Annual Report
2013-14

CIRG
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CENTRAL INSTITUTE FOR RESEARCH ON GOATS
Makhdoom, Farah, Mathura 281122, U.P.

ICAR

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PREFACE

Goat, the poor man's cows, fit in amicably to achieve the the inter-dependent objectives of poverty alleviation, availability of food, creation of employment and growth in rural income. The livelihood security of an incredibly large number of farm families is linked to livestock . Majority of small and marginal farmers derive their livelihood from goats. In order to make goat farming more remunerative continued research efforts and innovations for development of low cost technologies, machines and tools are necessary. 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 Institute is focusing on emerging issues like climate change, natural resource degradation, feed and fodder availability, appearance of new host-parasite complex, concerns for health and bio-safety, restrictive trade regimes, competitiveness of goat produce, improvement in income of goat farmers, shift in the consumption pattern towards processed food and increased demand for food items of animal origin especially goat.

The Institute has developed farmers friendly and commercially viable technologies for goat improvement. The Institute scientists have filed 18 patents, commercialized one technology and recently developed technologies for diagnostics of brucellosis & J.D. and vaccine against J.D. which are under process of commercialization. The Institute is maintaining elite herd of Barbari, Jamunapari and Jakhrana goats and Muzaffarnagri sheep for distribution of superior females and males for the genetic improvement of goats and sheep under field conditions. The Institute during the year supplied 470 elite goats and 65 sheep to different SAUs, State Governments, NGOs and farmers for genetic improvement of their goats and sheep. The mortality rate of goats and sheep have been below 5% during the year which is mainly due to effective health care and management of the livestock farms. The scientists have worked on 19 institute funded and 17 out funded research projects. Whole genome sequencing of *Mycobacterium paratuberculosis*, TLR expression studies in brucellosis , characterization of Peste des petits ruminants virus , *in vivo* development of parthenogenetic embryos, identification and formulation of low methane producing feed ,role of azolla as protein source in goat feed,positive genetic trend in production in Jamunapari, Barbari and Jakhrana goats and Muzaffarnagari sheep are some of the salient achievements of the year. Agro-forestry is one of the important sections of the Institute which produced and supplied 9649 quintals of green fodder to different livestock units, 251 quintals barley & oat grains besides 7.40 quintals of cowpea and guar seed. Scientists have published 122 research papers in International and National Journals of repute.

During the year, SFC and Vision 2050 documents were finalized and approved by the Council. These documents will serve as guiding force for all our future programs. The All India Coordinated Research Project on Goat Improvement (A.I.C.R.P.) with fourteen research centres all over the country is running at this institute. The Council has approved four new centres under A.I.C.R.P. on goat improvements in XIIth Plan SFC. ie Changthangi goat unit at SKUAST, Kashmir; Andaman goat unit, Portblair; Uttarakhand goat unit, Pantnagar and Himalyan goat unit, IVRI, Mukteshwar. Now under AICRP, there are 18 units covering 13 breeds of goats in the country.

We have introduced designer training programmes with prioritized content for

specialized groups under sponsored training programmes for the dissemination of technologies of the Institute. We conducted four National training programmes on scientific goat production for the capacity building and human resource development of goat farmers across the country. There was a total of 16 trainings organized during the year which included trainings sponsored by DADF, Punjab Veterinary Council, Odisha Veterinary Council, BAIF, Bankers Institute for Rural Development, Govt. of Bihar and Jharkhand. The Institute activities were covered extensively by All India Radio (AIR) and Doordarshan (DD) New Delhi. Regular Clinical Camps were organized in adopted villages for enhancing goat production. We have proud distinction of offering widest possible range of solutions to the problems of goat farmers and enterpreneurs. The Institute participated in nine exhibitions and Kisan Melas at different place of the country to display its various technologies for the benefit of the goat farmers, professionals and other stakeholders and awarded 1st, 2nd and 3rd prizes at DUVASU ,Mathura; NDRI, Karnal and IVRI, Izatnagar, respectively.

The Institute is working in the area of development of strong liaison amongst research institutes for collaborative research and developmental programmes in the area of goat development and marching towards its goal in this competitive environment by following the path of ethics, values, dedication, research excellence and enhanced social values.

The Institute scientists were awarded with Ram Lal Agrawal Gold Medal , ISSAR fellowship , President, ISSAR; Vice-President of ISSGPU; Member board of Management, NDRI, Karnal, MAFSU, Nagpur; Member selection board GADVASU, Ludhiana; RAJUVASU, Bikaner; JNU, New Delhi; PDC, Meerut and ASRB, New Delhi , IVRI, Izatnagar and NDRI, Karnal.

I express my sincere gratitude to Dr. S. Ayyappan, Secretary DARE, and Director General, ICAR, for his support for the development of the Institute. I am thankful to Dr. KML Pathak, DDG (Animal Sciences), Dr. B.S. Prakash, ADG (AN&P), Dr. Gaya Prasad, ADG (AH), Dr. Ravinder Singh Gandhi, ADG (AP&B), and other scientists of SMD for their ever encouraging support for the progress and overall development of the institute. Our thanks are also due to Chairman and members of RAC and IMC of the Institute for their valuable guidance and support. The editorial team needs appreciation for their untiring efforts for compiling and editing of the Annual Report. I hope the annual report will be useful for scientists, administrators, entrepreneurs and stakeholders working in the field of goat production.

(S.K.Agarwal)
Director

Contents

CIRG

Annual Report 2013-14

Executive Summary

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 5,00,000 remote villages in the country. Goat meat production in the country has increased from 4.70 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 annual growth rates of 2.6 %. The country stands first in goat milk production and is the second largest in goat meat production 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

A positive genetic trend was recorded for milk yield in Jamunapari goat population showing significant improvement in milk yield over the years during 90 and 140 days of lactation. Total 213 improved Jamunapari goats were distributed during the year to goat breeders for the breed improvement of their flocks. Barbari goat is known for its wide adaptability and institute has supplied 241 improved goats for genetic improvement programme. The positive genetic correlations among lactation traits indicates lactation yield of 90 days a reliable trait for constructing selection indices. There was significant increase in milk production in Jakhrana goats indicating the average daily milk yield of 1.32 liter and average peak yield 1.95 liter. Body weights of Muzaffarnagri sheep at all stages were significantly higher during year 2013 as compared to previous two years. The average daily gain of Muzaffarnagari lambs during 0-3, 3-6, 6-9, 9-12 and 3-12 months were 159.81, 106.78, 75.53, 54.63 and 77.18g under semi-intensive feeding management. The breed specific expression analysis of Hsp70.3 revealed that Sirohi goats had higher expression (2-8 folds) as compared to Jamunapari, Jakhrana and Barbari goats. It has been observed that the heat stress tolerant individuals had 3 to 10 folds higher expression of Hsp than heat stress susceptible individuals. Goat based integrated farming livelihood models were developed for livelihood security in disadvantaged districts of Bundelkhand region.

Physiology, Reproduction and Shelter Management Programme

Semen of superior bucks of Barbari, Jamunapari, Sirohi and Jakhrana breed were cryopreserved for AI and other research purposes. The post thaw motility, live sperm count, acrosomal integrity and hypo osmotic swelling positive spermatozoa were significantly higher in 0.01% of EDTA and 1mg % of vitamin C fortified group. Parthenogenetic embryos were produced and their in vivo development observed up to 23rd and 28th days in two recipients. Intra cytoplasmic sperm injected in vitro matured oocytes were developed up to 8-16 cell stage. Stem cells up to third passage were produced from 8-16 cell and morula stage embryos. The female fetal skin fibroblast cell monolayer attained the same percent of confluences 24 h earlier than to male

fetal skin fibroblast cell monolayer. Embryonic cell colonies were passaged up to third passage on goat fetal fibroblast monolayer and stored in liquid nitrogen. Hormonal profile of Jakhrana goats at different reproductive stages was established. The growth of kids was better in slatted floor housing system as compared to kutcha floor.

Nutrition, Feed Resources and Products Technology Programme

Leucaena leucocephala foliage may be used as sole green fodder on goat feeding. It is found that mustard oil meal, and combination of urea and guar korma can replace conventional protein supplement linseed cake in lactating goats feeding, with improved lactation performance. Integrated nutrient management in nursery seedlings was perfected. Mustard cake inclusion reduced methane production by 21.09 %, whereas the concentrate pellet containing guar korma and urea produced 4.83 % less methane in comparison to linseed cake pellets. It was found that quality of feed especially the protein content is responsible for the level of methane production. Methane gas production significantly got reduced with increasing proportion of azolla in goat feed. Meat from intact animal had significantly higher total omega-3 as well as omega-6 fatty acids.

Goat Health Programme

Considerable progress has been made in development of herbal anthelmintic formulations for goats and four potential plants were selected for prototype formulation against haemonchosis. Complete genome sequence of Mycobacterium avium subspecies paratuberculosis Strain 'S-5' of goat origin has been carried out. Johne's disease vaccine technology has been transferred to Biovet under PPP mode and the vaccine is currently under clinical trial for commercialization. Factors such as season, age etc. were found to have significant effect on fecal egg count in the goats infected with Haemonchus contortus while, factors such as type of birth, birth weight and sex had little effect on the count. Toll like Receptors genes such as TLR-1, 2, 3 were sequenced in full length first time and expression of TLR- 4 and TLR-9 was found to be higher as compared to TLR-2 suggesting their strong role in innate response against brucellosis. Expression of TLR following exposure of PPRV to Vero cells was studied and a peak in TLR 3 and TLR7 expression was observed at 1 and 3 hr. post-infection, respectively. A unique PPR virus (PPRV/ Nanakpur/2012) that cross reacts poorly with monoclonal antibodies and hyper immune serum (against vaccine strain) was isolated suggesting this PPR virus may evade the vaccinal immunity. E coli and Cryptosporidium were found to be the main causative agents of the neonatal diarrhea in the kids of Jakhrana, Jamunapari and Barbari goats. Salmonella spp. and Rotavirus were also found capable to cause diarrhea in the kids. Procedures for diagnosis of Cryptosporidium spp. infection in goats were standardized, and prevalence of the infection was found higher in 0-15 days old kids and during the summer season as compared to 15-30 days old kids and winter season, respectively. Sex or breed had no correlation with the occurrence of cryptosporidiosis. Various viral and bacterial pathogens such as Orf virus, goat pox virus, PPRV, MAP strain 'S-5' (Indian Bison Type), Pseudomonas aeruginosa, Klebsiella spp., Pasteurella multocida, Listeria monocytogenes, Salmonella spp., Brucella melitensis and Shiga toxin producing E. coli from goats were isolated, identified, characterized and submitted to VTCC, Hisar for accessions. Concentration of non-esterified fatty acids (NEFA) in serum was found to be a better indicator of negative energy balance in peri-parturient goats. The method for confirmatory diagnosis of pregnancy toxaemia in morbid goats by estimation of beta- hydoxy butyrate in vitreous humor of eye was developed and standardized. Main causes of death in goats diagnosed by post-mortem analysis were found as enteritis (17.46%), pneumonia (17.03%), septicemia (6.98%), haemonchosis (4.37%), & pregnancy toxemia (3.05%), gastro-enteritis (2.18%) and toxaemia (2.18%).

Extension Education and Socio-Economics Programme

Four national trainings on Commercial Goat Farming and seven sponsored training programme on Scientific Goat farming were organized during the year. In addition five other trainings were organized for specialized groups like veterinary Officers, project officers, bankers with tailor made content to suit the client's requirements. Institute participated in 9

exhibition/Kisan mela at different places and won first prize in Kisan Mela at DUVASU, Mathura, 2nd at NDRI, Karnal and 3rd prize at IVRI, Izatnagar. One hundred and thirty three (133) technical letters were received and replied. Institute also entertained 11,694 visitors from different parts of the country and received 1785 helpline calls and answered accordingly.

The All India Coordinated Research Project on Goat Improvement (A.I.C.R.P.) with fourteen research centres all over the country is runningat this institute. The Council has approved four new centres i.e. Changthangi goat unit at SKUAST, Kashmir, Andaman goat unit, Port Blair, Uttarakhand goat unit, Pantnagar and Himalyan goat unit, IVRI, Mukteshwar under A.I.C.R.P. on goat improvements in XIIth Plan. Now under AICRP, there are 18 units covering 13 breeds of goats in the country.

The Institute scientists have been addressing various problems in goat production through nineteen Institutes funded and seventeen extramural research projects. The revenue generation during the year was 141 lakhs. Institute scientists were awarded and recognized by various organizations for their contributions.

Three postgraduate students from IVRI completed thesis research work for M.V.Sc degree. Three students from GLA University Mathura are conducting research work for PhD degree under guidance of institute scientists. Three graduate students from GLAU, Mathura completed one month summer training and one PhD student from SHIAT, Allahabad, UP was given expert guidance on HPLC analysis of plant extract samples. One batch of BVSC and AH Students from College of Veterinary science and AH, Mathura completed training under internship programme. Students of different academic colleges and veterinary colleges visited the institute laboratory and livestock Units. The institute recently developed technologies for diagnostics of brucellosis & J.D. and vaccine against J.D. which are under process of commercialization.

The institute scientists published 122 research papers in various national and international journals, 36 popular articles, 68 research abstracts, 38 lead/invited papers, 22 books/chapters/bulletins/manuals and 11 radio talks/ and three TV programmes covered by the DD National

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, 72 technicaland 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-coordinating unit of All India Coordinated Research Project is also located at CIRG. The project aims at improving production performance of different 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 landline phones 0565-2763380, 2763323 and helpline 0565-2763320. The profile of the Institute can be visited at www.cirg.res.in

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 impart National and International trainings in specialized fields of goat research and development.
- To transfer technologies for improving milk, meat, fiber production, value addition of goat products and capacity building.
- To provide referral and consultancy services on goat production and product technologies.

Highlights of Achievements

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±0.03, 0.59±0.12, 1.58±0.19, 2.66±0.28 and 2.14±0.36, respectively) and at 9 month (0.999±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 successful 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 HSPgenes 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

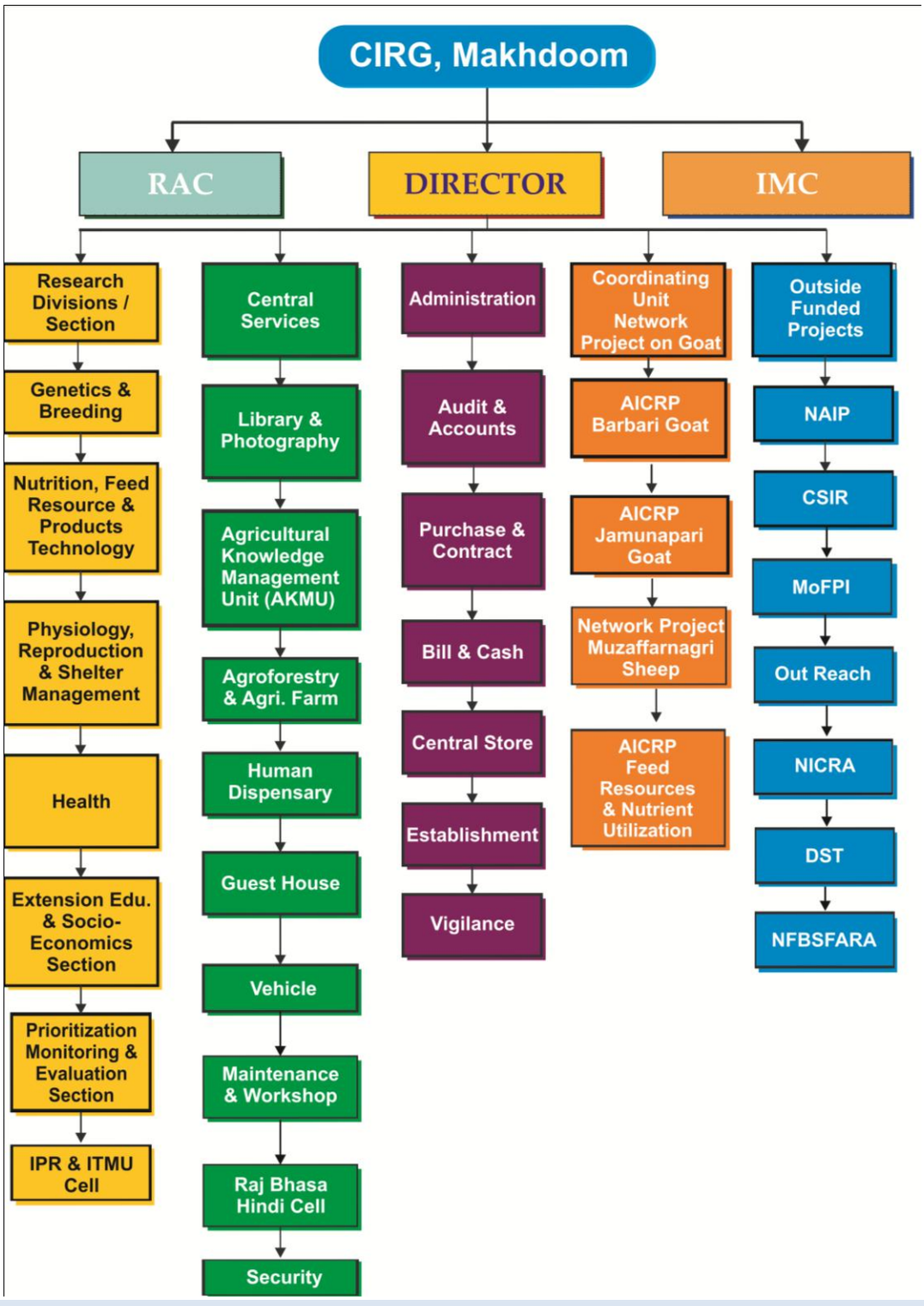
- ALQUIT- Ectoparasiticidal Drug for animals (commercialized)
- BRUCHEK-Dot ELISA Kit for diagnosis of Brucellosis
- ELISA Kit for diagnosis of Johne's Disease
- Inactivated Johne's disease vaccine
- Intra vaginal pessaries for oestrus synchronization.
- Modern goat appliances to reduce feed and water 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)

Impact of Research

- Improved productivity and genetic 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 ectoparasitical 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

Organizational Setup



Staff Position

Category	No. of post sanctioned	No. of post filled
Director	1	**1**
Scientific	50	**39**
Administrative Staff	33	**36**
Technical	72	**59**
Supporting	104	**96**
Temporary Status		**98**
Total	**260**	**329**

Financial Statement (2013-14)

	Plan (Rs. lakh)		Non Plan (Rs.lakh)	
	Allocation	Expenditure	Allocation	**Expenditure**
A.Recurring				
Establishment charges	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**
Other charges	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. Non-recurring				
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**
Library books & 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**
Land Development	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**
Grand Total (A+B)	**325.00**	**323.63**	**1962.03**	**1888.83**

Revenue Generation

Particulars	Amount (in lakh)
Sale of Farm Produce	26.20
Sale of Meat/Meat Products	4.16
Income from royalty/Sale of Publications and Advertisement	8.07
License Fee	8.07
Application fee from candidates	1.20
Interest earned on short term deposits	62.25
Income generated from Internal Resource Generation	8.22
Miscellaneous Receipts	23.68
Grand Total	141.85

Goat Genetics and Breeding Division

Improvement and sire evaluation of Jamunapari goats for milk production

P.K.Rout , Gopal Dass, Mahesh Dige ,N. Shivsaranappa, H. A. Tewari and S. K.Singh

Population growth

The annual flock strength of Jamunapari goats for the year 2013-2014 showed opening balance of the flock was 739 and closing balance was 741. The population growth of the flocks was 125.4% during the year. The overall mortality of the flock during the year 2013-14 was 4.76%.

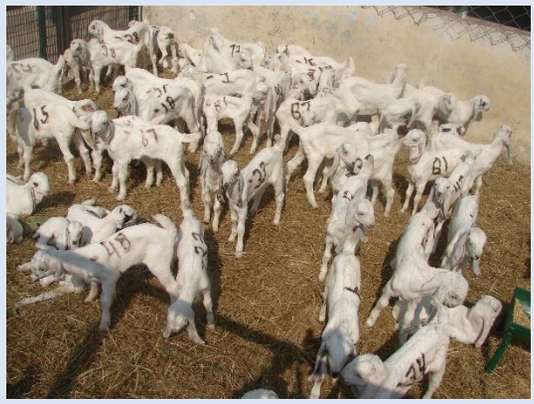
Production performance

The mean of body weights of kids at birth, 3, 6, 9 and 12 months of age over the year were 3.41, 12.11, 15.10, 19.50 and 26.48kg, respectively. Parity of dam had significant effect on kid's body weight up to 6 months of age. Male kids maintained higher weights at all growth stages over their counterpart. Kids born as single also showed significantly higher weights than those born as twins or triplets. The average daily weight gain (ADG) of the kids under intensive management was 73.89, 120.78, and 111.89 g/day, respectively during 3-6, 6-9 and, 9-12 month age group. Least squares means of part lactation milk yield in 90 days and 140 days were 86.45 and 111.16 liters, respectively, during the year. 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.

Reproduction Parameters

Reproductive performance of Jamunapari goats in terms of breeding efficiency and kidding percent on the basis of does tupped were 86.03 and 121.10%, respectively. The kidding rate was 1.46. During this year, a total of 254 does kidded 373 kids , out of which single, twin and triplet born kids were 138, 226 and 9 respectively.

Supply of improved germplasm



During year , 213 improved animals were supplied to various developmental agencies, farmers and state governments, non-government organizations and progressive breeders for genetic improvement in the field conditions.

Genetic Parameter estimates of milk production performance

Estimates of variance and co-variance components were obtained using the ASREML program (Gilmour et al., 2002), initially fitting the univariate models. Likelihood ratio tests were carried out to determine the most suitable model for each trait in the univariate analyses. Subsequently, bivariate analyses were carried out using an animal model to estimate the genetic, phenotypic and environmental correlations. Milk production data of 2217 Jamunapari goat during the period 1995 to 2012 was analyzed. Summary statistics for milk production traits are shown in table 1. The mean 90 days, 140 days and lactation milk yield of the Jamunapari goat over the 17 years was 80.18 litres, 113.98 and 124.82 liter, respectively. The average lactation yield was 124.82 liter with a lactation length of 179.5 days.

Table 1 Milk yield and lactation length traits of Jamunapari goats

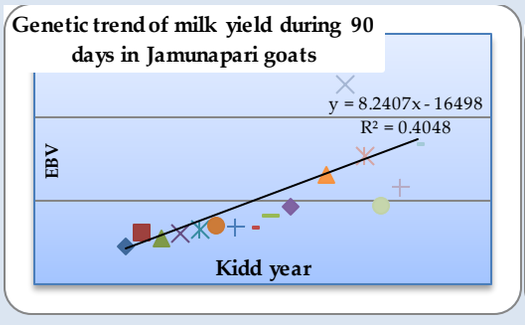
	Milk yield 90 days	MY140 days	Lactation milk yield	Lactation Length
Number of Records	2217	1788	2099	2099
Number of does	2217	1788	2099	2099
Number of years	17	17	17	17
Mean	80.18litre	113.98 lire	124.82 litre	179.5days
SD	33.3	38.1	51.06	42.17
Standard error	0.708	0.90	1.11	0.92
CV	41.6	33.48	40.90	23.49
Range/ Maximum	21.8-168.0	46.8-233.6	33.0-273.7	70-277

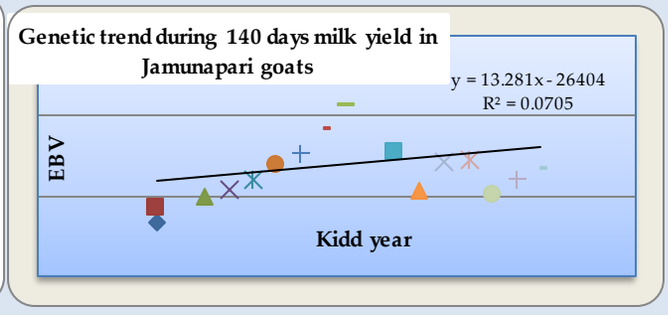
The log-likelihood obtained for each trait in four different models was compared (Table 2). The most appropriate model for milk yield at 90, 140 and lactation yield was animal and maternal effect. The appropriate model for lactation length was direct (animal + PE) effect. Parameter estimates fitting the most appropriate model for milk yield and lactation length was presented in Table 2.The estimates of direct heritability for MY90,MY140 LMY and LL 0.577, 0.765,0.781and 0.148, respectively. The maternal variance and variance due to permanent environment were very low for all the traits under study. The maternal permanent environmental component due to dam and litter contributed negligibly. The heritability estimates across different traits with small standard errors (varies from 0.015 to 0.036) resulted from the large size of the data and the precise estimate showed the genetic improvement for milk production for 90 days and 140 days period will be successful by selection.

Table 2: Model effect and genetic parameter of Jamunapari goats

	MY90		MY140		LMY		LL	
Components	anim	maternal	anim	maternal	anim	maternal	anim	pe
var direct	55329.2	54825.8	98190.3	95471.2	149108	138727	267.162	217.488
var-maternal		723.148		3137.35		11358		
Var-pe								88.1905
var-res	39473.2	39422.3	26223.3	26148.4	27505.6	27358.8	1181.9	1158.29
pheno	94802	94971	1.24E+05	1.25E+05	1.77E+05	1.77E+05	1.45E+03	1.46E+03
se	4404.4	4427.8	6629	6649.9	8959.8	9016.6	50.329	51.913
h2	0.5836	0.5773	0.7892	0.7653	0.8443	0.7818	0.1844	0.1486
se	0.0267	0.0367	0.0152	0.0351	0.0106	0.035	0.0312	0.033
mat2		0.0076		0.0251		0.064		
se		0.0282		0.0329		0.0346		
								0.0602
								0.025
Log L	-3242.62	-3242.59	-10580.7	-10580.4	-2573.18	-2571.15	-8557.1	-8553.05

Genetic trends were estimated for each trait by regression of EBV averages on year of birth, weighted by the number of animals in each year. A positive genetic trend was obtained for milk yield in Jamunapari goat population and showing significant improvement over the years in milk yield during 90 and 140 days. (Fig1)





Genetic improvement of Barbari goats for meat and milk production

M.K. Singh, Mahesh Dige, S. K. Singh, Nitika Sharma

Flock statistics and dynamics

The annual flock strength of Barbari goats for the year 2013-14 was 690. The population growth was 147% and overall mortality of the flock was 3.5%. During this year 241 goats were supplied for breed improvement to farmers and various goat improvement and development agencies

Growth production traits (body weights)

The data on body weight growth viz birth, 3, 6, 9, and 12 month of ages recorded from 2009-10 to 2013-14 were analyzed for effect of year, season of birth, sex of kid and type of kidding. Weight of dam was included in the model as an independent trait. Year, season, sexes of kid, type of birth and parity have significantly affected body weight at different ages. The overall least squares means of body weight of kids at birth, 3, 6, 9, and 12 month of ages for the year 2013-14 were 1.68±0.02, 8.32±0.09, 12.59±0.17, 18.01±0.37 and 21.06±0.44 kg respectively (Table 1). Kids born during autumn season have attained significantly higher body weight at 6, 9 and 12 months of ages. Single born kids were significantly heavier than those born as multiple. Similarly males were heavier than their counterpart's right from birth to 12 months of ages. The estimates of heritability (h2) for body weight of kids at birth, 3, 6, 9, and 12 month of ages were 0.189±0.043,0.231±0.048, 0.260±0.051, 0.494±0.074 and 0.655±0.088.

Lactation performance

The lactation performance data were analyzed from 2009 to 2013 for non-genetic effects i.e. year, season, type of kidding, parity and polynomial regression of weight of dam at kidding using mixed model least square techniques. Overall mean for 90 days milk yield, 140 days milk, total lactation yield and lactation length for the does kidded in 2013-14 were 57.90, 79.78, 68.27 liters and 131 days, respectively. Does kidded during spring season produced significantly higher milk production for 90, 140 days milk yield, lactation yield, and lactation length than those which kidded in autumn season. 90 days milk yield increases up to 3rd lactation then remained highest in 4th and 5th parity thereafter declined with the advancement of parity order (Table-2). The estimates of h2 for MY 90, LMY and LL were 0.465±0.131, 0.483±0.133, 0.445±0.129 and 0.309±0.115 respectively. The genetic correlations among lactation traits were of high magnitude and positive in nature indicates part lactation yield of 90 days are reliable for constructing selection indices.

Reproductive performance

Overall mean for age and weight first mating, age and weight after first kidding, kidding interval and gestation period, breeding efficiency on the basis of does available, kidding % (tupped goat), goat produced multiple birth, and litter size are given in Table 3.

Selection Differential

The selection differential for 9 months body weight was 5.47 kg and that of the dam's 90 days milk yield was 7.09 liters. The high selection differential indicates the further scope of improvement through selective breeding in these goats.

Table 1: Least squares mean of body weight growth (kg) in Barbari goats

Factor	Body Weight at				
Year	Birth	3M	6M	9M	12M
2011	1.85±0.16 (577)	7.70±0.08 (555)	11.66±0.13 (529)	16.28±0.20 (489)	19.26±0.24 (489)
2012	1.77±0.02 (443)	7.27±0.09 (398)	10.46±0.15 (359)	15.00±0.23 (288)	18.60±0.27 (288)
2013	1.68±0.02 (316)	8.32±0.09 (308)	12.59±0.17 (221)	18.01±0.37 (80)	21.06±0.44 (80)
***P<0.01, *P<0.05*					

Values in parenthesis are number of observations

Table 2: Lactation Performance of Barbari Goats

Year	90 days milk (litre)	140 days milk (litre)	Lactation yield (litre)	Lactation length (days)
2011	50.46±0.85 (333)	71.44±1.77 (120)	59.11±1.17 (334)	123.26±1.36 (334)
2012	52.18±0.90 (288)	78.08±1.88 (97)	61.13±1.21 (295)	125.64±1.41 (295)
2013	57.90±1.04 (191)	79.78±1.71 (113)	68.27±1.41 (194)	131.38±1.64 (194)
***P<0.01, *P<0.05*				

Table 3: Reproductive performance in Barbari goats over the years

S.No	Traits	2011-12	2012-13	2013-14
1	Age at first mating (days)	348.2±3.4 (114)	362.9±7.4 (109)	354.7±6.4 (97)
2	Weight at first mating (kg)	15.54±1.07 (114)	14.44±3.2 (109)	15.01±2.3 (97)
3	Age at first kidding (days)	492.1±5.4 (113)	406.9±8.3 (109)	422.3±5.2 (102)
4	Weight at first kidding(kg)	17.23±2.5 (113)	16.23±3.3 (109)	16.01±2.3 (102)
5	First kidding interval(days)	226.03±1.1 (37)	219.07±6.2 (67)	221.04±7.2 (54)
6	Gestation period (days)	143.8±1.5 (246)	146.7±1.4 (307)	145.4±1.4 (204)
7	Breeding efficiency / fertility (does tupped)	91.1	92.5	90.7
8	Kidding percentage (does tupped)	140.3	135.0	145.3
9	Kidding rate (liter size)	1.54	1.46	1.60

Genetic evaluation and improvement of jakhrana breed for milk and growth traits

Saket Bhusan, Gopal Dass, A. K. Mishra

Jakhrana goats are maintained at CIRG, Makhdoom for genetic improvement of goats for milk and meat production. Adult females were selected on the basis of 90 days milk production and of 9 month body weight. Kids were selected for future bucks and does on the basis of 9 months body weight to increase body weight of kids and 90 days milk production of their dam. Out crossing breeding method in Jakhrana flock was conducted. Kidding rate is also considered for selection 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:

There were 88 kids, 30 adult males and 110 adult females in the Jakhrana Unit Thirteen animals were culled on production ground and 16 animals on health ground and 17 animals were died. Thirteen breeding males and 3 breeding does were supplied to the farmers and other government and non-government agencies for breed improvement.

Kidding rate

Total 108 kids were born from 74 kidding during the year 2013-14. Out of 108 kids, 59 kids (54.63

%) were male and 49 kids (45.37 %) were female. Out of 74 kidding, 43 does (58.11 %) gave single birth, 28 does (37.83 %) produced twins and 3 does (4.05 %) gave triplet births. Over all multiple births were 34 (43.24 %). The kidding rate of Jakhrana goats was 1.47. Gestation period, kidding interval and dry period of Jakhrana goats were 151.45±0.52, 290.42 ±0.46 and 143.32±0.48 days, respectively.

Production of breeding bucks for breed improvement in the field and farm.

Male and female kids were selected on the basis of their 9 month body weight and 90 days milk yield of their mothers. Does were selected on the basis of 90 days milk yield.

Growth performance of kids and milk production of nucleus flock:

Males were selected on the basis of 9 month body weight for selective breeding. Pooled average body weight at birth, 3 and 6 months of Jakhrana kids born in 2013-14 increased as compared to kids born during 2012-13.

Body weight of male kids at birth, 3 and 6 months of Jakhrana kids born in 2013-14.

Body weight of female kids at birth, 3 and 6 months of Jakhrana kids born in 2013-14 increased 6.02 %, 44.38 % and 26.42 %, respectively than kids born in 2012-13. Body weight of single born kids at birth, 3 and 6 months of Jakhrana kids born in 2013-14 were increased. Body weight of multiple born kids at birth, 3 and 6 months of Jakhrana kids born in 2013-14 were increased 5.84 %, 40.27 % and 46.77 %, respectively than kids born in 2012-13. Results indicated that selection of bucks at 9 month body weight also significantly affects the 3 and 6 month body weight. Milk production of Jakhrana goats increased effectively from 2009 to 2012 each year due to genotypic effect of selection.

Females are selected on the basis of 90 days milk production for selective breeding. Therefore, milk yield of 30, 60, 90, 120 and 150 days of does kidded in 2013-14 than does kidded in 2012-13. Average lactation production was 183.80±10.23 liter. Average per day milk production of Jakhrana goats was 1.32 liter. Average peak yield of the flock was 1.95±0.07 liter and average time of peak yield in the flock was 18.17±7.37. Lowest variation in lactation length, lactation production, peak yield and time of peak yield were found to be 56-196 days, 25.84-306.60 days, 1.4-2.8 litter and 7-49 days, respectively.

Table 1: Least Square means of body weight of Jakhrana kids.

2012-13	Birth wt.	3 m wt	6 m wt	9 m wt	12 m wt
Pooled	2.60±0.03 (119)	8.07±0.12 (100)	11.63±0.27 (69)	16.04±0.35 (63)	21.34±0.46 (54)
Male	2.68±0.05 (63)	8.29±.0.18 (54)	11.50±0.39 (35)	16.73±0.59 (32)	21.29±0.65 (28)
Female	2.49±0.05 (54)	7.84±0.19 (43)	11.77±0.40 (32)	15.21±0.39 (29)	21.17±0.73 (24)
Single	2.68±0.07 (33)	7.78±0.23 (23)	11.49±0.52 (22)	16.42±0.66 (21)	21.63±0.84 (19)
Multiple birth	2.57±0.04 (84)	8.17±0.15 (75)	11.70±0.32 (46)	15.84±0.58 (41)	21.18±0.58 (34)
2013-14	Birth wt.	3 m wt	6 m wt	9 m wt	12 m wt
Pooled	2.76±0.03 (109)	11.69±0.14 (67)	14.40±0.27 (27)	-	-
Male	2.86±0.05 (59)	12.00±0.20 (36)	19.56±0.57 (7)	-	-
Female	2.64±0.06 (49)	11.32±0.20 (31)	14.88±0.65 (12)	-	
Single	2.82±0.06 (41)	12.06±0.22 (26)	15.37±2.42 (06)	-	-
Multiple birth	2.72±0.05 (67)	11.46±0.18 (41)	17.11±1.00 (13)	-	-

Table 2: Means of Milk Production (liter) of Jakhrana goats

Year	30 d	60 d	90 d	120 d	150 d
2012-13	45.91±1.18 (77)	83.32±1.99 (74)	113.01±3.20 (70)	146.26±4.28 (49)	**165.14±11.22 (29)**
2013-14	**51.16±9.25 (71)**	**97.23±3.80 (48)**	**141.28±5.12 (39)**	**178.22±6.38 (35)**	**209.27±11.74 (16)**

Genetic evaluation and improvement in muzaffarnagari sheep for body weight.

