

# Dynamics of Agricultural Biotechnology

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# **Dynamics of Agricultural Biotechnology**

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A S Chandel and R M Kamal



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**SAARC Agricultural Information Centre (SAIC)**

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## ANIMAL HUSBANDRY

## Laboratory animals

**2083** ARULDHAS, MM; DEVAMANOHARI, WG; VALIVULLAH, HM; GOVINDARAJULU, P. 1981. **Influence of thiouracil and thyroxine treatment on rat mammary gland.** *Journal of Reproductive Biology and Comparative Endocrinology*, 1: 2, 95-100; 16 ref.

Effects of thiouracil-induced hypothyroidism and thyroxine-induced hyperthyroidism were studied in rat mammary glands. Adult female virgin rats were treated intramuscularly with thiouracil at 10 mg/100 g body wt., thyroxine at 10 µg/100 g, or with vehicle only for 2 wk. Thiouracil treatment increased mammary DNA, RNA, protein and glycogen (P less than 0.001), while thyroxine caused decreases in DNA, RNA and protein (P less than 0.001) and an increase in glycogen (P less than 0.001). Thyroxine also decreased blood oestradiol (P less than 0.001). It is concluded that short-term thiouracil treatment has a beneficial effect on rat mammary growth possibly through increased prolactin secretion, but that severe hyperthyroidism may decrease mammary growth.

**2084** BABU, PS; SRINIVASAN, K. 1993. **Influence of dietary spices on adrenal steroidogenesis in rats.** *Nutrition Research*, 13: 4, 435-444.

Experiments were carried on adult rats which were fed the following diets for 2 months: control, Curcumin (0.5%), Capsaicin (15mg%), Ginger (50mg%), Black pepper (0.5%), Cumin (1.25%), Mustard (250mg%), Fenugreek (2%) and Onion (3%). Adrenal weights in the various experimental groups were comparable to controls. Adrenal cholesterol was found to be significantly lower in all the spice fed animals except mustard suggesting a higher rate of cholesterol turnover to corticosteroid hormones. Cholesterol depletion was accompanied by reduced ascorbic acid content in the adrenals of curcumin, capsaicin, fenugreek and onion fed rats. urinary excretion of 17-oxo and 17-hydroxy steroids which are the metabolites of corticosteroids was significantly higher in these spice fed groups. These data are indicative of the stimulatory influence of dietary spices on adrenal steroidogenesis.

**2085** BANSAL, MP; GUPTA, VK; RAM, GC. 1990. **Effect of conditioned medium (granulocyte macrophage colony stimulating factor) on level of various leucocytes in peripheral blood of rabbits.** *Indian Veterinary Journal*, 67: 6, 574-578; 2 ref.

A conditioned medium, prepared by stimulation of

buffalo peripheral blood mononuclear cells with concanavalin A, was injected i.p. into 4-week-old rabbits. The total leukocyte and absolute monocyte and granulocyte counts in the inoculated rabbits increased, compared with pre-inoculation values; lymphocyte counts were not affected.

**2086** DAS, AM. 1989. **Staphylococcal dermatitis in white rats: treatment by autogenous vaccine.** *Indian Veterinary Journal*, 66: 10, 990; 4 ref.

*Staphylococcus aureus* was isolated in pure culture from skin scrapings collected from areas of erythema and epidermal exfoliation that developed in a colony of laboratory rats. A multiple drug resistance pattern was shown in in vitro antibiotic sensitivity tests. Rats given an s.c. injection of an autogenous vaccine prepared from one of the isolates improved after the first and were cured after the second injection.

**2087** DAS, SK; GOSWAMI, SL; RAMESHA, KP. 1993. **Sexing of preimplantation embryos in mice.** *Indian Journal of Animal Sciences*, 63: 9, 970-972.

**2088** DWIVEDI, PP; KUMAR, A. 1989. **Lindane mediated induction of cytochrome P-450 mRNA in rat liver: studies with a nonradioactive cDNA probe.** *Indian Journal of Experimental Biology*, 27: 8, 729-731; 25 ref.

**2089** GULATI, N; MANGAL, PC. 1986. **Effect of selenium (selenite) on DNA and RNA synthetic activities in mouse liver, kidney and spleen following 7,12-dimethylbenz(alpha) anthracene administration.** *Indian Journal of Experimental Biology*, 24: 2, 85-87; 16 ref.

ICRC mice weighing about 25 g were given drinking water without or with sodium selenite 4 µg/ml and some of both groups had 9,10-dimethyl-1,2-benzanthracene (DMBA) 40 mg/kg body weight subcutaneously on 3 occasions at weekly intervals. They were killed 2, 4, 6, 8, 10 or 12 weeks after the last dose of DMBA was given. One h before death, they were given 25 µCi [3H]thymidine and 20 µCi [3H]uridine. DNA and RNA activity in liver, kidney and spleen was stimulated significantly at 2 to 4 weeks after DMBA was given, declined slightly at 4-6 weeks and then increased again. In rats given selenium, DNA and RNA activity was inhibited by 25 to 70% at 2-4 weeks but later inhibition declined. At no stage did Se return activity to normal.

**2090** KABIR, SN; PAL, AK; PAKRASHI, A. 1984. **Luteolytic influence of intrauterine dead embryos in the early pregnant rat.** *Biology of Reproduction*, 30: 3, 532-536; 19 ref.

Unilateral ovariectomy was carried out on pregnant rats after implantation (on day 5 after mating). The implantation sites in one uterine horn, ipsilateral or contralateral to the remaining ovary, were selectively destroyed by injecting 0.1 ml of sterile normal saline to that particular horn only, and the peripheral progesterone level and viability of the embryos in the untreated horn, which depended on the functions of the remaining ovary, were examined. Selective killing of embryos in the uterine horn of the ovariectomized side did not exert any influence on the foetal viability in the untreated horn (non-ovariectomized side), and the peripheral progesterone level also remained unaffected. The induction of foetal resorptions in the uterine horn of the intact side, however, produced a significant fall in the peripheral level of progesterone and induced resorption of embryos of the ovariectomized side also. The latter could be prevented by simultaneous administration of exogenous progesterone, indicating luteolysis as the major, if not sole, factor responsible for foetal resorption in the untreated horn. The luteolytic effect could not be attributed to saline or to the distension of the uterine horn caused by saline injection. Luteolytic factors from the dead embryo-bearing horn which act locally on the adjacent ovary only, are discussed.

**2091** MAJUMDAR, AC. 1991. **In vitro fertilization of follicular oocytes from gonadotropin primed rabbit does.** *Indian Journal of Animal Sciences*, 61: 5, 535-536; 7 ref.

21 female rabbits were injected with 100 IU PMSG, and 46 h later were given an injection of 100 IU HCG. Oocytes were collected 6, 8 or 10 h after the HCG injection, were inseminated with capacitated spermatozoa, and incubated for 24 h. Of 48 oocytes collected at 6 h, 2 had the 2nd polar body. Of 62 and 76 oocytes collected at 8 and 10 h resp., 17 and 35 had developed to 2-cell embryos, and 23 and 29 had the 2nd polar body.

**2092** MIRHADI, SA; AHUJA, SP; GUPTA, PP. 1983. **Effect of garlic (*Allium sativum* L.) on the lipid composition and lipid biosynthesis in tissues of rabbits during experimental atherosclerosis.** *J. of Nuclear Agriculture and Biology*, 12: 2, 33-37; 26 ref.

Ten rabbits were given an atherogenic diet with daily cholesterol 200 mg/kg bodyweight without or with garlic 1 g/kg. The tissues and blood were analysed for

lipid changes. After 115 days of feeding and 3 h before killing 2 animals from each group were injected intraperitoneally with [2-14C]acetate and [1-14C]-palmitate. A progressive increase in the total lipids of red blood cells (RBC) and plasma and ratios of cholesterol (C) to phospholipids (PL) in plasma and RBC, were observed with both diets, but the increase was less with the garlic diet. The haematocrit values decreased significantly with the cholesterol diet. The results suggest that RBC get cholesterol and phospholipids from the plasma. With cholesterol plus garlic in diet the aorta, heart and liver had relatively less amounts of total lipids. Heart, liver and adrenals also showed lowered ratios of C to PL. Fewer fatty streaks of less severity were observed in aorta and no coronary lesions were noted when cholesterol plus garlic was given. Both diets produced fatty changes. The garlic diet decreased the biosynthesis of fatty acids from acetate and of glycerolipids from palmitate.

**2093** NATH, N; NATH, M; MUDDESHWAR, MG. 1984. **Ascorbic acid in thyroidectomized rats. 1. Biosynthesis and catabolism.** *Acta Vitaminologica et Enzymologica*, 6: 2, 83-89; 23 ref.

In thyroidectomized rats ascorbic acid and dehydroascorbic acid decreased compared with values in sham-operated controls. Diketogulonic acid in liver and kidneys was unchanged. In urine total ascorbic acid increased and glucuronic acid decreased significantly. Ascorbic acid synthesizing enzymes were unchanged. Activity of degrading enzymes increased in the liver and was unchanged in kidney. In thyroidectomized rats given thyroxine 5 mg/100 g body weight daily for 10 days by intraperitoneal injection activities of dehydroascorbatase and 2,3-diketoaldonate decarboxylase in the liver were normal. A single injection of thyroxine 10 mg/100 g on the 7th day after thyroidectomy did not affect values. Results indicate that thyroxine does not directly affect ascorbic acid metabolism.

**2094** NATH, N; NATH, M; MUDDESHWAR, MG. 1984. **Ascorbic acid in thyroidectomized rats. 2. Ascorbic acid status of the storage tissues and hepatic biosynthesis of glucuronic acid.** *Acta Vitaminologica et Enzymologica*, 6: 2, 91-95; 15 ref.

