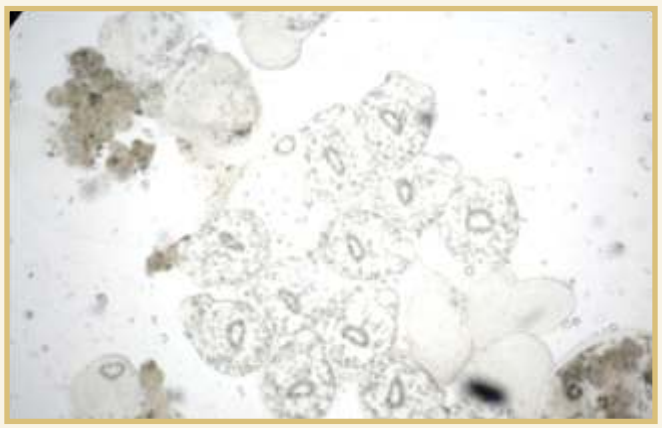


Fig. 71 :. Hydatid sand containing many protoscolices. 10X

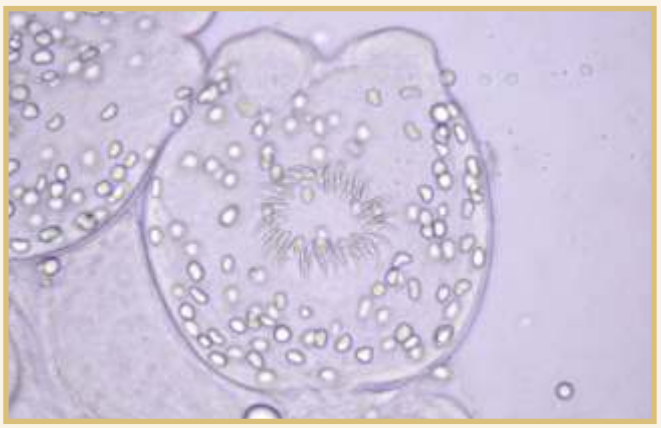


Fig. 72 : Protoscolices of echinococcus parasite. 40X

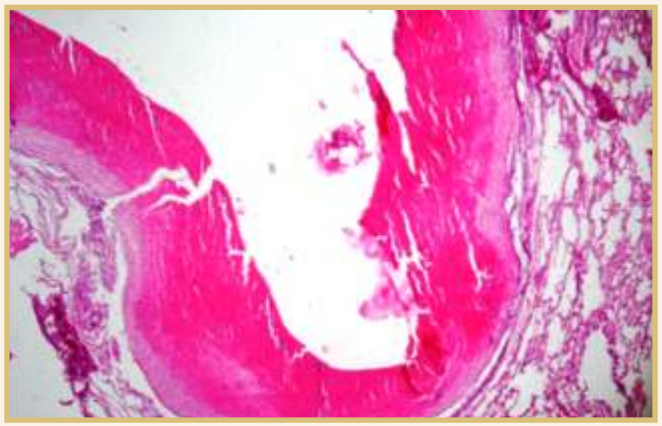


Fig. 73 :Thick connective tissue wall of hydatid cyst in lung. H & E 10X

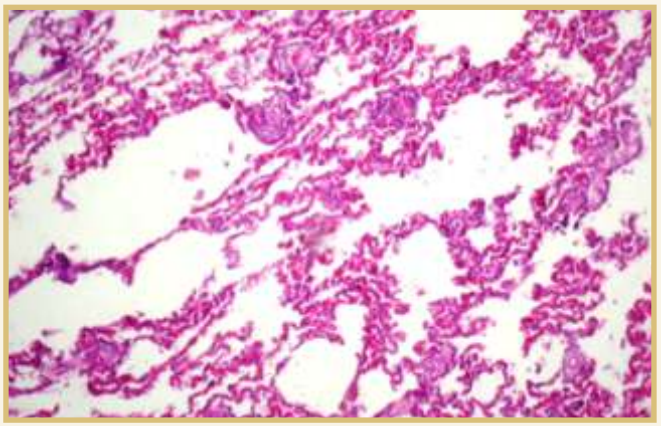


Fig.74: Lung showing congestion and emphysema. H & E 10X

VP-3.Project: Bionomics and molecular characterization of ticks infesting the camel

Project Leader : G. Sivakumar

Associates : S. K. Ghorui, F.C. Tuteja and G. Nagarajan

Ticks on camels were collected from places in and around Bikaner, such as Garhsisar road, Gadwala, Gigasar, Jaimalser, Deshnok, Jorbeer and processed for morphological examination and it was found to be *Hyalomma dromedarii* (Fig.75).

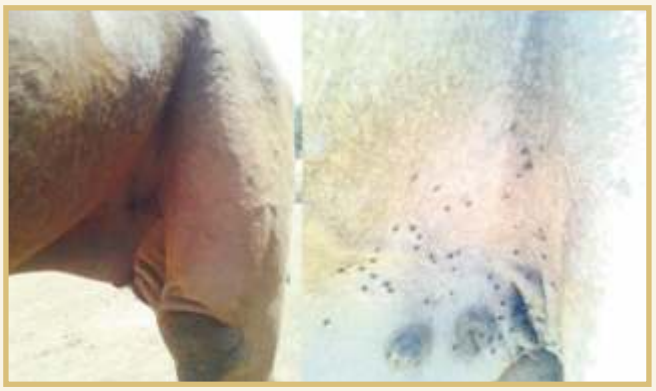


Fig. 75: Ticks infesting camel

The genomic DNA from salivary gland of female ticks collected from different places was extracted by GENAXY- DNA isolation kit and stored at -20°C for future use. PCR amplification of ~1.4 kb expected amplicon was amplified from genomic DNA of ticks collected from Jorbeer, Bikaner (Fig.76).

The amplified DNA fragments were cloned in pGEM-T Easy vector and transformed to *E. coli* DH5α. Ticks salivary gland was isolated from the engorged female tick (*H. dromedarii*).

Fig. 76: Agarose gel showing DNA of camel tick (*H. dromedarii*). Lane M : Marker and Lane 1: Tick DNA

Fig. 77 :Agarose gel showing amplification of Calreticulin gene of tick (*H. dromedarii*). Lane M : marker, Lane 1: Calreticulin gene

BTAS-1.Project: Molecular cloning and characterization of cameline cytokine gene (s)

Project Leader : G. Nagarajan

Associates : S. K. Ghorui, G. Sivakumar

The phylogenetic analysis based on the amino acid sequences of IL-2,IL-4,IL-6,IFN-Gamma and TNF-alpha in dromedarian camel and other animal species showed the expected clustering of all camelids (Fig. 78-82).

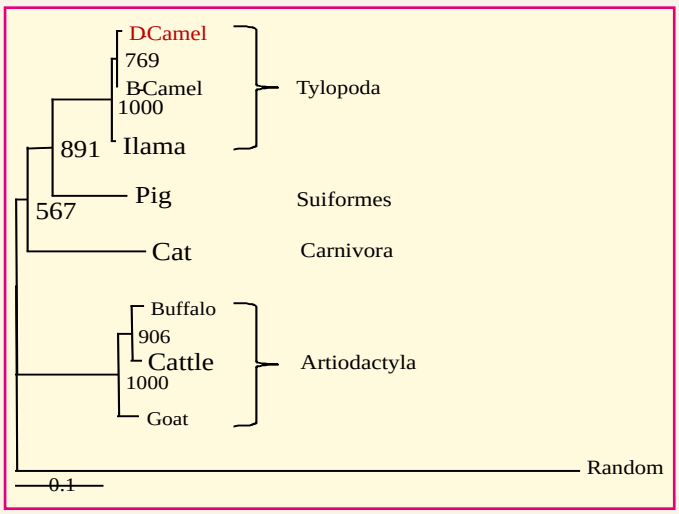


Fig. 78: Phylogenetic tree based on amino acid sequence of IL-2 gene of different livestock species

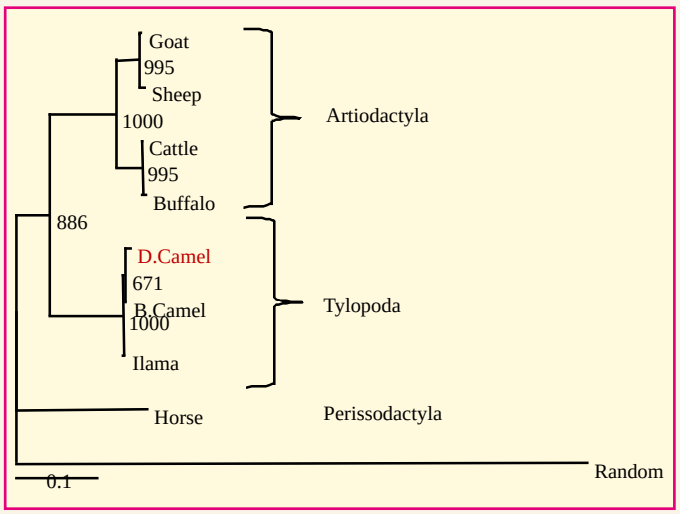


Fig. 79 : Phylogenetic tree based on amino acid sequence of IL-4 gene of different livestock species

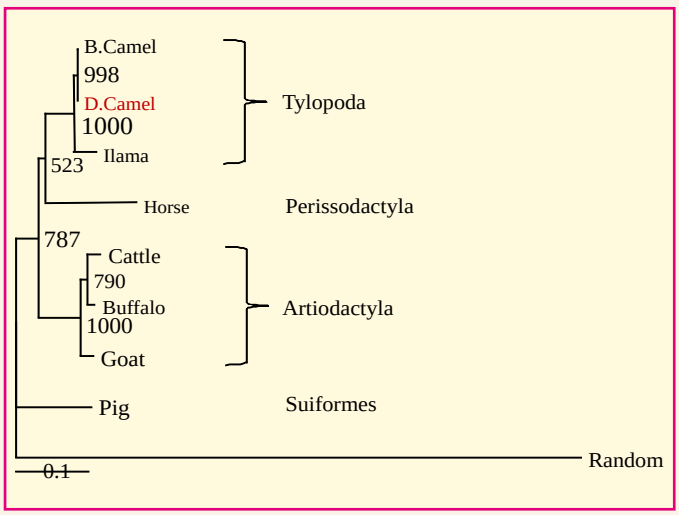
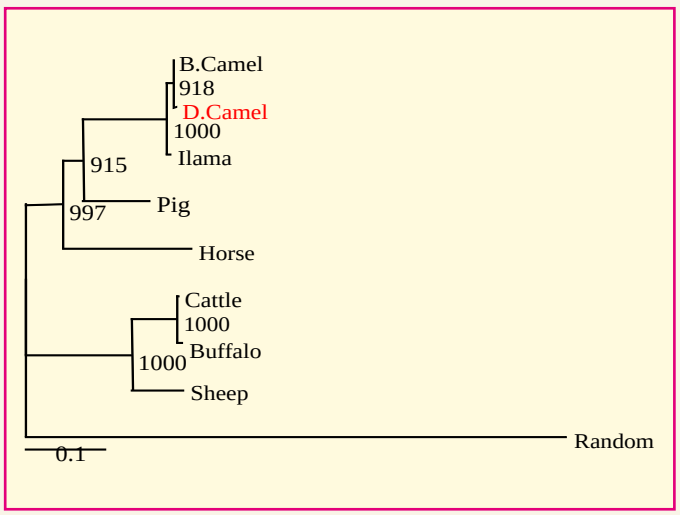


Fig. 80 : Phylogenetic tree based on amino acid sequence of IFN- gamma gene of different livestock species



speciesFig. 81 : Phylogenetic tree based on amino acid sequence of IL-6 gene of different livestock

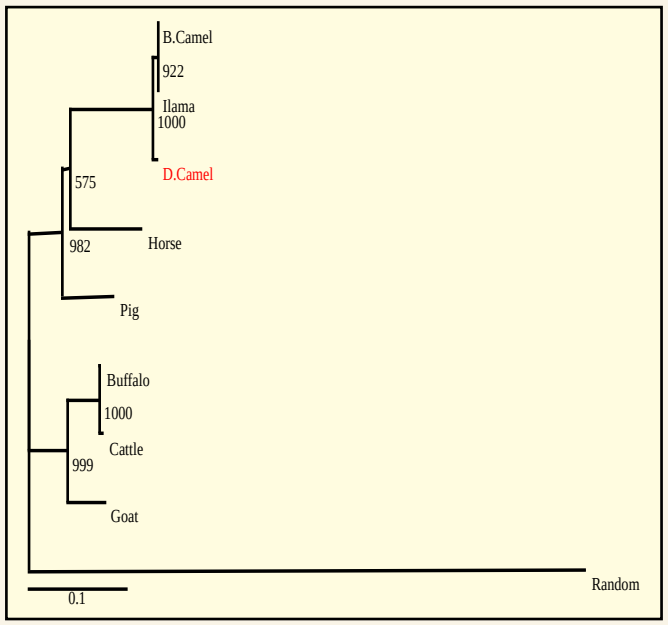


Fig. 82 : Phylogenetic tree based on amino acid sequence of TNF-alpha gene of different livestock species

Unit : Camel Nutrition

AN-3. Project :Studies on nutrient requirement and feed resource availability in camel for optimum production

Project Leader: A. K. Nagpal

Associate : N.V. Patil

Energy requirements of lactating camels : Ten healthy Jaisalmeri lactating camels (age 10-20 years; 607.90 ± 24.63 kg body weight) after 68 days (17-129 days) of calving were selected from NRCC herd and effect of three dietary energy levels on body weight changes, milk yield and nutrient utilization, was studied for 191 days. The lactating camels were randomly allotted to 3 groups, 3 calves each in group I and II and 4 in group III and fed feed blocks containing 50, 55 and 60% TDN and almost similar crude protein level. Feed blocks were made on feed block making machine at 4000 psi. The dietary composition of group I animals was, dry chaffed groundnut (*Arachis hypogea*) haulms 86.5, guar churi 12, mineral mixture 0.5 and common salt 1.0 % and that of group II was groundnut haulms 77.5, bajra 12, guar churi 9, mineral mixture 0.5 and common salt 1.0 % while that of group III was groundnut haulms 67.5, bajra 25, guar churi 6, mineral mixture 0.5 and common salt 1.0%. The data on monthly intakes of dry matter intake kg/d showed decrease with increase in lactation period from April to October (Table 60). The overall or average DM intake kg/d was minimum in group I (9.42 ± 0.10 kg/d) as compared to group II (9.84 ± 0.50 kg/d) and maximum in group III (10.66± 0.34 kg/d) over 7 months. In case of group I lactating camels, average daily milk yield was observed to range between 7.68 to 8.12 litres/day in different months from April to October while it ranged between 7.19 litres/day to 8.97 litres/day in group III and between 7.34 to 8.94 litres/day in group III (Table 61). Overall milk yield of 3 lactating camels varied between 7.40 to 8.54 litres/d in different months. Milk yield of group was minimum with value of 7.69 litres/d and was maximum of 8.44 litres/d in group indicating positive effect of higher dietary energy level. The initial body weights of group I, II and III lactating were 614, 596 and 613 kg respectively (Table 62 and Fig. 83). During the course of 191 days study, group I lactating camels lost their body weights (- 49 kg or -256.54 g/d), group 11 camels maintained their weights whereas the lactating camels of group III lost marginally (-5.75 kg or -31.41 g/d live weight) during the lactation period. The data on chemical composition in terms of proximate principles of guar *phalgati*, groundnut haulms, bajra, guar *churi* and feed block rations have been presented in Table 63. The

variation in the chemical composition of 3 rations was due to varying proportions of feed ingredients to ensure that animals derive required amount of energy and protein. The data on feed intake, digestibility coefficients and growth performance of different camel groups have been presented in Table 64. The dry matter intake (DMI) kg/day or kg/100 kg body weight was 9.77± 0.07 and 1.72 ± 0.03 in group I and,9.84 ±0.12 and1.65 ± 0.04 in group II which were statistically similar but significantly (P<0.5) increased to 11.57 ±0.81 or 1.99 ± 0.08 in group III respectively which might be due to higher energy contents of diet. Digestibility coefficients of OM and NFE proximate principles differed significantly (P<0.05) among three groups and was observed to increase from group 1 to group III. The digestibility of DM, CP, EE and CF was similar among group 1 and 2 but was significantly (P<0.05) different and lower than that in group III. Daily intake of DCP (g), TDN (g) and ME (MJ) /kg metabolic body weight was significantly (P<0.05) different among 3 groups and increased from group I to III with increase in dietary energy level. The daily intake of DCP (g), TDN (g) and ME (MJ) /kg metabolic body weight was 5.07 ± 0.07, 43.19 ± 0.53 and 0.65±0.01 in group I; 5.32±0.13, 44.19± 1.12, 0.67±0.02 in II and 6.79 ± 0.03, 60.32 ± 1.53 and 0.91±0.03 in III respectively. The results indicated that lactating camels given completed feed block containing 6.97% DCP and 107.21 ME MJ performed better in terms of milk yield, body weight maintenance and nutrient utilization. When present observations were compared with the standards recommended by ICAR (1985) for lactating camel, it was found that the daily intake of DM & ME were lower in present experiment than the ICAR (1985) recommendations but DCP intakes were almost similar (Table 65).

