

# Annual Report

2012-13



**केन्द्रीय बकरी अनुसंधान संस्थान**  
मखदूम, फरह-281122, मथुरा (उ.प्र.) भारत

**CENTRAL INSTITUTE FOR RESEARCH ON GOATS**

Makhdoom, Farah-281122, Mathura (U.P.) INDIA



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## PREFACE

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In order to sustain food security and to feed burgeoning human population which is likely to be 1.7 billion by 2050, continued research efforts for the development of technologies are needed. Role of goats in human food chain is increasing day by day. Increased urbanization, income and strong preference to functional food enriched with protein are expected to increase demand of goat milk and meat products. Goat milk possesses health-promoting properties and needs to be focused as therapeutic milk. Goat production is facing diverse challenges and multiple constraints with respect to climate change, availability of feed and fodder and emergences of newer pest, pathogens and diseases which necessitates continued research efforts. The Central Institute for Research on Goats(CIRG) is moving forward to tackle these problems by focused research, visionary approach and road map on goat development for nutritional security and prosperity of the country.

The scientists of the Institute contributed significantly to the research, teaching and training in goat production. Some of the achievements during the year have been presented in this annual report. The notable achievements include viz. successful freezing of semen of Jamunapari, Barbari,

Jakhrana and Sirohi breeds, and production of kids through AI with a pregnancy rate of 53.12%, Parthenogenic goat fetus upto day 34 of pregnancy and its confirmation by Micro-satellite marker and SRY 1 gene analysis, Characterization of heat stress tolerant genes, Isolation, identification and characterization of a new strain of PPR virus, sequencing of whole Genome of Mycobacterium avium subspecies paratuberculosis (Indian bison type), development of herbal flavoured goat milk ice cream, low fat goat milk products, CIRG Beans, CIRG Khasta, and methane production properties of different goat feeds.

National and sponsored training programmes were organized for the dissemination of technologies of the Institute as well as for the capacity building and human resource development. The Institute participated in various exhibitions and Kisan Melas at different places of the country to display its various technologies for the benefit of the goat farmers, professionals and other stakeholders. The Institute stall won II prize in Pusa Krishi Vigyan Mela at IARI, New Delhi.

Several new works viz. construction of C Block of laboratory building and renovation of Shalihotri hostel, type II and III quarters were undertaken.

Rising affluence may see a change in India's food consumption patterns from being primarily driven by basic to "high-value foods" with complex proteins. An increase in per-capita GDP is likely to drive a 4% increase in overall food consumption per annum. To meet out increasing demand of animal products in coming decades it would not be possible just only by increasing their numbers alone, but to a

large extent by enhancing per animal productivity in a sustainable manner. CIRG envisages that innovations and reinforcement of research on goat production, processing, policy and technology delivery mechanisms would lead to faster growth of the millions of poor and landless and marginal goat farmers in this country.

I express my sincere gratitude to Dr. S. Ayyappan, Secretary DARE, and Director General, ICAR, for the leadership and strong support for the overall development

of the Institute. I am thankful to Dr. K.M.L. Pathak, DDG (Animal Sciences), Dr. B.S. Prakash, ADG (AN&P), Dr. Gaya Prasad, ADG (AH), Dr. S.C. Gupta, ADG (AP&B), and other scientists of SMD for their ever encouraging support for the progress and success of the Institute. My thanks are also due to Chairman and members of RAC and IMC of the Institute for their valuable guidance and support. A word of appreciation to the editorial team for their untiring efforts for compiling and editing of this document.

(S.K. Agarwal)  
Director



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## EXECUTIVE SUMMARY

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India with 154 million goats is one of the largest goats owning country in the world and playing a significant role in livelihood and nutritional security as well as providing supplementary income to nearly 70 million farmers of over 500,000 remote villages. Goat meat production in the country has increased from 4.7 lakh tons to 5.96 lakh tons during the last decade (2002 to 2011) with an annual growth rate of 2.4%. Similarly, goat milk production in the country has also increased from 36.4 to 45.9 lakh tons during the same period with an annual growth rates of 2.6 %. The country stand first in goat milk production and is the second largest in goat meat in the world by sharing 29% & 12% goat milk and meat production, respectively. Goat meat (Chevon) is most preferred and widely consumed meat in the country. Since ancient times goat milk has traditionally been known for its medicinal properties and has recently gained importance in human health due to its proximity to human milk for easy digestibility and it's all round health promoting traits.

The goat sector contributes Rs. 22,138 crores to the country's livestock GDP through meat (Rs. 11,932 crores), milk (Rs. 5,513 crores), skin (Rs. 800 crores) and manures (Rs. 1,594 crores).

### Genetic Improvement Programme

Selective breeding in institutional farm and in AICRP field units is being carried out to increase the production performance and to fulfill the need of good quality genetic potential bucks in their home tract. Selective breeding of Jamunapari, Barbari, Jakhrana goats and Muzzaffarnagari sheep at the institute farm have shown significant improvement in milk yield and body growth. The institute supplied a total of 583

superior animals i.e. 434 goats and 149 Muzzaffarnagari sheep to various stakeholders for breed improvement programme in field. The overall mortality in the flock has been less than 9% during the year. The field programme under AICRP is being carried out in 14 units across the country and significant improvement in body weight has been observed in different field flocks. These units are also rearing bucks and supplying to farmers for breed improvement programme. Gene expression analysis in different tissues in response to heat stress has been analysed with respect to Hsp 70, Hsp 90 and leptin gene.

### Physiology, Reproduction and Shelter Management Programme

Semen of Jamunapari, Barbari, Sirohi and Jakhrana goat breed was successfully frozen and kids have been born through A. I. Achieved pregnancy rate of 53.12% in Jamunapari goats using frozen semen stored by modified freezing protocol. The maturation rate of oocytes using nuclear examination after the DAPI staining procedure of matured oocytes in which Metaphase II stage of nuclear maturation with two shiny spot in cytoplasm or polar body were evaluated. The activation of *in vitro* matured oocytes by 7% ethanol for 5 minute followed by treatment with 2.0 mM DMAP for 4 hr in mCR2aa has been the most favorable for parthenogenetic caprine embryos production. The activation of *in vitro* matured oocytes by 7% ethanol for 5 minute followed by treatment with 2.0 mM DMAP and 10µg/ml CHX for 4 hr in KSOM has been most favorable for parthenogenetic caprine embryos production. The cleavage rate, morula and blastocyst development were

comparatively higher following activation with 5  $\mu$ m calcium ionophore and 4hr culture in 5 mM DMAP of *in-vitro* matured goat oocytes. Parthenogenetic foetus was produced following embryo transfer first time which continued up to day 34 of pregnancy and confirmed its identity by micro-satellite marker and amelogenin gene analysis. The plasma progesterone concentration was found to be higher in the actively inhibin immunized group than that of the control.

Studies on improving on livelihood security of farmers in Rae Bareilly district of U.P. indicated adoption of grading-up, strategic feeding and health care to increase productivity of goats. Critical inputs in the form of vaccination, deworming and plantation of fodder trees are essentially needed to enhance the productivity of goats. Castrated kids consumed 7.31 kg feed while kids of control group consumed 8.04 kg feed for each kg gain during the experiment, which accounted for feed efficiency of 24 and 25 % respectively. The scrotal circumference though decreased gradually after castration, however, it increased at 5.54% up to 2 weeks which could be due to the swelling of scrotum after castration.

### **Nutrition, Feed Resources and Products Technology Programme**

The feed resource *Boerhavia diffusa*, which is a very succulent plant growing naturally on fallow and cultivated land during monsoon season contained dry matter, CP, ash and ME contents as 11.5, 13.2, 22.6 percent and 6.08 MJ/kg dry matter, respectively. Fresh harvested *Boerhavia diffusa* can be fed to goat with 200 g gram straw, while sole feeding may lead to weight loss. The single cut management system of barley crop decreased the yield and yield related attributes over the two cutting management system. Mustard cake replaced

conventional protein supplement in Jamunapari goat feeding provided economic benefits as it is available locally at cheaper prices. Mustard cake can be included in goat diets up to 24 % level without affecting palatability and performance of lactating Jamunapari goats. Herbal medicated pelleted feed containing herbal anticoccidial feed mix [extract of *Allium sativum* (Bulb) and *Annona squamosa* (Leaves)] and feeding @ 7 mg/g body weight enhanced daily gain due to reduced coccidial load and diarrheal incidences. Azolla is growing well under prevailing water quality and environmental conditions. The *in-vitro* methane production of cereal crop straws, wheat (*Triticum aestivum*), barley (*Hordeum vulgare*) and oat (*Avena sativa*), and sorghum (*Sorghum bicolor*) ranged from 9.92 to 16.6 g/kg DM and the CP content had a high correlation with methane production. Legume crop straws, arhar (*Cajanus cajan*), gram (*Cicer arietinum*) and guar (*Cyamopsis tetragonoloba*) produced methane from 8.7 to 23.4 g/kg DM, which accounted methane energy loss of 482 to 1299 kJ/kg DM. The community/ protected grassland and wastelands feed resources had IVDMD from 36 to 68 %, and methane production ranged 6.8 to 29.0 g for each kg digestible DM. The protein feeds produced methane which ranged from 17.0 to 25.4 g for each kg digestible DM, with methane energy loss 797 to 1216 kJ/ kg feed DM intake. The energy feeds wheat grain, barley grain, maize grain, rice broken and wheat bran produced methane from 20 to 24 g for each kg digestible DM. The major top feed resources produced methane ranging from 7.9 to 20.5 g for each kg digestible DM. Type of straw makes difference in methane production but feeding system hardly affect methane production level as increased quantities of concentrate increasing the total fermentability of substrate with a little decline of methane content in gas mixture.

Concentrate mixture replacing 50 % conventional protein source with mustard cake reduced methane production as glucosinolate content of mustard cake has antimicrobial properties for several microorganisms. The herbal methanolic extract CIRG-2 ameliorated heat stress as evidenced by highest growth rate and better physiological response. Fifteen isolates of fiber degrading bacteria were characterized based on 16S RNA gene sequence and deposited to the VTCC culture collection center. Paneer yield from milk of different goat breeds was 12.0 %, with a variation of 1% during different months. The paneer prepared from the milk having half of the original cream had lower proximate components except fat. Medium fat paneer had improved textural properties. Goat fat had higher myristic acid, palmitic acid, stearic acid and oleic acid while linoleic acid was higher in refined vegetable oil. Goat fat had higher (%) monounsaturated fatty acids (MUFA) and saturated fatty acids (SFA) whereas polyunsaturated fatty acids (PUFA), omega-3 and omega-6 fatty acids were high in refined vegetable oil. The use of combination of goat fat and vegetable oil in chevonnuggets makes them lighter, softer and flavourful as well as functional with balanced PUFA/SFA ratio. The meat of six month's old Barbari kids has been found to be a very good source of EPA and DHA, low saturated fatty acid content and is a good source of PUFA. The dried guava (*Psidium guajava* L.) flesh (DGF) inclusion at 1 % improved total dietary fiber and enhanced products shelf life through antioxidant potential. Feed restriction and re-alimentation did not have influence on moisture, ash, and fat and crude protein content of meat. However, feed restriction and re-alimentation lowered fat (%) by 1.19 %. The feed restriction and re-alimentation tends to improve the carcass and meat quality in barbari goats. The institute has also developed three goat products *i.e.*

CIRG Beans, CIRG Khasta and CIRG Meat Sticks during the year.

### Goat Health Programme

Besides surveillance and monitoring, the Division of Animal Health undertakes and executes the research to provide better health care, prevention and control of economically important diseases of goats. The surveillance and monitoring revealed Peste des Petits Ruminants (PPR), pox, Orf (Contagious ecthyma), enterotoxemia, Brucellosis and John's disease as the major diseases of goats.

Whole-genome of Indian Bison type Biotype of *Mycobacterium avium* subspecies paratuberculosis (MAP) strain S5 was sequenced. The MAP was transferred to Biovet, Bangluru under PPP mode for preparation of John's disease vaccine. Human samples from suspected colitis, inflammatory bowel disease (IBD) and diabetes were screened for MAP/anti-MAP antibodies under outreach programme on zoonotic diseases. The nucleotide and amino acid sequence analysis as well as phylogenetic relatedness of *Brucella melitensis* were performed. A new PPR virus (PPRV/Nanakpur/2012) strain was isolated which cross reacted poorly with sera/monoclonal antibodies derived from Indian vaccine strain (PPRV/Sungri/96), which may help for devising proper control strategies against PPR in India by choosing a homologous candidate vaccine prototype. Capripoxviruses from sheep (Poonchh, J&K) and goats (Kanker, Chhatisgarh) were isolated in primary goat testicle culture and identified by PCR. An orf virus was also isolated (primary goat testicle culture) and identified (PCR) from outbreak in Muzzafarnagri sheep at CIRG farm unit. Procedure for isolation of the endolysins from the bacteriophages virulent to *Staphylococcus aureus* associated with

clinical mastitis in goats was standardized. The endolysins were characterized in terms of their optimum conditions for reactivity, and in vitro lytic range. These endolysins showed thermal stability at various temperatures, and an inhibitory activity against wide variety of *Staphylococcus* isolates suggestive of their therapeutic use against *Staphylococcus* causing mastitis in goats. *Toxoplasma gondii* from goats was characterized at serological and molecular (PCR-RFLP) level. Herbal therapy against Caprine coccidiosis was formulated; use of this herbal extract reduced the egg counts *in vivo* in infected animals.

A total of 358 necropsies were conducted during the year involving 99 animals from Barbari unit, 74 from Jamunapari unit, 65 from Animal Health Shed, 50 from Sheep unit, 39 from Jakhrana unit, 25 from PRSM and 6 from NFR&PT. The major causes of death diagnosed were pneumonia (39.10%), gastro-enteritis (15.64%), toxemia (5.86%), pneumoenteritis (4.74%), septicaemia (3.63%), acidosis, hemochromatosis, predation, autolysis (8.93%), and miscellaneous diseases (12.84%).

### **Extension Education and Socio-Economics Programme**

Total nine i.e. three national training on Commercial Goat Farming and six sponsored training programme on Scientific Goat farming were organized during the period under report. Institute participated in 9 exhibition/Kisan mela at different places and won II and III award for

showcasing CIRG technologies at IARI, Pusa, New Delhi and NDRI, Karnal respectively. Total six health camps were organized at Haridwar and CIRG adopted village Hayatpur. Inter institutional convergence were developed with KVK, Mathura, KVK, Agra and KVK, Auraiya. Sixty five technical letters were received and replied. Institute also entertained 1599 visitors from different parts of the country and received 1466 helpline calls and answered accordingly.

Thirteen MSc Dissertation and two Ph.D. thesis were submitted during the year. Five MVSc, one M.Sc. (Biotechnology) and six Ph.D. students are currently enrolled with various Universities and carrying out their research work under the institute scientists. Final year batch of BVSc&AH 2012 of College of Veterinary science and AH Mathura successfully completed the Internship programme at the Institute. A batch of semester II and III of M.Sc. biotechnology students of DUVSU, Mathura are also undertaking courses conducted by Institute scientists.

Eighteen Institutes funded and fifteen extramural research projects have been carried out by the Institute scientists. The revenue generation during the year was 77.9 lakhs. Institute scientists were awarded and recognized for their contributions. The scientists published 57 research articles in various national and International journals, 109 research abstracts, 23 invited papers, 20 popular articles, 10 radio talks and 16 books/book chapter/bulletins/manual.

## CIRG : AN INTRODUCTION

Considering the significance of goats in the agrarian economy of India, The Indian Council of Agricultural Research established a National Goat Research Centre at Makhdoom, Farah in Mathura district of Uttar Pradesh on 12th July, 1976. The centre got the status of a full fledged Institute on 12th July, 1979 and named as Central Institute for Research on Goats. The Institute is located almost at equi distance from two famous places – Mathura (22 Km), the birth place of Lord Krishna, and Agra (32 Km) the abode of world famous Taj Mahal. Director is the head of Institute and its apex body like IMC, RAC and QRT guide its research and other activities. Presently 38 Scientists, 65 technical and 36 administrative personnel share the responsibility to achieve mandate of the institute, which has 4 research divisions and one section including well equipped Library, ARIS cell, PME cell, Agricultural farm, IPR Cell, Livestock farm and Health Section. The Co-ordinating unit of All India Coordinated Research Project on Goat is also located at CIRG. The project aims at improving production performance of 13 breeds of goats distributed in different regions of the country under farm and field conditions. The Institute is well connected with modern information and communication facilities comprising a helpline 0565-2763320. The profile of the Institute can be visited at [www.cirg.res.in](http://www.cirg.res.in)

### Highlights of Achievements

#### Vision

To develop - the Goat- as a source of livelihood and nutritional security for future prosperity of India.

#### Mission

Improvement in productivity of goats through research, extension and HRD support.

#### Mandate

To undertake research, training and extension education for improving milk, meat and fiber production of goats and to develop processing technology of goat products.

#### Objectives

- To undertake basic and applied research in all disciplines relating to goat production and product technology.
- To develop, update and standardize area specific package of practices on breeding, feeding, management, prophylactic and curative health cover for goats.
- To transfer technologies for improving milk, meat, fiber production, value addition of goat products and capacity building.

The Institute has developed farmers' friendly and commercially viable technologies for goat improvement in the country. So far, 18 patents have been filed; one green drug technology (Alquit) for control of ecto-parasites has been commercialized to M/S Natural Remedies Pvt. Ltd, Bangaluru. Value added goat meat and milk products, area specific mineral

mixture, diagnostics for brucellosis and JD are under process of commercialization. The scientists of the Institute have successfully produced kids from embryo transfer and through IVF. A strain of *Mycobacterium avium* subspecies paratuberculosis genotype 'Indian Bison type' strain 'S 5' of goat origin has been transferred to M/S Biovet (P) Ltd, Bengaluru for development and commercialization of indigenous vaccine against John's Disease (J.D.). Recently, in recognition of its meritorious scientific achievements and technology innovation, the Institute has been bestowed with the prestigious ICAR's **Sardar Patel Outstanding Institute Award-2010**. Some of the major achievements are as follows.

- Multiplication and conservation of elite germ plasm of Jamunapari, Barbari, Sirohi and Jakhrana breed of goat for genetic improvement of indigenous goats.
- Improved reproductive performance resulting in higher population growth in Jamunapari (94.65%) and Barbari (183%) goat flocks.
- Positive genetic improvement trend in body weight at birth, at 3, 6, 9, and 12 month of age in Jamunapari goats, ( $0.12 \pm 0.03$ ,  $0.59 \pm 0.12$ ,  $1.58 \pm 0.19$ ,  $2.66 \pm 0.28$  and  $2.14 \pm 0.36$ , respectively) and at 9 month ( $0.999 \pm 0.213$  kg) in Barbari goats.
- Significant improvement in milk yield in Jamunapari, Barbari and Jakhrana goats compared to their base population performance.
- Successful freezing of semen of Jamunapari, Barbari, Jakhrana and Sirohi breeds, and production of kids through AI in goats.
- Standardized Embryo Transfer and IVF technology in goats and successfully production of kids through above technologies.
- Characterized heat stress tolerant genes i.e. AP-2 binding site in the promoter region of hsp70.1 gene, Melanocortin 1 receptor (MC1R) gene, Tyrosinase (TYR) gene and Signal transducer and activator of transcription 5 A (STAT5 A) gene to facilitate further studies on resilience of goat production system under changing climate.
- Established genetic origin of Indian goat breeds and genetic variation in Myf, leptin, Pit I, FecB, SCD gene and HSP genes in Indian goats.
- Developed complete feed pellet for efficient growth (80g/d) in finisher kids. Strategic supplementation of concentrate mixture @ 1.2 % of the body weight for better growth and meat quality of Barbari goats.
- Better dressing percentage and meat quality by supplementation of area specific mineral mixture under intensive goat rearing system.
- Identified anti-methanogenic feed resources for goat production system.
- Developed higher bio-mass producing fodder system (Guar+ Lobia + Sunhamp) for goats under rain fed conditions and *Morus alba* based cost-effective agro-forestry system for sustainable goat husbandry in semi-arid and rain fed areas.
- Developed package of practices and dynamic health calendar for goat farmers.
- Determined fatty acids and mineral status of milk of different Indian goat breeds. Standardized process for preparation of herbal functional milk, whey drinks, goat milk and meat based biscuits, and low fat cheese.

- Developed low cost-protein and mineral enriched value added goat meat products using fresh goat spleen and herb supplemented functional goat meat and milk products.
- Created baseline data on commercial goat farming.

### Technologies Developed/ Commercialized

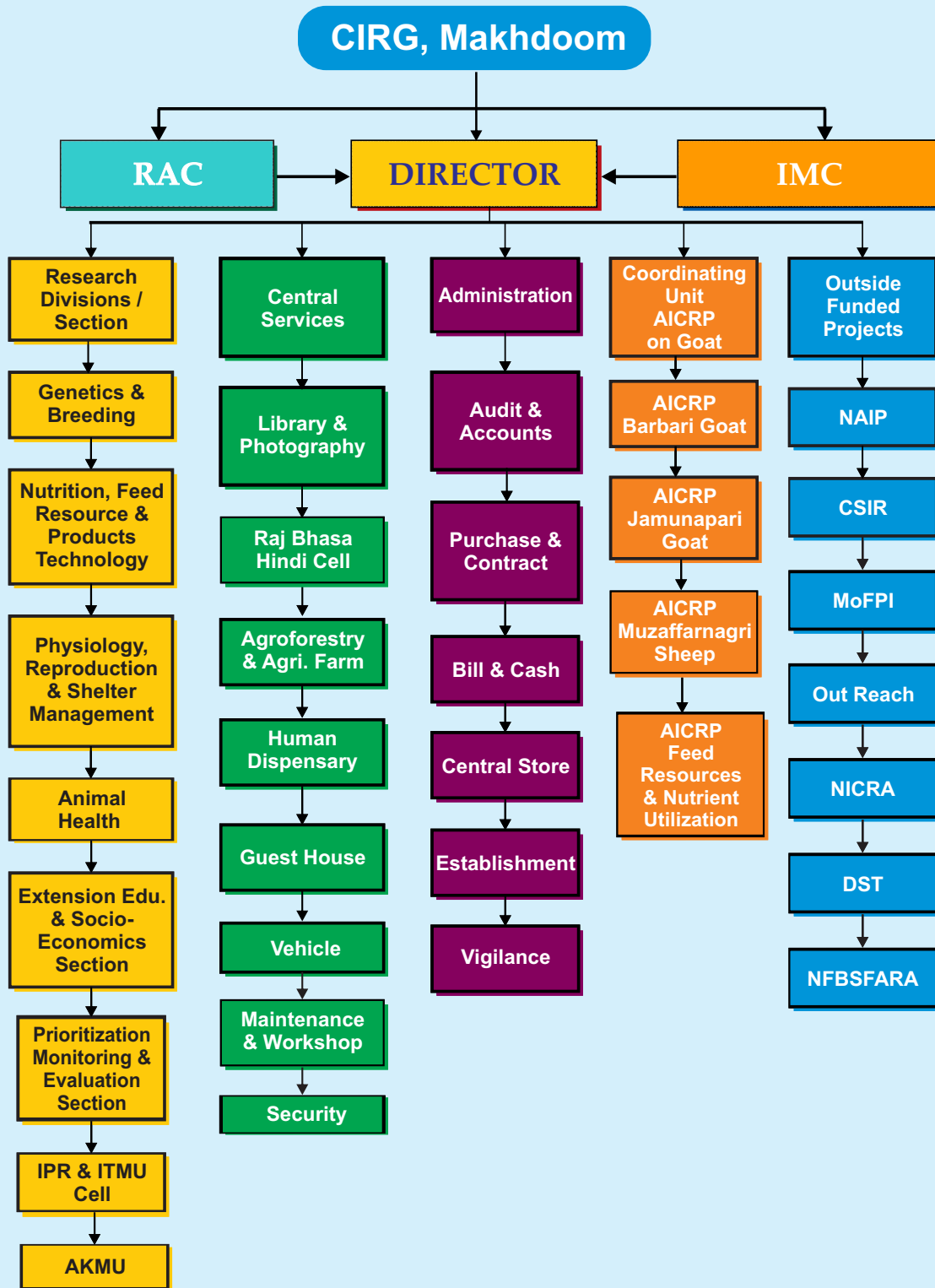
- ALQUIT- Ectoparasitocidal Drug for animals (commercialized)
- BRUCHEK-Dot ELISA Kit for diagnosis of Brucellosis
- ELISA Kit for diagnosis of Johne's Disease
- Inactivated Johne's disease vaccine
- Intra vaginal pessaries for oestrus synchronization.
- Modern goat appliances to reduce feed and water wastage
- Area specific mineral mixture
- Low cost complete feed pellet
- Cost-effective milk replacers for kids
- Goat meat Murukku: A crispy food product
- Goat meat Nimkee: A snack food
- Goat milk based moisturizer soap (Ajas)
- potential of indigenous goats through supply of superior germ plasm from institute to State Animal Husbandry Department, other developmental agencies and goat farmers
- Facilitated in establishment of several small and large commercial goat farms in different parts of the country through different training for capacity building to Veterinary professionals, farmers and other entrepreneurs on scientific goat rearing and entrepreneurship.
- Improved body weights of Jamunapari (45.67%), Barbari (31.96%) goats at 12 month age and kidding rate (1.4 in Jamunapari and 1.48 Barbari)
- Created semen bank for important goat breeds and standardized technique for successful AI in goat.
- Development of goat health calendar leading to over-all reduction in mortality.
- Development of diagnostic kit for JD and Brucellosis.
- Commercialization of ectoparasitocidal drug- Alquit.
- Development of suitable milk replacer for pre weaning kids.
- Developed complete pelleted feed, feed blocks and designing of low cost pelleting machine that is being adopted by commercial goat farmers for intensive goat rearing.

### Impact of Research

- Improved productivity and genetic



# ORGANIZATIONAL SETUP



# STAFF POSITION

Category	No. of post sanctioned	In position
RMP	1	1
Scientific	50	38
Administrative	36	36
Technical	72	65
Supporting	98	98

# FINANCIAL STATEMENT (2012-13)

	Plan (Rs.lakh)		Non Plan (Rs.lakh)	
	Allocation	Expenditure	Allocation	Expenditure
<b>A. Recurring</b>				
Establishmentcharges	0.00	0.00	1396.00	1392.40
Wages	0.00	0.00	378.00	323.33
OTA	0.00	0.00	1.00	0.62
TA	8.00	7.18	3.60	2.54
Othercharges	154.00	153.65	172.43	159.74
HRD	3.00	2.93	3.00	2.52
Total	165.00	163.76	1954.03	1881.15
<b>B. Non recurring</b>				
Equipments	35.00	34.90	7.00	6.69
Information & technology	2.04	2.03	1.00	0.99
Furniture	2.10	2.08	0.00	0.00
Librarybooks&Journals	7.13	7.13	0.00	2.49
Livestock	0.00	0.00	0.00	0.00
Work	112.50	112.50	0.00	0.00
LandDevelopment	0.00	0.00	0.00	0.00
Others	1.23	1.23	0.00	0.00
Total	160.00	159.87	8.00	7.68
<b>GrandTotal (A+B)</b>	<b>325.00</b>	<b>323.63</b>	<b>1962.03</b>	<b>1888.83</b>

## GOAT GENETICS AND BREEDING DIVISION

### GGB-1.09 : Improvement and sire evaluation of Jamunapari goats for milk production

*P.K. Rout, Gopal Dass and H.A. Tiwari*

#### Population growth

The annual flock strength of Jamunapari goats for the year 2012-2013 was 739. The population growth of the flocks was 101% during the year. The overall mortality of the flock during the year was 6.67%.

#### Growth and Milk yield

The mean of body weights of kids at birth, 3, 6, 9 and 12 months of age over the year were 3.04, 10.66, 14.45, 18.71 and 23.83 kg, respectively. The body weight at 12 months of age has increased from the year 2008 and body weight is maintained over the years at different ages. Parity of dam had no effect on kid's body weight. Male kids maintained higher growth rate at all growth stages over their counterpart. Kids born as single also showed significantly higher weights than those born as twins or triplets. A total of 20 randomly selected male kids were kept under feedlot experiment where they were offered the concentrate, green and dry fodder ad lib. These kids were kept in feedlot at 3 month of age. The overall mean of body weights were 19.31, 30.18 and 40.25 kg, respectively at 6, 9 and 12 month of age. As compared to semi-intensive feeding management, the kids under feedlot (intensive feeding system) were heavier by 3.07, 7.96 and 11.71 kg, respectively at 6, 9 and 12 month age. The average daily weight gain (ADG) of the kids under intensive management were 73.89, 120.78, 111.89 and 102.18 g/day, respectively during 3-6, 6-9, 9-12 and 3-12 month age group.

Least squares means of milk yield at 90 days and 140 days were  $86.26 \pm 2.98$  and  $126.23 \pm 8.69$  liters, respectively during the

year. There was a significant increase in milk yield at 90 days and 140 days over the years. Season of kidding had highly significant ( $P < 0.01$ ) influence on both the milk yields. Parity had significant effect on milk yield over the years. The fortnight milk yield increased up to 4<sup>th</sup> fortnight and thereafter started to decline. The doe, which had multiple births, produced more milk in comparison to doe having single kid.

#### Reproduction Parameter

Reproductive performance of Jamunapari goats in terms of breeding efficiency and kidding percent on the basis of does tupped were 93.40% & 116.41%, respectively. The kidding rate was 1.32. During this year, a total of 254 kids were born, out of which 77 does produced twin and triplet.

#### Genetic and Phenotypic Parameters

The heritability estimates for body weights at birth, 3, 6, 9 and 12 month age were  $0.15 \pm 0.07$ ,  $0.74 \pm 0.16$ ,  $0.65 \pm 0.14$ ,  $0.51 \pm 0.13$  and  $0.29 \pm 0.09$ , respectively. The heritability estimates for 90 day and 140 day milk yield were  $0.39 \pm 0.11$  and  $0.34 \pm 0.11$ . The  $h^2$  estimates for milk yield traits were moderate.

#### Supply of Improved germplasm

A total of 180 improved animals were supplied to different developmental agencies, research organizations, Non-Government Organizations and farmers for genetic improvement in the field conditions.



### **GGB1.10 : Genetic improvement of Barbari goats for meat and milk production**

*S. K. Singh, Shivsharanappa, Nitika Sharma*

Genetic improvement programme for meat and milk in Barbari goats at institutional farm continued during the year 2012-13. On 1st April, 2012, 776 Barbari goats were available out of this 256 were adult females and 88 were bucks. Overall mortality was 8.25%. At the end of the financial year of 2012-13, 690 goats were available out of this 79 males were for sale for breed improvement purpose. The population growth during the year was 149%.

Data on adult body weight for birth, 3, 6, 9 and 12 months of age were analyzed using least square method (LSMLMW/PC2 version). The fixed effects included in the analysis were year, season of birth, sex of kids and type of birth while weight of dam at kidding were taken as regression. The least squares mean of body weights at birth, 3, 6, 9 and 12 months of ages were  $1.75 \pm 0.02$ ,  $7.27 \pm 0.09$ ,  $11.55 \pm 0.26$ ,  $14.81 \pm 0.38$  and  $18.19 \pm 0.65$  kg, respectively during the year. The corresponding body weight during the year 2011-12 born kids were  $1.84 \pm 0.02$ ,  $7.66 \pm 0.09$ ,  $11.69 \pm 0.14$ ,  $16.22 \pm 0.19$  and  $19.37 \pm 0.22$  kg respectively. Single born kids were significantly heavier than that of twin or triple up to 9 month of age. Year and season of birth significantly affected body weight at different ages. The heritability of for body weight at birth, 3, 6, 9 and 12 months of ages were  $0.189 \pm 0.043$ ,  $0.231 \pm 0.048$ ,  $0.260 \pm 0.051$ ,  $0.494 \pm 0.074$ ,  $0.655 \pm 0.088$ , respectively. The absolute selection differential for 9 months body weight was 3.09 kg and that of the dam's milk yield 2.58 liters, respectively which has resulted in significant and positive genetic and phenotypic trend of body weight at different ages.

The lactation performance of the Barbari goats for milk yield for 90, 140 days and Lactation Milk Yield (LMY) and Lactation Length (LL) were  $52.91 \pm 0.89$ ,  $79.48 \pm 1.91$ ,  $62.05 \pm 1.24$  liter and  $126.48 \pm 1.42$  days, respectively during the year. Corresponding milk lactation performance in 2011-12 were  $51.39 \pm 0.84$ ,  $73.81 \pm 1.86$ ,  $60.07 \pm 1.14$  and  $123.32 \pm 1.31$ , respectively. Goats kidding in March-April season produced significantly higher milk than does kidded during October-November (autumn season). The order of kidding (Parity of dam) did influence lactational traits significantly. Highest milk production was observed in 4th and 5th parities. The  $h^2$  estimates for MY 90, 140 days, LMY and LL were  $0.465 \pm 0.131$ ,  $0.483 \pm 0.133$ ,  $0.445 \pm 0.129$  and  $0.309 \pm 0.115$ , respectively. Genetic trend for lactation traits were negative and might be due to gradual reduction in age at first kidding.

The breeding efficiency on the basis of does available was 101% and on the basis of does tugged was 98% during the year 2012-13, while respective values for the year 2011-12 were 102 and 85 percent. Kidding rate was 1.46. Out of 307 kiddings 172 (56.02%) were single, 130 (42.02%) were twin and 5 (1.95%) were triplet. Age and weight at first kidding, kidding interval, service period and gestation period were  $406.9 \pm 8.3$  days,  $16.23 \pm 3.3$  kg,  $219.07 \pm 6.2$  days and  $146.7 \pm 1.4$  days respectively. Desirable gain in body weight might have allowed goats for early sexual maturity. Since the health condition of herd was optimum and they were allowed to rebreed during the same year because of this few goats reproduced twice within a span of 12-14 months. During 2012, 332 does were available for breeding making tugging % as 102. Out of this 307 does kidded during the calendar year 2012-13 produced 448 kids at the rate of 1.46 kids per kidding. Kids born as multiple were 61.61%. 158 buck and 83 females were sold for conservation and improvement in field.

The BLUP estimates of breeding values for all animals were estimated using animal model and ASREML programme. Deworming and drenching, vaccination for FMD, ET, PPR and dipping to control ectoparasite were practiced as per schedule. The overall mortality of flock was 8.25%.

### **GGB 1.12: Improvement of Jakhrana breed of goat (*Capra hircus*) for milk and meat production under farm and field conditions**

*Saket Bhusan, U. B. Chaudhary, Gopal Dass, A. K. Mishra*

Jakhrana is a valuable dairy breed of India and also used for meat due to higher kidding rate and its compact and large size body. It is a hardy breed and can be reared in low resources. The coat colour of the breed is black with white speckles on the ears. Teats and udder of the breed are long and heavier. It is distributed in Alwar and its surrounding districts in Rajasthan. Small population of the breed and its grades are also reported in Narnaul, Gurgaon, Bhiwani and Rohtak districts of Haryana and adjoining areas of U.P. The breed derives its name from the name of village "Jakhrana", where it is found in most pure forms. Farmers generally prefer to rear these goats because of their shining body colour, beautiful look and good performance.

Jakhrana goats are maintained under semi intensive system of management. Animals were allowed for grazing from 8 am to 4 pm. Regular treatment and prophylactic measures were adopted in terms of vaccination against all important diseases like PPR, enterotoxaemia and FMD and H. S. Deworming with different anthelmintic was done pre monsoon and post monsoon seasons. Dipping was done as per health calendar schedule.

Kids were selected for future bucks and does on the basis of 9 months body weight to increase body weight of kids. Does are selected on the basis of 90 days milk yield to increase milk production. Kidding rate is also considered for selection of the does and bucks for breeding. Selective and controlled breeding was practiced in the flock. The does were bred during May-June and October-November only because more than 85 % does comes in heat in these two season followed by kidding in the months of October-November and March-April. After kidding, kid birth weight, sex and birth status of each kids are recorded then kids are weighted 15- day's interval from birth to weaning and thereafter at monthly interval up to 12 months of age. Weaning of kids is generally done at 3 months of age.

#### **Population Dynamics:**

Initial population of Jakhrana goats was 251 (81 males and 170 females). Animals of different groups in closing population were 5 males and 7 females of 0 to 1 months, 16 males and 9 females of 1-3 months, 21 males and 18 females of 3-6 months, 2 males of 6-9 months and 32 males and 114 females of above one year age groups. Closing population of Jakhrana goats was 224 (76 males and 148 females).