In thyroidectomized male rats, weighing initially 140 to 150 g, weight loss was accompanied by a significant decrease in ascorbic acid and membrane bound sialic acid in adrenals, brain and epididymis. Sialidase activity increased. In liver the activities of hepatic UDP-glucuronyl transferase and beta-glucuronidase decreased. Activity of UDP-glucose dehydrogenase was unchanged.

**2095** RAO, VH; MONGHA, IV; ANSARI, MR; BHATTACHARYYA, NK. 1984. **Survival of rabbit embryos after rapid freezing and thawing.** *Experientia*, 40: 8, 821-822; 19 ref.

16-cell rabbit embryos were stored for 10 days at  $-196^{\circ}\text{C}$  in 2.0 M DMSO in phosphate-buffered saline, then thawed at  $500^{\circ}$  per min. Of 148 frozen embryos, 138 (93%) were morphologically normal after thawing. Of 70 thawed embryos transferred directly to pseudo-pregnant recipient females, 37 (52%) developed to term. Of 28 thawed embryos incubated in vitro for 24 h before transfer to recipients, 12 (43%) developed to term.

**2096** SHARMA, HS; MISRA, UK. 1985. **Development pattern of the hepatic DNA, RNA and protein in relation to maternal vitamin A status in rats.** *Acta Vitaminologica et Enzymologica*, 7: 1/2, 85-91; 15 ref.

During pregnancy and lactation female Wistar rats weighing initially 160 to 180 g were given diets deficient in vitamin A and vitamin A supplements 6, 40 or 100  $\mu\text{g}$  retinol equivalents/kg bodyweight daily. On day 20 of pregnancy and on days 0, 10 and 23 post partum 3 dams and their litters from each group were killed. In foetuses and young liver weight, liver DNA, RNA, protein and cell number increased linearly with age and with increasing vitamin A in the diet. Synthesis of DNA and protein from  $[3\text{H}]$ thymidine and  $[3\text{H}]$ leucine in young at 10 and 23 days old increased with increasing vitamin A.

**2097** SHUKLA, RR; JOSHI, HC; MISRA, UK. 1983. **Developmental pattern of DNA and proteins in brain, liver, lung and heart of rats given excess vitamin A postnatally.** *Biol. of the Neonate*, 44:4, 243-250; 26 ref.

**2098** SUNEJA, SK; RAM, GC; WAGLE, DS. 1983. **Effects of feeding T-2 toxin on RNA, DNA and protein contents of liver and intestinal mucosa of rats.** *Toxicology Letters*, 18: 1/2, 73-76; 14 ref., 2 tab.

A significant decrease in body weight and an increase in liver weight were observed in young male albino rats fed 1.5 mg/kg body wt. T-2 toxin daily for 4 days. Liver protein and DNA and intestinal mucosal protein contents were significantly decreased, whereas intestinal mucosal RNA content was increased. Decreased liver and intestinal protein synthesis in T-2 toxin-fed rats was inferred from  $[14\text{C}]$  leucine-incorporation studies.

**2099** TANDON, A; SINGH, MM; KAMBOJ, VP. 1983. **Steroid metabolism by rabbit embryos: time of onset of steroidogenic activity.** *Experimental and*

*Clinical Endocrinology*, 82: 3, 285-290; 17 ref.

Day-5 and day-6 preimplantation embryos and day-7 and day-8 postimplantation embryos were incubated for 24 h in the presence of  $3\text{H}$ -labelled steroids, including dehydroepiandrosterone (DHEA), androstenedione and testosterone. Although the preimplantation and postimplantation embryos were able to metabolise the various neutral steroids into other neutral, mostly  $5\alpha$ -reduced, steroid metabolites, the conversion of DHEA to androstenedione or that of DHEA, androstenedione and testosterone to oestrogens was exhibited only by day-7 and day-8 postimplantation embryos. The findings suggest that rabbit preimplantation blastocysts lack the potential to synthesise steroids, and that blastocysts acquire this ability only after implantation.

## Animal breeding

**2100** AMBROSE, JD; SINGLA, SK; MANIK, RS; MADAN, ML. 1991. **Laparoscopy in animal Reproduction Research Present Status and Future prospects in India.** *Int. Symposium on "Biotechnology in animal Production"*. (NDRI, Karnal:1991: Mar 13-14).

**2101** MADAN, ML; CHAUHAN, MS; SINGLA, SK; MANIK, RS. 1994. **Procedures on in vitro fertilization technique.** *Advances in animal Production and Gynaecology*. (PAU, Ludhiana: 1994: July 25-Aug 13).

**2102** MADAN, ML; SINGLA, SK; MANIK, RS. 1994. **Technologies for Breeding biology and assisted reproduction including genome banking.** *Workshop on "Indira Gandhi's Vision on Wildlife Conservation-Zoo as one such Instrument"*. 1994: Oct. 29).

**2103** MANIK, RS; ARCHANA. 1991. **Recent advances in animal reproduction.** *Indian Dairyman*, XLIII: 8, 341-346.

**2104** MANIK, RS; MADAN, ML; SINGLA, SK. 1994. **Ultrasound procedures in production and reproduction.** *Advances in Animal Production and Gynaecology*. (PAU, Ludhiana: 1994: July 25-Aug 13).

## Equines

**2105** JAVED, MH; ULLAH, N. 1993. **Preliminary results of field embryo transfer in Pakistan.** *Pakistan Veterinary Journal*. [vol. 13?].

**2106** MADAN, ML; MANIK, RS. 1992. **Embryo transfer and artificial Insemination in Equines.**

Souvenir, Scientific Meeting cum Round Table Discussion on "Newer Frontier Areas of Research in Equine Health and Production". (NRCE, Hisar: 1992: December 5).

**2107** MADAN, ML; NAQVI, SMK; CHAUHAN, MS; SINGLA, SK; MANIK, RS. 1992. **In vitro production of ovine preimplantation embryos from in vitro matured oocytes using epididymal and frozen thawed spermatozoa.** *Proceeding of 12th International Conference on Animal Reproduction: Vol. 3.* Central Sheep & Wool Research Institute, Avikanagar, Rajasthan, India, p. 1318-1320.

**2108** ULLAH, N; JAVED, MH. 1991. **An appraisal of embryo transfer in Pakistan.** *Biotechnology Bull.*

## Bovines

**2109** AFZAL, M; JAVED, MH; ANJUM, AD. 1983. **Calf mortality: seasonal pattern, age distribution and causes of mortality.** *Pak. Vet. J.* 3: 1, 30-33.

**2110** ALI, CS; SAMAD, HA; JAVED, MH. 1985. **Occurrence of post partum estrus and fertility in buffaloes and cows under field conditions.** *Pak. Vet. J.* 5: 1, 45-46.

**2111** GOHLWAR, CS; SETHI, RP; MARWAHA, SS; SEGHAL, VK; KENNEDY, JF. 1984. **Gibberellic acid biosynthesis from whey and simulation of cultural parameters.** *Enzyme and Microbial Technology*, 6: 7, 312-316; 9 ref.

Of 5 isolates of *Fusarium moniliforme*, 2 gave good production of gibberellic acid (GA) from whey permeate (4% lactose) in 12 day culture at 27°C and pH 5.5. GA accumulated at the end of the max. growth phase, days 9-12, and final GA concn. were 635 and 520 mg/l. Tests on the best isolate and mathematical modelling indicated that a 12 day culture at 28°C, pH 5.0 and a 10-12.5% (v/v) inoculum were optimum for GA production, which reached 685 mg/l with 80% lactose utilization. Supplementation of whey with N from inorganic or organic sources inhibited GA production and lactose utilization, but increased biomass.

**2112** KALE, MM; MANIK, RS; TOMER, OS. 1992. **Ingestive behaviour of crossbred calves.** *Indian J. of Anim. Sci.* 62: 3, 282-284.

**2113** MANIK, RS; SINGLA, SK; CHAUHAN, MS; MADAN, ML. 1992. **Superovulatory responses in**

**cattle as influenced by presence or absence of dominant follicle.** *Proc. International Conf. on fertility Regulation.* (Bombay: 1992: Nov. 5-8). p. 296.

**2114** MARWAHA, SS; SETHI, RP; KENNEDY, JF. 1983. **Influence of 5,6-dimethylbenzimidazole (DMB) on vitamin B12 biosynthesis by strains of *Propionibacterium*.** *Enzyme and Microbial Technology*, 5: 5, 361-364; 12 ref.

Studies on vitamin B12 biosynthesis by *Propionibacterium shermanii* in a whey permeate medium (containing 3.28% lactose, 0.5% yeast extract and cobalt nitrate at 5 mg/l and 5,6-dimethylbenzimidazole (DMB) at 15 mg/l) have been made, but the stage of fermentation at which DMB should be added has not been determined. In the present studies, 168 h incubation at 30°C was found to be optimum for vitamin B12 biosynthesis. Addition of DMB after incubation of the culture for 144 h was optimum for vitamin B12 biosynthesis, growth and substrate utilization by *P. shermanii*.

**2115** MARWAHA, SS; SETHI, RP; KENNEDY, JF. 1983. **Role of amino acids, betaine and choline in vitamin B12 biosynthesis by strains of *Propionibacterium*.** *Enzyme and Micr. Techn.*, 5: 6, 454-456; 10 ref.

Addition of L-glutamic acid at 0.05% (w/v) to whey permeate medium stimulated vitamin B12 biosynthesis by *Propionibacterium shermanii* and a *Propionibacterium* strain AKU 1251. Addition of betaine at 0.5% (w/v) also increased biosynthesis of the vitamin.

**2116** REDDY, GS; SRINIVASAN, VA. 1993. **Serological response in cattle, sheep and goats to vero cell culture rinderpest vaccine.** *Indian Veterinary Journal*, 70: 7, 597-599.