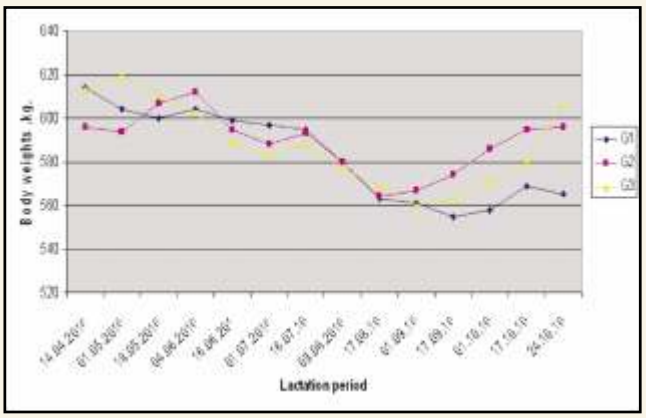


Fig. 83 : Variation in body weights with lactation period

Table 60: Dry matter intakes of lactating camels

Month	Group 1		Group II		Group III	
	Mean	SE	Mean	SE	Mean	SE
April,10	10.74	0.03	11.3	0.09	12.12	0.24
May, 10	10.60	0.04	10.49	0.6	11.6	0.34
June,10	9.58	0.06	9.2	1.14	10.5	0.45
July,10	9.33	0.19	9.9	0.49	11.01	0.18
August, 10	8.92	0.19	9.19	0.64	9.54	0.32
Sept, 10	8.03	0.11	8.89	0.52	9.31	0.51
Oct., 10	8.71	0.1	9.92	0.05	10.57	0.33
Average	9.42	0.10	9.84	0.50	10.66	0.34

Table 61: Milk yield of lactating camels

Month	G 1	G II	G III	Mean
April,2010	7.68	7.19	7.34	7.40
May,2010	8.29	7.76	8.47	8.17
June,2010	8.12	8.71	8.64	8.49
July,2010	7.44	8.87	8.72	8.34
August,2010	7.18	8.4	8.41	8.00
Sept, 2010	7.39	8.5	8.59	8.16
Oct.,2010	7.7	8.97	8.94	8.54
Average	7.69	8.34	8.44	8.16

Table 62 :. Body weight changes of lactating camels

(Weight in kg)

Parameter	G 1	G II	G III	SE
Initial BW	613.67	596.00	612.50	17.71
Final BW	564.67	597.00	606.75	8.78
Gain	-49.00	1.00	-5.75	15.08
ADG g/d	-256.54	5.21	-30.10	78.97

Table 63: Chemical composition of experimental diets on percent dry matter basis

Parameter	CP	EE	CF	NFE	Total ash
Groundnut haulms	10.7	1.86	26.47	47.99	10.99
Bajra	13.06	9.22	3.76	71.16	2.80
Cotton seed cake	26.33	6.84	28.93	33.44	4.46
G 1	11.8	2.28	27.8	47.15	10.98
G2	12.39	2.79	23.35	50.06	11.42
G 3	12.15	3.53	21.98	52.25	10.09

Table 64. Feed intake, digestibility and growth performance of camel calves

Particular	Gp I	Gp II	Gp III
Body wt. Kg	569.00 ± 14.98	597.00 ± 13.22	579.25 ± 27.29
DMI kg/d	9.77± 0.07	9.84 ±0.12	11.57 ±0.81
DMI kg/100 kg B.Wt**.	1.72 ^{a}± 0.03	1.65 ^{a}± 0.04	1.99 ^{b}± 0.08
Digestibility %			
DM**	51.68^{a}± 0.38	52.51^{a}± 2.28	59.12 ^{b}± 1.72
OM**	56.10 ^{a} ± 0.26	59.13 ^{b} ± 2.21	66.05 ^{c}± 1.32
CP**	51.20 ^{a} ± 0.81	52.73 ^{a}± 2.22	57.81 ^{b} ± 1.53
EE**	50.49 ^{a}± 5.12	53.62 ^{a} ± 2.50	66.96 ^{b} ± 1.24
CF*	47.36 ^{a}± 0.73	44.96 ^{a}± 4.41	55.55 ^{b}± 1.29
NFE**	62.80 ^{a}± 0.94	67.61^{b}± 1.40	72.33 ^{c}± 1.42
Nutritive value			
CP %	11.8	12.39	12.15
DCP %	6.04	6.54	6.97
TDN %	51.46	54.24	61.79
ME MJ /kg	7.75	8.17	9.31
Plane of Nutrition			
DMI kg/d	9.77± 0.07	9.84 ±0.12	11.57 ± 0.81
CPI g/d	1.15±0.01	1.22±0.01	1.39±0.09
DCPI g/d	0.59±0.01	0.64±0.02	0.80 ± 1.53
TDNI kg/d	5.03±0.04	5.33 ± 0.13	7.12 ±0.35
MEI MJ/d	75.75±0.63	80.35 ± 1.99	107.21 ± 5.30
DMI** g/kg W $^{0.75}$	83.94 ^{a}± 1.08	81.54 ^{a}± 1.46	97.84 ^{b}± 4.41
DCPI** g/kg W $^{0.75}$	5.07 ^{a}± 0.07	5.32 ^{a}±0.13	6.79 ^{b}± 0.02
TDNI** g/kg W $^{0.75}$	43.19 ^{a}± 0.53	44.19 ^{a} ± 1.12	60.32 ^{b} ±1.90
MEI** MJ / kg W $^{0.75}$	0.65 ^{a}±0.01	0.67 ^{a}±0.02	0.91 ^{b}±0.03

Means bearing different superscripts in a row differ significantly * P<0.05, ** P<0.01

Table 65. Comparison of nutrient intakes with ICAR (1985) feeding standards

Group	BW (kg)	DM (kg)	CP (g)	DCP (g)	TDN (kg)	ME MJ
Gp I	569.00	9.77	1.15	0.59	5.03	75.75
Gp II	597.00	9.84	1.22	0.64	5.33	80.35
Gp III	579.25	11.57	1.39	0.80	7.12	107.21
Average	581.75	10.39	1.25	0.68	5.83	87.77
ICAR (1985)	550	16.25		0.656	7.25	-
	600	17.5		0.688	8.125	-

AN-5.Project :Enhancing nutrient utilization and reducing methane emission

Project Leader : A.K. Nagpal

Associates: S.D. Sena, U. K. Bissa, N. Sharma and N.V. Patil

In-vitro fermentation studies of seven feeds and fodders (guar *phalgati*, groundnut haulms, bajra grains, guar *churi* and three complete feed block rations CFB 1, 2 and 3) was done. The rumen liquor was collected with the help of stomach tube from 4 years old camel calf maintained on guar phlagati. The strained rumen liquor was brought to the laboratory in pre-warmed and carbon dioxide pre-gassed thermos flask and processed (Fig. 84 and 85). Total gas was measured by 24 hours incubation of each feed ingredient (0.5g) in 100 ml glass bottles. The pH, IVDMD,VFA, NH3, total-N and protozoa count were also estimated. Maximum gas production was observed in case of Bajra grain. Gas production varied between 94 to 97 ml in case of guar *phalgati*, groundnut hualms and guar *churi*. Gas production was lower in CFB 1 and increased to CFB 2 and was maximum in CFB 3. The pH was higher in guar phalgati and GN haulms and lower in Bajra and Guar churi (Table 66 and 67). The present study indicated that the basic characteristic of a feed in term of gas production and other parameters is unique, thus selection of a feedstuff on the basis of these parameters appears to be a logical proposition for future studies.

Fig. 84 : Processing of rumen liquor

Fig. 85 : Incubation of feed/ fodder samples

Table 66: *In vitro* fermentation studies of some camel feeds and fodders

Feeds	3 hr	6 hr	12 hr	18 hr	24 hr	Total gas ml/0.5 g sample	pH
Guar phalgati	18.50	13.50	22.50	27.50	14.30	97.00	6.59
GN haulms	18.25	15.00	22.00	28.50	10.25	94.00	6.58
Bajra	16.70	13.30	22.00	29.50	22.20	103.70	6.41
Guar churi	16.75	15.75	21.25	22.75	18.50	95.00	6.42
CFB 1	12.00	11.00	20.50	18.50	10.00	72.00	6.54
CFB 2	15.50	12.00	22.00	23.50	7.00	80.00	6.52
CFB 3	15.75	15.00	21.50	24.75	8.00	85.00	6.50

Table 67 :*In vitro* fermentation studies of some camel feeds and fodders

Feeds	Gas production ml /1 g/ 24 hr	IVDMD %	VFA mmol/dl	Ammonia mg/dl	Protozoa *10^5
Guar *phalgati*	193.6	76.00	7.37	18.50	17.78
GN haulms	188.0	64.86	8.00	18.50	13.89
Bajra	207.0	77.33	8.20	14.24	10.38
Guar *churi*	188.2	92.87	8.97	31.62	7.78
CFB1	143.4	69.69	8.2	19.92	7.78
CFB2	159.6	67.80	7.0	18.09	6.67
CFB3	169.6	65.22	8.35	22.02	10.00

Inter Institutional Project : National

AICRP :Improvement of feed resources and nutrient utilization in raising animal production

Project Leader: N. Saini

Associates: S. Vyas, B. D. Kiradoo and D. L. Bohra

Effect of strategic supplementation on reproductive performance in female camels : Under existing practice in the villages, no supplementary feed and mineral mixture is given to the camels. Some farmers, however adopt the practice of giving some grains (Guar/Bajra /Dal) in addition to basal feed to their camels with a view to provide energy for better calf and to reduce reproductive problems. Guar grains are generally preferred over Bajra grains (Table 68).

Eight camels at 10 months of pregnancy were divided into two groups of four camels each. Camels of group I were offered Guar *korma* (500 gm) and *ad-lib* groundnut haulms according to prevalent practice at villages. While group II camels were fed total mixed ration (80 ground nut haulm:20 bajra: 1part salt and 1 part ASMM) of 10 % CP and 65 % TDN. ME intake in group I was 12 % less than the requirement. In group II it was adequate (17.64 Mcal/d) to meet the energy demand

of pregnant camels (Table 69). Camels in group I gained 0.94 kg body weight per day (Table 69 and Fig. 85). The body weight gain in group II was higher (1.36kg/day) due to significantly higher intake of protein and energy (Table 70). Similarly, body weight of calves were higher in group II (41.35±1.94 vs. 32.40±3.93) compared to group I. Cost of feeding in respective groups was 51.00 and 63.6`/d. But calculated feed cost/kg gain was comparatively lower in group II (46.69) than group I (54.36). Total protein, glucose, Ca, P and Mg were also estimated in the serum of pregnant camels (Table 71).Thus, strategic supplementation of Bajra grain plus ASMM in diet of late pregnant was beneficial than feeding of guar *korma*.

Table 68:- Chemical composition of experimental feed

Percent value	G.N haulms	Guar korma (Cluster bean grain)	Bajra (Pearl millet grain)
OM	89.04	83.38	84.18
CP	9.64	32.00	12.54
CF	27.6	13.04	2.68
EE	1.34	5.08	14.30
Total ash	10.96	16.62	15.82
NEF	50.46	33.26	54.66
TDN	60	70	90

Table 69: Growth during pregnancy, loss in body weight of pregnant camels on calving & birth weight of calves of experimental camels

Parameter s	T1	T2
Pregnant camels body weight		
Initial Body wt. (kg)	524.90±40.53	544.50±36.22
Final Body wt. (kg)	570.04±43.21	605.62±30.72
Total gain (kg)	84.65±15.31	122.83±7.75
ADG (kg/d)	0.94±0.17	1.36±0.86
Performance of Dam at calving		
Body wt. before calving (kg)	611.05±48.43	672.45±35.24
Body wt. after calving (kg)	570±45.37	629.55±31.14
Loss (kg)	41.05±6.23	42.90±8.25
% loss in body weight	6.70±0.77	6.31±1.13
Placenta Wt.	7.5±2.50	10.25±0.25
Body wt. of new calves (kg)	32.40±3.93	41.35±1.94

Table 70 :Daily intakes of nutrients by camels during experimental period

Parameters	T1	T2
Mean body wt.	594.06±45.27	637.17±30.83
$W^{0.75}$body wt.	120.12±6.92	126.74±4.55
DMI		
% body wt.	2.09±0.22	2.01±0.10
Kg/d	12.16±0.35	12.75±0.18
g/kg $W^{0.75}$	103.81±9.08	101.02±3.97
CP intake		
g/d	1182.14±34.84[a]	1344.28±19.40[b]
g/kg $W^{0.75}$	9.99±0.88	10.64±0.41
TDN		
kg/d	7.29±0.21[a]	8.29±0.11[b]
g/kg $W^{0.75}$	61.68±5.44	65.66±2.58
ME		
Mcal	14.88±0.43[a]	19.64±0.28[b]
kcal/kg $W^{0.75}$	125.84±11.11	155.62±6.11

Superscript differ significantly P<0.05

Table 71 : Serum constitutes (Mean± SE) at different months of pregnancy during experimental period

Parameters	Month 10	Month 11	Month 12
Total protein (g/dl)			
T1	6.35±0.36	6.60±0.28	6.74±0.27
T2	6.15±0.11	6.85±0.10	7.32±0.20
Glucose (g/dl)			
T1	89.00±6.01	110.20±4.02	107.25±4.44
T2	85.41±1.15	110.48±5.67	101.73±7.25
Ca(mg/dl)			
T1	7.02±0.38	6.16±0.26	7.17±0.11
T2	7.08±0.10	6.85±0.25	7.58±0.25
P(mg/dl)			
T1	5.39±0.29	4.77±0.39	4.27±0.12
T2	4.45±0.50	4.27±0.37	4.03±0.25
Mg(mg/dl)			
T1	3.19±0.24	3.13±0.28[a]	3.14±0.24
T2	3.68±0.05	3.54±0.19[b]	3.37±0.22

Strategic supplementation of limiting nutrients to grazing camels with locally available feed resources and area specific mineral mixture : Most of camel keepers (56%) in Himtasar and Gadwala village know the importance of mineral supplements and its benefits to camels. Some indicating signs of mineral deficiency, which were observed by camel keepers, were restlessness (3.63%), chewing wood material (18.27%), chewing bones (45.5%), licking of soil (27.7%), licking of urine (4.54%) and dullness & reduced appetite (10 %).

Twenty respondent's perception about the effect of mineral supplementation on performance of camel

was recorded. 27% respondents found it better for good appetite and health, 22% respondents perceived it good for smooth and shiny hair coat while 9% respondent's perception was for better calf growth and better body condition.

Eight camels of same age (2.5-3 year) and body weight (412.65±10.16) were selected in Himtasar villages to observe the effect of strategic supplementation of limiting nutrients and ASMM. Four camels were kept exclusively on grazing and another 4 camels were fed 500 g locally available grains (Bajra: guar) with ASMM in addition to grazing. Body weight and biometrical parameters over 53 days study period have been presented in Table 72 and 73.

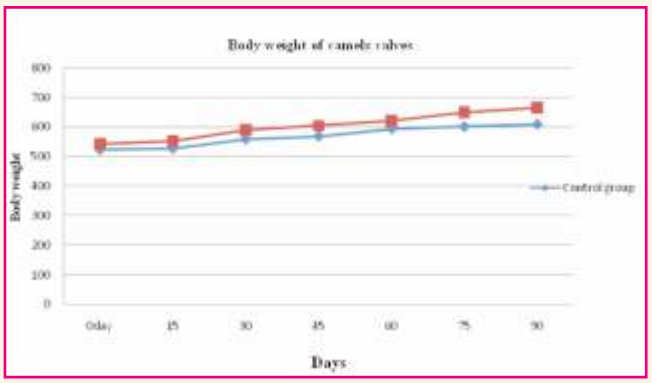


Fig. 86 : Body weight of camels calves under two different feeding systems

Table 72 : Body weight of calves

Over 53 days (kg)	T1	T2
Initial body weight	407.5±12.50	406.25±17.7
Final body weight	414.75±12.25	419.25±18.04
Total gain*	7.25±0.47[a]	13±0.81[b]
Gain/day*	0.13±0.009[a]	0.24±0.015[b]

Table 73 : Biometrical parameters before and after experiment

	HG	HW	BL
Before experiment			
T1	194.12±1.91	195.72±2.49	132.32±3.25
T2	194.10±2.03	195.35±2.56	134.27±3.07
After experiment			
T1	196.52±1.77	197.50±2.56	133.67±3.45
T2	197.97±1.46	200.00±1.97	136.42±2.93

Significant effect (P<0.05%) of strategic supplementation was observed on total gain (kg) and average gain per day in supplemented groups than grazing alone. Blood and hair samples were analysed for minerals and presented in Table 74 and 75.Total protein and Mg level were significantly higher in GR II compared to GR I.