#### **Kidding rate:**

In the year 2012 -13, out of 77 kidding 119 kids were born. Out of 119 kids, 63 kids (52.94 %) were male and 56 kids (47.06%) were female. Out of 77 kidding, 35 does (45.45 %) gave single birth and 42 does (54.55 %) produced twins. The kidding rate of Jakhrana goats was 1.54.

#### **Supply of improved germplasm:**

Nine males and 4 does were supplied to the farmers, government and non-government agencies for the breed improvement in the field during 2012-13.

#### **Growth performance of kids and milk production of nucleus flock:**

Means for birth weight, 3, 6, 9 and 12 month weight of kids during 2009-10, 2010-11, 2011-12 and 2012-13 were calculated and presented in the table given below. Economic traits like growth and milk production of goats are affected due to genotypic effect, environmental effect and genotypic and environmental interactions. To express fully genotypic effect of selection proper environment is required. There was lowest mortality and morbidity of kids in 2010-11 hence 3, 6, 9 and 12 month weight of kids during this year and birth weight of 2011-12 were increased effectively. It indicated that genes were expressed properly in the proper management and other environmental conditions in 2010-11. Since mortality and morbidity of kids in 2009-10 was more due to different environmental factors hence 3, 6, 9 and 12 month weight of kids during this year were lower than 2010-11 and 2011-12. Birth

weight of 2010-11 was lower due to poor environmental conditions of 2009-10 because gestation period of these kids were completed in 2009-10. Similar results were also observed for the birth weights of kids of 2011-12 and 2012-13. In 2011-12, there was again more mortality and morbidity in kids hence genotypic effect could not expressed fully in comparison of 2010-11 ultimately body weight of 3, 6, 9 and 12 month weight of kids during this year were decreased than 2010-11 but these were higher than 2009-10 due to genotypic effect of continuous last two years of selection. Means for 30, 60, 90, 120 days milk production of 2009-10, 2010-11, 2011-12 and available data 2012-13 were calculated and presented in the table given below. Milk production of Jakhrana goats were increased effectively from 2009 to 2012 each year due to genotypic effect of selection of each year.

**Table 1: Least Squares Mean of Body Weight Growth (Kg) of kids and milk production (liter) of Jakhrana does**

Year	Birth	3M	6M	9M	12M
Least Square Means of Body Weight					
2009-10	2.76±0.05(122)	7.67±0.13(108)	10.45±0.23(79)	14.24±0.32(66)	19.53±0.48 (61)
2010-11	2.69±0.07(83)	10.00±0.21(81)	13.55±0.30(77)	17.90±0.41(73)	23.55±0.52 (70)
2011-12	2.72±0.04(119)	9.28±0.12(111)	12.74±0.28(103)	16.77±0.30 (81)	21.50±0.31 (66)
2012-13	2.63±0.07(119)	7.31±0.10(62)	9.21±0.96(9)	-	-
Least Squares Means of Milk Production					
Year	30 d	60 d	90 d	120 d	150 d
2009-10	36.10±1.29(82)	72.12±2.59(74)	98.47±4.09.(70)	121.44±4.96(59)	161.11±7.81(26)
2010-11	44.72±1.76(59)	86.23±3.25(59)	121.58±4.69 (59)	152.15±5.93(52)	184.28±7.78(38)
2011-12	48.57±1.92(76)	91.06±3.32(74)	124.71±4.65 (67)	167.12±5.38(55)	193.77±7.73(28)
2012-13	46.14±1.17(72)	80.62±1.95(51)	108.78±2.74(45)	133.02±4.10(31)	

### **GGB 2.10 : Genetic evaluation and improvement in Muzaffarnagari sheep for body weight and wool yield.**

*Gopal Dass, Souvik Paul,  
S.D. Kharche and V. Rajkumar*

Muzaffarnagari, the heaviest mutton producing sheep breed of the country, is mainly distributed in Muzaffarnagar and its adjoining districts of Western Uttar Pradesh viz. Meerut, Bulandshahar, Saharanpur and Bijnor. The breed is usually reared for mutton production as wool production is low with coarse quality, thus not suitable for carpet manufacture. This breed is considered as less known genotype exhibiting better growth and good adaptability than other Indian sheep breeds. The institute has been maintaining a pure bred flock of Muzaffarnagari sheep under a "Network Project on Sheep improvement" since 1976. Presently the efforts are being made to improve the breed for higher mutton production through selective breeding.

#### **Management of flocks**

Flocks were maintained under semi-intensive system of feeding management. Controlled breeding was practiced to improve the managerial efficiency. Ewes were bred during May-June and October-November followed by lambing in the months of October-November and March-April, respectively. The lambs were weaned at 2 months of age due to poor milk production as well short lactation period of their dams. Regular treatment and strict prophylactic measures were practiced for vaccination against Enterotoxaemia, Foot and Mouth Disease, Sheep Pox, H.S., PPR etc. De-worming with different anthelmintic was practiced at pre-monsoon and post monsoon seasons and as and when required. Dipping was done after 15-20 days of each shearing. On the first day of the year the opening balance was 588 which comprised of 171 males and 417 females and

closing balance of 550 sheep had a stock of 185 males and 365 females. During this year a total of 263 lambs born and overall mortality was recorded 5.05%.

#### **Production Performance**

The overall least-squares means of body weights of lambs at birth, 3, 6, 9 and 12 month age were  $3.75 \pm 0.05$ ,  $15.21 \pm 0.25$ ,  $23.59 \pm 0.55$ ,  $27.23 \pm 0.63$  and  $31.00 \pm 0.64$  kg, respectively. Sex and year of lambing had significant influence on almost all body weights. Male lambs gained higher weights as compared to female lambs at all growth stages. Body weights in different year showed that birth weight and 6 month weight were significantly higher in year 2012 as compared to previous two years while body weights at other stages were almost similar to previous year. The overall least-squares means of birth weight of lambs born in first season of year 2013 was  $3.63 \pm 0.07$  kg. The average daily weight gain during 0-3, 3-6, 6-9, 9-12 and 3-12 months were  $127.15 \pm 2.62$ ,  $83.55 \pm 3.63$ ,  $41.29 \pm 3.58$ ,  $51.05 \pm 4.30$  and  $54.32 \pm 2.29$ g, respectively. The average adult body weights of males and females were respectively 51.2 and 39.9 kg.

The overall least squares means for lambs 1st and 2nd six monthly and adult annual clips were calculated to be  $530.70 \pm 9.72$ ,  $567.62 \pm 10.05$  and  $1198.16 \pm 22.88$ g, respectively. Males produced significantly higher greasy fleece yield than females in all the clips which might be due to larger surface area for wool growth in males as compared to females.



Particular	Birth wt.	3M wt.	6M wt.	9M wt.	12M wt.
Overall mean	3.65±0.03 (691)	15.26±0.15 (577)	22.72±0.24 (434)	26.96±0.26 (407)	31.09±0.27 (370)
Sex	NS	*	**	**	**
Male	3.69±0.03 (363)	15.61±0.20 (296)	24.34±0.33 (207)	29.39±0.35 (194)	33.91±0.37 (167)
Female	3.61±0.04 (328)	14.91±0.21 (281)	21.11±0.31 (227)	24.53±0.33 (213)	28.26±0.34 (203)
Year	*	**	**	**	NS
2010	3.53±0.05 (146)	13.65±0.29 (135)	21.14±0.38 (128)	25.71±0.39 (122)	30.90±0.42 (104)
2011	3.71±0.04 (265)	16.92±0.21 (261)	22.44±0.28 (244)	27.94±0.28 (237)	31.36±0.29 (222)
2012	3.75±0.05 (197)	15.21±0.25 (181)	23.59±0.55 (62)	27.23±0.63 (48)	31.00±0.64 (44)
2013	3.63±0.07 (83)	-	-	-	-

Being large sized, the twinning rate is comparatively lower in Muzaffarnagari sheep. But due to proper screening and use of those rams and ewes responsible for producing twins and triplets, the twinning rate improved tremendously during this year. The annual tupping, lambing on available basis and lambing on bred basis were 86.9, 74.3 and 86.7%. These reproductive parameters in season first and second were respectively 83.7, 75.1, 91.0% and 81.1, 62.2, 77.9%. During this year, the twinning rate recorded to be 17.6, 26.7 and 20.3% respectively in first & second season and annual. The twinning rate during this year was the highest of till date performance and it increased by 73.9 % over last year. The overall replacement rate was estimated as 33.2%.

#### **Distribution of elite germplasm and revenue generation:**

A total of 149 elite animals (58 rams and 91 ewes) were supplied to various developmental agencies, Research organizations, Non-Government organizations and progressive farmers for genetic improvement of their flocks under field conditions.

#### **NAIP Project: Goat husbandry based integrated approach for livelihood security in disadvantaged districts of Bundelkhand region**

*M.K. Singh, A.K. Dixit, R.B. Sharma, S.V. Singh, A.K. Goel, Sanjeev Kumar (wef: February 2012), A.K. Roy*

24 breeding Bucks and 458 females was made available to 225 project beneficiaries of 9 adopted villages. Low potential goats were upgraded by supplied bucks. Males born as twin from high yielding does were selected as future buck. About 30% goat keepers have replaced their poor quality and aged bucks with new unrelated bucks. Castration of scrub buck is going on with support of Kirti Soudh Sansthan (NGO). Progenies born from superior bucks were showing significantly higher growth performance. Establishment of a kid's nursery by Kirti Soudh Sansthan (NGO) is in progress in collaboration of the project. Concentrate for supplementation was provided to 570 beneficiaries for pregnant and lactating goats and those yearlings which have bred at early ages. About 35% beneficiaries have adopted supplementary /strategic feeding for their goats. Vaccination against major infectious diseases of goat brought down mortality

from 30% (2009) to 4.2% (2012). Mortality in cattle and buffaloes brought down from 9.6% (2009) to 3.7% (2012). Adoption of health calendar schedule in livestock (goat, cows and buffaloes) provided additional income of Rs 3204/household/year. About 70% livestock keepers have adopted prophylactic measures. Mineral mixture provided to cow and buffaloes have substantially improved their fertility status. Low cost water devices were provided to 100 beneficiaries. 40 low cost innovative goat shelters were introduced in 7 adopted villages. Three training programmes were conducted at Mahoba and Rath. Fodder resources were developed through Horti-silvipasture, perennial grasses and cultivated fodder crops with improved varieties in 302 farmer's field of 14 villages. Perennial grasses provided 10-12 ton fodder/h. Fodder crop yield was 312 Qt/h in Kharif and 615 Qt/h in rabi season. Fodder crop varieties introduced were also adopted by 94 farmers of adjoining 11 non-adopted villages. Milk yield of goat, cow, and buffalo were increased 18, 22 and 30%, respectively over baseline value due to additional fodder availability which provided additional income of Rs 4285/household/year. Goat rearing with improved management practices is also in progress in another 12 villages of Mahoba district and at some progressive flocks of Banda and Lalitpur districts in

collaboration of State AH department and NGO's. Goat keepers of all 16 villages were introduced to organized goat market through a NGO supported by Tata Trust. Remunerative price for goat (9-18 month old male) will be paid @ Rs 150/kg/live weight. Farmers were motivated for insurance of their goats and 42 goat keepers of 2 villages have insured their goats. One unit of goat of 5 adult females provided additional income of Rs 19000/year/household above baseline income. Four goat based integrated livelihood models were recommended. Linkages and synergy developed mainly with a Mahoba based NGO, Kriti Sodh Sansthan (KSS) and also with state agriculture and animal husbandry departments, financial institutions namely State Bank of India, Allahabad Bank and National Horticulture Mission. Banks and District Agriculture department, Horticulture departments has agreed to provide technical and financial supports to the goat keepers. Group discussions were jointly organized with KSS in adopted village under NAIP Comp-3 Bundelkhand project to discuss social-environment issues (malnutrition, mortality, child sex abuse, dropping of school children, road side for night soiling by women, Anna Pratha, maintenance of common grazing and water drinking resources.



## NAIP Project: Bioprospecting of genes and allele mining for abiotic stress tolerance

P.K. Rout, S.K. Jindal and  
N. Ramachandran

### I. Phenotyping of the population basing on physiological indicators in response to heat stress

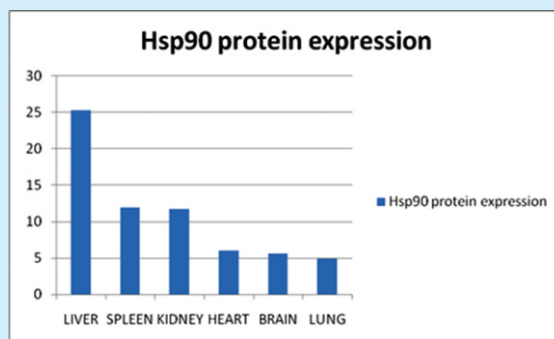
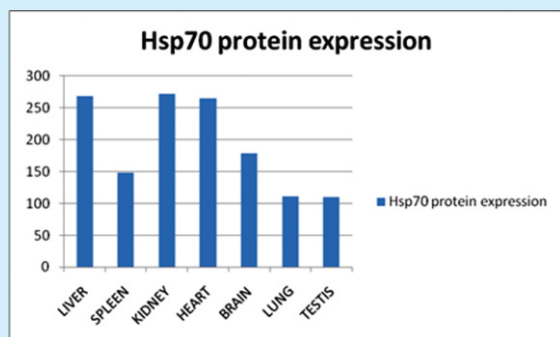
As there was no clear-cut method to define an individual stress susceptible and stress tolerant in livestock species, therefore it becomes very difficult for phenotyping the animal. Physiological response including surface temperature was recorded in 194 animals. Basing on physiological response in four different breeds, phenotyping method is proposed on respiration rate (RR) and Heart rate (HR). On the basis of this method, three different types of animals were observed i.e. Heat stress susceptible, Heat stress tolerant and Intermediate type.

### II. Hsp70 gene genotyping by HRM analysis.

HRM analysis was carried out in 48 individuals for Hsp70 gene in goat. The analysis showed 5 different genotypes. Two major groups shared by 58.3% and 33.3% of the population. The other three groups shared only 4.16%, 2.08% and 2.08% population and it is being analysed for determining SNP in the region.

### III. Gene expression analysis in different tissues in response to heat stress

The individuals belonging to four breeds (96) were phenotyped based on respiration

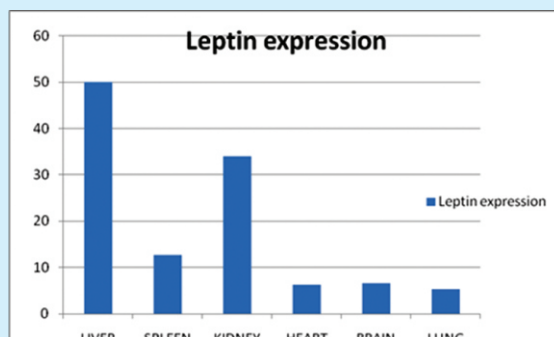


rate and heart rate. The contrasting genotypes were identified and 22 different individuals slaughtered during peak heat stress period and high THI. The differential gene expression was analysed for Hsp70 gene in goat.

As there was no information available on target organ for Hsp gene expression in goat in response to heat stress. The protein expression was analysed for Hsp70, Hsp 90 and Leptin gene in different tissues. Hsp70 protein was highly expressed in kidney, liver and heart followed by brain, spleen, lungs and testis. Kidney, liver and heart had two fold higher protein expression as compared to other organ.

Hsp90 protein was comparatively less expressed in those tissues. Liver was showing highest expression of protein and 5 fold higher than lungs, brain and heart. Kidney and spleen were showing one fold less expression as compared to liver.

Leptin expression was highest in liver followed by kidney and about 10 fold higher than heart, brain and lungs. Spleen had two fold higher expression than brain, heart and lungs.



## PHYSIOLOGY, REPRODUCTION AND SHELTER MANAGEMENT DIVISION

### XI/PRSM-1.1: Studies on refinement of frozen semen technology and strengthening of goat semen bank

S.K. Jindal, A.K. Goel, S.D. Kharche, N.Ramachandran, Satish Kumar and R. Priyadharshini ( upto 12.5.2012)

#### Strengthening the semen bank

Ejaculates were selected if the following criteria were met: semen volume more than 0.5 ml, mass activity more than grade 4 and initial progressive sperm motility more than 80%. Semen dilution was performed using a Tris buffer, with 10% egg yolk (Tris-0.29M, Citrate-0.1M and Fructose-0.11M, Streptomycin- 100 mg and Penicillin-1.0 lakh IU/100ml) and 6% glycerol as the semen cryoprotectant and diluted to a final concentration of approximately  $250 \times 10^6$  cells/ml - calculated using a haemocytometer. The samples showing individual motility of more than 30% were stored and later used for AI. Thawing of the straws was performed individually at 40°C for 15 seconds in water bath, for microscopic post thaw sperm evaluations.

#### Frozen semen artificial insemination in Jamunapari, Sirohi and Barbari goats

Artificial insemination of Sirohi, Barbari and Jamunapari goats were done during the



Artificial Insemination Crate for Goat



Triplet born through A.I. in Jamunapari goat

breeding season. To overcome the difficulties during goat AI particularly during hot humid climate a suitable AI crate was designed and developed.

#### A.I. of Jamunapari Does:

Thirty two Jamunapari does were presented for AI during first oestrus at the start of breeding season i.e. June, 2012. For A.I., Jamunapari goats were randomly divided into two groups

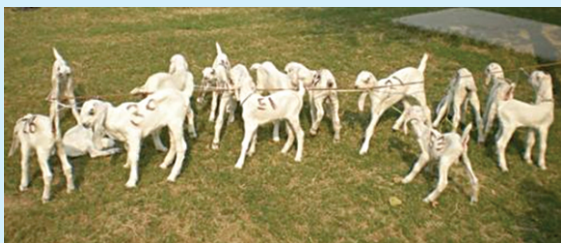
Group 1 (n=18) Jamunapari does were restrained in such a way that the rear part was kept higher as both the hind legs were lifted and held by the helper at the time of A.I.

Group 2 (n=14) Jamunapari does were restrained in a dorsal recumbence position in a specially designed crate for A.I.

The does were inseminated 12 hr after the onset of oestrus, twice at 12hr interval using frozen semen. The result indicated that the kidding rate in group 1 Jamunapari goats



Twin kids born through A.I. in Jamunapari goat



*Jamunapari Kids born through A.I.*

following artificial insemination without crate was 44.44% whereas that of group 2 Jamunapari goats was 64.28% by using especially designed AI crate.

Our data demonstrated a higher kidding rate by using especially designed AI crate as compared to without crate. This might be due to use of crate particularly during hot humid environment facilitates the AI by providing comforts to goat as well as helper. Overall, out of 32 Jamunapari goats 17 become pregnant with a pregnancy rate of 53.12%. One doe gave triplets (5.88%), nine does delivered twins (52.94%) and seven does produced singles (41.17%). Thus 17 does delivered 28 kids with kidding rate of 1.64.

#### **A.I. of Barbari Does :**

Twenty five Barbari does were presented for AI during first oestrus at the start of breeding season i.e. April, 2012. The does were inseminated 12 hr after the onset of oestrus, twice at 12hr interval using frozen semen. Eighteen does were return into oestrus within a period of 5 to 10 days post oestrus indicating 72.0% of short oestrus cycles at the start of breeding season in the Barbari goats. Out of seven does, two does were delivered kids with a CR of 28.57%.

#### **Transrectal Ultrasonography of Goats**

Goats after 28-30 days of AI were selected for ultrasonography. These goats were kept off feed for 24 hour before ultrasonography and assisted during Transrectal ultrasonography (Toshiba, Just Vision 200) using 7 MHz transducer specially designed for goats.

### **XI/PRSM-1.2: Augmentation of prolificacy by using biotechnological tools in goats**

*S. D. Kharche , A.K. Goel, S.K. Jindal, P. Raju (upto 12-05-2012), Satish Kumar*

#### **Induction of Oestrus using Intravaginal Pessaries/ Injection during winter (Oct-Nov):**

Sirohi goats (26) were randomly divided into two groups for induction of oestrus. Group 1 (n=17) goats were inserted with 'CIRG Sponges' for 10 days. At the time of insertion, each goat received 1ml injection intramuscularly. Group 2 (n=9) goats were only inserted with 'CIRG Sponges' for 10 days. All goats of group 1 were treated with 300 IU of PMSG inj. and group 2 was injected with 2mg estradiol valerate 24hr before withdrawal of sponge. Intravaginal pessaries were removed 10 days after insertion and at this time each goat received 1 ml of Cyclicx (Cloprostenol). The oestrus response, onset of oestrus and duration of oestrus in Group 1 and Group 2 were 82.3%, 37.7hr, 26.5hr and 88.8%, 28.5 hr and 73.5 hr, respectively.

#### **Effect of immunization on prolificacy of Sirohi Goats**

Synthetic peptides mimicking  $\alpha$ -subunit of porcine Inhibin were conjugated to Ovalbumin with the peptide-Ovalbumin molar ratio being approximately 20:1 to increase their antigenicity. Primary immunization involved subcutaneous injection at two different sites of 400 $\mu$ g of peptide-ovalbumin conjugate dissolved in 1ml of isotonic saline emulsified with an equal volume of Freund's complete adjuvant to the treatment group comprising of six non-pregnant cyclic adult does. A control group of six non-pregnant cyclic adult does were injected subcutaneously with 400 $\mu$ g of ovalbumin dissolved in 1ml of isotonic saline emulsified with an equal volume of Freund's complete adjuvant.

Three booster doses of 200 µg of peptide-ovalbumin conjugate to treatment group and 200µg of ovalbumin to control group dissolved in 1ml of isotonic saline and emulsified with an equal volume of Freund's incomplete adjuvant were given to each goats at every 4 weeks interval. Estrus detection was synchronized by using a double injection schedule of PGF2 α (Cloprostenol@ 263µg/ml/doe) on day 35 and 45 from the day of last booster dose. Blood sample of experimental goats were collected after the inhibin immunization on twice a week to observe the ovarian activity in relation to the increased ovulation and corresponding increase in corpora lutea.

#### **Estimation of progesterone in blood:**

The progesterone concentration in serum on different days after inhibin immunization was estimated by ELISA technique using commercially available LabServ progesterone ELISA kits-(Thermo Fisher Scientific India Pvt Ltd, Mumbai). The plasma progesterone concentration was found to be higher in the actively immunized group than that of the control group throughout the observation period.

#### **Breeding of Goats**

Following estrus detection the goats were mated with breeding bucks. The conception rate in treated and control group were 83.33% and 50.0%, respectively. In the present study the increase in the ovarian activity by immune neutralizing the inhibin has been clearly demonstrated by increasing the conception rate as compare to control.

### **Developmental potency of parthenogenetic goat embryos**

*S.D. Kharche, A.K. Goel, S.K. Jindal*

#### **Oestrus Detection and Synchronization**

A flock of 50-70 goats maintained at experimental farm of the division was used as recipients for synchronization with donor goats for embryo transfer.

#### **Parthenogenetic embryo production and transfer**

#### **Chronology of nuclear maturation of *in vitro* matured goat oocytes:**

A total of 376 cumulus-oocyte complexes (COCs) were used for *in-vitro* nuclear maturation of goat oocytes. The maturation rate of oocytes was recorded employing the criteria of nuclear examination after the DAPI staining procedure of matured oocytes in which Metaphase II stage of nuclear maturation with two shiny spot in cytoplasm or polar body were evaluated. The maturation rate in group at 24hr, 27hr and 30hr were 61.43, 76.75 and 71.96 % respectively.

#### **Parthenogenetic embryo production in potassium simplex optimization medium:**

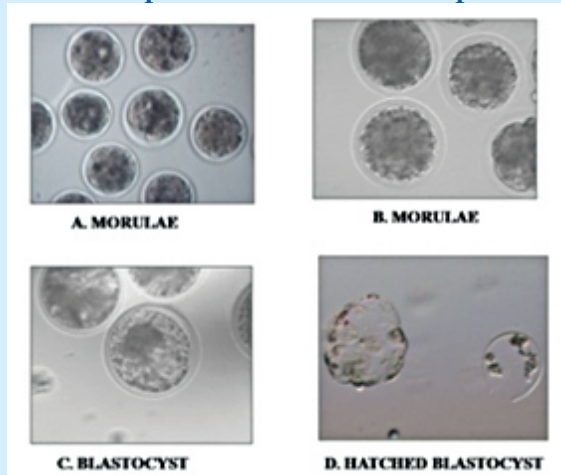
A total of 1004 cumulus oocyte complexes (COC's) were collected from 454 ovaries. Oocytes were matured in TCM-199 medium for 27h. Matured oocytes (n=933) were randomly divided into 4 groups. Group 1 *in-vitro* matured oocytes (n=109) were cultured for 4 hr without any chemical activation treatment in KSOM (control). Group 2 *in-vitro* matured oocytes (n=579), were exposed to 7% ethanol for 5 minutes followed by treatment with 2.0 mM DMAP for 4 hr in KSOM. Group 3 *in-vitro* matured oocytes (n=145) were exposed to 7% ethanol for 5 minutes followed by treatment with 10µg/ml CHX for 4 hr in KSOM. Group 4 *in-vitro* matured oocytes (n=100) were exposed to 7% ethanol for 5 minutes followed by treatment with 2.0 mM DMAP

and 10µg/ml CHX for 4 hr in KSOM. The percentage of cleavage and morula production in group 1, 2, 3 and 4 were 0.00% and 0.00%, 42.83% and 24.59%, 58.62% and 30.58% and 74.0% and 31.08%, respectively.

#### Parthenogenetic embryo production in mCR<sub>2</sub>aa medium

*In-vitro* matured oocytes (n=933) were randomly divided into four groups. Group 1 *in-vitro* matured oocytes (n=108) were cultured for 4 hr without any chemical activation treatment in mCR<sub>2</sub>aa medium (control). Group 2 *in-vitro* matured oocytes (n=226), were exposed to 7% ethanol for 5 minutes followed by treatment with 2.0 mM DMAP for 4 hr in mCR<sub>2</sub>aa medium. Group 3 *in-vitro* matured oocytes (n=294) were exposed to 7% ethanol for 5 minutes followed by treatment with 10µg/ml CHX for 4 hr in mCR<sub>2</sub>aa medium. Group 4 *in-vitro* matured oocytes (n=325) were exposed to 7% ethanol for 5 minutes followed by treatment with 2.0 mM DMAP and 10µg/ml CHX for 4 hr in mCR<sub>2</sub>aa medium. The percentage of cleavage rate group 1, 2, 3 and 4 was 0.00%, 54.42%, 44.55% and 51.69%, respectively. The percentage of morula and blastocyst production in group I, group II and group III were 26.01%, 29.77% and 29.76% and 2.43%, 1.52% and 1.78%, respectively.

#### Dose dependent effect of protein



#### synthesis inhibitor on the developmental potency of parthenogenetic goat embryos:

Morphological matured oocytes (n=972) were randomly divided into five groups. Group 1 (n=170) *in-vitro* matured oocytes activated with 5 µm Calcium ionophore for 5 min. and cultured in mCR<sub>2</sub>aa medium without DMAP treatment for 4 hours (control). Group 2 (n=189) *in-vitro* matured oocytes activated with 5 µm Calcium ionophore for five min. and cultured in mCR<sub>2</sub>aa medium containing 2.5 mM DMAP for 4 hours. Group 3 (n=272) *in-vitro* matured oocytes activated with 5 µm Calcium ionophore for five min. and cultured in mCR<sub>2</sub>aa medium containing 5 mM DMAP for 4 hours. Group 4 (n=178) *in-vitro* matured oocytes activated with 5 µm Calcium ionophore for five min. and cultured in mCR<sub>2</sub>aa medium containing 10 mM DMAP for 4 hours. Group 5 (n=163) *in-vitro* matured oocytes activated with 5 µm Calcium ionophore for five min. and cultured in mCR<sub>2</sub>aa medium containing 20 mM DMAP for 4 hours. After 4 hours of DMAP treatment, the presumptive zygotes of five groups were washed and cultured in the embryo culture medium. The cleavage rate, blastocyst and hatched blastocyst percentage in groups 1, 2, 3, 4 and 5 were 61.76, 0.00% & 0.00%, 59.79, 10.62% & 0.00%, 72.43, 10.66% & 1.52, 64.61, 7.83% & 0.00%, and 63.19, 3.88% & 0.00%, respectively.

#### Parthenogenetic embryo transfer

Parthenogenetic embryos produced as above of different stages were surgically transferred into twenty six recipients. In twelve recipient 2 to 8 cell parthenogenetic embryos (8-12 embryos in each recipient) were transferred into the fallopian tube through infundibulum epsilateral to the corpus luteum whereas other fourteen recipients received 16 to 32 cell parthenogenetic embryos (8-12 embryos in each recipient) at the tip of the uterine horn epsilateral to the corpus luteum.

### Ultrasonography

Oestrus detection following embryo transfer in recipients was carried out with the teaser buck twice a day. Following embryo transfer, *in-vivo* survivability of parthenogenetic embryos into the recipients were also monitored by using B-mode ultra sonography (Just Vision, Toshiba, Japan) at day 30 and pregnancy was confirmed in one recipient. The foetus aborted on day 34 of pregnancy.

### Isolation of DNA from foetal tissue:

Tissue from the head of parthenogenetic fetus was crushed, mixed with proteinase K and incubated overnight and DNA was isolated. (Dr. P. K. Rout, CIRG, Makhdoom).

### Analysis of Amelogenin gene for sexing of foetal DNA sample:

DNA Sample was taken in 0.2 ml PCR tube for PCR reaction and Amelogenin gene was analyse for sexing of parthenote.

(Dr. D. Malakar, NDRI, Karnal).

### .Microsatellite analysis:

Based on the results of genotyping approximately 662 goats for these 14 loci amplifiable (Table1) in a single multiplex PCR reaction and loaded in a single lane of an ABI Automated DNA sequencer.

PCR products were separated on an ABI Prism 3130xl Automated DNA Sequencer (Invitrogen Inc.) and sized relative to an internal size standard (GS500, Applied Biosystem Invitrogen). Fluorescent signals from the dye labeled microsatellites were detected using GENESCAN 3.1 software (Applied Biosystems). Genotypes were assigned using Gene Mapper 4.0 software (Applied Biosystems)

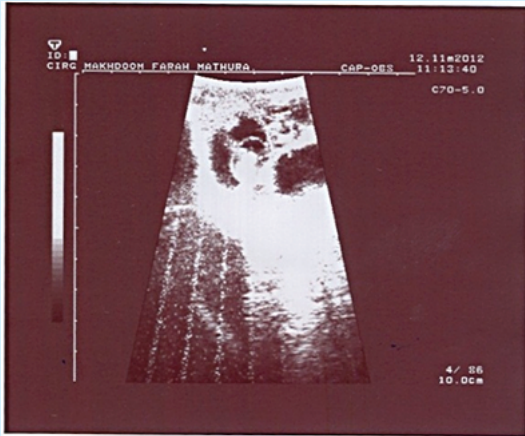
(Dr. R. K. Vijh, NBAGR, Karnal).

Out of the 14 microsatellite loci utilized for the analysis 12 loci amplified. Two markers exclude the origin of the parthenogenetic foetus from the other and thus reveal that the surrogate mother has not contributed genetically to the foetus.

**Table 2. Markers used for genotyping**

S.No.	Markers	Forward	Reverse	Tag	Size of allele	
					Min	Max
1	BB719	AAATGCCAGGACCTCACAG	GCTAGGAGATGTTGCTGCTG	NED	263	299
2	BM6548	CGTTTTGGGAGTTTTCTTATGG	TAGCATGCACACATACACGC	FAM	234	250
3	BM8215	CCAAAGAAGCTGAAGTTGACTG	CTGACTTTTGCATTTCAACCC	FAM	100	130
4	BMS1909	ACTTGTTAGGAGGGCTATTGTAA	CCACATACACCACCAACATTAA	NED	59	93
5	BMS356	ACCTCAGAGATGACGCAAGG	TTGAAGTTTTTGCTGTTTGG	PET	88	120
6	BMS4011	TGAAGCTGACATTTCCACATG	CTTCCAGGCAACTAAATCAACC	PET	193	209
7	BMS817	TGGGAAAGTTGGCAAATG	TTGTGATACCTGAAATGGTCAA	VIC	93	121
8	DIK2816	ACCTTGGGAATCAAGGTCAT	CCCAGTAGTCCAGTGGCTCA	VIC	166	200
9	DIK4314	GGCCCTAAAACTCATTGCAC	CCCCTGAAATCTCAAAGCAG	NED	173	203
10	HUJI-13	TCCTTGATTACACGTGGG	TTCTCAGCCAAAGTCAAGG	FAM	71	97
11	ILSTS029	TGTTTTGATGGAACACAGCC	TGGATTTAGACCAGGGTTGG	VIC	147	165
12	ILSTS011	GCTTGCTACATGGAAAGTGC	CTAAATGCAGAGCCCTACC	VIC	241	291
13	TGLA116	GCACAGTAATAAGAGTGATGGCAGA	TGGAGAAGATTTGGCTGTGTACCCA	VIC	77	91
14	TGLA261	TCAAATCTCATTCTCTCCAGAAGGC	CCAACCTATATTAGGCACAATGTCC	PET	237	283

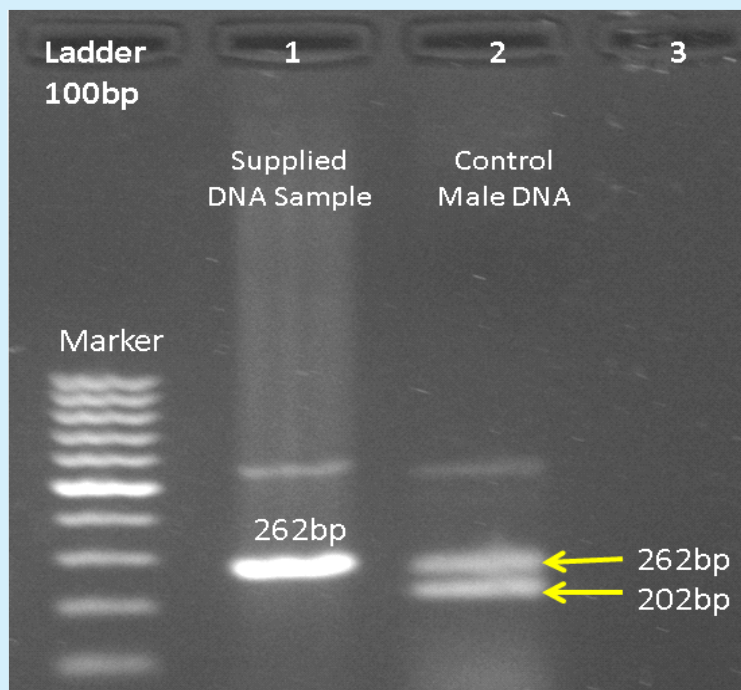
(By Dr. R. K. Vijh, P. S, AGB Division, NBAGR, Karnal)



*Ultrasonogram of Parthenote at day 30*



*Aborted parthenote at day 34*



*Sexing of DNA sample using amelogenin gene.  
Amplified amelogenin gene (AMELX, 262bp; AMELY, 202bp). Marker 100bp DNA ladder Lane. Female specific DNA sample (1). Control male specific DNA sample Lane (2).*

## **XI/ PRSM-2.03 Economic managemental interventions for augmenting growth in kids**

*N. Ramachandran, M. K. Tripathi, S.K. Singh, V. Raj Kumar and B. Rai*

An experiment was initiated during November 2012 to assess the effect of castration as an economic managemental intervention on performance of Barbari kids from pre- weaning to market age and weight. A total of 30 Barbari male kids of uniform age (2m) and mean live weight (6.10 kg) were randomly allocated in two groups of 15 each viz. control group (CON; intact kids) treatment group (CAST; castrated at around 2 months of age using Burdizzo castrator at two sites in each side of the testicle). Kids were allowed to suckle their dams until weaning (90 days of age) and were maintained on ad lib feeding under group management conditions and followed all the routine managemental practices of the livestock sector

### **Recording of observations**

The live weight change is being monitored at weekly intervals for two consecutive days to assess the daily gain in kids. The data up to seventh months of age is being compiled for the report and the recording will be continued till the kids attain 12/18 months of their age.