**2117** SHANKER, V; BHATIA, S; BALAIN, DS. 1992. **Isolation and endonuclease digestion of DNA from leucocytes of crossbred cattle for restriction fragment length polymorphism studies.** *Indian Journal of Dairy Science*, 45: 7, 349-352; 11 ref.

DNA from Karan Swiss and Friesian X Sahiwal cattle was digested with 6 restriction endonucleases. Several restriction sites were detected.

**2118** SHARMA, AK. 1987. **Biotechnology and dairy industry.** *Dairy India*/edited by PR Gupta. National Dairy Development Board, Anand, India, p. 55-59.

This paper discusses techniques in genetic engineering and their potential use for improvement of cattle health, growth rate, fertility, milk yield and milk quality. The use of monoclonal antibodies is also considered.

**2119 VARADARAJ, MC; NAMBU DRIPAD, VKN.** 1983. **Production of thermostable deoxyribonuclease and enterotoxins by *Staphylococcus aureus* in khoa during storage.** *Journal of Food Science and Technology, India*, 20: 4, 179-181; 16 ref.

The ability of 4 strains (K-283, K-192, K-220 and A100) of *S. aureus* to produce thermostable DNAase and enterotoxins in khoa (moisture contents of 26-28%, 38-42% or 45-48% and stored at 25-35°C or at 4-5°C) was tested. All the inoculated samples stored at 25-35°C produced almost equal quantities of thermonuclease within a wk, irrespective of the moisture in the khoa. Detectable amounts (2µg) of enterotoxin were produced by during storage at 25-35°C; the wild cultures K-283 and K-192 and the standard culture A100 produced enterotoxins A, E and E, resp. The ability of strain K-220 to produce enterotoxins A, B and E in khoa varied with moisture content. Samples stored at 4-5°C did not generally produce enterotoxins, the exception being toxin B produced by K-220 in small quantities.

## Genetic improvement

**2120 KAIKINI, AS.** 1992. **Embryo transfer for an effective break-through in livestock production.** *Indian Journal of Animal Reproduction*, 13: 1, 1-4.

A discussion, with particular emphasis on the application of embryo transfer in livestock improvement.

**2121 ROBERTSON, A.** 1984. **The relevance of molecular biology to animal improvement.** *Genetics: new frontiers: Proceedings of the XV International Congress of Genetics, Vol. IV.- Applied genetics*. New Delhi: Oxford & IBH Publishing, p. 193-200; 16 ref.

A discussion of the possibilities of exploiting recombinant DNA techniques in selection and gene transfer in livestock.

**2122 SHANKER, V; BHATIA, S.** 1990. **Genetic manipulation and livestock improvement: possibilities and prospects.** *Indian Journal of Dairy Science*, 43: 4, 553-563; 29 ref.

Methods of gene mapping, gene cloning and gene transfer in livestock are reviewed, and possible applications in animal breeding are discussed.

**2123 SIKKA, P; SIKKA, VK.** 1991. **Animal bioreactors.** *Indian Dairyman*, 43: 12, 414-416; 13 ref.

A discussion on the applications of gene transfer in livestock, consideration being given to problems associated with gene expression and reproduction.

**2124 SINGLA, SK; AMBROSE, JD; MANIK, RS; MADAN, ML.** 1991. **Comparative embryo production performance in indigenous and crossbreed cows vis-a-vis buffaloes.** *International Symposium on "Biotechnology in animal Production"*. (NDRI, Karnal: 1991: March 13-14).

## Breeding

**2125 AGARWAL, SK; TANEJA, VK; YADAV, MC; SHANKAR, U.** 1993. **Effect of season on superovulation response, recovery rate and quality of embryo in crossbred cattle.** *Indian Journal of Animal Sciences*, 63: 5, 505-510.

**2126 BALAKRISHNAN, CR; GOSWAMI, SL; MANIK, RS.** 1992. **Recent advances in in vitro assessment of fertility of spermatozoa.** *National Symposium on Recent Advances in Clinical Reproduction in Dairy Cattle*. (1992: April 8-10).

**2127 NANDAKUMARAN, B; TANDON, SN; KHANNA, ND.** 1985. **Genetic studies on transferrin polymorphism in Haryana crossbreds.** *Indian Veterinary Journal*, 62: 5, 408-413; 9 ref.

Blood samples from 70 Holstein-Friesian (HF) X Haryana, 78 Brown Swiss X Haryana, and 69 Jersey X Haryana cattle, and 69 backcrosses of the F1s to the exotic parent breed, were examined by starch-gel electrophoresis. 16 phenotypes were observed, controlled by the TfA, TFB, TfD1, TfD2, TfF and TfE alleles. Phenotypic and gene frequencies are tabulated; they did not differ significantly among the crossbred groups. In all populations except the HF X Haryana, there was good agreement between observed and expected phenotype frequencies.

**2128 SHANKER, V; BHATIA, S.** 1984. **Serum transferrin polymorphism in Indian zebu cattle and their crossbreds with Brown Swiss inheritance.** *Indian Journal of Animal Sciences*, 54: 4, 301-304; 13 ref.

Serum samples from 326 Tharparkar, 290 Sahiwal, 120 Red Sindhi (RS) and 411 Brown Swiss X zebu cattle were examined by starch-gel electrophoresis. Gene frequencies for TfA, TfD, TfE, TfB and TfF are tabulated. The frequency of TfB was 0.002-0.025. The frequency of TfA was higher in Tharparkars (0.39) than in RS (0.18) or Sahiwals (0.08). Its frequency in Brown Swiss crossbreds was 0.13-0.15. 136 of the crossbreds were typed for the TfD1 and TfD2 alleles. The frequencies of TfD1 and TfD2 were 0.04 and 0.43 resp. The gene frequency of TfD in the indigenous breeds was

0.24-0.36 vs. 0.53 in the crossbreds not typed for TFD1 and TFD2.

## Superovulation

**2129** AGARWAL, SK; TANEJA, VK; SHANKAR, U; YADAV, MC. 1992. **Effect of age on superovulation response, embryo recovery and their quality in cattle.** *Indian Journal of Animal Sciences*, 62: 1, 59-60; 8 ref.

Crossbred cows (Holstein, Brown Swiss and Jersey X Haryana) aged <5, 5-10 or >10 yr were superovulated with PMSG (2500 IU) or FSH-P (40 mg) during the mid-luteal phase. All animals were given PGF2alpha 48 h after gonadotropin treatment and inseminated 4, 12 and 24 h after the onset of oestrus. For the 3 age groups, the percentage responding to superovulation was 73.3, 69.2 and 78.9 resp., ovulation rate 5.73, 4.46 and 7.42, embryo recovery percentage (number of embryos X100/number of ovulations) 42.1, 25.4 and 3.0, number of embryos + ova recovered 3.2, 1.56 and 2.8, percentage of fertilized eggs 87.5, 92.8 and 64.3, percentage of transferable embryos 56.2, 64.3 and 26.2, and the percentage of degenerate embryos 31.2, 28.5 and 38.1.

**2130** AGARWAL, SK; TANEJA, VK; SANWAL, PC; VARSHNEY, VP. 1992. **Progesterone and oestradiol 17-beta in relation to ovulation rate, quantity and quality of embryos in crossbred cattle.** *Indian J. of Animal Sciences*, 62: 2, 108-111; 14 ref.

48 crossbred cows were superovulated with PMSG or FSH plus PG, and inseminated 12-24 h after the onset of oestrus. Ovarian response was determined by rectal palpation. Eggs were collected non-surgically by flushing 7 days after oestrus. The plasma concentration of progesterone or oestradiol-17beta at initiation of superovulation was not correlated with ovulation rate, or numbers of fertilized eggs and embryos recovered or of transferable embryos. Progesterone concentration on the day of flushing was positively correlated with ovulation rate (0.55), and numbers of total eggs (0.172), fertilized eggs (0.418) and transferable embryos (0.31). The plasma concentration of oestradiol-17beta at oestrus was positively correlated with ovulation rate (0.40), and numbers of total eggs (0.53), fertilized eggs (0.60) and transferable embryos (0.70).

**2131** GUPTA, RC; SINHA, AK; SWAMY, AK. 1983. **Preliminary report on superovulation and non-surgical embryo collection in cattle.** *Indian Journal of Animal Reproduction*, 4: 1, 1-4; 5 ref.

11 crossbred, repeat-breeder cows were given 1500 IU PMSG between days 10 and 14 of the oestrous cycle, followed 48 h later by 5 mg PGF2alpha. When induced oestrus occurred, 3 inseminations were carried out at 12-h intervals. Three, 4 and 4 females had more than 10, 2-4, and 1 or no corpus luteum resp. Non-surgical embryo recovery was attempted in 6 females using a 2-way Foley catheter. From 1 female, 4 embryos and 2 unfertilized ova were recovered.

**2132** KADU, MS; FASIHUDDIN, M; SHRIVASTAVA, OP; CHEDE, SA; PAWASHE, CH; TOTTEY, SM. 1989. **Preliminary trials on superovulation, non-surgical embryo recovery and embryo transfer in cows.** *Ind. J. of Animal Reprod.*, 10: 2, 101-104; 6 ref.

2 Jersey X Sahiwal cows and 1 Holstein X Haryana cow were treated twice with 20 mg PGF2alpha at an 11-day interval (days 0 and 11), and superovulated with twice-daily injections of FSH from day 24 for 4 days, with total daily doses of 11, 9, 7 and 5 mg FSH. After oestrus on day 28, the cows were inseminated 4 times at 12-h intervals. Embryos were recovered on day 35, and 2 blastocysts were transferred to 2 synchronized Holstein X Haryana cows that had been inseminated twice on the day of oestrus. One of the recipients returned to oestrus after 12 days; the other was still pregnant on day 60.