Table 74. Blood bio chemical profile of experimental camels

Parameters	Feeding system	
	Grazing	Grazing+ concentrate
Total protein (g/dl)	5.20±0.18	5.65±0.27
Albumin (g/dl)	2.32±0.13	2.42±0.14
Globulin (g/dl)	2.97±0.10	3.10±0.27
Urea (mg/dl)	89.92±1.97	85.75±2.04
Minerals		
Ca	8.40±0.31	8.45±0.50
P	4.47±0.42	4.70±0.20
Mg	2.57±0.25	3.17±0.15
Mn	1.00±0.43	1.07±0.06
Zn	1.17±0.10	1.11±0.09
Cu	0.88±0.05	0.87±0.02

Table 75. Hair minerals status of treatment groups

Par ameters	Feeding system	
	Grazing	Grazing+ concentrate
Ca	407.00±31.39	468.75±20.18
Fe	199.57±6.21	239.16±24.16
Mn	15.97±2.25	17.15±1.11
Zn	48.44±3.64	48.44±2.11
Cu	5.97±0.49	6.51±0.73

HERBAGE AVAILABILITY IN AREA NUMBER 2 AND 5 OF NRCC

Fig. 87 : Plant Availability Area No. 2

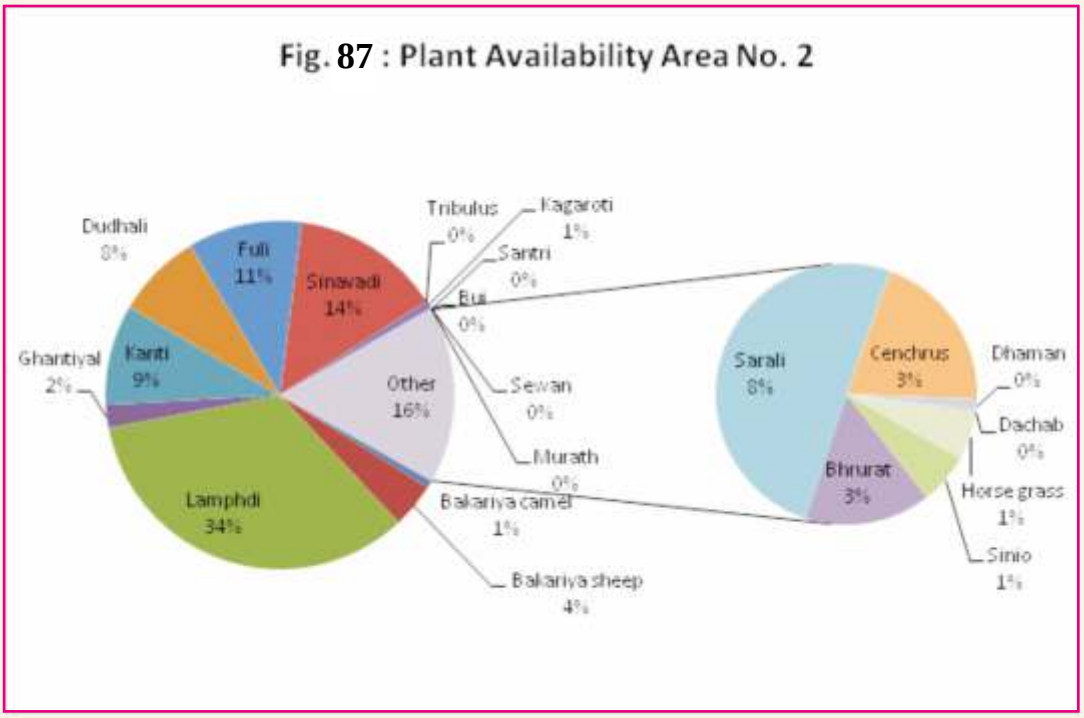


Fig. 88 : Edible Plants in Area No 2

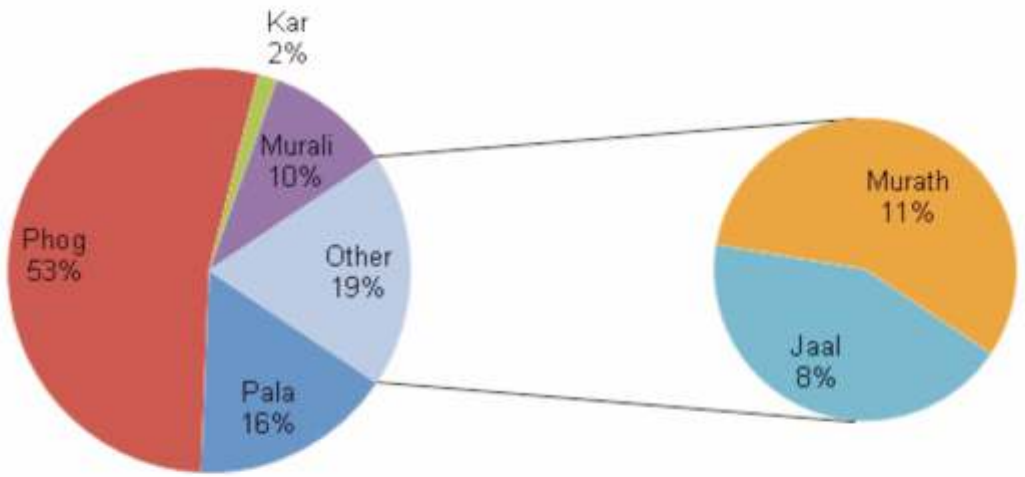


Fig. 89 : Non-edible Plants in Area No. 2

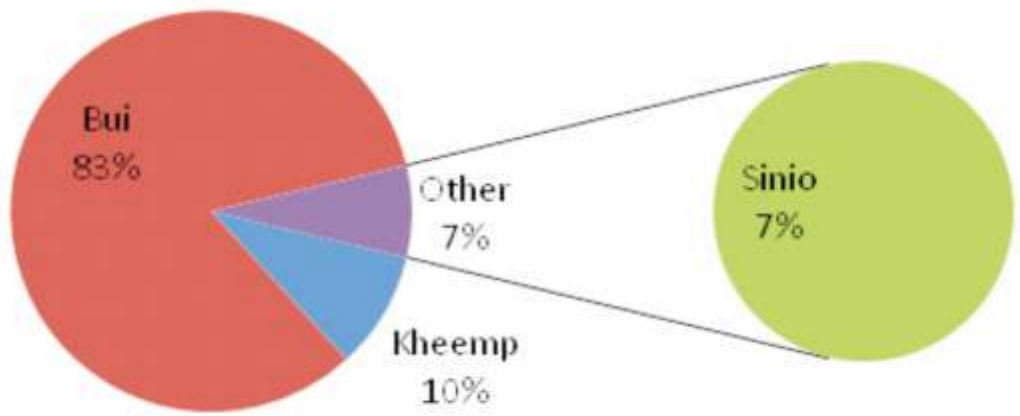


Fig. 90 : Plant Availability Area No 5

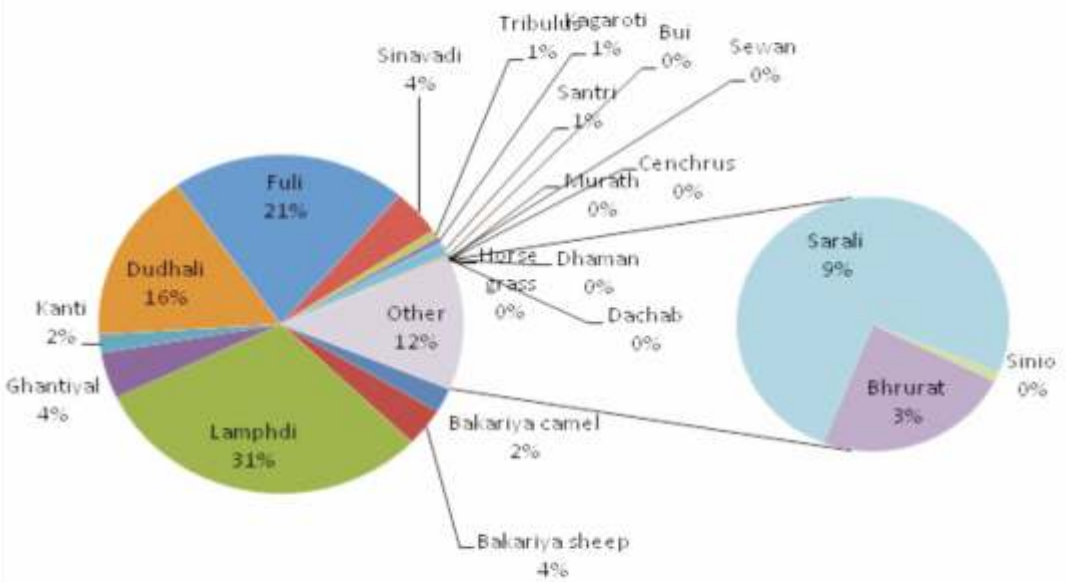


Fig. 91 : Edible plants in Area No. 5

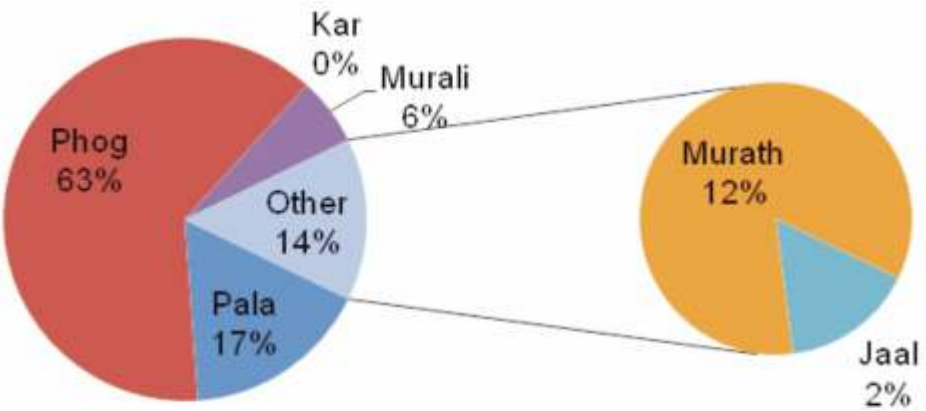


Fig. 92 : Non-edible Plants in Area No. 5

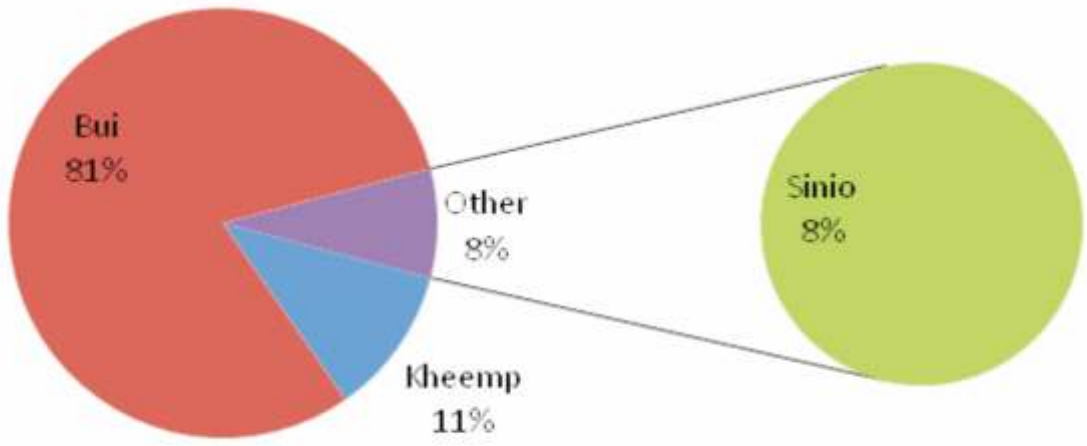


Fig.93: Average bite in a single boluse of different vegitation

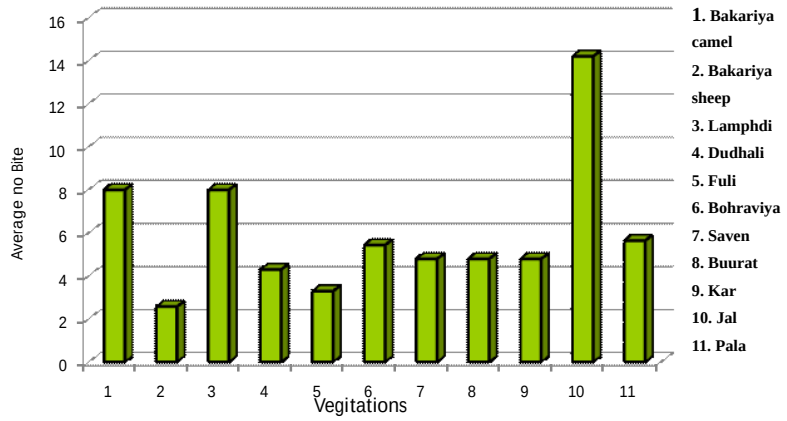
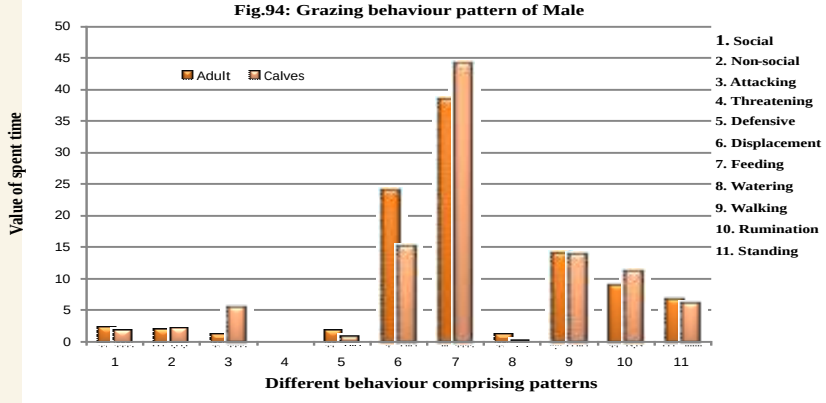


Fig.94: Grazing behaviour pattern of Male



Network Project. Veterinary type culture - rumen microbes

Project Leader : A.K. Nagpal

Associates : F. C.Tuteja, D.S. Sena & N.V. Patil

Rumen fluid from growing camel was collected with the help of stomach tube (Fig. 95) and cellulose media plates were streaked with loopful of inoculum of diluted rumen fluid. Twelve colonies of cellulolytic rumen bacteria wereisolated and purified. Identification was based on morphological methods (Table 76 and 77). All 12 isolates gave positive test for gas production (Fig. 97). DNA isolation of 5 cellulolytic bacterial isolates was done but the yield was low. Application for fistulation of 4 adult female camels was submitted to Institute Animal Ethics Committee (IAEC) in September, 2010. The recommendations of the IAEC were sent to CPCSEA, New Delhi for seeking its permission. The permission is awaited.

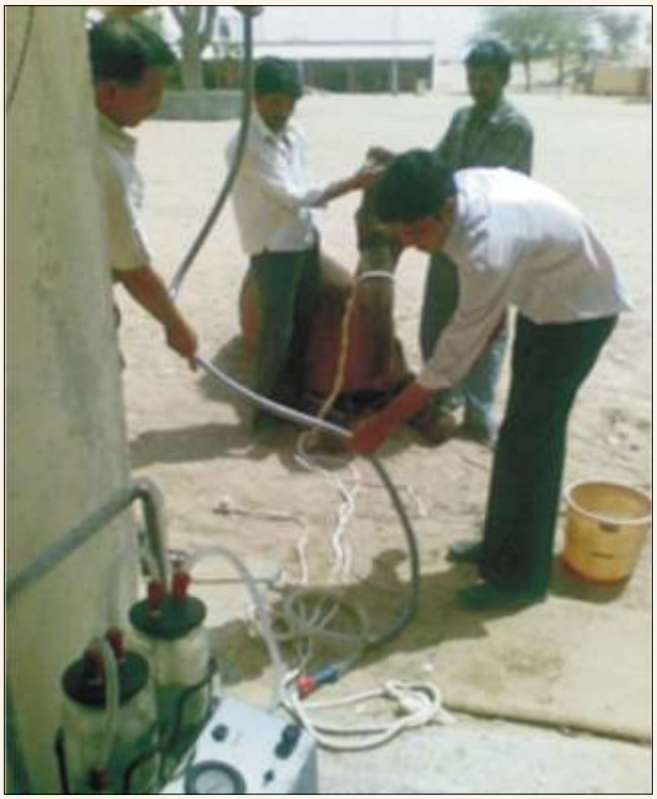
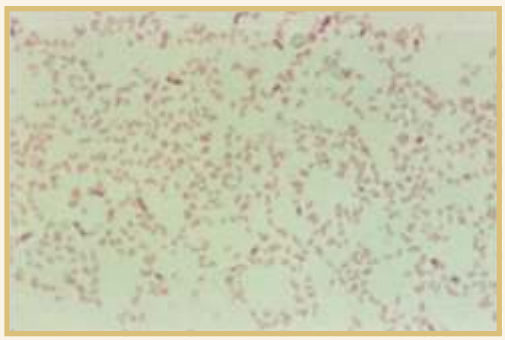
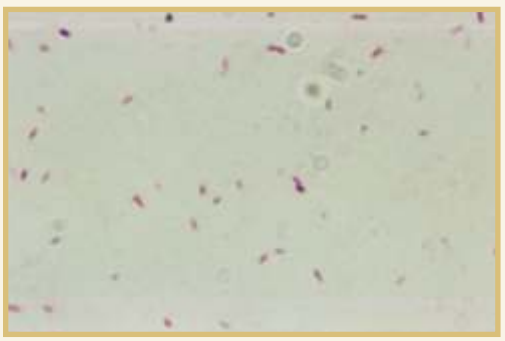


Fig. 95 :Collection of rumen fluid by stomach tube

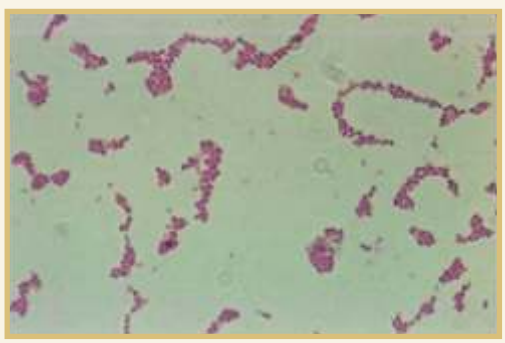
Microscopic x100 photographs of anaerobic cellulolytic bacterial isolates (Gram stain)