### **Feed intake and Growth rate**

The castration at 2.5 months of age by Burdizzo method in Barbari kids under ad lib group feeding management conditions did not show any improvement in weight gain as compared to intact kids. The growth rate in intact kids was higher ranging from 9.59 to 27.1 % with an average of 18.78 % from weaning to 7 months of age. Castrated kids had the mean finishing live weight of 18.56 kg in comparison of 20.94 kg in intact kids. The body weight trend was remained higher in intact kids than castrated kids through the progress of the trial. The

reduction in body weight during 8-10 weeks in both the groups might be due to the lowered feed intake and severe winter stress occurred during third of week of December 2012 to first week of January 2013.

Similarly, kids of treatment group had a lower feed intake at weaning (3.85%) and during experiment (4.17%) than that of control kids though the feed intake improved linearly in both groups with the progress of experiment. Kids had an ADG of 100 and 91 g at weaning, 93 and 73 g at 3 to 6 months of age, 102 and 89 g at 6 to 7 months of age, and mean ADG of 96 and 81 g during experiment respectively in intact and castrated kids. Under the present experimental protocol, intact kids had higher feed efficiency at all stages of growth. Castrated kids consumed 7.31 kg feed while kids of control group consumed 8.04 kg feed for each kg gain during the experiment, which accounted for feed efficiency of 24 and 25 % respectively.

### **Body measurements**

The body length, height at withers, chest girth and paunch girth recorded fortnightly revealed that all the four parameters were higher in intact kids than castrated kids. The mean BL, HW, CG, PG in castrated kids from 1<sup>st</sup>-9<sup>th</sup> fortnight was 52.89, 52.10, 53.93, 56.56 cms respectively. The respective values for intact kids were 54.17, 53.57, 54.63, 57.69 cms. The body measurements were also followed similar trend as that of body weight showing superiority in intact kids.

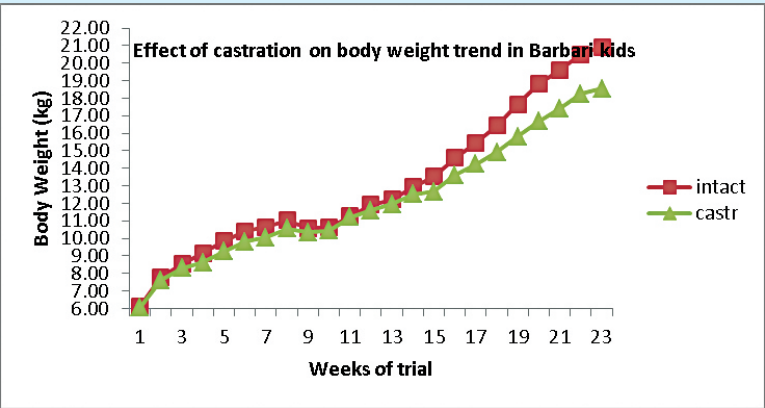
### **Scrotal measurements**

The mean scrotal circumference (SC) of castrated and intact kids on the day of castration was 10.17 and 11.47 cm, respectively. The SC increased in intact kids at 5.31% per week till 7th week (15.08 cm) and 4.52% till 19<sup>th</sup> week (19.93 cm) after castration with an average increase of 4.88%. However, the SC decreased in the

**Effect of castration on intake, growth and feed efficiency of Barbari kids**

Parameters	Control group	Treatment group
Feed DMI/ kid/ day (g)		
At weaning	270	260 (- 3.85%)
3-6 months	530	520 (- 1.92%)
6-7 months	820	750 (- 9.33%)
Overall	500	480 (- 4.17%)
Average daily gain (g)		
At weaning	100.20	91.43 (-9.59%)
3-6 months	92.58	72.84 (-27.10%)
6-7 months	101.51	89.38(-13.57%)
Overall	96.22	81.01(-18.78 %)
Feed Efficiency		
At weaning		
kg feed DMI/ kg Gain	3.99	4.21
Per cent (%)	46.43	46.19
3-6 months		
kg feed DMI/ kg Gain	10.25	8.42
Per cent (%)	16.32	13.83
6-7 months		
kg feed DMI/ kg Gain	8.65	10.09
Per cent (%)	12.86	12.58
Overall		
kg feed DMI/ kg Gain	8.04	7.31
Per cent (%)	25.43	23.96

castrated kids at 3.99% per week and thereafter testes regressed completely within 7 weeks of castration with the SC of 8.43 cm for scrotal skin only. The SC though decreased gradually after castration in kids of treatment group, it increased at 5.54% up to 2 weeks which could be due to the swelling of scrotum after castration.



### Holistic approach for improving livelihood security through livestock based farming system in Barabanki and Raebareli districts of U.P.

*B.Rai, M.K.Singh and Ashok Kumar*

Data was collected from 57 households keeping goats from 5 villages Raebareli and 6 villages of Barabanki district on production performance and income attributes of existing non-descript and supplied Sirohi goats. Data was also recorded on feeding practices, housing, adoption level of improved technologies and marketing of goat and goat products. The average flock size was  $3.2 \pm 0.4$  in Barabanki and  $2.8 \pm 0.4$  in Raebareli district. Space for goats was highly inadequate and no separate housing was provided for goat which were generally kept in human dwellings. The awareness and adoption level about improved goat rearing practices such as breeding practices, strategic/supplementary feeding of concentrates, deworming and vaccination, etc. was negligible. The average age at first kidding, milk yield per day and body weight at 12 months of age of Sirohi goats were  $18.5 \pm 0.7$

months,  $705 \pm 25$  ml and  $22.50 \pm 0.72$  kg in Barabanki district. Corresponding values for non-descript goats were  $16.2 \pm 0.6$  months,  $510 \pm 22$  ml and  $16.6 \pm 0.34$  kg. The corresponding values in Sirohi goats were  $19.7 \pm 0.83$  months,  $710 \pm 21$  ml and  $19.5 \pm 0.63$  kg, respectively in Raebareli district and in non-descript goats were  $16.6 \pm 0.66$  months,  $490 \pm 18$  ml and  $15.7 \pm 0.25$  kg, respectively. Average mortality in young kids (up to 3 months of age) was 16.4% and varied from 5–24% , however, mortality in adult was 8.4%. More than 90% goats for meat are sold by goat keepers at their village to the butchers. Average gross income from non-descript goats under extensive management system was Rs. 2465 per goat per year. Overall income per Sirohi goat was about Rs 4000 per year through sale of milk and kids and net profit per goat was Rs 2925 which was 28% higher than non-descript goats. The study indicated that the adoption of grading-up, strategic feeding and health care are necessary in order to increase productivity of goats. Critical inputs like vaccination, deworming and plantation of fodder trees are essential to enhance the productivity of goats in this region.



# NUTRITION, FEED RESOURCES & PRODUCT TECHNOLOGY DIVISION

## Project No. XI-NFR&PT-1: Development of fodder production, conservation and processing technologies for small holders and commercial goat farmers

Prabhat Tripathi

An experiment was carried out to study the response of barley crop to organic manure treatments . These treatments were Vermi compost @15, 10, 5, 2.5 t/ha, Goat manure (FYM) 15, 10,5,2.5 t/ha, Goat manure + Vermi compost @10t/ha, Vermi wash spray, Urea application and control. After treatment application barley crop was allowed to grow under two cutting management system i.e. single cut for green fodder after that crop was left for grain production. Plant growth parameters were recorded and post-harvest parameters i.e. yield attributing parameters were studied. There was decrease in yield and yield attributed under single cut management system. Crop samples were also analysed for chemical parameters i.e. Na, Ca, K, Li and nitrogen content.

## Development of feed resources on poor lands for goats

Prabhat Tripathi, M.K. Tripathi,  
Ravindra Kumar and U.B. Chaudhary

### Evaluation of *Boerhvia diffusa* as feed for goats

The suitability of *Boerhvia diffusa* as feed resource for goats was assessed. *Boerhvia diffusa* is a very succulent plant growing naturally on fallow and cultivated lands. It is available in plenty during monsoon season. Dry matter, CP, ash and ME contents were 11.5, 13.2, 22.6 percent and 6.08 MJ/kg dry matter, respectively. Twelve adult Barbari male were divided in to two equal groups, one group of adult Barbari males received daily harvested *Boerhvia diffusa* as sole feed, while other group was fed *Boerhvia diffusa* with 200 g gram straw. Animals were fed on respective feeding regimen for 21 days followed by a metabolic trial. Dry matter intake was 0.91 and 1.58 percent of live weight in *Boerhvia diffusa* and in *Boerhvia diffusa* supplemented with gram straw. Metabolic energy intake was 1.97 times higher in *Boerhvia diffusa* supplemented with gram straw group than occurred in sole *Boerhvia diffusa* fed animals.

### Dry matter and ME intake of goats on *Boerhvia diffusa* feeding

Parameter	<i>B. diffusa</i>	Straw+ <i>B.diffusa</i>
Live weight (kg)	36.0	39.0
Dry matter intake (g/d)		
<i>B. diffusa</i>	328.45	457.33
Gram Straw	-	159.86
Total	328.45	617.19
Dry matter intake( % BW)	0.91	1.58
Dry matter intake (g/kg <sup>W0.75</sup> )	22.33	39.63
Digestible organic matter intake (g/d)	140.41	273.20
Metabolizable Energy intake (MJ/d)	1.997	3.928

### Economisation of cost of feeding though nutritional manipulations

Experiment was carried out on eighty lactating Jamunapari goats to explore the possibility of utilisation of mustard cake as protein supplement in replacement of conventional protein sources on goat feeding. Mustard cake replaced linseed cake in goat concentrate mixture at 7, 14 and 24 % level. Palatability and performance of lactating Jamunapari goats were similar in all the four groups. Preliminary observations indicate suitability of mustard cake in goat feeding. Experiment on lactating Barbari goats is being carried out to replace costly protein supplements such as groundnut, linseed, til cake etc. by mustard cake, and or urea and guar korma. Complete replacement of cake component by urea and guar korma had similar milk production.

### Outreach/Network program on Estimation of methane emission under different feeding systems and development of mitigation strategies

M.K. Tripathi, Prabhat Tripathi, Ravindra Kumar, P.K. Rout and U.B. Chaudhary

*In-vitro* fermentation experiments were carried out to determine methane

production of different feeds and under prevailing goat feeding systems. Methane mitigation experiments were also carried out using different levels of mustard cake as mustard cake has antimicrobial properties.

### Methane production under straw based feeding cereal straw

Cereal crop straws, wheat (*Triticum aestivum*), barley (*Hordeum vulgare*), oat (*Avena sativa*), and sorghum (*Sorghum bicolor*) fodder were evaluated. The ME (MJ/kg DM) ranged from 5.7 to 6.9, which was similar in barley and oat straw, and in wheat straw and sorghum fodder. The percent methane was 17.6 in wheat, 15.7 in barley, 12.4 in oat and 12.4 in sorghum fodder. Methane production ranged from 9.92 to 16.6 g/kg DM, was higher ( $p < 0.001$ ) in wheat and barley, followed by oat straw and sorghum fodder, which accounted methane energy loss 924, 881, 740 and 552 kJ/kg DM respectively in wheat, barley, oat straw and sorghum fodder. CP content had a high correlation with methane production and can be predicted using the equation: Methane (g/kg DM) =  $-1.707 \times \text{CP \%} + 23.85$ ;  $R^2 = 0.993$ . The sorghum fodder produce low methane than produced by oat, wheat and barley straw in each kg digestible OM, and the CP content of straw indicated methane production level.

### Methane production potential of cereal straw and sorghum fodder in goats.

Attributes	Cereal straw			Fodders sorghum	SEM	P
	Wheat	Barley	Oat			
Feed characteristics						
CP (%)	4.88 <sup>c</sup>	4.09 <sup>d</sup>	6.20 <sup>b</sup>	8.11 <sup>a</sup>	0.46	<0.001
ME (MJ/kg DM)	5.74 <sup>b</sup>	6.65 <sup>a</sup>	6.95 <sup>a</sup>	5.97 <sup>b</sup>	0.16	0.001
Gas and CH <sub>4</sub> characteristics						
Gas (ml/g DM)	120 <sup>a</sup>	155 <sup>b</sup>	162 <sup>b</sup>	122 <sup>a</sup>	6.14	0.001
CH <sub>4</sub> (% in gas)	17.6 <sup>a</sup>	15.8 <sup>b</sup>	12.3 <sup>c</sup>	12.6 <sup>c</sup>	0.69	<0.001
CH <sub>4</sub> (g/kg DM)	15.8 <sup>a</sup>	16.6 <sup>a</sup>	13.3 <sup>b</sup>	9.9 <sup>c</sup>	0.84	<0.001
CH <sub>4</sub> (g/kg DOM)	50.9 <sup>a</sup>	45.5 <sup>a</sup>	36.7 <sup>b</sup>	28.9 <sup>c</sup>	2.65	<0.001
CH <sub>4</sub> energy loss (kJ/kg DM)	881 <sup>a</sup>	924 <sup>a</sup>	740 <sup>b</sup>	552 <sup>c</sup>	46.16	<0.001

### Legume straw

Legume crop straws, arhar (*Cajanus cajan*), gram (*Cicer arietinum*) and guar (*Cyamopsis tetragonoloba*) were evaluated. The ME (MJ/kg DM) ranged from 7.02 to 7.18 was similar, while CP content was lower (p=0.001) in gram straw than occurred in arhar and guar straw. Methane production and energy loss as methane was significantly low in guar straw compared to arhar and gram straw. Arhar and gram

straw had similar levels of methane production and therefore methane energy loss. Methane production ranged from 8.7 to 23.4 g/kg DM, which amounted to methane energy loss of 482 to 1299 kJ/kg DM. CP content had polynomial relationship with methane production, which can be calculated using the equation:  $CH_4 \text{ (g/kg DM)} = -3229 + 786.5 \times (CP\%) - 47.35 \times (CP\%)^2$ ;  $R^2 = 1$ . The guar straw produced low methane than arhar and

### Methane production potential of legume straw in goats.

Attributes	Legume straw			SEM	P
	Arhar	Gram	Guar		
Feed characteristics					
CP (%)	8.83 <sup>a</sup>	7.77 <sup>b</sup>	9.07 <sup>a</sup>	0.209	0.001
ME (MJ/kg DM)	7.06	7.18	7.02	0.077	0.752
Gas and CH <sub>4</sub> characteristics					
Gas (ml/g DM)	160.0	166.7	158.4	3.08	0.571
CH <sub>4</sub> (% in gas)	18.7 <sup>a</sup>	18.2 <sup>a</sup>	9.6 <sup>b</sup>	1.57	0.001
CH <sub>4</sub> (g/kg DM)	23.4 <sup>a</sup>	22.9 <sup>a</sup>	8.7 <sup>b</sup>	2.68	0.007
CH <sub>4</sub> (g/kg DOM)	59.4 <sup>a</sup>	58.0 <sup>a</sup>	22.2 <sup>b</sup>	6.69	0.005
CH <sub>4</sub> energy loss (kJ/kg DM)	1299 <sup>a</sup>	1278 <sup>a</sup>	482 <sup>b</sup>	149.3	0.007

### Methane production under range feeding system

The community/ protected grassland and wastelands mainly having the vegetations that includes grasses (Anjana, Doob, Makra, Hathi, Moonj), wasteland vegetation/weeds includes Vishkhapara, Montha, Onga, Khartua, Baisurai, kateli and Latjeera. Gas and methane production characteristics differed significantly (p<0.001) among these feed resource. Total 24 h gas production varied from 54 to 135 ml, IVDMD from 36 to 68 %, methane percent in gas mixture ranged from 11 to 20 %, while methane production ranged from 4.5 to 18.6 ml/g DM, 9 to 28.3 ml/g digestible DM, these correspond to 3.2 to 13.4 g and 6.8 to 29.0 g for each kg DM and digestible DM of feed. Methane energy loss

was 177 to 652 kJ/ kg feed DM intake.

### Methane from protein feeds

The major protein feeds used in goat feeding includes Mustard cake, linseed cake, ground nut cake, soybean cake, cottonseed cake, guar korma and sesbania grains. Gas fermentation and methane production characteristics differed significantly (p<0.005) among these feed resources. Total 24 h gas production varied from 77 to 204 ml, IVDMD from 53 to 84 %, methane percent in gas mixture ranged from 12 to 18 %, while methane production ranged from 13 to 30 ml/g DM, 24 to 35 ml/g digestible DM, this corresponded from 9.1 to 21.9 g and 17.0 to 25.4 g for each kg DM and digestible DM of feed. Methane energy loss was 797 to 1216 kJ/ kg feed DM intake.

### Methane from energy feeds

The major energy feed used in goat feeding includes wheat grain, barley grain, maize grain, broken rice and wheat bran. Gas fermentation and methane production characteristics differed significantly ( $p < 0.005$ ) among these feed resources. Total 24 h gas production varied from 160 to 249 ml, IVDMD from 62 to 88 %, methane percent in gas mixture ranged from 10 to 14 %, while methane production ranged from 19 to 290 ml/g DM, 21 to 44 ml/g digestible DM, this corresponded from 14 to 24 g and 20 to 24 g for each kg DM and digestible DM of feed. Methane energy loss was 749 to 1335 kJ/kg feed DM intake

### Methane production from top feeds

The major top feeds used in goat feeding includes Ardu leaves, Ber leaves, Jharberi, Chonkra leaves, Subabool leaves, Siris leaves, Shahjan leaves, Khdiyar leaves, Neem leaves, Anni leaves, and Pipal leaves. Gas fermentation and methane production characteristics differed significantly ( $p < 0.005$ ) among these feed resource. Total 24 h gas production varied from 67 to 167 ml, IVDMD from 58 to 80 %, methane percent in gas mixture ranged from 11 to 15 %, while methane production ranged from 6.4 to 21.6 ml/g DM, 11 to 32 ml/g digestible DM, this corresponded from 4.5 to 15.5 g and 7.9 to 20.5 g for each kg DM and digestible DM of feed. Methane energy loss was 255 to 860 kJ/kg feed DM intake

### Methane production under different feeding systems

Goat production system in India largely under four feeding and management systems that employs only roughage bases feeding or grazing on crop harvested fields making highly extensive system, straw feeding with little concentrate/ kitchen waste (R:C, 70:30) also an extensive system, straw plus concentrate (R:C 50:50) semi-intensive and intensive system (R:C, 30:70). Although, type of straw makes difference in

methane production but system hardly affect methane production level as increased quantities of concentrate increase the total fermentability of substrate with a little decline of methane content in gas mixture. Methane production (g/kg DDM) varied from 35.2 to 38.6 g on arhar straw, 31.0 to 38.6 on gram straw, 27.3 to 45.8 g on wheat straw, 36.7 to 43.7 g on barley straw, 30.0 to 39.6 on rice straw and 29.7 to 40.6 on oat straw based feeding systems.

### Methane mitigation using mustard cake

Among several methane mitigation strategies, use of different fodders and forages is suggested, which do not have adverse effect on ruminant physiology. The products and by-products *Brassica spp.* can be used in ruminant for methane mitigation as their glucosinolate content have antimicrobial properties for several microorganisms. The effect of glucosinolates on rumen fermentation and methanogenesis under in-vitro fermentation using whole goat rumen flora was assessed. Four concentrate mixtures MC-0, MC-25, MC-50 and MC-75, where linseed cake was replaced by mustard cake as protein supplement which contain glucosinolates were evaluated. MC inclusion did not affect total gas production which ranged from 182 to 248 ml/g DM, while methane percent in gas and methane production was 13.14, 13.03, 12.98 and 14.32 %, and 17.24, 15.25, 13.31 and 23.48 g/kg DM, respectively in MC-0, MC-25, MC-50 and MC-75 concentrates. MC inclusion up to 50% reduced methane production linearly, while at 75 %, a quadratic increase was observed. The pH of the fermentation medium decreased linearly with the increase in MC levels. Therefore, linseed cake replacement with mustard cake in concentrate mixture did not affect total gas production; however methane production reduced linearly up to 50 % replacement levels.

Another *in-vitro* experiment assessed the effect of different levels of roughage: concentrates (R:C) on fermentation, methanogenesis, pH and total volatile acid production (TVFA) on gram straw based feeding. Concentrate containing 50 % mustard cake in replacement of linseed cake was used at C-0, C-25, C-50 and C-75 percent respectively for replacing roughage. Total gas production had a trend ( $p=0.052$ ) of linear increase with increasing concentrate levels, while methane percent in total gas was the lowest ( $p=0.001$ ) with C-25 substrate. Different levels of concentrate revealed a linear increase ( $p=0.004$ ) with increasing concentrate level. The methane in total gas ranged between 10.5 to 15.16 % among the four substrates. The methane production was 14.6 g/kg substrate (C-0), where gram straw alone was used, while the highest methane was 22.9 g/kg substrate (C-50), where substrate had gram straw and concentrate 50:50. Although, methane production increased linearly ( $p<0.001$ ) with increasing concentrate levels but C-50 has a quadratic ( $p=0.040$ ) increase. The pH of fermentation medium reduced linearly ( $p<0.001$ ) with increasing concentrate levels. The TVFA also increased linearly ( $p=0.001$ ) with increasing concentrate levels. The pH and TVFA were not different between C-0 and C-25, C-50 and C-75 substrates, while C-0 and C-25 substrates had significantly ( $p=0.004$ ) higher pH and lower TVFA than occurred in C-50 and C-75 substrates. The gram straw based substrates containing concentrate up to 50 % did not reduce methane, while reduced pH and increased TFVA levels in fermentation medium. Therefore, mustard cake based concentrate mixtures replacing 50 % conventional protein sources, and inclusion of such concentrates making R:C, 50:50 did not change rumen methanogenesis, while affecting rumen fermentation favorably.

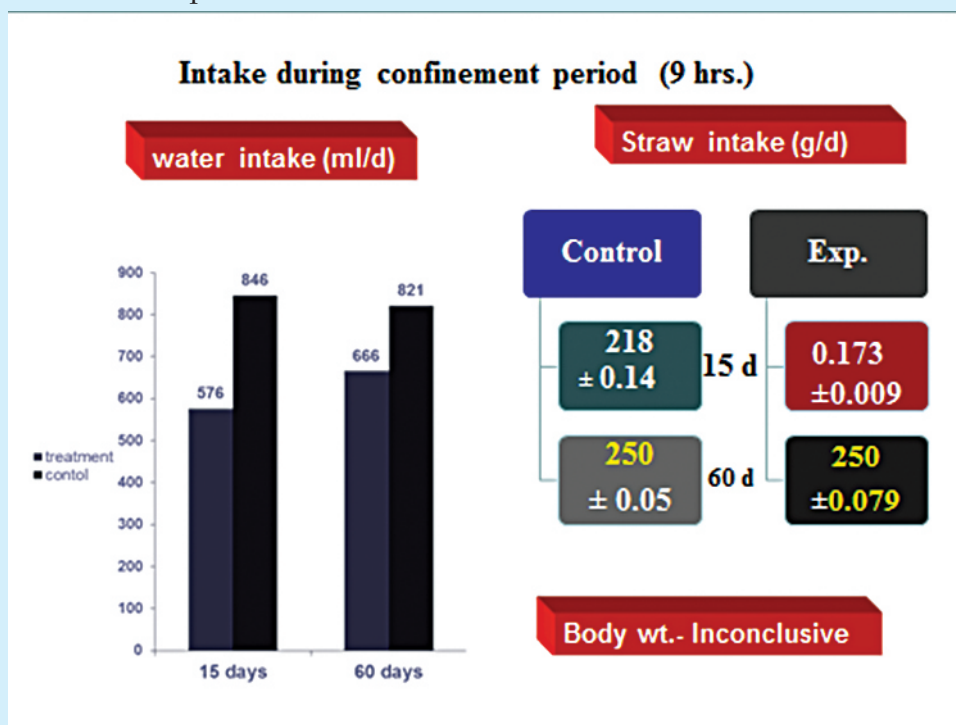
### **NICRA Project : Assessing resilience of small ruminant production under changing climatic condition in semiarid zone**

**U.B. Chaudhary, P.K. Rout, Ashok Kumar and N. Ramachandran**

NICRA project aimed to undertake research on adaptive capability of sheep and goats to abiotic stresses (thermal and water) based on growth, physiological, endocrine and biochemical responses, feeding and managemental strategies to combat environmental stresses and analyze the nutrient-gene interaction in relation to stress regulator and identifying candidate genes through differential expression of selected traits. Experiments were conducted to assess the effect of change in ambient temperature on productivity of goats and herbal supplementation in feed to ameliorate stress during hot dry period. Effect of change in ambient temperature was studied on productivity of growing male barbari goats during hot humid period for 60 days. Control animals were maintained at normal ambient temperature whereas experimental goats were reared in psychrometric chamber at temperature above 2°C of the ambient. Feeding conditions were identical in both the groups. The results indicated that at the initial stage (up to two weeks), the experimental animals were under stress than the control, and stress reduced water and dry matter intake, volatile fatty acids level and rumen bacterial population in rumen, increased respiration and heart rate. However, these observations were normal in both the groups after fortnight interval. The results revealed that goats have adaptability towards increase in normal temperature and there is no adverse effect on goats if maintained under increased atmospheric temperature (>2°C) during hot humid period. The experiment conducted on growing Jamunapari goats during the

hot dry periods to see the effect of feeding three herbal methanolic extract on growth and biochemical parameters indicated that, CIRG-2 Extract has potential effect on

amelioration of heat stress as evidenced by highest growth rate and better physiological response.

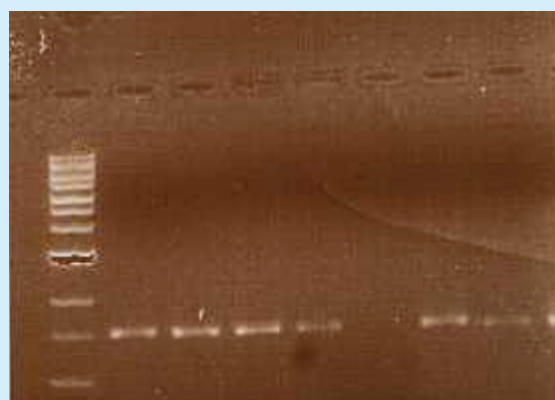


### Network project on veterinary type culture (Rumen microbes)

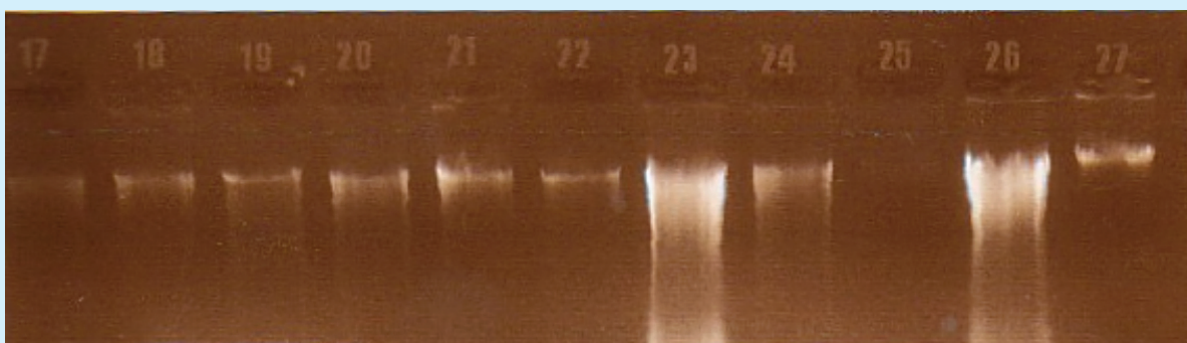
*U.B. Chaudhary and Ravindra Kumar*

Study was aimed to isolate the anaerobic cellulose degrading bacteria from the rumen of goat fed high roughage diet using selective medium for cellulose degradation and submission of effective cultures to the repository center. Rumen liquor samples were collected from grazing adult Barbari goats maintained under semi intensive system of feeding management for cultivation of fiber degrading anaerobic rumen bacteria using the microcrystalline cellulose media. The cultivated isolates of microcrystalline cellulose degrading bacteria from these goats were used for extraction of DNA. PCR was performed for amplification of 16S RNA gene from cultivated isolates using universal primer (F-S\*-univ-530a-S-16(5'-GTGCCAGCM

GCCGCGG-3'and R-S\*-univ-1392-a-A-15(5'-ACGGGCGGTGTGTRC-3'd). Fifteen isolates of fiber degrading bacteria were characterized based on 16S RNA gene sequence. These isolates will be deposited to the VTCC culture collection center. The effectiveness of these isolates is being evaluated in terms of fiber degrading ability.



Amplified 16S rRNA gene from bacterial isoates



DNA extracted from the cellulose degrading bacteria

### Development of herbal medicated pelleted feed for enhancing goat productivity

Ravindra Kumar, U.B. Chaudhary,  
A. Kumar and D.K. Sharma

Two types of complete feed pellets were prepared and fed to 3 month old Barbari kids for 90 days in two equal groups of six each i.e. control (C) and treatment (T) containing herbal anticoccidial feed mix extract of *Allium sativum* (Bulb) and *Annona squamosa* (Leaves) each mixed @ 7 mg/g body weighty was formulated. A feeding trial of 90 days on these pellets was carried out in twelve barbari goats (age 3 months) in two groups of six each and daily feed intake, fortnightly body weight gain, rumen fermentation parameters, oocyst count

(OPG) and number of diarrhea cases was studied. The daily dry matter intake (g) was significantly ( $P < 0.05$ ) higher in treatment group (709) than control group (648) of goats. The average daily gain (g) was higher in treatment group (81.68) as compared to control group (69.14) (Table ). There was improvement in body weight gain after herbal anticoccidial addition. Ruminal fluid parameters were similar in control and treated groups. OPG count of feces did not reflect any definite conclusion but number of diarrheal cases was higher in control group than treatment group of goats. Production parameters affected due to coccidial infection get improved by feeding of pellet containing herbal anticoccidial feed mix.

#### Feed intake and body weight gain in different groups of goat

	Control group	Treatment group
Initial B. Wt.(Kg)	12.12	12.43
Final B. Wt.(Kg)	18.41	19.86
Body weight gain(Kg)	6.29	7.43
ADG (g)	69.14	81.86
DMI(Kg/day)*	0.65	0.71
DMI(Kg/day/100 kg Body wt)	4.43	4.44
DMI (Kg/day/W <sup>0.75</sup> )	86.25	88.70
Feed Conversion Ratio (FCR)	11.54	8.95

\*Means differ significantly at 5% level of significance

### **XI/NFRPT-3.1: Studies on nutritional value of goat milk**

**R.B. Sharma**

#### **Seasonal variations in paneer yield of goat milk**

Milk collected from different breed of goats maintained at institute livestock sectors was processed to assess paneer yield during the year. Pooled milk samples were processed as per standard protocol for paneer production. A variation of 1 % in paneer yield was observed during different months. The paneer yield varied from 11.54 to 12.54 % from April to December 2012. The lowest paneer yield was in July (11.54 %, from 26 observations) followed by 11.63 % (May, N=29; November, N=18), 11.71 % (September, N= 24), 12.18 % (June, N=28), 12.21 (April, N=27), 12.22 (August, N=14), 12.47 (October, N=25) and 12.54 % (December, N=19). Pooled goat milk (n=210) of different breed resulted paneer yield 12.01 % from April to December 2012 at the Institute.

### **XI/NFR&PT-3-2 Evaluation of carcass traits, meat quality and products from goat meats**

**A. K. Das; V. Rajkumar; A. K. Verma and R. B. Sharma**

Effect of age on quality of Barbari goat meat  
Barbari goats were slaughtered at 6 and 12 months age for comparative study on carcass traits and meat quality. Slaughter age has significant effect on the quality of Barbari goat meat. The *Longissimus dorsi* muscle fat content was high ( $p<0.05$ ) in 6 month (2.11 %) than occurred in 12 months (0.78 %) old Barbari kids, while total pigments (ppm) were very low (80.7) in six months old compared to 12 month ((145.18) old kids. The moisture, protein, ash, pH and, water, salt and total soluble proteins were similar in *Longissimus dorsi* muscle of 6

and 12 months old kids. Fatty acid profiles (percent of total fatty acids) varied in *Longissimus dorsi* muscle of kids slaughtered at six months or 12 months of age. The meat of six month's old Barbari kids is a very good source of EPA and DHA. Percent saturated fatty acid content was also less and it is a good source of PUFA than the 12 months old Barbari meat. Later meat is a good source of PUFA. The n-6/n-3 ratio was very low in 6 months old Barbari goat meat. The SFA were 30.9 and 50.9, MUFA 19.8 and 35.1, PUFA 48.9 and 12.9, n3-PUFA 37.5 and 2.61, and n-6 PUFA 9.9 and 7.9 % (percent of total fatty acids) in *Longissimus dorsi* muscle of 6 and 12 months old kids.

#### **Guava powder: A new source of antioxidant dietary fibre for sheep meat nuggets**

Guava (*Psidiumguajava* L.) is widely cultivated and its fruit is popular in India. The presence of antioxidants has been previously documented and it is a good source of dietary fiber. Guava powder used contained moisture 6.4, protein 5.1, fat 4.3, ash 5.0, insoluble dietary fibre 42.6, soluble dietary fibre 0.65 and total dietary fibre 43.2%. The total phenolics were 44.4 mgGAE/g. For these characteristics dried Gauva flesh (DGF) was incorporated at different levels in the formulation of sheep meat nuggets. Freshly prepared DGF was used to replace 0.5 (treatment I) and 1 % (treatment II) lean meat in the formulation. Before inclusion the DPPH radical scavenging activity and Ferric reduction antioxidant potential of the DGF was carried out besides measurement of proximate principles and dietary fibre (Figure 1 and 2). Addition of DGF significantly affected the sheep meat nuggets physicochemical characteristics. As the level of DGF inclusion increases in the formulation, the emulsion stability, cooking yield and pH decreased

significantly ( $p<0.05$ ). Product with 1 % DGF had pH value 6.36. Differences were also observed in the proximate composition. Texture profile analysis indicated that significantly ( $p<0.05$ ) less shear force is required to shear 1 % DGF included product. Similarly the springiness was also significantly low for product with 1 % DGF. Dietary fibre content in DGF and in the product also carried out. Addition of DGF significantly increased the amount of

total dietary fibre in the product and highest value was observed in the product with 1 % DGF. DGF inclusion did not affect the sensory characteristics. Sensory panelists gave non-significantly high scores for the product with 1 % DGF. Since meat is a poor source of dietary fiber, inclusion of DGF can significantly contribute towards total dietary fibre. Additionally it could also enhance products shelf life through antioxidant potential.

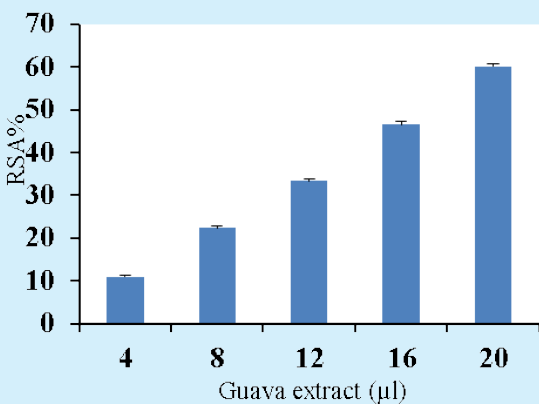


Figure 1. DPPH radical scavenging activity of guava extract.

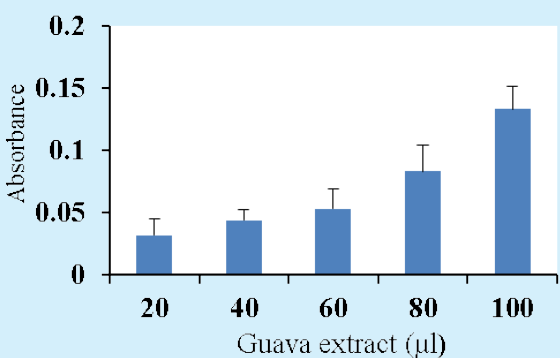


Figure 2. Ferric reduction antioxidant potential (FRAP) of guava extract.