**2133** MISHRA, AK; JOSHI, BV; NAIR, HK. 1992. **Preliminary trials of multiple ovulation and embryo transfer in cows under field conditions.** *Indian Journal of Animal Reproduction*, 13: 1, 16-17; 8 ref.

Nine Holstein and Jersey crossbred cows were superovulated with PMSG, and embryos were recovered non-surgically. For the 2 breed type ovulation rate averaged 8 and 3 resp. and the number of embryos recovered 2 and 0.8. Seven fresh embryos and 22 frozen embryos were transferred to synchronized recipients, resulting in a pregnancy rate of 43 and 27% resp.

**2134** SUBRAMANIAM, A; DEVARAJAN, KP; MOHANAN, M. 1990. **'On farm' embryo transfer in crossbred cows under Indian field conditions.** *Indian Journal of Animal Reproduction*, 11: 2, 114-116; 9 ref.

31 crossbred cows were treated with PMSG and PGF2-alpha for superovulation, and those exhibiting oestrus were inseminated. From the 19 cows responding to treatment, 45 embryos were recovered non-surgically. 24 good quality embryos were transferred to 24 naturally synchronized recipients; 7 recipients became pregnant, and 2 female and 2 male calves were born. Two cows aborted after 120 days of transfer.

## Embryo culture

2135 JAVED, MH; WRIGHT, RW. 1990. **Bovine amniotic and allantoic fluids for the culture of murine embryos.** *Theriogenology*, 34: 3, 445-460.

2136 JAVED, MH; WRIGHT, RW. 1990. **Determination of pentose phosphate and Embden Meyerhof Pathway activities in bovine embryos.** *Theriogenology*, 35: 5, 1029-1037.

## Embryo transfer

2137 KURUP, MPG. 1992. **Embryo transfer.** *Dairy India*/edited by PR Gupta. National Dairy Development Board, Anand, India. p. 171-173.

The use of embryo transfer to increase India's milk production to 80 million t by the yr 2000 is discussed.

2138 SETHI, IC; JAIN, JP. 1993. **Progeny testing with multiple ovulation and embryo transfer in cattle.** *Ind. Journal of Animal Sciences*, 63: 3, 257-262.

2139 SINGH, G; TOTEY, SM; SINGH, G; TALWAR, GP. 1991. **Successful pregnancies from transfer of half embryos without zona pellucida in crossbred cows.** *Indian Journal of Animal Sciences*, 61: 3, 292-294; 6 ref.

Embryos were recovered from Holstein X Sahiwal cows on day 6-7 of oestrus following superovulation with FSH, and 35 whole embryos and 12 half-embryos were transferred to oestrus-synchronized donors. The number of pregnant animals 90 days after transfer was 18 and 7.

2140 SINGH, GURPREET; TOTEY, SM; SINGH, GURCHARAN; TALWAR, GP. 1989. **Live birth of calves as a result of non-surgical embryo transfer of demi-embryos obtained by splitting of embryos.** *Ind. Journal of Animal Reproduction*, 10: 2, 109-110; 4 ref.

Holstein X Sahiwal cows were superovulated with 28 mg FSH. Embryos were recovered at the early blastocyst stage, and those of the highest quality bisected and transferred without the zona pellucida to synchronized recipients. One calf was born to each of 3 recipient cows.

2141 SUBRAMANIAM, A; DEVARAJAN, KP; MOHANAN, M. 1990. **Incidence and avoidance of zona fracture in cryopreserved bovine ova and embryos.** *New Zealand Veterinary Journal*, 38: 4, 156-157; 22 ref.

Ova (n=62), which were collected from slaughterhouse bovine ovaries, and embryos (n=26), which were non-surgically recovered from 11 superovulated crossbred donor cows, were frozen. The frozen ova and embryos were then thawed using 2 conventional thawing protocols, at 37°C for 30 seconds in a water bath and at 25°C for 2 min in the air. Some 64.5% of the ova and 53.8% of the embryos thawed in the water bath and 16.1% of the ova and 7.7% of the embryos thawed in ambient air exhibited fractured zonae pellucidae. The slow thawing protocol had a lower incidence of zona damage in cryopreserved ova and embryos than the fast thawing protocol. A low pregnancy rate (12.5%) was recorded for embryos transferred with zona fracture while embryos transferred with intact zonae had a rate of 35.3%, indicating that embryos with zona damage are less viable.

2142 TOTEY, SM; SINGH, G; TANEJA, M; TALWAR, GP. 1991. **Ultrasonography for detection of early pregnancy following embryo transfer in unknown breed of Bos indicus cows.** *Theriogenology*, 35: 3, 487-497; 13 ref.

Real time B mode ultrasonography was used from day 18 to 64 to detect and monitor the conceptus in 30 unknown breeds of zebu recipients following embryo transfer. The embryonic vesicle was first visible within the uterus between days 18 and 20 (mean  $\pm$  SD 18.5  $\pm$  0.7 days). The embryo proper was detected at day 19.5  $\pm$  0.7. The heartbeats were detected at day 22.6  $\pm$  0.9. The average day of first detection of the allantois, the C-shaped embryo and the amnion was 23.1  $\pm$  0.8, 23.8  $\pm$  1.4 and 25.1  $\pm$  1.4 days; respectively. The forelimb, the limb buds, the spinal cord and the optic area were observed on days 32.7  $\pm$  1.3, 32.9  $\pm$  1.3, 33.0  $\pm$  1.5 and 33.6  $\pm$  1.4, respectively. Fetal movements could be detected at day 50.7  $\pm$  1.0. Ribs and vertebrae were detected on day 60.9  $\pm$  1.7. The mean length of the embryo proper was 4.5  $\pm$  0.8 mm on day 19. At day 60 it was 52.5  $\pm$  7.0 mm. The growth of the embryo proper increased steadily until day 39, growing rapidly thereafter. Embryonic death was detected in one recipient on day 32.

2143 ULLAH, N; MEHMOOD, A; JAVED, MH; ANWAR, M. 1985. **Comparison of superovulation treatments for embryo transplantation in cattle.** *Seminar on Progress of Science and Technology in Pakistan.* (Islamabad: Pakistan: 1985: Dec. 20-22). Sponsored by Pakistan Science Foundation, Islamabad, Pakistan.

## Diseases

**2144** AKHTAR, S; IQBAL, N; ANJUM, AD. 1984. **Clinical response of calves against rinderpest disease vaccination.** *Pak. Vet. Journal*, 4: 2, 129-131; 6 ref.

From observations on 40 bovine and buffalo calves up to 12 months of age, it was judged safe to inoculate cell-culture rinderpest vaccine at 3 months of age and above.

**2145** BANERJEE, PK; GUHA, C; GUPTA, R. 1989. **Recrudescence of haemoprotista following an outbreak of rinderpest in cross-bred cattle.** *Indian Journal of Veterinary Medicine*, 9: 1, 47-48; 2 ref.

Recrudescence of haemoparasitic infection following an outbreak of rinderpest and vaccination with tissue culture vaccine is described among cross-bred cattle on a farm in Calcutta in 1986. Of the 150 cattle examined, 83 showed recrudescence, with the highest incidence being with *Theileria annulata*. A rare infection with *Trypanosoma evansi* was seen in two animals. *T. annulata* and *Anaplasma marginale* infection developed in 45% of the vaccinated cattle and 66% of healthy in-contact controls.

**2146** DOYLE, JJ. 1987. **The potential of the new technologies for improved control of infectious diseases of livestock.** *Agricultural Applications of biotechnology: Proceedings of the Nayudamma Memorial Symposium*. (Madras: 1986: Dec 5-17)/edited by AN Rao, HYM Ram. Committee on Science and Technology in Developing Countries, Madras, India. p. 139-150; 8 ref.

**2147** GIRIDHAR, P; VENKATESHA, MD; AGNI-HOTHRI, GJ; ANANTH, M; KESHAVAMURTHY, BS. 1990. **Merits of different tests in the evaluation of protection of calves given varying doses of alum precipitated haemorrhagic septicaemia vaccine.** *Indian Veterinary Journal*, 67: 11, 1002-1005; 9 ref.

The efficacy of s.c. vaccination of calves with 3, 5 or 10 ml of an alum-precipitated *Pasteurella multocida* vaccine was assessed by passive haemagglutination (PH) or complement fixation (CF) tests. Potency testing, by challenge inoculation with 1 ml of a 1:10 dilution of an 18-h culture of the organism, was performed 3 weeks after vaccination; all vaccinated calves survived, while control unvaccinated calves died. All 3 dosages of the vaccine conferred satisfactory immunity. The CF test, using killed whole cell antigen, was better than the PH test, using capsular antigen, for measuring protective antibody titres.

**2148** MISHRA, AK; CLABAUGH, G; KAKOMA, I; RISTIC, M. 1992. **In vitro cultivation of *Babesia bovis* in a modified microaerophilous stationary phase (MASP) culture system.** *Acta Parasitologica*, 37: 1, 51-52; 3 ref.

A continuous modified microaerophilous stationary phase (MASP) culture technique for cultivation of *B. bovis* was modified: the contents of the well were increased from 1.2 ml to 2.2 ml, so as to have more exoantigen. Other conditions remained the same and the kinetics of the growth of the parasites was studied. A stabilate of *B. bovis* (Mexican isolate) was inoculated into a splenectomized bovine calf. The infected blood from the calf at 6% parasitized erythrocytes (PPE) was collected, and parasites were cultivated in MASP culture system for 3 months before being used in this study. The MASP culture technique was followed using coster tissue culture, flat bottom plates, medium 199 and 40% bovine serum. Three dilutions (1:1, 1:2 and 1:5) of the cultures were maintained. The supernatant in each well was replaced every 24 h with fresh medium and PPE was recorded. *Babesia bovis* in cultures multiplied in every well in the modified MASP culture system. The mean maximum PPE observed was 9.07, 8.13 and 5.75 in culture dilutions 1:1, 1:2 and 1:5 respectively after 72 h of initiation of the culture. The percent increase in PPE was also recorded and it was observed that the increase was directly proportional to time up to 72 h. It is concluded that *B. bovis* actively multiplies under the conditions used. Increased PPE and change in colour of the culture medium provided indirect evidence of production of exoantigen. It is suggested that the present modification in the MASP technique may be useful for scaling up the vaccine production once the quantification of antigen in the supernatant has been established.