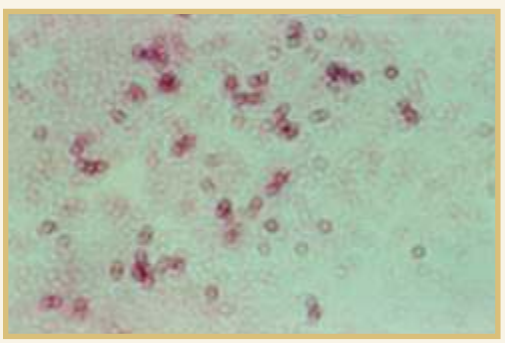
Rumen bacteria-1



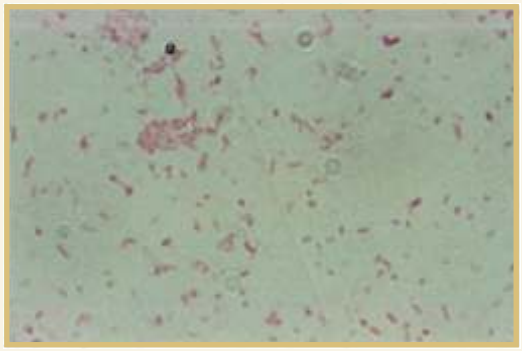
Rumen bacteria-2



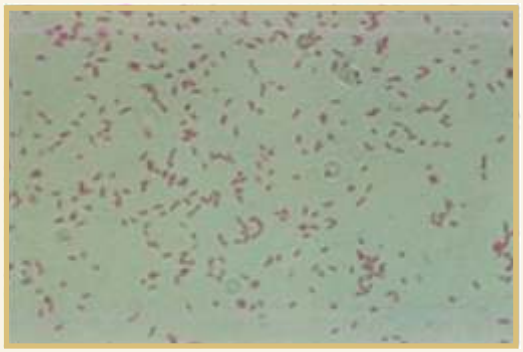
Rumen bacteria-3



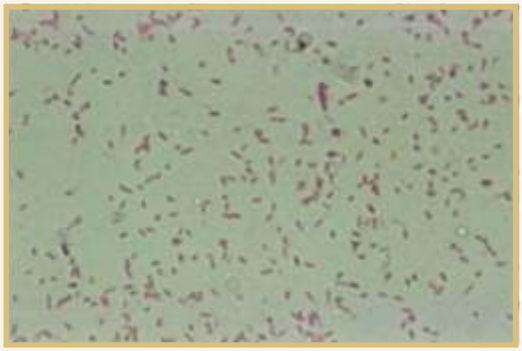
Rumen bacteria-4



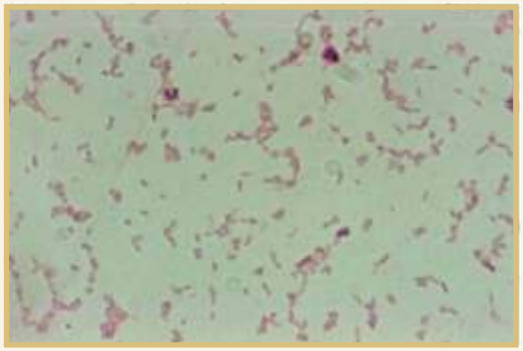
Rumen bacteria-5



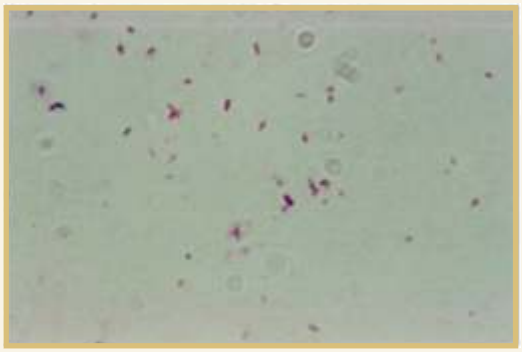
Rumen bacteria-6



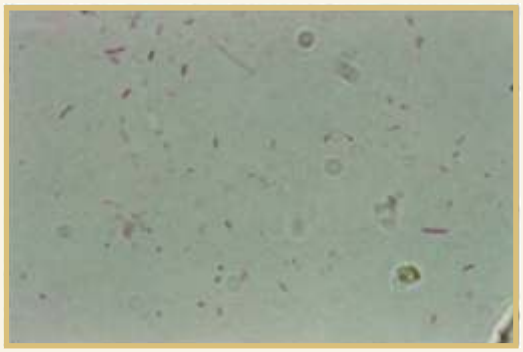
Rumen bacteria-7



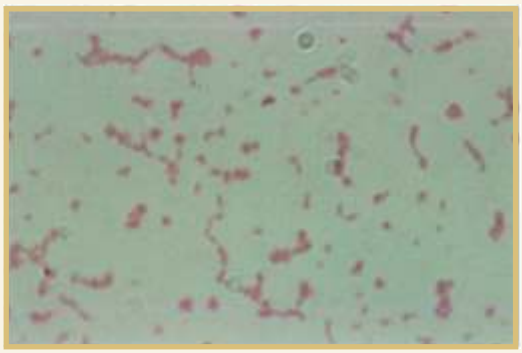
Rumen bacteria-8



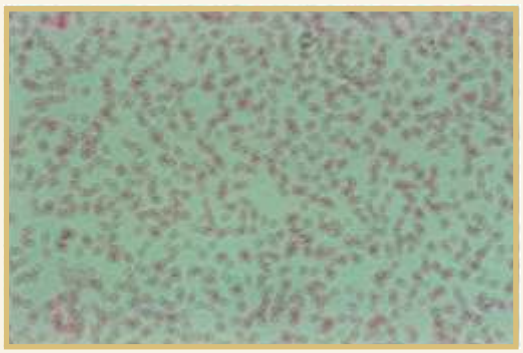
Rumen bacteria-9



Rumen bacteria-10



Rumen bacteria-11



Rumen bacteria-12

Fig. 96 :Anaerobic cellulolytic rumen bacteria

Table 76. Colony Morphology of rumen bacteria isolates

Culture No.	Shape	Color	Surface	Edge	Size
1	Round	Creamish	Mucoid	Smooth	Strap like
2	Round	Creamish	mucoid	Smooth	Pin head
3	Round	Creamish	glistening	Smooth	Pin head
4	Round	Creamish	Mucoid	Smooth	Smaller than pin head
5	Round	Creamish	Glistening	Smooth	1-2 mm
6	Round	Creamish	mucoid	Smooth	Pin head
7	Round	Creamish	Glistening	Smooth	Dot like
8	Round	Creamish	Mucoid	Smooth	1-2 mm
9	Round	Creamish	Mucoid	Smooth	Dot like
10	Round	Creamish	Mucoid	Smooth	2-3 mm
11	Round	Yellow	Mucoid	Smooth	1-2 mm
12	Circular	Creamish	Glistening	Smooth	Pin point

Table 77. Morphology of bacterial cell isolates and their motility

Culture No.	Shape	Size (µ)	Gram stain	Motility test
1	Short rods (Bacillus)	<0.5	Negative	Positive
2	Short rods in chains (Streptococcus)	<0.5	Negative	Positive
3	Short rods in clusters (Staphylococcus)	About 0.5	Positive	Negative
4	Spherical	<0.5	Negative	Positive
5	Spherical	<0.5	Positive	Positive
6	Spherical in chains	<0.5	Negative	Positive
7	Spherical in chains	<0.5	Negative	Positive
8	Short rods in chains (Streptococcus)	<0.5	Negative	Positive
9	Short rods (Bacillus)	<0.5		Positive
10	Spherical in chains (Streptococcus)	<0.5	Positive	Positive
11	Spherical in diplo, tetrads and in chains (Streptococcus)	0.5-1.0	Positive	Positive
12	Spherical in clusters (Staphylococcus)	<0.5	Positive	Positive

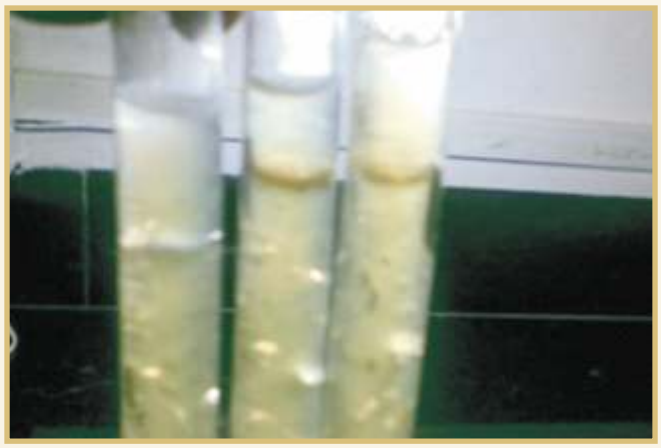


Fig.97 : Gas production by bacteria isolates

NAIP: Bio-prospecting of genes and allele mining for abiotic stress tolerance

Project Leader: G. Nagarajan

Associate : S. S. Dahiya and S. C. Mehta

Data on biochemical, physiological and haematological parameters of dromedaries at different weather conditions are being recorded. Amplification of HSP70 gene of *Camelus dromedaries* was carried out (Fig.98)

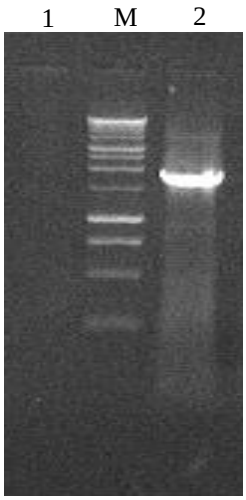


Fig.98 : Amplification of HSP70 gene of camel

M- Marker, 1- Negative control, 2- PCR amplification with cattle HSP70 gene specific primers from blood genomic DNA

Project: Identification, characterization and structural studies of proteins from camel milk

Sub-project: Structural studies of camel peptidoglycan recognition protein-S and its complex with a peptidoglycan moiety

Sub-project leaders: N.V Patil and P. Singh, AIIMS, New Delhi

Associates : G. Mal and P. Sharma, S. Sharma, P. Kaur, A. Srinivasan, AIIMS, New Delhi

Peptidoglycan recognition proteins (PGRPs) of the innate immune system provide the first line of defense against infecting bacteria. These proteins specifically recognize various peptidoglycans (PGNs) which are the major components of the bacterial cell walls and represent an excellent target for innate immune recognition. PGNs are polymers of alternating N-acetyl-glucosamine (GlcNAc) and N-acetyl-muramic acid (MurNAc) in a β (1-4) linkage, cross linked by short peptide stems composed of alternating L- and D- amino acids. The glycan moiety of PGN is conserved among almost all the bacteria but the peptide part displays a considerable diversity. According to the residue at number three position of the peptide stem, PGNs are divided into two major categories- Lysine type (Lys-type) and meso-diaminopimelic acid type (Dap-type). Peptidoglycan or its fragments are recognized by the host causing many biological effects, including inflammation, accumulation of pus, arthritis, fever, sleepiness, decreased appetite, hypotension, leukocytosis, thrombocytopenia, toxicity to tracheal epithelial cells leading to the enhancement of immune responses. A combination of peptidoglycan and lipoteichoic acid induces

shock and multiple organ failure. Most of these effects are induced indirectly by stimulation of the production of various mediators, such as cytokines and chemokines. The pattern recognition receptors (PRRs) are the integral part of the innate immune system, which bind unique products of the microbial metabolism not produced by hosts. A number of PRRs have been known to interact with PGNs, including CD14, nucleotide binding oligomerization domains (NODs) and PGRPs.

PGRPs are highly conserved molecules and bind to PGN with high affinity and are the important members of the host defense against all the bacterial infections. Till date crystal structures of small form of PGRP, *Drosophila* PGRP-SA, human PGRP-S and camel PGRP-S in their unliganded forms have been reported, showing that the overall conformation of the putative PGN-binding site is maintained across the PGRP family. To understand the molecular basis for PGN recognition by PGRPs, information on PGRPPGN interactions in the binding site is required. Hence we present here the first crystal structure of camel PGRP-S (CPGRP-S) in complex with muramyl dipeptide (MDP) (representing the conserved core of all types of PGNs) determined at 2.5Å resolution. The use of such small fragment is necessitated by the polymeric structure of PGN, which renders this large, heterogeneous molecule unsuitable for crystallization with PGRPs in its native form. Moreover the significant decrease in the levels of the pro-inflammatory cytokines like TNF-α and IL-6 in the MDP augmented PBMCs proved its excellent therapeutic potential in various diseased conditions of infectious origin.

Purification CPGRP-S was isolated from fresh camel milk obtained from National Research Center on Camels, Bikaner, India and purified to homogeneity. The purity of the protein was checked on sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE) and matrix assisted laser desorption /ionization- time of flight (MALDI-TOF).

Antibacterial Activity Assay The inhibition ofbacterial growth was assessed by suspension assay in the absence and presence of MDP. *S.aureus* were grown to mid-log phase in 1X-TSB (3% wt/vol; 0.5% NaCl) at 37°C. 10µl aliquots of the cells were added to 2ml TSB. The purified CPGRP-S was added to a final concentration of 25 µg/ml either alone or supplemented with 100 µg/ml MDP or LPS (Sigma Aldrich). The tubes were shaken at 300 rpm for 5 hours. The bacterial growth was monitored by measuring the optical density (O.D.) at 600 nm at 1 hour interval. To minimize the effect of bacterial aggregation on O. D., the cell suspensions were stirred for one minute before each measurement.

Crystallization - CPGRP-S was crystallized at room temperature using hanging drop vapor diffusion against 2 ml of reservoir solution containing 10% PEG3350, 200 mM sodium potassium tartarate in Tris-HCl buffer (pH 7.5). In all the crystallization setups, 4 µL of protein solution at a concentration of 12 mg/ml was mixed with 4 µL of reservoir solution. Crystals were soaked in the reservoir solution containing MDP at a concentration of 12 mg/ml for 24 hours before they were flash cooled in liquid nitrogen after soaking them for 30 seconds in the cryo-protection solution consisting of 20% glycerol (v/v) in the reservoir solution.

X-ray Intensity Data Collection - X-ray intensity data were collected on a crystal that diffracted to 2.5Å resolution at Department of Biotechnology (DBT), India sponsored beamline BM14 at European Synchrotron Radiation Facility (ESRF), Grenoble, France. In order to minimize the radiation damage, the crystal was mounted in the nylon loops and kept at 100K in liquid nitrogen

stream during the measurements. The data were indexed, integrated, scaled and merged using HKL2000 package. The crystals belong to orthorhombic space group I222 with unit cell dimensions of a = 87.1, b = 102.0, c = 161.6 with four molecules in the asymmetric unit of the crystal unit cell.

Structure Determination and refinement - The structure of complex of CPGRP-S with MDP (CPGRP-S-MDP) was determined by molecular replacement method using the program AMoRE from the CCP4 suite by using native PGRP structure (PDB: 3C2X) coordinates as the search model. The model was subjected to several rounds of simulated annealing/positional refinement followed by B-factor refinement in CNS. The model building was performed using the program O using the silicon graphics workstation O_2. The positions of water oxygen atoms were determined using difference Fourier (Fo-Fc) map on the basis of peak height and distance criteria. The water molecules whose thermal B-factors were 50Å^2 or above were removed from the refinement. The atomic model of PGN was built into a strong and characteristic electron density that was found in the binding cleft at the interface of molecules C and D. The final cycle of refinement using REFMAC resulted in the R_{cryst} and R_{free} values of 0.236 and 0.249 respectively. There were no non-glycine residues in the disallowed regions of the Ramachandran plot which was obtained by using the program PROCHECK. The structure of CPGRP-S complexed with PGN is shown in Figure 96. This shows that CPGRP-S binds to PGN with high affinity and destroys bacteria by sequestering it completely.

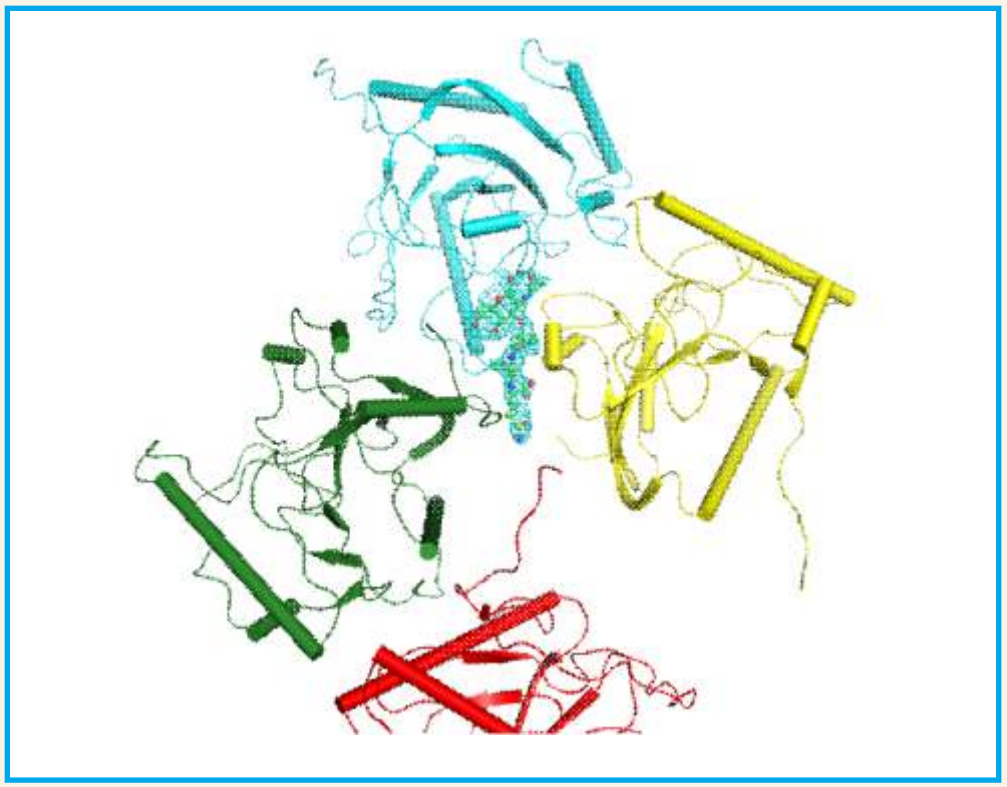


Figure 99: PGN is shown in the binding groove along with electron density map of PGN contoured at 2.5σ (Fo-Fc)

Inter-Institutional Projects : International

Project : Molecular genotyping of Sudanese camel types

Research Scientist (Sudan) :Wathig H. Mohamed

Principal Investigator (India) : S.C. Mehta

Principal Investigator (Sudan) :Galal M. Yousif

Microsatellite profiling of Sudanese camel types :The microsatellite genotyping of 17 types and sub types of Sudanese camel was carried out on automated DNA sequencer ABI 3730 (Applied Biosystems) at 25 polymorphic loci. The PCR amplifications were carried out using AmpliTaq Gold Kit using 50 ng template, 1X PCR buffer, 5pmol each of forward and reverse primers, 2.0 mM $MgCl_2$ in 15 µl total reaction volume. The PCR amplification program comprised initial denaturation at 95°C for 5 min followed by 35 cycles of denaturation at 94°C for 45sec, annealing at 55°C for 45sec and extension at 72°C for 1min final extension was carried out at 72°C for 10 min.