Effect of guava powder on physicochemical properties of sheep meat nuggets

Parameters	Control	Treatment I	Treatment II
Emulsion stability (%)	92.02 <sup>a</sup>	90.74 <sup>ab</sup>	88.77 <sup>b</sup>
Cooking yield (%)	97.17 <sup>a</sup>	95.61 <sup>b</sup>	94.89 <sup>b</sup>
Emulsion pH	6.31 <sup>a</sup>	6.26 <sup>b</sup>	6.25 <sup>b</sup>
Nuggets pH	6.39 <sup>a</sup>	6.36 <sup>b</sup>	6.36 <sup>b</sup>
Expressible water (%)	19.64	21.03	20.03
Nuggets moisture (%)	67.42 <sup>a</sup>	67.98 <sup>a</sup>	66.49 <sup>b</sup>
Nuggets protein (%)	15.25 <sup>a</sup>	13.43 <sup>b</sup>	12.87 <sup>b</sup>
Nuggets fat (%)	11.62	11.97	11.03
Total dietary fibre (%)	0.48 <sup>c</sup>	1.60 <sup>b</sup>	3.58 <sup>a</sup>
Total phenolics (µg/g)	904 <sup>c</sup>	1658 <sup>b</sup>	1881 <sup>a</sup>

Means bearing different superscripts in a row differ significantly ( $P<0.05$ ),  $n=6$

### Effect of guava powder on the texture profile analysis of sheep meat nuggets

Parameters	Control	Treatment I	Treatment II
Hardness	58.04	59.18	53.62
Springiness	0.75 <sup>a</sup>	0.73 <sup>a</sup>	0.63 <sup>b</sup>
Cohesiveness	0.29	0.29	0.31
Gumminess	17.13	17.47	16.50
Chewiness	12.94	12.80	10.60
Shear force	8.04 <sup>a</sup>	7.25 <sup>a</sup>	4.40 <sup>b</sup>
Work of shear	4.69 <sup>a</sup>	4.04 <sup>a</sup>	2.39 <sup>b</sup>

Means bearing different superscripts in a row differ significantly ( $P < 0.05$ );  $n=9$

### Nutritional quality evaluation of medium fat goat milk paneer

Paneer prepared from the cream separated goat milk has a fat content about 1 % and can be regarded as no fat paneer. However, organoleptic and textural properties of such product are severely affected. Thus it was proposed to improve the quality of no/low fat goat milk paneer. To achieve this half of separated cream was mixed in skim milk and product (medium fat paneer) was prepared. Table shows that paneer prepared from the milk having half of the original cream had significantly lower proximate components except fat. Medium fat paneer had significantly improved

textural properties when compared with low/no fat paneer. However, hardness, gumminess and chewiness values of medium fat paneer were significantly higher than the full fat paneer. The fatty acid profile of the product revealed that almost all the individual fatty acids in medium fat paneer were significantly lower than the full fat paneer. There were significant differences in medium chain fatty acids (MCFA), saturated fatty acids (SFA) and monounsaturated fatty acids (MUFA) among low, medium and full fat goat milk paneer. Polyunsaturated fatty acids (PUFA) were significantly higher in full fat paneer than the other products.

### Nutritional properties of low, medium and full fat Barbari milk paneer

	Fat level in Barbari milk paneer		
	Full fat	Medium fat	Low fat
Proximate analysis			
Moisture	43.66 <sup>c</sup>	50.87 <sup>b</sup>	52.95 <sup>a</sup>
Fat	28.02 <sup>a</sup>	15.35 <sup>b</sup>	0.97 <sup>c</sup>
Ash	1.74 <sup>c</sup>	2.44 <sup>b</sup>	2.81 <sup>a</sup>
Protein	21.55 <sup>b</sup>	25.84 <sup>b</sup>	39.33 <sup>a</sup>
Fatty acids (% of total fat) in Barbari milk paneer			
%MCT	34.72	33.47	33.29
%SFA	73.42 <sup>b</sup>	79.74 <sup>a</sup>	70.38 <sup>b</sup>
%MUFA	20.39 <sup>ab</sup>	18.28 <sup>b</sup>	24.76 <sup>a</sup>
%PUFA	5.54 <sup>a</sup>	2.52 <sup>b</sup>	4.25 <sup>a</sup>
%n3 PUFA	3.62 <sup>a</sup>	1.76 <sup>b</sup>	0.91 <sup>b</sup>
%n6 PUFA	0.97 <sup>b</sup>	0.27 <sup>c</sup>	3.03 <sup>a</sup>

## Value chain for the development of goat products with healthy traits

A. K. Verma, V. Rajkumar and A. K. Das

### Fatty acid profile of added source of fat in goat meat nuggets

Fatty acid profile of added source of fat i.e. goat fat and refined vegetable oil was determined to decide their proportion in the product formulations. Goat fat had significantly higher myristic acid, palmitic acid, stearic acid and oleic acid while linoleic acid was significantly higher in refined vegetable oil. As far as various categories of fatty acids are concerned, percent monounsaturated fatty acids (MUFA) and saturated fatty acids (SFA) were significantly higher in goat fat whereas percent polyunsaturated fatty

### Fatty acid profile of source of added fat in goat meat nuggets

	Goat fat	Vegetable oil
<b>Fatty acids</b>		
(C14:0) <sup>+</sup>	8.10	0.35
(C15:0) <sup>+</sup>	1.77	0.08
(C16:0) <sup>+</sup>	31.77	27.38
(C16:1) <sup>+</sup>	2.68	0.32
(C17:0) <sup>+</sup>	1.22	0.20
(C17:1)	0.81	0.25
(C18:0) <sup>+</sup>	7.45	1.36
(18:1n9c) <sup>+</sup>	26.62	17.26
(C18:2)n6 <sup>+</sup>	6.05	41.70
<b>Fatty acids groups</b>		
%SFA <sup>+</sup>	51.73	30.12
%MUFA <sup>+</sup>	38.68	27.94
%PUFA <sup>+</sup>	8.43	45.32
%n3 PUFA <sup>+</sup>	1.18	2.29
%n6 PUFA <sup>+</sup>	6.36	43.03
PUFA/SFA <sup>+</sup>	0.16	1.49
N6/N3 PUFA <sup>+</sup>	5.66	24.60

n=6; \*p<0.05; \*\*p<0.01

acids (PUFA), omega-3 and omega-6 fatty acids were significantly high in refined vegetable oil. Omega-6 to omega-3 fatty and polyunsaturated fatty acids to saturated fatty acids ratio was significantly higher in refined vegetable oil as compared to corresponding goat fat.

### Development and quality evaluation of healthier low fat functional chevon nuggets

An attempt was made through present investigation to develop healthier low fat functional chevon nuggets with balanced PUFA/SFA ratio and to evaluate their various physicochemical, colour, textural and sensory properties as well as fatty acids profile against control. Low fat chevon nuggets were prepared with incorporation of goat fat (control nuggets) and combination of goat fat and refined vegetable oil (functional nuggets). Functional chevon nuggets had higher (P<0.05) emulsion stability, product yield, fat and ash content as compared to control nuggets. Ash content in functional emulsion was lower (P<0.05) than control. Hunter colour lightness value was higher (P<0.05) for functional chevon nuggets than control. Textural profile analysis revealed lower (P<0.05) hardness and work of shear values for functional nuggets as compared to control nuggets. Functional nuggets had lower (P<0.05) fatty acids such as (C14:0), (C15:0), (C16:0), (C17:0), (C18:0) and (C18:1) while fatty acids such as (C18:2) was significantly higher. Monounsaturated fatty acids and saturated fatty acids (SFA) were lower (P<0.05) in functional nuggets whereas polyunsaturated fatty acids (PUFA), omega-6 and omega-3 fatty acids, PUFA/SFA ratio and omega-6/omega-3 fatty acids ratio were significantly higher. Sensory evaluation of both the products revealed statistically non-significant differences (P>0.05) among all the attributes except flavour which was higher (P<0.05) for functional nuggets. Thus, use of

combination of goat fat and vegetable oil in chevon nuggets makes them lighter, softer

and flavourful as well as functional with balanced PUFA/SFA ratio.

#### Physicochemical characteristics and fatty acid profile of low fat functional goat meat nuggets

	Control	Treatment	Significance
Physicochemical characteristics			
Emulsion pH	6.42	6.40	NS
Product pH	6.46	6.45	NS
Emulsion stability (%)	91.66	92.73	*
Cooking yield (%)	90.50	95.17	**
Nuggets moisture (%)	67.50	67.29	NS
Nuggets protein (%)	14.91	14.95	NS
Nuggets fat (%)	6.41	7.60	**
Nuggets ash%	2.67	2.82	*
Fatty acid profile (% of total fat)			
SFA (%)	50.51	35.31	**
MUFA (%)	41.22	32.34	**
PUFA (%)	7.84	32.10	**
n-3 PUFA (%)	1.31	2.14	**
n-6 PUFA (%)	6.17	29.73	**
PUFA/SFA	0.16	0.91	**
n-6/n-3	4.87	13.97	**
n=6; **p<0.01			

#### Traceability, food safety standards and food chain evaluation (HACCP) pertaining to goat meat and value added products

*V. Rajkumar, Arun K. Verma, Arun K. Das and Khushyal Singh*

Major Goat meat markets were identified. Goat meat processing units were also identified. Average slaughter weight of goat in India 20Kg and meat yield is 9-10Kg. Slaughter weight of Barbari, Sirohi, Jamunapari and Jhakrana goat at CIRG is 25.57, 8.14, 26.84 and 19.07 Kg and amount of meat produced by these are 8.33, 12.81, 12.26 and 8.58 Kg, respectively.

#### HACCP for Goat meat products:

To identify critical control points microbiological quality of the stages of nuggets processing including slaughter has been done (Table ). Similarly estimation of bacterial counts in the raw materials used in the formulation of nugget has been done (Table ). After the complete analysis HACCP design will be prepared. Perusal of data reveals that slaughter house floor (log 4.74), wall (log 3.91), butcher's hand (log 3.95), bleeding knife (log 3.46) and carcass splitting chopper (log 3.95) had higher SPC. Regarding raw material like keema (log 4.41) and fat (log 3.93), if the initial counts can be reduced, fresh product count can also be reduced considerably.

### Physico-chemical and microbial traits of freshly prepared nuggets.

Traits	Control	Nuggets with Vegetable oil
pH	6.34	6.18
Water activity	0.981	0.976
W-B shear force values (kgcm <sup>-2</sup> )	1.44	1.38
Moisture, %	63.63	59.46
Fat, %	14.51	17.08
Standard plate counts	4.72	4.21
Psychrotrophic bacteria counts	3.47	3.43
Lactic acid bacteria counts	2.23	2.03

### Standard plate counts at various stages of Nugget processing including slaughter

S.N.	Place of sampling	SPC (log CFU 10 <sup>1</sup> sqcm)
1.	Slaughter house floor	4.53
2.	Slaughter house wall	3.87
3.	Bleeding knife (Iron)	3.27
4.	Dressing knife (Iron)	3.62
5.	Butcher's hand	2.41
6.	Carcass splitting chopper	4.01
7.	Deboning knife I (Stainless steel)	2.74
8.	Deboning knife II (Stainless steel)	2.63
9.	Carcass surfaces	
1.	a. Carcass neck portion	4.64
1.	b. Carcass – Loin cut	4.87
1.	c. Carcass – Leg cut	3.43
10.	Carcass cutting wood	3.61
11.	Deboning table	3.81
12.	Surface of meat mincer	2.01
13.	Surface of bowl chopper	1.02
14.	Surface of SS Emulsion box	2.18
15.	Surface of nuggets cutting plates	1.71

### HACCP system for the production of goat meat nuggets:

To identify critical control points, microbiological quality of the stages of nuggets processing including slaughter has been done. Similarly estimation of bacterial counts in the raw materials used in the formulation of nuggets has been done (Table). After the complete analysis HACCP design was prepared.

### Estimation of bacterial counts in the raw materials used in the formulation of goat meat nuggets

S.No.	Place of sampling	SPC (log CFU g <sup>-1</sup> )
1.	Meat Keema	3.92
2.	Meat fat	4.06
3.	Maida	3.07

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

*Ravindra Kumar, U.B. Chaudhary,  
A. Kumar and A. K. Das*

Twelve male barbari goats (10 months age) were randomly divided into two groups (Control and treatment) of six animals each. Animals were fed on complete pellet feed containing gram straw (60%), barley (20%), linseed cake (12 %), wheat bran (6.8%), mineral mixture (0.8%) and salt (0.4%). The duration of experimental feeding was 14 weeks consisting of stabilization (4 weeks),

feed restriction (6 weeks) in treatment group only and Re-alimentation (4 weeks). Carcass trait and meat composition study was conducted after restriction and re-alimentation. The carcass, vital organs, carcass cuts and fat were weighed and the chemical composition of meat was determined. Slaughter weight (kg) of feed restricted group was significantly ( $P < 0.05$ ) lower (30.37) as compared to control group (33.60) however after re-alimentation slaughter weight of both the group was statistically similar. Feed restriction and re-alimentation did not effected body measurement attribute length, height, heart

#### Effect of feed restriction and re-alimentation on Carcass characteristics and carcass components of Barbari goat.

	After feed restriction		After re-alimentation	
	Group A	Group B	Group A	Group B
<b>Carcass traits</b>				
Hot carcass wt (kg)	16.81	14.25	16.62	18.15
Dressing per cent <sup>a</sup>	50.09 <sup>a</sup>	46.85 <sup>c</sup>	48.29 <sup>bc</sup>	47.25 <sup>b</sup>
Dressing per cent <sup>b</sup>	56.22 <sup>a</sup>	55.24 <sup>a</sup>	54.18 <sup>ab</sup>	53.10 <sup>b</sup>
Fore quarter (kg)	9.53 <sup>ab</sup>	7.89 <sup>b</sup>	9.66 <sup>ab</sup>	10.05 <sup>a</sup>
Hind quarter (kg)	7.28 <sup>ab</sup>	6.36 <sup>b</sup>	6.97 <sup>ab</sup>	8.10 <sup>a</sup>
<b>Variety meat</b>				
Testes (g)	236.33 <sup>a</sup>	163.00 <sup>b</sup>	179.33 <sup>ab</sup>	206.67 <sup>ab</sup>
Pancreas (g)	61.33	51.33	43.33	62.67
Spleen (g)	72.67	47.67	58.67	71.67
Kidney (g)	94.33 <sup>a</sup>	72.33 <sup>b</sup>	96.33 <sup>a</sup>	107.33 <sup>a</sup>
Liver (g)	574.33 <sup>ab</sup>	444.67 <sup>b</sup>	568.33 <sup>ab</sup>	676.67 <sup>a</sup>
Heart (g)	151.00 <sup>ab</sup>	120.00 <sup>b</sup>	139.33 <sup>ab</sup>	161.33 <sup>a</sup>
<b>Depot fat (g)</b>				
Cod fat	121.00	124.33	248.00	118.67
Kidney fat	663.33	434.67	617.33	500.00
Omental fat	351.33	302.67	317.00	283.335
Mesenteric fat	323.33 <sup>a</sup>	186.67 <sup>b</sup>	205.00 <sup>ab</sup>	269.67 <sup>ab</sup>
Total visceral fat (kg)	2.02 <sup>ab</sup>	1.55 <sup>b</sup>	2.08 <sup>ab</sup>	1.778 <sup>b</sup>

<sup>a</sup>on slaughter weight basis; <sup>b</sup>On empty body weight basis

girth, loin width and leg circumference. Loin eye area (cm<sup>2</sup>) significantly ( $P<0.05$ ) get reduced (8.85) after feed restriction as compared to control group (14.34) but after re-alimentation it was similar in both the groups (15.29, 11.64). No significant difference was reported in back fat and breast fat thickness of control and treatment groups. Hot carcass weight (kg) was lower (14.25) after feed restriction and higher (18.15) after re-alimentation in treatment group as compared to control group (16.81 and 16.62). Feed restriction reduces the dressing per cent significantly on slaughter basis (46.85 vs. 50.09). No significant effect of feed restriction and re-alimentation was observed on dressing per cent on empty weight basis and different quarter weights. Among non carcass trait no significant effect of feed restriction and re-alimentation was observed between groups except head weight (Kg) which was significantly higher in treatment group (2.54) as compared to control group (2.20) after feed restriction. No significant effect of feed restriction and re-alimentation was observed on variety meat except kidney weight (g) which was lower after feed restriction in treatment group (72.33) in comparison to control group (94.33) after feed restriction but become similar after re-alimentation (107.33, 96.33). The different depot fat was similar in both the groups but mesenteric fat significantly get reduced after feed restriction. No significant change was observed in total visceral fat after feed restriction and re-alimentation but values were lower in treatment group of goats. Feed restriction and re-alimentation did not have influence on moisture, ash, fat and crude protein content of meat. However fat (%) in meat was lowest (1.19) in treatment group which undergo feed restriction and re-alimentation. Study concluded that feed restriction and re-alimentation tends to improve the carcass and meat quality in barbari goats.

### Development of complete feed for environmentally and economically sustainable goat production

*Ravindra Kumar, Prabhat Tripathi, U.B. Chaudhary and R.B. Sharma*

Majority of goats are reared in extensive system involving grazing alone in the country. Concentrate feeds are the major source of protein and energy, which are not in routine feeding of goats mainly due to high price of the ingredients. Azolla is a good source of nitrogen (Protein) and essential minerals as well as cheaper source. Azolla can replace a part of concentrate mixture in the complete feed of goats. To propagate azolla feeding in goat, azolla culture was procured from Microbiology Division of Indian Agriculture Research Institute, New Delhi. The cultural conditions are being optimized in the plastic tub for harvesting higher biomass at our conditions. Permanent cemented structures are manufactured and azolla cultivation has been initiated. Feeds will be formulated by incorporation of Azolla and feeding trial will be carried out.



## ANIMAL HEALTH DIVISION

## XI/GH-1: Monitoring and surveillance of important goat diseases in India

*D.K. Sharma, V.K. Gupta, Ashok Kumar, V.S. Vihan (upto May 2011), A.K. Mishra, Manjunath Reddy (upto July 2012).*

A total of 122 blood and 46 faecal samples collected from goats from Assam, Odisha and Arunachal Pradesh were processed

and antibodies against PPRV, FMDV and Capripox viruses were worked out. Total of 6 outbreaks (Keetham, Lohara(2), Balajipur, Kurkanda, Machhera(Haryana) were attended and samples of different kind were collected and examined for diagnosis along with the spot treatment and vaccination required. Report prepared and submitted in the form of RPF-III to PME.

### Sero prevalence of PPR virus antibodies in goat sera samples (Outbreaks/Collected)

S. No.	Place of out break	Total samples processed	Positive for PPR virus antibodies	Sero prevalence %
1.	Batabari, Assam	26	2	7.69
2.	Tatelia, Assam	47	13	27.65
3.	Chhatarpur, Ganjam Odisha	14	8	57.14
4.	Rambha, Odisha	24	19	79.66
5.	Itanagar, Arunachal Pradesh	11	1	9.09

## GH2.1.Molecular diagnosis and epidemiology of Brucellosis in goats

*V.K. Gupta, S.V. Singh, M. Reddy (upto July 2012)*

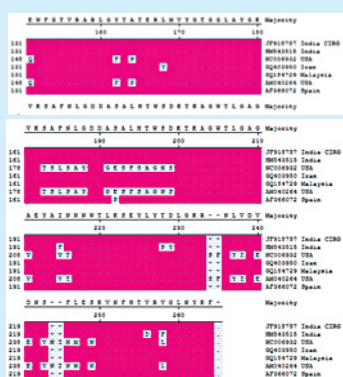
## Amino acid sequence variation Analysis of different strains of *Brucella melitensis*

The amino acid sequence variation analysis of different strains of *Brucella melitensis* revealed that the sequence varied considerably among the isolates, with overall identity ranging from 74±3% to 96±5% at the nucleotide level, and from 83±5% to 100% at the amino acid level, when using *B. melitensis* 16M as a reference strain. Details of the analysis based on different genes of *B. melitensis* are given below.

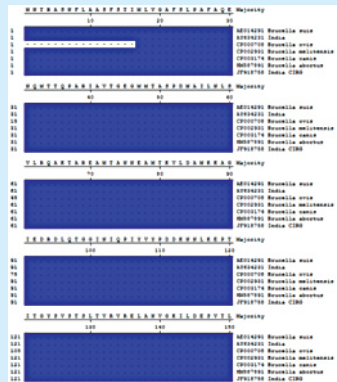
## Omp31 gene amino acid sequence variation analysis



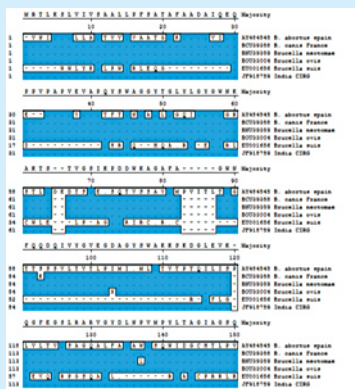
### Analysis of amino acid sequences of Omp31 gene



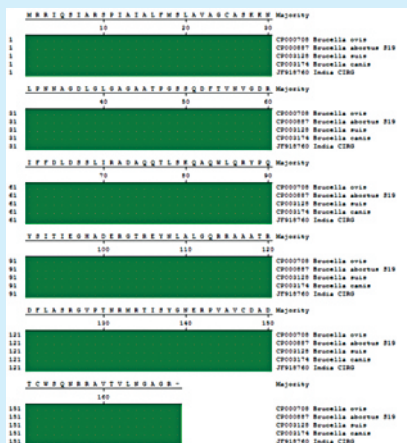
### Analysis of the amino acid sequences of Omp 28



Analysis of the amino acid sequences of Omp16 gene



Analysis of the amino acid sequences of Omp25 gene



Analysis of the amino acid sequences of 16s rrna GENE

## GH-2.2 : Toll like receptors (TLRs) expression and characterization in different breeds of goats and their role in disease resistance with special reference to brucellosis

V.K. Gupta, N. Shivasharanappa, P.K. Rout and A. Kumar

### Amplification of TLR1,2 and 3:

Blood samples from Barbari, Jamunapari, Sirohi and Jakhrana breeds were collected. Genomic DNA was isolated and PCR was carried out to amplify TLR 1, 2 and 3 each having 3 fragments of size approx. 800bp. These products will be used for sequencing to identify genetic variation.

### Screening and diagnosis of Brucellosis:

5 natural cases of brucellosis diagnosed by cultural and serological and PCR methods.

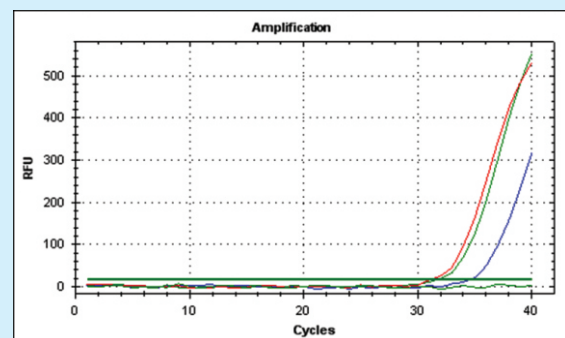
Tissue samples such as spleen, liver, uterus, supra-mammary lymph nodes, mammary glands were collected from three natural cases of brucellosis in Barbari goats which were euthanized, for molecular studies such as differential expression of TLRs and cytokines of innate immune response.

RNA isolation and cDNA synthesis was done by standard methods.

### Quantitative Real Time PCR assay:

By using SYBR Green PCR kit different pro-inflammatory cytokines and TLRs in different tissues and blood is being analysed.

#### 1. IL-1 $\alpha$



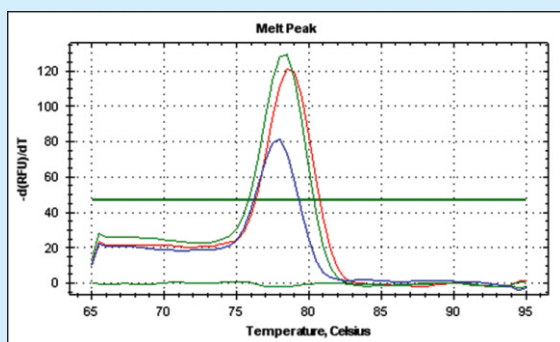
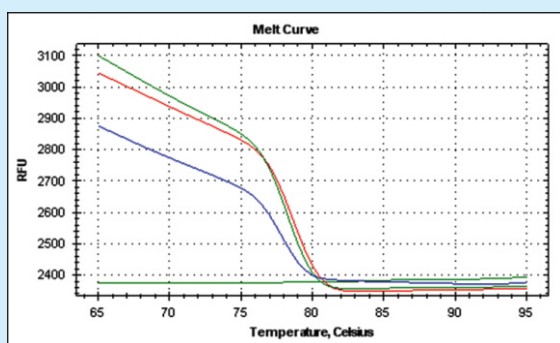


Figure 1 : Melting curves of IL-1 $\alpha$  in spleen

## 2. IL-6

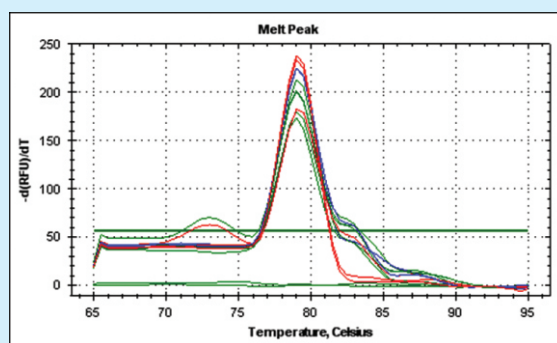
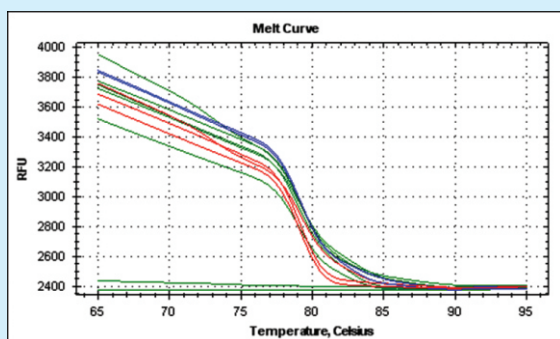
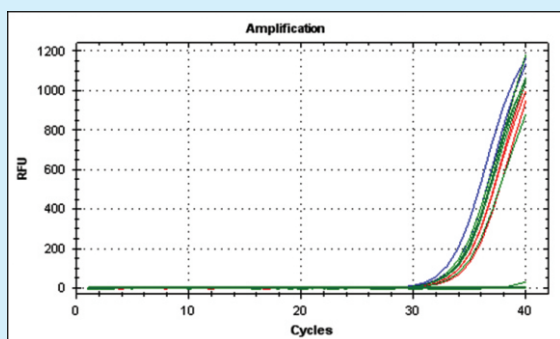
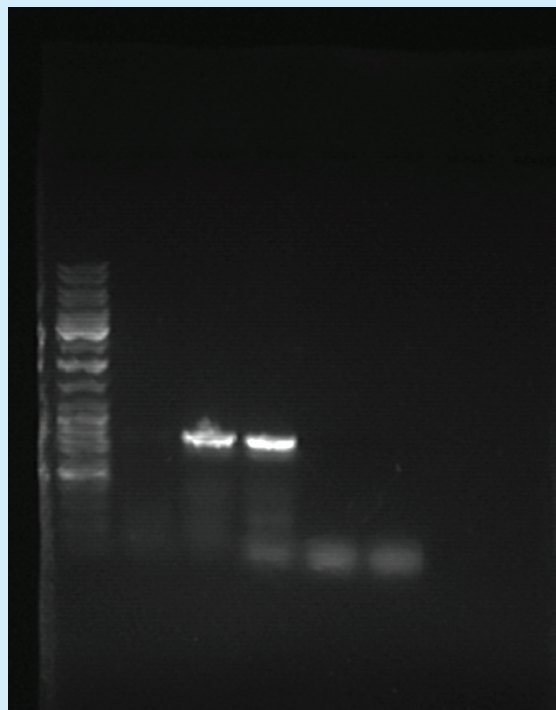


Figure 2 : Melting curves of IL-6 in spleen and liver

I. PCR amplification results of TLR 1, 2 and 3 if different breeds of goat from genomic DNA



TLR-1-Fragment 3 product of size 821bp

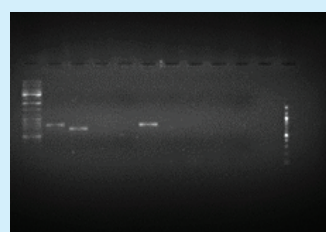


Figure 4: TLR-2 fragments 2 and 3 products of size 825 and 687bp

## Project GH: XI/GH-2.2 Development of herbal antidiarrhoeal drug for goats

A. Kumar and V.K. Gupta.

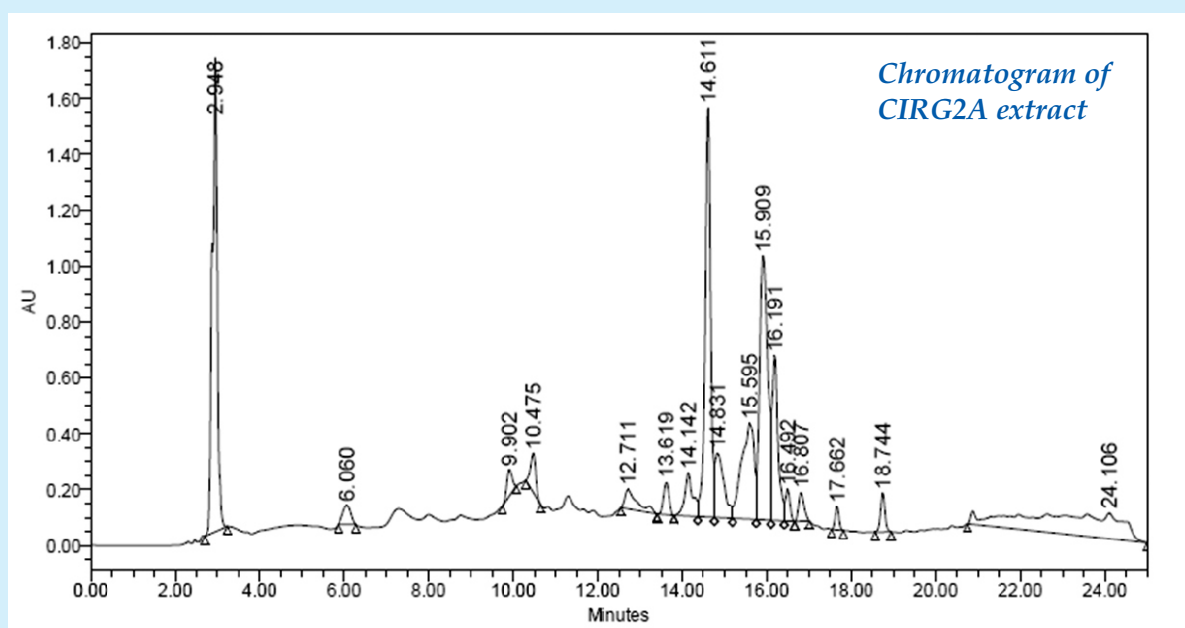
### Antidiarrheal powder preparation:

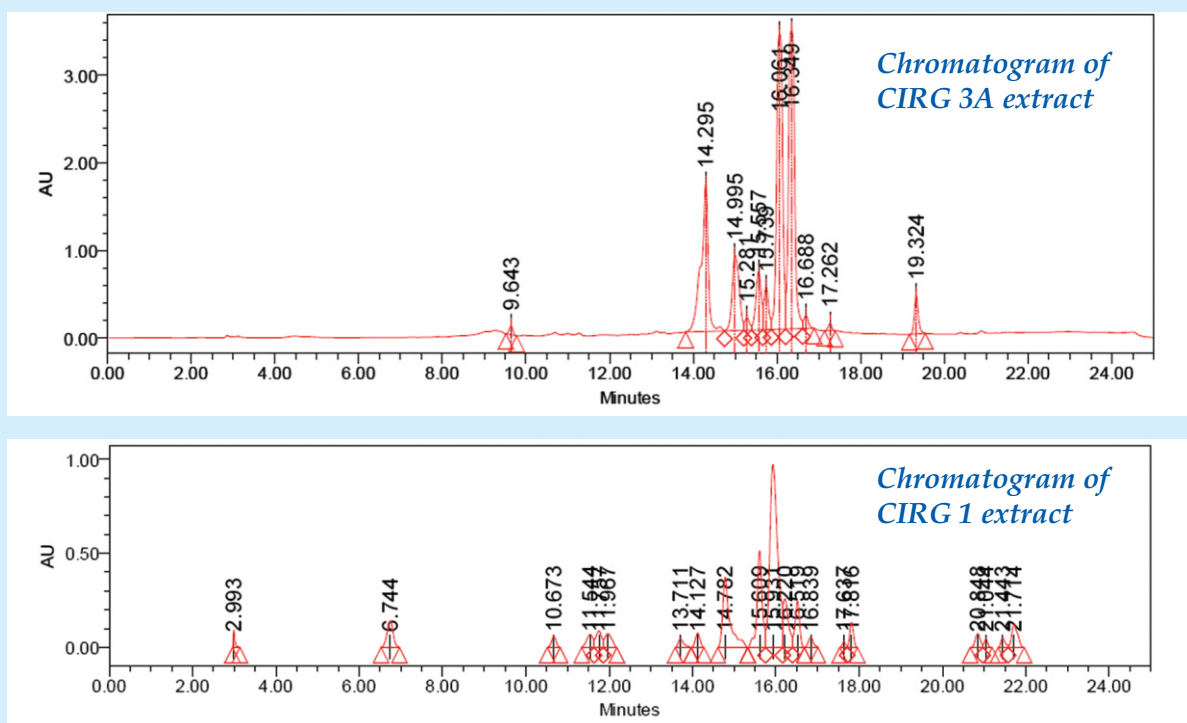
The antidiarrheal powder was prepared by using three selected plants collected from local area of Mathura Distt. Extracts were prepared by soxhlet extraction in the methanol under low temperature (25-30°C). The recovery of solvent was done by rotatory vacuum evaporator (Heidolph, Germany) under reduced pressure and temperature (4°C). The concentrated extracts were air dried and stored at 4°C. The formulation of three plants extracts were prepared in gum acacia powder to prepare pulverized powder for oral therapy.

### Standardization of formulation:

Qualitative chemical analysis was conducted to verify the chemical constituents for the presence of mainly flavonoids, alkaloids, saponins, carbohydrates, glycosides, steroids, tannins & phenolic compounds and protein &

amino acids by standard methods for the confirmation of chemical ingredients. The CIRG 1 was positive for flavonoids, alkaloids, carbohydrate and triterpenoids and negative for proteins & amino acids, saponins, steroids and tannins. CIRG 2A chemically composed of carbohydrate, tannins and triterpinoids & phenolics only and CIRG 3A was positive for flavonoids, and tannins. Standardization of three plant extracts was done by HPLC (Waters). The mobile phase gradient was standardized with the mixture of methanol and water with the run time of 30 minute. In CIRG 2A, total 11 major peaks were identified with the major peaks at RT (Retention Time, minute) 14.29, 15.53, 16.06 and 16.34 minute covering area (%) of 17, 63, 5, 15, 29.13 and 30.49 percent respectively. In CIRG 1, the total peaks were 20, with major detectable peaks at RT (minute) and covering area (percent) are; 14.78 (12.71), 15.60(12.45), 15.93(36.17), 16.22(6.65) and 16.51(5.24). Also in CIRG 3A, the total 17 peaks were noticed. The major peaks RT (Minute) and covering area (percent) were 2.94 (17.21), 14.61(16.68), 15.59(8.84), 15.90(15.94), 16.19(7.41) and 24.01(15.99).





#### Therapeutic validation:

Herbal powder was tested in clinical cases of diarrhetic kids and goats in the Institute at the dose rate of 10 mg/kg B.W for 1- 2 days orally in 40 goats and observed degree of recovery (score) and recovery days. In clinical trials, pretreatment values of appetite (Good-1, Low-2, No appetite-3), fecal consistency (Watery-1, Semi solid-2, Loose ball-3, Normal-4) and dehydration (+1, +2, +3, +4) were recorded on score basis. Rectal temperature was recorded in both the groups. Recovery score recorded as (Poor-1, Partial-2, Moderate-3, and Complete 4. In spontaneous nonspecific clinical diarrhea in different age group were treated with anti-diarrhoeal formulation with or without anti-bacterial drug for 1-3 days duration depending upon recovery. The animals responded to therapy with average recovery score of 3.4 and average recovery days of 3.0.