**2149** RAMANNA, BC; SRINIVASAN, VA. 1992. **Serological response in cattle to tissue culture rabies vaccine.** *Indian Veterinary Journal*, 69: 1, 8-10; 6 ref.

Using the CVS strain of rabies virus, grown in BHK 21 cell cultures and inactivated with bromoethylenamine, a vaccine was prepared and adsorbed with aluminium hydroxide gel. 17 crossbred cattle were inoculated s.c. in the neck region, using 1 ml of the vaccine. The immunological response to vaccination was followed with the rapid focus fluorescent inhibition test. A satisfactory immune response, with titres of log<sub>10</sub> 2.02 and 1.27 were seen at 2 and 17 months after vaccination, respectively. The animals showed an anamnestic response when revaccinated after 17 months.

**2150** RAY, DK; BHATTACHARYYA, UK; CHOWDHURY, B; DASGUPTA, P; BHATTACHARYYA, AK. 1989. **Studies on a severe outbreak of foot and mouth disease in regularly vaccinated cross-exotic dairy cattle in West Bengal (India). I. Isolation of virus from typical and atypical lesions and also from milk.** *Indian J. of Animal Health*, 28: 1, 51-55; 16 ref.

Foot and mouth disease with involvement of A22 subtype of the virus was reported in an organized and regularly vaccinated dairy farm in West Bengal. The last vaccination with aluminium hydroxide gel adsorbed formaldehyde inactivated tissue culture vaccine was 1-2 months before the disease outbreak. The disease was very severe with lesions on the mouth, foot, muzzle, eyelids, tail, teats and vulva. Virus isolation through inoculation of unweaned mice and characterization of the serotype were performed by complement fixation test from all the samples of tissue of typical as well as atypical lesions. Virus was also isolated from milk samples of cows with mastitis, and a number of cows aborted.

**2151** SHUKLA, PC; SHARMA, RD. 1991. **Immuni-zation of bovine calves with cell culture vaccine against *Theileria annulata*.** *Acta Veterinaria Brno*, 60: 1, 79-86; 18 ref.

*Theileria annulata* (Hisar) was propagated in a lymphoblastoid cell line for up to 139 passages, and its immunogenicity tested by challenging 45 calves of 3-5 months of age that had been inoculated with varying concentrations of the *T. annulata* after 10, 50 and 100 passages. Pathogenicity was present after 10 and 50 passages, and with *Theileria* concentration of 104 cells/ml after 100 passages. S/c injection of 106 cells/ml after 100 passages produced no signs of pathogenicity except for a slight reduction in the erythrocyte indices, while there was only a mild reaction to severe challenge.

**2152** SHUKLA, PC; SHARMA, RD. 1988. **In vitro establishment of lymphoblastoid cell cultures infected with *Theileria annulata* (Hisar).** *Indian Veterinary Medical Journal*, 12: 3, 142-145; 13 ref.

*T. annulata* was established in lymphoblastoid cell cultures using RPMI-1640 supplemented with 20% fetal bovine serum. The cultures were propagated up to passage 139 by using precolostral bovine serum instead of fetal bovine serum.

**2153** SINGH, KULDEEP; BHARGAVA, DN; KUMAR, ASHOK; SHRIFI, D. 1992. **A bacteriological study of non-surgical wounds in bovines.** *Indian Veterinary Journal*, 69: 4, 291-293; 6 ref.

Culture of 25 pus swabs taken from non-surgical wounds yielded *Proteus spp.* in 21, *Staphylococcus aureus* in 14, *Bacillus sp.* and *Escherichia coli* in 10 each, and *Pseudomonas aeruginosa* in 5. Yeasts and fungi were also isolated. The sensitivity of these isolates to 14 antibiotics was assessed using the disc diffusion technique. Most of the isolates were resistant to erythromycin, ledermycin, tetracycline, vibramycin and cloxacillin and sensitive to chloramphenicol, penicillin, gentamicin and kanamycin.

**2154** VASUDEVACHARI, MB; KRISHNASWAMY, S; KESHAVAMURTHY, BS. 1981. **Maternally derived measles haemagglutination inhibition antibody response in calves to rinderpest tissue culture vaccine.** *Kerala Journal of Veterinary Science*, 12: 2, 224-228; 15 ref.

Of 9 cows inoculated with rinderpest tissue culture vaccine at 5-7 months of pregnancy, 3 possessed blood serum antibodies to rinderpest virus at calving, as judged by inhibition of measles virus-induced haemagglutination (MHI). Antibody titres in colostrum collected soon after calving were much higher than those in serum, and 3 of the 6 animals with no detectable serum MHI antibodies had high colostrum titres. Colostral MHI antibody titres decreased by 24 h post partum. Before colostrum feeding, calves' blood serum contained no detectable MHI antibodies, but 24 h after feeding, 8 of the 9 calves had MHI antibodies in serum. Titres in calves' serum decreased with age, only 40% of animals being positive at 3 months of age.

## Buffaloes

**2155** ACHARYA, RM. 1992. **Buffalo: the dominant force.** *Dairy India*/edited by PR Gupta. Indian Council of Agricultural Research, New Delhi, India. p. 51-55.

Alternative approaches are being developed for improving buffalo breeds in India, including the application of embryo transfer technology. Equally urgent is the need to check genetic erosion caused by the slaughter of high milk yielders in the cities. Buffalo milk is better than cow milk for production of yoghurt, ghee, khoa and paneer, but is less suitable for production of chhana, rasagolla, butter, evaporated milk, Cheddar cheese, ice cream and infant formulae.

**2156** ALEXIEV, A; VLAKVOV, K; KARAIVANOV, C; KACHEVA, D; POLYKHONOV, O; PETROV, M; NIKOLOV, N; DROGOEV, A; RADEV, P. 1990. **Embryo transfer in buffaloes in Bulgaria.** *World Buffalo Congress Vol. II, Part II: Proceedings.* (New

Delhi: 1988: Dec). Indian Council of Agricultural Research, New Delhi. p. 591-595; 10 ref.

Results of experiments carried out between 1984 and 1987 are summarised. The response to treatment with FSH and PMSG, expressed as a percentage of the number of animals treated was as follows: oestrus induction 90 and 85 resp.; >2 corpora lutea 72 and 54; eggs fertilized 93 and 74; embryos transferable 90 and 70. Recipients were oestrus-synchronized with 2 doses of cloprostenol given 11 days apart. Oestrus was exhibited by 84% of treated animals within  $60.3 \pm 1.4$  h after the 2nd dose, and oestrus lasted for 10 h. 172 embryos were recovered 4-6 days after AI; all were at the morula or hatched blastocyst stage. 99 embryos were transferred, resulting in a pregnancy rate of 18.5% and a calving rate of 10%

**2157** ALEXIEV, A. 1990. **Genetic aspects of embryo transfer in buffalo breeding.** *Proceedings, II World Buffalo Congress: Volume II, Part II.* (New Delhi, ICAR: 1988: December). Indian Council of Agricultural Research, New Delhi. p. 330-335; 15 ref.

**2158** BABU, PSK; JAIN, SK; SRIVASTAVA, AK. 1991. **Nucleic acid sequence encoding buffalo beta FSH and beta LH.** *Medical Science Research*, 20: 1, 35-37; 20 ref.

Northern blot analysis of RNA extracts from the anterior lobe of buffalo pituitaries was carried out using sheep cDNA probes specific for beta-FSH and beta-LH. The hybridization signal with the FSH probe was strong and that with the LH probe was weak. These results suggest that the beta-LH of buffaloes is coded by more than 1 species of mRNA. Dot blot hybridization of buffalo cellular RNA with nick-translated sheep beta-FSH and beta-LH probes showed strong signals, suggesting a considerable degree of homology between buffalo and sheep sequences. EcoRI and Sall digests of buffalo genomic DNA revealed positive signals on hybridization to a sheep FSH probe, and a sheep LH probe recognised a 23.1 kb fragment in the EcoRI digest of buffalo genomic DNA. Concluded that sheep cDNA probes can be used to screen buffalo genomic or cDNA libraries.

**2159** BASU, SB. 1990. **Maximizing genetic improvement in buffaloes.** *Indian Dairyman*, 42: 9, 382-385.

A discussion on the application of embryo transfer in the genetic improvement of buffaloes for milk production.

**2160** BHAT, PP; MISHRA, BP; BHAT, PN. 1990. **Polymorphism of mitochondrial DNA (mtDNA) in**

**cattle and buffaloes.** *Biochemical Genetics*, 28: 7/8, 311-318; 11 ref.

Using 13 restriction enzymes, restriction fragment length polymorphism was studied in mitochondrial DNA (mtDNA) of 2 Haryana and 2 Friesian cattle and 3 Murrah buffaloes. In the Friesians, different mtDNA genotypes were seen in digests with BamHI, BglII, HindIII, HpaI, PstI and AvaII; no such variation was seen in the Haryanas. The Murrah buffaloes differed by only a single (BglI) restriction site.

**2161** BHATTACHARYA, NK; NANDY, DK. 1990. **Present status of embryo transfer in buffaloes.** *World Buffalo Congress Vol. II, Part II: Proceedings.* (New Delhi, ICAR: 1988: December). p. 596-602; 42 ref.