Genic diversity among Sudanese dromedary breeds : The microsatellite statistics was derived by utilizing GeneClass2 software. In Sudanese populations the mean number of alleles ranged from 3.72 to 7.04, mean heterozygosity ranged from 0.516 to 0.689 and Nei's genic diversity ranged from 0.619 to 0.745.

Existence of population structure : Utilizing GenepopV4, the Hardy-Weinberg exact probability test using Markov chain algorithm was performed. Most of the populations having less number of samples were not in Hardy Weinberg equilibrium at most of the loci. However, some of the populations having enough sample size showed existence of population structure at most loci.

Genetic distance and phylogenetic tree : Phylip 3.6 was utilized for calculating the genetic distance among Sudanese camel types. Nei's distance (Ds), Cavalli-Sforza Chord distance (Dc) and Reynold's distance (Fst) were calculated. The phylogenetic tree was constructed from all the three measures of the genetic distance using the UPGMA method of clustering by DRAWGRAM program of PHYLIP package (Fig 100).

Individual assignment : The individual assignment and detection of first generation migrants was done utilizing the GeneClass 2 software. Using Rannala and Mountain (1997) algorithm 45.9% individuals were correctly assigned and the quality index was 44.10%.

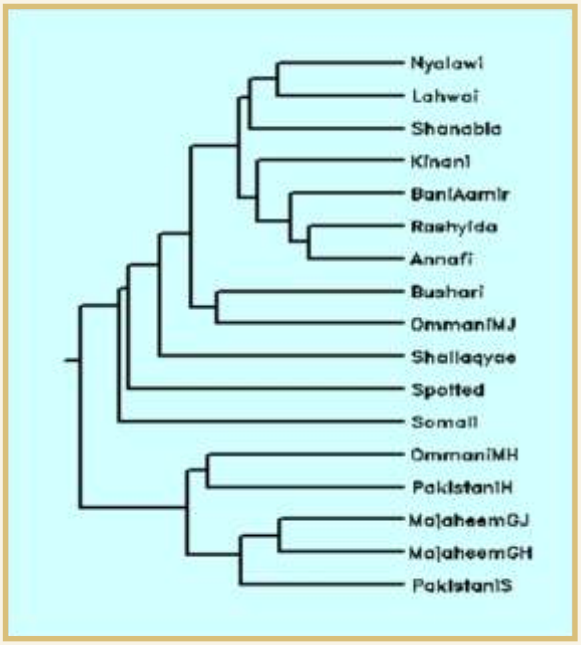


Fig. 100 : Phylogenetic relationship among Sudanese camel types and sub-types

M. V. Sc. Thesis

Title: Use of ultrasonography to study the effect of melatonin implants on female camel reproduction

Student: Dr S. Dholpuria,

Department of Animal Reproduction, Gynaecology and Obstetrics, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner

Major Advisor: G. N. Purohit

Co-Advisor: Sumant Vyas

Abstract

Lactating healthy she camels (n=12) were selected and divided into 2 groups i. e. treatment group (T) (n=6) in which melatonin implants were introduced subcutaneously, and untreated control group (C) (n=6). The ovarian activity and fertility in female camel with augmented reproduction was observed and analysed by ultrasonography, reproductive behaviour, progesterone assay and VER recordings. Early diagnosis of pregnancy was also done using ultrasonography.

The ultrasonographic examination of ovaries in treated she camels (n=6) revealed the appearance of follicular growth onset within a week of treatment as 'black periphery' in 83.3% (5/6) of treated camels by day 7 and in 100% (6/6) camels by day 14.

By the end of the 7th week post treatment, 83.33% (5/6) of treated camels evidenced the presence of mature follicle, capable of ovulation. All the treated camels were mated when the mature follicle (=10 mm) was visible on the ovaries. In treated camels, mature follicle was 60% of the times (3/5) on the right ovary and 40% (2/5) of the times on the left ovary. The follicular size at the time of mating ranged from 10.2 to 13mm and ovulation occurred in all the she camels mated to a male camel.

In the control group 'black periphery' was observed in one ovary in 50% (3/6) camels K 101, K 455 and J 223, and in both ovaries in 16.6% (1/6) camels (J 77) by 2nd week. Small follicle (=5mm) was observed over the right ovary of 16.6% (1/6) camels (K 455) by the end of 7th week however, no female camel was observed to have a developing follicle (5-10mm) or mature (=10 mm) follicle up to 7th week.

The receptive behaviour was shown by she camel K 159 of treatment group and she camels B 455 and J 77 of control group, however, follicular activity was not observed in control camels. Five she camels (K 159, B 529, K 155, J113, B 425) in treatment group were mated to male camel by the end of 7th week post treatment.

The pregnancy diagnosis in she camels was done by tail cocking, ultrasonography and progesterone assay. The characteristic “cocking of tail” was observed in one she camel K 159 of treatment group after 20 days. Ultrasonographic examination in 5 she camels of treatment group was performed for early pregnancy diagnosis. The CL was present in she camels K 159 and J 113 on day-15 post mating. On day 25 post mating, the increased diameter of the non-echoic conceptus, fluid accumulation and the presence of embryo was also visible, while an overall increase in the diameter of conceptus due to rapid accumulation of foetal fluid was evident on day 45 post mating in she camel K 159. A clear division was also observed between the amniotic fluid and the much large volume of allantoic fluid, which was very clearly observed and further development of foetal head with a 23.6 mm diameter was visible at 60 days post mating.

The progesterone levels in she camels before mating (0-day) ranged from 0.28-0.69 ng/ml. On 15th day post mating, progesterone levels

in she camels J 113 and K 159 were found increased 1.51 ng/ml and 1.17 ng/ml, respectively and were considered pregnant. However the progesterone levels in she camels B 425, K 155 and B 529 showed decreased progesterone levels ranging from 0.54-0.96 ng/ml on 15th day and were found non-pregnant. On 30th day post mating the progesterone level in she camel J 113 was decreased to 0.517 ng/ml, which suggested the possibility of early embryonic death.

With the onset of breeding season, the she camels of the present study in which no follicular activity was observed till 7th week were further examined at weekly interval to observe the subsequent fertility during the breeding season.It was found that all the 6 (100%) she camels of treatment group and 2 (33.33%) out of 6 she camels (J 77, J 223) of control group were found pregnant at the end of breeding season (April 2010).

The vaginal electrical resistance (VER) in dromedary camel did not give significantly different values. The maximum and minimum temperature and time of sunset and sunrise were also recorded during the experiment.

It was concluded that subcutaneous melatonin implants during the non- breeding season can augment reproduction in the female camels and this also improves fertility of treated camels during the breeding season.

4. Technology Assessed and Transferred

Rasogolla: Pure camel milk, camel milk plus cow milk and camel milk plus buffalo milk in different ratios were boiled for 5 minutes and cooled to 76-80°C. Then 1% Citric acid was boiled and cooled to 70-74°C. It was then added to the milk. The coagulum was allowed to settle down and contents were hanged in muslin cloth to allow the whey to drainout. Manual kneading and ball formation of *Chhana* was done. 1-2% *Maida* was added in the *Chhana* to avoid cracks in the ball. *Chhana* balls were boiled in the sugar syrup for 20-25 minutes. *Chhana* balls were transferred to hot water for 10-15 minutes for texture stabilization and colour improvement. Finally, *Chhana* balls were put into the sugar syrup with rose essence. *Chhana* balls made from the pure camel milk developed cracks and could not be boiled due to loose binding. Similar types of observations were made with camel milk and cow milk used in 1.5:1 ratios. *Chhana* made from camel milk plus cow milk (1:1 ratio) and camel milk plus buffalo milk (1:1; 1.5:1 ratios) showed good binding.

Mini Feed Plant: A Mini Feed Plant to prepare different fodder and concentrate combination has been installed at the Centre. Now the researchers and camel owners have the privilege to get the feed prepared as per their requirement.

Camel Ambulatory Clinic : The Centre has started Camel Ambulatory Clinic to have the better interface with camel farmers and to give on the spot health services. Scientists of the Centre visit the villages thrice in a month.

Transfer of Technical Know-How : Attempts have been made to transfer the technical know-how generated out of the research work done at the Centre in different disciplines. Exhibitions were arranged and meetings were organized at the Centre as well in the villages. Trainings, especially for the preparation of camel milk products like flavored milk, tea, coffee and *kulfi*, were organized at the Centre. The knowledge sharing between national and international scientists and research executives was arranged through the interactive meetings in the camel museum and visitors' room of the Centre.

EXTENSION ACTIVITIES

5. Education, Training and Awards

International

1. Dr. (Mrs.) D. Suchitra Sena got an international training on molecular diagnostics in animal sciences under National Agricultural Innovation Project for three months duration at University of Minnesota, Minnesota, USA on the topic "Molecular detection and sequencing of pesti viruses" from April 17 to July 21, 2010.
2. Dr. Sumant Vyas attended an International training on "Assisted Reproductive Technologies for Livestock Genetic Improvement" at Livestock Research Institute, Council of Agriculture, Executive Yuan, Hsinua, Taiwan from October 24 to 29, 2010. Apart from NRCC and ICAR, it was partly sponsored by Asia-Pacific Consortium on Agricultural Biotechnology, Asia-Pacific Association of Agricultural Research Institutions, New Delhi and International Livestock Research Institute, Kenya.
3. Dr. Gorakh Mal got an international training under National Agricultural Innovation Project at Riddet Institute, Massey University, New Zealand in the area of nutraceuticals on the topic "Bioactivity of traditional ingredients and milk proteins" from January 17 to April 16, 2011.

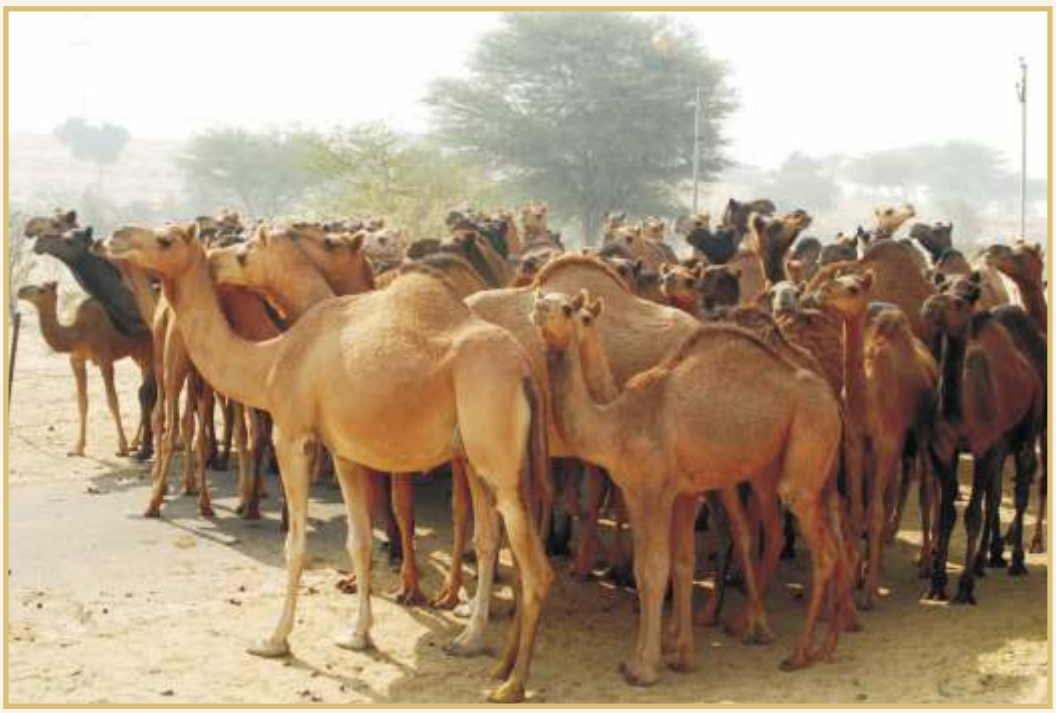
National

1. Dr. S. C. Mehta attended Orientation & Installation Training of SAS Software under NAIP project on "Strengthening Statistical Computing for NARS" organised by Maharana Pratap University of Agriculture and Technology, Udaipur from June 21 to 22, 2010.
2. Dr. Devendra Kumar participated in summer school on "Food Safety and Quality for Global Competitiveness of Traditional Foods of India" at Banaras Hindu University, Varanasi from September 15 to October 5, 2010.
3. Dr. S. S Dahiya, attended a training on "Patenting System in India (special emphasis on chemical and Biotech invention)" conducted by National Institute of Intellectual Property Management at Nagpur, Maharashtra from October 4 to 8, 2010.
4. Dr. U. K. Bissa attended FAO Regional Training Workshop on "*In-vivo* Conservation of Animal Genetic Resources" organized by NBAGR, Karnal held at Delhi, from October 28 to 30, 2010.
5. Dr. F. C. Tuteja attended a training course on Knowledge Management at Institute of Secretariat Training and Management, New Delhi from November 15 to 16, 2010.

6. Dr. S. D. Narnaware attended a training on Introduction to Intellectual Property Rights conducted by National Institute of Intellectual Property Management at Nagpur, Maharashtra from December 20 to 21, 2010.
7. Dr. G. Sivakumar attended a training on Introduction to Intellectual Property Rights conducted by National Institute of Intellectual Property Management at Nagpur, Maharashtra from December 20 to 21, 2010.
8. Dr. F. C. Tuteja attended a training on Intellectual Property Management at National Institute of Intellectual Property Management, Nagpur from December 22 to 23, 2010
9. Dr. (Mrs.) D. Suchitra Sena attended a training programme on GS-FLX high throughput pyro sequencing at Anand Agricultural University, Anand, Gujarat from January 17 to 22, 2011.

Awards

Dr. (Mrs.) D. Suchitra Sena received best oral presentation award at National symposium on "Recent developments in diagnostics and therapeutics including applications of nanotechnology in veterinary medicine" for the paper entitled "Clinical disorders as well as biochemical changes in dromedaries during different seasons" held at Bombay Veterinary College, Mumbai from February 17 to 19, 2011.