Gopal Dass, Souvik Paul and S.D. Kharche

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. 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 with 6-7 hours grazing supplemented with 100-500 gm concentrate in various stage and age group of the animals. Dry and green fodder was also offered as per the requirement. Controlled breeding was practiced to improve the managemental efficiency. Ewes were bred during May-June and October-November followed by lambing in the months of October–November and March-April, respectively.

The opening balance of sheep was 550 which comprised of 185 males and 365 females and closing balance of 590 sheep had a stock of 197 males and 393 females. During this year a total of 219 lambs born and overall mortality was recorded 3.64%.

Production performance

The overall least-squares means of body weights of lambs at birth, 3, 6, 9 and 12 month age were 3.78±0.04, 18.18±0.27, 26.34±0.53, 30.78±0.66 and 35.49±0.75 kg, respectively. Sex and year of lambing had highly significant (P<0.01) influence on all body weights except non-significant effect of sex and year of lambing on birth weight. Male lambs gained higher weights as compared to female lambs at all growth

stages. Body weights at all stages were significantly higher in year 2013 as compared to previous two years. The average daily gain of Muzaffarnagari lambs during 0-3, 3-6, 6-9, 9-12 and 3-12 months were 159.81±2.76, 106.78±3.41, 75.53±3.29, 54.63±3.73 and 77.18±2.51g under semi-intensive feeding management. The average adult body weights of males and females were respectively 56.5 and 41.1 kg.

The overall least squares means for lambs 1st and 2nd six monthly and adult annual clips were calculated to be 478.25±12.45, 492.83±13.84 and 1119.38±21.51g, respectively. The 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.

Growth performance of Muzaffarnagari lambs (kg).

Particulars	Birth Wt.	3M Wt.	6M Wt.	9M Wt.	12M Wt.
Overall mean	3.75±0.02 (717)	16.84±0.15 (686)	24.25±0.25 (513)	29.07±0.28 (456)	33.41±0.33 (430)
Sex	NS	**	**	**	**
Male	3.79±0.03 (386)	17.45±0.20 (370)	26.24±0.32 (268)	31.82±0.36 (241)	36.89±0.42 (223)
Female	3.71±0.04 (331)	16.24±0.22 (316)	22.25±0.34 (245)	26.31±0.39 (215)	29.94±0.45 (207)
Year	NS	**	**	**	**
2011	3.72±0.05 (278)	17.02±0.24 (274)	23.95±0.32 (257)	28.60±0.33 (250)	32.46±0.38 (235)
2012	3.75±0.04 (211)	15.33±0.28 (196)	22.46±0.40 (165)	27.82±0.43 (144)	32.30±0.50 (134)
2013	3.78±0.04 (228)	18.18±0.27 (216)	26.34±0.53 (91)	30.78±0.66 (62)	35.49±0.75 (61)

Reproduction performance

The twinning rate in Muzaffarnagari sheep is comparatively low due to large body size. But due to the intensive breeding of those rams and ewes responsible for producing twins and triplets, the twinning rate improved tremendously. The annual tupping, lambing on available basis and lambing on bred basis were 93.4, 76.9 and 83.2%. These reproductive parameters in season first and second were respectively 95.4, 75.6, 80.5% and 95.4, 75.6, 80.5%. During this year, the twinning rate recorded to be 9.1, 26.7 and 14.9% respectively in first & second season and annual. The twinning rate was found significantly higher than previous years. The overall replacement rate was calculated as 24.5%.

Distribution of elite germplasm

A total of 65 elite animals (51 rams and 14 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, A.K. Roy

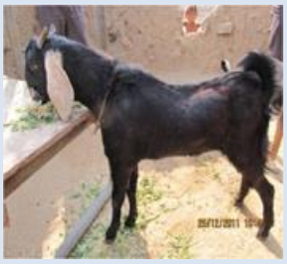
Eight villages were selected from each of two disadvantaged districts namely Hamirpur and Mahoba of Bundelkhand. The following programmes were implemented in an integrated manner:

- Goat based improvement and livelihood programmes
- Poultry based livelihood programme
- Bovine (cow and buffalo) health and production improvement
- Fodder resource development
- Crop improvement
- Eco-friendly integrated insect-pest control,
- Soil and water conservation measures
- Capacity building of beneficiaries.

A total of 909 elite goats were provided to 364 resource poor people for strengthening their income and nutrition. The milk yield from these goats ranged from 78 to 164 liters with an average 106 liters in a lactation period of 125 days. It was

115% higher over baseline values (49 liter). The bodyweight of kids at 9 months of age born from these pure bred and elite goats varied from 16 to 23 kg with an average of 18.2 kg. Multiple births from these goats were also higher (15-22%) over local non-descript goats. The price of yearlings from these goats was 30-50% higher over non-descript goats.

Fifty two superior breeding bucks were provided for the up-gradation of villager's low yielding and non-descript goats. Progeny born from these bucks were superior in body weight and fetch better price in the market. Simultaneously, scrub bucks were disposed off and a kid's nursery farm from high milk yielding "Bundelkhandi goats" was established with the support of a local NGO to meet out the requirement of breeding bucks. Bundelkhandi breed of goat was phenotypically characterized.



Distribution of pure-bred and high potential goats and buck






Activities/Innovations implemented in adopted villages

Under promotion of package of goat improved management practices, 45 low cost goat shelters were constructed, 80 goat feeders, 150 water devices 386 kg mineral mixture and 580 quintal concentrate feed provided to beneficiaries. A total of 11421 goats were vaccinated and 10313 goats were dewormed. These measures reduced mortality from 26.4% to 8.5 %. Increase in the survival of goat increased the net annual income of Rs 3500 from a unit of five goats. Similarly, feeding of concentrate increased the body weight of kids in flock from 13.5 kg (before concentrate feeding) to 17.6 kg at 9 month of age. The concentrate ration provided to the goats helped in prolonged lactation period by 20-30% and shortened kidding interval, morbidity and mortality. Supplementation of concentrate ration increased milk yield of goat by 39% . Three hundred eighty six kg mineral mixture was distributed to 322 goat keepers to strengthen immunity, health, fertility and productivity of goats. Construction of low cost goat shelters

decreased the morbidity by more than 35%. Low cost shelter is getting popular among goat farmers. Organized marketing for the sale of grown-up kids was introduced with "Sir Tata Trust" through a NGO at Rs 150 kg live body weight basis to increase competition. Goat keepers have also made insurance of their costly goats and breeding bucks. One cooperative goat farm was established in Hamirpur district with about 350 goats by adding resources of 22 farmers belonging to 5 villages. 12 medium scale commercial farms were established in the region. The overall impact of goat based interventions resulted in increase in survivability (21%), milk yield (70%), body weight of kids at 12 month (44%) and multiple births by 105%. Increased productivity and survivability resulted in increase in income by 250% on one adult goat ie net gross income with five adult goats increased from Rs 6758 to Rs 23705. Moreover, a unit of 2-5 goats with an average of 2.7 goats were provided to 364 poor people (land less marginal and small farmers) who were earning Rs 12000 to Rs 21000 with an average of Rs 14223/year from a unit of 3 adult goats. A unit of goat with five adult females provides employment for 182 man days/year.

Large ruminants are available with 76% household. Fodder intervention was mainly utilized by farmers keeping buffaloes and cows. Increased fodder availability to beneficiaries facilitated enhanced milk production by 34%. Supply of five hundred kg mineral mixture, deworming for endo-parasites and strategic supplementary feeding have also supported survivability and productivity of cows and buffaloes. These measures have increased the income over baseline from Rs 21175 to Rs 31325 per year with a unit of 3 bovine.

Supply of 8899 chicks to 400 beneficiaries has increased monthly income of beneficiaries from 3.25 to 13.75% with an average increase 8.11% (Rs 11,612/annum) under backyard poultry intervention. However, adoption of backyard poultry was low due to high mortality of chicks mainly due to predation and theft. Backyard poultry has great potential as additional source of income in the region.

Intervention of seeds of improved varieties of pulses (black gram, pigeon pea) and oilseed (sesame) crops was provided which increased the production yield of these crops by 56 to 136% with an average income of Rs 5360/household/ season (crop).

New fodder crops (oat, sorghum, multicut bajara, guar, napier grass, napier-bajara hybrid), seeds of improved varieties, horti-silvipasture, range grasses and perennial grasses were introduced to project beneficiaries for field demonstrations under fodder resources development. Seven hundred twenty five (725) demonstrations were conducted in different seasons in 394 farmers field with an average area of 0.03 ha/farmer. Farmers produced 350-400 q/h fodder in Zaid, 400-450 q/h fodder in Kharif and >600 q/h in rabi season. Increased fodder yield with high yielding varieties were higher by 40 to 60% over local varieties. Fodder from these crops was also sold as cash crop. Increase in availability of green fodder had increased the milk yield of buffaloes by 22-65% and, 12-30% in case of cows and goat. The fodder availability was increased by 10-15 kg over base line value of 5 kg fodder/buffalo/day and high yielding cows. Average milk yield of buffaloes, cows and goats were increased by 44, 33 and 16% respectively. Cultivated green fodder was predominately fed to buffaloes and high yielding cows. Sorghum (Zaid), Cowpea+Sorghum/bajara (Kharif), Berssem+oat (Rabi) were identified as suitable fodder crops for this region. In low fertile land seeds and rooted slips of guinea grasses, napier-bajra hybrid and Stylosanthes hamata, Cenchrusciliaris were provided to 99 farmers of 16 villages in 0.031 ha/farmer area. Yield from range grasses varied from 200 to 650 q/ha with an overall average of 410 q/ha. Guinea grass, Cenchrusciliaris,and Stylosanthes hamata were found suitable grasses for this region. Adoption of range grasses by the farmers was moderate due to lack of protection from stray grazing. Units of horti-silvipasture were established in 46 hectare land available with 82 farmers. Plants/seedlings of fruit cum fodder trees of papya, aonla, guava, citrus, jack fruit, karonda, peepal, mango, pakar, subabul, bair and bahuhinia were provided to farmers. Few units have started producing fodder @ 150-180 q/ha/year. Survivability of plants was low due to inadequate irrigation and stray grazing. Papaya +guinea grass and Cenchrus ciliaris found appropriate combination for horti-silvipasture.

Home-made insecticides such as neem seed kernel extract, trichoderma, bio-control agents (Beauveria bassiana), pheromone traps and bird perches were introduced as interventions. These interventions increased the crop yield by 9-31%. Its effect on vegetable crop was more pronounced followed by pulses. It also yielded an additional income of Rs 1500 to 5000 per acre with an average of Rs 3150/HH/Year.

More than 266 farmers were trained and motivated for harvesting of rain water through different types of trench and bund. About 30-35% run-off of rain water saved through these bunds helped increase in the crop yield by 10-15% *i.e.* savings of Rs 750-7500 per hectare with an average of Rs 3270/HH/year.

People were trained for preparation of paneer, jams, jelly, sauce, spices, muraba and chatni, of various fruits and vegetables and also for tie and dye of cloths through 59 demonstrations under value addition of livestock and crop products and their marketing. More than 167 field days, kisan gosthi, farmer's day, health camps, training and front line demonstrations were conducted for capacity building and skill development. More than 2760 rural households were enrolled under above group of capacity building. These trainings equipped the villagers with better confidence and knowledge levels.

Livelihood models for different categories (resources) farmers were suggested based on implemented interventions. Six thousand seven hundred fifty five farmers were covered under different project interventions. Goat and poultry were providing additional income of Rs 25835/year along with 250 man-days employment per year. The additional income from a unit of goat (5), poultry (25 chicks), crop (improved seed sown in 0.4 ha), fodder (0.035 ha), insect-pest control and soil and water conservation measures were Rs 18348, 11612, 5360, 11100, 7875 and 3270 per year. All above interventions together created employment of 343 man-days per household per year.

Outputs and Outcomes

S.No	Activity	Baseline value	Target	Achievement
1	Body weight at 12 month (kg)	16.6	18.0	23.8
2	Total milk yield/lactation (litre)	49.0	80	83.5
3	Lactation period (days)	85.0	110	129.0
4	Goat mortality (%)	25.5	15	8.5
5	Goat abortion (%)	25	10	9
6	Bovine milk yield (liter/d)	3.5	4.5	4.7
7	Bovine mortality (%)	10.0	5.0	4.5
8	Buffalo conception (%)	65	80	80
9	Bovine abortion (%)	35	15	12
10	Backyard poultry farm in villages	12	150	200
11	Egg production/chick/year	70	120	150
12	Use of eco-friendly pesticide by farmers	-	150	140
13	Fodder availability (q/ha/y)	7.0	15.0	21.0
14	Area under fodder crop (ha)	0.023	0.03	0.037
15	Pulse crop yield q/ha(rain-fed)	4.5	7.5	8.0
16	Oilseed crop yield q/ha (rain-fed)	4.0	7.0	7.5
17	Monthly income of landless, marginal and small farmer (Rs)	250, 480, 650	800, 1000, 1500	1600, 2550, 3800

Table :Recommended Goat based Integrated Livelihood Models

Model	Unit	Net income (Rs)	Suitability	House-holds Covered
Goat+ Poultry	15 adult F+ 25 Chicks	Rs 82727 (71115+11612)	Landless Marginal	64
Goat+ Cow+ Poultry+ Crops (Rain-fed)	10 adult F+ 2 cows + 50 chicks + 1 ha.	Rs 100634 (47410+22000+ 23224+8000)	Landless Marginal Small	142
Goat+ Buffaloes+ Cows+ Crop (semi-irri)	5 adult F + 2 buffaloes+ 2 cows + 2 ha.	Rs 109705 (23705+34000+ 22000+30000	Marginal Small Medium large	80
Goat Buffaloes Cows Crop (semi-irri)	10 adult F 2 buffaloes 2 cows 2 ha	Rs 119000 (47410+32000+ 22000+30000)	Semi-medium Medium Large	56

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

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

Genotyping by HRM analysis

HSP70.3 gene

The genotyping of HSP70.3 gene was carried out by HRM analysis for the region 1 to 304 bp and 2200 to 2700bp . HRM analysis showed 5 different genotype; the samples were confirmed by sequencing analysis. We obtained 100 percent concordance between HRM genotyping and sequence analysis. Two SNP was observed in this region of the gene which can be used for genotyping the goats in response to heat stress.

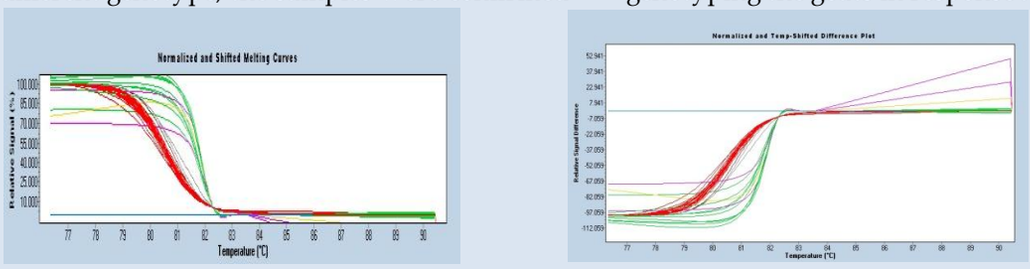


Fig : Normalised and temperature shifted difference plot of HSP70.3 gene in four different breeds indicating different genotypes in analysed samples

Nox gene

NADPH oxidase (Nox) proteins are membrane-associated, multiunit enzymes that catalyze the reduction of oxygen using NADPH as an electron donor. Nox proteins produce superoxide ($O2^-$) via a single electron reduction. Nox proteins have been shown to regulate many fundamental physiological processes, including cell growth, differentiation, apoptosis, and cytoskeletal remodeling. In addition, they have more specialized functions, such as host defense (Nox2Nox gene in goat was analysed by HRM and obtained 4 genotypes in this region and was also confirmed by sequencing.

Fig: HRM genotypes as differentiated by different colour for Nox gene in four different breeds

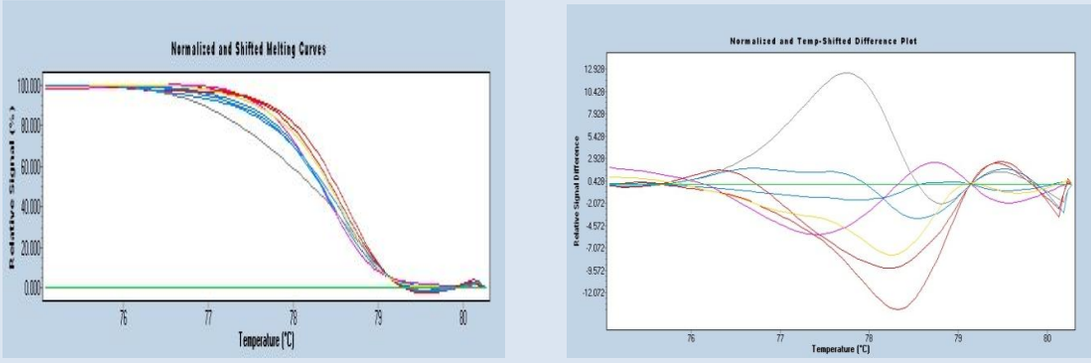


Fig : Normalised and temperature shifted difference plot of Nox gene in indicating different genotypes in the analysed samples

Gene expression analysis in different tissues in response to heat stress

The individuals belonging to four breeds were phenotyped based on respiration rate and heart rate. The contrasting genotypes were identified and individuals slaughtered during peak heat period and high THI .The differential gene expression was analysed for Hsp70 gene, HSP90, Leptin in goat.

Expression analysis of Hsp70.3 was carried out in different organs in four different goat breeds by Relative quantification RT-PCR. GAPDH gene expression was used as internal control for all the replicates. The results indicated that the Hsp70.3 gene expression was 5 Folds higher in spleen and kidney than heart and brain. (Fig)

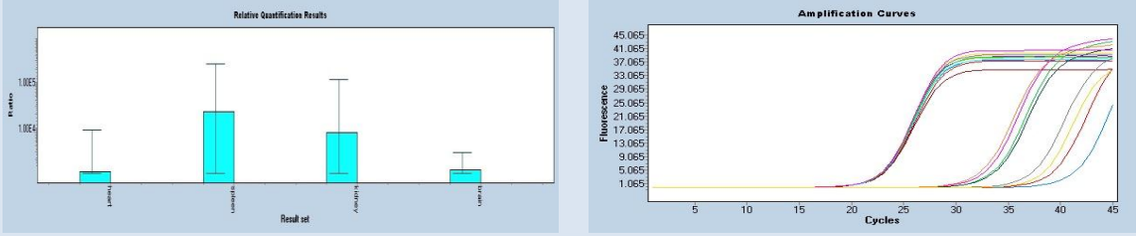


Fig: m-RNA Expression of Hsp70.3 gene in liver and spleen of goats by relative quantification RT-PCR. GAPDH expression was used as internal control for all analysis.

The breed specific expression analysis of Hsp70.3 revealed that Sirohi goats had higher expression as compared to three breeds. Similarly, Jamunapari goats had 2 fold higher expression than Jakhrana and Barbari goats (Fig).

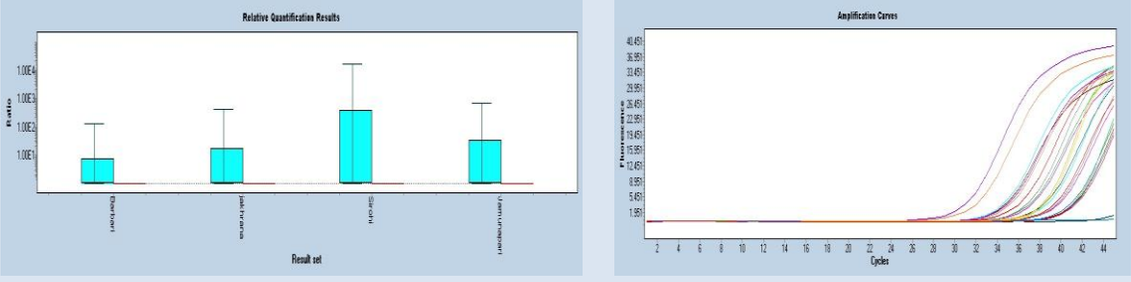


Fig: Relative normalized expression of Hsp70.3 by relative quantification RT-PCR in different goat breeds (Mean ± SE)

Based on the cardinal physiological responses, the individuals are defined as heat stress tolerant and heat stress susceptible phenotypes. The Hsp70.3 gene expression pattern with in these two phenotypes in four different breeds showed that the heat stress tolerant goats had higher expression (varied from 2 to 24 folds) as compared to heat stress susceptible phenotype. (Fig)

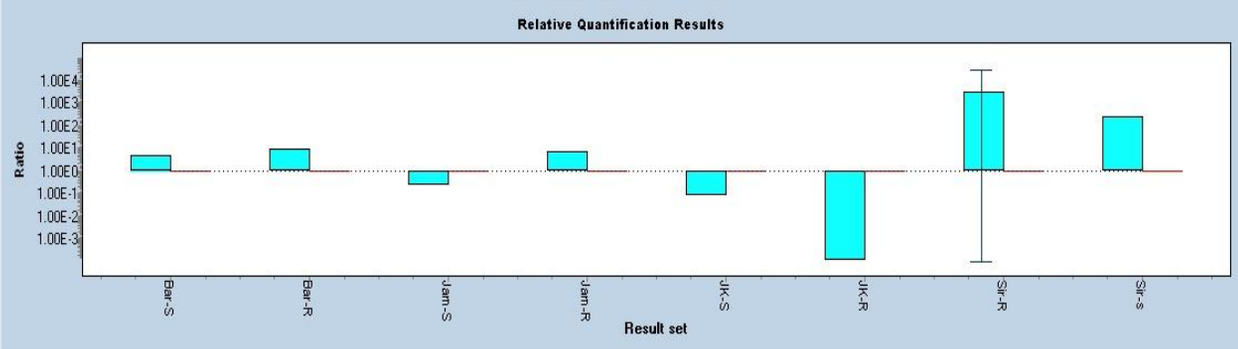
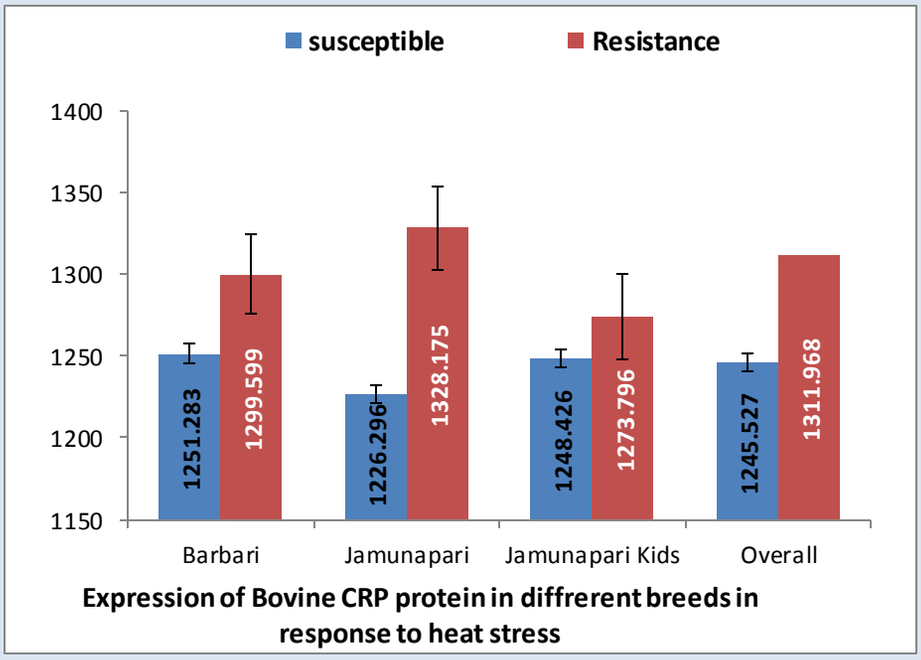


Fig: Relative normalized expression pattern of Hsp70 gene in different phenotypes in four different goat breeds by relative quantification RT-PCR. GAPDH expression was used as internal control for all analysis.

The expression analysis carried out in tissue extracts of different organs and expression pattern was analysed in liver and spleen on a within heat stress susceptible and heat stress resistant phenotypes. It was observed that the heat stress resistant individuals had 3 to 10 folds higher expression than heat stress susceptible individuals.

Expression of CRP in different tissues

The expression of C-reactive protein in plasma of different breed on a within heat stress tolerant and heat stress suceptible individuals are also analysed.



Physiology, Reproduction and Shelter Management Division

Improvement of post-thaw quality and fertility of frozen semen of different breeds of goats using various additives

Satish Kumar, S.K. Jindal, A.K. Goel, S.D. Kharche, Ravi Ranjan and Chetna Gangwar

Project is aimed to achieve better post thaw motility and fertility by using various semen additives and improve freezing protocols using automatic freezing machines. It also included strengthening of existing semen bank by storing sufficient number of frozen semen of elite goat breeds and widespread use of AI for augmenting productivity of indigenous goat breeds.

Semen freezing studies

Collection and evaluation of seminal parameter from different breeds of bucks for breeding/AI purpose from experimental shed of PR&SM Division were done. Bucks of different breeds were screened for seminal parameters and only those bucks donating good quality semen, were used for semen cryopreservation and subsequent AI. Semen of superior bucks of Barbari, Jamunapari, Sirohi and Jhakhrana breeds were cryopreserved for AI or other research purposes. Vitamin C and EDTA were added in diluents as an additive to find its effect on the freezing quality, post thaw seminal characteristics and its fertility.

Use of chelating agent as semen additive and its effect on post thaw quality

Thirty five semen ejaculates collected from adult Sirohi bucks (2-4 years old) maintained under semi intensive management system of Institute were utilized for the present study. The ejaculates were collected twice in a week using artificial vagina and were extended in such a way so as to maintain sperm concentration to the tune of approximately 100 million per dose (0.25 ml) with Tris- Citric acid- Fructose (TCF) diluent; having 10% (v/v) egg yolk and 6% (v/v) glycerol. Four concentrations of EDTA (Ethylene Diamine Tetra Acetic Acid - EDTA: 0%-as control, 0.01%, 0.05% and 0.1%) were used to find out its effect on various semen freezability parameters of buck semen. The diluted and processed semen was frozen by conventional method of freezing using Liquid nitrogen vapor. Filling and sealing of straws were done at 5^0C in cold handing cabinet and after 4 h of equilibration period straws were frozen in liquid nitrogen vapor for 10 minutes above 2 cm of liquid nitrogen level and finally plunged in to liquid nitrogen. Post thaw motility, live sperm count, sperm abnormalities, acrosomal integrity and hypo osmotic swelling test were performed. Analysis of data using SPSS 16 revealed that post thaw motility, live sperm count, sperm abnormalities, acrosomal integrity and sperm responsive to hypo osmotic solution differed significantly ($P<0.05$) in different concentrations of EDTA. The post thaw motility, live sperm count, acrosomal integrity and hypo osmotic swelling positive spermatozoa were significantly highest in 0.01% of EDTA than with other concentrations used. It could be inferred from these findings that 0.01% EDTA can be used as an additive in semen dilutor during routine freezing for better post thaw recovery of buck semen.

Table 1. Effect of different concentration of EDTA in the dilutor goat semen dilutor on post thaw quality of Sirohi buck semen

Concentration of EDTA (%)	Progressive motility (%)	Live (%)	Abnormality (%)	Acrosome intact (%)	HOS (%)
0.0 (control)	36.14±0.41^c	55.14±1.00^c	2.73±0.10^b	70.67±1.01^b	49.26±1.04^c
0.01	44.86±0.48^a	63.13±0.95^a	2.56±0.09^b	75.00±0.89^a	59.74±1.08^a
0.05	42.79±0.60^b	58.66±0.92^b	2.76±0.09^b	71.35±0.86^b	55.04±0.82^b
0.1	29.28±0.92^d	44.76±1.14^d	3.93±0.77^a	66.71±1.03^c	38.11±1.08^d

Effect of vitamin C as semen additive in the dilutor on post thaw quality

Effect of different concentration of vitamin C (L-Ascorbic acid) in goat semen dilutor on post thaw quality of Sirohi buck semen						
Concentration (Milligram %)	Motility	Live	Dead	Abnormal	Acrosome	HOS
0.0 (control)	41.04±1.08^{c}	56.92±1.49^{c}	43.08±1.49^{a}	3.58±0.61^{a}	76.67±1.43^{b}	41.71±1.37^{b}
0.8	47.29±1.16^{b}	61.87±1.43^{b}	37.29±1.75^{b}	3.12±0.58^{a}	78.67±1.36^{b}	46.58±1.41^{b}
1.0	53.54±1.29^{a}	68.21±1.37^{a}	32.62±1.32^{c}	2.83±0.59^{a}	83.62±1.15^{a}	53.92±1.93^{a}
1.2	44.17±1.89^{bc}	59.96±1.71^{bc}	40.46±1.68^{ab}	3.42±0.60^{a}	76.75±1.76^{b}	44.25±2.24^{b}
Pre freeze	84.05±1.23	89.71±0.94	10.76±0.92	2.86±0.64	91.57±0.91	75.43±1.03

Twenty four semen ejaculates collected from adult Barbari bucks (2-4 years old) maintained under semi intensive management system were utilized for the present study. Ascorbic acid (L-Ascorbic acid) in four different concentrations: 0%- as control, 0.8%, 1% and 1.2% milligram %) were supplemented in the dilutor and the diluted semen was frozen using conventional method of vapor freezing. The ejaculates collected twice in a week using artificial vagina were extended to maintain sperms concentration of approximately 100 million per dose (0.25 ml) with Tris- Citric acid- Fructose (TCF) diluent containing 10% (v/v) egg yolk and 6% (v/v) glycerol. Filling and sealing of straws were done at 5^{0}C in cold handing cabinet after 4 h of equilibration period then straws were vapor frozen for 10 minutes above 2 cm of liquid nitrogen and finally plunged in to liquid nitrogen. Post thaw motility, live sperm count, sperm abnormalities, acrosomal integrity and hypo osmotic swelling test were performed to find out its effect on various seminal parameters. Analysis of data using SPSS 16 revealed that post thaw motility, live sperm count, acrosomal integrity and per cent sperm responsive to hypo osmotic swelling solution differed significantly ($P<0.05$) with different concentrations of vitamin C in the dilutor. The post thaw motility, live sperm count, acrosomal integrity and hypo osmotic swelling positive spermatozoa were significantly higher in 1miligram % of vitamin C used in the present study. It is conceivable at this stage that 1 milligram % of vitamin C can be used as an additive in semen dilutor in routine freezing for better post thaw recovery of buck semen.

Semen collection, and AI

Collection, Evaluation and Freezing of Semen
During the period under report, a total of 4010 semen does of different breeds of goat (Jamunapari, Barbari, Jakharana and Sirohi) were prepared and frozen out of the total 4010 semen does, 1108 semen doses /straws (sirohi 206, Barbari 1108) were used under different experiment under the project and demonstration.

Artificial Insemination with frozen semen

In two major breeding seasons (May – June ; 44 and October :78) 122 goats of different breeds (Jamunapari, Barbari, Jakharana and Sirohi) were inseminated with frozen semen. Out of the total insemination carried out in goats, 22 Barbari exhibited 'short cycles' after insemination (range 5-8 days) and 20 other goats (Jamunapari : 08, Barbari :04, and sirohi : 08) shown the apparent symptoms of low grade uterine infection, which was evident during subsequent estrus period at the time of insemination.
In remaining 80 goats inseminated with frozen semen, 14 conceived and delivered a total of 19 kids.

Hormone profile during different reproductive stages in goats

A. K. Goel, S. K. Jindal, Satish Kumar, S.D. Kharche and Ravi Ranjan

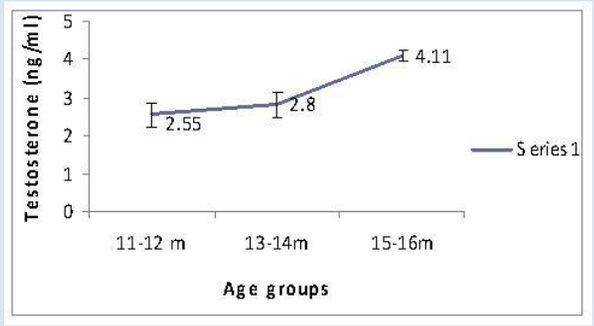
Gonadal hormones play a crucial role in reproduction and production in goats. Meagre information on hormonal profile in tropical goats is available before and after puberty and during peri- parturient period. Currently scanty information is available regarding regulatory mechanisms controlling post-partum oestrus period in goats with non-seasonal reproductive activity. Suckling has a negative effect on re-establishment of post- partum ovarian activity. Information on basal concentration of gonadal hormones during different physiological stages of tropical goats is lacking. The study shall be useful in understanding the role of various hormones playing role in the normal reproductive process of goats. The outcome of the project shall be used to imply its influence in improving the reproductive efficiency for higher productivity from the goats.

Jakhrana goats of both sexes were selected and grouped according to their physiological/reproductive stages. Blood samples (4 ml each) from 12 Jakhrana goats (6 each for male and female) at 10-12 months (Pre pubertal) 13-14 months (Pubertal) and 15-16 months (Sexually mature) were collected at 15 days interval and serum samples after separation were stored at -20^0 C till assayed for hormone concentration. Blood samples from Jakhrana pregnant does were collected at 30, 60, 90, 120 days and serum samples were stored and assayed in similar fashion as above.

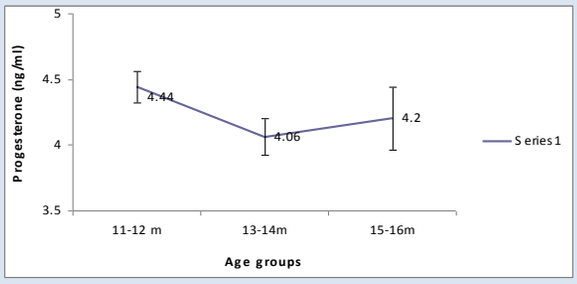
Hormone Assay (Testosterone and Progesterone)

In male goats, for testosterone assay, 72 samples (24 from each group in duplicate),in female goats for progesterone assay, 72 samples (24 from each group in duplicate) and 24 samples(in duplicate) from pregnant does were processed by using commercially available, Lab Serv (Fisher Scientific, India Private Ltd.) ELISA Kits. Results are summarized in following graphs

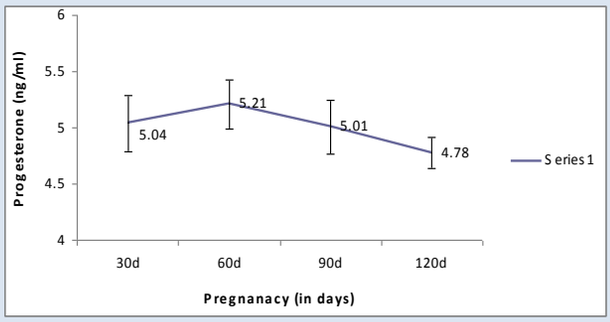
Testosterone concentration of the male goat at different months approaching sexual maturity



Progesterone concentration of the female goat at different months approaching sexual maturity



Progesterone concentration of female goat at



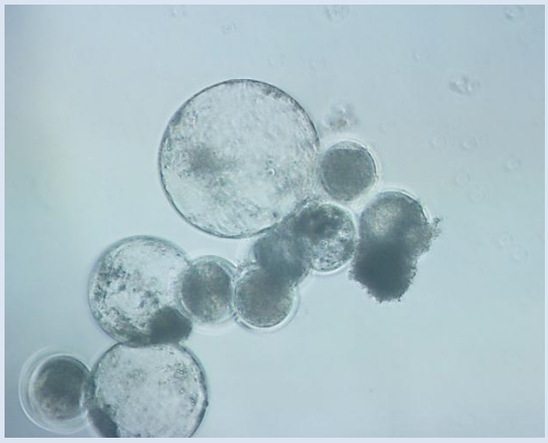
different months of pregnancy

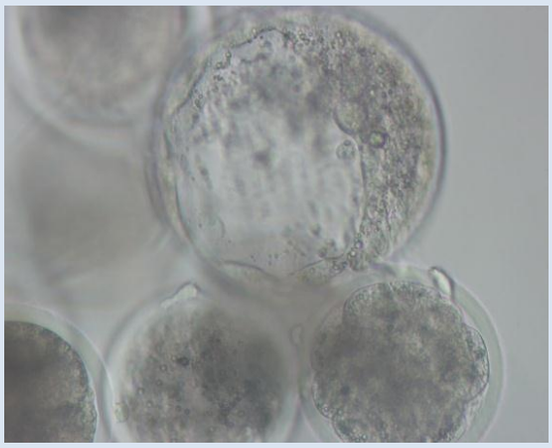
NFBSFARA Project : Development of parthenogenetic goat from embryonic stem cells

S.D. Kharche, Ravi Ranjan , A.K. Goel, S.K. Jindal and S. K. Agarwal

In vitro embryo production.