This paper reviews oestrous synchronization, superovulation, and surgical and non-surgical methods of embryo collection and transfer. Significant experiments relating to these aspects are tabulated by nature of the research, breed of buffalo and literature reference. A protocol for superovulation and embryo collection is given.

**2162** CHAUHAN, MS; MANIK, RS; SINGLA, SK; MADAN, ML; KATIYAR, P. 1992. **In vitro capacitation of buffalo spermatozoa by Heparin.** *Proc. International Conf. on Fertility Regulation.* (Bombay: 1992: Nov. 5-8). p. 300.

**2163** CHAUHAN, MS; KATIYAR, PK; MADAN, ML; MANIK, RS; SINGLA, SK. 1995. **Production of buffalo blastocysts through IVF in a media supplemented with caffeine/ Theophylline.** *Proceedings of the Society of Animal Physiologist of India.*

**2164** CHOUDHURY, JM; BARMAN, NN; SHARMA, DK; DUTTA, PK; BORO, BR. 1990. **Immune response of foot-and-mouth disease polyvalent vaccine in buffalo calves.** *Indian Journal of Virology*, 6: 1/2, 12-16; 10 ref.

Groups of 6 Murrah buffalo calves (6 months old), free from foot and mouth disease virus (FMDV) antibodies, were left as unvaccinated controls, inoculated once with a formalin inactivated, aluminium hydroxide gel absorbed, polyvalent, cell culture vaccine containing O, A5, C and Asia, FMDV types, or inoculated twice with the same vaccine with an interval of 26 weeks. Blood samples collected weekly for 39 weeks were examined by the tube serum neutralization test against all 4 virus types. The results were expressed as a log serum neutralization index (SNI). All vaccinated calves showed a good immune response to all 4 virus types. SN antibodies were detected from the first week after

inoculation (SNI 1.66-1.88). Peak antibody levels were found at 3 weeks (3.83-4.08) and were still detected at 39 weeks (1.01-1.26). Immune response was increased in boosted calves to a peak at 2 weeks after the second inoculation (3.73-4.04) and remained high at 13 weeks (3.66-4.08). No SN antibodies were detected in control calves.

**2165** KAPOOR, S. 1991. **Isolation, propagation and characterization of some strains of rotavirus from neonatal bovine calves in India.** *Indian Journal of Animal Sciences*, 61: 5, 463-467; 17 ref.

Rotavirus was isolated in cell-culture from the faeces of 2 of 14 cattle and 1 of 6 buffalo calves positive for rotavirus by polyacrylamide-gel electrophoresis. The isolation was made in MA 104 cell-line in the presence of trypsin. The isolates were confirmed as rotavirus by electron microscopy, dot-ELISA, polyacrylamide-gel electrophoresis of genome RNA and serum-neutralization tests. All of them were typical rotaviruses as revealed by RNA electropherotyping.

**2166** KASIRAJ, R; MISRA, AK; RAO, MM; JAISWAL, RS; RANGAREDDI, NS. 1993. **Successful culmination of pregnancy and live birth following the transfer of frozen-thawed buffalo embryos.** *Theriogenology*, 39: 5, 1187-1192.

A total of 141 embryos was recovered by nonsurgical flushing of the uterus of 31 superovulated buffalo. A total of 66 good quality embryos (Grade I and Grade II) was frozen using 1.4 M glycerol. Forty-two of the frozen embryos were thawed randomly over a 1-year period, and a total of 39 embryos (Grades I, II or III post thaw) were transferred into an equal number of estrus synchronized recipients. Of confirmed pregnancies, 9 calves were born live.

**2167** KATIYAR, PK; CHAUHAN, MS; MADAN, ML; MANIK, RS; SINGLA, SK. 1995. **Buffalo blastocyst development after in vitro maturation of cumulus oocytes complexes in a defined medium supplemented with fetal bovine serum and FSH-P.** *Proc. of the Society of Animal Physiologist of India*.

**2168** KUMAR, A; MISRA, UK. 1984. **Fatty acid biosynthesis in buffalo mammary tissue.** *Indian Veterinary Journal*, 61: 6, 463-468; 14 ref.

In vitro experiments with amino acids labelled with radiocarbon showed that long-chain amino acids (myristate and palmitate) became incorporated in the fatty acid fraction to a greater extent than acetate. In this respect the buffalo is similar to the cow.

**2169** KUMAR, A; MISRA, UK. 1984. **Lipid biosynthesis in buffalo mammary tissue from (1-14C) butyrate.** *Indian Journal of Animal Sciences*, 54: 7, 624-627; 12 ref.

Lipid extracts from slices of mammary tissue from 6 healthy lactating and non-lactating Murrah buffaloes were compared in order to examine the role of butyrate in lipid synthesis. In non-lactating mammary tissue, [1-14C]butyrate was not incorporated into lipid fractions. In lactating tissue, [1-14C]butyrate gave max. radioactivity in short-chain triglycerides followed by long-chain triglycerides (LCTG), free fatty acid (FFA), free cholesterol (FC) and phospholipid. Although generally linear with time, incorporation into LCTG, FC and FFA was rapid up to 15 min, thereafter slowing down. Butyrate seems to be used in lipid synthesis only in lactating tissue and primarily for triglyceride synthesis. The change in lipid metabolism that appears to occur during lactation is probably hormonally regulated.

**2170** KURUP, MPG. 1990. **Present status of embryo transfer in buffaloes and future expectations.** *World Buffalo Congress Vol. II, Part II: Proceedings*. (New Delhi, ICAR: 1988: Dec). p. 587-590; 20 ref.

**2171** MADAN, ML; CHAUHAN, MS; MANIK, RS; SINGLA, SK. 1994. **Effect of insulin on in vitro development of IVM/IVF buffalo embryos.** *Second Asia-Pacific Conference on Agricultural Biotechnology*. (Madras: 1994: March 6-10). Central Tobacco Research Institute, Rajahmundry - 533 105, A.P., India, p. 73.

**2172** MADAN, ML; MANIK, RS; MITTAL, R; SINGLA, SK. 1993. **Ovarian follicular distribution and development in buffaloes.** *Proc. National Symposium on Role of Theriogenology for Augmenting Fertility in Domestic Animals*. ISSAR, Calcutta: p. 25-26.

**2173** MADAN, ML; NAQVI, SMK. 1988. **Plasma progesterone and estrus induction using prostaglandin (PROSTIN) among anestrus rural buffaloes.** *11th International Congress on Animal Reproduction and A.I.* Central Sheep & Wool Research Institute, Avikanagar, Rajasthan-304 501, India.

**2174** MADAN, ML; CHAUHAN, MS; SINGLA, SK; MANIK, RS. 1992. **Pregnancies established from buffalo blastocyst derived from in vitro matured in vitro fertilized oocytes co-cultured with cumulus and oviductal cells.** *Proc. International Conf. on Fertility Regulation*. (Bombay: 1992: Nov. 5-8). p. 302.

- 2175 MANIK, RS; SINGLA, SK; CHAUHAN, MS; MADAN, ML. 1995. **Dynamics reproductive events in buffalo studied through ultrasound approach.** *First Congress of Federation of Indian Physiological Societies (FIPS)*. (New Delhi: 1995: March 1-3).
- 2176 MANIK, RS; SRIVASTAVA, A; MUDGAL, VD. 1982. **Effect of protein : energy ratio on blood cholesterol in buffalo bulls.** *Animal Nutrition Research Workers' Conf.* (Tirupati: 1982: Nov 29-Dec 3). p. 73.
- 2177 MANIK, RS; SRIVASTAVA, A; MUDGAL, VD. 1983. **Effect of protein : energy ration of nutrient utilization on buffalo bulls.** *Symposium on Recent Developments in Nuclear and Allied Techniques and Their application in Agriculture, Biology and Animal Sciences.* (Pantnagar: 1983: May 5-7). p. 177.
- 2178 MANIK, RS; MUDGAL, VD. 1984. **Monthly and seasonal variation in physico-chemical attributes of buffalo semen.** *World Review of Animal Production*, 20: 4, 45-51.
- 2179 MANIK, RS; MADAN, ML; AMBROSE, JD; SINGLA, SK; CHAUHAN, MS. 1992. **Real time ultrasound scanning for the study of follicular population on the day of estrus and ovulation in buffaloes.** *12th Int. Cong. Anim. Reprod.* The Hague, The Netherlands.
- 2180 MANIK, RS; SRIVASTAVA, A; MUDGAL, VD. 1989. **Seasonal Changes in the digestibility of nutrients and seminal attributes in buffalo bulls fed different levels of dietary protein.** *Indian J. Anim. Sci.* 59: 9, 1177-1180.
- 2181 MANIK, RS; SRIVASTAVA, A; MUDGAL, VD. 1988. **Significance of season influenced changes in haematology of Murrah buffaloes fed varying levels of dietary protein.** *Indian J. Anim. Prod. Mgmt.* 4: 1, 22-26.
- 2182 MANIK, RS; SRIVASTAVA, A; MUDGAL, VD. 1988. **Utilization of nitrogen by buffalo bulls as influenced by level of dietary protein and climatic conditions.** *Indian J. Anim. Sci.* 58: 6, 710-714.
- 2183 MISRA, AK; JOSHI, BV; AGRAWALA, PL; KASIRAJ, R; SIVAIHAH, S; RANGAREDDI, NS; SIDDIQUI, MU. 1990. **Multiple ovulation and embryo transfer in Indian buffalo (*Bubalus bubalis*).** *Theriogenology*, 33: 5, 1131-1141; 13 ref.
- Of 83 buffaloes injected twice with PG to induce oestrus, 73 had a palpable corpus luteum 1 day before being superovulated with FSH. Commencing on day 9 or 13 of the oestrous cycle, groups of 8-10 buffaloes were given a total of 9, 18, 21.6, 25.2, 28.8 or 36 mg FSH in twice-daily doses of diminishing amounts over 5 days. All buffaloes were treated twice with PG on the 4th day of FSH treatment, and were inseminated at oestrus or 48 h after the 1st PG treatment. Embryos were recovered non-surgically 6 days after AI. Maximum ovulation rate ( $5.3 \pm 0.79$ ) was obtained by treatment with 25.2 mg FSH (3.24, 2.88, 2.52, 2.16 and 1.8 mg twice daily on successive days, commencing on day 9), the highest av. number of embryos recovered (3.7) was obtained with 18 mg FSH commencing on day 13, and the highest av. number of transferable embryos (2.2) with 21.6 mg FSH plus GnRH at AI. Nine of 35 recipients became pregnant following the transfer of 41 fresh embryos, and 3 of 8 recipients following transfer of 9 frozen and thawed embryos.
- 2184 MISRA, AK; JOSHI, BV. 1991. **Relationship between the synchrony of donor-recipient oestrus in successful pregnancies of embryo transfer in buffalo.** *Buffalo Journal*, 7: 1, 71-75; 14 ref.
- Over a 2.5-yr period, 232 buffaloes were superovulated with FSH or PMSG and were inseminated after detection of oestrus with a teaser bull and again after 12 and 24 h. Embryos were collected non-surgically 5-6.5 days after the 1st insemination. Most embryos that were in excellent condition were frozen, and the remainder, plus those in good or fair condition, were transferred to recipients without freezing. Pregnancy was established in 24 recipients in which oestrus was synchronous with that of the donor, or varied from -40 h to +16 h, and which received fresh embryos by non-surgical or surgical transfer or thawed embryos by non-surgical transfer.
- 2185 MOHANTY, PK; VERMA, PC; RAI, A. 1989. **Detection of swine pox and buffalo pox viruses in cell culture using a protein A-horseradish peroxidase conjugate.** *Acta Virologica*, 33: 3, 290-296; 13 ref.
- Buffalo pox virus antigen was detected in Vero cells and swine pox virus antigen in the cytoplasm and nucleus of PK-15 and IB-RS-2 cells as early as 6 hours after infection (p.i.) by indirect immunoperoxidase technique using a protein A-horseradish peroxidase conjugate. The viral antigens localized in the cytoplasm of infected cells were the most prominent from 24 hours p.i.