6. Linkages and Collaborations

National

Collaborative University/ Institute	Programme
• AIIMS, New Delhi	Identification characterization and structural studies of proteins from camel Milk
• Rajasthan University of Veterinary, and Animal Science, Bikaner	Research work of M.V.Sc. and Ph.D. students
• Maharaja Ganga Singh University, Bikaner	Research work of Ph.D. students
• Maharana Pratap University of Agriculture and Technology, Udaipur	Camel drawn implements and electrical generation.
• Sardar Patel Medical College, Bikaner	Development of anti-snake venom. Anti-wrinkling properties of camel milk cream based skin ointment.
• Bhabha Atomic Research Centre, Mumbai	Development of single domain antibodies (SDA) for *in vivo* diagnosis/ therapy
• Urmul Dairy, Bikaner	Marketing of camel milk
• Lokhit Pashupalan Sansthan, NGO at Sadri, Pali	Extension of camel husbandry practices

International

• APRI, Ministry of Agric. & Land Reclamation, NodiEi –Said St., Dokki Giza, Egypt	Training of Fawzy M. Abo-Donia, in Animal Nutrition Sponsored by C.V. Raman fellowship of FICCI and Govt. of India
• Tumbool Camel Research Centre, Animal Resources Research Corporation, Khartoum, Sudan	Training of Mr. Wathig Hashim Mohammed in Molecular Genetics
• University of Bari, Aldo Moro, Italy	Ph. D. Research Work of Dr. Davide Monaco in Camel Reproduction

VISITING SCIENTISTS & SCHOLARS AT THE CENTRE

Discussion with Davide Monaco of Italy

Farewell to Wathig Hashim Mohammed of Sudan

Presentation by Fawzy M. Abo-Donia of Egypt

Director and scientists with Fawzy M. Abo-Donia

7. List of Publications

Research Papers

1. Bhakat C, Saini N and Pathak K M L (2010). Influence of rearing system on performance of camel calves. *Indian Veterinary Journal*. 87 (9) : 902 - 904.
2. Bhakat C and Pathak K M L (2011). Important factors affecting sustainable livelihood of camel dairying in changing scenario of desert ecosystem. *Indian Journal of Animal Sciences.* 81 (1) : 48- 51.
3. Mal G, Bhakat C, Sena D S and Pathak K M L (2010). Effect of coagulants on preparation of camel milk paneer. *Journal of Camel Practice and Research*. 17(2): 1-4.
4. Mal G, Saini N, Sena D S, Vyas S and Pathak K M L (2011). Protein and mineral profiles in the seminal plasma of dromedary camels. *Indian Veterinary Journal*. 88(3): 82-83.
5. Nagpal A K, Bissa U K and Sharma N (2010). Comparative performance of male breeding camels on two different energy rations during rutting season. *Indian Journal of Animal Nutrition*. 27 (3): 235-239.
6. Nagpal A K (2010). Performance of breeding male camels fed sole dry moth fodder vis- a-vis complete feed blocks. *Indian Journal of Animal Sciences*. 80 (12) 1226-29.
7. Nagarajan G, Ghorui S K, Kumar S, Ashraf M, Dixit S K, Sena D S, Tuteja F C and Pathak K M L (2010). Incidence of contagious Ecthyma in Indian dromedaries, *Indian Veterinary Journal.* 87: 1146-1147.
8. Nagarajan G, Ghorui S K, Kumar S and Pathak K M L (2010). Complete nucleotide sequence of the envelope gene of pseudocowpox virus isolates from Indian dromedaries (*Camelus dromedarius*). *Archives of Virology.*155 :1725-1728.
9. Nagarajan G, Swami S K, Ghorui S K, Pathak K M L, Singh R K and Patil N V (2011). Cloning and phylogenetic analysis of Interleukin-6 (IL-6) and Tumor necrosis factor-α (TNF-α) from Indian dromedaries *(Camelus dromedarius). Comparative Immunology, Microbiology and Infectious Diseases*. 34 : 291-298.
10. Nagarajan G, Swami S K, Dahiya S S,Sivakumar G, Narnaware S D, Tuteja F C and Patil N V (2011). Sequence analysis of topoisomerase gene of pseudocowpox virus isolates from camels *(Camelus dromedarius). Virus Research.*158 : 277-280.
11. Patil N V, Mathur B K, Patel A K and Bohra R C (2010). Nutritional evaluation of Colophosp-ermum mopane as fodder. *Indian Veterinary*

Journal. 88 (1): 87-88.

12.Paul S S and Patil N V **(**2010). Energy and protein requirements to counter temperature and humidity stress in buffalo heifers. *Indian Veterinary Journal*. 87 (11) : 1121-1123.

13. Roy A K, Vyas S, Singh R, and Khanna N D. (2010). Effect of induced hyperglycemia on insulin secretion in *Camelus dromedarius*. *Indian Journal of Animal Sciences*. 80 (9): 867-868.

14.Roy A K and Tiwari G S (2010). Work performance of dromedary camels on multipurpose tool carrier. *Journal of Camel Practice and Research*. 17(2): 199-200

15.Rohilla P P, Patil N V and Bohra H C (2010). Effects of probiotics and nutri-mix supplementation on productivity of Marwari Goats. *Indian Veterinary Journal*. 87 (4) :367-369.

16. Saini N, Kiradoo B D, Lukha A K, Vyas S and Pathak K M L (2010). Effect of strategic supplement on milk yield and its composition, growth of calves and economics in dromedary camel - a farmer door study. *Journal of Camel Practice and Research*. 17(1): 67-72.

17. Saini N, Lukha A K, and Kiradoo B D (2010). Intake of minerals, milk yield and blood biochemical profile of lactating camels under traditional vs. semi intensive system. *Indian Journal of Animal Sciences*. 80 (7): 666-670.

18 Tuteja F C, Pathak K M L, Ghorui S K, Chirania B L and Kumar S (2010). Skin candidiasis in dromedary camel calves. *Journal of Camel Practice and Research*. 17:59-61.

19 Vyas S, Kishore N, Bissa U K and Mal G (2010). Serum progesterone analysis by commercially available EIA kits to monitor ovulation and conception in dromedary camels. *Journal of Camel Practice and Research*. 17(1): 79-83.

Papers presented in Conferences, Symposia and Seminars

1. Bhakat C and Ghorui S K (2010). Camel Management from birth to production. In Short Course on Camel Health and Management organised by the National Research Centre on Camel, Bikaner from April 19 to 28, 2010.

2. Kachhawaha S, Patil N V, Gahlot A K, Mathur, B K and Mathur, A C (2010) Diseases management and control in ruminants in arid region. In Feeding and Management of Livestock during Drought and Scarcity (Editors: N. V. Patil, B. K. Mathur, A. K. Patel, M. Patidar and A. C. Mathur), Scientific Publishers (India), Jodhpur, Rajasthan.

3. Mal G, Kumar D and Patil N V (2010). Effect of heat treatment on camel milk whey proteins during mid and late lactations. In National Symposium on Technology Management, Visioning and Up-scaling for Accelerating Livestock Production held at College of Veterinary Sciences, Khanapara, Guwahati from November 11 to 13, 2010.

4 Mal G, Kumar D and Patil N V (2010). Preparation of different indigenous products from camel milk.InNational Symposium on Technology Management, Visioning and Up-scaling for Accelerating Livestock Production held at College of Veterinary Sciences, Khanapara, Guwahati from November 11 to 13, 2010.

5. Mal G and Pathak K M L (2010). Camel milk and milk products. In SMVS Dairy Year Book 2010-11. Published by Serva Manav Vikas Samiti, Ghaziabad, U.P.

6. Mal G (2010). Value addition of camel milk and its products. In Short Course on Camel Health and Management organised by the National

Research Centre on Camel, Bikaner from April 19-28, 2010.

7. Mehta S C, Bissa U K, Patil N V and Pathak K M L (2011). Camel Milk : A Possible Tool to Sustain Dromedary *in situ*. Lead paper VIII Annual Convention of Society for Conservation of Domestic Animal Biodiversity and National Symposium on Animal Genetic Resources for Sustainable Livestock Sector in India organised by Orissa Livestock Resources Development Society and Society for Conservation of Domestic Animal Biodiversity at Bhubaneswar from February 18-19, 2011.

8. Mehta S C (2010). Molecular Genetic and Breeding Tools for the Improvement of Indian Dromedary Breeds. In Short Course on Camel Health and Management organised by the National Research Centre on Camel, Bikaner from April 19 to 28, 2010.

9. Narnaware S D, Kumar D, Kumar S and Ghorui S K (2010). An approach to post mortem in camels. In Short Course on Camel Health and Management organised by the National Research Centre on Camel, Bikaner from April 19 to 28, 2010.

10. Nagarajan G, Swami S K, Dahiya S S, Sivakumar G, Narnaware S D, Tuteja F C and Patil N V (2010). Amplification and cloning of schlafen-like protein gene of Indian Camelpox virus (CMLV) isolates. In International symposium on Role of biotechnology in conserving biodiversity and livestock development for food security and poverty alleviation and XVII Annual Convention of Indian Society of Veterinary Immunology and Biotechnology held at Bikaner from December 29 to 31, 2010.

11. Nagarajan G, Swami S K, Dahiya S S, Sivakumar G, Narnaware S D, Tuteja F C and Patil N V (2010). Amplification and cloning of the topoisomerase gene of pseudocowpoxvirus isolates from Indian dromedarian camel. In International symposium on Role of biotechnology in conserving biodiversity and livestock development for food security and poverty alleviation and XVII Annual Convention of Indian Society of Veterinary Immunology and Biotechnology held at Bikaner from December 29 to 31, 2010.

12. Nagpal A Kand Patil N V (2010). Nutrient utilization and serum biochemical profile of adult dromedary camels given oat straw alone and in combination with groundnut haulms. In 7th Biennial Animal Nutrition Association Conference held at College of Veterinary Science & Animal Husbandry, Orissa University of Agriculture and Technology Bhubneshwar from December 17 to 19, 2010.

13. Narnaware S D, Tuteja F C, Sivakumar G, Ghorui S K,Nagarajan G, Dahiya S S and Patil N V(2010). Aspergillus pneumonia in a dromedary camel (*Camelus dromedarius*). In proceedings of XXVII Annual conference of Indian Association of Veterinary Pathology held atCollege of Veterinary Science, Assam Agriculture University, Guwahati from November 25 to 27, 2010.

14. Patil N V and Patel A K (2010). Forage production and feeding plan for small ruminants during scarcity in drought prone region. In Climate Change and Stress Management: Sheep and Goat Production.Satish Publishing House, Delhi.

15 Patil N V and Singh J P (2010). Optimal utilization of feed resources for enhancing livestock productivity in arid region In 7th Biennial Animal Nutrition Association Conference held at College of Veterinary Science & Animal Husbandry, Orissa University of Agriculture and Technology

Bhubneshwar from December 17 to 19, 2010.

16. Saini N, Patil N V, Nagpal A K, Bohra D L and Kiradoo B D (2010). Biotechnological approach in nutritional studies. In International symposium on Role of biotechnology in conserving biodiversity and livestock development for food security and poverty alleviation and XVII Annual Convention of Indian Society of Veterinary Immunology and Biotechnology held at Bikaner from December 29 to31, 2010.
17. Sena D S, Verma R, Sharma N and Pathak K M L (2011). Molecular detection of tuberculosis in camel- a case report. In 11th Indian Veterinary Congress and 28th annual conference of IAAVR held at Jaipur from February 11-12, 2011.
18. Sena D S, Sharam N and Patil N V (2011). Clinical disorders as well as biochemical changes in dromedaries during different seasons. In National symposium on Recent developments in diagnostics and therapeutics including applications of nanotechnology in veterinary medicine held at Mumbai from February 17-19, 2011.
19. Sena D S and Patil N V (2010). Gut microbial diversity in dromedaries: future implications. In International symposium on Role of biotechnology in conserving biodiversity and livestock development for food security and poverty alleviation and XVII Annual Convention of Indian Society of Veterinary Immunology and Biotechnology held at Bikaner from December 29 to31, 2010.
20. Sharma N, Suchitra D S and Patil N V (2011). Tumba as a laxative in camel: a case study. In National symposium on Recent developments in diagnostics and therapeutics including applications of nanotechnology in veterinary medicine held at Mumbai from February 17-19, 2011.
21. Tuteja F C, Ghorui S K, Narnaware S D and Patil N V (2011). Cutaneous alterinariasis in dromedary camel. In 11th Indian Veterinary Congress and XVIII Annual Conference of IAAVR & National Symposium on Veterinary Science & Education on Move: Critical Gaps & Needs held at Apollo College of Veterinary Medicine, Jaipur from February 11 to 12, 2011.
22. Tuteja F C, Dixit S K, Kumar S, Patil N V and Singh J P (2011). Traditional treatment practices adopted by camel owners against camel diseases. In 29th Annual convention of ISVM and National symposium on Recent Developments in Diagnostics & therapeutics including applications of nanotechnology in veterinary medicine held at Mumbai from February 17 to 19, 2011.
23. Tuteja F C, Ghorui S K, Narnaware S D, Nagrajan G and Kumar S (2010). Management of mastitis in camels. In Short Course on Camel Health and Management organised by the National Research Centre on Camel, Bikaner from April 19 to 28, 2010.

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8. List of Ongoing Research Projects

Institute projects

S. No.	Name of Project	Code No.
	Camel Breeding and Genetics	
1	Molecular genetic studies in Indian camel	AGB-2
2	Genetic improvement of milk production potential of Indian dromedary	AGB-7
3	Genetic evaluation of performance of Indian camel	AGB-8
	Camel Health	
4	Epidemiology of infectious diseases of camel	VM -8
	Sub projects	
	a. Epidemiology of Bacterial and Fungal Diseases of camels	--do--
	b. Epidemiology Prevalence of parasitic diseases of camel	--do--
	c. Epidemiology of Viral diseases of Camels	--do--
5	Management of GI Parasites in camel herd and molecular characterization of anthelmintic resistant strains of parasites	VP-2
6	Production of single domain antibodies against rabies in camel	VMI-1
7	Bionomics and molecular characterization of ticks infesting the camel	VP-3
8	Investigations on clinical cases for overall health improvement of camel herd	VPH-1
	Camel Reproduction	
9	Improving the efficiency of artificial insemination in camel using existing and emerging technologies	AR-5
10	Role of sexual and bio-stimulation in camel reproduction	AR-6
	Camel Nutrition	
11	Enhancing nutrient utilization and reducing methane emission	AN-5
	Livestock Production Management	
12	Adaptation of camel to climate change in relation to temperature humidity index	AP-6

	Camel Physiology	
13	Efficient utilization of camel energy during cart pulling and agricultural operations by camels	AP-2
	Camel Biochemistry	
14	Processing value addition and commercialization of different camel products and by products	AP-3
	Livestock Products Technology	
15	Standardization of membrane process for development of functional camel milk food	LPT-1

External and Inter-institutional Projects

S. No.	**Name of Project**	Code No.
1.	Improvement of feed resources and nutrient utilization in raising animal production	AICRP
2	Bioprospecting of genes and allele mining for heat and cold stress tolerance in Indian dromedaries (*Camelus dromederius*)	NAIP
3.	Network programme on veterinary type culture- rumen microbes	Network
4.	Development of a new camelid anti-snake venom. An inter -institutional project with SP Medical College, Bikaner	VM- 9
5.	Development of single domain antibodies for diagnosis/therapy . An inter-institutional project with BARC, Mumbai	BTAS-2
6	Identification, characterization and structural studies of proteins from camel milk. An Inter-institutional project with AIIMS, New Delhi	

9. QRT, IMC, RAC and IRC Meetings

Research Advisory Committee

A meeting of the RAC of the Centre was held at NRCC, Bikaner on July 9, 2010. The following members were present in the meeting:

1. Dr. Nagendra Sharma : Chairman
2. Dr. N. V. Patil : Director
3. Dr. N.D. Khanna : Member
4. Dr. M. B. Chhabra : Member
5. Dr. Sumant Vyas : Member Secretary

The Chairman and members were highly satisfied with the overall improvement in the progress made by the Centre in various research projects and new linkages developed to explore collaborative research and recommended that the NRCC should be upgraded to the status of an institute.

Institute Research Council

The annual meeting of Institute Research Council was held on 13.8.2010 under the chairmanship of Dr. N.V. Patil, Director of the Centre. All scientists of the Centre and following external experts participated in the meeting:

1. Dr. R. K. Singh, Director, NRCE, Hisar
2. Dr. S. B. S. Yadav, Dean, CVAS, RAJUVAS, Bikaner
3. Dr. A. K. Purohit. Ex-Director Extension, RAU, Jodhpur
4. Dr. R. C. Jakhmola, Head, CSWRI Regional Station, Bikaner
5. Dr. R. K. Tanwar, Head, Dept. of Preventive Medicine, CVAS, RAJUVAS, Bikaner
6. Dr. S. K. Kashyap, Head, Dept. of Microbiology,

CVAS, RAJUVAS, Bikaner

7. Dr. A. K. Patel, Principal Scientist, CAZRI, Jodhpur
8. Dr. P. K. Pareek, Professor (Retd.), CVAS, RAU, Bikaner
9. Dr. Arun Kumar, Principal Scientist, CAZRI, Jodhpur

The half yearly review meeting of the IRC was held on February 7, 2011

Institute Management Committee

A meeting of the IMC of the Centre was held on August 14, 2010 and following members participated :

1. Dr. N. V. Patil, Director NRC on Camel, Bikaner : Chairman
2. Dr. N.M. Singh, Joint Director, Animal Husbandry Department, Bikaner : Member
3. Dr. S. B. S. Yadav, Dean, CVAS, RAJUVAS, Bikaner : Member
4. Dr. R. S. Singh, Principal Scientist, CIAH, Bikaner : Member
5. Dr. R. K. Beniwal, Head (Retd.), RRS, CAZRI, Bikaner : Member
6. Dr. R. C. Sharma, Senior Scientist, NRC on Equines, Bikaner : Member
7. Dr. Arun Kumar, Principal Scientist, CAZRI, Jodhpur : Member
8. Sh. K. P. Sharma, AAO, NRCC, Bikaner : Member Secretary
9. Dr. Sumant Vyas, Senior Scientist, NRCC, Bikaner : Invited Member
10. Sh. Raj Kumar, AF& AO, NRCC, Bikaner: Invited Member

10.Participation in Conferences, Meetings, Workshop and Symposia

Seminars/ Conferences attended

Name	Meetings, Seminar, Workshops and Symposia	Date
Dr. N. V. Patil	Farmers Participatory Action Research Programme Meeting at CAZRI, Jodhpur	July 3, 2010
	ICAR Director's Conference & Annual Meeting of Directors of Animal Science Division at New Delhi	July 15-17, 2010
	Seminar on Use of Unconventional Feeds for Feeding of Livestock of North Gujarat and Technologies to Improve Feed and Fodder Quality for Feeding of Livestock of North Gujarat. Delivered address on Nutritional Constraints in Feeding Non - Conventional Feeds to Dairy Animals and Unconventional Feeds for Arid and Semi-arid Region Livestock at Banas Dairy, Palanpur	July 22, 2010
	Meeting on Üpdation of the Nutrient Requirement for Different Classes of Livestock and Nutritive Value of Indian Feed Stuffs at NDRI,Karnal	August 11, 2010
	Consultation Meeting on Aboitic Stress Management of Animal Sciences at NIAM, Baramati	November 19-20, 2010
	7th Biennial ANA Conference at CVAS, Orissa University of Agriculture and Technology, Bhubneshwar	December 17-19, 2010
	5th National Conference on KVK - 2010 held at Maharana Pratap University of Agriculture & Technology, Udaipur	December 22-23, 2010
	Brainstorming meeting of ADG's, Directors, Joint Directors and Officials of ASD, ICAR for XII Plan EFC at CIRG, Makhdoom	January 30-31, 2011
	Directors - Vice Chancellors Interface & Meeting of Directors of ICAR at New Delhi.	February 23-24, 2011