The oocytes were collected from ovary by slicing technique in a petridish containing oocyte collection media (OCM). A total of 2239 goat oocytes were processed for IVMFC. The oocytes surrounded in a compact cumulus mass with an evenly granulated cytoplasm were selected under stereozoom microscope. Selected oocytes (2239) were washed two or three times in Oocyte Holding Medium (OHM) and allowed for maturation in 50µl drop of IVM medium in 35mm×10mm Petri dishes for 27 hours in a CO_2 incubator maintained at 38.5º C, 5% CO_2 and 90% humidity. The matured oocytes





were separated from cumulus cells. Fresh semen samples were obtained by an artificial vagina from a fertile purebred Sirohi bucks and sperm were capacited in TALP medium supplemented with heparin, BSA or 10% FBS and antibiotics. Fertilization drop containing oocytes were inseminated with 25 to 50 µl of final diluted semen ($1x10^6$ sperm / ml). The oocytes were culture in culture medium TCM-199 for embryo development. The overall 2-cell, 4-cell, 8-16-cell, morula, blastocyst and hatched blastocyst production from in vitro fertilization of matured oocytes were 21.40%, 25.81%, 30.71%, 15.84%, 5.55% and 0.98%, respectively

Parthenogenetic embryo production:

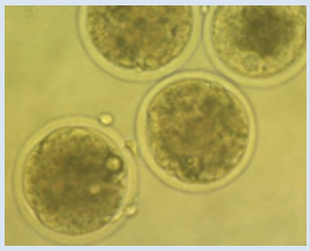
IVF Blastocyst

Ethanol Activation: The oocytes were collected from each ovary in a petridish containing oocyte collection media (OCM). Selected oocytes (2140) were washed two or three times in Oocyte Holding Medium (OHM) and allowed for maturation in 50µl drop of IVM medium Petri dishes for 27 hours in a CO_2 incubator. The matured oocytes (1988) were activated 7% ethanol in mCR2aa medium for 5 min followed by treatment with 2.0 mM DMAP for 4 hr in mCR_2aa medium. After 4 hr, the oocytes were washed 5 to 10 times in the culture medium and were divided in to two groups. Group 1 (n=1746) oocytes cultured in 50 µl drop of RVCL for 12 days. Group 2 (n=242) oocytes cultured in 50 µl drop of mCR_2aa medium for 12 days.

Table : Parthenogenetic embryo development in two different media

S. No.	Media		2-cell (%)	4-cell (%)	8-16-cell (%)	Morula-cell (%)	Blastocyst-cell (%)		Hatched Blastocyst-cell (%)
1.	RVCL		16.84	19.76	29.60	28.72	3.11		1.94
2.	mCR2aa	10.08	28.57	39.49			21.84	0.00	0.00

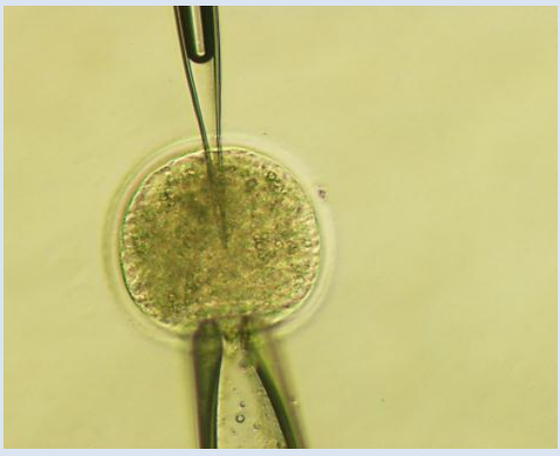
Ionomycin Activation: The oocytes were collected from each ovary in a petridish containing oocyte collection media (OCM). Selected oocytes (2339) were washed two or three times in Oocyte Holding Medium (OHM) and allowed for maturation in 50µl drop of IVM medium in Petri dishes for 27 hours in a CO_2 incubator. After maturation for 24–27 h, oocytes were stripped off their cumulus cells. The matured oocytes (2192) were activated 5 µM Ionomycin in mCR2aa medium for 5 min followed by treatment with 2.0 mM DMAP for 4 hr in mCR_2aa medium. After 4 hr, the oocytes were washed 5 to 10 times in the culture medium cultured in 50 µl drop of mCR_2aa medium for 12 days. The overall 2-cell, 4-cell, 8-16-cell, morula, blastocyst and hatched blastocyst production from in vitro fertilization of matured oocytes were 46.02%, 33.71%, 10.58%, 11.04%, and 0.57%, respectively.



Parthenogenetic Blastocyst

Intra Cytoplasmic Sperm Injection followed by activation for production of fertilized embryos

Intracytoplasmic sperm injection (ICSI) is a technique for assisted reproduction (ART) consisting of the microinjection of a single sperm across the membrane of a metaphase II oocyte leading to fertilization. The potential applications of ICSI in animals include its use with sperm obtained post-mortem, with samples that have low motility or with samples from individuals of high genetic value or special features, such as transgenic animals or endangered species. With respect to oocytes, ICSI can be useful in the fertilization of oocytes with alterations preventing the normal process of



fertilization, such as cryopreserved oocytes, in vitro matured oocytes and oocytes obtained from prepubertal females.

A total of 277 cumulus oocyte complexes (COC's) were collected from goat ovaries. In-vitro matured oocytes were evaluated for maturation on the basis of cumulus expansion. Morphological matured oocytes (n=146) were selected, denuded and randomly divided into two groups. Group 1 (n=200) in vitro matured oocytes were injected with GFP followed by activation with 5 µm ionomycin for 5 min. and cultured in RVCL medium. Group 2 (n=70) in vitro matured oocytes were injected with sperm followed by activation with 5 µm ionomycin for 5 min. and cultured in RVCL medium. The cleavage rate in groups 1 and 2 were 0.01% & 34.28%, respectively.

Fertilized embryo produced through ICSI

Goat fetal skin fibroblast cell monolayer preparation

The uterus containing 3-4 cm fetus was aseptically collected from local slaughter house and transported to laboratory within 1 hour. The whole organ was washed thoroughly in sterile normal saline solution (NSS) (38^{0}C) supplemented with gentamycin (50µg/ml). In brief, collected fetal skin samples was chopped and trypsinised. Finally fibroblast cells were bathed with DMEM media and cultured in 25 cm^2 of tissue cell culture bottle at 37^{0}C, 5% CO_2 level and 90% relative humidity in CO_2 incubator. Media was changed in every 72 hours interval and subculture was made as per requirement.

Fibroblast cells

Fibroblast cells monolayer

The fibroblast cells were plated in 25 cm^2 tissue cell culture bottle in DMEM with FBS. Fresh media was replaced every 72 hours for maintaining the culture. The media was replaced with trypsin (0.25%) solution sufficient to cover the entire surface and incubated for 5 minute in CO_2 incubator. The cells were centrifuge for 5 minute at 1000 rpm. Supernatant was discarded and 3.5 ml fresh DMEM media was added. The media with cells were transferred to 96 well plates or 6 well plates for setting monolayer or store at -80^{0}C for future use. Fibroblast monolayer derived after second subcultures were used for growing of blastomere culture. Once confluences, the mitotic growth was blocked by Mitomycin-C treatment for 4 hours.

The mitomycin-C (10µg/ml) was removed by washing the monolayer cells 3-4 times with warm (37^{0}C) 1X PBS and then replaced with fresh media.

Storage of fibroblast cells:

The media was replaced with trypsin (0.25%) solution sufficient to cover the entire surface and incubated for 5 minute in CO_2 incubator. The solution was pipetted in and out gently for complete detaching the cells from culture bottle and placed into 15 ml sterile tube containing DMEM media. The cells were centrifuge for 5 minute at 6000 rpm. Supernatant was discarded and pallete was dissolved in 3ml freezing media (DMSO-10%; FBS-30% and DMEM- 60%) and stored in cryovial contain 1-1.5 million cells/ml at -80^{0}C for future use.

Effect of fetal sex on confluences of goat fetal skin fibroblast cell monolayer: The passaging of goat fetal skin fibroblast cell monolayer was done when confluences attained more than 80% with trypsin (0.25%) solution. It was observed that female fetal skin fibroblast cell monolayer attained the same percent of confluences 24 h earlier than to male fetal skin fibroblast cell monolayer. The female fetal skin fibroblast cell monolayer has taken 96 h to attain more than 80 percent of confluences. The male fetal skin fibroblast cell monolayer has taken 120 h to attain more than 80 percent of confluences

Development of embryonic stem cell colonies by hanging drop culture method

For generation of embryonic stem cell colonies, blastomere of 8-16 cell stage parthenogenetic embryos were removed from IVC drops and put into warm PBS for washing. After washing, embryos were shifted to proteinase-K (0.02%) drops and the thinning or dissolution of zona pellucida was observed under zoom stereo microscope. After thinning or dissolution of zona pellucida, the proteinase-K activity was neutralized by addition of media containing FBS (20% FBS in DMEM media). The clumped blastomere cells were washed in 4-5 drops of stem cell culture media and kept in hanging drop of stem cell culture media (20 uL) and kept in CO_2 incubator for growth. The good quality ES colonies were isolated from the culture with different media, washed in PBS and stored at -80^{0}C in PBS for molecular studies. When the clumped blastomere divided and formed 100-150 cells, the colonies were eluted by 0.25% trypsin EDTA solution and further cultured in respective hanging drop culture condition. Parthenogenetic embryos of 8-16 cell (32) and morula (28) were used for embryonic cell colony formation. The percentage of embryonic cell colony formed was 28.12 and 25.00 from 8-16 cell and morula stage derived embryos, respectively.

Table- Embryonic stem cell colony formation by hanging drop culture method (Mean ± SE)

Types of embryos	Stage of embryos	No. of embryos used	No. of embryonic cell colony formed	Percentage of embryonic cell colony formed (%)
Parthenogenetic	8-16 cell	32	9	28.12
	Morula	28	7	25.00

Development of embryonic stem cell colonies on goat fetal fibroblast monolayer

For derivation of embryonic stem cell colonies, blastomere of 8-16 cell staged parthenogenetic embryos were removed from IVC drops and put into warm PBS for washing. After washing, embryos were shifted to proteinase-K (0.02%) drops and the thinning or dissolution of zona pellucida was observed under zoom stereo microscope. After thinning or dissolution of zona pellucida, the proteinase-K activity was neutralized by addition of media containing FBS (20% FBS in DMEM media). The clumped blastomere cells were washed in 4-5 drops of stem cell culture media and kept in CO_2 incubator for growth. The undissociated clumped blastomere were cultured in wells on mitomycin-C inactivated goat fetal fibroblast monolayer at 38.5^{0}C, 5% CO_2 and 90% relative humidity in CO_2 incubator in different media containing different growth factors. The good quality ES colonies were isolated from the culture with different media, washed in PBS and stored at -80^{0}C in PBS for molecular studies. When the clumped blastomere divided and formed 200-300 cells, the colonies were eluted by

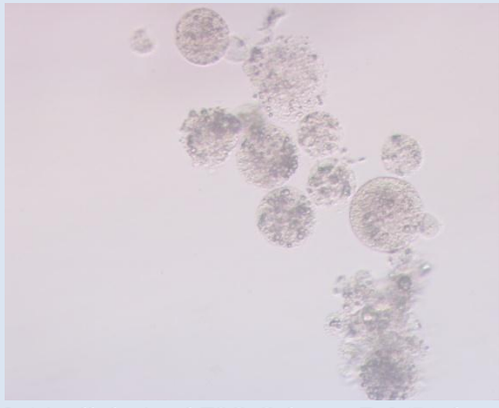
0.25% trypsin EDTA (Gibco, 25200) solution and further cultured in respective culture condition. Parthenogenetic embryos of 8-16 cell (20) and morula (18) were used for embryonic cell colony formation. The time taken for their attachment on goat fetal fibroblast monolayer was 72-96 hrs. The percentage of embryonic cell colony formed was 65.00±5.16 and 61.11±4.77 from 8-16 cell and morula stage derived embryos, respectively. There was no significant difference in the formation of embryonic cell colony between 8-16 cell and morula stage derived embryos on goat fetal fibroblast monolayer ($P<0.05$). Embryonic cell colonies were further passage up to third passage on goat fetal fibroblast monolayer and stored in liquid nitrogen for further use or molecular analysis.

Table 1 Embryonic cell colony formation on goat fetal fibroblast monolayer in caprine (Mean ± SE)

Types of embryos	Stage of embryos	No. of embryos used	No. of embryonic cell colony formed	Time taken for attachment (Hrs)	Percentage of embryonic cell colony formed (%)
Parthenogenetic	8-16 cell	20	13	72-96	65.00±5.16 [a]
	Morula	18	11	72-96	61.11±4.77 [a]

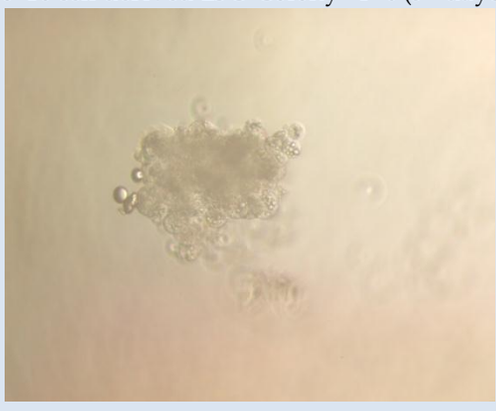
These embryonic cell colonies will used for molecular studies. The attachment rate of porcine embryonic cells on feeder layer was highest from in vivo embryos followed by parthenogenetically activated and IVF embryos (Ock *et al*., 2005). It has been reported that all the in vitro produced embryos are not able to propagate and give stem cells, when blastomere cells were cultured (Hassan-Hauser *et al*., 1990; Swain, 2006).

8-16 cell derived ESC Colony-P-0 (7th days)



8-16 cell derived ESC Colony -P-0 (5th days)

Morula stage derived ESC Colony-P-0 (7th days)



Morula stage derived ESC Colony-P-0 (7th days)

Parthenogenetic embryonic cell colony on goat fetal fibroblast monolayer during different days of culture in caprine (100X)

NAIP Project: Developmental potency of parthenogenetic goat embryos

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

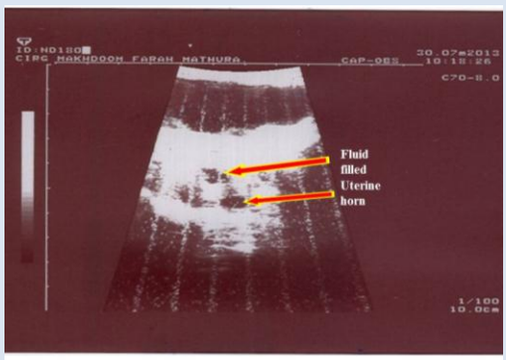
Parthenogenetic embryo production

The oocytes were collected from the ovary (916) in a petridish containing oocyte collection media (OCM. Selected oocytes (2162) were washed two or three times in Oocyte Holding Medium (OHM) and allowed for maturation in 50µl drop of IVM medium in Petri dishes for 27 hours in a CO_2 incubator maintained at 38.5º C, 5% CO_2 and 90% humidity.

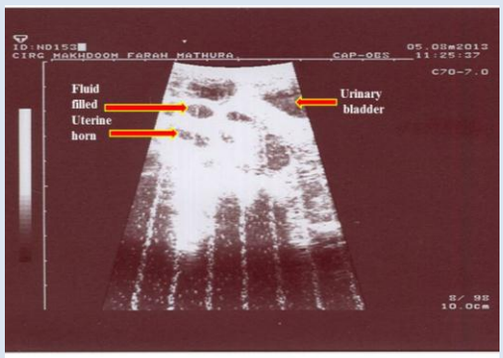
After maturation for 24–27 h, oocytes were stripped off their cumulus cells by treatment with 0.1% hyaluronidase. These oocytes were activated either by 7% ethanol in mCR2aa medium for 5 min followed by treatment with 2.0 mM DMAP for 4 hr in mCR$_2$aa medium. After 4 hr, the oocytes were washed 5 to 10 times in the culture medium and cultured in 50 µl drop of mCR2aa/RVCL. The overall cleavage rate, 2-cell, 4-cell, 8-16-cell, morula, blastocyst and hatched blastocyst production from parthenogenetically activated oocytes were 58.81%, 15.15%, 20.46%, 34.76%, 25.34%, 2.56% and 1.71%, respectively.

Transfer of Parthenogentic goat Embryos

Parthenogenetic embryos produced as above of different stages were surgically transferred into twenty one recipients. In six recipients 2 to 4 cell parthenogenetic embryos (4-6 embryos in each recipient) were transferred into the fallopian tube through infundibulum epsilateral to the corpus luteum whereas other eight recipients received 16 to 32 cell stage parthenogenetic embryos (4-6 embryos in each recipient) at the tip of the uterine horn epsilateral to the corpus luteum. Oestrus detection following embryo transfer in recipients was carried out with the teaser buck twice a day regularly for monitoring the onset of oestrus. Following embryo transfer, in vivo survivability of parthenogenetic embryos into the recipients were also monitored by using B-mode ultra sonography at different days of pregnancy by viewing anechoic fluid filled cavity. Out of 21 recipient one recipient was pregnant at day 23rd of pregnancy showing anechoic fluid filled cavity (Goat 180). The fetal fluid was reabsorb and no anechoic area was present on day 29th of pregnancy. Another recipient was pregnant up to 28th day of post transfer (Goat 153). The fetal fluid was reabsorb and no anechoic area was present on day 40th of pregnancy. Rest of the recipients did not shown any sign of pregnancy following ultrasonography.



Goat 180 Pregnant uterine horn showing anechoic pockets on day 23rd of pregnancy



Goat 153 Pregnant uterine horn showing anechoic pockets on day 28th of pregnancy

DST project : To analyse genetic trait and expression analysis of goat esr1 gene for buck fertility and sperm quality

Sonia Saraswat, S. D. Kharche, P. K. Rout

A total of 70 collections were done from bucks of Jamunapari (n=28) and Barbari (n=35) aged between 2-5 year, maintained at experimental shed of GGB Division, CIRG, Makhdoom, Farah. Before collection the bucks were trained for a month with teasure doe. The semen was collected by means of artificial vagina having internal temperature of 40^{0}C in the morning

hours between 7.30 to 8.30 AM. Before semen collection, two false mounts were given to each buck to improve the semen quality and to obtain maximum number of sperm cells. The semen was collected from each buck and immediately after collection, semen was evaluated for its various attributes like volume, colour, consistency and mass activity, after dilution with Tris egg yolk progressive motility, live & dead and abnormality was estimated. The average and SE values were determined for ejaculates of jamunapari bucks, volume (0.892±0.17); mass activity(3.44±0.68); progressive motility (77.6±15.52); live% (86.16±17.23) and abnormality(1.8±0.36). Similarly, the average and SE values were also determined for ejaculates of Barbari bucks, volume (0.69±0.12); mass activity (4.43±0.75 (); progressive motility (82.29±13.90); live% (89.49± 15.12) and abnormality (0.74± 0.13) respectively.

Furthermore, DNA isolation was done from blood samples. The O.D. of DNA samples was checked using biophotometer, the concentration of the samples which lies between 1.7 to 1.9µg/ml were used for PCR. Primers for gene ESR were standardized. The standardized PCR programme was comprised of following steps- Initial denaturation at 95°C for 5 min (step1), followed by 35 cycles of denaturation at 95°C for 30sec (step 2), annealing at 62°C for 30 sec (step 3), extension at 72°C for 45 sec (step 4) and a final extension at 72°C for 7 minute in a gradient thermal cycle.

Comparative study on different structures of goat shelters under farm conditions

N. Ramachandran, B. Rai, S K Jindal, M. K. Tripathi, A.K. Dixit, and Souvik Paul

The prevailing climate changes are impacting goat production system due to severe cold and harsh hot conditions, which generated necessity to search alternate and efficient housing systems for goat in minimizing production losses. The height of the slatted floor is normally recommended at 5 feet to have easy cleaning but varies widely depending on the agro climatic conditions and production system. The fixed height floors cannot be used for multiple purposes, whereas adjustable slatted floor can be used in protecting the animals from winter and hot weather conditions. Moreover, the most suitable height of slatted floor for goats is also not known. Therefore a small adjustable slatted floor (15'X 20'size) is constructed using Mirandi wood slats having 2" width and 1"thick with 1.5 cm gap between slats. The height of the floor is designed to have adjustment at 1.25, 2.5, 3.75, 5.0 feet from ground level using nut and bolts system in the wooden pillars. The designed slatted floor will be widely utilized to record the growth of kids, milk yield of lactating does at different heights giving due consideration on microclimate, welfare of goats, worm load (EPG), labor saving etc so as to assess the necessity of slatted floor before recommending for farmers in dry regions.

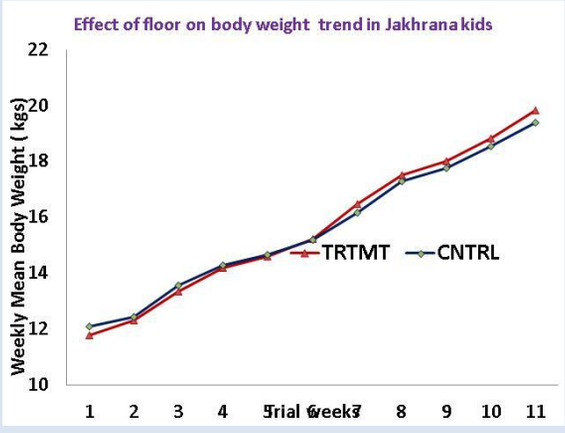
An experiment was initiated using thirty post weaned Jakhrana male kids adjusted for age, type of birth and body weight, and randomly divided in to two equal groups of 15 each and housed/managed on slatted floor Vs kutcha floor in goat farm of the Institute. The live weight change is being monitored at weekly intervals for two consecutive days to assess the daily gain in

kids. Animals were also observed for the incidence of diarrhea and other illness, if any. Since the beginning of experiment, the group feed intake (mash/kid pellet, bhusa, green fodders/tree leaves) is being recorded daily. The feed samples are being collected at fortnightly intervals for estimation of dry matter and proximate composition. The blood samples are collected at monthly intervals and the serum samples are being stored for hormone and biochemical assays. The faecal samples are processed for EPG counts once in two months. The average initial body weight at the start of the trial was 10.15 Kg in both the groups. Kids on the slatted floor had finishing live weight of 19.83 kg in comparison to 19.40 kg in kids on kutcha floor with the mean body weight gain of 8.04 and 7.29 kgs, respectively after 11 weeks of trial/ at 6 months of kids age.

Feed intake improved linearly in kids with progress of experiment. The kids of both group had an average dry matter intake of 643g/h/d at 91-180 days of age. However, the weight gain was 4.53% higher in kids under slatted floor than that under kutcha floor with the overall feed conversion efficiency of 17.48 and 16.74%, respectively. Under present experimental protocol, kids on slatted floor had higher feed efficiency at all stages of growth except 5-6 months. Kids on slatted floor consumed 5.06, 6.58, 7.32 and 6.43 kg feed while kids on kutcha floor consumed 6.12, 7.75, 7.04 and 7.05 kg feed for each kg gain during 3-4, 4-5, 5-6 and 3-6 months of age, respectively.

Effect of floor on intake, growth and feed conversion efficiency in Jakhrana kids

Parameters	Kutcha Floor	Slatted Floor
Feed DMI/ kid/day (g)		
3-4 months	517	548 (+5.66%)
4-5 months	668	658 (-1.52%)
5-6 months	712	700 (-1.71%)
Overall	643	643 (+0.00%)
Average daily gain (g)		
3-4 months	104.44	114.21 (+8.55%)
4-5 months	106.73	118.75 (+10.12%)
5-6 months	108.21	102.80 (-5.26%)
Overall	106.65	111.71 (+4.53%)
Feed Efficiency		
3-4 months		
kg feed DMI/kg Gain	6.12	5.06
Per cent (%)	19.94	20.73
4-5 months		
kg feed DMI/kg Gain	7.75	6.58
Per cent (%)	15.93	17.17
5-6 months		
kg feed DMI/kg Gain	7.04	7.32
Per cent (%)	15.14	14.65
Overall		
kg feed DMI/kg Gain	7.05	6.43
Per cent (%)	16.74	17.48



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

B. Rai, Ashok Kumar, M.K.Singh and H. Dixit

Goat rearing practices prevailing in 10 villages of Barabanki district of Eastern Uttar Pradesh was studied under NAIP project (Comp-3) during the year 2013-14. The survey during initial years 2009-2011, indicated that the goat feeding practices in this region was traditional and primarily based on zero-input system. Farmers are keeping large animals along with goats for milk and other products. The main stay of goat feeding was grazing followed by feeding tree leaves and kitchen waste. The grazing area is not demarcated and usually goats are grazed in the fields, bunds, wastelands and roadsides. The tree leaves commonly used are Neem, Pakar, Gular, Babul alongwith seasonal grasses. The field study indicated that pasture land grazing (17%) is not common and most of the goats (66%) grazed in wasteland (table). Colostrum feeding of kids was at satisfactory level (78.38 %) however, feeding of mineral mixture was at lower side (29.41%). The stall feeding was practiced by small number of the farmers (6.25%). The goat in production phases (pregnancy and milking) and kids during growth need higher amount of DM, protein and mineral supplements for better production. It was suggested that the goat keepers shoud go for supplementary feeding during crucial production phases. The farmers can easily go for supplementary feeding of productive goats (Grazing+300-500g dry fodder +150-250g concentrate mixture+5g mineral supplement per day) for better growth and production. The farmers may collect seasonal grasses and tree leaves dry it during sunny days and may keep the dried bundles for its further use in feeding goats during lean periods. Since in traditional goat rearing the concept of feeding goats at the farmer's doorstep is not common and farmers consider that merely grazing of goats is enough. The supplementary feeding of goats must be advocated among the goat keepers to enhance the productivity of goats in this region. Simultaneously plantation of fodder trees in grazing areas may be undertaken by state department and developmental agencies to ensure fodder in the form of tree loppings for goats in this region.

Feeding practices of goats under field condition

Particulars	Yes (%)	No (%)
Grazing on pasture land	54	46
Grazing on waste land	66	34
Supplementation of tree leaves	87	13
Supplementation of kitchen waste	91	09
Colostrum feeding to new born kid	78	22
Feeding of mineral mixture	30	70
Stall feeding of animals	07	93

Impact analysis:

The impact analysis of goat based interventions indicated positive impact on goat rearing venture in both Barabanki and Raebareli . The data shows that there was considerable improvement in body weight at 6 month, lactation yield and reduction in mortality rate as compared to baseline performance of goats. The Sirohi and Barbari breeds distributed among adopted farmers fetched better price and gross income from goat rearing increased at the rate of Rs.2000.00 per goat due to better growth and milk production in both the breeds. The improved breed, healthcare and integration of goat rearing with backyard poultry and horticulture made it possible to get more remuneration from goat keeping in this region.

Impact analysis of NAIP Com-3 project

Particulars	Baseline (2008-09)	(2013-2014)
Average flock size	3.4	5.0
Number of breeding bucks	12	49
Body weight at 6 month (kg)	8.4	12
Milk yield per day (ml)	502	705
Lactation length (day)	102	142
Mortality (%)	14.7	8.4
Price of adult buck (Rs.)	2412	4407
Price of adult doe (Rs.)	2218	4002
Gross income per goat (Rs.)	2356	4338

Nutrition, Feed Resources & Production Technology Division

Development of feed resources on poor lands for goats

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

Utilization of *Leucaena leucocephala* leaves as sole roughage source in kids.

Incorporation of *Leucaena leucocephala* foliage (LLF) provided alternative in tropical ruminant production due to nutrients richness, especially of protein, vitamins, and minerals. Present study evaluated intake, performance and mimosine tolerance of goat kids on LLF feeding as only source of roughage. Kids were fed *ad-libitum* LLF and concentrate supplement 2% of LW on fed basis.

	Control group (n=9)	Leucaena lecocephala group (n=9)
Initial live weight (kg)	7.18	7.34
Final live weight (kg)	17.76	17.84
Total gain (kg)	10.58	10.50
ADG (g/d)	75.56	75.00

Eighteen Barbari kids of 54±10.23 days of age and 7.25±0.81 kg live weight of either sex were randomly divided in to two equal groups. The kids of control group received sorghum fodder, while kid of other group received *Leucaena leucocephala* foliage in replacement of sorghum as green fodder. Feeding experiment lasted for 140 days. Mimosine content of *Leucaena leucocephala* foliage ranged from 14 to 57 g, with a mean 33.28 g/kg dry matter at different stages of growth. The CP content of *Leucaena leucocephala* was 21 %. Growth performance of the both kids groups was identical. Therefore, *Leucaena leucocephala* foliage may be used as sole green fodder on goat feeding

Effect of protein sources of on intake, digestibility and milk production of lactating goats

Experiment utilized mustard oil meal, urea and guar korma in replacement of conventional linseed oil cake as protein supplement in concentrate mixture of lactating goats feeding in economizing cost of feeding. Twenty seven lactating Barbari goats during their second week of parturition were randomly divided in to three equal groups of nine in each. Each goat received concentrate pellet with 16 % crude protein, the pellet fed to control goats contained linseed oil cake, MOM group contained mustard oil meal, while NPN group contained urea and guar korma as protein sources. The goats were also offered ad-libitum gram straw and green fodder at 2 kg per goat/day.

Total daily dry matter intake (DMI) was lower ($p<0.05$) in control (904 g) than occurred in MOM (999 g) and NPN (1036 g) groups of goats. Similar crude protein intake (CPI) was similar through straw, green fodder and concentrate, while total CPI was higher ($p<0.05$) in MOM and NPN group of goats in comparison to control goats. Dry matter, organic matter, crude protein, hemicelluloses and total carbohydrates digestibility were similar among three goat groups, however neutral detergent fiber, acid detergent fiber and cellulose digestibility were lower ($P<0.05$) in MOM group, which consumed concentrate pellet that contained mustard oil meal as protein source. Milk production performance of goats ranged from 755 to 839 ml/day, which was significantly lower by 5.6 and 11.1 % than occurred in MOM and NPN group of goats. It is concluded that mustard oil meal, and combination of urea and guar korma can replace conventional protein supplement linseed cake in lactating goats feeding, with improved lactating performance.

Evaluation of *L. multiflorum* for its Fodder Production Performance

The *L. multiflorum* was grown during the rabi season as sole crop as well as in combination. it is evaluated for production parameters as well as chemical composition. It can be successfully grown with Oat, Berseem etc crops. It contained 12.86 % CP, 48.92% NDF and 7.22 lignin. The *in-vitro* dry matter digestibility was 76.57% with energy value17.628MJ/kg dry matter.

Nutrient content of *Lolium Multiflorum* (Rye grass) for its fodder value

Fodder	*Green fodder t/ha*	*DM*	*OM*	*CP*	*EE*	*NDF*	*ADF*	*Cellulose*	*Lignin*	*TCOH*
Berseem	40.3	9.2	84.30	22.96	4.69	41. 22	38.14	28.29	9.62	56.63
Oat	86.22	8.13	82.70	12.46	3.31	53.34	40.40	35.84	4.20	66.92
Rye Grass	64	8.82	82.08	12.86	2.73	48.92	45.47	36.74	7.22	66.48
Berseem + Rye grass	44.88	7.51	79.56	15.91	2.91	52.36	29.23	26.87	1.82	62.73
Lucerne + Rye grass	38.66	9.1	80.99	14.81	3.46	47.43	35.95	23.51	6.96	65.70
Oat + Rye grass	72.00	8.03	83.29	12.51	2.22	52.95	29.97	22.35	7.11	67.55

Evaluation of *Commelina bemghalensis* and *Seteria sp.* for fodder value

These two plant species were identified for their natural production capacity in ravine area. The biomass was collected from the waste land just after monsoon season, The collected biomass was conserved as hay. *in-vitro* as well as chemical evaluation were carried out. C. benghalensis and Setaria sp. were recorded with 14.875 and 15.57 MJ/kg energy values. The *in- vitro* dry matter digestibility were 58.83 and 40.6 % respectively.

Fodder	CP	OM	EE	EE	NDF	ADF	Lignin	TCOH
Setaria sp.(Fox tail weed)	11.38	85.30	1.51	1.51	63.79	50.55	10.79	83.79
Commelina benghalensis	6.56	85.52	1.38	1.38	73.91	54.03	10.00	77.58

Integrated Nutrient Management in Nursery Seedlings

Treatments i.e.1% Urea+ $ZnSo_4$, 2% Urea, VermiWash, VermiWash + $ZnSo_4$+ $FeSo_4$, Soil application of NPK , 0.2 % spray of ZnSo4, FeSo4+ Boron and control were applied on nursery grown seedlings of *Acacia nilotica, P. cineraria, S. Cummunis, F. religiosa, F. glomerata, M. alba, Azadirachta indica, F. lacor.* Some buring spots were observed with urea solution spray in case of *M. alba*. Major injuries were observed in case of *F. religiosa* and *F. glomerata*. Seedlings of *Acacia nilotica* showed positive response towards high dose of NPK . All other plants species observed up to 90-100% mortality.

Network program on estimation of methane emission under different feeding systems and development of mitigation strategies

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

In-vitro fermentation experiments for 24 h were carried out to determine methane production potential of different feeds used goat feeding. Methane mitigation experiments were also carried out using different protein sources in concentrate pellet.

Methane production from different leaves

Leaves of seven bio-resources namely Aloevera (*Aloe barbadensis*), Banana (*Musa paradisiacal*), Aanar (*Punia granatum*), Meetha neem (*Murraya koenigii*), Mehendi (*Lowsonia inermis*), Biskhapra (*Boerhavia diffusa*) and Khejri (*Prosopis cineraria*) were evaluated. Nutrient content of all the bio-resources were different ($p<0.001$), and the gas production varied 57.7 to 161.7 ml/ g DM, which was the highest ($p<0.001$) in Aloevera and the lowest in Khejri leaves. Although, gas production was different among all feed resources, however gas production for each g DM fermented was similar in Banana, Aanar, Meetha neem and Mehendi leaves. Methane concentration in gas ranged from 14 to 21.2 %, where as ME (MJ/kg DM) varied from 4.75 to 7.11. Methane production in g/ kg DM and g/ kg fermented DM ranged from 6.7 to 18.9 g and 10.5 to 22.83 g respectively. Similarly, energy loss in the form of methane followed the trend of gas production, which ranged from 11.4 to 17.1 % of digestible energy. Different feed resources with varying nutrient contents have varying fermentability and methane production potential.