The therapeutic validation was conducted at Department of Clinical Medicine, college of Veterinary Sciences and AH , GBPAUT, Pantnagar (Uttarakhand). Clinical

evaluation was done in clinical cases of diarrhea in young calf of 20-120 days old at the dose rate of 5gram/10kg body weight (10mg/kg extract base) daily or twice for 2-5 days either single or with specific drug. It was tested in nonspecific diarrhea (12), in which *E coli* was isolated in some representative case; Clinical coccidiosis with bloody diarrhea(5) ,Toxocariasis(1), Nonspecific blood mixed diarrhoea(6). These cases were clinically examined for temperature, duration of diarrhoea, eye mucous membrane and isolation of possible causative agent. In nonspecific diarrhoea, all cases were responded with average recovery score of 3.4 and average recovery period of 2-4 days. In coccidiosis, along with amprolium herbal powder enhanced the recovery; and all cases of nonspecific blood mixed were responded with sole herbal powder therapy. Toxocariasis case responded with specific drug. Overall, herbal preparation has antidiarrhoeal property and enhanced antidiarrheal efficacy in cases of coccidiosis and toxocariasis. It can be good co-prescribing herb antidiarrhoeal powder.

## CSIR/XI/01/PPP mode: Development and characterization of indigenous vaccine and diagnostics for Johne's disease

S.V. Singh and Naveen Kumar

### Whole genome sequencing:

#### Genome sequence of the 'Indian Bison Type' Biotype of *Mycobacterium avium* subspecies *paratuberculosis* Strain 'S 5':

Sequencing of the whole genome of native isolate of 'Indian Bison Type' Biotype of *Mycobacterium avium* subspecies *paratuberculosis* strain 'S 5' was completed. Sequencing the genome of 'Indian Bison Type' biotype of *Mycobacterium avium* subspecies *paratuberculosis* (MAP) Strain 'S 5', isolated from terminally sick Jamunapari goat at the CIRG farm revealed the genome size of 4.79-Mb. This draft genome will help in studying novelties of this biotype, which is widely distributed in the animal and human population of the country. This novel strain 'S 5' of MAP has not been reported so far in the world and since it is new bio-type has been named as 'Indian Bison Type' and draft sequence has been reported in the GenomeA (Journal of Bacteriology).

The strain 'S 5' of 'Indian Bison Type' biotype of *Mycobacterium avium* subspecies *paratuberculosis* (MAP) was isolated from a terminally sick Jamunapari goat breed located at CIRG, Makdhoom, using decontamination and culture technique of Merkel *et. al.* (1964). This biotype has been recovered from biotic [domestic and wild ruminants (hog deer, blue bulls, bison deer), rabbits, non-human primates (monkeys) and human beings and abiotic (raw and pasteurized milk, milk products, soil, river water) environment of the country. This strain has been characterized as recently evolved MAP biotype. Strain is antigen source for indigenous 'ELISA kit' and 'Vaccine' for the control of Johne's

disease in animals. The vaccine developed is both preventive and therapeutic for the control of Johne's disease in animals. Whole-genome sequencing of strain S5 was carried to explore the genetic organization and genes involved in physiology, pathogenicity and immunogenicity.

The genome of strain S5 was sequenced by Illumina GAIIX, which produced a total of 112,487,226 paired-end reads of length 101 nucleotides and Ion torrent technology, which generated a total of 1,151,448 reads of length 5 to 202 nucleotides. NGSQC toolkit v2.2.1 was used to filter the Illumina data for high quality (HQ) (Cut off read length for HQ=40%, Cut off quality score=10) and vector/ adaptor free reads. A total of 100,506,616 paired-end reads and 5,300,026 single end reads were obtained after filtering and again trimmed at 3' end (last 11 bases with average quality score <15). All bases of Ion torrent reads at 3' end were trimmed with quality score <15. Reference assisted genome assembly of filtered data was performed with MAP strain K10 (GenBank accession: NC\_002944.2) using Velvet v1.2.08. A total of 178 contigs of size 4,798,157 nt with N50 contig length of 58,516 nt; the largest contig assembled measured 199.4 kb were produced as draft genome, annotated by RNAmmer 1.2 and PGAAP (7) pipeline of National Center for Biotechnology Information (NCBI). A total of 4,288 coding regions (CDSs), 3 rRNAs and 46 tRNAs were predicted.

Genome annotation by PGAAP pipeline showed that strain 'S5' contains genes for glycolysis, gluconeogenesis, pentose phosphate pathway, tri-carboxylic acid cycle and glyoxylate cycle. A total of 90 regulator genes were found, which indicate the ability of strain 'S5' to survive in a wide range of environmental conditions. Large numbers of regulatory genes (~150) were also found in case of *Mycobacterium avium* subspecies *paratuberculosis* strain K-10(8).

There are 18 oxidoreductases and 18 oxygenases present in the PGAAP annotation, which indicate the role of strain 'S5' in lipid metabolism and oxidation-reduction. A total of 4 serine/threonine protein kinases (STPKs) are also present in the annotation, which are part of the phosphorylation system.

Genes like lipoprotein *LpqH*, lipoprotein *LprG*, *pstS*, molecular chaperone *DnaK*, chaperonin *GroEL*, UDP-MurNAc hydroxylase (*namH*), acid phosphatase [EC:3.1.3.2] and serine/threonine-protein kinase *PknG* [EC:2.7.11.1], involved in tuberculosis have been found by mapping all predicted CDSs to KEGG pathways through KASS server.

#### **Nucleotide sequence accession number**

This whole genome shotgun project has been deposited at DDBJ/EMBL/GenBank under the accession ANPD000000000. The version described is the first version, ANPD010000000. This work was funded by the Council of Scientific and Industrial Research (CSIR), New Delhi in partnership with Indian Council of Agricultural Research (ICAR), New Delhi under the chairmanship of Professor N.K. Gaaguly (Ex-Director General, ICMR). Genome assembly and annotation data of this project is available at genomics web portal (<http://crdd.osdd.net/raghava/genomesr/>) of IMTECH.

#### **Development of test system for differentiation of Johne's disease infected and vaccinated animals (DIVA):**

The final preparation of Johne's disease vaccine is believed to be free from cultural filtrate proteins (CFPs) or secretory proteins as they exclude out during manufacturing process. Therefore Johne's disease vaccinated animals produce antibodies only against structural proteins whereas MAP infected animals produce antibodies against both structural and secretory proteins (CFPs). As per the OIE, DIVA

(Differentiation of Infected and Vaccinated Animals) is prerequisite to claim the status of freedom from infection if vaccine has been used to control the disease. Therefore, in order to make the JD control programme effective and in order to gain the JD free status as per OIE, it is very essential to develop DIVA test. To develop a DIVA test for MAP infection, cultural filtrate proteins (CFPs) will be clone into pET28a+ vector as a His-tagged (C-terminal) fusion protein and will be purified by Ni-Agarose affinity chromatography. The resulting recombinant protein will be used as tapping antigen in ELISA. Out of 14 CFPs, only six CFPs (*MAP 1693c*, *MAP 1693c*, *MAP 2168c*, *MAP Mod D*, *MAP 85c*, *Pep AN*, *Pep AC*) which are known to induce detectable antibodies will be used to establish a profiling ELISA.

#### **Cloning strategies:**

Among various CFPs, only six (*1693c*, *2168c*, *ModD*, *85c*, *Pep AN* and *Pep AC*) will be subjected to cloning, expression and purification to develop ELISA (DIVA) as these are the only proteins which have been shown to react with MAP-infected sera (Cho et al., 2007). We have successfully amplified these CFPs genes in PCR. For cloning, of *PepAC*, 540 nucleotide long PCR amplified gene segment (*PepAC*) along with Vector (pET28a+) were restricted with *Xho I* and *Nde I* and subsequently gel purified (Fig. 1). Following restriction digestion, pET28a(+) was dephosphorylated with fast alkaline phosphatase (Fermentas, USA). Gel purified *PepAC* gene fragment (insert) and dephosphorylated pET28a+ (vector) were ligated in 3:1 ratio along with a negative control (without insert) by using Ligase (Fermentas, USA). The ligated products were transformed into DH5± competent cells followed by plating on kanamycin containing LB agar and a further incubation at 37°C for 18 h. We observed kanamycin resistant colonies (30-40 in

number) only in pET28a/PepAC ligated product compared to control reaction (empty vector) (Fig. 2). Six colonies were selected and further cultured for 16-18 h followed by mini preparation of their plasmid DNA. The plasmid DNA was digested with the similar restriction enzymes (*Xho I* and *Nde I*) described above. We observed drop out of 540 nucleotide long fragment from plasmid DNA which was suggestive of the successful cloning of the gene of interest. For further confirmation, the nucleotide sequencing of few of the constructs (pET28a-PepAC) is underway.

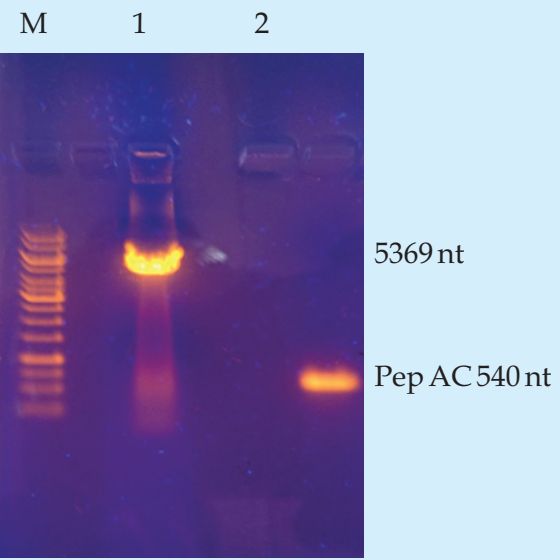


Fig. 1  
Gel purification: M=1kb DNA ladder, Lane 1=*Xho I* and *Nde I* digested pET-28a(+), Lane 2=PCR amplified and *Xho I* and *Nde I* digested Pep AC.

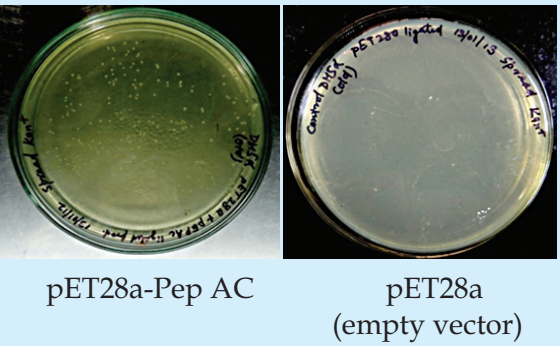


Fig. 2:

### Validation of the 'Indigenous Johne's Disease Vaccine'

Of the 9 trials 'Indigenous Johne's Disease Vaccine' only 5 trials were continued, one trial (Experimental Trial in goat's kid) was for limited time and was concluded and two trials in cattle (Swadeshi Goshala and Golo Goshala) has been closed down due to non-cooperation of the owner. The 5 trials (1 cattle, 2 goat and 2 sheep) were available for monitoring have been conducted on 'spontaneous cases of JD (50-75% clinical JD). Major limiting factors were extremely poor health and severe nutritional stress. Nutritional status of the sheep flock at Mannavanur, TN and a cow herd (Vaishnav Goshala at Vrindavan was optimum. Environmental stress (extreme winter and summer) was other burden. JD being 'Production disease' stress factors directly affected animal productivity and response to vaccination, which is directly related diversion of energy for fighting the disease.

### Vaccine trial using new 'Indigenous Vaccine'

A new trial of 'Indigenous vaccine' was started with the new batch of vaccine prepared with double strength (i.e. 5 mg / ml of adjuvant), since MAP infection is endemic in domestic ruminants, including goats. Therefore, under continued validation of the vaccine 'An entirely new experiment was started, wherein goats from farm herds (CIRG, Makhdoom) were procured and kept separately. These young goats were poor in body condition scores and had clinical symptoms of JD. Randomly these goats were divided in to three groups and were vaccinated using new and old batch of vaccine. Control group goats were given 1 ml of PBS. Animals were monitored for the response to vaccine.

### Monitoring of vaccine response by faecal microscopy, blood PCR and 'indigenous ELISA kit':

Microscopic examination of faecal smear

showed increase in shedding of MAP in adjuvant (8.4%) and control (8.3%) groups and decrease (16.7%) in the 'new vaccine group' from 0 to 360 days post vaccination. Result of blood PCR shows decrease in MAP bacteremia in new vaccine group upto 360 DPV and increase in control group. The study is continued and will be complied

with each screening.

#### Monitoring of humoral immune response:

Serum ELISA shows the gradual increment in sero-titer of anti MAP antibodies in 'new vaccine group' and 'old vaccine group', while it was varying 'control groups' upto 360 days post vaccination (Fig.1).

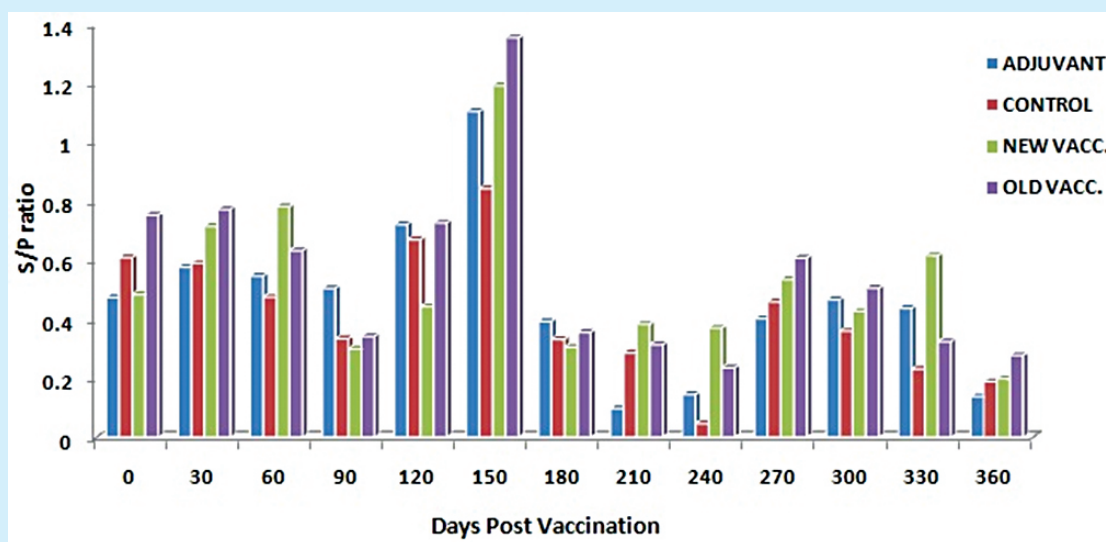


Fig.3 : Sero-titer (sample to positive ratio) in different groups of animals from zero to 360 DPV

#### Body weights:

Body weights of goat were recorded at weekly and monthly intervals upto 12 months. **Females:** Average body weights gained (within a year of vaccination) in vaccinated and control group of goats were statistically analyzed. Though values passed the normality test (P value >0.05), vaccinated goats gained weight as compared to control.

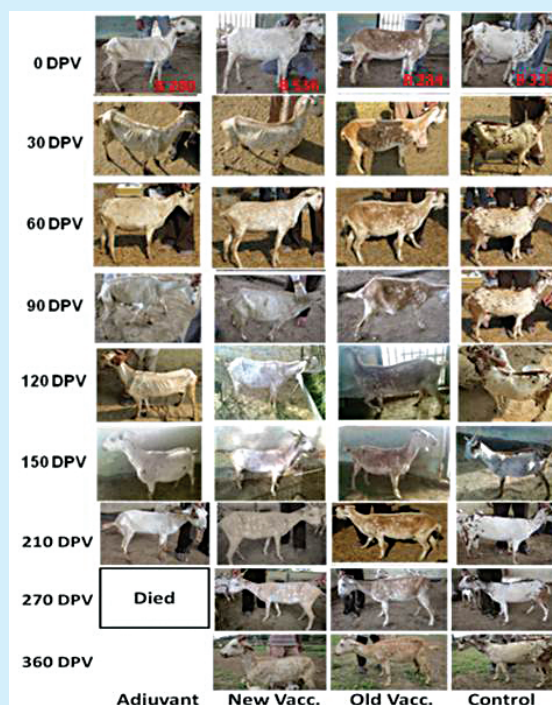


Fig. Physical appearance of different groups of goats at zero to 360 DPV.

### NAIP Component III: Achieving improved livelihood security through resource conservation and diversified farming systems approach in Mewat.

D.K. Sharma and P.K. Rout

An average growth rate in goat population of 44.4 percent was seen in adopted village. While average kidding rate was 123.1 percent, the average mortality was 9.05 percent. The overall percent of animals sold was 32.33. On annual basis the total

income earned through goat rearing was calculated to be Rs. 12592/- by per house hold. Under upgradation programme, a total of 432 services were provided by the backs distributed in three villages. Through 10 health camps organized in adopted villages a total of 96 (HS), 96(FMD) and 146 (ET)vaccination were performed along with 212 deworming and 86 dippings. In all, 84 animals of different livestock species were treated for different clinical conditions.

#### Population growth of goat in adopted villages during 2012-13

Villages	Opening Balance	Breedable female	Does Kided	Kid Born	Kid Died%	Total Population	Deaths	Sold	Available
Jharpadi	62	28	22	26	11.6(5)	88	8.23(7)	25	56
Singhalhedi	69	25	23	30	5.17(3)	99	9.09(9)	36	54
Maroda	48	23	19	23	15.6(5)	71	9.85(7))	24	40

### Modulation of caprine coccidiosis through herbal therapy.

D.K. Sharma and Ashok Kumar

An *in-vivo* trial with a new prototype prepared using two extracts found quite effective in checking the sporulation of Eimerian oocysts in *In-vitro* state was conducted using it in complete feed pallets. Two groups of kids (3M) with natural Eimerian infection were maintained separately. While one group maintained on feed pallets with prototype, the other one was kept on feed pallets without prototype. The Eimerian oocysts counts were made starting at Zero day to every 10 day up to 3 months. The data resulted was analyzed using two way ANOVA test. However, the raw data on OPG count was normalized by transforming it to normal log value and all the analysis was done on transformed data. The group means were tested using critical

Table : Group and Interval OPG Means

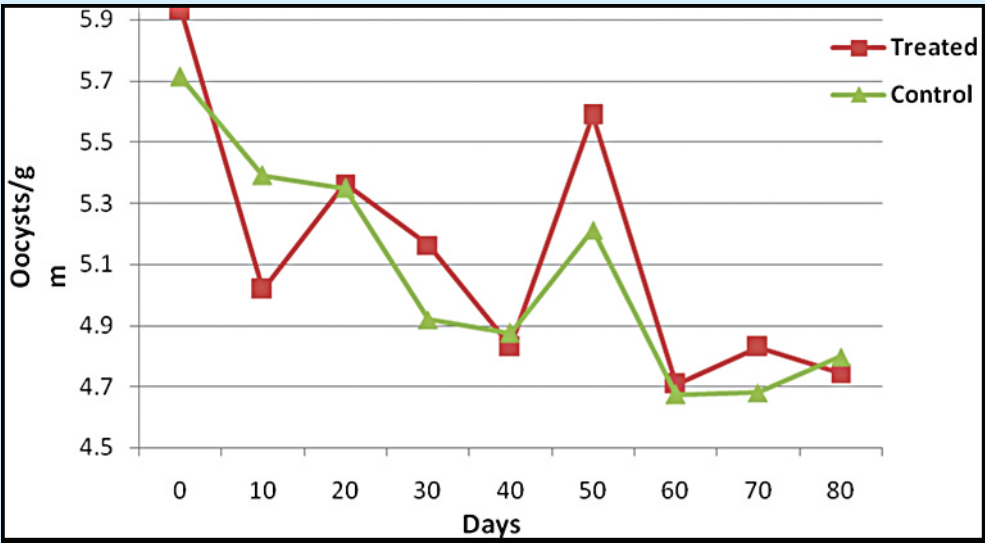
Source of variations	No. of Obs.	Mean	S. E.
Overall Groups	108	5.099	0.053
Treatment	54	5.130	0.076
Control	54	5.068	0.076
Interval			
Day 0	12	5.823	0.224
10	12	5.203	0.159
20	12	5.357	0.180
30	12	5.042	0.065
40	12	4.853	0.045
50	12	5.400	0.161
60	12	4.690	0.014
70	12	4.754	0.046
80	12	4.771	0.048

difference test. Analysis results have been shown in Table and along with Analysis of Variance table. The results showed that mean OPG counts both in treated as well as control group was not significantly different. However, the difference in OPG count means on different interval of 10 days were highly significant ( $P < 0.01$ ). The variations in OPG over the intervals were of varied nature. But in general the highest OPG count mean observed on 0-day reduced significantly over the period

showing the effectiveness of the treatment (Fig. 3). Similarity of both groups irrespective of treatment can be explained on the basis of post treatment Eimerian infection from outside as experimental period was quite long (3M) and possibility of mismanagement during this experimental period in hygiene and sanitation like practices. Finding was further supported by data on production traits like weight gain which were improved in treated group.

**Analysis of variance table showing the effect of prototype between groups and over the period**

Source of Variation	Degree of freedom	S.S.	M.S.S	F-Value
Treatment	1	0.104	0.104	0.523
Interval	8	13.805	1.726	80692
Treat X Interval	8	1.141	0.143	0.718
Error	90	17.867	0.199	
Total	107	32.917		



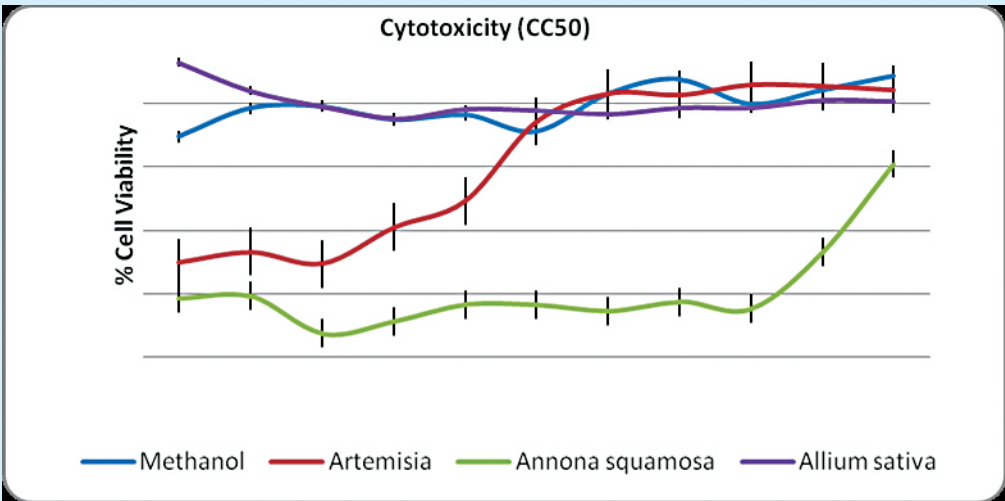
*Effect of Prototype treatment on OPG counts in natural infection*

Cytotoxicity assay was performed in the Vero cells. A two fold dilution (starting from 5000  $\mu\text{g/ml}$ ) along with a vehicle-control (methanol) were incubated with the Vero cells for 72 h followed addition of MTT

reagent. Of the three extracts tested *Allium sativa* was the safest with best cell viability ranging between 90 to 100 percent in all concentration. The viability in this case was as good as with methanol, the control used.

The extract of *Annona squamosa*, however, showed the least cell viability which was below 25% in all concentrations except when the concentration was less than 19.5 µg/ml. The cell viability of Vero cell culture was, however, of middle order when we

tested the toxicity of *Artemisia annua* which showed more than 50 percent viable in concentration below 625 µg/ml. But safety of this extract was of high order when used in concentration below 156 µg/ml and it was as safe as *Allium sativa*.



hyperplastic, sometimes thick verrucose mass or papillomatous continuous mass or nodules due to proliferation of dermal/epidermal tissue. Such lesions showed formation of thick large scabs or deep red to brownish gray or black encrustation which bled frequently due to stretching or rubbing of mouth. Clinical samples including sterile swabs and scabs from lesions were collected for virus isolation.

A disease outbreak of enterotoxaemia occurred in village Samaspur, Mathura in October, 2012. Disease investigation also revealed parasitic infection of coccidiosis and bursate eggs in addition to the ET.A sheep pox outbreak occurred in Poonchh and Doda (J&K) wherein more than 100 sheep and goats were affected.

Sheep pox. Confluent reddish-pale nodules surrounded by hyperemia (gunshot lesions) in the lung.

A total of 358 necropsies were conducted from 1.4.2012 to 31.3.2013 involving 99 animals from Barbari unit, 74 from Jamunapari unit, 65 from Animal Health Shed, 50 from Sheep unit, 39 from Jakhrana



*Severely hemorrhagic (reddened) intestine.*

unit, 25 from PRSM and 6 from NFR&PT. The major causes of death diagnosed were pneumonia (39.10%), gastro-enteritis (15.64%), toxemia (5.86%), pneumoenteritis (4.74%), septicaemia (3.63%), acidosis, hemonchosis, predation, autolysis (8.93%), miscellaneous diseases (12.84%) etc. Gross tissue specimens were collected for various pathological conditions including tissue specimens for microbiological (virological and bacteriological) isolation studies. Isolation studies performed on tissue and clinical samples revealed involvement of microorganisms such as *P. multocita*, *E.coli*, *Staphylococci*, *Streptococci*, *Micrococci*, *Pseudomonas* and *Bacilli* organisms in causation of diseases.

### **Genetic resistance study in Indian goats against gastrointestinal nematode, *Haemonchus contortus* infection**

*D.K. Sharma, S. Paul, Naveen Kumar, P.K. Rout and V.K. Gupta*

A total of 456 faecal samples from Jamunapari and Jakhrana goats were examined for parasitological parameters. The incidence of different parasitic infection has been given in table. The overall

incidence of Eimerian infection at CIRG in these flocks was 71.71%. The breed wise Eimerian incidence was however observed as 91.09 and 40.80% respectively in Jamunapari and Jakhrana goats. The overall strongyle infection incidence observed was 32.45% while breed wise incidence was 6.07 and 63.63% respectively in Jamunapari and Jakhrana goats. Moniezial incidence being 6.47 and 5.26% in Jamunapari and Jakhrana respectively.

**Incidence of Parasitic infection observe in Jamumapari and Jakhrana goats in Institute**

Breeds	Total Obs.	Coccidia+ ( %)	Bursate+ ( %)	Moniezia+ ( %)	Songyloidsest+ ( %)
Jamunapari					
0-3 M	31	80.64(25)	-	-	-
3-6 M	20	100(20)	-	-	-
Adult	196	91.89(180)	7.65(15)	8.16(16)	-
Total	247	91.09(225)	6.07(15)	6.47(16)	
Jakhrana					
0-3 M	10	90.0(9)	-	-	-
3-6 M	46	52.17(24)	26.08(12)	17.39(8)	-
Adult	153	81.69(69)	79.08(121)	1.96(3)	2.61(4)
Total	209	48.80(102)	63.63(133)	5.26(11)	1.91(4)
Overall	456	71.71(327)	32.45(148)	5.92(27)	0.87(4)

**Pilot study: Prevalence of caprine toxoplasmosis and cryptosporidiosis**

*S. Paul, D.K. Sharma, M. Reddy and N. Sharma*

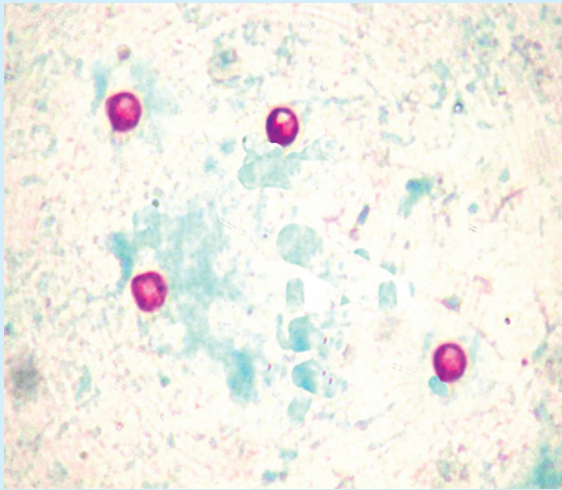
Cryptosporidiosis in goats is caused by the protozoan parasite, *Cryptosporidium parvum* and *Cryptosporidium xiaoi*; it is one of the major health problems among the neonatal goat kids.

In the present study a battery of tests were employed for the study of prevalence of *Cryptosporidium* spp. since there is no single test by which *Cryptosporidium* spp are identified.

In smears stained by modified Ziehl-Neelsen (mZN) technique the oocysts appeared as pink spherical bodies against a green background of malachite green (Fig. 1). The unstained oocysts appeared as small, shining and translucent spherical bodies under bright field microscopy (Fig. 2). The longitudinal and transverse diameters of 200 unstained oocysts were measured for the purpose. The oocysts diameter was found to be  $5.032691 \pm$

$0.323884$  ( $3.264$ - $5.802$ )  $\mu\text{m}$  X  $4.724035 \pm 0.317689$  ( $3.06$ - $5.1$ )  $\mu\text{m}$ . The shape index of oocysts was recorded as  $1.057$ - $1.06$ .

Kids below 15 days of age showed greater prevalence of the disease as compared to kids above 15 days of age. The prevalence of cryptosporidiosis in 0-15 days age group was around 47% whereas in 15- 30 days it was approximately 37%. It was found that the prevalence of cryptosporidiosis among kids were higher during summer months (47.53%) than winter months (37.28%). Other neonatal kid diarrhoeal pathogens like *E.coli* and Rotavirus are also important in causation of disease. In 84 cases only *Cryptosporidium* spp were found *Toxoplasma gondii* is an obligate intracellular protozoan parasite with a broad host range involving both mammals and birds. Because of its wide prevalence in man and animals, the parasite has significant impact not only on animal production but also on public health throughout the world. The ability of the parasite to multiply virtually in all the nucleated cells of body and the consequent encystment in various tissues constitutes a



Modified ZN staining of Faecal smear showing bright red oocysts over green background of Malachite Green (x 5000X)

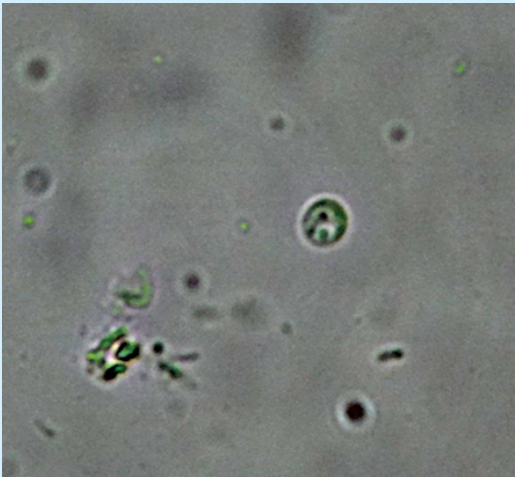
potential source of infection to the intermediate hosts. In animals, *T. gondii* infection is responsible for abortion, stillbirth and neonatal losses in all types of livestock, especially in goats, sheep and swine. In addition, the tissue cysts of *T. gondii* in meat of infected livestock are an important source of infection for humans and, therefore, considered as a disease of considerable economic importance. Under the present study total 47 serum samples from aborted does were serologically tested by ELISA with rSAG1 antigen of *Toxoplasma gondii*. 12 samples showed positive results which corresponds to 25.53% prevalence. From three Postmortem cases (where the doe was pregnant and died due to some other complications) placental cotyledons were collected and DNA was extracted from them by routine phenol chloroform method. The extracted DNA was subjected to PCR directed towards B1 gene of *Toxoplasma gondii*. Only in one sample there was amplification of B1 gene of *Toxoplasma gondii*.

The sample showed a 196 bp band during primary PCR and 96 bp band in nested PCR (Fig. 3). However, there still scope for

assessing the molecular epidemiology of these two diseases in goats on a larger scale for devising a suitable control strategy.

Isolation of *Cryptosporidium* spp. isolates from kid faecal samples

Breeds	Samples Screened	Samples Positive
Jamunapari	257	121
Barbari	209	87
Jakhrana	94	34
Total	560	242



Unstained *Cryptosporidium* oocysts (x 1000X)

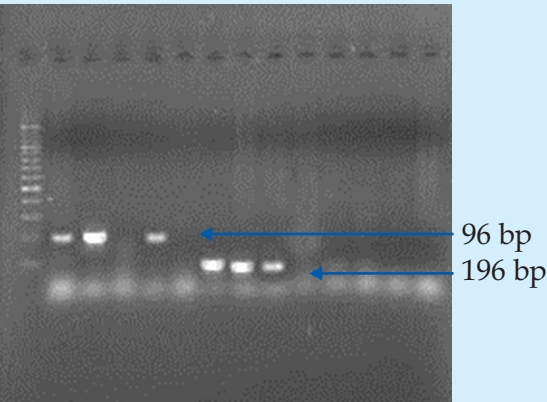


Figure: Amplification of B1 gene of *Toxoplasma gondii*. 196 bp in Primary PCR and 96 bp in nested PCR

**Development of alternative therapy for mastitis caused by *Staphylococci* using lytic bacteriophages ( Pilot study):**

*A.K. Mishra, A. Kumar and Nitika Sharma*

Endolysins (lysins) secreted by the bacteriophages virulent to *Staphylococcus aureus* associated with goat mastitis, were isolated by precipitation of fresh phage-bacteria culture lysate with ammonium sulphate, followed by high speed centrifugation. The double precipitation with  $(\text{NH}_4)_2\text{SO}_4$  was done to attain good quality lysin. The isolated/separated endolysins from six phage-isolates were tentatively named as LysCIRG 1, LysCIRG 2, LysCIRG 3, LysCIRG 4, LysCIRG 5 and LysCIRG 6 respectively. For determination of the optimum storage condition for endolysins, an amount of 100  $\mu\text{l}$  of each lysin-preparation was kept at 4°C for 6 months and 37°C for one month, and their lytic efficacies were assessed by spot inoculation method at weekly and daily intervals respectively. Activity of all six endolysins at 37°C storage lasted between 12 to 23 days (Table 1), while all showed stability even after 6 months of storage at 4°C. In the present study, all six endolysins showed considerable long-term stability at 4°C. Long-term stabilities are the essential requirement for any endolysin-preparation to be used therapeutically. Thereafter, we assessed the lytic potential of the endolysins against 124 isolates of *Staphylococcus*. Each staphylococcal isolate was inoculated into sterilized brain heart infusion (BHI) broth, and incubated at 37°C. The 16 h old pure broth culture of each isolate was spread plated onto the BHI agar plate and then, 5  $\mu\text{l}$  of the lysin-preparation was aseptically placed on the dried surface of agar. After overnight incubation at 37°C, the sensitivity of the target organism against the endolysin was observed by formation of lytic zone

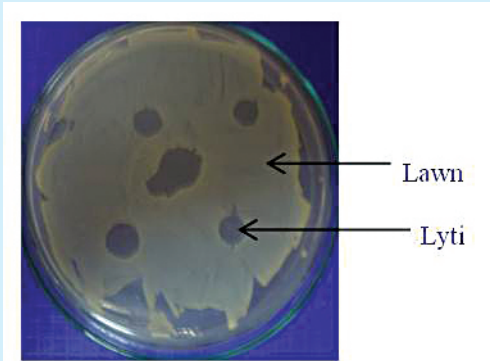


Fig. 1: Lytic efficacy of endolysin against host bacterium

(Fig.1). Lytic efficacy against more than 80 % staphylococcal isolates was demonstrated by LysCIRG 1, LysCIRG 4 and LysCIRG 5 (Table 2). Thus, these endolysins showed a very wide host range. The results of the present study provide insight for using endolysins for therapeutic interventions against multi-drug-resistant *S. aureus* induced goat mastitis.

**Table 1: Stability of endolysins at 37°C**

Name of Endolysin	Stability Period (in days)
LysCIRG1	23
LysCIRG 2	12
LysCIRG 3	21
LysCIRG 4	17
LysCIRG 5	19
LysCIRG 6	15

**Table 2: In vitro lytic efficacy of the endolysins against various isolates of *Staphylococcus***

Name of Endolysin	% Lytic efficacy
LysCIRG 1	83.87
LysCIRG 2	78.23
LysCIRG 3	72.58
LysCIRG 4	88.71
LysCIRG 5	86.29
LysCIRG 6	76.61

## Pilot study: Isolation and identification of important viruses of goats

Naveen Kumar and S. V. Singh

### Isolation and identification of a sheep pox virus from outbreak in Poonchh (J&K)

Goat and sheep pox are highly contagious viral diseases of small ruminants. The etiological agent belongs to genus *Capripoxvirus* of the family *Poxviridae*. Disease hitherto has been endemic in certain parts of the India (West Bengal and Maharashtra) and lately its epidemics have been reported from other parts of the country (Chattisgarh and J & K, U.P.), leading to significant economic losses to the livestock industry of the country. This study describes the diagnostic investigation of a severe sheep pox outbreak in Jammu, Poonchh, Rajori and Doda districts in J & K.