	Seminar on Technology Intervention to Enhance Camel Productivity at Bhuj	March 13, 2011
	Workshop on Camel Products for Livelihood Support at LPPS, Sadri	March 15, 2011
	Interactive meeting between Chairman of RAC, SMD and Director's under the chairmanship of Secretary (DARE) & DG, ICAR at New Delhi	March 18, 2011
Dr. S. C. Mehta	Group Monitoring Workshop of DST, as an expert to review the projects, at AFRI, Jodhpur	November 18-19, 2010
	VIII Annual Convention of Society for Conservation of Domestic Animal Biodiversity and National Symposium on Animal Genetic Resources for Sustainable Livestock Sector in India organised by Orissa Livestock Resources Development Society and Society for Conservation of Domestic Animal Biodiversity at Bhubaneswar	February 18-19, 2011
	Workshop on the Preparation RFD of the Centre for the year 2010-11 and 2011-12 at New Delhi	March 11-14, 2011
Dr. A. K. Nagpal	Annual Scientific Meet of the Network Units of VTC at NRCE, Hisar	September 21, 2010
	7th Biennial ANA Conference at CVAS, Orissa University of Agriculture and Technology, Bhubneshwar	December 17-19, 2010
Dr. A. K. Roy	SAS training under NAIP at Maharana Pratap University of Agriculture and Technology, Udaipur	July 19- August 11, 2010
	5th National Conference on KVK-2010 on Farm Innovations for Agri-pruners organized at Maharana Pratap University of Agriculture and Technology, Udaipur	December 22 - 24, 2010
	Workshop on Patent Awareness at CVAS, Bikaner	February 25, 2011
	ZREAC Kharif 2011 Meeting at SKRAU, Bikaner	March 3-4, 2010
Dr. S. Vyas	Short term training on PME at National Institute of Rural Development, Hyderabad	September 6-10, 2010
	National conference on "Samajik paripekshya main parman uurja ka bahu ayami karyakram" organized jointly by RAJUVAS and BARC at CVAS, Bikaner	March 4-5, 2011

	ASCAD Conference on control of Infectious Animal Diseases organized by Animal Husbandry Department, Govt. of India held at Kota	March 10-11, 2011
Dr. F. C. Tuteja	11th Indian Veterinary Congress and XVIII Annual Conference of IAAVR & National Symposium on Veterinary Science & Education on Move: Critical Gaps & Needs at Apollo College of Veterinary Medicine, Jaipur from	February 11 to 12, 2011
	29th Annual convention of ISVM and National symposium on Recent Developments in Diagnostics & therapeutics including applications of nanotechnology in veterinary medicine held at Mumbai	February 17 to 19, 2011
Dr. G. Mal	National Symposium on Technology Management, Visioning and Up -scaling for Accelerating Livestock Production held at College of Veterinary Sciences, Khanapara, Guwahati	November 11 to 13, 2010
Dr. C. Bhakat	Workshop on Common Property Resources at CAZRI, Jodhpur	November 8-9, 2010
	Seminar on Technology Intervention to Enhance Camel Productivity at Bhuj	March 13, 2011
	5th National conference on KVK- 2010 at MPAUT, Udaipur	December 22-24,2010
Dr. (Mrs.) D. S. Sena	International symposium on Role of Biotechnology in conserving biodiversity and livestock development for food security and poverty alleviation & XVII Annual Convention of Indian Society of Veterinary Immunology & Biotechnology at CVAS, Bikaner	December 29-31, 2010
	11th Indian Veterinary Congress and 28th annual conference of IAAVR at Jaipur	February 11-12, 2011
	National symposium on Recent developments in diagnostics and therapeutics including applications of nanotechnology in veterinary medicine at Mumbai	February 17-19, 2011
Dr. (Mrs.) N. Saini	International symposium on Role of Biotechnology in conserving biodiversity and livestock development for food security and poverty alleviation & XVII Annual Convention of Indian Society of Veterinary Immunology & Biotechnology at CVAS, Bikaner	December 29-31, 2010

Dr. U. K. Bissa	VIII Annual Convention of Society for Conservation of Domestic Animal Biodiversity and National Symposium on Animal Genetic Resources for Sustainable Livestock Sector in India organised by Orissa Livestock Resources Development Society and Society for Conservation of Domestic Animal Biodiversity at Bhubaneswar	February 18-19, 2011
Dr. G. Nagarajan	International symposium on Role of Biotechnology in conserving biodiversity and livestock development for food security and poverty alleviation & XVII Annual Convention of Indian Society of Veterinary Immunology & Biotechnology at CVAS, Bikaner	December 29-31, 2010
Dr. S. D. Narnaware	XXVII Annual conference of Indian Association of Veterinary Pathology. College of Veterinary Science, Assam Agriculture University, Guwahati	November 25-27, 2010
Dr. D. Kumar	Partner's Meet of NAIP- NABG Project at NBAGR, Karnal	November 19, 2010
	5th National Conference on KVK at MPUAT, Udaipur	December 22-24, 2010
	Regional KisanMela organized by SKRAU, Bikaner	February 8-11, 2011
Dr. S. S. Dahiya	Patenting System in India (special emphasis on chemical and Biotech invention) at National Institute for Intellectual Property Management, Nagpur	October 4-8, 2010
	International symposium on Role of Biotechnology in conserving biodiversity and livestock development for food security and poverty alleviation & XVII Annual Convention of Indian Society of Veterinary Immunology & Biotechnology at CVAS, Bikaner	December 29-31, 2010
	Recent Techniques in Proteome Analysis (NAIP) at National Dairy Research Institute, Karnal	March 10-30, 2011
Dr. G. Sivakumar	International symposium on Role of Biotechnology in conserving biodiversity and livestock development for food security and poverty alleviation & XVII Annual Convention of Indian Society of Veterinary Immunology & Biotechnology at CVAS, Bikaner	December 29-31, 2010

11. Distinguished Visitors, Appreciation and Awards

Distinguished Visitors

April 7, 2010

Dr. M. M. Anwar, Director, National Research Centre on Seed Spices, Ajmer

May 21, 2010

Prof. M. H. Karim, Counselor and Director, Science and Education, Embassy of Islamic Republic of Iran in India, New Delhi

August 3, 2010

Prof. A. K. Gahlot, Vice Chancellor, Rajasthan University of Veterinary and Animal Sciences, Bikaner

August 12-15, 2010

Prof. K.M.L.Pathak, Deputy Director General (Animal Science), ICAR, New Delhi

Dr. R. K. Singh, Director, National Research Centre on Equine, Hissar

October 8, 2010

Prof. K. Pradhan, Ex-Vice Chancellor, Rajasthan Agricultural University, Bikaner

Dr.A. M. Parakhia, Director of Extension Education, Junagarh Agricultural University, Junagarh

October 20, 2010

Dr.S.Ayyappan, Director General, ICAR and Secretary, DARE, New Delhi

Prof. K.M.L. Pathak, Deputy Director General (Animal Science), ICAR, New Delhi

Dr. S. A. Karim, Director, Central Sheep and Wool Research Institute, Avikanagar

Dr. R. K. Singh, Director, National Research Centre on Equine, Hissar

October 22, 2010

Dr. J. S. Samra, CEO, National Rainfed Area Authority, Planning Commission, New Delhi

Dr. S. K. Datta, DDG (CS), ICAR, New Delhi

Dr. J.S. Chauhan, Director, Directorate of Rapeseed-Mustard Research, Bharatpur

Dr. Madan Mohan, ADG (Fisheries), ICAR, New Delhi

Dr. Bangali Baboo, National Director, NAIP, ICAR, New Delhi

Dr. A. K. Singh, DDG (NRM), ICAR, New Delhi

October 23, 2010

Dr. N. C. Patel, Vice Chancellor, Junagarh Agricultural University, Junagarh

Dr. A. R. Pathak, Vice Chancellor, Navsari Agricultural University, Navsari

Dr.A.M. Shekh, Vice Chancellor, Anand Agricultural University, Anand

Dr. M. S. Purohit, Director of Extension Education, Navsari Agricultural University, Navsari

Dr. R. S. Tripathi, Project Coordinator, CAZRI, Jodhpur

Dr. D.K. Sharma, KVK Dangs, Navsari Agricultural University, Navsari

Dr. N. P. Shukla, Programme Coordinator, KVK Bhavnagar, Gujarat

Dr. S. S. Pareek, ASC-DEC, SKRAU, Bikaner

Dr. M. V. Patel, KVK Mehsana, Gujarat

Dr. B. B. Kunjadia, KVK Amreli, Gujarat

Dr.V. K. Garg, Programme Coordinator, KVK Gandinagar

Dr. B. B. Kabaria, Programme Coordinator, KVK, Rajkot

Dr. U. N. Tank, Programme Coordinator, KVK Mundra, Kutch

Dr. S.R. Thaker, SMS, KVK Khatpat, Gujarat

Dr. M. M. Patel, Subject Matter Specialist, BAIF Krishi Vigyan Kendra, Chasvad, Bharuch

December 7, 2010

Dr. Eric Chavera, Faculty of Veterinary Medicine, National University of San Marcos, Lima, Peru

December 29, 2010

Dr. A.K. Rawat, Joint Director, DBT, New Delhi

December 29, 2010

Dr. K.R. Tajane, Dean, College of Veterinary Science & Animal Husbandry, SDAU, S K Nagar

March 8, 2011

Prof. K.M.L. Pathak, Deputy Director General (Animal Science), ICAR, New Delhi

Dr. R. K. Singh, Director, National Research Centre on Equine, Hissar

March 22, 2011

Dr. S.C. Gupta, ADG (AP&B), ICAR, New Delhi

March 25, 2011

Dr. Fasil Reda, Ethiopian Institute of Agricultural Research, Jijiga, Ethiopia

Mr. Mohamed Badel Mohamed, Somali Region Pastoral Agro-pastoral Research Institute, Jijiga, Ethiopia

Mr. Muhudin Mohammed, Somali Region Pastoral Agro-pastoral Research Institute, Jijiga, Ethiopia

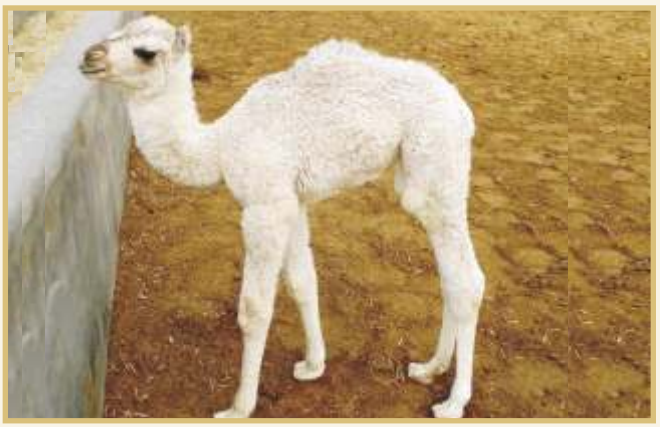
Mr. Mohamed Abduletif, Somali Region Pastoral Agro-pastoral Research Institute, Jijiga, Ethiopia

Mr. YohannesTeklu, Ethiopia

Appreciation and Awards

Ganesh Shankar Vidhyarthi Hindi Krishi Patrika Purushkar: Centre's Hindi magazine Karabh was awarded the Ganesh Shankar Vidhyarthi Hindi Krishi Patrika Purushkar for the year 2009 by the Indian Council of Agricultural Research. This award was conferred by Sh. Sharad Pawar, Hon'ble Agriculture Minister, Govt. of India to Dr. N.V. Patil, Director, NRCC on the eve of foundation day of the Council, i.e. July 16, 2010.

A White Camel Calf born at the Centre : A typical white coloured camel calf that was born at the Centre on December 14, 2010 has perhaps received highest ever media coverage among the developments at the Centre in the Country and abroad. Apart from websites of ICAR and NRCC, it was covered by The Hindu, Deccan Herald, Jansatta, Rajasthan Patrika, Dainik Bhaskar and by the common search engines like yahoo etc.



This white coloured Mewari breed camel calf was a female and it had a birth weight of 33 kg. The birth of this typical calf was due to the constant and dedicated efforts of the scientists to develop elite herds of each breed by concentrating the breed characteristics through a meticulously designed breeding plan. With continuous selection and time to time introduction of true to the breed studs of the breed from the breeding tract, the scientists could succeed in concentrating the breed characteristics in most animals maintained at the Centre.

Nagar Raj-Bhasha Appreciation Award : This award for the year 2009-10 was conferred on 29.06.2010 by Sh. Alok Ranjan, DRM, Bikaner to Dr. A. K. Roy, Senior Scientist and Raj-Bhasha Adhikari of the Centre for excellent use of Hindi in day to day working of the Centre.

Excellence in Sports - Inter-Zonal Tournament: Shri Mohan Singh Technical Officer, T-5 has won a Gold Medal in Discus throw and a Silver Medal in Shot- put event at ICAR inter-zonal tournament held at CAZRI, Jodhpur during November 9-13, 2010. The Centre has also got a Silver Medal in Volleyball (shooting) in the same tournament.

Excellence in Sports Inter-Institutional Tournament: Shri Mohan Singh Technical Officer, T-5 has won a Gold Medal in Discus throw and Shot- put event in the inter-institutional tournament held at IGFRI, Jhansi during February 15-19, 2011. The Centre has also got a Gold Medal in Volleyball (shooting) in the same tournament.

12. Personnel

Director

Dr. N.V. Patil, Director

Principal Scientist

1.Dr. S.K. Ghorui, Veterinary Parasitology
2.Dr. S.C. Mehta, Animal Genetics & Breeding
3.Dr. A.K. Nagpal, Animal Nutrition
4.Dr. Sajjan Singh, Animal Physiology

Senior Scientist

1. Dr. A.K. Roy, Animal Physiology
2. Dr. Sumant Vyas, Animal Reproduction
3. Dr. Raghvendra Singh (On Deputation)
4. Dr. F.C. Tuteja, Veterinary Medicine
5. Dr. Gorakh Mal, Animal Bio-Chemistry
6.Dr.C. Bhakat, Lives stock Prod. Management
7. Dr. (Mrs.) D. Suchitra Sena, Veterinary Medicine
8. Dr. (Mrs.) Nirmala Saini, Animal Nutrition
9. Dr. U.K. Bissa, Animal Genetics & Breeding

Scientist (Senior Scale)

1.Dr. G. Nagarajan, Animal Bio-technology

Scientist

1.Dr. Sanjay Kumar, Veterinary Parasitology
(on study leave)
2.Dr. S.D. Narnaware ,Veterinary Pathology
3.Dr. D. Kumar, Livestock Products Technology
4.Dr. S. S. Dahiya, Veterinary Microbiology
5.Dr. G. Sivakumar,Veterinary Parasitology

Technical Officer

1.Dr. N. Sharma, LSF, T-9
2.Sh. Ram Kumar, Farm Manager, T-9
3.Dr. B.L. Chirania, Veterinary Officer, T-9
4.Sh. Kashi Nath, Technical Officer, T-6
5.Sh. Ram Dayal Raigar, Technical Officer, T-6
6.Sh. Dinesh Munjal, Technical Officer, T-6
7.Sh. M. K. Rao, Technical Officer, T-5
8.Sh. Nand Kishore, Technical Officer, T-5
9.Sh. Mohan Singh, Technical Officer, T-5
10.Sh. Nemi Chand, Technical Officer, T-5

Administration

1.Sh. K.P. Sharma, Asstt. Admin. Officer
2.Sh. Raj Kumar, Asstt. Finance & Account Officer

13. Infrastructure Development

Visitors' Room: A visitors' room has been developed wherein a visitor can have the glimpses of camel research and development at the Centre. It is equipped with latest audiovisual aids for the display of Centre's Film in Hindi and English. Latest literature, handouts, pictures and relevant material has been kept here to apprise the visitors with the developments at the Centre.

Mini Feed Plant: A Mini Feed Plant to prepare different fodder and concentrate combinations has been installed at the Centre. Now the researchers and camel owners have the privilege to get the feed prepared as per their specific requirement.