Table: Nutrient content and methane production of different leaves

	Alovera	Banana	Aanar	Meetha Neem	Mehendi	Vishkhapra	Khejri	SEM	P-value
Nutrient contents (%)									
DM	2.21g	16.29e	64.26a	37.68c	27.83d	10.31f	44.83b	4.473	<0.001
OM	77.48f	88.43c	91.84b	85.26d	93.53a	81.25e	90.69b	1.229	<0.001
CP	9.04f	14.29d	13.39e	15.08c	15.86b	7.72g	17.62a	0.752	<0.001
Fat	2.07f	6.49b	8.15a	5.50c	4.89d	1.44g	3.50e	0.498	<0.001
NDF	24.07f	65.22a	26.04e	41.22c	16.07g	38.35d	48.24b	3.45	<0.001
ADF	16.32f	30.75b	17.90e	21.17d	11.83g	26.25c	39.95a	1.996	<0.001
Cellulose	13.25e	25.27a	9.37f	14.39d	8.42g	17.91c	20.51b	1.257	<0.001
Lignin	3.02f	4.12e	8.56b	6.80d	2.77g	7.79c	19.10a	1.167	<0.001
Gas production									
ml/g DM	161.7a	93.3cd	125.0b	86.7c	128.3b	77.5d	51.7e	7.804	<0.001
Ml/g DDM	186.4a	147.5b	152.1b	130.5b	141.5b	101.2c	79.3d	2.876	<0.001
Methane (%)	17.23b	16.44b	17.33b	16.52b	14.70b	21.21a	20.39a	0.544	0.001
DM Digestibility (%)									
	86.75b	63.30f	82.15c	66.45e	90.66a	76.57d	65.20ef	2.30	<0.001
ME (MJ/kg DM)									
	7.11a	5.55c	6.36b	5.44c	6.60b	4.75d	4.61d	0.201	<0.001
Methane Production (ml/g DM)									
ml/ g DM	26.44a	13.85cd	20.29b	12.75de	17.04bc	15.62cd	9.58e	1.214	<0.001
ml/ g DDM	30.49a	21.79b	24.68b	19.20bc	18.80bc	20.40bc	14.70c	1.184	0.001
g/kg DM	18.93a	9.92cd	14.53b	9.13de	12.21bc	11.19cd	6.86e	0.869	<0.001
g/kg DDM	21.83a	15.61b	17.68b	13.75bc	13.57bc	14.61bc	10.51c	0.848	0.001
Methane energy loss									
% of GE	14.81a	9.92b	12.69a	9.28b	10.29b	13.07a	8.27b	0.545	<0.001
% of DE	17.07a	15.61ab	15.44ab	13.97abc	11.35c	17.07a	12.69bc	0.567	0.015

Methane production in concentrate pellet feed

Methane production potential of the three concentrate pellet feed (16 % CP) was estimated in which different protein sources were used. The connectional protein supplement was used at 25 % in control pellet feed, linseed cake was replaced (w/w) by mustard cake and in another pellet feed guar korma (5.7%) and urea (1.3%) were used in replaced cakes. The methane production of the three feed varied from 38.87 to 47.08 ml/ g digestible DM. Mustard cake inclusion reduced methane production by 21.09 %, whereas the concentrate pellet containing guar korma and urea produced 4.83 % less methane in comparison to linseed cake included pellets.

Concentrate pellet feed	Gas (ml/g DM)	IVDMD %	CH4 %	CH_4(ml/g DDM)	CH_4 energy loss (MJ/kg DDM)
Linseed cake (25%)	241.7	79.2	18.09	47.08	1.87
Mustard cake (25%)	248.3	78.0	15.29	38.87	1.55
CH_4 reduced				21.09%	
Guar korma (5.7%) + Urea (1.3%)	262.5	81.8	16.69	44.91	1.78
CH_4 reduced				4.83%	

Methane production of Subabool leaves and its combination with concentrate

Methane production of Subabool leaves was estimated as sole and with 50 % concentrate feed. The concentrate pellet was containing CP 18% whereas subabool leaves having CP 26%. Subabool leaves produced 22.54 ml/methane in each g of digestible dry matter, whereas concnetarte pellet produced 52.14 ml methane. The substrate, which contained subabool leaves and concentrate in a 50 :50 ration produced methane 1.44 ml/ g digestible substrate. Similarly, methane energy loss (MJ/kg digestible DM) followed the similar trend. Subabool leaves produced less methane than that occurred in concentrate pellet. In, general concentrate feed producing less methane in comparison to fodders, the reverse trend of methane production in the present study show that the quality of feed especially the protein content is responsible for the level of methane production.

	Gas (ml/g DM)	IVDMD %	CH4 %	CH4 (ml/g DDM)	CH_4 energy loss (MJ/kg DDM)
Subabool leaves	112.5	76.48	20.35	22.54	0.89
Concentrate pellet	216.6	70.8	20.49	52.14	2.08
Concentrate + Subabool leaves (50%50)	160.0	77.58	20.80	36.06	1.44

Therefore, methane production potential (MPP) of different feeds was varied from 13.4 to 36.4 ml/ g digestible DM. The Energy loss as methane was ranging from 0.53 to 1.45 MJ/kg Digestible DM. Replacement of linseed cake by mustard cake in concentrate pellet reduced methane production by 21%. The quality of fodder, especially the CP level is responsible in determining the MPP of the feed resources/compound feeds.

Development of complete feed for environmentally and economically sustainable goat production

Ravindra Kumar, P. Tripathi, U. B. Chaudhary, and R. B.Sharma

Ponds were prepared at CIRG, Makhdoom for the cultivation of Azolla. Successful cultivation was carried out. Azolla was harvested, dried and stored for further analysis and experimental feeding.

Fig 1: Cultivation of azolla in the pond

Nutrient composition and digestibility of azolla was studied using *in vitro* technique to evaluate it as a protein supplement for the goats. The dry matter content of azolla was 7.10 %. Among proximate principles per cent ash, crude protein, ether extract and crude fibre were 20.31, 17.3, 2.71 and 12.02 respectively on dry matter basis .The per cent NDF and ADF was 46.90 and 31.73 respectively. Total gas production (ml/g DM) and methane production (ml/DM) was 78.49 and 11.96 respectively. The dry matter digestibility (%) and organic matter digestibility (%) was 83.15and 84.03 respectively. Microbial protein (mg) and partitioning factor was 76.57 and 5.25 respectively. Five feeds were formulated by the replacement of concentrate mixture by azolla meal at 0 (F1), 25(F2), 50 (F3), 75(F4) and 100 (F5) level. These feeds were evaluated for methane emission and digestibility with goat rumen liquor as inoculums in an *in vitro* gas production test. Gas production (ml/g dry matter and ml/digestible dry matter) significantly get reduced with increasing proportion of azolla. There was significant ($P< 0.05$) difference in methane production between different formulated feeds. Methane production (ml/Dry matter) was highest in F1 (27.54) followed by F2 (27.18), F3 (21.23), F4 (17.37) and lowest in F5 (14.77).Similar trend was observed with methane production (ml/ digestible dry matter). The dry matter digestibility (%) ranged from 63.19 to 51.69 being significantly highest in F1 (63.19) followed by F2 (61.19), F3 (58.83), F4 (51.33) and F5 (51.69). Similar trend was observed with organic matter digestibility (%) of different formulated feeds. The values ranged from 65.21(F1) to 54.01(F5).The dry matter and organic matter digestibility of F1 (63.19, 65.21) and F2 (61.19, 64.38) feeds were statistically similar. With increasing percent of azolla meal in the feed formulation a decreasing trend of dry matter and organic matter digestibility was reported.

Body weight gain and feed intake in different group of goats

Attributes	Group A	Group B
Initial body weight	11.19±0.56	11.42±0.39
Final body weight	14.44±0.93	15.80±0.68
ADG (g)	56.60±10.78	78.12±11.96
Feed intake	591.60±9.11	632.43±11.36
FCR	10.45	8.09

Intake and digestibility of nutrients in experimental goats

Attributes	Group A	Group B
Body wt.(Kg)	13.12±1.02	14.07±0.61
Body size (Kg)	6.88±0.39	7.26±0.24
Total dry matter intake		
g/animal /day	568.03±16.13	625.81±54.43
g/per cent live weight	4.41±0.32	4.44±0.34
g/Kg $^{0.75}$/day	83.54±4.94	86.02±6.71
Nutrient digestibility (%)		
Dry matter	55.38±1.87	52.41±3.06
Organic matter	57.89±1.79	55.46±2.78
Crude protein	71.14±0.71	77.43±2.02
Ether extract	73.55±1.94	69.72±2.04
Total carbohydrate	62.58±2.53	57.46±3.17
Neutral detergent fibre	60.78±3.10	57.26±5.54
Acid detergent fibre	51.27±3.67	52.25±5.06
Cellulose	54.47±2.50	55.86±4.34
Hemi cellulose	59.60±6.36	53.13±1.91

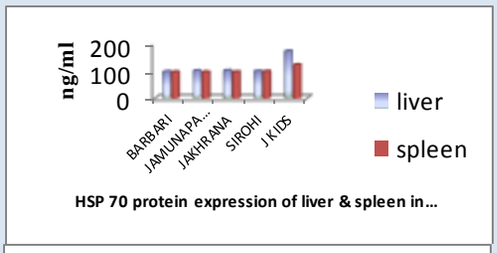
In another experiment Twelve male barbari goats of 3-4 months of age were divided into two groups (A and B) of six each as per completely randomized design. Complete pellet feed (control and treatment) were formulated. In treatment pellet twenty five percent of concentrate mixture was replaced with azolla meal. Feeding and growth trial was conducted for eight weeks. Group A was fed with control pellet while group B was fed with treatment pellet. The feed intake and body weight gain is presented in table 1.The Average daily gain (g) was 56.60 in group A and 78.12 in group B.

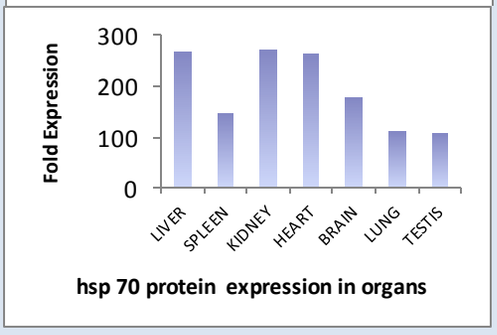
A metabolism trial of six days duration was conducted on all the six animals of each group to estimate the digestibility of different nutrients. The dry matter and other nutrient digestibility were similar in both the groups (Table 2). The digestibility of crude protein was significantly higher in group B (77.43) as compared to group A (71.14).Nitrogen utilization in treatment group of goats was better as compared to control group of goats. Nitrogen intake (g/animal/day) was statistically similar in group A (11.11) and group B (12.36). Balance of nitrogen (g) was 4.14 in group A while 6.40 in group B.

National initiative on climate resilient agriculture (nicra) on assessing resilience of small ruminant production under changing climatic conditions in semi-arid zone

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

An experiment was conducted on goats during peak summer season for estimation of heat stress and amelioration using herbal powder, liquid anti stress and vitamin E. Results indicated that, heat stress adversely affects body weight gain of goats. Higher, concentration HSP 70 in the plasma, in control than experimental group, indicated effectiveness of different anti-stress agents to combat the heat stress during peak summer season. Herbal powder was found most effective against heat stress than liquid form and Vit-E. Results of another experiment conducted to estimate the cold stress in goats and its amelioration using herbal powder and Vitamin E + selenium combination, indicated positive effect of herbal powder and Vit-E+Selenium against cold stress in goats based on the Concentration of HSP-27 & Ubiquitine Protein in plasma , as lower units of these proteins were observed in treatment groups than control. Herbal powder was found most effective in reducing the cold stress in goats than Vit-E+Selenium. Straw intake was adversely affected by cold stress as lower intake was recorded under control group. Effect of feeding different quantity of concentrate (1.5 and 2.0% of body wt.) on stress conditions of goats during winter season was also observed and it was found that cold stress was not reduced due to increase of the quantity of concentrate as evidenced by the same concentration of Ubiquitine Protein in the plasma of both the group of goats.





Gene expression analysis in different tissues of different goat breeds in response to heat stress indicated, highly expression of Hsp70 protein in kidney, liver and heart followed by brain, spleen, lungs and testis. Kidney, liver and heart had two fold higher protein expressions as compared to other organ.

Farmers awareness programmes with the aim to create the awareness about climate change and ameliorative measures to be taken were organized at Dai, Rajasthan on 26.10.2013, Rambha, Ganjam, Odisa on 23.11.2013 and at Kendu Pali, Bargarh,Odisa on 28.2.2014. Each camp was attended by > 100 goat farmers from nearby districts. Lectures were delivered by PI; Co-PI of the NICRA Project and veterinary officers of Animal Husbandry Department of Rajasthan and Odisa state. Farmers were also

given an opportunity to raise their queries related to climate change and its impact on the productivity of live stocks.

At the end, a questionnaire was distributed to the farmers with view to get a feedback with respect of the gain of knowledge regarding climate change and its probable effect on productivity of livestock and agriculture. Most of the farmers were not aware about the adverse effect of climate change on the productivity of goats however, awareness camp proved very useful to cope up the adverse effect of climate change on livestock productivity.

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

U.B.Chaudahry, Ravindra Kumar, Ravi Ranjan

Goats are generally reared under extensive system of feeding management with little or no supplementation in the form of concentrate, causing deficiency of energy protein and other nutrients. The present experiment was conducted to observe the effect of supplementary feeding on growth potential of goats under field conditions. Growing non-descript goats maintained under extensive system of feeding were divided in two groups; control (Without supplementation) and Experimental (With Concentrate supplementation @1.5% of Bwt.) under present experiment. Observation in terms of different parameters related to production and rumen fermentation were recorded. Significantly higher body weights were recorded under treatment group than control. Concentration of VFA and ammonia nitrogen in the rumen was also reported higher under treatment group. The Blood picture indicated higher values of hemoglobin and HCT under treatment group. Units of glucose, urea nitrogen and total protein in the plasma were also reported higher under treatment group. A separate experiment was conducted with the view that the supplementing of Vit.E orally or injectable form to the male goats may have a positive effect on improving semen quality of goats. Adult male goats were divided in two groups and were given traditional ration (Control) and Traditional ration +vitamin-E orally (Treatment group) observation in terms of semen quality were collected form the goats under both the groups. Same goats were switched over to another experiment and control group was given traditional ration whereas experimental group was given combination of Vit-E and Selenium in injectable form. Observation in relation to semen parameters was recorded. There was no significant difference ($P<0.05$) in any parameters estimated between control and treatment group. However, AST values was significantly higher ($P<0.05$) in control group (oral) compared to treatment group of animals.

Effect of Vitamin E & Selenium on the semen quality of goats.

Parameters	Control (Without vit.E+Selanium)		Treatment (vitamin E & Selanium)	
	orally	injectable	Oral	Injectable
ALT(IU/L)	22.26±7.28	26.58±7.28	18.932±7.864	20.481±8.614
AST(IU/L)	66.380±8.550	26.580±8.550	46.177±9.235	20.481±10.117
Testosteron(ng/ml)	10.527±1.338	11.349±1.338	11.170±1.445	8.895±1.583

Effect of oral supplementation of vitamin E given orally, on the semen quality of Goats

Attributes	Control	Experiment
Volume	0.655±0.071	.693±0.091
Mass Activity	0.397±0.183	3.87±0.211
Motility	71.42±3.40	70.37±3.92
Live & Dead	73.50±1.81	64.16±4.62
Acrosome	65.23±1.99	59.80±4.89
HOS	66.92±1.83	61.00±5.14

Net work programme on 'veterinary type culture' (rumen microbes)

U.B.Chaudhary, Ravindra Kumar and V.K.Gupta

Following cultures of fiber degrading bacteria, isolated from rumen of goats were deposited to NIANP Bangalore . The fiber degrading enzyme activities of these bacteria are as given below .

Name of the bacteria	Isolate	Enzyme activity (µmol glucose /minute)	
		CMCase	Avicelase
Selenomonas sputiqana	MSS-1	2.70	0.93
Enterococcus durans	MED-7	2.34	1.82
Enterococcus durans	MED-3	2.46	1.03
Enterococcus durans	MED-10	2.91	1.67
Clostridium	BS-6	1.83	1.57

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

V. Rajkumar, Arun K. Verma and Khushyal Singh

Major Goat meat markets were identified in and around this region. Goat meat processing units were also identified. Out of the 45 export meat plants approved by APEDA for slaughter of animals 15 abattoirs have goat/sheep slaughtering activity. Out of this 15, two abattoirs are approved for stand-alone for sheep slaughter and one is approved for exclusive slaughter of Goat/sheep. Rest of the abattoirs has buffalo slaughter activity also. Out of the 15 abattoirs which have Goat/sheep slaughter activity, seven are present in Uttar Pradesh. For computation and final development of complete package of practice we needed a computer modelling. Perusal of references revealed that similar model has been developed by the NRC on meat for buffalo meat production. NRC model are modified to suit our requirement .Under this project and within the time mentioned, following studies had been conducted. U*nder the work* "Food safety and HACCP standards for goat meat and products production process" Rosenthal Meat Science and Technology center, USA, HACCP plan was used as the base model for the development of our HACCP models. Already prepared goat /sheep slaughter plan was prepared in the above said plan that suits our laboratory and Indian conditions.

The other two plans prepared and presented are fully cooked, not shelf-stable product HACCP plan for Nuggets and sausages and heat treated (Annexure I), shelf-stable product HACCP plan for Murukku and Nimkee (Annexure II). In the half yearly IRC we have presented the data related to the nuggets/sausages and the next plan we have added in the next six months. HACCP plan document contains he signature page and the plan summery in the tabular form. Plan summary deals with the Critical Control Points (CCP) in the preparation of the products. There are three important critical points for nuggets /sausages and for Murukku/Nimkee. Product flow chart also presented and the product hazard analysis table also prepared the HACCP plan. Description of CCP, their monitoring procedure also prepared and presented. Verification and record keeping procedure for all the CCP has been identified and the individual records to be maintained are narrated and presented in the tabular form.

HACCP data for Goat meat products

Mostly microbial analysis was carried out. Residue analysis will be done when the facilities are created and accordingly we will modify critical limits for the chemical and other related residues. To identify critical control point's microbiological quality of the stages of nuggets processing including slaughter has been done (Table 1).

Table 1. Physico-chemical and microbial traits of freshly prepared nuggets and snack meat products.

Traits	Nuggets	Murukku/Nimkee
pH	6.14	6.01/6.03
Water Activity	0.976	0.421/0.65
W-B Shear force values ($kgcm^{-2}$)	1.38	TPA analysed
Moisture, %	59.46	6.32/1.32
Fat, %	17.08	21.53/28.32
Standard Plate counts	4.21	1.04/1.26
Psychrotrophic bacteria counts	3.43	Nil/Nil

Table 2. Standard plate counts at various stages of Nugget/sausage and Nimkee/Murukku processing including slaughter

Place of sampling	SPC (log CFU 10^{-1}sqcm)
Slaughter house floor	5.01
Slaughter house wall	3.87
Bleeding knife (Iron)	3.27
Dressing knife (Iron)	3.46
Butcher's hand	3.90
Carcass splitting chopper	4.01
Deboning knife I (Stainless steel)	2.74
Deboning knife II (Stainless steel)	2.63
Carcass surfaces	
a. Carcass neck portion	4.64
b. Carcass – Loin cut	4.87
c. Carcass – Leg cut	3.43
Carcass cutting wood	3.61
Deboning table	3.81
Surface of meat mincer	2.01
Surface of bowl chopper	1.02
Surface of SS Emulsion box	2.18
Surface of nuggets cutting plates	1.71
Surface of the murukku/nimkee making machine	1.09
Plates used for making	Nil
Wooden frame and handle used	Nil

Table 3. Estimation of bacterial counts in the raw materials used in the formulation of goat meat nuggets/sausage and Murukku/Nimkee

S.No.	Raw materials	SPC (log CFU g^{-1})
1.	Meat Keema	3.92
2.	Meat fat	4.06
3.	Casings	3.72
4.	Maida	3.07
5.	Meat powder	1.86
6.	Murukku/nimkee powder	1.09
7.	Oil	Nil
8.	Spices	2.04
9.	Condiments	1.03

Similarly estimation of bacterial counts in the raw materials used in the formulation of Nugget has been done. After the complete analysis HACCP design will be prepared. Perusal of Table 7 reveals that slaughter house floor (log 5.01), wall (log 3.87), butcher's hand (log 3.90), bleeding knife (log 3.46) and carcass splitting chopper (log 3.95) had higher SPC. This point needs consideration. 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.

Value chain for the development of goat products with healthy traits

A K Verma and V Rajkumar

Development of healthier chevon nuggets: P/S ratio standardization by the blend of animal fat and vegetable oil

Attempt was made to develop healthier chevon nuggets through standardization of PUFA/SFA ratio in the range of recommended value via replacement of animal fat by vegetable oil. Chevon nuggets were processed through replacement of goat fat to 0%, 33.33%, 50% and 100% with vegetable oil of known fatty acid profile and their quality characteristics were determined. Cooking yield of chevon nuggets prepared with 50% and 100% replacement of goat fat was significantly higher and product with 100% goat fat had low yield. Ash contents in meat emulsion and product with 100% vegetable oil was lower than other treatments. Replacement of goat fat with vegetable oil significantly affected the Hunter colour lightness values.

Table 1: Effect of goat fat replacement with vegetable oil on physicochemical characteristics of goat meat nuggets (n=6)

Parameters	GF	GFVO11	GFVO21	VO
Emulsion pH	6.42±0.01	6.40±0.01	6.43±0.01	6.41±0.01
Nuggets pH	6.48±0.01^{ab}	6.46±0.01^{b}	6.49±0.01^{a}	6.47±0.01^{ab}
Emulsion stability (%)	91.66±0.42^{b}	92.73±0.21^{b}	92.10±0.54^{b}	97.00±0.21^{a}
Cooking yield (%)	90.50±0.28^{c}	95.17±0.39^{a}	94.00±0.49^{b}	96.17±0.25^{a}
Emulsion moisture (%)	67.48±0.41	67.16±0.46	67.54±0.40	66.86±0.16
Emulsion fat (%)	8.52±0.33	8.43±0.35	8.48±0.24	8.32±0.37
Emulsion protein (%)	13.08±0.06	13.12±0.17	12.98±0.15	12.93±0.19
Emulsion ash (%)	2.78±0.01^{a}	2.75±0.01^{a}	2.71±0.05^{ab}	2.65±0.03^{b}
Nuggets moisture (%)	65.35±0.30	65.53±0.27	65.13±0.37	65.36±0.37
Nuggets fat (%)	8.56±0.15	9.36±0.38	9.29±0.22	9.10±0.22
Nuggets protein (%)	14.69±0.20	14.79±0.18	14.26±0.26	14.56±0.11
Nuggets ash (%)	2.80±0.05^{a}	2.82±0.02^{a}	2.72±0.08^{ab}	2.59±0.01^{b}

Table 2: Effect of goat fat replacement with vegetable oil on various categories of fatty acids (% of total fatty acid) in goat meat nuggets (n=6)

Fatty acid	GF	GFVO11	GFVO21	VO
ΣSFA	50.19±1.82^{a}	35.09±0.65^{c}	40.82±1.62^{b}	23.97±0.71^{d}
ΣMUFA	41.60±1.57^{a}	34.61±1.17b^{c}	38.44±1.15^{ab}	31.64±1.84^{c}
ΣPUFA	7.89±0.39^{d}	31.90±0.37^{b}	20.47±1.11^{c}	43.73±1.26^{a}
Σn3 PUFA	1.31±0.09^{b}	2.12±0.05^{a}	2.81±0.46^{a}	2.83±0.22^{a}
Σn6 PUFA	6.14±0.45^{d}	29.55±0.40^{b}	16.10±1.05^{c}	38.38±0.83^{a}
PUFA/SFA	0.16±0.01^{d}	0.91±0.03^{b}	0.52±0.05^{c}	1.83±0.05^{a}
N6/N3 PUFA	4.87±0.58^{b}	13.97±0.49^{a}	6.70±1.24^{b}	14.00±1.18^{a}

Increase in proportion of vegetable oil in chevon nuggets significantly increased yellowness value. Textural properties of the product did not affect significantly due to goat fat replacement, however product with 100% vegetable oil required lowest shear force value and work of shear. Sensory attributes of the products were significantly affected due to goat fat replacement, except appearance and chevon nuggets with 33.33 % and 50 % replaced goat fat received

highest acceptability scores. Higher proportion of vegetable oil in product significantly improved PUFA particularly omega-6 and decreased saturated and monounsaturated fatty acids. Product with 33.33 % and 50 % replaced goat fat showed P/S ratio (0.52-0.91) in the range of recommended value. Thus partial replacement of goat fat with vegetable oil can provide healthier chevon nuggets.

Effect of replacing goat fat with vegetable oils on the quality characteristics and fatty acid profile of chevon nuggets

Standardization of chevon nuggets having healthier fatty acid conformation such as PUFA/SFA ratio and omega-6/omega-3 fatty ratio was attempted. Two sources of fat from plant origin such as vegetable oil (VO) and linseed oil (LSO) were selected and were used to replace 50% and 100% goat fat (GF) in chevon nuggets. Four types of products were prepared such as control nuggets (7% goat fat), GFLSO nuggets (3.5% goat fat + 3.5% LSO), GFVOLSO nuggets (3.5% goat fat + 3.5% combination of VO and LSO) and LSO nuggets (7% LSO) and their different quality characteristics were evaluated. Batter stability and cooking yield of control nuggets and LSO nuggets were significantly lower as compared to other two products. Fat contents in control emulsion and nuggets were significantly lower. LSO emulsion and nuggets had significantly lower ash contents. Hunter colour lightness value for control nuggets was significantly higher while LSO nuggets had higher redness and yellowness values than other products. Texture profile analysis values for LSO nuggets were significantly lower in relation to other products. Sensory evaluation revealed that appearance and flavour scores for control nuggets were significantly lower, however overall acceptability scores of all the products did not differ significantly. Fatty acid profile of GFVOLSO nuggets had the most desired fatty acid conformation with PUFA/SFA ratio as 0.85 and omega-6/omega-3 fatty acid ratio as 1.40. Thus 50% replacement of goat fat with combination of vegetable oils can improve functional characteristics of chevon nuggets, which can be healthier also.

Table 3: Effect of goat fat replacement with two vegetable oils on physicochemical characteristics of goat meat nuggets (n=6)

Parameters	GF	GFLSO	GFVOLSO	LSO
Emulsion pH	6.42±0.01^{a}	6.35±0.01^{b}	6.34±0.02^{b}	6.36±0.01^{b}
Product pH	6.48±0.01^{a}	6.41±0.01^{c}	6.41±0.01^{c}	6.43±0.01^{b}
Batter stability (%)	91.66±0.42^{c}	96.19±0.09^{a}	96.69±0.33^{a}	94.18±0.16^{b}
Product yield (%)	90.50±0.28^{c}	97.83±0.25^{a}	97.94±0.16^{a}	97.07±0.10^{b}
Emulsion moisture (%)	67.48±0.41	66.73±0.23	67.25±0.13	67.33±0.14
Emulsion fat (%)	8.52±0.15^{b}	10.16±0.35^{a}	10.27±0.27^{a}	10.73±0.21^{a}
Emulsion protein (%)	13.16±0.07	12.71±0.21	12.91±0.21	12.91±0.19
Emulsion ash (%)	2.78±0.01^{a}	2.78±0.03^{a}	2.73±0.02^{a}	2.33±0.04^{b}
Product moisture (%)	65.35±0.30	65.87±0.57	66.15±0.44	65.88±0.15
Product fat (%)	8.56±0.15^{c}	10.08±0.21^{b}	10.66±0.19^{ab}	11.01±0.61^{a}
Product protein (%)	14.78±0.19	14.35±0.07	14.56±0.15	14.51±0.14
Product ash (%)	2.67±0.05^{a}	2.75±0.03^{a}	2.66±0.06^{a}	2.50±0.04^{b}

Table 4: Effect of goat fat replacement with two vegetable oils on various categories of fatty acids (% of total fatty acid) of goat meat nuggets (n=6)

Fatty acid	GF	GFLSO	GFVOLSO	LSO
ΣSFA	50.19±1.82^{a}	43.29±1.01^{b}	37.21±0.46^{c}	24.42±0.54^{d}
ΣMUFA	41.60±1.57^{a}	31.83±1.15^{b}	30.88±0.89^{bc}	27.77±0.24^{c}
ΣPUFA	7.89±0.39^{c}	30.47±0.67^{b}	31.60±0.58^{b}	47.59±0.42^{a}
Σn3 PUFA	1.31±0.09^{d}	23.15±0.69^{b}	13.09±0.25^{c}	34.14±0.50^{a}
Σn6 PUFA	6.14±0.45^{d}	8.95±0.12^{c}	18.26±0.33^{a}	13.36±0.32^{b}
PUFA/SFA	0.16±0.01^{c}	0.77±0.03^{b}	0.85±0.01^{b}	1.96±0.06^{a}
N6/N3 PUFA	4.87±0.58^{a}	0.42±0.01^{c}	1.40±0.01^{b}	0.39±0.01^{c}

Screening of ingredients for development of low salt meat products

Various ingredients low in sodium content were identified for the development of non-emulsion based meat product. These ingredients were used as a substitute of sodium chloride (common salt) to develop the meat product. Preliminary trial for the development of low sodium goat meat pickle was conducted and evaluated organoleptically. Additionally physicochemical characteristics and fatty acid profile of control goat meat pickle was evaluated. Goat meat pickle was found to be rich in animal protein (19.50%). Fatty acid profiling of the pickle revealed that the product contained high amount of healthier fatty acids such as linoleic acid (18.23%), alpha linolenic acid (16.83%) and arachidonic acid (6.17%). The ratio of omega-6/omega-3 fatty acids (1.09) in the product was found to be in the range of recommended value (1-4).

Table 5: Categories of fatty acids (% of total fatty acid), P/S and omega-6/omega-3 fatty acid ratio in goat meat pickle

Fatty acids	Value
ΣMCT	0.19
ΣSFA	20.80
ΣMUFA	34.62
ΣPUFA	43.33
Σn-3 PUFA	18.11
Σn-6 PUFA	19.68
PUFA/SFA	2.09
n-6/n-3 PUFA	1.09

Effect of age and management practices on quality characteristics of Barbari goat meat

Physicochemical, colour and fatty acid profile of Barbari goat meat from four groups viz., 12 month intact, 12 month castrated, 15 month intact and 15 month castrated were compared. Moisture content in meat was significantly decreased in castrated goat and more significant effect was observed with age while fat content increased. Protein and ash contents were significantly higher in meat from older animals. Water holding capacity (WHC) was found significantly higher in meat from older animals from both groups. Water soluble proteins (WSP) were significantly high in meat from 15 month castrated goat while salt soluble proteins (SSP) and total soluble proteins (TSP) were high in younger intact animals. Hunter colour evaluation of goat meat showed that meat from castrated goats was lighter while meat from younger animals was redder. Palmitic acid (C16:0) content was increased with age and it was significantly higher in 15 month castrated goat meat. Percent stearic acid (C18:0) was significantly decreased with age and it was much lower in castrated animal. Oleic acid (C18:1) content was significantly higher in castrated animals while amount of linoleic acid (C18:2) was higher in intact animals and both the fatty acids increased with animal age. Total saturated fatty acids (SFA) were high in meat from younger animals. Amount of monounsaturated fatty acids (MUFA) were found significantly higher in meat from castrated animals while meat from intact animals had higher polyunsaturated fatty acids (PUFA). Meat from intact animal had significantly higher total omega-3 as well as omega-6 fatty acids.

Goat Health Division

Patho-epidemiological studies on emerging and existing diseases of goats.

R.V.S. Pawaiya, S.V. Singh, D.K. Sharma, Ashok Kumar, V.K. Gupta, Naveen Kumar, K. Gururaj, Shivasharnappa N., A.K. Mishra, Nitika Sharma, Souvik Paul, H.A. Tiwari and V.K. Chaturvedi

A total of 3883 biological samples collected/ received from from Chattisgarh, J&K, Maharashtra, M.P., Rajasthan, U.P. which included sera, blood, swabs, feces, tissues and others. The samples were subjected to various laboratory tests for identification of diseases and the results are given in table below.

Laboratory test results

State	JD		Brucellosis	CAE*
	Sera	Feces		
CIRG	-	-	Goat: 10/48 = 20.83%; Sheep: 22/47 = 46.80%	-
J & K	-	-	47/335 = 14.02%	-
Maharashtra	157/1107 = 14.1%	199/1080 = 18.4%	1/82 = 1.2%	-
M. P.	57/119 = 47.8%	13/39 = 33.3%	17/202 = 8.4%	-
Rajasthan	13/16 = 81.2%	1/5 = 20.0%	0/12 = 0.0%	7/45 = 15.55%
U. P.	15/71 = 21.1%	12/25 = 48.0%	20/204 = 9.8%	6/45 = 13.33%
Total	242/1313 = 18.43%	225/1149 = 18.43%	117/930 = 12.58%	13/90 = 14.44%

*A total of 90 sera samples of goats from Rajasthan and Uttar Pradesh (Mathura Distt. & adjoining areas) were screened for presence of caprine arthritis-encephalitis (CAE) antibodies employing competitive ELISA test (VMRD, USA). Of these, 13 (14.44%) were found to be seropositive [4 (4.44%) strong positive & 9 (10%) weak positive) for CAE.

Out-patients attended

A total of 113 clinical cases comprising of Endoparasitism (30), Ectoparasitism (25), Acidosis (11), Diarrhoea (10), Dog bite (10), Bloat (8), Pregnancy toxaemia (6), Udder impetigo (5), Caesarean section (2), Urolithiasis (1), Plant poisoning (1), Hypovitaminosis A (1), Polioencephalomalacia (1) were diagnosed and treated.

Morbidity

A total 5474 animals were treated at CIRG farms for various disease conditions including diarrhea/enteritis (67.63%), dullness/PUO (8.88%), wound/abscess (5.52%), lameness (4.30), pneumonia/ cold (3.20%), general weakness (2.21%), tympany/colic (1.20%), swollen udder/ mastitis (1.13%), abortion (1.11%) etc.

Mortality

A total of 229 necropsies were conducted from 1.4.2013 to 31.3.2014 involving 59 (25.76%) animals from Animal Health Shed, 53 (23.14%) from Jamunapari unit, 37 (16.15%) from Barbari unit, 33 (14.41%) from Sheep unit, 18 (7.86%) from Jakhrana unit, 15 (6.55%) from NFR&PT and 14 (6.11%) from PRSM. The major causes of death diagnosed were enteritis (17.46%), pneumonia (17.03%), septicaemia (6.98%), hemonchosis (4.37%), anemia/weakness & pregnancy toxemia (3.05% each), gastro-enteritis (2.18%), toxaemia (2.18%), pneumo-enteritis, acidosis, predation, autolysis (14.41%) and miscellaneous diseases (14.84%).

Disease investigation

Eighty samples were processed for histopathological studies. Histopathological diagnosis revealed cases of granulomatous enteritis, acute serous pneumonia, suppurative pneumonia, bronchopneumonia, mycotic pneumonia, bronchioloalveolar proliferative changes etc. Disease investigations were carried out at three villages in Mathura district and one at Garh Mukteshwar in U.P. and arthritis, FMD and suppurative lymphadenitis were diagnosed in several goats. Parasitologically, out of total 542 fecal samples, 139 were positive for coccidian oocysts, 74 for nematode ova and 6 for tapeworm eggs. More than 60 samples from goats and sheep were collected and processed for bacteriological isolation.The samples comprised of blood, pus,

milk, lung, liver, pleural fluid, nasal discharge, kidney, skin scrapings etc. The bacterial pathogens isolated and identified were Staphylococcus aureus, Staphylococci, Streptococcus, Bacillus, E. coli, Pasteurella multocida and Pseudomonas aeruginosa. Fusobacterium necrophorum was identified by PCR from foot rot affected goats in Bundi District, Rajasthan.PCR amplification and sequencing of *E. coli*, Staphylococcus aureus from diarrhoea and pneumonia in goats.

Effect of nutritional deficiency diseases on gene expression profiles in goats.

R.V.S. Pawaiya, U.B. Chaudhary, Nitika Sharma, Shivasharnappa N. and S.P. Singh

Low Cu and Zn feed formulation was carried out as per the following table, considering the fact that normal requirement levels for Cu at 7-12 mg/kg DM and Zn at >35 mg/kg in ruminants.

Sl. No.	Ingredients	Quantity (g/kg)
1.	Maize	542.50
2.	Starch	200.00
3.	Casein	230.00
4.	Mineral mixture	20.00
5.	Vitamin premix	5.00
6.	Sodium bicarbonate	2.50
7.	Cu =	4.54 mg/kg
	Zn =	21.25 mg/kg

Experimentation was carried out in 36 6-9 month old male barbari goats after dividing them in 4 groups with 9 animals in each and treatment was given as: Group-A: Copper-deficient diet; Group-B: Zinc-deficient diet, Group-C: Copper & Zinc combined-deficient diet; and Group-D: Control with balanced ration. Regular observation on body wt. revealed consistent increase upto 180 weeks, with group-B animals showing marginally better body wt gains over time. Testicular measurements of experimental animals did not show significant changes among groups. The correlation of testicle sizes was quite significantly associated with the body wt., especially of testicular circumference and girth of left testicle. Effect of Cu & Zn deficient diet feeding on dry matter intake (g/d/animal) was found to be 640.41±8.43 in Gr-A, 607.22±8.00 in Gr-B, 643.75±8.48 in Gr-C and 636.52±8.38 in Gr-D.