**2186 MOHANTY, PK; RAI, A. 1989. Immune response induced by vero cell culture adapted buffalo pox virus in rabbits and buffaloes. *Indian Journal of Experimental Biology*, 27: 4, 350-355; 42 ref.**

The Vero cell culture adapted buffalo pox virus was found to be completely attenuated at 40th passage for rabbits as well as buffaloes since it did not produce any thermal reaction or skin lesions. It induced high level of humoral and cell mediated immune response in rabbits as well as buffaloes. The antibody titres obtained were 80-160 for SN antibody, 32 for complement fixing and 640-1280 for enzymeimmunoassay antibodies. The percent migration inhibition (MI) of leukocytes was 65.3% in rabbits and 69.50% in buffaloes, MI of macrophages was 62.15% in rabbits and 63.02% in buffaloes with a high skin reactive factor value. In protection tests conducted in rabbits and buffaloes, all the vaccinated animals were immune as compared to controls which showed severe disease.

**2187 MUDGAL, VD; RADHEY SHAM. 1985. Seasonal influences on semen quality of buffalo bulls. *Symposium on Seminology with Special Reference to Buffalo Semen*. (Pantnagar: 1985: Oct 29-30). p. 22.**

**2188 PALTA, P; PRAKASH, BS; MADAN, ML; PANDITA, S; MANIK, RS. 1995. Application of a sensitive direct RIA for estimation of estradiol17-B in buffalo ovarian follicular fluid. *First Congress of Federaton of Indian Physiological Societies: Proceedings*. (New Delhi: 1995: March 1-3).**

**2189 PALTA, P; PRAKASH, BS; MADAN, ML; MANIK, RS; PRAKASH, BS. 1995. Development of a sensitive and highly specific RIA for measurement of dimeric inhibin in buffalo ovarian follicular fluid. *Proceedings of the Society of Animal Physiologist of India*.**

**2190 PALTA, P; PRAKASH, BS; MADAN, ML; MANIK, RS. 1995. Dimeric inhibin contents of buffalo ovarian follicles. *First Congress of Federation of Indian Physiological Societies*. (New Delhi: 1995: March 1-3).**

**2191 PRAKASH, BS; JAILKHANI, S; SINGLA, SK; MADAN, ML. 1992. Application of a sensitive, heterologous enzymeimmunoassay for progesterone determination in unextracted buffalo plasma samples collected in an embryo transfer experiment. *Animal Reproduction Science*, 27: 1, 67-74; 9 ref.**

Seven buffaloes were superovulated using pig FSH, and

oestrus was induced by PG (Lutalyse R). The animals were injected with FSH during days 2-14 of the oestrous cycle (day 0 = oestrous) and injected with PG on day 16. All animals were inseminated 48 and 72 h after PG injection, and embryos were collected non-surgically 5 days after insemination. Blood samples were collected from all animals starting from the 1st day of FSH injection to about 8 days after AI. Ten embryos were recovered from 3 animals, of which 6 were from 1 animal. Of the 4 animals from which embryos were not collected, 2 did not respond to PG treatment (as shown by plasma progesterone concentrations), 1 failed to ovulate, and 1 did not show luteal development after ovulation.

**2192 PRAKASH, BS; PALTA, P; MANIK, RS; MADAN, ML. 1994. Estimation of progesterone by direct enzyme immunoassay in buffalo ovarian follicular fluid. *International Symposium on "Cell Signaling and Ova-implantation"*. (AIMS, New Delhi: 1994: November 21-23). p. 51.**

**2193 SARKAR, M; MANIK, RS; BAG, S; NASKAR, S. 1994. Ultrasound evaluation of morphometry of buffalo ovary and corpus luteum in vivo. *Proc. National Symposium on Livestock production and Management*. New Delhi: Anand, p. 99.**

**2194 SINGH, IP; CHANDRA, R; GARG, SK; RAO, VDP. 1984. Cultivation of buffalo pox virus in pup kidney cell culture. *Acta Virologica*, 28: 4, 344; 4 ref.**

Buffalo poxvirus produced a characteristic cytopathic effect in pup kidney cells in 40 hours at the first passage and in 18 hours at the third passage. The infectivity titre increased from 2.5 log EID<sub>50</sub>/0.2 ml at the first passage to 6.5 log EID<sub>50</sub>/0.2 ml at the fourth passage. When 1 ml of the virus suspension from the fifth passage was inoculated intradermally into five puppies, none developed any lesions.

**2195 TANDON, SN; KHANNA, ND. 1983. A study on the transferrin polymorphism in Indian buffaloes. *Journal of Veterinary Physiology and Allied Sciences*, 2: 1, 29-38; 16 ref.**

Blood samples from 375 Murrah, 110 Bhadawari, 61 Surti, 76 Nili and 88 Mehsana buffaloes on 9 farms were examined by starch-gel electrophoresis. Six Tf phenotypes (DD, NN, DN, KK, KN and DN) were observed, and were under the control of 3 alleles. Phenotype and gene frequencies are tabulated within each breed and farm. The gene frequencies were 0.802-0.959 for TfK, 0.041-0.156 for TfD, 0-0.048 for TfN.

All breeds except the Mehsana were in genetic equilibrium. The inheritance of Tf types, studied in 175 matings, showed that codominant alleles were involved. Sex and age group had no significant effect on the distribution of Tf types, nor were any significant relationships found between Tf type and various economic traits (age at 1st calving, 1st-lactation length, 1st-lactation milk yield, 1st dry period and 1st calving interval).

**2196** TANEJA, VK; NANDA, SK; DATTA, TK; BHAT, PN. 1990. **Embryo transfer in buffaloes: present status and future research needs.** *World Buffalo Congress Vol. II, Part II: Proceedings.* (New Delhi, ICAR: 1988: Dec). p. 603-609; 20 ref.

Oestrous behaviour and hormonal changes during the oestrous cycle in cattle and buffaloes are compared, and the use of FSH and PMSG for superovulation in the 2 species is discussed.

**2197** TOMER, OS; MANIK, RS; RAINA, VS; SURI, AK; TALWAR, GP. 1988. **Inhibition of spermatogenesis in buffalo bulls.** *Abstract of Contributory Papers. Pre-Congress proceedings of 2nd World Buffalo Congress.* Vol. 1, p. 121.

**2198** TOTEY, SM; PAWSHE, CH; SINGH, GP. 1993. **Effects of bull and heparin and sperm concentrations on in vitro fertilization of buffalo (*Bubalus bubalis*) oocytes matured in vitro.** *Theriogenology*, 39: 4, 887-898.

A study was undertaken to assess the ability of spermatozoa from 6 buffalo bulls, at different levels of heparin and sperm concentrations, to achieve an acceptable level of fertilization in vitro. Frozen-thawed spermatozoa, 3 dosages of heparin (0, 10 and 100 micrograms/ml) in the presence and absence of penicillamine, hypotaurine and epinephrine (PHE), and 4 sperm concentrations ( $1 \times 10^6$ ,  $2 \times 10^6$ ,  $3 \times 10^6$  and  $4 \times 10^6$ /ml) were studied using 3202 buffalo oocytes. The mean proportions of fertilized oocytes in the group treated with 10 micrograms/ml of heparin were significantly higher ( $P < 0.05$ ) with the semen of Bulls A, B and C (44.7 to 64.3%) than in medium devoid of heparin. An increase in the dosage of heparin from 10 micrograms/ml to 100 micrograms/ml reduced the overall fertilization rate. However, optimal fertilization (30.9%) at 100 micrograms/ml heparin was observed for semen from Bull D. Bulls E and F yielded the lowest fertilization rate (9.6 and 14.2%, respectively) at the above mentioned heparin dosage. Analysis of sperm density revealed that a concentration of  $2 \times 10^6$  spermatozoa yielded optimal fertilization rates in vitro. Higher sperm concentrations

( $3 \times 10^6$  or  $4 \times 10^6$ ) resulted in higher oocyte penetration rates but gave rise to polyspermy.