The affected animals especially sheep exhibited fever, widespread papules particularly around the mouth (Fig. 1A and 1B) and eyes (Fig. 1C), mucopurulent nasal discharge and respiratory symptoms with a mortality rate of about 40%. The predominant post-mortem findings were enlarged and edematous lymph nodes and severe lesions in lungs (congestion, edema and necrosis) (Fig. 1D). The goats

developed less severe lesions without significant mortality.

### Virus isolation: Cytopathic effect of the virus in primary goat testicle culture

A testicle from a healthy goat was received aseptically in PBS from slaughter house (Farah) and the fatty tissue and other outer layers were removed. Thereafter, the tissue was cut into small pieces followed by trypsinization. Finally the cell suspension was filter through muslin cloth to get rid off from the pieces of tissues that remained in the suspension after digestion. Trypsin was removed by centrifugation (1000 rpm for 15 minute) and the resulting cell pellet was resuspended in DMEM supplemented with 10% fetal calf serum and propagated in 75 cm<sup>2</sup> conical flasks.

For isolation and identification of the virus, scrapings from the papules (from live animals) and the lung tissues (collected at postmortem) were transported in the transport on ice until reached the Virology laboratory at CIRG. Scrapings from the pox lesions and lung tissues were processed as per standard procedure and filtered through 0.45 µm syringe filter to get rid off the bacterial contamination. The samples were stored in deep freezer at -80°C till further processing. The resulting filtrate was used to infect confluent monolayer of

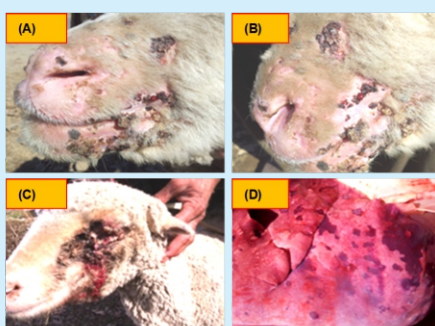


Fig. 1: Clinical and postmortem findings of affected sheep.

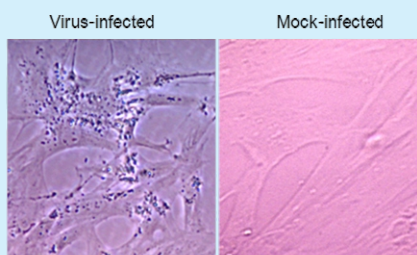


Fig. 2: Cytopathic effect of the virus in primary goat testicle culture

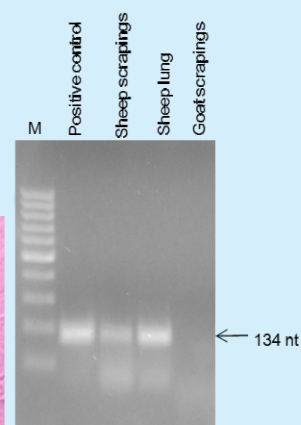


Fig. 3: Amplification of *Capripoxvirus* specific DNA segment by PCR

primary goat testicle cells. At 48 hrs post-infection, a cytopathic effect was observed in virus-infected but not in mock-infected cells (Fig. 2).

#### **Virus Identification: Amplification of goatpox virus specific genome in PCR**

DNA was isolated from (i) a piece of lung that was collected from a sheep that died due to suspected sheep pox (ii) scrapping from lesions in sheep (iii) scraping from the lesions in goat (mild) and along with a positive control (goatpox virus). A 134 nucleotide (nt) long *Capripoxvirus* specific gene segment was amplified in the PCR (Fig. 3) in the specimens derived from sheep lung and scab. However we could not detect it in the scab derived from goats.

Sheep pox virus (SPV) and goat pox virus (GPV) were once believed to be strains of the same virus, but genetic sequencing has now demonstrated them to be separate viruses. The genus *Capripox* is comprised of Sheep pox, Goat pox and Lumpy skin disease (LSD) viruses as the etiological agents of sheep pox, goat pox and lumpy skin disease in cattle, respectively. SPV, GPV and LSDV are very closely related genetically, sharing at least 96% nucleotide identity and cannot be differentiated serologically. Sheep and goat pox are indistinguishable clinically. For most SPV and GPV isolates, however, distinct host

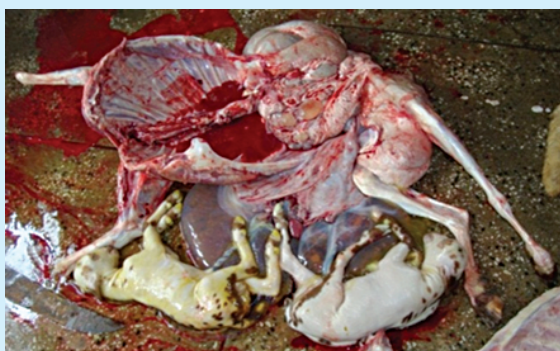
preferences exist with more severe disease evident in the homologous host. Some strains in contrast, demonstrate similar pathogenicity in sheep and goats.

Since sheep were more severely affected in current pox outbreak in J & K, it appears that the virus is of SPV type or sheep adapted pox virus. However in order to make firm conclusion whether it is SPV or GPV, some sequence analysis of this strain recovered at CIRG, Makdoo is essentially required. Further, in order to draw some more conclusions about the pathogenicity, antigenicity and genotype diversity of the virus associated with current pox outbreak (between pox virus recovered from sheep and goats, with other pox outbreaks in goats and vaccine strains in pox vaccines) in J & K state, it's whole genome sequence analysis will be required. This will provide insight for devising proper control strategies against the *Capripoxvirus* of J & K origin by choosing a homologous candidate vaccine prototype for the effective immunity and control of disease in sheep and goat population of the state. Based on the clinical and the postmortem findings and amplification of *Capripoxvirus* specific gene segment by PCR, the association of the *Capripoxvirus* infection in the undergoing pox outbreak in goats and sheep in J & K state was confirmed.

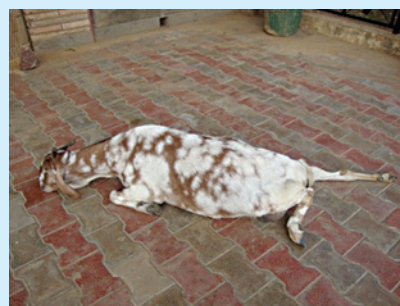
### Metabolic profiling for diagnosis and control of metabolic diseases in goats

Nitika Sharma, Ashok Kumar,  
Ravindra Kumar, R.V.S. Pawaiya and  
Vinay Chaturvedi

Thirty-six blood samples were collected from 18 primiparous and 18 multiparous goats after morning milking during periparturient phase. Haematological



*Pregnancy toxicaemia in a doe with twin foetuses*



*Hypocalcaemia in a doe*

parameters were estimated and the serum samples have been processed for metabolite, biochemical and mineral estimations. The data is under analysis. Twenty one natural cases of hypocalcaemia were diagnosed in goats just after kidding on the basis of clinical signs and laboratory examination. Serum samples were collected for calcium and glucose estimation from these clinical cases. The goats were found to be hypocalcaemic and hypoglycaemic.

### Veterinary type culture - Veterinary microbes (Network Project)

V.K. Gupta and G.B. Manjunatha Reddy

Following bacterial cultures (13) were accessioned by VTCC.

Accession No.	Name of organism	Strain design align
VTCCBAA218	<i>Staphylococcus</i>	CIRG/St/84B
VTCCBAA219	<i>Staphylococcus</i>	CIRG/St/82C
VTCCBAA220	<i>Staphylococcus</i>	CIRG/St/2A
VTCCBAA221	<i>Staphylococcus</i>	CIRG/St/2B
VTCCBAA222	<i>Staphylococcus</i>	CIRG/St/2C
VTCCBAA223	<i>Staphylococcus</i>	CIRG/St/2E
VTCCBAA224	<i>Staphylococcus</i>	CIRG/St/29A
VTCCBAA225	<i>Staphylococcus</i>	CIRG/23RH1
VTCCBAA226	<i>E. coli</i>	CIRG/13B E.coli
VTCCBAA227	<i>Brucella melitensis</i> biowar I	CIRG/Bru. meli.BV I
VTCCBAA228	<i>Brucella melitensis</i> biowar III	CIRG/Bru. meli.BV III
VTCCBAA282	<i>Staphylococcus</i> spp.	SD/249B/CIRG
VTCCBAA283	<i>Staphylococcus</i> spp.	St/345B/CIRG

### Outreach project on zoonotic diseases

**Sub-Title:** Zoonotic potential of *Mycobacterium avium* subspecies *paratuberculosis*, as the cause of inflammatory bowel disease (Crohn's Disease) in human beings

**S.V.Singh and Naveen Kumar**

A total of 27,937 samples (17,306 serum and 10,631 blood) were collected from 1<sup>st</sup> April, 2012 to 31<sup>st</sup> March 2013 from six different pathology laboratories located in Mathura city.

Of the total 24,676 samples, diabetes, anemia, liver dysfunction, typhoid and thyroid disorders were the leading causes

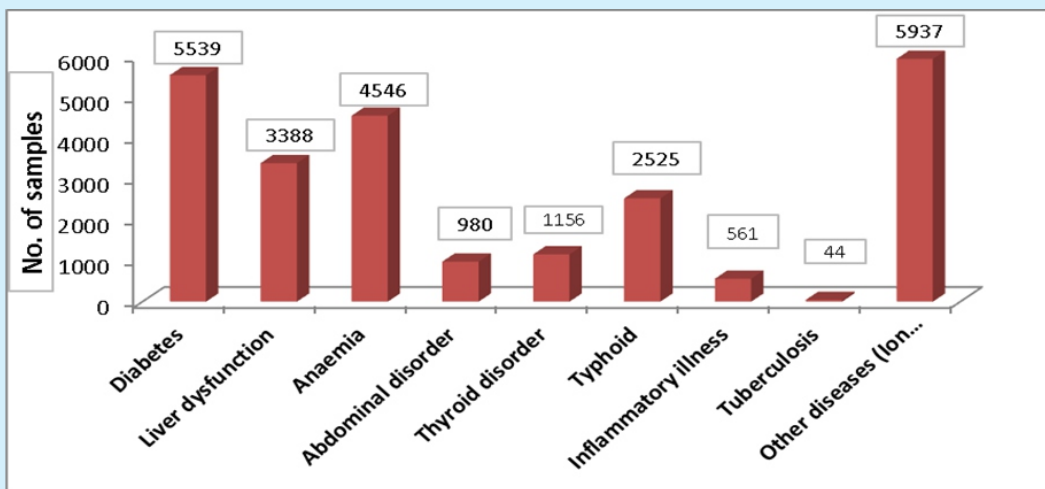
of sickness for which blood and serum were submitted for diagnosis to the above pathology laboratories.

Profile of health disorders for which samples (serum and blood) were submitted for screening to different pathological laboratories.

Of the 17,306 serum samples, 5,165 were screened by 'Indigenous ELISA kit' and 218 (4.2%) and 1591 (30.8%) were in strong positive and positives categories, respectively. Which showed that 35.0% serum samples were positive for the presence of MAP infection from Mathura district.

### Distribution of human samples collected from different pathological laboratories located in Mathura city

Pathology Laboratory	Human beings, <i>n</i>	Single samples ( <i>n</i> )		Paired samples, <i>n</i>	Days <i>n</i>
		Blood	Serum		
1. New Rangeswar Path	15356	5050	11248	942	365 (Av. 77 samples/day)
2. Mathura lab	7779	4901	4993	2115	
3. Swarna Jayanti Hospital	1053	463	749	159	
4. Pathak Pathology	19	19	5	5	
5. Sushila Hospital	61	36	36	11	
6. Varsha Pathology	408	162	275	29	
<b>Total</b>	<b>24676</b>	<b>10631</b>	<b>17306</b>	<b>3261</b>	



### Sero-status of MAP infection in human samples by 'Indigenous ELISA kit'

Samples processed (n)	S/P Ratio	Disease status	Sero-status (%)
5165	0.00-0.09	Negative	1403 (27.1)
	0.10-0.24	Suspected	1011 (19.5)
	0.25-0.39	Low positive	942 (18.2)
	0.40-0.99	Positive	1591 (30.8)
	1.0-10.0	Strong Positive	218 (4.2)

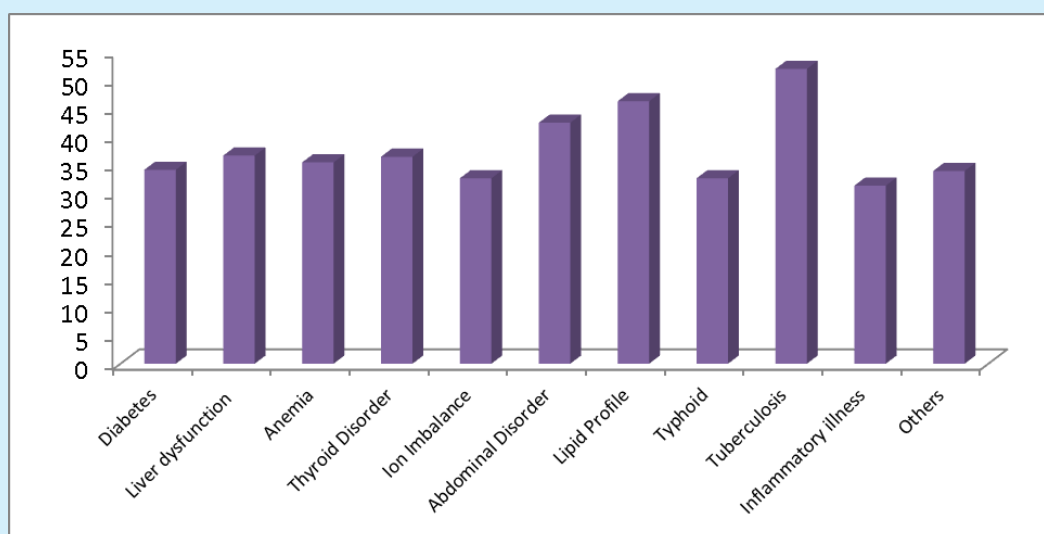
\*Total 17350 serum samples collected, of which 5165 were processed and 35.0% were positive..

Analysis of the clinical profiles of positive samples showed that MAP positive serum were not specifically correlated with any of the following clinical conditions for which human beings suffered or suspected suffering from non-infectious (diabetes, liver dysfunction, anemia, thyroid disorder, ion imbalance and abdominal disorder) and infectious (typhoid, tuberculosis,

inflammatory illness, others) health problems (fig.).

Percent sero-positivity in 'Indigenous ELISA' with respect to different conditions of sickness for which human patients were suspected.

Human blood samples were also screened for the MAP infection using specific IS900



PCR. Of the 65 samples screened, 7 (10.7%) were positive and diabetes samples showed maximum (25.0%) correlation. Besides diabetes, 11.0 and 8.0% blood samples were also positive for MAP infection from cases of typhoid and anemia, respectively. Our previous studies showed that correlation was significantly higher in infectious and

healthy human subjects as compared to non-infectious causes. As compared to previous years, overall positivity showed slight increase using IS900 PCR (8.4 to 10.7%). Of total 10,680 blood samples collected, 65 were processed and remaining blood and serum samples are under process.

## EXTENSION EDUCATION AND SOCIO-ECONOMICS SECTION

### EE&SE 1.03: Impact of improved technologies and emerging market conditions on goat production system

*M.K. Singh, A.K. Dixit, Braj Mohan, Khushyal Singh and Anil Kumar (IASRI)*

Data on goat marketing were collected from Bakra Mandi of Jaipur city which is under the control of municipal Corporation of Jaipur (Rajasthan). This is a biweekly market held on Saturday and Sunday. About 200-250 pairs of buyers and sellers visit the market and 4000-5000 goat were brought to market on market days in a week. Goats are brought for sale from nearby village of Jaipur and neighboring districts (Kota, Bhilwada, Pali, Tonk, Sikar etc). About 80-85% goats in this market were brought by middleman (8-25 goats/middle man) and 15-20% by farmers. These goats were purchased by Itinerant trader and further sold to wholesale traders at different locations throughout the country depending upon the current price/demand. A middleman earns Rs. 100-200 per goat and expenditure incurred varied from Rs. 50-100/goat. Middleman also sell goats directly to meat shop keepers almost with similar margins. Major expenses incurred on goat sale were transport (Rs. 20-50/goat), night shelter (Rs.1-2/goat/night), feeding and other (health, labour etc). Age, weight, health and sex were main price determining factors. Male sold/slaughter were of their 6 to 16 months of age group whereas, females brought to market were aged and paid almost half price of adult male. Data on meat price and other attributes of chevon marketing was also collected from 18 shopkeepers of Jaipur, Alwar, Mahendragarh (Rajasthan) districts. Majority of shopkeepers have network with butcher (middleman) for supply of goat

directly from farmers flock. The price of chevon ranges from Rs 260 to 375 per kg depending upon season and demand in 2011-12. Slaughter goat by-products (head, skin, intestine, hooves) account for Rs 500-600 per goat. Middle men earn Rs 150-200 per adult goat. Data was also collected on goat skin price from Bakra Mandi at Jaipur. About 2000 skin were made available per day and brought by the middlemen and meat shopkeepers. The rate of skin varies Rs 125 to 150 depending upon the quality of the skin. Middleman was provided Rs. 10 per skin.

Data collected on marketing of males for slaughter and Eid from Rajasthan and Uttar Pradesh indicate some people rear castrated male for Eid. Males with faster growth rate were purchased at the age of 2-5 months at the rate of Rs. 2500-3000 from goat keepers and kept on high input diet. Male predominately comprises of Sirohi, Jakhana, Battissi and Totapari. These males were mostly sold to Bombay based trader at the price of Rs. 25,000-50,000 per male. Similarly, many goat farmers in different states kept male goats on high input diet and sold at Eid with the margin of Rs.1500 to 2000 per male. Data was collected to determine the factors influencing the market prices of goats on the sale purchase of 50 goats between the pairs of buyers and sellers in Jaswantnagar weekly goat market of Etawah district indicated that a goat of one kilogram more weight would bring about Rs.112 additional to the seller. Similarly, sex also influenced sale price of goats. Animals more than 2 years of age fetched lesser prices than those of 1-2 years of age. Information compiled from Gulbarga district of Karnataka indicated that average weight of goat sold was 20 kg at Rs. 3900.

Data collected on goat and goat products (meat, milk) in Bundelkhand region indicate that 70% goats were sold through middlemen under a contractual arrangement at the average rate of Rs. 2900 at the age of one year. Price of milk and meat was Rs. 12.4 and Rs.260 / kg respectively. About 30% goat keepers sold surplus goat milk to the vendors.

Data on production system was collected from different goat farms in Rajasthan and Uttar Pradesh. Study indicated that goat production in these states is gradually shifting from extensive to semi-intensive production system. Major constraints in goat farming were unavailability of vaccines, indiscriminate use of bucks and unorganized marketing.

#### **EESE 1.04: A study on impact of various training programmes on commercial goat farming**

*Khushyal Singh, Braj Mohan and A. K. Dixit*

To study the impact of national training programme and its popularity among farmers, entrepreneurs and other stakeholders, data were compiled from 1,121 trainees at the time of registration in national training programme on commercial goat farming conducted during 2006-07 to 2011-12. Information on number of trainees participated in programme; their age, education, occupational status, social group and their home state were compiled. Number of trainees increased from 62 to 266 per year between 2006-07 and 2011-12. State wise participation of trainees indicated that trainees from 21 states participated in different training programmes conducted during 2006-07 to 2011-12. State wise participation in terms of their share to total trainees showed that

majority of the trainees were from Uttar Pradesh(42%) followed by Haryana (12%), Madhya Pradesh (9%), Bihar (7%) and Rajasthan (5%). Rests of the trainees (25%) were from other states. These trends indicated that the national training programme on commercial goat farming has gained importance across the country. Furthermore, age wise distribution of the trainees showed that about 72% of the trainees were between 30 to 40 years of age. Educational status of the trainees indicated that out of total trainees, 46% were graduate and post graduate and 7% of the trainees were technically educated in different streams. Occupational status of trainees reveals that 54% of the trainees were engaged with agriculture and animal husbandry followed by businessmen (21%) and servicemen (15%). Merely, 3% of the trainees were unemployed. Distribution of trainees according to their social groups indicated that about 50% of the trainees belonged to general category.

The major problems faced in the initial stage of goat farming were observed to be the high incidence of diseases and non-availability of vaccines, medicine and knowledgeable veterinarian, lack of elite germplasm and common pastures. The majority of the farmers wanted to increase their scale of production but desired support in the form of technical knowledge and easy institutional finance, insurance is essentially needed.



### **EESE 1.05: Sustainable livelihood through goat farming by disseminating the improved goat production technologies**

*Braj Mohan, A. K. Dixit, Khushyal Singh, A. K. Goel, N. Ramachandran, Ashok Kumar, M. K. Singh, R. B. Sharma, Ravindra Kumar, Anil Kumar (IASRI) and Vinay Chaturvedi*

#### **Socio-Economic Impact**

The project was started in the year 2009. Since then number of goat keepers in village has increased from 194 to 279 goat farmers (44%). However, goat population in the village increased by 42% (from 795 to 1130 goats). Goat farmers also acknowledged that mortality among kids and adult has significantly reduced. Mortality among kids (0-6 months) declined from 42% to 20% and among adults it decreased from 12% to 8%. The annual income from goat rearing increased from Rs. 2500 to Rs. 4000 per goat (60%).

#### **Breed Improvement**

Under breed improvement programme in CIRG adopted village Hayatpur, 3 (three) Barbari bucks were provided to goat farmers. The performance indicators show that about 111 goats were crossed in total. Information analyzed only for 51 goats of Hayatpur village who delivered 84 kids. Remaining goats of the same village and neighbor villages were sold. Sex wise distribution of newly born kids indicated that out of total kids born; about 43% and 57% were male and female respectively. About 65% of goats delivered twins. About 96% kids born were either Barbari or Barbari type. Average bodyweight of male and female kids at the age of 3 months was 8.9 Kg (n=11) and 7.8 Kg (n=12) respectively. Goat farmers were motivated to adopt improved breeding and management practices.

#### **Health improvement**

The goat population was provided timely strategic deworming and vaccination against infectious diseases, along with treatment of cases presented during visit and clinical camp. During clinical camps, animal owners were advised and trained for packages of practices in prevention of goat diseases. The scheduled vaccination against PPR, ET and FMD were conducted as per their schedule. No outbreak was observed during period. To achieve the targets under reproduction component, visits were undertaken in adopted village - Hyatpur. Breeding Barbari bucks (02) were supplied to goat farmers for breed improvement in their non-descript/ Barbari flocks. One buck was replaced after serving the females in one breeding season. Emphasis was given for breeding of oestrus goats in major breeding seasons rather than round the year breeding practices. For this a reproduction health calendar was distributed to goat owners. Reproductive health care of affected goats was undertaken. In total twenty seven cases of specific reproductive ailments were diagnosed and appropriately treated in adopted village. During this period a total of 27 goats were screened for their pregnancy status. In Health Camp, 302 goats were vaccinated for FMD, besides 12 cases of foot lesions.

#### **Constraints in goat production**

In order to analyze the constraints in goat farming in the adopted village, the major constraints were ranked by the goat farmers. These ranks were analyzed according to their urgencies. Although, treatment, vaccination and deworming were provided to the goat farmers however, goat farmers reported the unavailability of medicines and vaccine in general. The second, important constraint was non-availability of feed and fodder. Other constraints were parasitic infestation

followed by housing, technical knowledge and market.

### Extension education activities

#### Visits and advisory services

In all 13 visits made by the scientists and technical staff adopted village Hayatpur (Mathura) for Transfer of Technologies and made individual contact with about 173 goat farmers/farm women at their home during the period under report. They were educated and motivated about the Scientific/ commercial goat rearing and convinced them to take the services from the elite Barbari Breeding bucks because this area is home tract of Barbari breed.

#### Group discussions

In all 3 group discussions were conducted in related to scientific goat farming on the following aspects.

- Importance of Barbari breed in terms of survivability and production performance
- Nutritional intervention and mineral supplementation
- Health care.

#### Distribution of pelleted feed

- Pelleted feed was distributed to CIRG Barbari buck keeper at adopted village.

#### Collection of faecal sample

- Collected faecal samples from six goats in the village.

#### Organization of off-campus training

- Organized 1 off-campus training on



goat reproduction problems and importance of goat milk.

#### Organization of Health camps

Three (3) health camps were organized in adopted Village Hayatpur.

- Animal treated – 61 sick sheep and goat.
- Deworming – 431 sheep and goat.
- Vaccination – 308 sheep and goat (FMD) and HS)

### Extension approaches for dissemination of goat production technologies and impact assessment

*Braj Mohan, A.K. Dixit, Khushyal Singh, Vijay Kumar, U.B. Chaudhary and Ashok Kumar*

Pilot survey was conducted in different villages of Mathura district for the selection of village. Interview schedule was developed to collect baseline information from goat farmers in the selected village.

### Assessment of economic losses due to diseases in goat production

*A.K. Dixit, Braj Mohan, Khushyal Singh, Vijay Kumar, S.K. Singh and Ashok Kumar*

Literature on economic losses in livestock production was reviewed. Questionnaires developed to collect information from different stakeholders. State wise data on goat population, production and diseases for different livestock census were compiled.



## AICRP on Goat Improvement

S.K. Singh

Table : Ongoing AICRP units

Sl. No.	Name of the Unit	Location	Type of Centre
1.	Jamunapari Farm Unit	CIRG, Makhdoom	ICAR based
2.	Barbari Farm Unit	CIRG, Makhdoom	ICAR based
3.	Sirohi Farm Unit	CSWRI, Avikanagar	ICAR based
4.	Marwari Field Unit	RAJUVAS, Bikaner	SAU based
5.	Black Bengal Field Unit	WBUVS & F, Kolkata	SAU based
6.	Ganjam Field Unit	OUA & T, Bhubaneshwar	SAU based
7.	Sangamneri Field Unit	MPKV, Rahuri	SAU based
8.	Surti Field Unit	NAU, Navsari	SAU based
9.	Malabari Field Unit	KAU, Trichur	SAU based
10.	Sirohi Field Unit	RAJUVAS, Vallabhnagar	SAU based
11.	Black Bengal Field Unit	BAU, Ranchi	SAU based
12.	Assam Hill Field Unit	AAU, Guwahati	SAU based
13.	Gaddi Field Unit	HPKV, Palampur (HP)	SAU based
14.	Osmanabadi Unit	NARI, Phaltan (MH)	NGO

### Assam Hill Goat Field Unit Burnihat (Assam)

To improve Assam Hill Goat at Guwahati, two clusters comprise of several villages having 160 and 190 breedable goats respectively were completed. Initial data regarding the production performances like body weight at different ages from the field unit being collected. Four Bucks of high genetic merit, two in each village cluster

were distributed for breeding purpose. Number of kids born during the period was 673, out of the total 704 initial adult does indicating an overall population growth of 40.42% (53.76% at Batabari, 48.88% at Tetelia, 20.76% at Nahira and 21.68% at Tepesia villages). The rate of mortality is restricted at 8.29% as compared to 15.37% in the previous year. In all 6.67 % of the goats recorded under the project in four villages

were sold. Out of 268 males, 53 (19.78 %) were sold and out of 872 females, 23 (2.64%) were sold. Majority of the animals sold in different field units were between 3-6 m age group. Approximately 59.52% of male kids sold were between age group of 3-6 m and 2.78% between 6-12 m of age. Considering average litter size of two, a kidding interval of 7 months and 12.92 % kid mortality, the minimum gross income of a goat keeper per doe per was estimated as Rs.947.00. Four information leaflets on "Scientific rearing of Goats", "Primary healthcare of Goats", "Breeding of Goats", and "Goat diseases and its prevention" were published in Assamese. In all thirty seven selected bucks of superior quality, true to the breed were distributed in the field units for genetic improvement.

#### **Barbari Goat Farm Unit, CIRG Makhdoom, Mathura, UP**

The precise and reliable genetic parameters for body weight growth, reproduction and lactation traits were estimated. Implementation of genetic, nutritional and health strategies at Farm Unit of CIRG resulted in significant improvement in survival rate, body weight gain at different ages and reproductive performance. Positive genetic trend ( $0.999 \pm 0.213$  kg) was observed for body weight growth over last 25 year and reduction in mortality. Population growth was high (182%) in this elite herd. Over 2700 superior animals (male and female) were supplied for genetic improvement of farmers herd during the last 12 years.

#### **Black Bengal Goat Field Unit, BAU Ranchi, Jharkhand**

This unit was included in XI plan. Three clusters have been established in Jamshedpur, Deoghar and Ranchi Districts. Elite breeding bucks (45), selected on the basis of growth performance and multiple birth were introduced to improve farmers'

herds in adopted villages in these clusters. Preventive healthcare measures were also introduced and 10 farmers' training programmes were organized on scientific goat husbandry in these villages. Significant improvement in survival rate with drastic reduction in mortality (by 85-90%) was achieved. Supplementary feeding to the goats improved the health status of goats and improved growth trend in kids. It is estimated that annual income of farmers from sell of goats/kids has increased substantially (up to Rs.12000 to Rs 25000).

#### **Black Bengal Goat Field Unit, WBUAFC, Kolkata, West Bengal.**

The implementation of project resulted in significant gains in body weight of Black Bengal Goat at farmers herds by 11.32%, 9.96%, 4.76% and 4.05% at birth, 3 month, 6 month & 9 months of age over the initial weight of 1.095 kg, 4.860 kg, 7.57 kg and 10.12 kg respectively and the percentage of occurrence of multiple births increased from 78.38% in 2002-03 to 80.99% in 2011-12 with 52.09%, 22.55% and 6.35% twins, triplets and quadruplet birth, respectively. The population growth also has improved substantially from 48.89% to 63.26%. The sale of goat also increased by 38% over and above the base population of 2002-03. The herd size increased to 52% in 2011-12 over the initial flock size of 45% in 2002-03. The annual mortality rate has been reduced from 8.745% (2001-03) to 7.59% (2011-12). The income of farmers' family by keeping of goats is enhanced considerably from Rs. 2945/- (2002-03) to Rs. 9575/- (2010-11).

#### **Gaddi Goat Field Unit, HPKV, Palampur, Himachal Pradesh**

The breeding tract of Gaddi is distributed mainly in the pockets of Mandi, Kullu, Kangra and Chamba districts of Himachal Pradesh. The average family size was 5.82 and land holdings 8.88 bigha per family. The animals are managed purely on

transhumance (migratory) system, where no supplementary feeding is provided except common salt at weekly intervals. Natural service is the only method of breeding followed and one buck is kept per 50-75 breedable does. The main breeding season commences from April onwards and lasts up to June. The kidding starts from the month of October onwards and it occurs in the open. No special care to the dam or neonatal kid in the form of concentrate feeding, Thereafter three field units belonging to different migratory routes were established and 701 animals were registered and identified by ear tagging. A total of 452 young kids were born, 95 animals of different age groups died and 274 animals pertaining to different age groups were sold and 99.47% overall population growth and 6.24% overall mortality was recorded. The percent of twin births and incidence of abortions was 18.32 and 7.32. All the animals of the flock were provided health coverage by way of vaccination against PPR, dipping and deworming besides strategic supplementary feeding in the form of mineral mixture and concentrate feed. The overall least square mean for body weights at birth, 1 month and 3 months of age were 2.16, 8.66 and 15.71 Kg, respectively wherein significant effects of sex of birth and field units were observed. The overall body length, body height and body girth at birth was 26.49, 33.90 and 31.29 cm, respectively. The corresponding figures at one month were 46.24, 49.40 and 49.30 cm, respectively and at three months 52.37, 53.94 and 57.65 cm, respectively.

#### **Ganjam Goat Field Unit, OUAT, Bhubaneswar, Odisha**

The Ganjam field unit located at Bhubaneswar had a closing balance of goats at Rambha, Khallikote and Chattarpur centres was 1870, 1698 and 2465 respectively. The overall average body

weight at birth, 3, 6, 9 and 12 months of age were  $2.31 \pm 0.06$ ,  $6.36 \pm 0.01$ ,  $9.46 \pm 0.03$ ,  $13.81 \pm 0.02$  and  $17.78 \pm 0.03$  kg, respectively. There was a significant increase of the body weight at 9 and 12 months of age in comparison of base population average. The kidding percentage was 36.12 upto Sept. 2010. The average daily milk yield of Ganjam goats was  $425.5 \pm 10.8$  ml. Prophylactic measures were undertaken in the farmer's flock. A total of 33 superior breeding bucks were distributed to the farmers to improve production and productivity of their flock. Average body weight of animals increased considerably ( $\sim 2$  kg at 9 month and  $\sim 5$  kg at 12 month age) with improved kidding percentage (above 65%). Farmers have been motivated to adopt preventive healthcare measures and to produce value added goat products (ghee from goat milk) for better return.

#### **Jamunapari Farm Unit, CIRG Makhdoom, Mathura UP.**

The population growth was 100.8% and kidding rate varied from 1.38 to 1.55 over the years. The average 12 month body weight was 24.37 kg and the milk yield at 140 days was 140.98 kg. Genetic parameters have been estimated for all the body growth and milk yield traits. Jamunapari unit has supplied 603 improved animals during the period to different State Govt. / NGOs and farmers for breed improvement programme.

#### **Marwari Field Unit, RUJUVAS, Bikaner, Rajasthan**

A significant improvement in body weight at 12 months age was achieved (16.79 kg to 30.18 kg) following distribution of selected elite sires and effective health coverage in the farmers flock. The mortality was reduced to 11.43 % as compared to 18.46 % in kids born during the previous years with introduction of scientific management and supplementary feeding of goats by the

registered goat breeder. High kidding (up to 84.11%) and twinning (12.90 %) rate was recorded. Around 459058 goats were covered under health coverage from inception to year 2012. On an average 19,960 goats per year were given prophylactic and curative treatments for diseases. Milk production ranged between 0.41- 4.0 liters of goat milk /day. Children normally herd goats, while their day-to-day management and the care of young stock usually fall to women. Women, children and old men together contributed 77-92% of labor requirements in goat rearing. Women alone contributed 32-55% to it (census of India, 2001). This has helped women to achieve financial independence. Goat enterprises earned a family labor income of Rs 60,000 per year and Rs. 120000 per year from the sale of kids and goats on medium to large flock. There has been an increase in interest among farmers to get their registered in the project, use of improved elite sires and adopting scientific management of flocks and taking advantages from treatment and disease preventive services provided to them. Hence, the project has shown its impact towards achieving some of its major objectives.

#### **Malabari Field Unit, Trissur, Kerala**

Malabari field unit is located at KV&ASU, Trichur (Kerala). The survey work was conducted in six field centres i.e. Tellechery, Badagara, Tanur, Thaliparambu, Perambra and Thavanoor belonging to three northern districts of Kerala, Kozhikode Kannur and Malappuam forms the field centres of study. The flock statistics of Malabari goats under field condition is shown in Table 9.1. The closing balance of the registered flock was 1223 animals including 689 adult does. During the current year, 856 kids were born. Overall population growth recorded was 89.41%. A total of 1368 animals were sold out of which 678 were adult female goats. This is an indication of high rate of

movement of animals. The overall mean body weights of kids at different ages have been presented in Table 9.2. The overall least squares means of body weights at below one, three, six, nine and twelve months of age were  $3.10 \pm 0.07$ ,  $8.91 \pm 0.17$ ,  $14.93 \pm 0.34$ ,  $18.39 \pm 0.51$  and  $23.03 \pm 1.22$  kg respectively. Centre, sex, year of birth and type of birth had significantly affected body weights at different age groups. The heritability of body weight at below one and twelve months of age was low and that for six month body weight was high. The least squares analysis for body measurements were also carried out. The lactation performance of Malabari goats for average daily milk yield and 90 days milk yield are shown in Table 9.3. The overall mean average daily milk yield was  $0.86 \pm 0.06$  litres respectively. The overall mean of age at first service and age at first kidding was  $261.25 \pm 10.4$  and  $390.3 \pm 11.7$  days, respectively. The overall mean gestation length and inter kidding interval were  $149.65 \pm 0.27$  and  $276.81 \pm 12.58$  days respectively. Reproduction and breeding efficiency of Malabari goats during the report period are detailed in Table- 9.4. Among the total 916 does registered, 514 does kidded. Kidding percentage on the basis of does kidded was 166.53. Average litter size was 1.67 during the 2011-12. The percentage of singles, twins, triplets and quadruplets for Malabari goats born during the period and for different Malabari goat populations of Tellichery, Badagara and Tanur, Perambra, Thavanoor and Thaliparambu. The percentage of singles, twins, triplets and quadruplets were 41.83, 50.19, 7.59 and 0.39 respectively in the total population under study during the period. The percentage of multiple births was higher in Badagara (81.48%), Tanur (80.25%) followed by Thilassery (75.94%). The mean values of reproduction traits of Malabari goats in different centres are presented in Table- 9.5. The overall mean of

age at first service and age at first kidding was  $263.4 \pm 11.3$  and  $393.2 \pm 9.5$  days, respectively. The overall mean gestation length and inter kidding interval were  $149.2 \pm 0.25$  and  $292.5 \pm 10.7$  days respectively. Among the various centres, Thanur had lowest age at first service, age at first kidding and inter kidding interval.