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f}rh; % Mk-cyno nkl fdjkM

r`rh; % Mk-fueyk luh

¼2½ Hkk"k.k ifr;kfxrk

iFke % Mk-leUr 0;kl ,o Mk-th-ukxjktu

f}rh; % Mk-fueyk luh

r`rh; % Mk-pid Hkdr] Jh doj iky 'kek

,o Jh gjiky flg

¼3½ jkt Hkk"kk ,oa lkekU; Kku i'ukRrjh

dUn e fnukd 22-09-2010 dk vk;kftr jkt Hkk"kk ,o lkekU; Kku i'ukRrjh ifr;kfxrk d ifr dUn d lHkh dkfedk e fo'k"k :fp n[kh xbA lQy ifrHkkfx;k dk fun'kd egkn; d dj deyk l ijLdr fd;k x;kA

fgUnh i[kokMk % ijLdkj forj.k&lekiu lekjkg

dUn e vk;kftr fgUnh i[kokM d ijLdkj forj.k&lekiu lekjkg e e[; vfrfFk d :i e Jheku jke feyu] ikpk;] dUnh; fo|ky; uEcj 1] chdkuj dk vkef=r fd;k x;kA viu vfHkHkk"k.k e mUgku dgk fd djkMk ykxk dh vkthfodk l tMh gku d dkj.k fgUnh Hkk"kk dk Hkfo"; fuf'pr :i l mTToy gA lHkh {k=k e fgUnh iy&c< jgh gA vkt fgUnh jktxkj dh Hkk"kk d

:i e Hkh gekj lkeu vkrh g tgk fo|kfFk;k dk viuh ifr;kxh ijh{kkvk dk ek/;e fgUnh d :i e miyC/k gA

bl volj ij dUn fun'kd ,o dk;Øe v/;{k Mk-,u-oh-ikfVy u viu v/;{kh; Hkk"k.k e dgk fd dUn }kjk euk;k x;k fgUnh i[kokMk fuf'pr :i l Hkk"kk i;kx gr mi;Dr okrkoj.k dk l tu dju e lQy jgk gA bld fy, lHkh oKkfud] vf/kdkjh ,o depkjhx.k c/kb d ik= gA Mk-ikfVy u dgk fd gekjh Hkkoukvk] dk;dykik rFkk lekjkgk vkfn lHkh txg fgUnh Hkk"kk fo|eku gA jkt Hkk"kk iHkkjh Mk-jk; }kjk bl volj ij fgUnh e dfork ikB Hkh fd;k x;kA

ijLdkj forj.k&lekiu lekjkg d e[; vfrfFk Jh jke feyu th d dj deyk }kjk fgUnh i[kokM d nkjku vk;kftr fofHkUu ifr;kfxrkvk d fotrkvk dk ijLdkj inku fd, x,A

iFke jkt Hkk"kk dk;Z'kkyk

jkt Hkk"kk uhfr dk;kUo;u d vUrxr dUn e fnukd 14-06-2010 dk vk;kftr ,d fnolh; jkt Hkk"kk dk;'kkyk e vfrfFk oDrk d :i e jktdh; Mxj egkfo|ky;] chdkuj l Mk-ctjru tk'kh] 0;k[;krk] ¼fgUnh lkfgR;½ dk vkefU=r fd;k x;kA

dUn e vk;kftr jkt Hkk"kk dk;'kkyk e Hkk"kk ik|kfxdh ,o jkt Hkk"kk ic/ku fo"k;d 0;k[;ku iLrr djr g, Mk- tk'kh u dgk fd fgUnh] fgUnLrku l tMh gb ,d mRd"V Hkk"kk gA vkt dk le; lpuk ik|kfxdh dk g vkj ,l nkj e Hkk"kk dk ic/ku gkuk ije vko';d gA mUgku crk;k fd dEl;Vj dh nf"V l noukxjh fyfi lcl l{ke fof/k gA fgUnh Hkk"kk e fo|eku jpukRedrk] vfHk0;fDr] lEi"k.k vkfn fofHkUu fo'k"krkvk u fon'kh jk"Vk dk Hkh viuh vkj vkdf"kr fd;k gA

jkt Hkk"kk dk;'kkyk e dUn d dk;dkjh fun'kd Mk-jkt dekj flg u viu v/;{kh; vfHkHkk"k.k e dgk fd ljdkj vkj turk d chp lEid l= d :i e jkt Hkk"kk dk vf/kdkf/kd i;kx fd;k tkuk pkfg,A Mk-flg u dgk fd fdlh Hkh {k= e pkg og foKku gk ;k vU;] ik|kfxdh dk ftruk egRo g mruk gh mldk Hkk"kk ic/ku Hkh t :jh g] rHkh bldk ykHk fuf'pr :i l fey ik,xkA

f}rh; jkt Hkk"kk dk;Z'kkyk

fgUnh i[kokMk dh vUrxZr fnukd 21-09-2010 dk ,d fnolh; jkt Hkk"kk dk;'kkyk dk vk;ktu fd;k x;kA iHkkjh jkt Hkk"kk }kjk dk;'kkyk d mnn'; ,o egRo ij idk'k Mkyk x;kA

bl jkt Hkk"kk dk;'kkyk e fgUnh Hkk"kk dh egRrk ,o lpkj dh nfu;k fo"k;d 0;k[;kuk dh iLrfr gr jktdh; Mxj egkfo|ky;] chdkuj d ofj"B 0;k[;krk Mk-jtuh je.k >k dk vkefU=r fd;k x;kA Mk->k u viu 0;k[;ku e crk;k fd gekjh lH;rk lcl ijkuh g vkj lLdr Hkk"kk u bl lH;rk dk yEck lQj r; fd;k g ft ldh i=h fgUnh gA bruh ikphu lH;rk l tMh gku d dkj.k ge fgUnh Hkk"kk d i;kx ij xo dh vuHkfr gkuh pkfg,A

dk;'kkyk d bl volj ij dUn d fun'kd ,o dk;Øe v/;{k Mk-,u-oh-ikfVy u oKfudk dk vkgoku djr g, dgk fd gekj }kjk dh xb fdlh Hkh idkj dh 'kk/k o rduhdh tkudkjh fgUnh vFkok vke turk dh Hkk"kk d ek/;e l miyC/k djokb tkuh pkfg, rHkh gekj }kjk fu"ikfnr dk;k dh lkFkdrk fl) gk ldxhA

r`rh; jkt Hkk"kk dk;Z'kkyk

jkt Hkk"kk uhfr dk;kUo;u d vUrxr jk"Vh; m"V vul/kku dUn] chdkuj }kjk fnukd 13-12-2010 dk vk;kftr ,d fnolh; dk;'kkyk e nk 0;k[;ku iLrkfor Fk ftue dUn d oKkfud Mk-noUn dekj }kjk ÅVuh dk n/k ,o bldh c<+rh ykdfi;rk fo"k;d 0;k[;ku iLrr fd;k x;kA viu 0;k[;ku e Mk-noUn u m"V n/k dh x.kork] bll fufer mRikn ,o budh lHkkoukvk d ckj e foLrr tkudkjh nh rFkk bl {k= e fodkl dh icy lHkkouk, crkbA

jkt Hkk"kk dk;'kkyk e fgUnh % jkt dkt ,o

lekt dh Hkk"kk fo"k;d nlj 0;k[;ku dh iLrfr gr vfrFk oDrk d :i e vkef=r jktdh; egkjkuh ln'kuk dU;k egkfo|ky;] chdkuj dh 0;k[;krk Jherh l'khyk vk>k u dgk fd fgUnh e dke djuk vklku gA ;g ge viu gLrk{kj] vodk'k&i= vkfn fofHkUu ek/;ek l ikjHk dj ldr gA bld fy, lxkf"B;k] lEeyuk] dk;'kkykvk vkfn fofHkUu dk;Øek d ek/;e l fgUnh Hkk"kk dh l'kDrrk gr vkj vf/kd lfu;kftr i;kl fd, tku pkfg,A

bl volj ij dUn fun'kd Mk-,u-oh-ikfVy u viu mnck/ku e fgUnh Hkk"kk dk lLdfr dk vx crkr g, dgk fd bll n'k dh lHkh Hkk"kk, tMh gb gA vr% bl vkj vf/kd vPN Lo:i e fodflr fd, tku dh egRrh vko';drk gA

prFkh jkt Hkk"kk dk;'kkyk

dUn }kjk fnukd 31-03-2011 dk jkt Hkk"kk dk;'kkyk dk vk;ktu fd;k x;kA dk;'kkyk e oDrk d :i e dUn d Jh fnu'k etky] rduhdh vf/kdkjh ¼dEI;Vj½ u dEI;Vj ij ;fudkM }kjk fgUnh e dk;l fo"k;d 0;k[;ku iLrr fd;kA viu 0;k[;ku e Jh etky u ;fudkM i)fr l fgUnh e Vkbi dju rFkk bld vklku dthiVy vkfn d ckj e foLrr tkudkjh nhA mUgku dgk fd ;fudkM&fgUnh d ek/;e l dk; dju gr vkidk bVjuV dh dkb vko';drk ugh g] bl gr lk¶Vo;j ,d ckj bLVky dj yuk gh i;kIr gkrk gA Jh etky }kjk iLrr 0;k[;ku d vUrxr mifLFkr dkfedk }kjk dEI;Vj ij fgUnh e dk; dju d nkjku vku okyh db ck/kkvk] ftKklkvk vkfn dk lek/ku Hkh fd;k x;kA

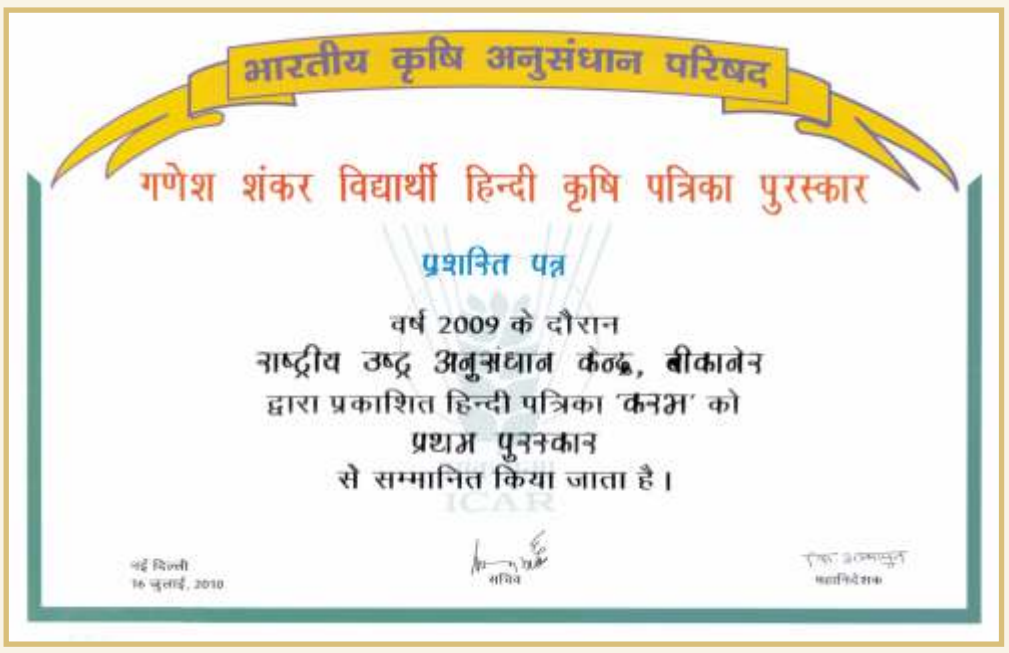
bl volj ij dUn fun'kd Mk- ,u- oh- ikfVy u viu mnck/ku e oDrk }kjk iLrr 0;k[;ku dh ljkguk djr g, mifLFkr lHkh dkfedk dk dEI;Vj ij fgUnh d vf/kdkf/kd i;kx gr fo'k"k :i l ikRlkfgr fd;kA Mk-ikfVy u dgk fd dEI;Vj ij fgUnh e dk; djuk dfBu ugh gA ;g vR;f/kd ljy o lyHk gkrk tk jgk g rFkk ;g dkfedk dh bPNk 'kfDr ij fuHkj djrk gA mUgku dgk fd jkt Hkk"kk uhfr dk;kUo;u dk /;ku e j[kr g, fgUnh e 'kr ifr'kr i=kpkj fd;k tkuk vif{kr gA bl gr lHkh viu Lrj ij vx"k.k&i= fgUnh e r;kj dj fHktok, rkfd 'kh?k gh dUn viuk y{; ikIr dj ldA

jk"Vh; m"V vuqlU/kku dUn] chdkuj dk jkt Hkk"kk lEeku

¼1½ Hkkjrh; df"k vuqlU/kku ifj"kn] ub fnYyh d v/khuLFk lLFkkuk vkfn e mRd"V fgUnh xg if=dk d idk'ku d fy, x.k'k 'kdj fo|kFkh fgUnh df"k if=dk ijLdkj ;ktuk d vUrxr o"k 2009 d fy, jk"Vh; m"V vuqlU/kku dUn dh jkt Hkk"kk okf"kd if=dk ^^djHk** dk iFke ijLdkj d fy, puk x;kA dUn dk ;g lokPp ijLdkj] Hkkjrh; df"k vuqlU/kku ifj"kn d fnukd 16 tykb] 2010 dk LFkkiuk fnol d volj ij jk"Vh; df"k foKku dUn ifjlj] ub fnYyh e vk;kftr ijLdkj forj.k lekjkg 2010 d vUrxr inku fd;k x;kA x.k'k 'kdj fo|kFkh fgUnh df"k if=dk dk ;g ijLdkj dUn d fun'kd Mk-,u-oh-ikfVy dk ekuuh; dUnh; df"k rFkk miHkkDrk ekey] [kk| vkj lkotfud forj.k e=h Jh 'kjn iokj ,o ekuuh; df"k] miHkkDrk

ekey] [kk| vkj lkotfud forj.k jkT; e=h ikQlj d-oh-Fkkeal d dj deyk }kjk inku fd;k x;kA

½2½ jk"Vh; m"V vul/kku dUn] chdkuj dk uxj jkt Hkk"kk dk;kUo;u lfefr] chdkuj }kjk o"k 2009&10 d nkjku ujkdkl Lrj ij jkt Hkk"kk d mRd"V i;kx d fy, lEekfur fd;k x;kA ;g lEeku e.My jy ic/kd] chdkuj d v/;{k Jh vkykd jtu d dj deyk }kjk dUn d iHkkjh jkt Hkk"kk Mk- vf'ouh dekj jk; dk ujkdkl] chdkuj dh fnukd 29-06-2010 dk vk;kftr cBd d volj ij inku fd;k x;kA



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व्यवस्था दिल्ली के बीकानेर हाउस सहित अन्य स्थानों पर बनेंगे बिक्री केंद्र

अनुसंधान

उंट में मौजूद एंटीजंस थायराइड कैंसर के उपचार में सक्षम

थायराइड कैंसर दूर करेगा ऊंट

शोध : साल भर में जीनोम सिक्वेंस बनने की उम्मीद

ऊंटों की बनेगी कुण्डली

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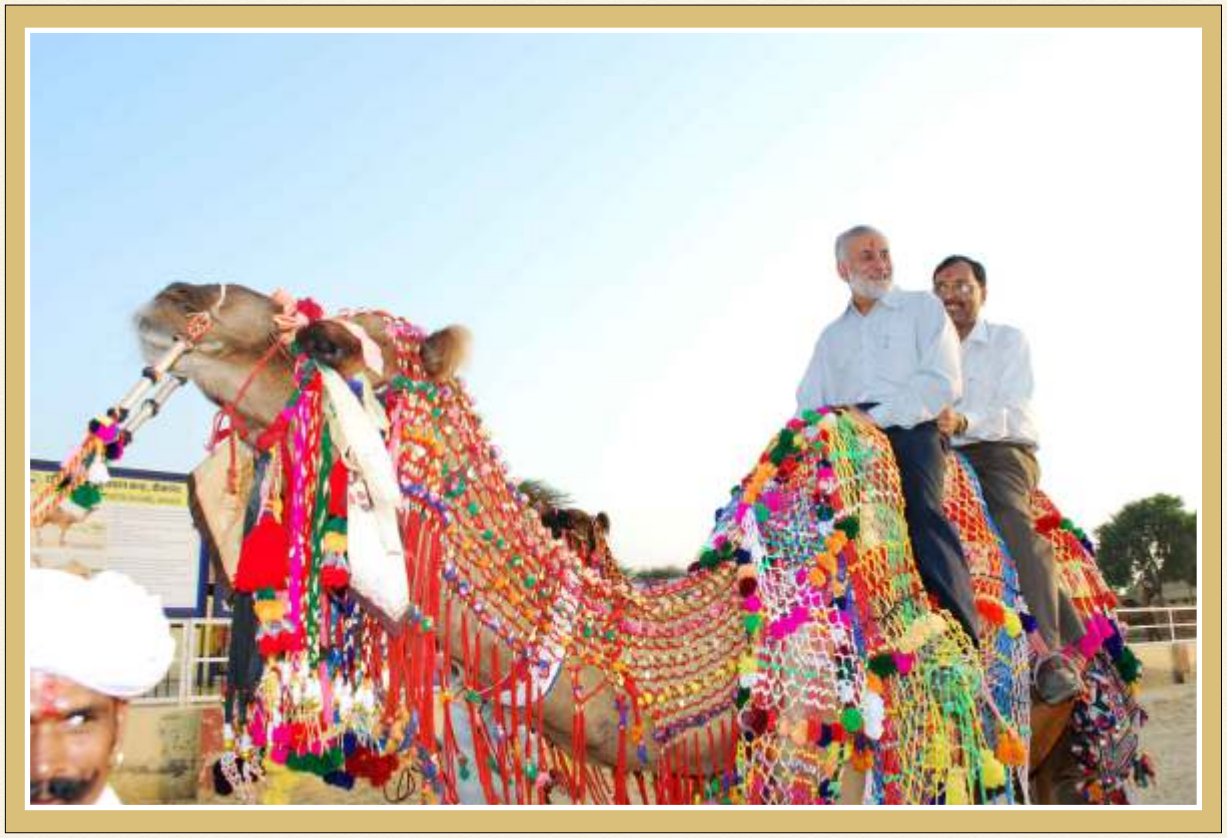
दैनिक भास्कर

इथियोपिया के दल ने किया उष्ट्र अनुसंधान केंद्र का दौरा

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