Clinically, the animals started showing signs, especially of Cu-deficiency in the A group, from 60 days onwards with progressive roughness of hair coat and increasing tendency of coarseness of hairs till 165 days as depicted in the figures below. Group-C animals fed Cu & Zn combined deficient diet also shoed tendency of rough hair coat with increasing time however, the degree of changes were less intense compared to the group-A animals. Group-B (Zn-deficient) and control (group-D) animals did not show any discernible changes in their skin hair coat.

Pathologically, gross lesions were not observed in an animal from Cu-deficient group-A which died at about 90 days of experimentation. However, the animal from Zn-deficient group-B died at about 105 days showed significantly atrophic testes in comparison to the control animal of group-D that was also died on the same day. The overall size and weight of both the testes of Zn-deficient animal was significantly decreased (wt. 9.19 and 9.39 g/ length 5.0 and 5.5 cm for right and left testicles, respectively) in comparison to the control animal (wt. 26.27 and 27.74 g/ length 6.5 and 7.2 cm for right and left testicles, respectively).

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

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

A total of 1203 faecal (749 from Jamunapari and 454 from Jakhrana) were collected and examined for gastrointestinal nematodes infection specially for *Haemonchus contortus*. The incidence of different parasitic infections was reported. The highest coccidian incidence was recorded 100 per cent in Barbari. The highest strongyles incidence (predominantly *Haemonchus contortus*) was 46 per cent again in Barbari. The other parasitic infections recorded were *Moniezial* and *Strongyloides* spp. The data generated on FEC was transformed through log transformation to normalise the skewedness. The transformed data was used for statistical analysis. The data was analysed using least squares means analysis model –I (Harvey, 1990) based on sire line. Non genetic factors like age, sex, type of birth, birth weight and season of collection along with genetic effect of sire were considered in analysis.

Farms	Age	Observations	Incidence			
			Cocci +	Strongyle+	Moniezia+	Strongyloides+
Barbari	Total	393	74.3(292)	38.7(152)	5.08(20)	0.50(2)
	Adult	220	65.0(143)	46.3(102)	0.45(1)	0.90(2)
	0-3 M	30	90.0(27)	3.33(1)	16.6(5)	0.0
	>3-6M	73	69.8(51)	23.28(17)	4.1(3)	-do--
	>6-12M	70	100.0(70)	35.7(25)	15.7(11)	-do--
Jamunapari	Total	749	83.2(623)	18.8(141)	2.00(15)	3.33(25)
	Adult	110	85.5(94)	41.8(46)	3.63(4)	15.45(17)
	0-3M	33	93.9(31)			0.0
	>3-6M	5.7	80.8(464)	12.6(64)	2.16(11)	-do--
	6-12M	99	92.0(92)	13.1(13)		8.08(8)
Jakhrana	Total	454	81.9(372)	34.6(157)	5.28(24)	0.66(3)
	Adult	191	82.2(157)	27.2(52)	3.66(7)	1.57(3)
	0-3M	51	68.6(35)	5.88(3)	1.96(1)	0.0
	>3-6M	89	98.8(88)	71.9(64)	12.35(11)	-do--
	>6-12M	123	80.5(99)	16.26(20)	4.06(5)	-do--

Most Resistant and susceptible Sires in Jakhrana and Jamunapari flocks at CIRG

S.No.	Jakhrana			Jamunapari		
	Sire	LFEC	GSM(x200)	Sire	LFEC	GSM(x200)
	Resistant			Resistant		
1	201(28)	5.030	152	6659(5)	4.395	81
2	0 (3)	5.039	154	6681(7)	4.505	91
3	598(2)	5.076	160	5902(10)	4.515	91
4	154(6)	5.147	171	6546(5)	4.537	93
5	190(38)	5.154	173	6996(11)	4.633	103
	Susceptible			Susceptible		
1	152(4)	5.947	382	5012(8)	6.105	448
2	12(3)	5.907	367	6697(5)	5.991	400
3	672(6)	5.681	293	5255(5)	5.321	205
4	314(6)	5.657	286	4682(7)	5.313	203
5	588(4)	5.377	216	5277(5)	5.296	200

A total of 14 sires with at least 2 offspring were evaluated. For Jamunapari, total 57 sires with at least 3 offspring were considered for evaluation. The effect of sire in both the breeds was not significant; however, the sires in both breeds were listed and graded on the basis of mean LFEC. The five resistant and five susceptible sires in both breeds are presented in Table above. Non

genetic factors like season of collection and age were found to have significant effect on faecal egg count in infected animals in both the breeds of goats (Table). On the other hand, effect of factors like type of birth, birth weight and sex was not significant.

A total of 120 blood samples (Jamunapari) were collected and haematological values were ascertained for generating the data for genetic correlation. The molecular techniques of extraction of RNA from tissues of natural infected (H. contortus) and cDNA preparation were standardized.

Factor wise Least Squares Means Faecal Egg Count in *Haemonchus contortus* infection (Natural) in Jakhrana goats.

Source of variation	No. of Observation	Least Squares means	SE
Age			
0-3M	32	4.612	0.236
>3-6M	73	4.995	0.187
>6-12M	11	5.753	0.332
>12M(Adult)	85	5.976	0.208
Season of Collection			
Summer	71	5.381	0.198
Rainy	68	5.754	0.215
Winter	62	4.868	0.226
Sex			
Male	94	5.302	0.196
Female	107	5.366	0.191
Type of Birth			
Single	66	5.341	0.163
Twin	127	5.530	0.159
Triplets	8	5.132	0.378
Birth Weight (Kg)			
<2.60	10	4.801	0.344
>2.6-3.0	72	5.365	0.184
>3.0-3.5	99	5.376	0.179
>3.5	12	5.742	0.306

Factor wise Least Squares Means Faecal Egg Count in *Haemonchus contortus* infection (Natural) in Jamunapari goats

Source of variation	No. of Observation	Least Squares means	SE
Age			
0-3M	40	4.367	0.147
>3-6M	393	4.967	0.077
>6-12M	105	5.211	0.104
>12M(Adult)	340	5.291	0.075
Season of Collection			
Summer	312	4.559	0.720
Rainy	264	5.152	0.814
Winter	302	5.167	0.667
Sex			
Male	280	4.897	0.071
Female	598	5.021	0.058

Achieving improved livelihood security through resource conservation and diversified farming system approach in Mewat

D.K. Sharma and P.K. Rout

A total of 7 animal health camps were organized in adopted villages to provide door to door health services to animal owners. In 4 Villages *i.e.* Singalhedi, Jharpedi, Badarpur and Maroda, 84 goats were vaccinated for FMD and HS, 103 goats were vaccinated for ET and 90 goats were vaccinated for PPR. A total of 87 animals (goats, sheep and buffaloes) were treated for various ailments in camps. In all 257 goats were dewormed and 54 dipping were performed in camps. Recording of data on production like milk, body weight and reproductive performance was recorded. Under reproductive performance kidding rate in Sirohi (Jharpadi), Jakhrana and Sirohi (Maroda) was 1.16, 1.40 and 1.21 litter/kidding, respectively. The overall mortality recorded in 2013-14 was 2.51 per cent. With highest sold percentage of goats of 45.05, being recorded in Jharpadi, the income of farmers from goats was enhanced with Rs.15400/annum. During upgrading programme of local goats, the performance of new genotype Sirohi x Totapari goats was recorded and compared with the Sirohi animals. The new genotype performed remarkably well in local conditions.

Population growth of goats in adopted villages

Villages	Opening Balance	Breed able Female	Addition	Total	Deaths	Sold	Available
Jharpadi	56	30	35	91	1	41	49
Singhalhedi	54	22	31	85	4	37	44
Maroda	40	19	23	63	1	26	36

Performance of Sirohi and Sirohi x Totapari cross

Crosses	Birth Wt. (Kg.)	15 Day Wt. (Kg.)	1 M Wt. (Kg.)	3 M Wt. (Kg.)
Sirohi ♂ x Totapari ♀				
Male	2.83(4)	5.95(4)	8.13(4)	17.0(2)
Female	3.01(6)	5.80(2)	7.86(3)	14.5(4)
Totapari ♂ x Sirohi ♀				
Male	3.54(4)	5.90(3)	7.23(3)	12.6(2)
Female	3.10(3)	5.80(3)	6.95(2)	11.8(2)
Sirohi ♂ x Sirohi ♀				
Male	2.62(15)	4.93(12)	6.80(8)	12.51(11)
Female	2.53(13)	5.14(11)	6.19(11)	12.4(9)

Development of herbal anthelmintic and acaricidal formulations for goats

Ashok Kumar, D.K. Sharma, Nitika Sharma, V.K. Gupta, U.B. Chaudhary, H.A. Tiwari and Vinay Chaturvedi

Collection and extract preparation of plant material

Selected 10 plants were collected from herbal garden maintained at CIRG , Makhdoom and near by area and coded as CIRG-1 to CIRG-10. Crude extract was prepared by using Methanol in Soxhlet and microwave extraction system. The percentage yield was ranged from 7-27%.

Brine Shrimp Lethality Assay: *Artemia salina* Leach cysts were obtained from pet USA. About 5 mg of cysts is incubated in plastic bottle with 50 ml of artificial sea water (ASW) of pH 8 at 28 °C during 48 hours. The nauplii slowly move out of the vial through the perforated lid into the beaker which is pipetted out using a micropipette. The shrimp of 20-32 hours old were pipetted in 24-

multiwell plates (20 per well) containing 1 ml of each plant crude extract. Concentrations of extracts (10, 5, 2.5, and 1.25 mg/ml), and Dichromate Potassium ($K_2Cr_2O_7$) solution (1.0, 0.5, 0.25 and 0.125%, used as positive control) were diluted in artificial sea water and were added to the wells (1 ml per well). Tree replicates were run per concentration. They are then incubated at temperature of 25°C. To determine the acute LC_{50}, the number of death nauplii in counted in every well after 6 h. counting for the chronic LC_{50} begins 24 h after initiation of the test. These data was processed in a readily available personal computer program (Finney) to estimate LC_{50} values for statistically significant comparison of potencies.

Artemia salina lethal concentration fifty (LC_{50})

Plant Extracts	LC_{50} current toxicity at 6h (mg/ml)	LC_{50} chronic toxicity at 24h (mg/ml)
CIRG-7	7.50	5.02
CIRG-8	5.53	1.46
CIRG-10	13.0	1.95
CIRG-9	2.50	1.26

Adult worm's mortality test: Adult worms were collected from goats in Slaughterhouse of Agra city. Immediately after slaughtering, the abomasum was removed, opened and placed in 37 °C saline (0.9%). The mobile worms were rapidly collected and put into 24-multiwell plates, 10 worms per well in 2 ml of each plant extract solution at 37 °C in saline at varying concentrations (50, 25, 12.5 and 6.25 mg/ml) or Albendazole solution (1.0, 0.5, 0.25, 0.125 %, used as positive control). The lowest LC_{50} was recorded 22.71 (2 hrs), 37.2 (3 hrs), 21.76 (6 hrs) , 27.06 (6 hrs), 30.33(6hrs) and 34.32mg/ml (3hrs) interval in *CIRG-2*, *CIRG-5*, *CIRG-3*, *CIRG-6*, *CIRG-1and* *CIRG-4* respectively. The results indicated that 2 exerts pronounced anthelmintic effect against adult worms of *Haemonchus contortus* with more than 50% mortality at a dose of 25 mg/ml from the sixth hour of incubation. This action is equivalent to 1% albendazole. The generalized death of all the worms intervened between 6 and 24 hours.

Adult worms Lethal concentration fifty (LC_{50}) mg/ml

Extracts plant	1 h	2 h	3 h	6 h
CIRG-2	48.62	22.71	15.32	-
CIRG-5	-	66.34	37.2	-
CIRG-3	50.81	39.68	29.15	21.76
CIRG-6	105.61	35.90	28.95	27.06
CIRG-1	-	-	61.61	30.44
CIRG-4	65.30	47.86	34.32	-
CIRG-7	-	106.0	-	-
CIRG-8	102	-	-	40
CIRG-10	-	-	-	88
CIRG-9	-	-	-	448

Mortality test of third-stage infective larvae

Fecal samples were collected from the goats reared at CIRG and farmers goat flock nearby to Institute for *Haemonchus contortus* larvae culture. *H. contortus* L_3 were obtained by fecal culture. Eggs reached the L_3 stage after 8 days. The L_3 were then collected by sedimentation using Baermann's devices. The larvae suspension with a concentration of 200 larvae/ml, was distributed in 24-multiwell plates (0.5 ml per well). Concentrations of crude extracts (100, 50, 25 and 12.5 mg/ml), and Albendazole solution (2.0, 1.0, 0.5, and 0.25%, used as positive control) were diluted in distilled water and were added to the

wells (0.5 ml per well). In addition, negative controls in distilled water was also included in the assay. In first phase , Anthelminitic activity on larvae of haemonchus contortus infection was good with *CIRG-2*, *CIRG-5*, *CIRG-3*, *CIRG-6*, *and CIRG-4* showing lowest LC_{50} of 8.44,14.27 ,11.89,3.44 and 10.62 mg/ml respectively in 1-6 hrs interval .The action of plant extracts of L_3 larvae indicates that they are all effective against the larvae of the parasite with 50-68 % mortality at 6 h at a dose of 25 mg/ml, which was better in comparison with 1% albendazole at the same time. Again *CIRG-8* seems to have the best efficacy as well as *CIRG-9*. The precocity effect is detained by *CIRG-9* that induced 20% mortality of larvae in the first hour of incubation.

Larvae L_3 lethal concentration fifty (LC_{50}) (mg/ml)

Extracts	2 h	3 h	4 h	5 h	6 h	24 h
CIRG-2	31.39	20.97	13.14	10.69	8.44	
CIRG-5	25.90	19.25	14.27	-	-	
CIRG-3	33.53	17.59	11.89	-	-	
CIRG-6	11.30	7.95	3.44	-	-	
CIRG-1	65.31	47.86	34.25	-	-	
CIRG-4	-	17.14	13.32	10.61	-	
CIRG-7	-	-	-	-	16.02	10.94
CIRG-8	-	-	-	-	8.57	8.57
CIRG-10	-	-	-	-	16.16	9.14
CIRG-9	-	-	-	-	11.33	8.01

Chromatographic seperation of *CIRG-2* leaves MeOH extract

Five chromatographic fractions were obtained during column chromatography of *CIRG-2* leaves MeOH extract. Fraction 2 and 4 were used for anthelmintic activity since they are in mojor proportion while rest of the fractions were in very minute quantity. The LC_{50} calculated for fraction 2 at 1, 2, 3 and 6 hour post exposure. Mortality percent recorded were 44.4, 37, 37.4, 62.7, 70.8; 77.8, 58.9, 60, 84.1, 84.7 and 100, 100, 100, 100, 100 post exposure at concentration 3.125, 6.25, 12.5, 25 and 50 mg/ml at different time intervals. LC_{50} calculated was 11.9 and 3.66 mg/ml at 2 and 3 hours post exposure respectively.

Egg Hatch assay

Fecal samples collections were made both at CIRG and at Farah and Mathura for *Haemonchus contortus* eggs extraction. Eggs were extracted from feces. The egg suspension with a concentration of 200 eggs/ml, was distributed in 24-multiwell plates (0.5 ml per well). Concentrations of crude extracts (100, 50, 25, and 12.5 mg/ml), and Albendazole solution (2.0, 1.0, 0.5, and 0.25%, used as positive control) were diluted in distilled water .The LC 50 recorded were 7.06,5.8, 40.7,47.0,21.7 and 81.7 mg/ml in CIRG 3,2,1,5,4,6 respectively.

Phytochemical screening of plants and results: both qualitative and GC-MS analysis was done.

Thin Layer Chromatography of plant extrcats : The TCL Plates (Silica gel 60 F 254 nm, MERCK) was used. The solvent system was kept **n-Hexane:Acetone(75:35).** The plates were examined under UV 366 and UV 254 nm and Rf values were recorded.

Rf values of various spots detected under 366 nm on TLC plate (Sovent front= 71 mm). Sovent system used was

CIRG-3	CIRG-4	CIRG-1	CIRG-2	CIRG-6
0.09	0.09	0.029	0.10	0.16
0.70	0.57	0.51	0.53	0.50
0.77	0.77	0.77	0.74	0.61
0.86	0.86	0.89	0.89	0.77
				0.86

Clinical trial of plants Extracts : CIRG-3 and CIRG-2 was given at The doses of 100 mg/kg body weight o.i.d for 3 days as oral formulation . In CIRG-3 ,the percentage faecal egg count reduction was 11.81% and 50.26% 7th and 14th day post treatment . The EPG counts also showed significant reduction on 7th day post treatment and on day 14 post treatment. Similarly, The CIRG-2 crude methanolic extract at same dose rate, resulted percentage faecal egg count reduction of 16.42 ±2.63 and 59.20±2.26 on the 7th and 14th day post treatment respectively. The EPG counts also showed significant reduction on 7th and 14 post treatments. In positive control, six animals were treated with tab. Albendazole @7.5 mg/kg body weight single dose on Day 0 and Day 14. The percentage faecal egg count reduction was recorded as 96.027 ± 1.95 and 100.00 ± 0.00 on the 7th and 14th day post treatment. The EPG counts also showed significant reduction on both duration. The hamatological and biochemical parameters were monitored.

Development and characterization of indigenous vaccine and diagnostics for johne's disease

S.V. Singh and Naveen Kumar

Whole genome sequencing

Sequencing of whole genome of native isolate of 'Indian Bison Type' Biotype of Mycobacterium avium subspecies paratuberculosis Strain 'S 5' of goat origin (CIRG, Makhdoom) was completed and data was analyzed. Genome size of indigenous MAP strain, named as 'Indian Bison Type' and draft sequence reported in Genome Announcement.

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. NGS QC 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 (Genebank 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 oxido-reduction. A total of 4 serine/threonine protein kinases (STPKs) are also present in the annotation, which are part the of phosphorelay system.

The MAP 'S 5' strain has been transferred to Veterinary Type Culture Center (VTCC), Hisar and MTCC, Chandigarh.

Quality test of 'Indigenous Vaccine' for Johne's disease by the Standardization division of IVRI, Izatnagar The vaccine vials supplied for testing belong to batch numbers; PD75aC 12001, PD75aC 12002 and PD75aC 12003 and vaccine was found to be 'safe and sterile' by the Standardization division of IVRI, Izatnagar.

Screening of farm animals for MAP infection (Johne's disease) by multiple diagnostic tests

Jakhrana unit at CIRG, was reported suffering with weakness, diarrohea and deaths. Therefore, all the adult goats (males and females) at the farm were sampled (118 fecal samples). Goats were screened for the presence of MAP infection by

microscopy. Of 118 fecal screened by Ziehl Neelsen staining, 92 (77.9%) were positive for acid fast bacilli indistinguishable to MAP. Screening of 17 goats by Indigenous ELISA, 11 (64.7%) were positive for MAP infection.

Fecal samples from suspected Jamunapari goats (suffering with diarrohea) were sampled and screened for MAP by microscopy. Of 18 Jamunapari goats screened, 16 (88.8%) were positive for acid fast bacilli indistinguishable to MAP and 2, 2, 8 and 4 goats were in +4, +3, +2 and +1 level shedders, respectively. Of 8 Barbari goats screened by microscopy, 4 (50.0%) were positive by microscopy. Muzaffarnagri sheep unit at CIRG was reported suffering with weakness and diarrohea. Forty adult sheep (males and females) of farm unit were sampled (40 fecal and 40 serum samples). Of 40 fecal samples, 32 (80.0%) were positive by microscopy for acid fast bacilli indistinguishable to MAP. Of 40 serum samples, 29 (72.5%) were positive for MAP antibodies.

General screening of farmer's goats

Screening of goat farm at Barabanki, Lucknow: Of 33 goats screened by fecal microscopy, 23 (69.6%) were positive for acid fast bacilli indistinguishable to MAP using ZN staining.

Of 50 adult sheep (2-2.5 years old) screened, 29 (58.0%) were positive for JD using 'Indigenous ELISA kit'. Sero-incidence of JD was higher in adult sheep at Aseda sheep farm.

Screening of cattle and buffaloes from Dantiwada, Gujarat: Of the 15 animals screened, 6 (40.0%) were positive for JD using 'Indigenous ELISA kit'.

Of the total 71 [17 (0-18 months), 11 (18-30 months) and 43 (>30 months)], nine calves (2-11 months of age) died showing symptoms of weakness except one calf which had diarrhea. Of 35 fecal samples screened by microscopy, 24 (68.5%) were positive for *Mycobacterium avium* subspecies *paratuberculosis* (MAP). Screening of 26 serum and 23 milk samples by 'Indigenous ELISA kit' employing, 24 (92.3%) and 14 (60.8%) were positive, respectively. Sensitivity of 'Indigenous serum ELISA' with reference to fecal microscopy and milk ELISA was 88.2 and 90.0%, respectively. Screening of blood samples of 14 cows, by specific PCR (IS*900*), 5 (35.7%) were positive. Genotyping of PCR positive HF crossbred cows using IS*1311* PCR-REA showed presence of highly pathogenic 'Indian Bison type' genotype. Comparison of 3 tests (milk ELISA, fecal microscopy and IS*900* PCR) with 'Indigenous serum ELISA' revealed substantial agreement between tests.

Vaccine Therapy to recover dairy farm from outbreak of JD using indigenous vaccine

Developed vaccine were used in 20 JD positive cows . Gel (Aluminium hydroxide gel) with 2.5 mg of Inactivated *Mycobacterium avium* subspecies *paratuberculosis* strain 'S-5'genotype 'Indian Bison Type' in 1 ml of the Alhydro-oxide gel with 0.01% Thiomersal (antifungal agent) were used in small ruminants (1 ml sub-cutaneously) and 2 ml in bovines (cattle and buffaloes). On the basis of screening of 509 samples from 309 animals belonging to different livestock farms, the prevalence of MAP was 69.9, 61.2 and 47.6% using microscopy, indigenous ELISA and IS*900* PCR, respectively. Present findings report very high bio-load of the MAP in the domestic livestock population screened.

Experimental shed, Animal Health Division, CIRG, Makhdoom: Goat herds maintained on Optimum Plane of Nutrition

The vaccine was also tried in different goat farms in India with encouraging results.

Outreach program on zoonotic diseases : Zoonotic potential of *Mycobacterium avium* subspecies paratuberculosis, as the cause of inflammatory bowel (Crohn's disease) in human beings.

S. V. Singh and Naveen Kumar

1054 samples (blood – 518, serum – 518 and stool - 18) were collected from 518 individuals from Agra. Of 518 serum samples collected were screened by 'Indigenous ELISA kit' and 1.0 and 48.1% were found in strong positive and positive categories, respectively for *Mycobacterium avium* subspecies *paratuberculosis* (MAP) infection. Cumulatively, 49.2% human samples were positive for MAP infection from Agra region. Study showed significantly higher association of MAP in cases of hypo-thyroidism (67.0%) and diabetes (42.6%) as compared to other conditions (33.3%).

Screening of twenty two human patients suffering from different types of chronic illness for MAP infection by 'Indigenous ELISA kit' revealed that 9.0 and 36.0% samples were in strong positive and positive categories, respectively. However, cumulatively here too 45.4% human samples were positive for MAP infection. Screening of 22 blood samples of these patients by IS*900* blood PCR, 18.1% were positive for MAP infection. Of 18 stool samples screened by microscopy, 54.4% were positive for presence of acid fast bacilli indistinguishable to MAP. Shedding intensity of MAP was graded as +1, +2, +3 and +4.. Comparatively stool microscopy was most sensitive followed by serum ELISA and blood PCR (table).

Comparative evaluation of Indigenous ELISA kit, IS*900* PCR and Microscopy for presence of MAP infection in IBD/IBS humans ailments

Diagnostic tests	Combinations							
Indigenous ELISA kit	+	-	+	-	+	+	-	-
IS*900* PCR	+	-	+	+	-	-	+	-
Microscopy	+	-	-	+	+	-	-	+
Total (17)	3 (17.6)	3 (17.6)	1 (5.8)	0 (0.0)	5 (29.4)	1 (5.8)	0 (0.0)	4 (23.5)

*Figures in parentheses are percentage.

Some of the chronically sick patients positive for MAP infection were treated with anti-MAP therapy and have been followed up for improvement.

A total of 111 human samples (88 serum and 71 blood) were collected from a health camp organized by NGO and Gwalior Medical College, at Chattarpur district of Madhya Pradesh for screening of human population for diabetes. Of the 111 suspected human patients screened for diabetes, 20 (18.0%) were positive using commercial kits (ACCU-CHEK test strips). Of the 88 suspected diabetes patients, 3.4 and 35.2% were positive for MAP infection by ELISA kit. Of the 88 and 71 healthy suspects screened by ELISA kit and IS900 PCR, 38.6 and 39.4% were positive, respectively for MAP infection. And of 19 and 16 diabetes patients screened, by ELISA kit and IS900 PCR, 31.5 and 43.7% were positive, respectively for MAP infection. Comparative evaluation of two tests in 68 suspected human patients showed that 23.5% persons were positive for MAP infection by both the tests. However, 20.5 and 14.7% were positive in ELISA kit and IS900 PCR, respectively. Comparative evaluation of two tests in 15 diabetes patients, showed that 6.6% patients were positive for MAP infection by both the tests. However, 20.0 and 46.6% were positive in ELISA kit and IS900 PCR, respectively. In suspected and confirmed cases of diabetes, blood IS*900* PCR was more sensitive as compared to indigenous ELISA kit. Typing of IS*900* and IS*1311* PCR positive MAP DNA showed that human population was infected with 'Indian Bison Type' MAP, which is major bio-type infecting animals.

A new trend was noticed with emergence of Cryptosporidium in adult human and animal population with clinical disease in association with infection of MAP. Following fecal / stool samples from goats, cattle and human beings were routinely processed for the diagnosis and monitoring of MAP infection. The samples were processed for microscopy by routine method of concentration by cerntrifugation and acid fast staining of the smears and were examined under 100X of the microscope. Results show the increased presence of heavy (+4) infection of Cryptosporidium spp., singly or with MAP infection. These fecal samples were driven from goats (Etawah), cattle (Ludhiana) and human (Farah, Mathura) samples and were suspected for MAP infection and had symptoms of weakness, constipation, loss in body condition and diarrhoea. Present study revealed presence of heavy infection (+4) of Cryptosporidium spp. Cryptosporidium spp., a single cell parasite has been associated with cases of diarrhoea in young age in animals and has also been reported from young children (Zoonotic) has been found. However, we have reported two cases of Cryptosporidiosis in human beings, where patients suffered with symptoms of IBD. In case of a teenage girl (16 years) suffered with symptoms of IBD and was positive for MAP infection in ELISA, PCR and microscopy (+ 2). Whereas, an adult boy (22 years) suffered with chronic constipation for last one year was exclusively affected with Cryptosporidium .

Of 24 paneer samples processed for the detection of MAP, 3 (12.5%) and 1 (4.2%) samples of paneer fat and sediment, were positive respectively in microscopic examination.

PCR standardization of five susceptibility gene for Crohn's Disease :

Screening of milk samples and milk products (Paneer) for presence of MAP: Of 24 paneer samples processed for the detection of MAP, 3 (12.5%) and 1 (4.2%) samples of paneer fat and sediment, were positive respectively in microscopic examination.

Screening of milk samples and milk products (Paneer) for presence of MAP: Raw milk samples from rural area to district headquarter were screened to estimate presence of MAP in raw and bulk milk tank supplies

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, Shivasharanappa N., K. Gururaj, P.K. Rout and Ashok Kumar

PCR, Sequencing and Characterization of goat TLRs 1, 2 and 3

DNA isolation from blood samples

Blood samples were collected from 4 different breeds of goats viz., Barbari, Sirohi, Jamunapari, Jakhrana from the CIRG experimental Goat shed. The blood samples were subjected to DNA isolation using commercial DNA isolation kit. The concentration and quality of isolated DNA was checked using Biophotometer.

Primer designing

Primer designing for goat TLR1, 2 and 3 were done using the available database sequences from Genbank. Sequences from different submissions were aligned using ClustalW and the coding sequence of 2193bp, 2355bp and 2715 bp respectively for TLR1, 2 and 3 were taken for primer designing and gene amplification. Multiple sets of oligonucleotide primers spanning the entire coding region of all the TLRs from 1-3 (see Table 1) were designed using FastPCR and validated using OligoAnalyzer 2.0.

Primers for TLR 1-3 in Goat *(Capra hircus)*

Gene	Accession No	F/R PRIMER	Length (bp)	Size(bp)
TLR1_F1	NM_001135060.1	F CAGATGCCTGACATCCTCTC	20	828
		R CGCAGCAGACACTGTGAGAT	20	
TLR1_F2	NM_001135060.1	F CCAACATCTCACAGTGTCTGC	21	666
		R CAGCCCTCTACCACGTCACT	20	
TLR1_F3	NM_001135060.1	F CAAAGCAGGGAACAATCCAT	20	821
		R AAATCTCTGTGTAAAGTACTTCTGCTG	27	
TLR2_F1	NM_001048231.1	F ATGCCACGTGCTTTGTGG	18	890
		R GCTGTAAAATCGCCAACTCC	20	
TLR2_F2	NM_001048231.1	F GGAGTTGGCGATTTTACAGC	20	825
		R GTCACAGCGGTAGCCATCTG	20	
TLR2_F3	NM_001048231.1	F GACTGGCCAGATGGCTACC	19	687
		R CTAGGACCTTATTGCAGCTCTC	22	
TLR3_F1	NM_001135928.1	F ATGAGCAGGCCTTTGCCTTA	20	697
		R TGGCATTGTTCAGAGAGAGG	20	
TLR3_F2	NM_001135928.1	F GGCCTCTCTCTGAACAATGC	20	829
		R GTGAAGGGGAGCTATCCACA	20	
TLR3_F3	NM_001135928.1	F TGTGGATAGCTCCCCTTCAC	20	749
		R AACCGAGAACTCGATGCACT	20	
TLR3_F4	NM_001135928.1	F CATTTTGAAGGCTGGAGGAT	20	539
		R TGTACTGAATTTCTGGACCCAAG		

Polymerase chain reaction

The TLR sub-genic fragments were amplified using PCR. The PCR products were purified using commercial gel elution kit and sequenced using Sanger's dideoxy method.(Fig 2)

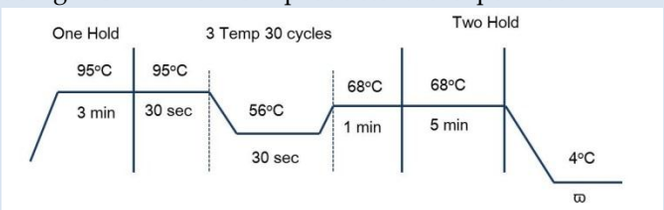


Fig 1. Cycling conditions for PCR Hi-fidelity amplification of TLRs 1, 2 and 3

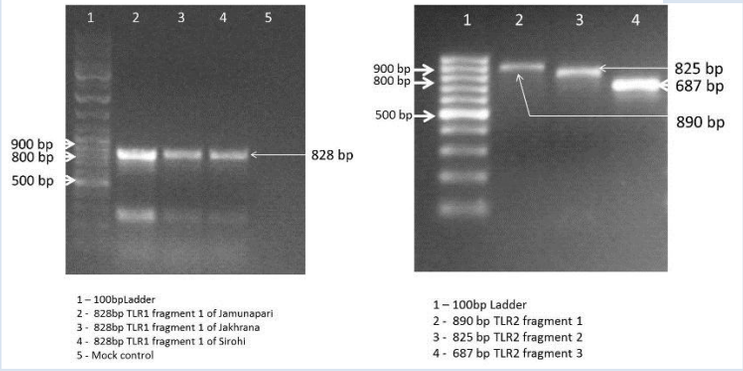


Fig 2. Showing different TLR fragments amplified using hi-fidelity PCR

Sequence alignment and phylogenetic analysis

The different contiguous fragments that were sequenced were aligned using Bioedit software with the existing database sequences. The contiguous fragments for TLR1, 2 and 3 are three, three and four respectively.The final coding sequence was aligned and it contained 2355 nucleotides for all the four breeds of goat TLR2 (see Fig. 3) that were sequenced, followed by 2193 and 2715 nucleotides for TLR1 and 3 respectively. All the four breeds of goats were aligned with the different species of livestock and other animals using Clustal W and were subjected to phylogenetic analysis using neighbor joining (maximum composite likelihood) method with molecular evolution and genetic analysis [Mega 5.2] software as represented in fig 4. The ORF of TLR2 consisted of 2355bp and the sequenced information was submitted to genbank for the breeds Barbari (KF 765736.1), Jamunapari (KJ183648.1), Sirohi (KJ183650.1) and Jakhrana (KJ183649.1). The aligned and processed nucleotide sequences were drawn to phylogeny using maximum composite likelihood method, and found that all the four breeds of goats taken in the current study were in the same clade as of other goats and sheep. While, the other species that were found to be closest in clade are exotic cattle and nilgai. Whereas the primates and rodents falling much distant in the phylogenetic tree. TLR2 sequences of four different breeds were sequenced with the idea that the preliminary data of these indigenous breeds be available for the researchers. But interestingly the TLR2 was found to contain considerable nucleotide variations in the open reading frame of all the four different breeds.

TLR2 protein homology and 3D modeling

The TLR2 coding sequence of goat was translated and it was composed of 785 amino acid residues. The translated sequence was compared with the other species by aligning them in a SMART online tool (http://smart.embl-heidelberg.de/) for identification of signaling domains using protein domain annotation as depicted in Fig 5.