#### **Osmanabadi Field Unit, NARI Phaltan, Maharashtra**

The Osmanabadi goat field unit started functioning since 2009 and has therefore been in operation only for three years. Four clusters were established in four districts i.e. in Satara district and three others in collaboration with local NGOs in Ahmednagar, Osmanabad and Solapur districts and production performance was recorded on more than 800 adult does. Capacity of goat farmers was enhanced through organizing awareness programmes so as to increase their profits from goat keeping and raise the status of the profession of goat keeping. Two goat keepers won the Breed Saviour Awards sponsored by the National Biodiversity Authority. Created facility for frozen semen of Osmanabadi bucks.

#### **Sangamneri Field Unit, Rahuri (MH)**

In Sangamneri field Unit at Rahuri, total of 642 breedable does in four clusters were registered and 33 elite bucks were rotated in the selected clusters. Population of Sangamneri goats was increased by 25.15 per cent over the last year in registered cluster; however the population in breeding tract was increased by 126 per cent. The overall superiority for body weights at 1, 3 and 6 months of age was 3.99, 7.27 and 6.98 per cent, respectively over the contemporaries. Overall economic gain was Rs. 62.00 and 98.00, respectively for 3 and 6 months weights. The improvement in milk yield over the baseline population was 21.42 per cent, with economic gain of Rs.

256.50. Farmers – Scientist forum of goat keepers is formulated for dissemination of new techniques of goat keeping. The same forum will be registered as Sangamneri goat breeders association. Five bucks were transferred to Frozen Semen Lab., MPKV, Rahuri for semen preservation.

#### **Sirohi Field Unit, RAJUVAS, Vallabhnagar, Rajasthan**

Genetically superior Sirohi bucks (147) were introduced to improve the genetic potential and technology intervention in form of healthcare, proper nutrition and management were used to improve performance of native goats. Significant increase in milk yield over the year indicated impact of technological interventions. As compared to 2003, the mortality in different age groups reduced considerably by 2011 (from 4.08% to 2.44% 0-3 month age, 6.79% to 1.31 % 3-12 month age and 5.39% to 0.48% adult age groups). The overall mortality also reduced from 5.40% to 1.43%. The kidding rate was improved from 1.12 to 1.29%. The overall population growth was 84.58%. Since inception of the project, a total of 4573 kids with better body weight and performance have been born from selected breeding bucks. The implementation of project has resulted to better financial gains and to the farmers.

#### **Sirohi Farm Unit, CSWRI, Avikanagar, Rajasthan**

The unit has contributed significantly to the genetic improvement of goat in the farmers flock for meat and milk production, thus playing vital role in providing livelihood to the resource-poor farmers of different regions. This unit possesses the most superior germplasm of Sirohi goat in the country in terms of production, reproduction traits as well as breeds conformation characteristics and has distributed 979 animals (257 males and 225

females in X plan and 298 males and 199 females in XI plan) to farmers, NGO and other developmental agencies. The overall least squares means at birth, 3, 6, 9 and 12 months of age were  $3.27 \pm 0.03$ ,  $12.52 \pm 0.16$ ,  $20.79 \pm 0.28$ ,  $24.55 \pm 0.27$  and  $27.60 \pm 0.28$  kg, respectively. The pre- and post-weaning average daily gain was  $99.67 \pm 1.04$  and  $52.44 \pm 0.65$  g, respectively. The milk yield in the does averaged  $87.53 \pm 1.37$  for 90 days,  $112.23 \pm 2.31$  kg for 150 days and average total lactation length was  $161.25 \pm 2.57$  days.

#### **Surti Field Unit, NAU, Navsari, Gujarat**

A total of 20 superior and evaluated Surti bucks were supplied in field to promote production capacity and breed purity of local goats. There was 8.70% increase in birth weight and 3.24% increase in total milk yield from 2009 to 2011 in adopted

villages. Kidding rate had been increased to 1.44 from 1.41 in 2009. Overall mortality in farmers flocks is reduced to 3.15% from 5.30% reported in year 2009. A net annual income of Rs. 78215 per farmer and Rs. 2580 per doe was obtained after deducting all the expenses. Overall benefit cost ratio (BCR) of 2.45 was obtained by goat farmers. The realized income was even higher if we do not include yearly labour cost of Rs. 36500 per farmer and Rs. 1204 per doe, since it was supported by own family members. They earned 57.18% higher income above maximum daily wage of Rs 200 obtained by youths in nearby factories. With continuous bilateral efforts from farmers and Surti field unit, first notified goat cooperative comprised of five adopted villages involving 40 goat farmers was been established in the year 2011-12.



**Meteorological observations (2012-13)**

Months	Mean Max Temp. (°C)	Mean Min. Temp. (°C)	Mean Daily Temp. (°C)	Mean Vapor Pressure (mmHg)	Mean RH (%)	Mean Rain Fall (mm) / Wet Days	Sun Shine (hrs)
April 2012	38.77	21.2	29.98	13.66	34.31	5 (2)	286
May 2012	43.19	25.34	34.27	11.48	21.67	0	292.90
June 2012	44.07	28.73	36.4	17.40	31.62	54 (3)	228.4
July 2012	37.97	27.52	32.74	25.40	67.66	116 (13)	163.1
August 2012	33.48	25.58	29.53	26.32	82.43	243 (18)	109.3
September 2012	35.53	24.52	30.03	24.27	70.38	75 (10)	237.6
October 2012	35.79	17.56	26.68	14.72	46.02	2 (2)	262.6
November 2012	30.48	11.50	20.99	12.00	55.21	1 (1)	170.1
December 2012	23.69	7.66	15.68	9.59	65.82	0	172
January 2013	20.69	4.60	12.65	8.75	67.98	6 (1)	150.1
February 2013	24.84	9.61	17.22	11.83	67.94	22 (6)	181.3
March 2013	34.56	14.45	24.51	12.39	42.92	1 (1)	298.30

Maximum temperature: 49.0 °C on 01.06.2012  
 Minimum temperature: 0 °C on 01.01.2013, 05.01.2013, 07.01.2013 and 08.01.2013.  
 Annual Rain Fall: 526 mm in 50 Days

## TEACHING AND TRAINING

### Teaching

- Thirteen MSc Dissertation and two Ph.D. Thesis were submitted during 2012-13.
- Final year batch of BVSc&AH 2012 of College of Veterinary science and AH Mathura successfully completed the Internship programme at the Institute.
- Five MVSc students and one M.Sc. (Biotechnology) and Six Ph.D. Students are currently enrolled with various Universities and carrying out their research work under Institute scientists. A batch of semester 2 and 3 of M.Sc. biotechnology students of DUVSU are also undertaking courses conducted by Institute scientists.

### Training Programmes

- Organized a training on scientific goat rearing to 15 farmers and 2 staff, sponsored by ATMA, Aurangabad, Bihar on 2-4 April 2012 (3 days) at CIRG, Makhdoom.
- Organized a 10 days 51st National Training Programme on Commercial Goat Farming on 23 May to 01 June 2012 at CIRG Makhdoom. In this training course in all 55 participants were present.
- Organized a 5 days training programme on scientific goat rearing from 25-29 June 2012 to 25 farmers of Haridwar district. This training was sponsored by ICAR.
- Organized a 5 days training programme on scientific goat rearing to 31 goat farmers and 7 farm women of Dumka District of Jharkhand through Gramin Vikas Kendra, Nalanda, Bihar, sponsored by NCAP, New Delhi from 2-6 September 2012.



- Organized a 10 days 52nd National Training programme on Commercial Goat Farming on 18-27 September, 2012. In this training course, in all 87 men and 2 women participants were present.
- Organized five days training programme on scientific goat rearing for veterinary officers (5) and assistant veterinary field officers (10) on 03-07 December 2012, sponsored by Project Director Bastar Integrated Livestock Development project, Jagdalpur (Chhattisgarh).
- Organized a 10 days 53rd National Training Programme on Scientific Goat Farming on 16-25 January, 2013 at CIRG, Makhdoom. In this training Course in all 45 Participants were present.



- Organized a two days training Programme on Scientific Goat Farming Technologies and Extension Approaches for 17 KVK's Subject Matter Specialists on 26-27 February 2013 sponsored by Zonal Project Directorate (ICAR), Kanpur.
- Organized a five days training Programme on Scientific Goat Farming for 19 goat farmers on 11-15 March, 2013 sponsored by ATMA of Siwan district of Bihar.
- Participated in National Dairy Mela at NDRI, Karnal, Haryana on 25-27 February, 2013 (Won IIIrd Prize).
- Participated in Pusa Krishi Vigyan Mela at IARI, New Delhi on 06-08 March, 2013 and Won IIInd Prize (Uttam).
- Participated in Kisan Mela at Katihar, Bihar on 17-18 March, 2013.
- Participated in Bhed Mela at CSWRI, Avikanagar (Rajasthan) on 23.03.2013.

### Exhibition/Kisan Mela

- Participated in Krishi evam Gramya Vikas Pradarshani at Pt. Deen Dayal Dham, (Nagla Chandrabhan), Farah, Mathura (U.P.) on 12-14 October, 2012.
- Participated in Kisan Mela, Krishi evam Pashupalan Pradarshani va Krishi evam Pashupalan Goshthi at KVK Mathura (U.P.) on 26.10.2012.
- Participated in Virat Kisan Mela evam Krishi Vikas Pradarshani at GIC Ground Pachkuinya Crossing, Shahganj, Agra on 23-25 November 2012.
- Participated in agriculture exhibition on the occasion of IIIrd International Agronomy Congress at IARI, New Delhi on 26-30 November 2012.
- Participated in 19th Sarson Vigyan Mela at Directorate of Rapeseed-Mustared Research (DRMR), Sewar, Bharatpur (Raj.) on 03.02.2013.



### Display of CIRG Technologies

- On 30.04.2012 put a CIRG stall on the occasion of celebration of Farm Innovator Day at CIRG, Makhdoom.
- CIRG exhibits on CIRG technologies were displayed in National Seminar-Goatery 2012 on profitable goat farming organized by Royal Net International at Coimbatore, Tamilnadu from 04-05 August 2012.
- Displayed CIRG technologies at CIRG on the visit of Hon'ble State Agriculture and Food Processing Industries Minister (Dr. Charan Das Mahant Ji) on 18.8.2012.
- Displayed CIRG technologies at CIRG on the visit of Hon'ble Secretary DAHDF Govt. of India Mr. G.C. Pati IAS on 15.9.2012.
- Displayed CIRG technologies in National Seminar on Future Challenges and Opportunities to



Improve Health and Production of Small Ruminants and annual conference of the Indian Society for Sheep and Goat Production and Utilization (ISSGPU) on December 22-23 at CIRG, Makhdoom.

### Technical Correspondence

In all 65 inquiry letters of which 58 in Hindi and 7 in English were received from different categories of aspirants covering different parts of country on various aspects of goat production and replied suitably.

### Visit Arrangement

In all 1599 visitors were entertained and apprised them with research, extension and development activities of the Institute.

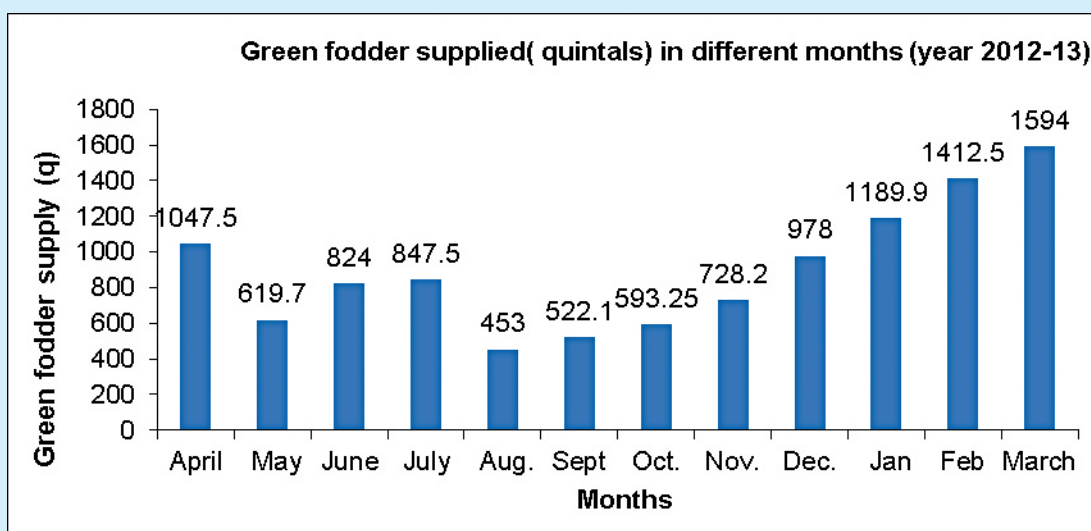
### Helpline Calls

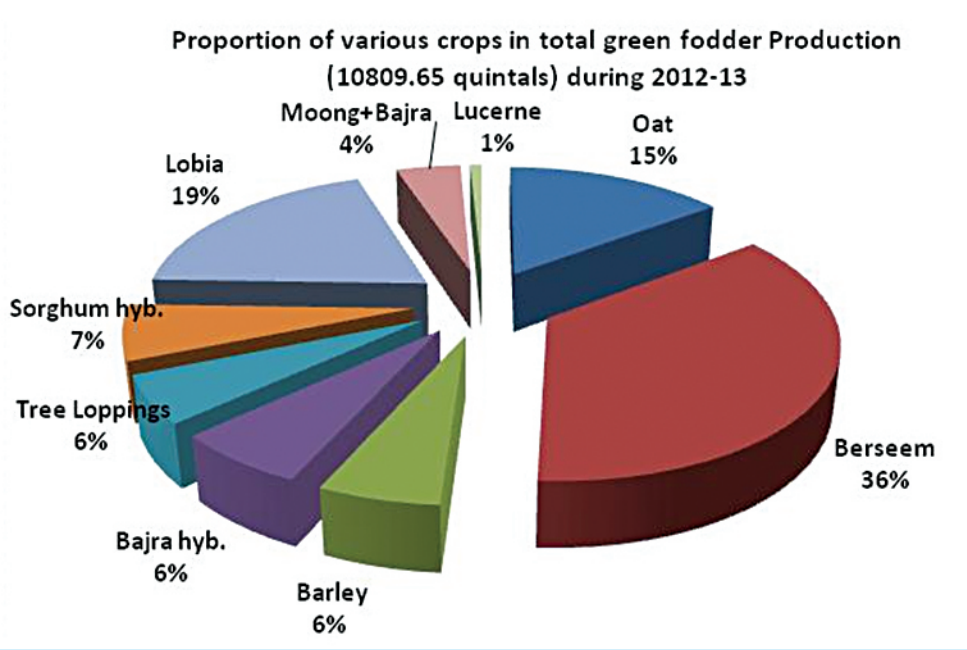
In all 1466 calls were received regarding various aspects of commercial goat farming, improved goat production technologies, elite germ plasm and training programmes and replied suitably.

## Agriculture Farm and Agroforestry Section Report Year 2012-13

*Prabhat Tripathi*

Agriculture farm section is working with main objectives to produce nutritionally sound fodder for goats and sheep in the institute and to develop ravenous degraded soils of institute in to a fodder production models through agroforestry or other agricultural interventions. During the year 2012-13 farm section supplied 10809.65 quintal green fodder to different livestock units and produced about 400 quintals barley & oat grains with about 600 quintals of straw. One quintal lobia seed was also harvested to raise summer crop. One acre land was brought under plantation of fodder tree species and two acre new land area was brought under cultivation during the rainy season under rainfed conditions. Apart from its main objectives this section also supports horticulture, maintenance section and staff welfare club through regular irrigation of road side ornamental plants, supply of drinking water to entire institute etc.





*Fig: Lobia crop under rainfed conditions*

## LINKAGES AND COLLABORATIONS

The institute has developed effective linkages with DUVASU, Mathura; IVRI, Izatnagar; NDRI, Karnal; IARI, New Delhi; CCS HAU, Hisar; Dr. B.R. Ambedkar University, Agra; CARI, Izatnagar; NIANP, Bangalore; IGNOU, New Delhi; CSWRI,

Avikanagar; IGFRI, Jhansi and various Agricultural Universities and NGOs under AICRP programme. Institute is also running a project in collaboration with Biovet Pvt., Bengaluru under Public Private Partnership programme.



# TECHNOLOGY SERVICES

## Goat Germplasm supplied

CIRG Makhdoom supplied 434 goats and 149 sheep to the progressive farmers and various government agencies for breed improvement programmes.

## Diagnostic Services provided

For the screening of map infection, samples (serum, fecal) from Veterinary College, Mathura, Faizabad and Pondicherry and Regional Centres of CSWRI, Avikanagar (SRC, Kodai Kanal and WRC, Bikaner) were received. These samples were screened by ELISA, microscopic examination, faecal culture and PCR.

# REVENUE GENERATION (2012-13)

Particulars	Amount
Sale of Farm Produce	4221045.00
Sale of Meat/ Meat Products	166641.00
Income from royalty/ Sale of Publications and Advertisement	333825.00
Licence Fee	1218679.00
Income generated from Internal Resource Generation	415800.00
Miscellaneous Receipts	1434513.00
Grand Total	7790503.00

## AWARDS AND RECOGNITIONS

- चलवैजन्ती व प्रशस्ति पत्र केन्द्रीय गृह मंत्रालय भारत सरकार के आधीन कार्यरत नगर राजभाषा कार्यान्वयन समिति (नराकास), मथुरा द्वारा वर्ष 2011-12 के दौरान राजभाषा हिन्दी में उत्कृष्ट कार्य हेतु संस्थान को प्रथम पुरस्कार के रूप में प्रदान कर सम्मानित किया गया।



- ISSGPU Fellow -2012 'by the Indian Society for Sheep and Goat Production and Utilization (ISSGPU) (A.K.Goel and S.K. Singh).



- Appreciation award-2012-13 for the project "Holistic Approach for improving Livelihood Security

Through Livestock based Farming System in Barabanki and Raebareli districts of U.P. (Component-3)" by NAIP, ICAR, New Delhi on 21..09.12 (B.Rai).

- Member, Board of Management , National Dairy Research Institute, Karnal (S.K.Agarwal)
- Vice President, Indian Society for Sheep and Goat Production and Utilization (ISSGPU) (S.K.Agarwal)
- President, Indian Society for the study of Animal Reproduction (ISSAR)- (S.K. Agarwal)
- Member, RAC, NRC Equines, Hisar (Haryana) (S.K.Agarwal)
- Member of Editorial Board of Animal Science Reporter Journal (S.K.Jindal)
- Organizing Secretary, National Seminar on "Future Challenges and Opportunities to Improve Health & Production of Small Ruminants & Annual Conference of Indian Society for Sheep & Goat Production & Utilization (ISSGPU), CIRG Makhdoom, Farah (Mathura) U.P., 22-23 December 2012 (S.K.Jindal)

- Best oral presentation on “Comparative study on adipogenesis and fibrogenesis in skeletal muscle of Angus and Wagyu cattle” in V convention of Indian Meat Science Association and National Symposium held on February 7-9, 2013 at NRC on Meat, Hyderabad. (**A.K.Das**)
- R.T. Doshi Foundation Award for Best Paper published in Agricultural Economics Research Review during 2011 (First Prize). (**A.K.Dixit**)
- First prize and Third prize for poster presentation on “Application of Artificial Insemination for Conservation and Propagation of Jamunapari goats” in National Seminar on “Future Challenges and Opportunities to Improve Health & Production of Small Ruminants & Annual Conference of Indian Society for Sheep & Goat Production & Utilization (ISSGPU), CIRG Makhdoom, Farah (Mathura) UP, 22-23 December 2012- (i) **Naveen Kumar**, (ii) **S.D.Kharche**, **A.K.Goel**, **S.K.Jindal**.
- IIIrd Prize in Hindi Shodh Patra Pratiyogita at CIRG, Makhdoom on 25.09.2012 for poster Mohan, B., Dixit, A.K., and Singh, K. (2012). Angikrat Gaon ke Bakri Palakon ka Samajik-Arthik Vishleshan. (**Braj Mohan**)
- Dr M.S. Rahal best research paper award. The award was presented by Animal Nutrition Association of India during 8th Biennial Animal Nutrition Association Conference on “Animal Nutrition Research Strategies for Food Security” November 28th 2012 at Bikaner (**M.K.Tripathi**).
- Best Paper Award -International conference of 3<sup>rd</sup> World congress in Biotechnology held at Hyderabad during 13-16<sup>th</sup> September, 2012. (**S. D. Kharche**).
- Best Paper Award - 20<sup>th</sup> Annual Conference of Agricultural Economics Research Association of India on Agricultural Inputs and Service Delivery System for Accelerating Growth and Improving Farm Income held at IARI, New Delhi during 9-11<sup>th</sup> October, 2012. (**A. K. Dixit**).
- Best Paper Award -29<sup>th</sup> All India Scientific and Technical Hindi Essay Competition. (**Saket Bhusan**).



## Success Story

### CIRG developed new goat meat and milk based value added products

Goat products technology of Central Institute for Research on Goats (CIRG), undertaking research and development initiatives in generating value added goat meat and milk products technologies. The institute developed three new technologies for commercialization using goat milk, cream and meat components. The nutritional properties of these products are being evaluated.

Goat milk and cream based **CIRG Beans** and **CIRG Khasta** were developed using pure goat milk, cream, dietary fibres and natural antioxidants. These products contains higher amount of medium chain fatty acids, which are known to be beneficial for human health. Organoleptic attributes revealed that the product has score of 8 out of 9 of various parameters under hedonic scale. Flavour and colour of the product was more appealing to the sensory panelists. These products were snacks type with low moisture, high protein and desirable fatty acids profile and higher shelf-life.

Another meat based snack food "**CIRG Meat Sticks**" was developed with the aim to provide good quality protein along with valuable micronutrients to consumers. These products are highly nutritious and palatable, enriched with dietary fibre. These technologies are commercially viable which helps to develop small scale industry.



*A.K. Das, V. Rajkumar and A.K. Verma*

## PUBLICATIONS

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### Research Articles

1. Agrawal N, Sharma D K and Mandal A. 2012. Susceptibility pattern of Jamunapari and Sirohi goats to natural infection with *Haemonchus contortus* in semi-arid region of India. *Indian Journal of Animal Sciences* 82(6): 581-585.
2. Bhusan S. 2012. Effect of non-genetic factors on body weights of Jakhrana kids. *The Indian Journal of Small Ruminants* 18(21): 253-255.
3. Dadawala A I, Chauhan H C, Chandel B S, Singh S V, Ranaware P B, Patel S S, Kumar P, Shah N M, Kher H N. 2012. Incidence of Bovine paratuberculosis in cattle and buffaloes in North Gujarat. *Indian Veterinary Journal* 89 (4): 16-18.
4. Das A K, Yan Q, Fu X, Liang J, Huang Y, Duarte M S, Zhu M J, Trobridge G D and Du M. 2012. AMP-activated protein kinase stimulates myostatin expression in C2C12 cells. *Biochemical Biophysical Research Communication* 472:36-41.
5. Dass Gopal, Mandal A, Rout P K and Roy R. 2012. Rearing practices, morphology characteristics and growth performance of Muzaffarnagari sheep in its home tract. *Indian Journal of Small Ruminants* 18: 37-40.
6. Dixit A K, Singh M K, Reddy B S and Manohar N S. 2012. Potential of wastelands for mixed farming system in India. *Range Management and Agroforestry* 33(2):118-122.
7. Goel A K and Kharche S D. 2012. Fertility after Induction of Oestrus in Anoestrus Jamunapari Goats Primed with Progesterone and eCG Treatment. *Indian Journal of Animal Sciences* 82(5): 464 -467.
8. Goel A K and Kharche S D. 2012. Ovulatory pattern and serum progesterone levels during oestrous cycle in jamunapari goats. *Indian Journal of Animal Sciences* 82(5): 468 - 471.
9. Gupta Anjali, Tripathi Prabhat, Tripathi M K, Dutta T K, Kumar Ravindra and Chaudhary U B. 2012. Microbial and chemical changes in goat manure during composting and vermin-composting. *Indian Journal of Small Ruminants* 18: 207-211.
10. Gupta V K and Kumar A. 2012. Zoonosis and Veterinary public health. *Agra Veterinary Journal* 2: 29-33
11. Gupta V K, Radhakrishnan G, Harms J and Splitter G. 2012. Invasive *Escherichia coli* vaccines expressing *Brucellamelitensis* outer membrane proteins 31 or 16 or periplasmic protein BP26 confer protection in mice challenged with *B. melitensis*. *Vaccine* 30: 4017-4022
12. Huang Y, Das A K, Yang Q Y, Zhu M J and Du M. 2012. Zfp423 promotes adipogenic differentiation of bovine stromal vascular cells. *PLoS ONE* 7: e47496.
13. Ingale S L, Singh P, Verma A K, Mehra U R and Sharma Nitika. 2012. Effects of plane of nutrition on IL-2 and IL-10 expression in *Fasciola gigantica*

- infected calves as determined by real-time PCR. *Indian Journal of Veterinary Research* 21(1):16-21.
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  15. Kharche S D and Birade H S. 2013. Parthenogenesis and activation of mammalian oocytes for in vitro embryo production: A review. *Advances in Bioscience and Biotechnology* 4:170-182.
  16. Kharche S D and Goel P. 2013. Quality control measures for improving in vitro embryo production in small ruminant: A Review, *Indian Journal of Animal Sciences* 83(3):111-117.
  17. Kumar A, Rout P K and Mohanty B P. 2013. Identification of Milk Protein Polymorphism in Indian Goats by 2D Gel Electrophoresis. *J Proteomics Bioinform* 6: 001-004. doi:10.4172/jpb.1000252
  18. Kumar K, Singh Renu, Ranjan R, T Yasotha, Singh R K, Kumar Manish, Bhanja S K, Das B C, Mohan N H and Bag Sadhan. 2013. Use of extract egg for parthenogenetic embryos development in caprine. *Indian Journal of Animal Sciences* 83(4):377-378.
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  23. Kumar V, Singh K, Dixit A K and Mohan B. 2012. Awareness among goat keepers about CIRG helpline service. *Indian Journal of Small Ruminants* 18(2): 250-252.
  24. Mandal A, Dass Gopal, Rout P K and Roy R. 2012. Model comparisons for estimation of genetic parameters of pre-weaning daily weight gains in Muzaffarnagari sheep. *Small Ruminant Research* 106:118-124.
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27. Mir I A and Kumar Ravindra. 2012. Effect of feeding fenugreek seeds (*Trigonella foenum-graecum*) as feed additive on nutrient utilization in goats. *Indian Journal of Animal Nutrition* 29:256-261.
28. Mishra A K, Rawat M, Abhishek and K a n n a n S u r e s h . 2 0 1 2 . Characterization and lytic activity of endolysin induced by bacteriophage SA4 against mastitogenic isolates of *Staphylococcus* of bovine origin. *Indian Veterinary Journal* 89(6):24-26.
29. Mishra A K, Rawat M, Viswas K N, Kumar Abhishek and Reddy G B M. 2012. Expression and lytic efficacy assessment of *Staphylococcus aureus* phage SA4 lysin gene. *Journal of Veterinary Science* 14 (1):37-43.
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31. Mohan B, Singh K and Dixit A K. 2012. Socio-economic status of goat farmers in semi-arid zone of Uttar Pradesh. *Indian Research Journal of Extension Education* 1:128-131.
32. Pandey Anand Kumar, Dhaliwal Gurcharan Singh, Ghuman Sarvpreet Singh, Singh Jagir, Kumar Ajeet and Agarwal Sudhir Kumar 2013 Impact of norgetormet supplementation during early luteal phase on subsequent luteal profiles and conception rate in buffalo, a preliminary study *Tropical Animal Health and Production* 45:293-298,
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- meat nuggets. *Journal of Food Science and Technology* DOI 10.1007/s13197-012-0819-4.
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- Biotype of *Mycobacterium avium* subsp. *paratuberculosis* Strain S5. *Journal of Bacteriology* 1(1): e00005-13.
51. Singh S V, Singh A V, Gupta S, Rajindran A S, Swain N, Singh P K, Singh H, Sohal J S and Kumar N. 2012. Interspecies sharing of "Indian Bison Type," a novel predominant genotype of *Mycobacterium avium* subspecies *paratuberculosis* between naturally infected and endemic flocks of Bharat merino sheep and a colony of rabbits (*Oryctolagus Cuniculus*) raised on the same ecosystem in South India. *Research and Reviews: A Journal of Life Sciences* 2(3): 1-8.
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  53. Suguna K, Sarath T, Mehrotra S, Arunmozhi N, Agarwal S K and Uma Shankar 2013 Serum triiodothyronine and thyroxine profile in insulin treated pregnant goats *The Indian Veterinary Journal* 90(3): 123-124.
  54. Tripathi M K, Mondal D, Raghuvansi S K S and Karim S A. 2012. Effect of Bt-cottonseed meal feeding on intake, growth, nutrient utilization, serum cholesterol, immunological status, organ weight and slaughtering performance of growing lambs. *Animal Nutrition and Feed Technology* 12:165-178.
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### Lead/Invited papers

- Agarwal S K and Singh S K. 2013. Recent advances in maternal recognition of pregnancy in livestock. Short Course on Augmentation of Livestock Production through upstream Reproductive Technologies during the 24.01.2013- 13.02.2013 at CAFT Veterinary Physiology, IVRI, Izatnagar
- Ashok Kumar and V K Gupta. 2012. Nutraceuticals: an emerging and potential therapeutic approach in animal disease management . National Seminar on "Challenges and opportunities to improve health and production of small ruminants" held at CIRG, Makhdoom from Dec 22 – 23.
- Goel A K. 2012. Advances in reproductive techniques in small ruminants. In: Souvenir cum compendium, National symposium on "Addressing animal reproductive stresses through biotechnological tools" and 28th Annual convention of Indian society for study of animal reproduction (ISSAR), COVS, AAU, Khanapara, Guwahati (Assam), Nov 21-23.

- Gupta V K and Kumar Ashok. 2012. Experiment on Animals: Ethical and welfare issues. National seminar on "Future challenges and opportunities to improve health and production of small ruminants" and Annual conference of Indian society for sheep and goat production and utilization (ISSGPU) held at CIRG, Makhdoom, Mathura, U.P. during Dec 22-23.
- Gupta V K and Shivasharanappa N. 2013. Molecular targets for the development of improved diagnostics and vaccines for Brucellosis in animals. In ICAR Short course Multipronged approaches in surveillance and diagnosis of brucellosis. PD\_ADMAS, Bengaluru, Feb 19-28.
- Kumar Ashok. 2012. Technologies in goat farming, on the occasion of Farmers innovators day organized at CIRG, Makhdoom on 5th Aug.
- Kumar Ashok. 2012. "A new dimension in veterinary and animal science research : Veterinary Ayurveda , Environmental sensitivity , wild life and Animal welfare . CIRG Makhdoom, Dec 28.
- Kumar Ashok. 2012. Status and veterinary regulatory environments on drugs in India, at Confluence on "Veterinary regulatory reforms in India: Current status and the road ahead. Organized by Indian Vet Association (IVA) and Bovian Delhi at Delhi on Oct 6.
- Kumar Ashok. 2013. Advanced approaches in diagnosis of small ruminant diseases, ASCAD programme organized by State animal husbandry department Rajasthan, 24 Jan.
- Kumar Ashok, Gupta V K, Sharma Nitika and Kumar Ravindra. 2013. Challenges in quality assurance of herbal drugs" at National Conference on Phyto-medicine ( PAMMME-2013) Feb 15-16 at GLA University Mathura
- Kumar N. 2013. "Pox virus infections in small ruminants: their diagnosis and control" in CAFT training course on Diagnosis and control of infectious diseases of small ruminants, LLR University of Veterinary and Animal Sciences, Hisar.
- Rout P K. 2012. The promise of molecular tools for livestock production, well being and health: A key note address in National Conference "Emerging trends in biotechnology and pharmaceutical research" Feb 18-19. Mangalayatan University, Aligarh.
- Rout PK. 2012. Technological options for enhancing goat production, Goattery-2012, Royal livestock International, Aug 4-5, Coimbatore.
- Rout PK. 2013. Genetic improvement in host resistance: A sustainable strategy to maintain livestock productivity in changing climatic condition. Xth National symposium on "Integrated development of vast biodiversity of indigenous livestock for long term rural livelihood security" Feb 7-8, College of Veterinary and Animal Sciences, GBPUAT, Pantnagar, Uttarakhand.
- Singh S K and Singh M K. 2012. Genetic Improvement of small ruminants germplasm: Challenges and Opportunities: In Proceeding of Souvenir cum Abstract of National Seminar on "Future challenges and opportunities to improve health and production of small ruminants" Dec 22-23 CIRG, Makhdoom.
- Singh S V. 2012. Control and eradication of Johne's disease: A Journey. 2012. XXVI

IAVMI and International seminar on future of livestock health: A paradigm change to maximize productivity for economic gains. TANUVAS, Tamil Nadu, Sept 6-8.

Singh S V. 2012. Diagnosis of Johne's disease: An update. XXVI IAVMI and International seminar on future of livestock health: A paradigm change to maximize productivity for economic gains. TANUVAS, Tamil Nadu, Sept 6-8.

Singh S V. 2012. Evaluation of therapeutic efficacy of 'Indigenous vaccine' developed using 'Indian Bison Type' genotype of *Mycobacterium avium* subsps. paratuberculosis strain 'S5' of goat origin in a sheep flock endemic for Johne's disease.. National seminar and Annual conference on "Future challenges and opportunities to improve health and production of small ruminants" CIRG, Makhdoom, Dec, 22-23.

Singh S V. 2012. Impact of host genetics on the control of *Mycobacterium avium* subspecies paratuberculosis infection in domestic livestock. National seminar and Annual conference on "Future challenges and opportunities to improve health and production of small ruminants" CIRG, Makhdoom, Dec, 22-23.

Singh S V. 2012. Prospects of control and eradication of Johne's disease in India. National seminar and Annual conference on "Future challenges and opportunities to improve health and production of small ruminants" CIRG, Makhdoom, Dec, 22-23.

Singh S V. 2013. Bio-burden of *Mycobacterium avium* subspecies paratuberculosis in the Biotic (animals, primates and human beings)

and abiotic (soil and water resources, raw and pasteurized milk and milk products) environment and strategies for control. National Conference on 'Zoonotic Mycobacterial infections and their impact on Public Health', AIIMS and DBT, New Delhi, Feb 25 - 27.

Swarup D and Gupta V K. 2012. Economic impact of disease on sustainable goat husbandry. In Proc: International seminar on future of livestock health: A paradigm change to maximize productivity for economic gain and XXVI Annual convention of IAVMI. TANUVAS, Chennai, Sep 6-8.

Swarup D and Gupta V K. 2012. Animal health challenges affecting efficient livestock production in global village. International symposium on the "One health: way forward to challenges in food safety and zoonoses in 21st century" and National conference of IAVPHS, School of public health and zoonoses, GADVASU, Ludhiana, Dec 13.

## Popular Articles

Bhusan S. 2012 Genetic improvement of Jakhrana goats for meat production. *CIRG, News*, Vol. VII, p-2.

Bhusan S. 2012. Jakhrana: a Breed having higher potential for milk and multiple kidding. *CIRG, News*, Vol. VII-I, p-5.

Bhusan S. 2012. Selection to improve production of goat (in Hindi). *Ajamukh*, Vol. 26-I, p-3

Dixit A K, Roy R, Goel, A K, Singh S K, Singh K, Mohan B and Kumar V. 2012. Five kids Born to a Barbari Doe under CIRG TOT. *CIRG, News*, Vol VI-VII, P- 9.