Table 2. Toll-like receptor genes 1 to 3 sequenced for different breeds of Indian Goats and its Genbank accession numbers

S.No	Gene	Breed	Accession No. obtained
1.	TLR1	Barbari	KJ 210570.1
2		Jamunapari	KJ 210567.1
3		Sirohi	KJ 210568.1
4		Jakhrana	KJ 210569.1
5	TLR2	Barbari	KF 765736.1
6		Jamunapari	KJ 183648.1
7		Sirohi	KJ 183650.1
8		Jakhrana	KJ 183649.1
9	TLR3	Barbari	KJ 210566.1
10		Jamunapari	KJ 210563.1
11		Sirohi	KJ 210565.1
12		Jakhrana	KJ 210564.1

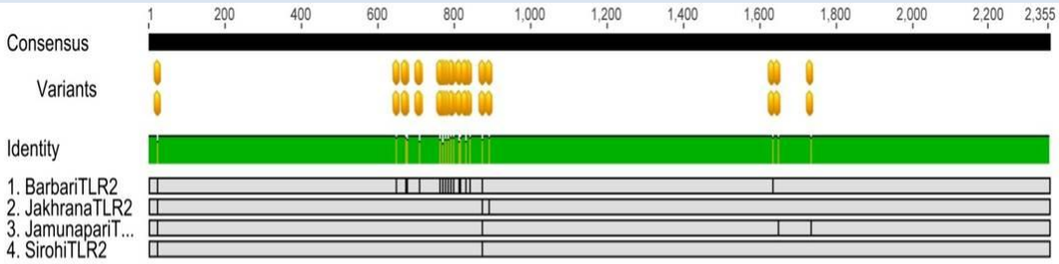


Fig 3. Nucleotide variations in TLR2 of four different breeds of Indian goats in comparison with the consensus sequence

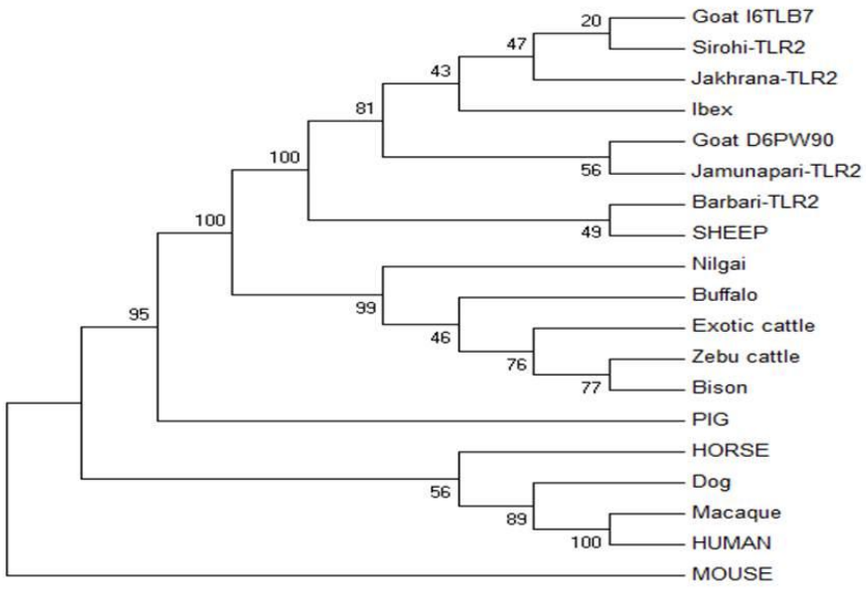


Fig 4 . Phylogenetic analysis of TLR2 sequences of four breeds of goats with the other domestic species

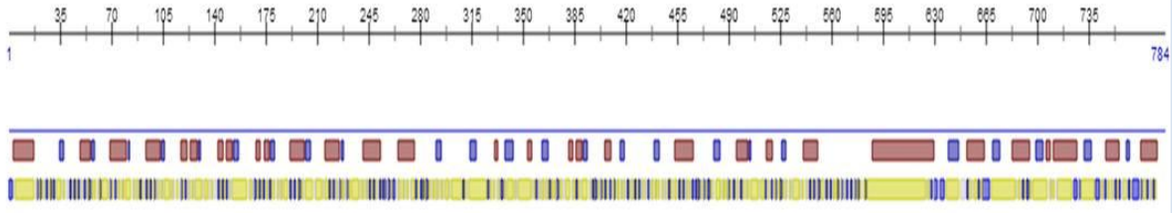


Fig 5. Signaling domains of TLR2 protein of Barbari

The goat TLR2 protein sequence was analyzed for its homology by ranking with the closest template based protein model (Fig. 6) and a three dimensional structure was designed using RaptorX online structure prediction server that identifies 3-state and 8-state secondary structure of protein along with its solvent accessibility. Further analysis was aimed at model assisted protein binding site prediction and Protein residue contact prediction for TLR2 amino acid sequence using RaptorX binding site prediction tool and contact prediction tool respectively. The nucleotide sequences were translated into aminoacids to predict the structural and functional properties of caprine TLR2. All the four breeds analyzed contained 10 leucine rich repeats, one LRR-CT and a transmembrane domain followed by a much conservative Toll interleukin 1 receptor (TIR) domain. The ectodomain of predicted TLR2 protein structures were between aminoacid residues 22 to 574 and the intracytoplasmic domains were between residues 624-784 (Fig. 7). The aminoacid changes in the TLR-2 protein between different Indian goats against other species of domestic animals have been compared and identified to foresee any gross structural changes in the protein molecule.

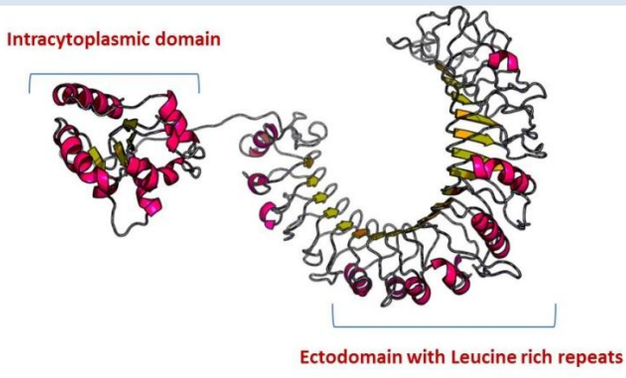


Fig. 6 TLR2 protein model predicted using template –based Raptorx prediction tool

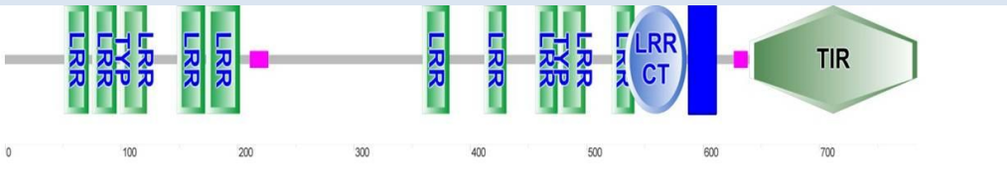


Fig. 7 Illustrative structure of Jamunapari TLR2 receptor depicting the different domains

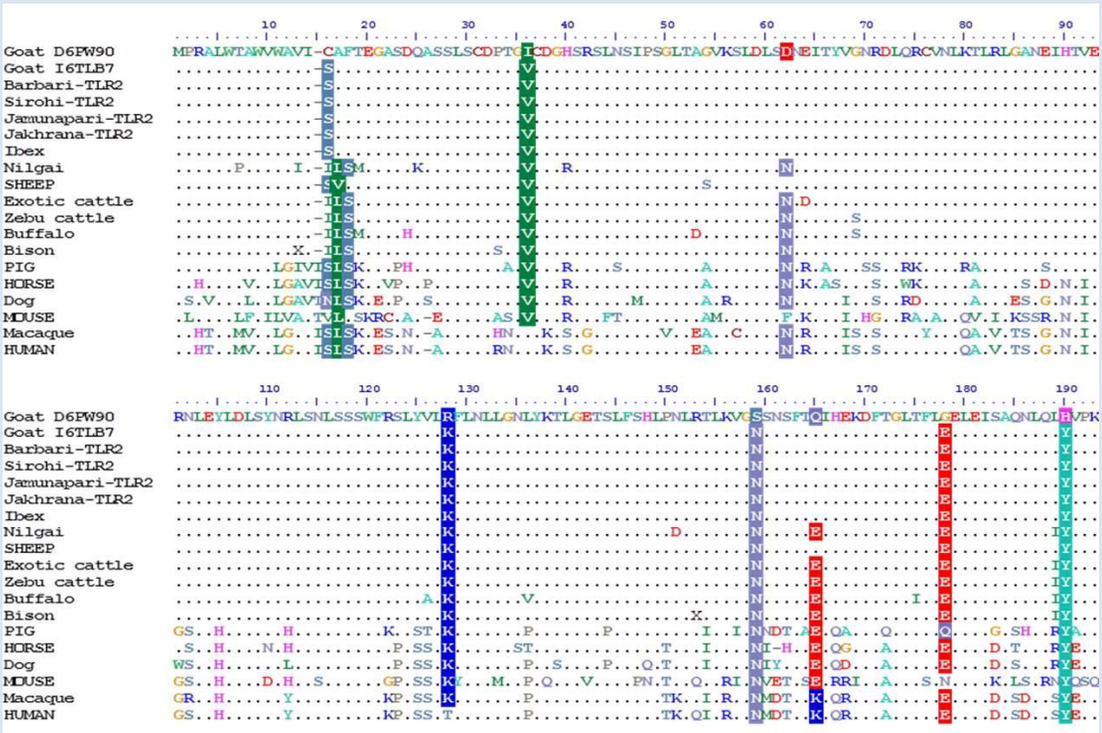
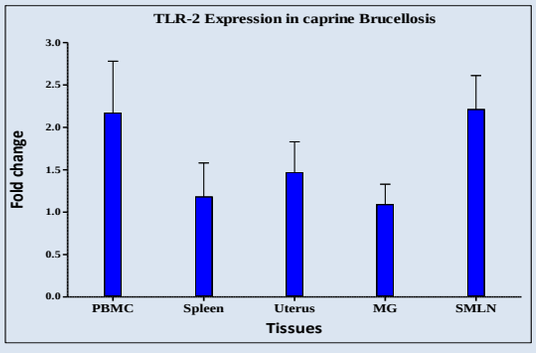


Fig. 8 Conservative regions (shaded) and amino acid variations in Toll like receptor – 2 protein of different breeds of Goats and other domestic species

Differential Expression of Toll-like receptors (TLR-2, 4 and 9) in natural caprine brucellosis by using real time RT-PCR assay

The differential expression of Toll-like receptors (TLR 2, 4 & 9) was studied in natural *Brucella melitensis* infection in goats. The mammary gland, supra-mammary lymph nodes (SMLN) and uterus were collected in RNA later from both groups after sacrifice. Total RNA was extracted and quantified. cDNA was synthesized and quantitative SYBR Green Real Time PCR assay of TLR-2, 4 and 9 was performed by using specific primers of bovine and sheep origin. Comparative Cq method (2-ΔΔCq method / Livak method) was used to calculate the differential expression in various organs (Fig 9 and 10). The SMLN showed significantly higher expression of TLR-4 (5 fold), TLR-9 (4 fold) and TLR-2 mRNA (3.5 fold) than that of in control tissues. Mammary gland showed higher expression of TLR-9 (8 fold) followed by TLR-4 (3 fold) and TLR-2 (2.5 fold). But uterus showed lower expression of TLR-2 (2 fold), TLR-9 (2 fold) and TLR-4 (1.5 fold). The study indicated that, supra-mammary lymph nodes followed by mammary gland elicited strong innate immune response by expressing higher levels of TLRs when compared to uterus (See Fig. 11). In this study we also found that the expression of TLR- 4 and 9 was more as compared to TLR 2 suggesting their strong role in innate response against the brucellosis.



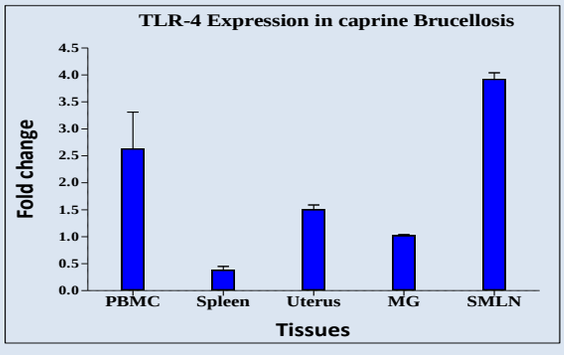


Fig. 9. TLR 2 (left) and 4 (right) mRNA expression in Peripheral Blood Mononuclear Cell (PBMC) spleen, uterus, Mammary Gland (MG) and Supramammary Lymph Node (SMLN) of *Brucella melitensis* infected goats. Normalized fold change expression were assayed by Real Time PCR.The data are expressed as Mean±SEM of 3 infected goats at each time point.

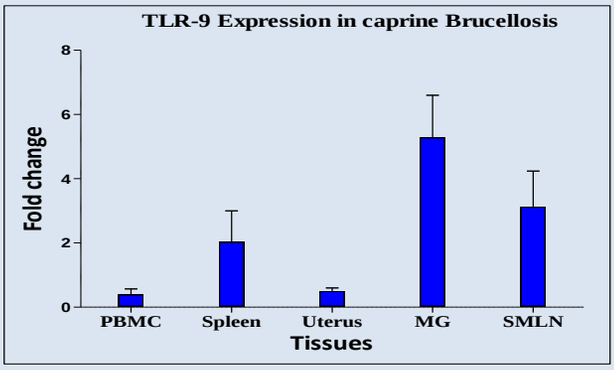


Fig. 10 TLR 2 (left) and 4 (right) mRNA expression in Peripheral Blood Mononuclear Cell (PBMC) spleen, uterus, Mammary Gland (MG) and Supramammary Lymph Node (SMLN) of *Brucella melitensis* infected goats. Normalized fold change expression were assayed by Real Time PCR.The data are expressed as Mean±SEM of 3 infected goats at each time point.

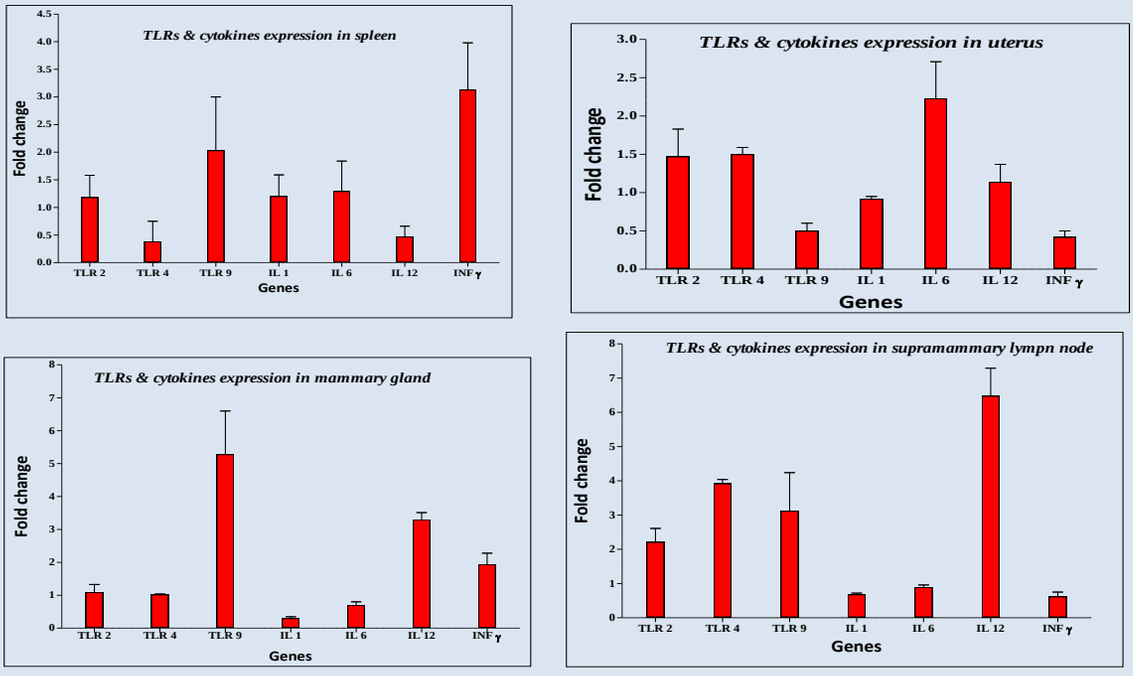


Fig. 11 Expression of different TLRs & cytokines mRNA in different tissues of *Brucella* infected goats.

Characterization of innate immune receptor following exposure to *peste des petits* ruminants virus

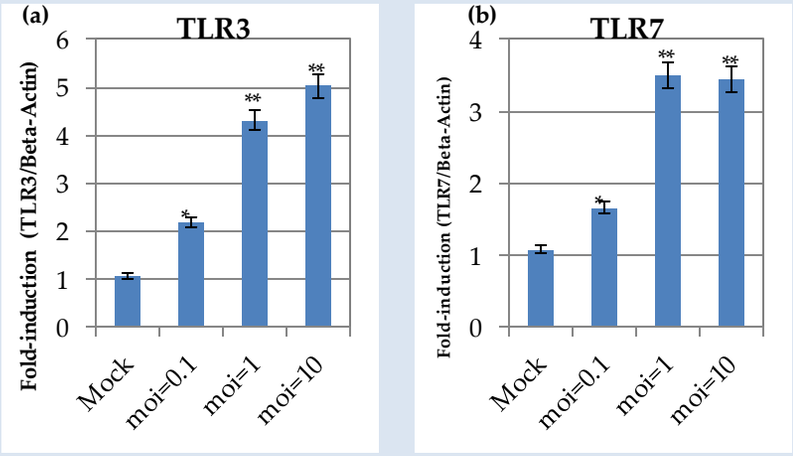
Naveen Kumar, S. V. Singh and A. K. Mishra

Peste des Petits Ruminants Virus (PPRV) is important viral pathogen across the developing world that places a huge disease burden on animal industry particularly in small ruminants and leads to loss of production. Peste des Petits Ruminants (PPR) leads to high morbidity (10-83%) and high mortality (10-100%) in sheep and goat resulting in high economic losses. Adaptive immune response (generation of virus specific antibodies and T-cell response) following viral infection has been well studied but emerging evidences suggest that the innate immune system also plays an important role in modulating the strength, quality and persistence of adaptive immune response. However, the role of innate immune system in PPRV replication is unknown.

The innate immune system can sense viruses, bacteria, parasites and fungi through the expression of pattern recognition receptors (PRRs) which recognize conserved structure in pathogens called pathogen associated molecular pattern (PAMPs). The most common PRRs are toll like receptors (TLRs), retinoic acid-inducible

gene I (RIG I) like receptors (RLRs) such as RIG-I, Mda-5 and LGP2 and Nod like receptors (NLRs) (1). Emerging evidences suggests innate immune system (nature of PRRs triggered) also plays an important role in modulating the strength, quality and persistence of adaptive immune response. Characterization the innate immune receptors (PRRs) following exposure to PPRV is unknown which may help identifying those PRRs that may play a significant role in generation of persistent antibody and cell-mediated immune response against PPRV.

Expression of various TLRs (TLR3, TLR7 and TLR8) in response to exposure of PPRV in Vero cells was determined by quantitation of the respective mRNA (TLRs). For amplificastion of various TLRs gene segments, primers were designed to select conserved sequences among human/mice/caprine or bovine by multiple sequence alignments. Vero cells were cultured in Minimum Essential Medium (MEM) supplemented with 10% fetal bovine serum (FBS) and antibiotics. Confluent monolayers were then infected with various multiplicity of infection (moi) (Fig. 1) of PPRV for 1h followed by washing 5 times with PBS and addition of fresh MEM. At 2 hpi, cell lysates were prepared to isolate the total RNA using TRI Reagent as per the instruction of manufacturer (Sigma, Steinheim, Germany). mRNA of various TLRs (Fig 1) was quantified by quantitative real-time reverse transcription PCR (qRT-PCR). RNA was cleared of possible DNA contamination by incubation for 45 min at 37°C and 80°C for 20 min with DNAse I followed by reverse transcription. qRT-PCR was carried out with a 20 µl reaction mixture containing gene specific primers and Sybr green DNA dye (Promega, Madison, USA). The primer pairs used for amplification of TLRS were: TLR3 forward primer- 5'- GGC CTT AAT GAA ATT GGG CAA GAA C -3' and TLR3 reverse primer- 5'- GAC TCC AAG TTA AGG ATG TGG AGG -3', TLR7 forward primer2 5'- CAA AAC TTC TTG GCC AAA GAA ATT G -3' and TLR7 reverse primer 5'- GAA GGT GAT ATT TTA TTC ACT GAA AG -3', TLR8 forward primer- 5'- CCT CAT GCA GAG CAT CAA CCA AAG CAA GAA AAC -3' and TLR8 reverse primer 5'- GGC CAC TGG AGG ATG GAG CTC TT -3'. β-actin was used as a house keeping control gene and was amplified using forward primer: 5'- CCC CAG CCA TGT ACG TTG CTA TCC -3' and reverse primer: 5'- GCC TCA GGG CAG CGG AAC CGC TCA -3'). For PCR amplification of all the genes (TLR3/7/8, β-actin and PPRV-N gene), initial denaturation of 95°C for 5 minutes followed by 40 cycles of 95°C for 30 seconds, 52°C for 30 seconds and 72°C for 1 minutes and a final extension step of 72°C for 10 minutes. As shown in Fig. 1a and b, a dose dependent enhanced expression of TLRs (TLR3 and TLR7) was observed following exposure of PPRV to Vero cells. However, we did not observe a clean amplification of TLR8; its further standardization (qRT-PCR) is underway. Further, we performed a time course experiment on expression of TLR following exposure of PPRV to Vero cells. A peak in TLR 3 and TLR7 expression was observed respectively at 1-3 hours post-infection (hpi) (Fig. 2a) and at 1hpi (Fig 2b).



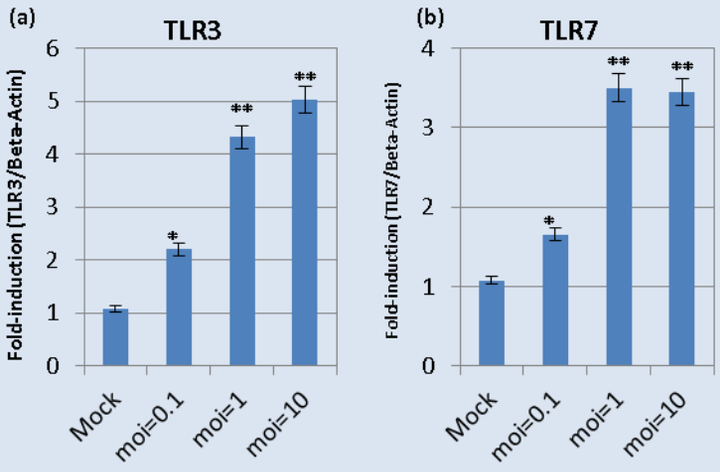


Fig. 1: Dose dependent effect of PPRV on TLR expression in Vero cells Vero cells were infected with PPRV at indicated moi for 1h, washed 5 times with increasing volume of PBS followed by addition of fresh MEM. At 1 hpi, cells lysates were prepared and the viral RNA of TLR 3 (a) and TLR7 (b) was quantified by qRT-PCR. β-actin was used as a house keeping control gene for normalisation. Pairwise statistical comparisons to the mock-control group were performed using Student's t test. * and ** represent statistical significance at $P<0.05$ and $P<0.01$ respectively

Fig. 2: Time course assay: TLR expression in Vero cells following exposure to PPRV Vero cells were infected with PPRV at moi = 5 for 1h, washed 5 times with increasing volume of PBS followed by addition of fresh MEM. At indicated times, cells lysates were prepared and the viral RNA of TLR3 (a) and TLR7 (b) was quantified by qRT-PCR. β-actin was used as a house keeping control gene for normalisation. Pairwise statistical comparisons to the mock-control group were performed using Student's t test. *, ** and *** represent statistical significance at $P<0.05$, $P<0.01$ and $P<0.001$ respectively.

VTC-Veterinary microbes (CIRG-Unit)

V.K. Gupta, A. K. Mishra, K. Gururaj and Naveen Kumar

Cultures submitted by CIRG-VM Unit to VTCC, Hisar

Virus	Capripox virus/CIRG	Goat pox virus
Virus	Orf virus/CIRG	Orf virus
Virus	PPRV/*C.hircus*-India/2012/Nanakpurtc/India/2012/Nanakpurtc/India/2012/Nanakpur	PPR Virus
Bacteria	LM1/CIRG	Listeria monocytogenes
Bacteria	LM2/CIRG	Listeria monocytogenes
Bacteria	LM3/CIRG	Listeria monocytogenes
Bacteria	MAP/01/CIRG	Mycobacterium avium var paratuberculosis
Bacteria	Pseudo/1/CIRG	Psedomonas aeruginosa
Bacteria	Sal/1/CIRG	Salmonella spp.
Bacteria	Esch/1/CIRG	Escherichia coli
Bacteria	Past/1/CIRG	Pasteurella multosida
Bacteria	Kleb/1/CIRG	Klebsiella pneumoniae
Bacteria	Shiga Ecoli/CIRG	Shiga toxin producing *E Coli*

Isolation, identification and characterization of different viral and bacterial pathogens of veterinary importance from goats

A goatpox virus reported in Kanker District of Chhatisgarh was isolated in primary goat testicle culture (Fig.) and the identity of the virus was confirmed as Capripox virus by PCR (Fig).

An Orf virus (ORFV) reported in Barbari goat at CIRG farm unit (Fig.) was isolated in primary lamb testicle culture (Fig.) and identified by amplification of ORFV-specific gene segment in

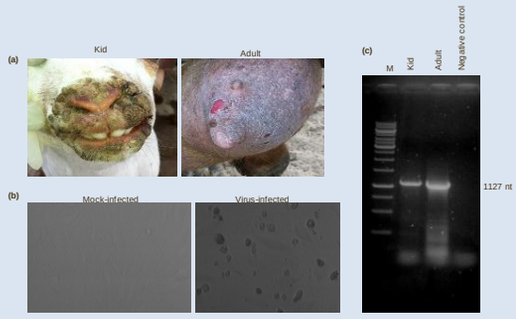


Fig. 1: Isolation and identification of ORFV: (a) Exanthematic gross skin lesions on the lips, mouth, muzzle and nostrils in the orf affected kids and adults (Barbari goats). (b) Cytopathic effect of ORFV in primary lamb testes cell culture. (c): Amplification of the ORFV major envelope glycoprotein (B2L) gene segment in PCR.

PCR (Fig.). The phylogenetic analysis (based on the sequence analysis of envelope protein, B2L) revealed that the CIRG strain is more closely related with ORFV strain originated from China. Peste des Petits Ruminants virus (PPRV) was isolated from an outbreak that occurred in Sheep and goats in Nanakpur village of Mathura District in Uttar Pradesh (India). Based on hemagglutination with chicken red blood cells (rbcs), cytopathic effect similar to the Morbilliviruses in Vero cells, and amplification and sequence analysis of the viral nucleoprotein (N) gene, the identity of the virus was confirmed as PPRV and named PPRV/C. hircustc/ India/2012/Nanakpur1 (in short PPRV/Nkp1/2012). Isolation and characterization of native strains of MAP 'S-5' ("Indian Bison Type') strain of CIRG, Makhdoom was done on the basis of cultural characteristics and morphology of bacilli, biochemical, lipid and protein profiles, RFLP and DNA probes. Pseudomonas aeruginosa, Klebsiella pneumoniae Pasteurella multocida, *E. coli*, Listeria, Salmonella, Brucella melitensis and Shiga toxin producing E coli were isolated, identified and characterized by cultural, morphological, biochemical and molecular methods.

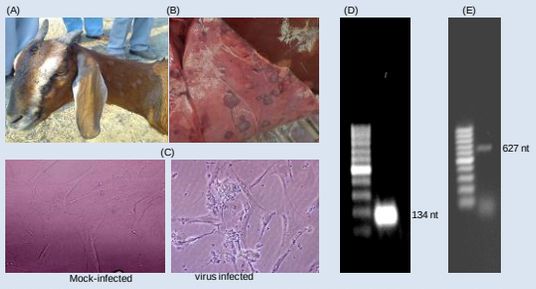


Fig. 2. Isolation and identification of a *Goatpox virus*: (A) pox lesions (papules) on the body surface in an affected goat. (B) Pox lesions in lungs. (C) Cytopathic effect of the virus in primary goat testicle culture. (D, E) Amplification of *Capripoxvirus*-specific gene segments in PCR .

Isolation, identification and characterization of major infectious agents associated with neonatal diarrhoea in kids

Anil Kumar Mishra, Naveen Kumar, K. Gururaj, Souvik Paul and Vinay Chaturvedi

The diarrheic samples (n=210) from the neonatal kids from Jamunapari, Jakhrana and Barbari goats were aseptically collected, and immediately processed for bacteriological isolation. From the samples, 178 isolates of E. coli were isolated, identified and characterized. The molecular identification of E. coli was done by PCR amplification of the universal stress protein A (uspA) gene using species specific primers. On the basis of cultural, morphological, biochemical and molecular characteristics, the organism was confirmed as E. coli. Congo red dye agar test was performed to assess the invasiveness (pathogenicity) of the E coli isolates. All of the 178 isolates showed 100 % Congo red binding activity. The identification of shiga toxin producing E. coli (STEC) or verotoxin producing E. coli (VTEC) was done by PCR amplification of stx-1 and stx-2 genes. Out of 178 isolates of E. coli from the diarrheic neonatal kids, 3.93 % (7/178) were identified as STEC. The common serotypes of E. coli responsible for neonatal diarrhoea in kids were identified as O36, O26, O59, O29, O43, O91, O82, 9 and O171, out of which, the most common were O36, O26 and O59. Out of 210 diarrhoeic samples, 16 and 5 isolates of Salmonella spp. and Klebsiella spp. respectively were isolated,identified and characterized on the basis of cultural, morphological, biochemical and molecular characteristics. In five cases of the neonatal diarrhoea, Salmonella spp. was found as single causative agent of the diarrhoea. All

isolates of Klebsiella spp. were isolated simultaneously with E.coli.Hence, Klebsiella spp. alone was not found responsible for causing neonatal diarrhoea in the kids.

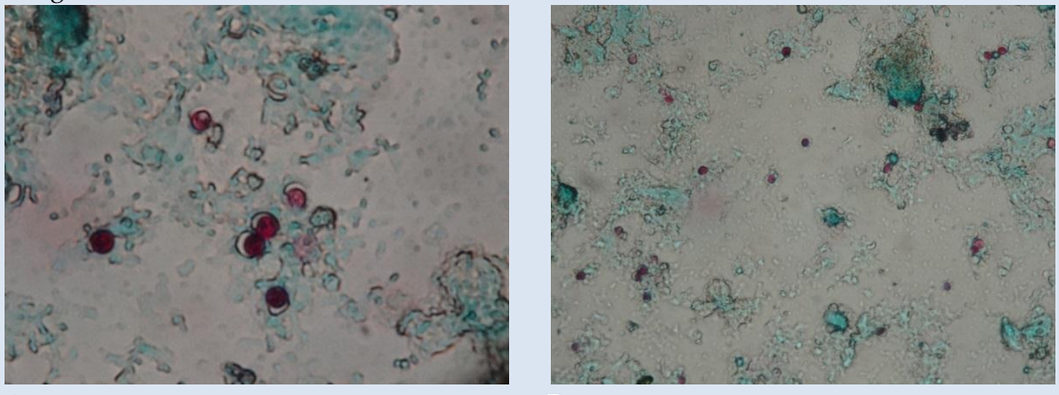
Out of 20 diarrhoeic samples, rota virus was isolated from 1 sample only. The Monkey Intestinal Epithelial Cells (MA104) were used for the isolation, purification and propagation of the virus. Cytopathic effects were observed at 3rd blind passage in virus-infected cells but not in mock-infected ones. No bacterial or parasitic agents were isolated from the sample positive for rota virus.For detection of the oocysts of Cryptosporidium in the diarrhoeic faeces in kids, modified ZN staining method was used. Out of 148 samples, the presence of Cryptosporidium was found in 46 samples. From 16 samples positive for Cryptosporidium, no bacterial agent was isolated indicating its ability to cause the disease alone.

E coli and Cryptosporidium were found to be the main causative agents of the neonatal diarrhea in the kids of Jakhrana, Jamunapari and Barbari goats. The results also indicated that Salmonella and Rotavirus were capable to cause the disease in the kids.

Development of diagnostic assay, molecular characterization and epidemiology of cryptosporidiosis in goats

Souvik Paul

For diagnosis of cryptosporidium oocysts in kids faeces Sheather's flotation, NSS sedimentation and modified ZN staining procedures were standardized. Total 807 samples were analysed, out of which 265 were positive for presence of Cryptosporidium oocysts. Careful analysis of the above epidemiological observations leads to the conclusion that Cryptosporidiosis is one of the main agents responsible for neonatal diarrhoea in goat kids both under farm and field conditions. The occurrence of the disease was found more in farmers flocks which may be due to lack of hygiene in the premises. The prevalence of the infection was higher in 0-15 days old kids than 15-30 days old kids. The prevalence of infection was greater during summer months than winter months. Sex or breed had no correlation with the occurrence of the disease



A B

Cryptosporidium sp oocysts under 100X (A) and 40X(B) magnification in modified Ziehl-Neelsen stained faecal smears

Metabolic profiling for diagnosis and control of metabolic diseases in goats

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

A total of 135 blood samples were collected from female goats of Jamunapari (n=54) and Barbari (n=81) breeds. The status of the negative energy balance (NEB) in the goats of the aforesaid breeds was assessed by estimation of glucose (<2mmol/l glucose), beta-hydoxy butyrate (BHBA >3 mmol/l) and non-esterified fatty acids (NEFA> 0.4 mmol/l) in the serum. Overall prevalence rate of subclinical ketosis among the goats was determined as 13.3 % (18/135). The prevalence

rate in Barbari and Jamunapari does was found as 17.28 % (14/81) and 7.47 % (4/54) respectively. The BHBA and NEFA concentration varied from 0.12 to 0.38 mmol/l and 0.166 to 0.89 mmol/l respectively in healthy peri-parturient does.. However, the number of does with elevated NEFA concentration (n = 10) was higher than the number of does with BHBA concentration above the threshold value (n = 2). These does with elevated NEFA concentration showed AST concentrations above the cut off value (>100 U/l). Thus, NEFA concentration was found to be a better indicator of NEB in peri-parturient goats.

Spearman correlation tests of the results among glucose, BHBA and urea concentrations in non-pregnant does showed a negative correlation between glucose and urea concentrations ($P < 0.01$) and positive correlation between BHBA and urea concentrations ($P < 0.05$) while no correlation was observed between BHBA and glucose concentration. The presence of significant correlations among serum parameters in non-pregnant does could be useful to compare with values in late pregnant does in order to check pregnancy toxaemia.

Nine cases of death due to pregnancy toxaemia were diagnosed on the basis of increased concentrations of BHBA in the aqueous humor of eye. The method for confirmatory diagnosis of pregnancy toxaemia in morbid goats by estimation of BHBA in the vitreous humor was developed and standardized. Histopathological studies revealed severe fatty degeneration of the liver, hypertrophy of adrenal gland and neuronal necrosis.

Extension Education and Socio-Economics Section

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

Villages' Activities

Total 25 visits were made in adopted villages to perform different extension activities. A pilot survey was conducted and basic information collected. A total of 10 field days, 5 group discussions, one Scientists-Farmers interaction, a kisan gosthi, an off-campus training, advisory services, two Research – Extension – Farmers - Interface meetings, 10 health camps organized in adopted villages. Besides, mineral mixture and anti-diarrhea powder were distributed to 151 goat farmers.

Socio-Economic Profile

Out of 50 respondents, 66% were landless, 30 % were marginal and 4% were medium size land holder whereas average land holding size was 2.1 acre. Majority of farmers (72%) belonged to middle age group (>30-50yrs), 22 % belonged to old age group (>50yrs) and only 6% belonged to young age group (≤30yrs). Average age of respondents was 46±9.16 yrs and range varied from 28-70 yrs. Half of the respondents were illiterate and 34 % respondents were able to read or write only. Furthermore, as majority of households (42%) belonged to small family size (≤5), 40 % belonged to medium (6-8) and 18% belonged to large (>8) family size. Average family size was 7.28±2.25 and range varied from 3-16. Income status of the household indicated that 76% of farmers belonged to low income group followed by medium 20% and high 4%. Average family income was 56.3±47.8 thousands. Similarly, 74% farmers had small flock size (≤5 goats) followed by medium 24% (6-10 goats) and large 2% (>10 goats). Average flock size was 4.48±2.88 goats and range varied from 1-16 goats.

Health and Nutrition

Grazing was important source of nutrition in the adopted villages. Grazing pattern of goats in the adopted revealed that the average grazing hours during summer, rainy and winter was 4.22 hrs, 3.62 hrs and 3.71 hrs, respectively. Adoption of vaccination and deworming of goats was nil. Crude mortality was 18.35% at the time of intervention and major cause of mortality was GIT related problems.

Marketing

Nearly, 48 percent of respondents sell their animals through middleman and rest followed direct or other channels. Minimum age of selling was found 4 moths and maximum was 24 months. Average selling age was 13.4 months. Minimum selling price of a goat was found Rs. 300 and maximum Rs. 17500 whereas; average price of a goat was Rs. 5603 in adopted village. It was found that unit change in average age (month) the sale price of goatincreased by Rs. 314, it indicates that farmers were getting Rs.314 for keeping a goat for additional one month.

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

A study has been conducted for pre-testing of schedule and methodology in Jaganpur village of Auraiya district of Uttar Pradesh where outbreak of *Peste des petits ruminants* (PPR) disease was reported. Data collected through personal interview method pertaining to village profile, production system, disease incidence, and mortality, direct and indirect losses which also

include opportunity cost incurred due to disease. The findings from the household survey as also the focus group discussions in village visited brought out the role of goat rearing in providing livelihood security. The major findings of this study were:

Social attributes of respondents

There were 210 households in the village out of which 178 (85%) households (HHs) reared goats with an average flock size of five goats.

Social Attributes of Respondents

Attributes	Values
Total number of respondents/HHs	20
Average age of goat farmers (Yrs)	39.6
Education	
Illiterate	3 (15)
Upto middle	8 (40)
Upto high school	6 (30)
Upto intermediate	1 (5)
Graduate & Above	2 (10)
Average family size	6.4
No. of landless goat farmers	7 (35)
Social class	SC
Major crops:	
Rabi	Wheat, Maize
Kharif	Paddy, Jowar and Bajra
Income sources (%)	
Agriculture	24.44
Animal Husbandry	12.79
Goat rearing	17.32
Others/wages	45.46
Production system	Extensive (70%)/Semi-intensive (30%)

However, 20 affected HHs with an average flock size of 13 goatswere interviewed to explore the information on various parameters. Majority of the goat farmers (70%) reared goats under extensive system. Social attributes of respondents indicated that 15% of the goat farmers were illiterates and 65% were educated up to 10th, 12th and graduate level. The average age of the respondents was 40 years and average family size was of 6. About 35% goat farmers were landless and majority of goat farmers belonged to schedule cast. The contribution of goats to family income was about 17%.

Composition of goats and mortality

The composition of flock mainly constituted with adult (55%) and kids/young stock (45%).The overall morbidity rate was 57.52% however, the rate was found slightly higher in young stock than adults.Similarly, mortality rate in goats in study households was 42% and case fatality was reported to 73% (Table). It was high due to delay in diagnosis and unavailability of veterinary services during the outbreak, as revealed by the goat farmers. Economic loss due to mortality was estimated to be Rs. 12320 per household. Total morbidity loss due to reduction in milk yield, weight loss and reduction in market value was Rs.1567 whereas,the opportunity cost which include expenses on veterinary care, extra labour and other charges was estimated to be Rs. 269.The total economic loss due to disease was Rs. 14156.00.

Morbidity, mortality and case fatality

Particulars	Value
Total no. of goats	266
No. of goats infected	153
No. of goats died	112
Morbidity rate (%)	57.52
Mortality rate (%)	42.11
Case Fatality (%)	73.2

Goat management status and constraints

The farmers were asked to assess the knowledge level on a continuum of 'poor', 'average' and 'good' which carried weightage of 1, 2, 3 respectively. The intensity of knowledge and adoption level were highest with the lower score. The status of management practices in study households indicated that about 50% of goat farmers were rated as poor, 34% as an average and 16% were as good in knowledge and management practices which includes kids management, health, nutrition, breeding and general management. Furthermore, unavailability of vaccines,medicines, timely veterinary services, high cost of medicines and poor knowledge of diseases and their symptoms were to be found major constraints (Table).

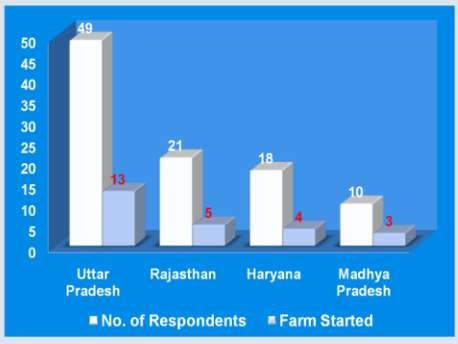
Constraints in goat production

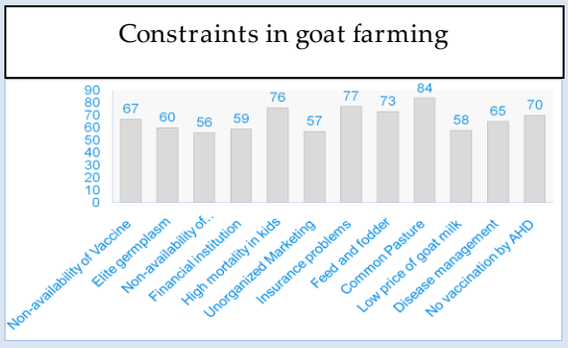
Constraints	Mean Scores	Rank
Unavailability of vaccines	12.19	I
Unavailability of medicines	10.48	II
Lack of veterinary doctors/vet hospitals	9.12	III
High cost of services and medicines	8.88	IV
Poor knowledge of diseases and their symptoms	7.23	V
Poor knowledge of home remedies/Ayurveda/Herbal medicines	5.30	VI
Lack of transportation and other infrastructure	4.27	VII

Impact assessment of training programmes on scientific goat farming

Khushyal Singh, Braj Mohan, A.K. Dixit, Vijay Kumar

Data was collected from 98 trainees of 4 states (Haryana-18, Uttar Pradesh -49, Madhya Pradesh -10 and Rajasthan-21). Only 25.5% farmers started their farms and their number are presented in following diagram:



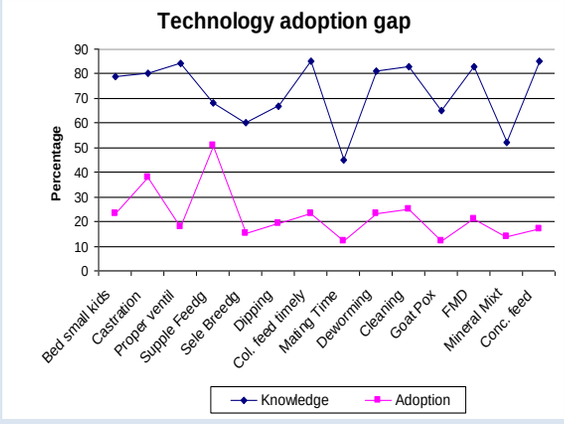


Survivability of adult goats in the commercial goat farms was good as per feedback. The kid mortality was higher in all commercial goat farms. There were many constraints responsible for high mortality like low adoption of improved practices, preventive goat health calendar, non-availability of critical inputs like vaccines, medicines and type of housing

Marketing

Middlemen and butchers mainly managed marketing of goats. Some of the commercial goat farmers were doing strategic marketing such as plan for Eid, Holi, Diwali and other local festivals. They were rearing castrated male as it gave better prices. The farmers realized remunerative price for pure breed animals as compared to non-descript goats.

Knowledge and Adoption of Technology



The level of adoption of technologies was also not good. Gap in knowledge and adoption of improved technologies was high due to inaccessible/unavailablity/ shortage of critical inputs.

AICRP on goat improvement

S.K. Singh, M.S. Dige, M.K. Singh, P.K. Rout, C. Nimbkar, N. Nahardeka, K.K. Tyagi, P.K. Dogra, S. Mandakmale, L.B. Singh, D.K. Karna, R.K. Nagda, V. Thirupathy, S.S. Misra, P.K. Senapati, G.C. Gahlot

Assam Hill Goat Field Unit

The project encompasses 209 farmer's families rearing around 1667 Assam hill Goats. The population growth has been increased to 121.64% during the year 2013-14. The twining and triplet percentage has been recorded to be 39.80% and 8.6% respectively and average mortality rate was reduced from 9.29% to 6.7%.The average family income from the goatery has increased to Rs. 3,461 /per anum Two Goat Rally cum Judgings camps were organized on 12th February and 13th March, 2014 at Nahira and Tetelia Field Units of the project respectively. An exposure visit was organized for 16 farmers from different field units of the project to visit Central Institute for Research on Goats, Makhdoom, Mathura (U.P) from 21st February to 2nd March, 2014. A total of 5000 doses of frozen semen of Assam Hill Goat from selected elite buck has been stored. A total of 16 proven bucks maintained at the base farm, Goat Research Station, AAU, Burnihat – 793101 has been distributed replacing the existing bucks in the four field units of the project. Moreover, exchange of bucks between the field units is also practiced on a regular basis. Eighteen (18) numbers of elite bucks has been distributed to different NGOs of the state.

Gaddi Field Unit, COVAS, CSKHPKV, Palampur

In the year under report performance recording in the four field clusters comprising of 1149 goats including 749 breedable does following four different migratory routes were carried out.A total of 625 young kids were added in selected flocks through birth, 118 animals of different age groups died and 459 animals pertaining to different age groups were sold by the owners for income generation.The closing balance as on 31.03.2014 was 1197 animals under different age groups.A total of 25 male kids of 4-6 months age group were purchased from adopted farmers after primary selection. These male kids were then transferred to Palampur center for subsequent rearing up to the age of sexual maturity. After final selection, a total of 17 bucks were distributed to 15 farmers for breed improvement. All adopted animals were provided with health coverage under migratory field conditions and strategic supplementary feeding was also provided in the form of mineral mixture and concentrate feed. The overall population growth was 106.14%.The overall mortality incidence was found to be 6.65% and abortion incidences 6.71%.The incidence of twin birth was recorded 19.96%. The kidding rate of the flocks were observed to be 1.25%.

Black Bengal (Field Unit) of Birsa Agricultural University, Ranchi

A new village Tiko having 194 does in Lohardaga district was adopted during October 2013. Thus, unit has adopted four village clusters, namely Palajori (Deoghar district), Beko (East Singhbhum district), Chamguru (Ranchi district) and Tiko (Lohardaga district) consisting of approx. 1042 does in coverage areas. Twenty one elite bucks and 8 does were selected on the basis of growth and multiple birth to establish the elite Black Bengal seedstock at the university farm. Out of these 8 bucks were distributed at new centre i.e. Tiko village. A total of 872 does kidded and growth parameters of kids were recorded. The average litter size was recorded 1.76 and twining % was observed as 65.23 %. The breeding efficiency on the basis of does tupped was estimated to be 182.54 %. Selection differential was estimated to be 4.02 kg in males at 9 M of age as compare to previous year 3.39 kg. The mortality in adult goats and kids were reduced up to 93.07% in the farmer's flock. Health measure was under taken as vaccination (PPR, ET, Goat Pox), dipping, drenching etc. as required. Goat feed prepared by our university and Mineral mixture were distributed among the farmers. Two training programmes on goat husbandry was organized at Goat farm of Ranchi Veterinary College, BAU, in which 26 goat farmers from different four centres participated and benefited by learning by doing on scientific goat rearing.

Marwari Field Unit, Bikaner, Rajasthan

Four clusters were established in Bikaner districts i.e. in Deshnok, Kalyansar, Raisar and Daiya. The new cluster in Kan Singh JiKi Sid with about 500 goats does in the Jodhapur district was adopted. The Buck rearing Center is also functioning at Livestock Research Center, Kodemdeshar for rearing of elite bucks for distribution to the farmers. All the registered goats in new cluster of Kan Singh jiKi Sid were identified by brass tag and distributed superior Marwari bucks for breeding purpose.Total 215 adult does and their 75 kids were tagged. The average family size was 27.8 in this new cluster.Sixteen selected superior breeding bucks were placed in the selected cluster for breeding of does.Total 1296 adult does and their 1396 kids were recorded. The overall least square mean for body weights at birth, 3 M, 6 M, 9 M and 12 M of age were 2.57, 7.96, 14.91, 19.07 and 25.42 Kg, respectively. Milk yields were recorded more than 200 does about fortnightly during the lactation.The kidding take place in all the months but it was more from the month of October onwards and it occurs in the open. The overall kidding percent was 91.50 %, incidence of abortions was 0.33 % and twinning was 7.71 %. For all field flock health coverage was provided besides strategic supplementary feeding in the form of mineral mixture.

Surti Field Unit, NAU, Navsari

This center was able to establish first notified goat cooperative of five adopted villages involving 40 goat farmers through bilateral efforts of farmers from Valsad District and this project. Capacity building programme was undertaken and a 5 day on farm training program was conducted. Eighteen (18) key persons have been identified from 14 villages for the implementation of scheme in their villages. Six training programmes were organized for the registered farmers from South Gujarat. They were given lectures and farm exposure about the superiority of Surti goat over local breeds. A total of 12 Surti bucks had been supplied in field to minimize the problem of non availability of Surti bucks. Additionally 16 selected bucks are ready for dissemination this year. Kidding rate had been increased to 1.46 from 1.41 in 2009.Almost three fold increase in registered Surti goat population had been achieved under the project area. Four additional PG research work and four ancillary departmental projects were undertaken in the scheme.

Osmanabadi Field Unit, NARI, Phaltan

A new village Borla with about 130 does in Jamkhedtaluka of Ahmednagar district was adopted in July 2013. Thus, the unit is now working in four villages Wadgaon (Satara district), Kamone (Solapur district), Sakat and Borla (Ahmednagar district). Goat keepers in Borla got the benefit of using for breeding superior Osmanabadi bucks disseminated by the Osmanabadi Field Unit instead of their earlier practice of using inferior young bucks. Total 748 adult does and their 1505 kids were recorded during 2013-14. Milk yields of 400 does were recorded about 4 times during the lactation. About 90% of the does older than one year, kidded during the year and 15-20% of the does kidded twice in the year. The average litter size in the four villages was 1.72. The adult and kid mortality was extremely low i.e. 3 to 4%. Fourteen selected superior breeding bucks were placed in the four villages for 3.5 to 8 months for breeding of does in the village. Additionally, Osmanabadi buck frozen semen was also made available in Borla village. Five superior and true-to-type Osmanabadi bucks were purchased during the year. For the first time in 2013-14, fodder seed of the legume Desmanthusvirgatus and of multi-cut fodder sorghum COFS-29 was supplied to 16 participating goat keepers in Wadgaon and Kamone. Four self-help groups (SHG) of women (61 members in total) were established in Wadgaon, Borla and Kamone. These are all operating smoothly with regular meetings and micro-finance benefits to all members.

The SHG members of Wadgaon were trained in goat management and first-aid in evening one-hour sessions held in their village in the first week of January 2014. Two visits were organized for SHG and Pashusakhi group members and one visit of Wadgaon men goat keepers. About 7,000 straws of frozen semen of 25 Osmanabadi bucks were produced; 4,000 of these were given to the Government of Maharashtra and were supplied by the government to five district AI centres. Seven hundred straws were given to

field technicians. From their records, an average 50% conception rate was achieved

Black Bengal Field Unit, Kolkata

A new village Bamunia with 119 does in Bhagabangola Block of Murshidabad district has been adopted in collaboration with KVK, Digha, Mursidabad district. Now the BBG, Kolkata unit is working in three clusters i.e. Ayeshpur and Ganguria (Nadia cluster), Rangabelia cluster (South 24 Parganas), Bamunia (Mursidabad cluster). Goat keepers in all the villages got the benefit of breeding superior Black Bengal bucks disseminated by the Black Bengal Field Unit. The average flock strength of the farmers is 4.49 during 2013-14. Total 451 does and their 934 kids were recorded during 2013-14. They were protected with vaccination as per schedule and deworming and spraying as required. About 83 % of the does kidded once and 17 % of the does kidded twice during 2013-14. The average litter size from 526 kidding was 1.78. The kid mortality was extremely low i.e. 5.39%. Nineteen selected superior breeding bucks were distributed in the villages. Twelve Black Bengal bucks have been distributed in the clusters. Twelve Self-Help Groups running by women are operating smoothly with regular meetings and micro-finance benefits to all members. Seven deworming cum mineral mixture distribution camp, 10 treatments cum vaccination camp (against PPR, Goat Pox and Enterotoxaemia), 11 awareness cum interactive sessions in evening hour sessions also conducted besides regular treatment of all goats.The average income per farmer per year is Rs 4316/- and per doe per year is 1769/- during 2013-14.

The AICRP on Goat Improvement Centers (XII Plan)

SN	Breed	Location of Centre	Type of Centre
	Project Coordinators Unit	CIRG, Makhdoom, Farah, Mathura 281122	Coordinating Unit
	Assam Hill Goat Unit (NEH)	AAU, Khanpara Guwahati	Field
	Barbari Unit	CIRG, Makhdoom	Farm
	Bengal Goats (TSP)	BAU Ranchi	Field
	Black Bengal (Partial TSP)	WBUV and FS, Kolkata	Field
	Gaddi Field Unit(TSP)	HPKVV, Palampur (HP)	Field
	Ganjam Field Unit	OUAT, Bhubaneswar	Field
	Jamunapari Farm Unit	CIRG, Makhdoom	Farm
	Malabari Field Unit	KV&ASU, Thrissur	Field
	Marwari Field Unit	RAJUVAS, Bikaner	Field
	Osmanabadi Unit	NARI, Phaltan (MH)	Field
	Sirohi Field Unit (partial TSP)	RAJUVAS,Veterinary College Vallabhnagar (Raj.)	Field
	Surti Field Unit(TSP)	N.A.U., Navsari (Guj.)	Field
	Sangamneri Field Unit	MPKV, Rahuri (MH)	Field
	Sirohi Farm Unit	CSWRI, Avikanagar	Farm
Newly added Units			
	Andamani Goats	CARI, Port Blair, Andman	Field
	Himalayan Local Goats	IVRI Campus,Mukteshwar	Field
	Changthangi Goat Unit	SKUAST-K, Leh, J&K	Field
	Uttarakhand Local Goats	GBPUA&T,Pantnagar	Field

Meteorological observations (2013-14)

N. Ramachandran

Months	MeanMax Temp. (°C)	MeanMin Temp. (°C)	MeanDaily Temp. (°C)	MeanVapor Pressure (mmHg)	MeanRH (%)	MeanRainFall (mm) /WetDays	Sun Shine (hrs)
April2013	40.63	20.85	30.74	11.98	29.21	2 (1)	286.00
May2013	46.31	25.35	35.83	11.92	21.28	0 (0)	304.30
June2013	41.08	28.02	34.55	23.29	33.53	36 (3)	185.70
July2013	36.87	26.98	31.93	27.66	77.41	122 (11)	133.50
August2013	35.60	26.40	31.00	27.11	78.57	117 (15)	157.5
September 2013	37.83	25.17	31.50	23.12	61.80	49 (3)	254.60
October 2013	34.67	20.63	27.65	19.46	63.26	35 (3)	213.70
November 2013	30.35	11.57	20.96	11.08	51.23	0 (0)	185.50
December 2013	25.18	8.58	16.88	10.63	67.06	5.4 (2)	166.10
January 2014	18.50	8.15	13.32	10.59	84.06	30(3)	84.60
February 2014	24.09	9.59	16.84	11.27	69.12	14.40 (3)	171.60
March2013	31.55	14.87	23.21	13.24	52.49	22.60 (2)	261.00

Maximum temperature: 49.5 °C on 24.05.2013 and 25.05.2013
Minimum temperature: 1°C on 30.12.2013
Annual Rain Fall: 433.4 mm in 46 Days
High sunshine: 11.6 hrs on 19.05.13.

Kiddings

Breed	Male	Female	Total
Barbari	**176**	**151**	**327**
Jamunapari	**186**	**187**	**373**
Jakhrana	**59**	**49**	**108**
Sheep	**105**	**114**	**219**
Total	**526**	**501**	**1027**

Milk production

Breed	Milk (in Kg.)
Barbari	**9824.00**
Jamunapari	**14239.25**
Jakhrana	**8740.25**
NFR&PT Experimental Shed	**5267.50**
PR&SM Experimental Shed	**2134.50**
Total	**40205.50**

Teaching and Training

Teaching

Three postgraduate students from IVRI completed thesis research work for M.V.Sc degree. Three students from GLA University Mathura are conducting research work for PhD degree under guidance of institute scientist. Three graduate student from GLAU, Mathura completed one month summer training and one PhD student from SHIAT, Allahabad, UP was given expert guidance on HPLC analysis of plant extract samples. One batch of BVSC and AH Students from College of Veterinary science and AH Mathura completed training under internship programme. Students of different academic colleges and veterinary colleges visited the institute laboratories and livestock units.

Training

The following training programs were organized by the Institute during the year 2013-2014.

- Training Programme on 'Nutrition, Management and Prevention of goat diseases for Optimum Productivity' Under Trainers' Training Programme of DADF, Ministry of Agriculture, Govt. of India Trainees: Veterinary Officers of State A.H. Department (15)(April 10-16, 2013)
- Training Programme on 'Nutrition, Management and Prevention of goat diseases for Optimum Productivity' Under Trainers' Training Programme of DADF, Ministry of Agriculture, Govt. of India , Trainees: Veterinary Officers of State A.H. Department (October 21-29, 2013)
- Training Programme on 'Leadership Development for Sustainable Goat Production' for Project Officers/Managers of BAIF, Pune (April 22-27, 2013)
- Training programme on Advances in Goat Production for 10 Veterinary Officers from Training Institute, Laxmisagar, Bhubaneswar from December 5-7, 2013
- Training Programme for Bank Mangers and Govt. Officials-One Day Technical Session and Field visit on Goat Keeping Bankers Institue of Rural Development (BIRD), Lucknow on 25 Sept 2013
- Training on goat farming to group of Women, sponsored by Mahila Samakhya (NGO HRD, Delhi) under Women empowerment (30.9.2013)Organized a 54th 10 days National Training Programme on Scientific Goat Farming on 01-10 May, 2013 at CIRG, Makhdoom. In this training programme 58 Participants (56 farmers and 02 farm women) from 12 States were present.
- Organized a sponsored training programme on Scientific Goat Farming for 07 Veterinary Officers (05 from Rural Development Deptt., Punjab and 02 from Deptt. Of A.H., Punjab) on 20-24 May, 2013 (05 days). Sponsored by Punjab State Veterinary Council, Chandigarh.
- Organized a sponsored training programme on Scientific Goat Farming for 19 farmers on 01-05 July, 2013 (05 days). Sponsored by Dr. YS Parmar University of Horticulture & Forestry Reginal Centre, National Afforestation and Eco-Development Board, Integrated Watershed Management Programme, Nauni, Solan, Himachal Pradesh.
- Organized a sponsored training programme on Scientific Goat Farming for 09 farmers and 11 farm women (Total = 20 trainees) on 23-27 July, 2013 (05 days). Sponsored by Dr. YS Parmar University of Horticulture and Forestry Regional Centre, National Afforestation and Eco-Development Board, Integrated Watershed Management Programme, Nauni, Solan, Himachal Pradesh.

- Organized a 55th 10 days National Training Programme on Scientific Goat Farming on 04-13 September, 2013 at CIRG, Makhdoom. In this training programme 30 Participants (01 disabled) from 09 States were Present.
- Organized a sponsored training programme on Scientific Goat Farming for 08 Veterinary Officers from Deptt. Of A.H., Punjab on 07-11 October, 2013 (05 days). Sponsored by Punjab State Veterinary Council, Chandigarh.
- Organized a 56th 10 days National Training Programme on Scientific Goat Farming on 20-29 November, 2013 at CIRG, Makhdoom. In this training programme 55 participants (52 farmers and 03 farm women) from 13 States were present

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National Training Programme on Scientific goat farming (10 days duration)

Sr. No.	Training	Period	Participants from No. of states	No. of trainees
1	54th	01-10 May, 2013	12	58
2	55th	04-13 Sept. 2013	9	30
3	56th	20-29 Nov. 2013	13	55
4	57th	04-13 Mar. 2014	12	58

Sponsored Training Programme on Scientific goat farming

Sr. No	Period	Duration (days)	No. of Participants	Type of Participants	Sponsoring Agency
1	20-24 May, 2013	5	7	Veterinary Officers	Punjab State Veterinary Council, Chandigarh
2	01-05 July, 2013	5	19	Farmers	Dr. YS Parmar University of Horticulture & Forestry Regional Centre N. A. E. D. Board, I. W. M. Programme, Nauni, Soan, Himachal Pradesh
3	23-27 July, 2013	5	20	Farmers	Dr. YS Parmar University of Horticulture & Forestry Regional Centre N. A. E. D. Board, I. W. M. Programme, Nauni, Soan, Himachal Pradesh
4	07-11 October, 2013	5	8	Veterinary Officers	Punjab State Veterinary Council, Chandigarh.
5	16-20 Dec. 2013	5	25	Farmers	ATMA, Sitamarhi, Bihar
6	10-15 Feb. 2014	6	30	Farmers	ATMA, Vaishali, Bihar
7	25-29 March 2014	5	34	Farmers	Gramin Vikas Kendra, Nalanda, Bihar

- Organized a sponsored training programme on Scientific Goat Farming for 19 farmers and 06 farm women (Total = 25 participants) & 01 team leader on 16-20 December, 2013 (05 days). Sponsored by ATMA, Sitamani, Bihar.

- Organized a sponsored training programme on Scientific Goat Farming for 30 farmers from ATMA, Vaisali, Bihar on 10-15 February, 2014 (06 days) at CIRG, Makhdoom.
- Organized a 57th 10 days National Training Programme on Scientific Goat Farming on 04-13 March, 2014 at CIRG, Makhdoom. In this training programme 58 participants (farmers) from 12 States were present
- Organized a sponsored training programme on Scientific Goat Farming for 28 farmers and 06 farm women (Total 34 trainees) from Distt. Bolangeer, Odisa. Sponsored by Gramin Vikas Kendra, Nalanda, Bihar on 25-29 March 2014 (05 days) at CIRG, Makhdoom.

Exhibition/ Technology Display /Kisan Mela

- Participated in Krishi Evam Gramay Vikas Pradarshani at Pandit Deendayal Dham, Nagala Chandrabhan, Farah, Mathura,U.P. on 01-03 October, 2013.
- Participated in Krishi Vasant Exhibition at Central Institute of Cotton Research, Nagpur on 09-13 February, 2014.
- Participated in kisan mela and gosthi at Jawahar Bagh, Mathura, U.P., on 21.06.2013.
- Participated in "Showcasing of Agricultural Technologies" jointly organized by ICAR Research Complex for Eastern, Patna and Directorate of Knowledge Management in Agriculture, New Delhi during December 06-07, 2013 at ICAR Research Complex for Eastern Region, Patna, Bihar.
- Participated in 20th Sarson Vigyan Mela-cum Exhibition at Directorate of Rapeseed-Mustard Research (DRMR), Sewar, Bharatpur (Rajasthan) on 22-24 February, 2014.
- Participated in National Dairy Mela-2014 at NDRI, Karnal (Haryana) on 25-27 February, 2014 (Won IInd Prize).
- Participated in Pusa Krishi Vigyan Mela at IARI, New Delhi on 26-28 February, 2014.
- Participated in Kisan Mela at IVRI, Izatnagar, Bareilly, U.P., on 28.02.2014 (Won IIIrd Prize).

- Participated in Kisan Mela at U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Viswa Vidyalay Evam Go-Anusandhan Sansthan, Mathura, U.P., on 14-15 March, 2014 (Won Ist Prize).

Technical Correspondence

Received and replied 133 letters (117 in Hindi and 16 in English) of different stakeholders on various aspects of goat production.

Helpline Calls

During the year 1785 calls received at CIRG Help line service regarding various aspects of goat farming, production, and elite germ plasm and training programmes etc and replied suitably.

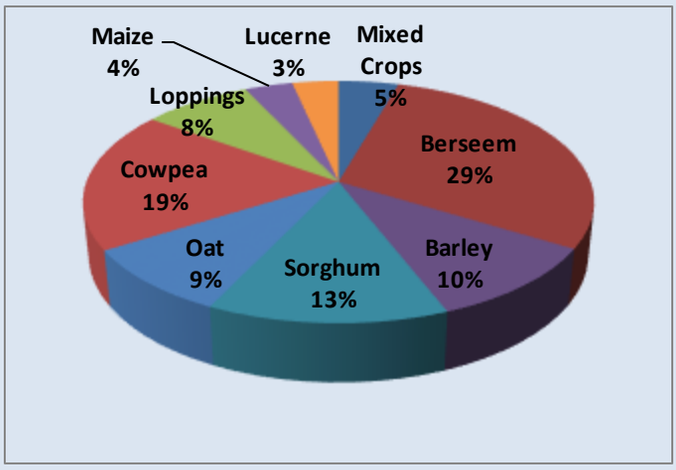
Visit Arrangement

1694 visitors were entertained and apprised with research, extension and development activities of the Institute during the year.

Agriculture Farm and Agroforestry Section

Prabhat Tripathi

Agriculture farm section is working with main objectives to produce nutritious fodder for goats and sheep and to develop ravenous degraded land of institute in to a fodder production models through agroforestry or other agricultural interventions. During the year farm section supplied 9649 quintals of green fodder to different livestock units and produced 251 quintals barley& oat grains. Apart from barley and oat Agril farm section also produced 7.40 quintals of cowpea and guar seed, which will be utilized for fodder production at farm area of the institute. About three acre land area was cleaned and developed. A nursery of about 4000 seedlings (Acacia nilotica, Azadirachta indica, Syzygium cumini, Ficus lacor, Prosopis cineraria etc.) was raised and maintained. During the year about 60% of total supplied fodder was leguminous with high crude protein percentage.



Proportion of various fodder crops supplied green during the year 2013-14

Farm Area Development

Ber(*Zizyphus Sp*.) Stand

Nursery beds raised at CIRG, Makhdoom

Farm innovator's day organized

Institute organized Farm Innovator's day on 27 April 2013. Dr. A.K. Mishra, Vice Chancellor, MAFSU was the Chief Guest and Dr. Rakesh Babu Gangwar, Deputy Director Agriculture, Uttra Pradesh was the Guest of Honour on this occasion. The chief guest of the function while delivering his inaugural address praised the efforts made by CIRG in the field of goat husbandry and informed that goat is one of oldest animal to be domesticated by man and is an important animal for providing livelihood security and alleviating poverty. He accentuated that interactions like Farm Innovator's day will serve to answer the issues of a sustainable goat husbandry under the burden of increasing population, decreasing land and forage resources and climate change in addition to entrepreneurship development, reducing involvement of middlemen in goat marketing, value addition of goat products etc. The Guest of Honour in his address emphasized that inputs like improved breeds, improved nutrition and better health care facilities should be readily accessible to farmers for achieving optimum production in the field of animal husbandry. Dr. S.K. Agarwal, Director, CIRG presided over the function and highlighted the importance of goat husbandry in the rural scenario in terms of diminishing pastures and grazing land. He further stressed upon the use of technologies developed and available at CIRG like artificial insemination for breed improvement. The farm innovators day was attended by 167 farmers including progressive farmers, BAIF officers and women from Mahila Samakhya, an NGO from Mathura. On this occasion, few farmers shared their experiences and local remedies and innovations related to goat farming. The few progressive goat farmers were also awarded with appreciation certificate for sustaining and motivating other farmers in the field of goat rearing.

Success Story

CIRG Beans and CIRG-Khasta – Goat Milk and Meat Based Products

Goat milk and cream based .'CIRG Beans' and 'CIRG Khasta' .were developed using pure goat .milk, cream, dietary fibres and .natural antioxidants. These .products contain higher amount .of medium chain fatty acids, .which are known to be beneficial .for human health. Organoleptic .attributes revealed that these .products 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 as well as 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.

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 470 goats and 65 sheep to the progressive farmers and various government agencies for breed improvement programmes.

Superior Animal Germplasm Supplied

Breed	Total
Jamunapari	213
Barbari	241
Jakhrana	16
Muzzaffarnagri	65
Total	535

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.

Awards and Recognitions

- **pyoStUrh o iz'kfLr i=** dsUæh; x`g ea=ky; Hkkjr ljdkj ds vk/khu dk;Zjr uxj jktHkk"kk dk;kZUo;u lfefr (ujkdkl) eFkqjk }kjk o"kZ 2012&13 ds nkSjku jktHkk"kk fgUnh esa mRd`"V dk;Z gsrq laLFkku dks **izFke iqjLdkj** ds :Ik esa iznku dj lEekfur fd;k x;kA
- First prize at Kisan Mela U.P. Pt. Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalya evan Go-Anusandhan Sansthan, Mathura, 14-15 March, 2014.
- President , Indian Society for the study of Animal Reproduction (S.K. Agarwal)
- Vice President, Indian Society for the study of Sheep and goat Production and Utilization (S.K. Agarwal)
- Vice President , Indian Society for the study of Animal Reproduction (S.D. Kharche)
- Member , Board of Management, National Dairy Research Institute, Karnal (S.K. Agarwal)
- Member , Board of management, MAFSU, Nagpur ((S.K. Agarwal)

- Member, Selection board of GADVASU, RAJUVAS, JNU, PDC, ASRB, NDRI, IVRI, (S.K. Agarwal, Ashok Kumar, A.K.Goel, P.K.Rout, S.K.Singh, R.V.S.Pawaiyya)
- Member, IMC, CARI, Izatnagar (P.K.Rout)

- Second Prize at National Dairy Mela-2014 at NDRI, Karnal (Haryana) on 25-27 February, 2014 .
- Third Prize at Kisan Mela at IVRI, Izatnagar, Bareilly, U.P., on 28.02.2014

- Best Paper Award - All India Scientific and Technical Hindi Assay Competition.(Saket Bhusan)
- First Prize Hindi Shodh Patra Competetion held at CIRG (Chetna Gangwar)
- First Prize in Technology dissemination in Kisan Mela at U.P. Pt. Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalya evan Go-Anusandhan Sansthan, Mathura, 14-15 March, 2014. (Chetna Gangwar)
- ISSAR fellowship 2013 (A.K.Goel)
- Panelist in a ILRI meet on Small Ruminant Sector development held at New Delhi (S.K.Singh)
- Member of Management Committee of NBAGR, Karnal (S.K.Singh)
- Third Best Poster Award for Status of bovine brucellosis and its associted risk factors in Western Uttar Pradesh. National symposium and XXVII Annual convention of IAVMI on Productivity enhancement through improved animal health and nutrition Organized by Department of Animal Husbandry, Government of Uttar Pradesh, Lucknow from 13-15 December. (Vijay Kumar)
- Ram Lal Agrawal Gold Medal award -2014" from Indian Society for Veterinary Medicine at Jammu for outstanding contribution in Veterinary medicine ,particularly in Herbal drug Research (Ashok Kumar)
- Advisor for World Bank Funded Mega Project RACP, Jaipur (S.K.Singh)
- Member, Sub-committee member on Sheep Nutrition" in the National Committee on Nutrient Requirement of Animals. by ICAR (M. K. Tripathi)

- First Prizes in Hindi Hastakshar Pratiyogita and Second Prizes in Shodh Patra Pratiyogita, Hindi Anuprayog Pratiyogita and Hindi Shrut Lekh Pratiyogita. (Gopal Dass)
- Best Reviewer Award 2013" by Asian-Australasian Journal of Animal Science (M. K. Tripathi)
- Regional Director of Indian sub-continent International Goat Association (M. K Tripathi)
- Indian National Science Academy (INSA) Summer Research fellowship for two months (Mahesh Shivanand Dige, Shivsharanappa)

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Research articles

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Lead / Invited Papers

1. Dass, Gopal (2013). Sheep production in India with special reference to Muzaffarnagari sheep. State Level Seminar on "Challenges and strategies for conservation of small ruminants in India" at DUVASU, Mathura, U.P. on Oct 9-10, 2013, pp. 14-24.
2. Dass, Gopal, P. K. Rout and S. K. Singh (2014). Goat genetic resources in India and future strategies for its genetic improvement and conservation. National Seminar & Annual Conference on "Sheep and goat biodiversity and breeding Policies – Issues and Perspectives" held at Shirwal, Maharashtra on February 21-22, 2014, pp. 217-229.
3. Dixit A.K., B.Rai, M.K.Singh and N.Ramachandran (2014. Goat production Scenario in India : Opportunities and challenges.Lead paper in National seminar on 'New Dimensional approaches for livestock productivity and profitability enhancement under era of climate change' held at CVS,Anand (Gujrat) during 28-30 January, 2014, pp 317-324.
4. Dixit, A.K. (2013). Economics of Goat Farming in India. In: Training Manual on "Nutrition, Management and Prevention of Goat Diseases for Optimum Productivity" held during 10-16 April, 2013 for Veterinary Officers of State AHD of UP and UK under Trainer's Training Programme (Skill Development) Sponsored by Department of DADF, Ministry of Agriculture, Government of India.
5. Dixit, A.K. and Birthal,P.S. (2013). Positive Environmental Externalities of Livestock in Mixed Farming Systems of India. Agricultural Economics Research Review. 26(3):21-30.
6. Dixit, A.K., M.K. Singh and B. Rai (2014) Goat production and marketing in India. Lead paper in National seminar on Sheep andgoat biodiversity and breeding policies issuesand perspective held at Mahabaleshwar (Satara) M.H. on 21-22 Feb, 2014 pp 81-92.
7. Dixit, A.K.,Singh,M.K. and Rai,B. (2014). Goat Production and marketing in India. Published as lead paper in Souvenir of Annual Conference on 'Sheep and Goat Biodiversity and Breeding Policies-Issues and Perspectives' organized by Department of ARGO,KNPC of Veterinary Sciences, Shirwal and Indian Society for Sheep and Goat Production and Utilization on February 21-22, 2014.
8. Goel, A.K. and Kharche S. D. (2014). Emerging Reproductive Biotechnologies in Small Ruminants. In: Abstracts & Souvenir, National Seminar on 'Sheep and Goat Biodiversity and Breeding Policies-Issues and Perspective' held at Department of ARGO, K N Patil College of Veterinary Science, Shirwal, MAFSU, Nagpur (MS State) on Feb 21-22 2014, pp. 369-384.
9. Kharche, S.D., S.K .Jindal, Satish Kumar, A.K. Goel and Ravi Ranjan (2014). Recent Advances in augmentation of reproduction in goats Proceeding National Seminar and Annual Conference of ISSGPU on Sheepand Goat Diversity and Breeding Policies: Issues and perspectives. 21-22nd Feb. 2014, KNPVC, Shiervel, Maharashtra.
10. Kharche, S.D. (2014). Oestrous synchronization in goats. Lecture delivered at Krantisinh Nana Patil College of Veterinary Science, Shirwal (Satara).
11. Kharche, S.D. and Agarwal, S.K. (2013). Assisted reproductive technologies for enhancing goat production. "Interactive meeting on Prospects in improving production, Marketing and value addition of carpet wool", Arid Region Campus ofCSWRI Avikanagar at Bikaner, December 31 2013, pp. 28-35.