- Gopal Dass. 2012. Muzaffarnagaru sheep: Best choice for commercial mutton production. *CIRG News* Vol. VII, P-6.
- Abhishek, Mishra A K and Rawat M. 2012. Bacteriophage endolysins: A novel therapeutic agents. *Livestock Line* 6 (2):43-45.
- Kumar A, Gupta V K and Tiwari H A. 2012. Disease management and annual health calendar for profitable goat farming in India. *Agra Vet J* 2: 51-53
- Mandal A, Dahiya N K, Sharma D K and Rout P K. 2012. GENCODE: A Fortran program for estimation of generation number from pedigree of an animal. *CIRG News*, Vol. VIII.
- Mishra A K. 2012. Lytic bacteriophages: An alternative to antibiotics. *Ajamukh* 25:12.
- Mohan B and Singh K. 2012. Role of newer extension tools in promoting the role of goats in sustainable livestock development-current strategies and future perspective. *Indian Farmers Digest* 45(4): 30-33.
- Ranjan R. 2012. Metabolomics: New tool to analyse metabolic profile. *Goat News* Vol VII, P-7.
- Sharma Nitika, Shivasharanappa N, Mishra A K and Chaturved, Vinay. 2012. Memno mein kukandriya rog avam use bachav. *Ajamukh*, July-Dec 26, P-5.
- Pawaiya R V S. 2012. Current status of caprine arthritis encephalitis (CAE) in Indian goats. *Goat News*. Vol. VII, P-3.
- Kumar Santosh, Mehla R Kand Ranjan R. 2012. Role of intensive goat farming in rural poverty alleviation. *Indian Farming* 62(9):35-38
- Sharma D K. 2012. Bakari Paneer/ Cheese. *Ajamukh*, 25, P-8
- Sharma D K and Paul Souvik. 2012. Bakriyon ki vyavharik evam sansarg pravrityan. *Ajamukh*, 25, P-5
- Shivasharanappa N, Gupta V K, Sharma Nitika, Mishra A K and Paul Souik. 2012. Goat Genome Project; Future goat research may find new avenues. *C.I.R.G News*, vol VII, P-2.
- Paul Souvik, Manjunath Reddy G B and D K Sharma. 2012. FAMACHA- A smart and selective treatment programme for Haemonchosis. *CIRG News*, Vol. VI-VII, P-6
- Paul Souvik, Manjunath Reddy, G B and Sharma D K. 2012. Nutraceuticals- A novel approach for GI parasite control. *CIRG News*, Vol. VI-VII, P-8
- Tripathi M K. 2012. Methane mitigation: Opportunities and Options. *CIRG News*, Vol VI-VII, P-3-4.

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## HUMAN RESOURCE DEVELOPMENT

### Scientist Trained in India/ Abroad

**BOYSCAST Fellowship 2011** by Department of Science and Technology, Government of India to carry out advance post-doctoral training (July 2011-July 2012) cum study on mechanisms regulating the differentiation of mesenchymal stem cells into myocytes and adipocytes at Department of Animal Science, University of Wyoming, Laramie and Washington State University, Pullman, USA. (**Das A K**),

**C V Raman International Fellowship programme for African Researchers :** Dr. Justin Kouamo, PhD., School of Veterinary Medicine and Sciences, The University of Ngaoundere, Cameroon has been completed his Post-Doctoral programme on the topic entitled "In-vitro maturation, In-vitro fertilization and culture of oocytes for caprine in-vitro embryo production" from May to October, 2012 under the supervision of Dr. S. D. Kharche, Senior Scientist.

25th Workshop on Developing Winning Research Proposals sponsored by National Fund scheme of ICAR, held at National Academy of Agricultural Research Management, Hyderabad during November 19-21, 2012. (**Kharche S.D.**)

Workshop on Quality management system



for ISO 9001-2000 on dated 04-12-2012 (**Kharche S.D.**).

Refresher course on Agricultural Research Management for Newly recruited senior/ principal scientists of Non-ARS stream of ICAR held at NAARM, Hyderabad from 5-18 June, 2012 (**Ravindra Kumar**)

Refresher Course on Agricultural Research Management organized by National Academy of Agricultural Research Management(NAARM), Rajendra nagar, Hyderabad from June 5-18, 2012. (**A.K.Dixit**)

Training on Gycans Expression in Early Larval Stages Of *Fascioloides magna* from 15th May 2012 to 5th June 23, 2012 in Laboratory of Dr. Timothy P Yoshino, Professor of Pathobiological Sciences, Department of Pathobiological Sciences, School of Veterinary Medicine, University of Wisconsin, Madison USA (**DK Sharma**)

NAIP sponsored training at Department of Microbiology and Molecular Genetics at Oklahoma State University, USA from 8.5.2012-28.5.2012 in the area of Molecular tools to identify methanogenic archea (**U.B. Chaudhary**)

NAIP sponsored training at United State Department of Agriculture (USDA) ARS Eastern Regional Research Centre (ERRC) Wyndmoor , Pennsylvania, USA from 19.7 .2012-16.8.2012 in the area of Use of natural product for the control of microorganism ( **Ashok Kumar**)

Specialized Training on "Management Development Programme on Leadership Development (a Pre-RMP Programme)" at NAARM, Hyderabad from 08-19 October 2012 (**A.K.Goel, S.V.Singh and R.V.S. Pawaiyya** ).

## National Seminar

National Seminar on “Future Challenges and Opportunities to Improve Health and Production of Small Ruminants” was organized at CIRG, Makhdoom, Mathura from 22-23 December, 2012. The seminar was inaugurated by Dr. S. Ayyappan, Secretary, DARE, Govt. of India and Director General, ICAR, New Delhi. The presidential address was delivered by Sh. G. C. Pati, IAS, Secretary, DAHD&F, Govt. of India. Dr. S. K. Bandyopadhyay, Member, ASRB, New Delhi and Prof. A. P. Singh, Vice Chancellor, DUVASU, Mathura were the guest of Honour on the occasion. The Organising secretary of the seminar was Dr. S. K. Jindal. Dr Ashok Kumar and Dr M K Tripathi were the joint organizing secretaries.



## Farm Innovation Day

Institute organized a Farm Innovator Day on 30 April, 2012. Dr. J.S. Chauhan,



Director, Project Directorate on Rapeseed Mustard, Bharatpur and Dr. S. K. Dubey, Incharge, CSCWRTI, Regional Station Chhalesar, Agra were the chief guest and guest of honor respectively on this occasion. The Farm Innovator Day was attended by 112 farmers across the country. Dr. J.S. Chauhan,, the chief guest of the function in his address welcomed and conveyed his regards to the farmers and explained the importance of farmers and farm science in the development of the country by quoting the words of DG, ICAR “Farmer First”.

He emphasized that this meeting will serve to answer the issue of a sustainable goat husbandry under the burden of increasing population, decreasing land, forage resources and climate change. The technologies developed by CIRG were displayed. The participants and farmers showed keen interest for the adaptation of CIRG technologies. Farmers shared their experiences on local remedies (ITK's) on control of goat diseases and general management practices.



### हिन्दी कार्यशाला

दिनांक 02-03 मई, 2012 तक आयोजित की जाने वाले संस्थान अनुसंधान समिति की बैठक को एक राजभाषा कार्यशाला के रूप में परिणित कर दिया गया। इस दौरान आयोजित की जाने वाली उपरोक्त बैठक में संस्थान के समस्त वैज्ञानिकों एवं वरिष्ठ तकनीकी अधिकारियों द्वारा सहभागिता की गयी। इस बैठक में संस्थान के समस्त वैज्ञानिकों द्वारा पिछले एक वर्ष के दौरान किये गये अनुसंधान कार्यों को प्रस्तुत किया गया तथा निदेशक महोदय व अध्यक्ष राजभाषा कार्यान्वयन समिति डा. देवेन्द्र स्वरूप द्वारा वर्ष के दौरान किये गये अनुसंधान कार्यों की समीक्षा की गयी। विभिन्न अनुसंधान परियोजनाओं की प्रकृति राजभाषा हिन्दी व अंग्रेजी द्विभाषी रूप में की गयी।

### Gene sequences published:

Partial nucleoprotein (N) gene sequences of Peste des Petits Ruminants virus, GenBank Accession: KC200262.1 (**Naveen Kumar 2013**)

Complete nucleotide sequence analysis of "Indian Bison type" *Mycobacterium avium* subspecies *paratuberculosis* BenBank Accessions NZ\_ANPD01000009.1 to NZ\_ANPD01000178.1 (Total 176 sequences deposited). (**S. V. Singh 2012**)

### Conference attended

14th Annual convocation of NAVS and National seminar on Livestock policy for National Food and Nutritional security in the Scenario of WTO Regulations held at COVSc & AH, DUVASU, Mathura from Nov 02-03, 2012 (**Ravindra Kumar**).

20th Annual Conference on Agricultural Inputs and Services Delivery System for Accelerating Growth and Improving Farm Income held on 9-11 October, 2012 organized by IARI, NCAP and IASRI, New Delhi (**A.K.Dixit**).

3rd World Congress on Biotechnology, 13-16th September, 2012 organized by OMICS Group at HITEC City, Hyderabad, A.P. (**S.D.Kharche**)

5th Conference and National Symposium of Indian Meat Science Association "Emerging Technological Changes to Meet the Demands of Domestic and Export Meat Sector" and acted as Rapporteur for the session - V "Industry - Academia meet" held at NRC, Hyderabad from 7- 9th February, 2013 (**R.B.Sharma**).

8th Biennial Animal Nutrition association Conference on "Animal Nutrition Research Strategies for Food Security" Nov 28-30, Bikaner, Rajasthan (**M.K. Tripathi**)

Annual Review Meet of All India Coordinated Research Project on Goat Improvement held on Nov. 1 - 2, 2012 at CIRG, Makhdoom, Mathura, Uttar Pradesh (**S.K.Singh**)

Fifth Convention of Indian Meat Science Association and National Symposium on "Emerging technological changes to meet the demands of domestic and

- export meat sector", February 7-9, 2013 at NRC on Meat, Hyderabad (**A.K. Das and A.K.Verma**)
- Goatery-2012, Royal livestock international, August 4-5, 2012 Coimbatore (**P.K.Rout, N. Ramachandran, S.K.Singh, V.K. Gupta, Devendra Swarup**)
- ICAR-NDDDB-IIL Joint working group meeting at Indian Immunological, Hyderabad on 4<sup>th</sup> Oct 2012 (**V. K. Gupta**).
- International Symposium agricultural communication and sustainable rural development held at G.B. P.U.A. &T. Pantnagar 22-24 November 2012. (**Prabhat Tripathi**)
- Joint Annual Meeting of ADSA®-AMPA-ASAS-CSAS-WSASAS, Phoenix, Arizona, USA on July 15-19, 2012 (**A.K.Das**)
- Meeting of Directors/Heads with DG, ICAR, New Delhi on March 04, 2013 (**S.K. Jindal, S.K. Singh, S.V. Singh**)
- National Conference on 'Zoonotic Mycobacterial infections and their impact on Public Health', held at All Indian Institute of Medical Sciences, New Delhi and Department of Biotechnology, 25 - 27, Feb., 2013 (**S.V.Singh**).
- National Seminar and XXth Annual Convention of ISAPM on "New Paradigms in Livestock Production: From Traditional to Commercial Farming and Beyond" at NDRI, Karnal from 28-30 January, 2013. (**N. Ramachandran**)
- National Seminar on "Future Challenges and Opportunities to Improve Health & Production of Small Ruminants & Annual Conference of Indian Society for Sheep & Goat Production & Utilization (ISSGPU), CIRG Makhdoom, Farah (Mathura) UP, 22-23 December 2012. (**A.K.Das, A.K.Dixit, A.K.Goel, A.K.Verma, A.K.Mishra, Ashok Kumar, B.Rai, Braj Mohan, D.K.Sharma, Devendra Swarup, Gopal Dass, Khushyal Singh, M.K.Tripathi, Naveen Kumar, Nitika Sharma, N.Ramachandran, P.K.Rout, Prabhat Tripathi, Ravi Ranjan, R.B.Sharma, Ravindra Kumar, R.V.S.Pawaiyya, Saket Bhushan, S.D.Kharche, S.K.Jindal, S.K.Singh, Souvik Pal, S.V.Singh, Souvik Pal, U.B.Chaudhary, V.K.Gupta**)
- National Seminar on Livelihood options for small and marginal farmers in fragile eco-systems, held at ICAR NEH Complex, Shillong on 09-10th August, 2012. (**B.Rai**)
- National Seminar on Value Added Functional Foods: Prospects and Future Challenges at Janta College, Bakewar, Etawah (U.P.) on 23-24 February, 2013. (**A.K.Dixit, Braj Mohan**)
- National Symposium on "Addressing Animal Reproductive Stresses Through Biotechnological Tools & 28th Annual Convention of Indian Society for Study of Animal Reproduction (ISSAR), COVS, AAU, Khanapara, Guwahati (Assam), Nov. 21-23, 2012 (**A.K.Goel**)
- National workshop on "Foresight and future pathways of Agricultural Research through youth in India" from March 1-2, 2013 held at NASC Complex, New Delhi (**Ravindra Kumar**).

National workshop on stem cell research and therapeutics: current status and future strategies held at IVRI, Bareilly from 28th-29th September, 2012 (**Ravi Ranjan**).

PME incharges meeting at NDRI, Karnal, December 7-8, 2012 (**P.K. Rout**)

Scientific seminar on “Opportunity, Prospects and Challenges of Goatery Development in Jharkhand” on 09/03/2013 at Ranchi, Jharkhand organized by Department of Animal Husbandry, Jharkhand as Keynote Speaker (**S.K. Jindal**)

Scientist meet on “Net Work Project on Sheep Improvement” held at CSWRI, Guest House, Jaipur from, 2-3 January, 2013 (**Gopal Dass**).

Seminar on “Role of Veterinarians in the Society and Their Contribution to National Economy” organized by Agra Veterinary Club (AVC) Agra on 27.10.2012. (**A.K. Goel, R.B. Sharma, S.D. Kharche**)

Seminar organized by World Noni Research foundation & ISNS Chennai,

India on 3-4 August, 2012, Sponsored by Noni Bio-Tech Chennai (**S.K. Singh**).

Shetakari Prashikshan shiveer on 15th March, 2013 at Kaswad, Panchgani, Mahabaleshwar, Satara (MS) (**S.D. Kharche**)

Xth National symposium on “ Integrated development of vast biodiversity of indigenous livestock for long term rural livelihood security” February 7-8, 2013, College of Veterinary and Animal Sciences, GB Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, (**P.K. Rout, S.K. Singh**)

XXI Meeting of ICAR Regional Committee to be held at Patna from 21.09.2012 to 22.09.2012 (**S.K. Singh**).

XXVI IAVMI and International seminar on future of livestock health: A paradigm change to maximize productivity for economic gains held (TANUVAS), at Madras Veterinary College, Chennai, Tamil Nadu, 6-8 Sept. 2012 (**S.V. Singh**).

## IMPORTANT MEETINGS

### Composition of the Research Advisory Committee (RAC)

Position	Status	Name and Designation
An eminent retired ICAR Scientist nominated by DG, ICAR	Chairman	Dr. V. Prabhakar Rao, Vice Chancellor, Sri Venkateswara Veterinary University, Tirupati (AP)
4-5 external members (including retired ADG, Director, Scientists representing the major areas of research and development programme of the institute nominated by DG, ICAR.	Members	<ol style="list-style-type: none"> <li>1. Dr. N.Krishnan, Ex Associate Dean, Hyderabad (AP)</li> <li>2. Dr. S.K.Dwivedi, Ex. Director, NRC on Equines, Hisar</li> <li>3. Dr. R.J.Sharma, Ex. Dean, GBPUAT, Pantnagar (UK)</li> <li>4. Dr. K.Kumanan, Prof. and Head, Madras Veterinary College, Chennai(TN)</li> <li>5. Dr. S.N. Maurya, Former Vice Chancellor, DUVASU, Mathura(UP)</li> </ol>
	Member Secretary	<ol style="list-style-type: none"> <li>6. ADG (AN&amp;P), ICAR, New Delhi</li> <li>7. Director, CIRG, Makhdoom, Farah, Mathura</li> <li>8. Dr. P.K.Rout, Principal Scientist, CIRG, Makhdoom</li> </ol>

### Composition of the Institute Management Committee (IMC)

Position	Status	Name and Designation
Director, CIRG, Makhdoom	Chairman	Director, CIRG, Makhdoom
Members include ADG, Former Head, Principal Scientist, Finance Account Officer & Administrative Officer representing the major areas of research and development programme of the institute nominated by DG, ICAR.	Member	<ol style="list-style-type: none"> <li>1. Director, Animal Husbandry, U.P., Lucknow</li> <li>2. Director, Animal Husbandry, Uttarakhand</li> <li>3. Vice Chancellor, Pt. Deen Dayal Upadhyay Pashu Chikitsa Vigyan Vishwavidyalaya evam go anunsandhan Sansthan, Mathura</li> <li>4. Shri, S.K.Pathak, DD(F-III), ICAR, Krishi Bhavan, New Delhi</li> <li>5. Dr. Sanjeev Kumar, Senior Scientist, NBAGR, Karnal</li> <li>6. Dr. Taru Sharma, PS &amp; Head, Animal Physiology, IVRI, Izatnagar</li> <li>7. Dr. Dharendra Singh, PS, Animal Health, CSWRI, Avikanagar</li> <li>8. Dr. S.K.Singh, PS, AG&amp;B, CIRG,</li> <li>9. ADG(AN&amp;P), ICAR</li> <li>10. Mr. R.N.Mallik, Administrative Officer, CIRG, Makhdoom</li> </ol>
	Member Secretary	

### Institute Research Committee (IRC)

Six monthly Institute Research Council (IRC) Meeting of the Institute was held on 16-17<sup>th</sup> July, 2012 and 8-9<sup>th</sup> November 2012. Institute Research Council (IRC) meeting was held at the Institute from 2-3<sup>rd</sup> May, 2012 and 7<sup>th</sup> May, 2012. Project Review Meeting for projects completed and new proposed was held on 12-14<sup>th</sup> March, 2013 under the Chairmanship of Dr. S.K. Agarwal, Director, CIRG. The meetings aimed to review the progress made under different research projects and also to approve new proposed projects.

### Institute Management Committee (IMC)

The Institute Management Committee meeting was held on 19<sup>th</sup> November, 2012.

### Research Advisory Committee (RAC)

The meeting of Research Advisory Committee (RAC) of CIRG was held on 04-05 May, 2012 under the chairmanship of Dr V. Prabhakar Rao, Chairman RAC, Dr. S.K. Dwivedi and Dr. S.N. Maurya, Dr. N. Krishna, Dr. R. J. Sharma members of RAC, and Dr. Devendra Swarup, Director, CIRG were present.



## CONSULTANCY, PATENTS AND COMMERCIALIZATION OF TECHNOLOGIES

Under the Memorandum of Understanding which was signed with M/s BioVet Ltd, Bengaluru for production of Johne's disease vaccine on commercial scale, a Material Transfer Agreement (MTA) was signed between M/s Biovet Ltd and CIRG duly

vetted by the ICAR. Under this MTA the bacterial strain *Mycobacterium avium subsp paratuberculosis* was transferred to M/s BioVet during 2012-13. This strain of bacteria will be used for production of a killed Johne' disease vaccine.

## RESEARCH PROJECTS (2012-13)

### A Externally Funded Projects

S. No.	Project	P.I.
1.	All India Coordinated Research Project on Goat Improvement	Dr. S.K. Singh
2.	AICRP Network Project on Sheep Improvement – Muzaffarnagri Unit	Dr. Gopal Dass
3.	AICRP - Improvement of feed resources and nutrient utilization in raising animal production	Dr. Ravindra Kumar
4.	Estimation of methane emission under different feeding systems and development of mitigation strategies	Dr. M.K. Trpathi
5.	Goat Husbandry based integrated approach for livelihood security in disadvantaged districts of Bundelkhand region (NAIP comp III)	Dr. M.K. Singh
6.	Bioprospecting of genes and allele mining for abiotic stress tolerance (NAIP Comp IV)	Dr. P.K. Rout
7.	Achieving Improved Livelihood Security through Resource Conservation and Diversified Farming Systems Approach in Mewat (NAIP Component III)	Dr. D.K. Sharma
8.	NAIP- Developmental potential parthenogenetic goat embryos.	Dr. S.D. Kharche
9.	NAIP- Holistic Approach for improving Livelihood Security through livestock based farming system in Barabanki & Rae Bareilly Districts of U.P. (NAIP Comp III)	Dr. B. Rai
10.	Development and Characterization of an Indigenous Vaccine and Diagnosis for Johne's disease (CSIR and Biovet) NIMTLI	Dr. S.V. Singh
11.	DST project on Development of diagnostic assay, Molecular characterization and epidemiology of cryptosporidiosis in goats	Dr. S. Paul
12.	NICRA Project – Assessing resilience of small ruminant production under changing climatic conditions in semi-arid zone	Dr. U.B. Chaudhary
13.	Outreach Programme on Zoonotic Diseases	Dr. S.V. Singh
14.	VTCC – Veterinary Type Culture-Microbes in collaboration with NRCE, Hissar	Dr. V.K. Gupta
15.	VTCC – Veterinary Type Culture-Rumen Microbes in collaboration with NAINP, Bangalore.	Dr. U.B. Chaudhary

## B. Institute Projects

S. No. Project	P.I.
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### GENETICS AND BREEDING DIVISION

- |  |              |
|--|--------------|
| 1. Improvement of Jakhrana Breed of Goats ( <i>Capra hircus</i> ) for Milk and Meat Production under Farm and Field Condition. | Saket Bhusan |
|--|--------------|

### NUTRITION, FEED RESOURCES AND PRODUCTS TECHNOLOGY DIVISION

- |  |                  |
|--|------------------|
| 1. Developmental of Fodder production, conservation and processing technologies for small holders and commercial goat farmers. | P. Tripathi      |
| 2. Studies on nutritional value of goat milk.  | R.B. Sharma      |
| 3. Studies on herbal medicated pellated diet for enhancing goat productivity.  | Ravindra Kumar   |
| 4. Development of Feed Resources on poor lands for goats   | Prabhat Tripathi |
| 5. Evaluation of carcass traits, meat quality and products from goat meats   | A. K. Das        |
| 6. Value chain for the development of goat products with healthy traits  | A. K. Verma      |

### PR & SM DIVISION

- |   |                 |
|---|-----------------|
| 1. Studies on Refinement of frozen semen technology and strengthening of goat semen bank. | S.K. Jindal     |
| 2. Augmentation of prolificacy by using biotechnological tools in goats.                  | S.D. Kharche    |
| 3. Economic Managemental intervention for Augmenting Growth in kids.                      | N. Ramachandran |

### GOAT HEALTH DIVISION

- |  |                  |
|--|------------------|
| 1. Monitoring and Surveillance of important Goat Diseases in India   | D.K. Sharma      |
| 2. Development of herbal anti-diarrhoeal drug for goats.   | Ashok Kumar      |
| 3. Prevalence of caprine toxoplasmosis and cryptosporidiosis   | Souvik Paul      |
| 4. Development of alternative therapeutics for mastitis by using lytic bacteriophages against staphylococci and streptococci | Anil Kumar Misra |

S. No.	Project	P.I.
5.	Isolation and Identification of important viruses of Goats.	Naveen Kumar
6.	Molecular diagnosis and epidemiology of Brucellosis in goats	V.K. Gupta
7.	Toll like receptors (TLRs) expression and characterization in different breeds of goats and their role in disease resistance with special reference to brucellosis	V.K. Gupta
8.	Patho-epidemiological studies on emerging and existing diseases of goats	R.V.S. Pawaiya
9.	Genetic resistance study in Indian goats against gastrointestinal nematode, <i>Haemonchus contortus</i> infection	D.K. Sharma
10.	Metabolic profiling for diagnosis and control of metabolic diseases in goats	Nitika Sharma

#### EXTENSION EDUCATION & SOCIO-ECONOMICS SECTION:

1.	Impact of improved technologies and emerging market conditions on goat production system.	A.K. Dixit
2.	TOT – Multi – disciplinary Project on Transfer of Technology for sustainable Livelihood through Goat Farming by disseminating the improved Goat Production Technologies.	Braj Mohan
3.	A study on impact of various training programmes on commercial goat farming	Khushyal Singh
4.	Assessment of economic losses due to diseases in goat production	A.K. Dixit

## DISTINGUISHED VISITORS

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Following distinguished guests paid a visit to the Institute during 2012-13 :

- ◆ Dr. S. Ayyapan, Secretary, DARE and DG, ICAR, New Delhi; 22-12-2012
- ◆ Dr. S. D Rai, Former ADG (TC), ICAR, New Delhi; 06-04-2012
- ◆ Dr. V. Prabhakar Rao, VC, Shri Venkateshwara Veterinary University, Trupati; 05-05-2012
- ◆ Dr. S.K. Dwivedi, Former Director, NRCE; 04-05-2012
- ◆ Shri B. D. Dash, IAS, Director, AH&VS, Odisha; 02-06-2012
- ◆ Dr. S. N. Singh, MD, Biovet; 11-06-2012
- ◆ Dr. R.C.Agrawal, Registrar General, PPV&FRA, Ministry of Agriculture, New Delhi; 15-06-2012
- ◆ Hon'ble Sh. Charan Das Mahant, State Minister for Agriculture and Food Processing Industries ; 18.8.2012
- ◆ Dr. J. M. Kartaria, Director, CARI, Bareilly; 21-08-2012
- ◆ Dr. Harpal Singh, Former Dean, GBPAU, Pantnagar, UK; 24-08-2012
- ◆ Dr. S.C Gupta, ADG (AG&B), ICAR; 31-08-2012
- ◆ Shri G. C. Pati, Secretary, DAHDF, New Delhi; 14-09-2012 and 22.12.2012
- ◆ Shri Farah Abdullah Kismayu, Somalia, East Africa, UNHRC; 17-09-2012
- ◆ Dr. Nagendra Sharma, Ex Director CIRG and NDRI; 15-10-2012
- ◆ Dr. N. Nadrajan, Director, IIPR, Kanpur, U.P.; 28-10-2012
- ◆ Dr. Chanda Nimbkar, Director, NARI, Paltan; 31-10-2012
- ◆ Dr. K. Sharma, ADG, ICAR; 21-12-2012
- ◆ Dr. A.N Shukla, EX-ADG, ICAR; 17-12-2012
- ◆ Dr. B. S. Prakash, ADG (AN&P), ICAR; 22-12-12.
- ◆ Dr. S. A. Karim, Ex-Director, CSWRI, Awikanagar; 22-12-12
- ◆ Dr. N. V. Patil, Director, NRCC, Bikaner; 22-12-12
- ◆ Dr. S.M.K Naqvi, Director, CSWRI, Awikanagar; 22-12-12
- ◆ Dr. S. K. Bandopadhyay, Member, ASRB; 22-12-12
- ◆ Dr. D. Swarup, Former Director, CIRG; 09-01-2013
- ◆ Dr. K. P. Agrawal, Former National Coordinator, NAIP; 22-12-2012
- ◆ Dr. A.P. Singh, VC, DUVASU, Mathura; 22-12-2012
- ◆ Dr. S. K. Garg, Dean, DUVASU, Mathura

- ◆ Dr. Arjava Sharma, Director, PDC, Meerut; 22-12-2012
- ◆ Shri M. A. Madani, MP-RS; 01-10-2012
- ◆ Shri Farhana Tarapuri, MP-RS; 01-10-2012
- ◆ Prof.(Dr.) Col. A. K. Gehlot, VC, RUVAS, Bikaner, Rajasthan; 03-11-2012
- ◆ Dr.B. N. Singh, MD, RKDF Group of Education, Bhopal; 03-11-2012
- ◆ Mr. Rajesh Ranjan, Director, DARE, ICAR, 23-02-2013

### Production performance and supply of superior germ plasm by CIRG

The number of kiddings, number of elite animals supplied and total milk production from the goat flocks at CIRG during 2012-13 is given below. Proper health, lower kid mortality, improved management and better nutritional interventions were responsible for this achievement. During the period under report 583 superior animals were supplied by the institute to goat farmers, state government and other agencies for breed improvement.

Year	No of kiddings	No of elite animals supplied	Milk production (L)
2003-04	504	499	20445
2004-05	456	363	25019
2005-06	478	521	19628
2006-07	565	414	22942
2007-08	536	232	35665
2008-09	576	338	25446
2009-10	493	392	22638
2010-11	663	374	29181
2011-12	651	689	40907
2012-2013	902 goat 203 sheep	583	31372

## PERSONNEL

### Administration

Dr. S.K. Agarwal	Director (wef 1.1.2013)
Dr. D. Swarup	Director (upto 31.12.2012)
Dr. A.K. Goel	Vigilance Officer
Dr. P.K. Rout	Scientific Secretary
Mr. R.N. Mallik	Administrative Officer
Mr. Kailash Chandra	Asstt. Finance and Account Officer
Mr. S.S. Gautam	Asstt. Admn. Officer
Mr. A.K. Sharma	Asstt. Admn. Officer
Mr. C.S. Sagar	Asstt. Admn. Officer
Mr. S.R. Achary	Private Secretary

Dr. Satish Kumar	Principal Scientist
Dr. A.K. Goel	Principal Scientist
Dr. B. Rai	Principal Scientist
Dr. S.D. Kharche	Principal Scientist
Dr. N.Ramachandran	Scientist
Dr. Ravi Ranjan	Scientist
Dr. S.P. Singh	Scientist (on study leave)
Dr. Priyadharsini Raju	Scientist (on study leave)
Mr. Krishan Kumar	Technical Officer T-5
Mr. H.K. Himkar	Technical Officer T-5
Mr. Hari Om	Technical Officer T-5
Mr. Dinesh Bhat	Technical Officer T-5

### Goat Genetics and Breeding Division

Dr. S.K. Singh	Principal Scientist and Head
Dr. Saket Bhushan	Principal Scientist
Dr. P.K. Rout	Principal Scientist
Dr. Gopal Dass	Principal Scientist
Dr. M.K. Singh	Sr. Scientist
Mr. Ram Das Bharti	Technical Officer T-5 (upto 31.10.2012)
Mr. Badan Singh	Technical Officer T-5
Mr. A.S. Prajapati	Technical Officer T-5

### Physiology, Reproduction and Shelter Management Division

Dr. S.K. Jindal	Principal Scientist and Head
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### Nutrition, Feed Resources and Products Technology Division

Dr. U.B. Chaudhary	Principal Scientist and Head
Dr. M.K. Tripathi	Principal Scientist
Dr. R.B. Sharma	Principal Scientist
Dr. Prabhat Tripathi	Sr. Scientist
Dr. Ravindra Kumar,	Sr. Scientist
Dr. V. Rajkumar	Scientist (Sr. Scale)
Dr. A.K. Das	Scientist
Dr. A.K. Verma	Scientist
Mr. Suresh Tewari	Technical Officer T-6
Mr. Dori Lal Gupta	Technical Officer T-6
Mr. Raj Kumar Singh	Technical Officer T-5
Mr. Suraj Pal	Technical Officer T-5

### Goat Health Division

Dr. S.V. Singh	Principal Scientist and Head
Dr. D.K. Sharma	Principal Scientist
Dr. Ashok Kumar	Principal Scientist
Dr. V.K. Gupta	Principal Scientist
Dr. R.V.S. Pavaiyya	Principal Scientist
Dr. Naveen Kumar	Senior Scientist
Dr. K. Gururaj	Scientist (On study leave)
Dr. Shivsharnappa	Scientist
Dr. A.K. Mishra	Scientist
Dr. Souvik Pal	Scientist
Dr. Nitika Sharma	Scientist
Dr. H.A.Tiwari	Senior Veterinary Officer
Dr. Vinay Chaturvedi	Veterinary Officer

### Extension Education and Socio-Economics Section

Dr. Braj Mohan	Principal Scientist and I/c
Dr. A.K. Dixit	Sr. Scientist
Dr. Khushyal Singh	Scientist (Sr. Scale)
Dr. Vijay Kumar	Scientist (On study Leave)
Mr. Dinesh Prasad	Technical Officer T-6
Mr. U.C. Yadav	Technical Officer T-5

### AICRP on Goat Improvement

Dr. S.K. Singh	Principal Scientist
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### AICRP on Sheep Improvement

Dr. Gopal Dass	Principal Scientist
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### Prioritization Monitoring and Evaluation Section

Dr. P.K. Rout	Principal Scientist and I/c
Dr. Souvik Pal	Scientist
Dr. H.S. Sisodiya	Tech. Officer T 7-8 (upto 31.12.2012)
Dr. Balraj Singh	Technical Officer T-6

### IPR Cell

Dr. V.K. Gupta	Principal Scientist and I/c
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### RTI Cell

Dr. V.K. Gupta	Principal Scientist and Transparency Officer
Dr. H.A. Tewari	Sr. Veterinary Officer and PIO

### Agriculture Knowledge Management Unit (AKMU)

Dr. S.K. Singh	Principal Scientist and I/c
Mr. M.P. Agrawal	Technical Officer T-5
Mr. Satish Chandra	Technical Officer T-5

### Maintenance

Dr. U.B. Chaudhary	Principal Scientist and I/c
Sh. Jagdish	Technical Officer T-5

### Security Section

Dr. R.B. Sharma	Principal Scientist and I/c
Mr. P.K. Sharma	Security Officer

### Medical Section

Dr. V.K.Gupta	Sr. Medical Officer ( upto 25.12.2012)
Mr. Mohan Lal	Technical Officer T-5

### Library

Dr. A.K.Goel	Principal Scientist and I/c
Dr. Pratap Singh	Technical Officer,T-9

### Agriculture Farm

Dr. Prabhat Tripathi	Sr. Scientist and I/c
Mr. Bhagwan Singh	Tech. Officer T 7-8

### Transfer

Dr. Manjunath Reddy	Scientist to PDADMAS, Bengaluru (w.e.f. 25-06-2012)
Shri Joseph George	FAO to NIANP, Bengaluru (w.e.f. 06-10-2012)

### Joining

Dr. Sudhir Kumar Agarwal	Director (w.e.f. 01-01-2013)
Shri Deepak K. Mahlawat	Asstt. (wef 10-07-12)
Shri jitendra Singh Gaithe	Asstt. (wef 21-07-12)

### Superannuation

Dr. D. Swarup	Director (w.e.f. 31.12.2012)
Mr. C.B.Pandey	Technical Officer (w.e.f. 31.12.2012)
Dr. H. S. Sisodiya	Technical Officer (w.e.f. 31.12.2012)
Dr. V. K. Gupta	Medical Officer (w.e.f. 25.12.2012)
Shri Ram Das	Technical Officer (w.e.f. 31.10.2012)
Shri Abhiram	Technician (w.e.f. 31.03.2013)
Shri Manik Pal	Technician selected in Rajasthan Govt.
Shri Bangali	Supporting Staff (w.e.f. 31-07-2012)

### Career Advancement / Promotion

Dr. S. D. Kharche	Principal Scientist
Dr. R. B. Sharma	Principal Scientist
Dr. Gopal Dass	Principal Scientist
Dr. M. K. Tripathi	Principal Scientist
Dr. V. K. Gupta	Principal Scientist
Dr. Khushyal Singh	Senior Scientist
Dr. V. Rajkumar	Senior Scientist
Dr. N. Ramachandran	Scientist (RGP 7000)
Dr. A. K. Das	Scientist (RGP 7000)
Dr. Ravi Ranjan	Scientist (RGP 7000)
Dr. H. S. Sisodiya	T-9
Shri R. K. Singh	T-6
Shri D. K. Bhatt	T-5
Shri Radhey Shyam	T-5

Shri M. P. Agrawal T-5  
 Shri Vinod Kumar T-5  
 Shri Ram Kishan T-5  
 Shri Vijay Kishore T-5  
 Shri Ishwari Sharan T-5  
 Shri V. K. Sharma T-5  
 Shri Gulzari Lal T-5  
 Shri Chet Ram T-5  
 Shri S. C.L. Gautam T-4  
 Shri Shiv Charan T-4

Shri Ashok K. Bhatia (Asst. RGP 4600)  
 Shri Chandra Mohan Sharma  
 (Asst. RGP 4600)  
 Shri Ter Singh (Asst. RGP 4600)

### Deputation Abroad

Dr. U. B. Chaudhary  
 Dr. D. K. Sharma  
 Dr. V. K. Gupta  
 Dr. A. K. Das  
 Dr. Priyadharshani Raju (Study leave)