12. Kharche, S.D., Gangwar, Chetna and Agarwal, S.K. (2014). Animal Cloning: Technological Development for future application. National Symposium on "Frontier Reproductive Biotechnologies for enhancing Animal fertility and fecundity global perspective and XXIX annual convention of Indian society for study of animal reproduction" organized by Department of ARGO at MAFSU Nagpur, January 8-10, 2014, pp. 297-311.

13. Kharche, S.D., Gangwar, Chetna, Ranjan, R. and Agarwal, S.K. (2014). Reproductive technologies for enhancing animal production. "2nd Annual meeting of society of veterinary science and Biotechnology and national seminar on Biotechnologies approaches to challenges in animal health and production", U.P. Pt. Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalya evan Go-Anusandhan Sansthan, Mathura, March 6-7, 2014 pp 72-79.

14. Kharche, S.D., Goel, A.K., Jindal, S.K., Gangwar, Chetna, Ranjan, R., Saraswat, S., Pathak, Juhi, Agarwal, Surbhi, Sikarwar, A.K.S., Rout, P.K., Vijh, R.K., Malakar, D., Bag, S. and Agarwal, S.K. (2014). Developmental potency of parthenogenetic goat embryos following in vivo transfer in capra hirus. "International conference on reproductive health: Issue and strategies under charging climate scenario" held at IVRI, Izatnagar Bareilly, 6-8 February, pp71.

15. Kharche, S.D., Goel, A.K., Jindal, S.K., Gangwar, Chetna, Ranjan, R., Saraswat, S., Pathak, Juhi, Agarwal, Surbhi, Sikarwar, A.K.S., Rout, P.K., Vijh, R.K., Malakar, D., Bag, S. and Agarwal, S.K. (2014). Developmental potency of parthenogenetic goat embryos following in vivo transfer in capra hirus. "International conference on reproductive health: Issue and strategies under charging climate scenario" held at IVRI, Izatnagar Bareilly, February 6-8, 2014, pp 71.

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17. Kumar, Ashok (2014) Technologies of CIRG for enhancing goat productivity in Asia and Africa . Lecture delivered to Senior Officers of Asia and Africa organised by IIM Noida , 26-3-14.

18. Kumar, Ashok (2014).Goat Health and management of Goatery Unit. Deliberation and interaction at State specific farmer Scientific interaction during Krishi Vasant 2014 at National Agriculture fair cum exhibition at Nagpur during February9-13, 2014. Hall -1, Session IV, Feb 10, 2014.

19. Kumar, Ashok, V K Gupta and Ravindra kumar (2014). Scientific and economic goat farming in Punjab. In Technical session "Rearing of small ruminant " Progressive Punjab summit-2014 organised by Govt of Punjab, Chandigarh on 18-2-14

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Human Resource Development

Scientist deputed/Trained in India / Abroad

- ✓ ICAR International fellowship (Dr R.Priyadharshini -continuing her Ph.D. programme in Germany)
- ✓ ICAR International fellowship.(Dr. S.P.Singh -completed Ph.D. programme from University of Bonn, Germany)
- ✓ International Training on New techniques for sustainable sheep and goat prodcution. from 26th Jan-6th Feb, 2014 held at Amman, Jordan (Dr. N. Ramachandran)
- ✓ International Training Programme on Quality Growth Services (ISO 9001:2008) on February 22, 2014.(S.D.Kharche, Vijay Kumar, Ashok Kumar, P.K.Rout)
- ✓ Management development programme on leadership at NAARM Hyderabad , 26th August -7th September 2013 (Ashok Kumar)
- ✓ Management development programmes on leadership development" 25 Nov to 7 Dec 2013 at National Academy of Agricultural Research Management, Rajendranagar, Hyderabad (Andhra Pradesh). (Braj Mohan, Saket Bhushan)
- ✓ Review meeting on progressive control of PPR, organized by FAO (SAARC) at Kathmandu, Nepal from 19-20 December 2013 (Naveen Kumar)
- ✓ Training programme on "Advances in Methodological Paradigm and Tools in Extension Research" Sponsored by ICAR, at Division of Extension Education, IARI, New Delhi from 17th Sept. to 7th Oct. 2013 (Vijay Kumar).
- ✓ Training programme on Market, Trade and Institutions for Agricultural Development 27 January to 16 February (21 days) at Division of Agricultural Economics, IARI, New Delhi-12 sponsored by CAFT, ICAR (Dr. A.K.Dixit)

Training organized

A **Post doc fellow Scholar (Dr Erick Virgile Azando From Republic of Benin)** under C V Raman International Fellowship was guided by Dr Ashok Kumar Principal Scientist on " Effect of local anthelmintic plants on gastrointestinal nematodiasis in small ruminants" (15 Sep to 14 Dec 2013)

Official language programmes

- Hindi pakhwada was organized from 13.9.2013 to 28.9.2013 and several programme like Hindi Hastakshtra Pratiyogta, Hindi Anuprayog Pratiyogta, Hindi Sodh Patra Partiyogta, Sulekh Pratiyogta etc. were organized.
- Quarterly meeting of Rajya Bhasha Karyanwan Samiti were organized on 11th June, 2013; 4th Sept. 2013 and 4th March, 2014.
- The Hindi Karyashalas were organized on 29.5. 2013, 26.9.2013 and 26.12.2013 at CIRG and several programmes and guest lectures were organized.

Gene sequences published

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3. Gupta,V.K., Gururaj,K., Shivasharanappa,N., Trivedi,R.N., Singh,V.K., Singh,A., Rout,P.K. and Kumar,A (2014). Capra hircus breed Barbari Toll like receptor-1 protein (TLR-1) gene, partial cds. Gene Bank Accession: KJ210570
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11. Kumar, N., Kachhawa,S., Kashyap,S.K., Maherchandani,S., Singh,S.V., Chaubey,K.K., Gupta,S. and Rawat,K.D.Peste-des-petits-ruminants virus strain Nagaur1 fusion protein mRNA. GenBank Accession: KJ081283.1
12. Kumar, N., Wadhwa,A., Chaubey,K.K., Singh,S.V., Gupta,S., Sharma,S.,Sharma,D.K., Singh, M.K. and Mishra,A.K., Orf virus isolate CIRG major envelope protein gene, partial cds. GenBank Accession: KC992325
13. Mishra, A K, Gururaj K, Gupta G, Gupta V K, Kumar N, Shivasharanappa N, Sharma N and Paul S (2014). Staphylococcus aureus strain CIRG-SM1 thermostable nuclease gene, partial cds. GenBank Accession: KF765737.

14. Mishra, A K, Gururaj K, Gupta G, Gupta V K, Kumar N, Shivasharanappa N, Sharma N and Paul S (2014). Escherichia coli strain CIRG-ECD1 universal stress protein A (uspA) gene, complete cds. GenBank Accession: KF765738
15. Mishra, A K, Gururaj K, Gupta G, Gupta V K, Kumar N, Shivasharanappa N, Sharma N and Paul S (2014). Escherichia coli strain CIRG-ECM1 universal stress protein A (uspA) gene, complete cds. GenBank Accession: KF765739.
16. Mishra, A K, Gururaj K, Gupta G, Gupta V K, Kumar N, Shivasharanappa N, Sharma N and Paul S (2014). Escherichia coli strain CIRG-ECP1 universal stress protein A (uspA) gene, complete cds. GenBank Accession: KF765740.
17. Mishra, A K, Gururaj K, Gupta G, Gupta V K, Kumar N, Shivasharanappa N, Sharma N and Paul S (2014). Escherichia coli strain CIRG-ECS1 Shiga toxin gene, partial cds. GenBank Accession: KF765741.
18. Shivasharanappa, N, Gupta, V K, Gururaj K, Manjunathreddy GB, Kumar A and Rout P K (2013). Capra hircus breed Barbari Toll-like receptor 2 (TLR2) gene complete cds. Gene Bank Accession: KF765736.
19. Shivasharanappa, N, Gupta, V K, Gururaj K, Trivedi,R.N., Singh,V.K., Singh,A., Rout,P.K. and kumar,A. (2014). Capra hircus breed Jakhrana Toll-like receptor 1 (TLR1) gene partial cds. Gene Bank Accession: KJ210569
20. Shivasharanappa, N, Gururaj K, Gupta, V K, Trivedi,R.N., Singh,V.K., Singh,A., Rout,P.K. and kumar,A. (2014). Capra hircus breed Barbari Toll-like receptor 3 (TLR3) gene complete cds. Gene Bank Accession: KJ210566

Conference/ Seminar/ Symposium/Workshop attended

Annual conference of society of animal physiologists of India and National Symposium on Physiological and Nutri-genomic Interventions to Augment Food Security and Animal Welfare from November 19-21, 2013 at DUVASU, Mathura, India. (M.K.Tripathi, Nitika Sharma, Vinay Chaturvedi, Chetna Gangwar and S.D.Kharche)

Annual Convention *of* Indian Society for Veterinary Immunology & Biotechnology & National Symposium *on* Emerging Challenges & Opportunities in Veterinary Immunology & Biotechnology for Improved Animal Health & Productivity, held at Veterinary College Palampur, HP, India from November 11 to 13, 2013 (Naveen Kumar)

Annual Convention of the Indian Society for Study of Animal Reproduction (ISSAR) and National Symposium on Frontier Reproductive Biotechnologies for Enhancing Animal Fertility and Fecundity: Global Perspective, 8-10 January 2014, Nagpur Veterinary College, MAFSU, Nagpur (M S).(A.K.Goel, S.D.Kharche, Ravi Ranjan)

ANGR Country Report meeting held at Karnal on from 20-12-2013 to 22-12-2013 (S.K.Singh)

Annual KVK meet at GKVK, Bangalore, from 22-25, 10-2013 (S.K.Singh)

Annual meeting of society of Veterinary science and Biotechnology and national seminar on Biotechnologies approaches to challenges in animal health and production' organized by department of Biochemistry held at U.P. Pt. Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalya evan Go-Anusandhan Sansthan, Mathura, 6-7 March, 2014.(S.D.Kharche, Chetna Gangwar, A.K.Mishra, Nitika Sharma, V.K.Gupta, Ashok Kumar, K.Gururaj, N. Shivasharanappa, Dige Mahesh Shivanand)

Annual Review Meeting of "Net Work Project on Sheep Improvement" and "Mega SheepSeed Project" held at CSWRI, Guest House, Jaipur from, 16-17 November, 2013. (Gopal Dass)

Annual Review Meet of All Indian Coordinated Research Project on Goat Improvement held at MPKV, Rahuri held on 6-7 sept 2013 (Dige Mahesh Shivanand).

Annual Review Workshop of the NFBSFARA projects on July 22-23, 2013 at NASC Complex, Pusa, New Delhi 110012. (S.D.Kharche)

Awareness Programme on Quality Management system (ISO-9001:2008, Fourth Edition, Quality Growth) from New Delhi at CIRG, Makhdoom on 27.07.2013.(All scientists of Institute)

Brain Storming on "Strategy related to conservation and productivity enhancement of farm animal genetic resources "jointly organized by ICAR and TAAS at NASC Complex, DPS Marg, New Delhi on 10 January, 2014. (Gopal Dass)

CAC meeting of NAIP-3 project "Goat husbandry based integrated approach for livelihood security in disadvantaged district of Bundelkhand region" held on 01.03.14 at

CIRG, Makhdoom. (All Heads, component workers and scientists of GGB Division)

Director's Conference held at Pune and Baramati,from 18-01-2014 to 21-01-2014(S.K.Singh)

Farm Innovation Day held on 27.04.04 at CIRG, Makhdoom. (All scientists of Institute)

Interactive meeting on Prospects in improving production, Marketing and value addition of carpet wool organized by Arid Region Campus of CSWRI Avikanagar at Bikaner,31 December, 2013. (S.D.Kharche)

International conference on 'Reproductive Health: Issue and Strategies under Changing Climate Scenario', organized by Division of Physiology and Climatology at IVRI, Izatnagar Bareilly, February 6-8, 2014.(S.D.Kharche, Ravi Ranjan, Chetna Gangwar)

International conference on "Emerging and Transboundary diseases of Global importance" held at Madras veterinary college on 15-16th July 2013, jointly organized by TANUVAS (India), University of Nottingham (UK) and Virginia Maryland regional college of veterinary medicine (USA) (K.Gururaj)

International Conference on Production Diseases in Farm Animals (ICPD), Uppsala, Sweden, June 24-28, 2013. (S.P.Singh)

International Seminar on "Vishva ki pragati men vigyan evam prodyogiki ka yogdan held at Metkalf House, DRDO, Ministry of Defence, New Delhi from 05-07 December, 2013. (Gopal Dass)

International Symposium and Annual Convention of Society for Immunology and Immunopathology on 'Latest trend in immunodiagnosis, immunopathology and immunomodulation' organised by RAJUVAS, Bikaner during 22nd – 24th Dec, 2013. (A.K.Mishra, Souvik Paul and Nitika Sharma)

International Symposium of the World Associationof Veterinary Laboratory Diagnosticians (WAVLD), Berlin, June 5-8, 2013(S.P.Singh)

International Symposium on "The 21st Century Road Map of Veterinary practice , education and research in India and developing countries" and XXXII Annual ISVM convention at Jammu (14-16 Feb,2014) (Ashok Kumar)

Joint American Dairy Science Association (ADSA) - American Society of Animal Science (ASAS) Annual Meeting, Indianapolis, Indiana, USA, July 8-12, 2013. (S.P.Singh)

Meeting of AICRP on Goats and KVKs of UP to develop collaborative program for genetic improvement of goats which was held on 12.02.14 at CIRG, Makhdoom (All heads and scientists of GGB Division).

Meeting with BAIF officials for discussion on Mutual Areas of Interest for working together in the field of goat production held on 21.05.13 at CIRG, Makhdoom (All scientists of Institute)

National Seminar on "Biotechnological approaches to challenges in Animal Health and Production" at DUVASU Mathura UP (6-7 March 2014) (Ashok Kumar, A.K.Mishra and Nitika Sharma)

National seminar on "New technology of agricultural and allied sciences: Achievements & challenges (in Hindi language)" 11-13 December 2013 at Central Institute of Fisheries Education, (I.C.A.R.) Versova, Mumbai. (Saket Bhushan)

National Symposium "Harmonizing phenomics and genomics for sustainable management of livestock for upliftment of rural masses" organized by SOCDAB, NBAGR, Karnal 6-7 February, 2014 at NBAGR, Karnal. (Saket Bhushan, Dige Mahesh Shivanand)

Quarternly Hindi Workshop held on 26.12.2013 at CIRG , Makhdoom (Attended by all staff of CIRG)

Seminar on "Challenges and strategies for conservation of small ruminants in India" from 9-10 October, 2013 at DUVASU, Mathura, UP.(Gopal Dass)

Society of Nutrition Physiology Conference, Göttingen, Germany, March 19-21, 2013. (S.P.Singh)

Workshop/seminar on Conservation of animals ICAR, New Delhi from 09.01.2014 to 11.01.2014(S.K.Singh)

Workshop on 'Physiology and Biotechnology of Milk Removal' at Veterinary Physiology, Vetsuisse Faculty, University of Bern, Switzerland, April 25-26, 2013. (S.P.Singh)

Workshop on 'Professional Skills' by Zentralstelle für Schlüsselkompetenzen, University of Bonn, August 12-13, 2013. (S.P.Singh)

World Congress on Agroforestry, February 10-14, 2014, New Delhi, India. (M.K. Tripathi, Prabhat Tripathi and Ravindra Kumar)

Important Meetings

Composition of the Research Advisory Committee

Dr.V.Prabhakar Rao,Vice Chancellor, Sri Venkateswara Veterinary University, Tirupati	Chairman
Dr.N.Krishnan, Ex Associate Dean, Hyderabad	Member
Dr.S.K.Dwivedi,Ex. Director, NRC on Equines, Hisar	Member
Dr.R.J.Sharma,Ex.Deam,Mathura	Member
Dr.K.Kumanan,Prof. and Head, Madras Veterinary College, Chennai	Member
Dr. S.N.Maurya, Former Vice Chancellor, DUVASU, Mathura	Member
Shri Ashok R Kale, 21, Kisan Kranti, Market Yard, Ahmednagar 414001, Maharashtra	Member
Shri K Venkatesh, Vijay Farms, Villupuram, Tamil Nadu	Member
Dr. S.K.Agarwal, Director, CIRG, Makhdoom	Member
ADG (AN&P),ICAR	Member
Dr.P.K.Rout, Principal Scientist, CIRG and Incharge, PME	Member Secretary

Composition of the Institute Management Committee

Dr. S.K.Agarwal, Director, CIRG, Makhdoom	**Chairman**
Director, Animal Husbandry, Uttar Pradesh, Lucknow	Member
Director, Animal Husbandry, Uttrakhand	Member
Vice Chancellor, Pt. Deen Dayal Upadyay Pashu Chikitsa Vigyan Vishwavidyalaya evam go anunsandhan Sansthan, Mathura	Member
Shri, S.K.Pathak, DD(F-III), ICAR, Krishi Bhavan, New Delhi	Member
Dr. Sanjeev Kumar, Senior Scientist, NBAGR, Karnal	Member
Dr. Taru Sharma, PS & Head, Animal Physiology, IVRI, Izatnagar	Member
Dr. Dhirendra Singh, PS, Animal Health, CSWRI, Avikanagar	Member
Dr. S.K.Singh, PS, AG&B, CIRG,	Member
Shri Ashok R Kale, 21, Kisan Kranti, Market Yard, Ahmednagar 414001, Maharashtra	Member
Shri K Venkatesh, Villupuram, Tamil Nadu	Member
ADG(AN&P),ICAR	Member
Administrative Officer,CIRG, Makhdoom	Member Secretary

Institute Research Committee (IRC)

The half yearly IRC of the Institute was held on 30-31st Oct, 2013 and progress of all Institute and external funded projects was reviewed. The meeting was chaired by Dr. S.K.Agarwal, Director CIRG and attended by all the scientists of the Institute.

Institute Management Committee (IMC)

The Institute Management Committee meeting was held on 12th June, 2013. The meeting was attended by Dr. A.C.Varshney, VC, DUVASU, Mathura and member IMC, Dr. Dhirendra Singh, Principal Scientist, CSWRI and member RAC, Dr. Sanjeeva Kumar, NBAGR, Karnal and Dr. G.Taru Sharma, Head and Director, CAS, Physiology and Climatology Division, IVRI and Mr. R.N.Mallik, A.O. and member secretary, IMC. The committee discussed various issues related to Institute and appreciated the achivements of the Institute scientist in the area of goat production and health management. Director, CIRG Dr. S.K.Agarwal chaired the meeting and thanked the members for their contribution.

Research Advisory Committee (RAC)

The meeting of Research Advisory Committee (RAC) of CIRG was held on 29th May, 2013 under the chairmanship of Dr V.Prabhakar Rao, Chairman RAC, Dr.S.K. Dwivedi and Dr.K.Kumanen, Dr. N.Krishnan, Dr. S.N.Maurya, Dr. B.S.Prakash, ADG (AN&P) and Dr S.K.Agarwal, Director, CIRG were present. Dr. Prabhakar Rao emphasized on dissemination of technologies developed by the Institute. He further empahsised that considering the importance of women in goat rearing, more training should be taken up by the Institute for women goat farmers. Dr. Dwivedi and Dr. Kumanan also extended suggestions to strengthen the goat research programmes at the Institute.

Research Projects

List of Approved Institute Projects

S.No.	Project Title	P.I.
	Improvement of Jakhrana breed of goats for milk and meat production under farm and field conditions	Dr. Saket Bhusan
	Extension Approaches for Dissemination of Goat Production Technologies and Impact Assessment	Dr. Braj Mohan
	Economic Losses due to Important Diseases in Goat Production	Dr Anupam Krishna Dixit
	A study on impact assessment of various training programmes	Dr. Khushyal Singh
	Patho-Epidemiological Studies on Emerging and Existing Diseases of Goats	Dr. R.V.S. Pawaiya
	Effect of Nutritional Deficiency Diseases on Gene Expression Profiles in Goats	Dr. R.V.S. Pawaiya
	Genetic Marker study in Indian Goats for GI nematode Resistance with special reference to Haemonchus infection.	Dr. DK Sharma
	Toll like receptors (TLRs) expression and characterization in different breeds of goats and their role in disease resistance with special reference to brucellosis	Dr. VK Gupta
	Development of herbal anthelminitic and acaricidal formulation for goats	Dr. Ashok Kumar
	Study on the molecular mechanism of resistance and susceptibility to PPR virus in goats	Dr. Naveen Kumar
	Metabolic profiling for diagnosis and control of metabolic diseases of goats	Dr Nitika Sharma
	Isolation, identification and characterization of major infectious agents associated with neonatal diarrhoea in kids	Dr. A.K. Mishra
	Improvement of post-thaw quality and fertility of frozen semen of different breeds of goats using various additives.	Dr Satish Kumar
	Hormone profile during different reproductive stages in goats	Dr AK Goel
	Comparative Study on Different Structures of Goats Shelters under Farm Conditions	Dr. N Ramachandran
	Traceability, food safety standars and food chain evaluation (HACCP) pertaining to goat meat and value added products	Dr. V. Rajkumar
	Development of complete feed for environmentally and economically sustainable goat production	Dr. Ravindra Kumar
	Value Chain for the Development of Goat Products with Healthy Traits	Dr. A.K. Verma
	Development of feed resources on poor land for goats	Dr. P. Tripathi

Out Funded Projects

S.No.	Project Title (AICRP Projects)	P.I.
	Improvement and Sire evaluation of Jamunapari goats for milk & meat production AICRP Jamunapari Unit	Dr. PK Rout
	Network Project on Sheep Improvement – Muzaffarnagri Unit	Dr.Gopal Dass
	AICRP - Improvement of feed resources and nutrient utilization in raising animal production	Dr. U.B.Chaudhary

	Estimation of methane emission under different feeding systems and development of mitigation strategies	Dr. M.K. Trpathi
	Project Title (NAIP Projects)	
	Goat Husbandry based integrated approach for livelihood security in disadvantaged districts of Bundelkhand region (NAIP comp III)	Dr. M.K. Singh
	Bioprospecting of genes and allele mining for abiotic stress tolerance (NAIP Comp IV)	Dr. P.K. Rout
	Achieving Improved Livelihood Security through Resource Conservation and Diversified Farming Systems Approach in Mewat (NAIP Component III)	Dr. D.K. Sharma
	Developmental potentio parthenogenetic goat embryos (NAIP).	Dr. S.D. Kharche
	Holistic Approach for improving Livelihood Security through livestock based farming system in Barabanki&RaeBareilly Districts of U.P. (NAIP Comp III)	Dr. B. Rai
	Project Title (External Funded Projects)	
	Development and Characterization of an Indigenous Vaccine and Diagnosis for Johne's disease (CSIR and Biovet) NIMTLI	Dr. S.V. Singh
	DST project on Development of diagnostic assay, Molecular characterization and epidemiology of cryptosporidiosis in goats	Dr. S. Paul
	Assessing resilience of small ruminant production under changing climatic conditions in semi-arid zone (NICRA).	Dr. U.B. Chaudhary
	Development of Parthenogenetic Goat from Embryonic Stem Cells (NFBSFARA).	Dr S.D. Kharche
	National Referral Laboratory for Testing of Animal Products (MOFPI).	Dr. V. Rajkumar
	Outreach Programme on Zoonotic Diseases	Dr S.V. Singh
	VTCC – Veterinary Type Culture-Microbes in collaboration with NRCE, Hissar	Dr. V.K. Gupta
	VTCC – Veterinary Type Culture-Rumen Microbes in collaboration with NAINP, Bangalore.	Dr. U.B. Chaudhary

Consultancy, Patents and commercialization of Technologies

Patent application filed:

- Patent No 2913DEL/2014 "Novel herbal antimicrobial gel for animals" S K Garg , Prashant Yadav, Ashok Kumar (2014)
- Patent No. 3516/DEL/2013 "Economic concentrate pellet feed with Brassica oilcake for ruminant feeding, chemical composition, production protocol, storage and uses thereof" Inventors M.K. Tripathi, Prabhat Tripathi, U.B. Chaudhary, D.L. Gupta and Ravindra Kumar.
- Patent No. 3517/DEL/2013 "Oil extracted meal (cake) less concentrate feed for ruminants: chemical constituents, production methodology, storage and uses" Inventors M.K. Tripathi, Prabhat Tripathi, U. B. Chaudhary, Ravindra Kumar and D.L. Gupta.
- Patent No. "Process to Develop Functional Chevon Nuggets with Healthier Fatty Acid Profile" Inventors A.K. Verma and V. Rajkumar

Distinguished Visitors

- Dr. G.K.Singh, Dean, COVS, GBPUAT, Pantnagar. 20.04. 2013.
- Dr. Harpal Singh, Ex-V.C., Dean, GBPUAT, Pantnagar, 19.05.2013.
- Dr. A.K.Mishra, V.C., MAFSU, Nagpur, 27.04.2013.
- Dr. D.V.Ragnekar, Ex Programme Coordinator, BAIF, Urulikanchan, 21.5.2013
- Dr. D.K. Sharma, Director, CSSRI, Karnal, 20.05.2013.
- Dr. B.S. Prakash, ADG (A N & P), Krishi Bhawan, New Delhi. 28.05.2013.
- Dr. V. Prabhakar Rao, V.C., SV Veterinary University, Tirupati. 28.05.2013.
- Dr. K. Kumanan, Director Research, TANUVAS, Chennai. 28.05.2013
- Dr. S.K.Dwivedi, Ex- Director, NRCE, Member RAC. 29.05.2013.
- Dr. S.N. Maurya, Member RAC, Ex-V.C., DUVASU, Mathura. 29.05.2013.
- Prof. A.C.Varshney, V.C., DUVASU, Mathura, 12.06.2013.
- Dr. V.K. Bhatia, Ex-Director, IASRI, New Delhi, 13.07.2013.
- Dr. Mahendra Johari, Vice- President, Heifer International, USA, 02.08.2013.
- Dr. Gaya Prasad, ADG, Animal Health, ICAR, New Delhi, 24.08.2013.

- Dr. Maureen Valentine, Cornell University, USA, 23.09.2013.
- Prof. P.K. Uppal, Ex-Director, NRCE, Advisor Punjab Government (A.H.), 09.09.2013.
- Dr. H.S.Sandhu, Director, Animal Husbandry, Punjab. 09.10.2013.
- Dr. Anatoly Zherdev, Inst. of Bio-Chemistry, Moscow, Russia. 23.10.2013.
- Dr. V. Brahamandan, Director, Animal Husbandry, Kerala. 13.11.2013.
- Dr. K.M.L.Pathak, DDG(AS), ICAR, New Delhi 19.11.2013

- Dr. B.N. Bhatacharyya, Dir. Res. (Vety.), Assam Agr. University, Khanapara. 19.11.2013.
- Mr. Alok Jain, I.A.S., V.C., GBPUAT, Pantnagar, 29.11.2013.
- Dr.S.D.Singh, ADG (Inland Fisheries), ICAR, 17.2.2014.
- Dr. Dilip Kumar, Ex-Director, CIFE, Mumbai. 18.02.2014.
- Dr. A.P. Srivastava, National Coordinator, NAIP, New Delhi, 01.03.2014.
- Dr. Arun Verma, Ex-ADG, ICAR and CAC Chairman NAIP. 01.03.2014
- Dr. D.S.Singh, Ex-Professor, NDUA&T, Faizabad, 1.3.2014
- Dr. Nagendra Sharma, Ex Director, CIRG, NDRI, 5.3.2014.
- Dr. K.K.Katoch, V.C., CSK HP Agr. University, Palampur. 06.03.2014.

- Dr. V.K.Singh, Ex-Director, CSWRI, Avikanagar. 24.03.2014.
- Dr. B.S. Dwivedi, Head, IARI, New Delhi. 24.03.2014.

Personnel

Administration

Dr.S.K. Agarwal	Director
Dr.P.K.Rout	Scientific Secretary
Dr.A.K.Goel	VigilanceOfficer
Mr.R.K.Sharma	Senior Administrative Officer
Mr.P.K.Singh	Finance and Accounts 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

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. Badan Singh	Technical OfficerT-5
Mr. A.S.Prajapati	Technical OfficerT-5
Mr. Vinod Kumar	Technical OfficerT-5
Mr. Gulzari Lal	Technical OfficerT-5
Mr. Rajendra Kumar	Technical OfficerT-5

Physiology,Reproduction and Shelter Management Division

Dr. S.K.Jindal	Principal Scientist and Head
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. S.P.Singh	Scientist
Dr. RaviRanjan	Scientist
Dr. PriyadharsiniRaju	Scientist (on study leave)
Mr. Krishan Kumar	Technical OfficerT-5(upto 08.12.2013)
Mr. H.K.Himkar	Technical OfficerT-5
Mr. Hari Om	Technical OfficerT-5
Mr. Dinesh Bhat	Technical OfficerT-5

Nutrition,Feed Resources and Products Technology Division

Dr. U.B.Chaudhary	Pr.Scientist and Head
Dr. M.K.Tripathi	Principal Scientist
Dr. R.B.Sharma	Principal Scientist
Dr. Prabhat Tripathi	Senior Scientist
Dr. Ravindra Kumar,	Senior Scientist
Dr. V.Rajkumar	Sr. Scientist
Dr. A.K.Verma	Scientist
Mr. Suresh Tewari	Asstt. Chief Technical OfficerT-7(7-8)
Mr. Dori Lal Gupta	Sr. Technical Officer T-6
Mr. Raj Kumar Singh	Sr. Technical Officer T-6
Mr. Suraj Pal	Technical OfficerT-5
Mr. Lal Singh	Technical OfficerT-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
Dr. Nikita Sharma	Scientist
Dr. Shivsharnappa	Scientist
Dr. A.K.Mishra	Scientist
Dr. Souvik Pal	Scientist
Dr. H.A.Tiwari	Chief Technical Officer (T-9)
Dr. Vinay Chaturvedi	Sr. Technical Officer (T-6)
Sr. Vijay Kishore	Technical OfficerT-5 (On study leave)
Sh. Chet Ram	Technical OfficerT-5
Sh. V.K.Gautam	Technical OfficerT-5
Sh. T.K.Gautam	Technical OfficerT-5

Extension Education and Socio-Economics Section

Dr. Braj Mohan	Pr.Scientist and I/c
Dr. A.K.Dixit	Senior Scientist

Dr. Khushyal Singh	Scientist (Sr. Scale)
Dr.Vijay Kumar	Scientist
Mr. S.C.L.Gautam	Technical OfficerT-5
Mr. U.C.Yadav	Technical OfficerT-5

AICRP on Goat

Dr. S.K. Singh	Principal Scientist and I/c
Dr. Shivanand Mahesh Dige,	Scientist

Network Project on Sheep

Dr. Gopal Dass	Principal Scientist

Priortization Monitoring and Evaluation Section

Dr. P.K.Rout	Pr. Scientist and I/c
Dr. Ashok Kumar	Principal Scientist
Dr. Souvik Paul	Scientist
Dr. Balraj Singh	Sr. Technical Officer T-6

IPR Cell

Dr V.K.Gupta	Principal Scientist and I/c

RTI Cell

Dr V.K.Gupta	Principal Scientist and Transparency Officer
Dr. H.A.Tewari	Chief Technical Officer (T-9) and PIO
Dr. Vijay Kumar	Scientist and APIO

Agriculture Knowledge Management Unit (AKMU)

Dr. R.V.S.Pavaiyya	Principal Scientist and I/c
Sh. M.P.Agarwal	Technical Officer T-5
Sh. Satish Chandra	Technical Officer T-5

Maintenance

Dr.U.B.Chaudhary	Principal Scientist and I/c
Sh. Jagdish Singh	Technical OfficerT-5
Sh. Ishwari Saran	Technical Officer T-5
Sh. Inder Pal	Technical OfficerT-5

Security Section

Mr. P.K.Sharma	Security Officer

Medical Section

Dr. Ashok Kumar	Principal Scientist and I/c
Mr. Mohan Lal	Technical Officer T-5

Library

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

Agriculture Farm

Dr. Prabhat Tripathi	Sr.Scientist and I/c
Sh. Ram Kishan	Technical OfficerT-5

Horticulture Section

Dr. B.Rai	Pr.Scientist and I/c
Sh. Suraj	Technical OfficerT-5
Sh. Hukam Singh	Technical OfficerT-5

Transfer

Dr. A.K. Das	Scientist transferred to, IVRI Regional Station, Kolkata
Mr. R.N.Mallik, AO	Transferred to IVRI Izatnagar
Sh. Kailash Chand, JAO	Transferred on promotion to CARI, Izatnagar

Joining

Shri Rajesh Kumar Sharma, SAO	w.e.f. 05.07.2013
Shri. P.K.Singh, FAO	w.e.f. 01.04.2013
Sh. Bacchu Singh, LDC	w.e.f. 01.10.2013
Dr. Shivanand Mahesh Dige, Scientist	w.e.f. 12.04.2013
Dr. Chetna Gangwar, Scientist	w.e.f. 23.05.2013
Dr. S.P. Singh, Scientist	w.e.f. 14.02.2014 after completion of study leave

Dr. K. Gururaj, Scientist	w.e.f. 01.10.2013 after completion of study leave
Dr. Vijay Kumar	w.e.f. 29.05.2013 after completion of study leave

Retirement/ Death

Sh. Bhagwan Singh, Technical Officer	Retired on 31.1.2014
Sh. Jagdish Singh,T-5 Technical Officer	Retired on 31.1.2014
Sh. Soren Singh SSG	Retired on 31.3.2014
Sh. M.P.Agarwal, T-5, Technical Officer.	Retired on 28.2.2014
Sh. Dinesh Prasad, T-6 Sr. Technical Officer	Retired on 31.1.2014
Sh. Krishna Kumar, T-6 Technical Officer	Died on 08.12.2013

Career Advancement/Promotion

Shri Lal Singh	Promoted to the post of Technical Officer (T-5)
Shri. S.C.L.Gautam	Promoted to the post of Technical Officer (T-5)
Shri.T.K.Gautam	Promoted to the post of Technical Officer (T-5)
Shri. V.K.Sharma	Assured Promoted to the post of Sr.Technical Assistant T-4/T-3
Shri.Shiv Charan T-II=3	Assured Promoted to the post of Sr.Technical Assistant T-4/T-3
Shri.Govind Prasad	Assured Promoted to the post of Sr.Technical Assistant T-4/T-3
Sh.Yatendra Kumar	Assessed promoted to the post of Sr.Technician(T-2)
Sh.RamSwarop	Assessed promoted to the post of Sr.Technician(T-2)
Sh. R.S.Sarswat	Assessed promoted to the post of Sr.Technician(T-2)
Sh.Krishna Kumar	Assessed promoted to the post of Sr.Technician(T-2)

Deputation abroad

Dr. R.Priyadarshini	Scientist on study leave for Ph.D. in Germany under ICAR International Fellowship