**2199** TOTEY, SM; PAWSHE, CH; SINGH, GP. 1993. **In vitro maturation and fertilization of buffalo oocytes (*Bubalus bubalis*): effects of media, hormones and sera.** *Theriogenology*, 39: 5, 1153-1171.

Media (TCM-199 and Ham's F-10); sera (fetal calf serum, FCS, and buffalo estrous serum, BES); and hormones (FSH, 0.5 ug/ml, LH, 5 ug/ml and estradiol 1 ug/ml) were tested to determine the efficiency of in vitro maturation and fertilization of buffalo follicular oocytes. Immature good quality cumulus-oocyte complexes (COCs) were randomly assigned to 1 of 4 experiments. Each experiment consisted of 6 treatment groups. Oocytes cultured for 24 hours in medium (TCM-199 or Ham's F-10) containing 10% FCS or BES had a significantly higher maturation rate than those in medium alone ( $P < 0.05$ ). However, the maturation rate was higher in medium supplemented with 10% FCS than with 10% BES. Addition of hormones alone or in combination with sera further improved the maturation rate, but no significant difference was observed in the maturation rate among the 3 hormone-treated groups. Immature oocytes matured in the various cultures were fertilized with frozen-thawed buffalo spermatozoa. Our findings show that hormone and/or serum supplementation of TCM-199 did not improve the fertilization rate. Supplementation of Ham's F-10 with LH alone or in combination with LH + FSH + E2 and with FCS significantly improved the fertilization rate of oocytes while medium with FSH, E2 or no hormones did not ( $P < 0.05$ ); same media supplemented with BES resulted in lower fertilization rates both in the presence or absence of hormones. The results indicate that the culture medium has a marked effect on the fertilization rate of buffalo oocytes. Ham's F-10 + LH + FSH + E2 supplemented with FCS was the most efficacious culture system of those studied for the in vitro maturation of buffalo oocytes.

**2200** TOTEY, SM; SINGH, G; TANEJA, M; PAWSHE, CH; TALWAR, GP. 1992. **In vitro maturation, fertilization and development of follicular oocytes from buffalo (*Bubalus bubalis*).** *Journal of Reproduction and Fertility*, 95: 2, 597-607; 39 ref.

5596 cumulus-oocyte complexes were cultured for 24 h in TCM 199 or Ham's F10 medium with or without LH and/or FSH, and supplemented with 20% buffalo oestrous serum (BES) or fetal calf serum (FCS). The maturation rate of oocytes cultured in TCM 199 + BES and Ham's F10 medium + BES was  $47.4 \pm 17.8$  and

44.8±25.6% resp. Addition of LH (5 µg/ml) significantly improved the maturation rate in Ham's F10 medium + BES (76.8±18.3%), but no further increase occurred with LH + FSH (0.5 µg/ml) + oestradiol (1 µg/ml) (71.7±19.5%). In TCM 199 + BES, LH failed to increase the maturation rate (42.7±1.4 vs. 47.8±17.8% without LH), but the addition of FSH + oestradiol + LH significantly increased the percentage of mature oocytes (81.7±14.5). Thawed spermatozoa prepared in Bracket and Oliphant (BO) medium and treated with 5 mM caffeine + 10 µg heparin per ml showed a higher fertilization rate (29.8%) than those treated in HEPES-TALP plus heparin (19.6%). Fertilization rate of fresh ejaculated spermatozoa was significantly improved by treatment with 5 mM caffeine and heparin in BO medium (50%). The rates of cleavage and development to morulae + blastocysts were also higher after in vitro fertilization with fresh ejaculated spermatozoa treated with caffeine and heparin (34.1 and 36.8% resp.) than with thawed spermatozoa (27.0 and 22.0%). Development rate was increased when fertilized ova were cultured in ligated rabbit oviduct (28.0%) than when cultured on oviduct cell monolayers (8.2%).

**2201** ULLAH, N; WRIGHT, RW, JR; MEHMOOD, A; BAIG, SM. 1992. **Endocrine profiles in relation to ovarian response, recovery rate and quality of embryos in Nili-Ravi buffaloes treated with FSH.** *Buffalo Journal*, 8: 1, 47-56; 45 ref.

Seven multiparous buffaloes were treated with FSH for 5 days (total dose, 50 mg) starting on days 9-10 of the oestrous cycle; 25 mg PGF2alpha was injected 60 h after starting FSH treatment, and buffaloes were mated twice after oestrus. Ovarian response was assessed before slaughter (day of embryo recovery) by rectal palpation and compared with the number of corpora lutea recovered. Buffaloes were slaughtered 4-6 days after mating, and embryos were collected by flushing the uterine horns and fallopian tubes. Blood was sampled daily from the day of initiation of FSH treatment. An average of 5.3 corpora lutea and 3.0 embryos (2.2 of good quality) were recovered per animal. Only 57.9% of corpora lutea were located by palpation. Progesterone concentration on day 1 of FSH treatment was not related to the ovarian superovulatory response. A significant correlation was found between levels of serum progesterone on days 2, 3, 5 and 6 of FSH treatment and the superovulatory response (0.64-0.89). In addition, there was a positive correlation between progesterone levels on days 2 and 3 and the number of good quality embryos recovered (.81 and .84). Day-2 and day-1 oestradiol concentrations were also positively correlated with the number of good quality embryos.

## Oocytes

**2202** CHAUHAN, MS; MADAN, ML; KATIYAR, P; SINGLA, SK; MANIK, RS. 1994. **Influence of superovulated buffalo serum on in vitro development of IVM/IVF buffalo oocytes upto blastocyst stage.** *Proc. of the Int. Symp. on "Cell Signaling and Ova-implantation"*. (New Delhi: 1994: November 21-23). p. 33.

**2203** MADAN, ML; CHAUHAN, MS; SINGLA, SK; MANIK, RS; KATIYAR, P. 1992. **Development pattern of buffalo embryos derived from in vitro matured in in vitro fertilized oocytes cultured with cumulus and oviductal cells.** (8th Annual Conf. Soc. Anim. Physiol.: HAU, Hisar), p. 91.

## Reproduction

**2204** MADAN, ML; SINGLA, SK; CHAUHAN, MS; MANIK, RS. 1994. **In vitro production and transfer of embryos in buffaloes.** *Theriogenology*, 41: 139-144.

**2205** MANIK, RS; TOMER, OS; RAINA, VS; TALWAR, GP; SURI, AK. 1988. **Block of spermatogenesis without loss of male sex hormone in buffalo bulls - trials on Talsur.** *Post Congress Proceedings of 2nd World Buffalo Congress: Vol. III Physiology and Reproduction*. p. 20-25.

**2206** MANIK, RS; MADAN, ML; SINGLA, SK. 1994. **Role of ultrasonography in augmenting reproduction in buffaloes.** *National Symposium on Reproductive Health Care and the Fifth Annual Meeting of the Indian Society for the Study of Reproduction and Fertility*. (University of Rajasthan, Jaipur), p. 140.

**2207** SINGH, NP; MANIK, RS; RAINA, VS. 1989. **Effect of cysteine fortification on preservability of buffalo semen in milk whey extenders.** *Theriogenology*, 32: 6, 979-986.

## Superovulation

**2208** MANIK, RS; MADAN, ML; SINGLA, SK. 1994. **Sonographically diagnosed reasons for poor superovulatory responses in buffaloes.** *Second Asia-Pacific Conference on Agricultural Biotechnology*. (Madras: 1994: March 6-10). Central Tobacco Research Institute, Rajahmundry - 533 105, A.P., India, p. 74.

**2209** PRAKASH, BS; SINGLA, SK; AMBROSE, JD; JAILKHANI, S; MADAN, ML. 1992. **Assessment of**

**superovulatory responses in terms of palpable corpora lutea and embryo recovery using milk progesterone.** *Theriogenology*, 37: 4, 897-905; 13 ref.

Nine lactating buffaloes were superovulated with 30 ml of follitropin, given in 10 divided doses over 5 days, starting on day 10 after PG-induced oestrus. All cows were inseminated 48 and 72 h after PG injection, and subjected to embryo recovery 5 days after insemination. Milk samples for progesterone assay were collected on alternate days from 1 day before the expected oestrus to 5 days after embryo recovery. All cows were palpated rectally 1 day prior to embryo recovery to assess the number of corpora lutea. For the 9 cows, the total number of palpable corpora lutea was 23, the number of ova and embryos recovered 1 and 11 resp. Milk progesterone profiles indicated a poor superovulatory response in some cows, and some did not respond to PG treatment. It is suggested that in buffaloes trapping of ova by the fimbriae of the fallopian tubes may not be efficient, particularly after superovulation.

### Embryo transfer

**2210 GOSWAMI, SL; MANIK, RS; BALAKRISHNAN, CR.** 1992. **Status of buffalo and goat ovaries collected from slaughter house.** *Seminar on Embryo Transfer and Associated Techniques in Livestock Improvement*. (IVRI, Izatnagar: 1992: April 16-17).

**2211 SINGLA, SK; MANIK, RS; MADAN, ML.** 1994. **Cloning buffalo embryos through nuclear transfer.** *Advances in animal Production and Gynaecology*. (P.A.U., Ludhiana: 1994: July 25-August 13).

### Murrah buffalo

**2212 MANIK, RS; JADHAV, KE; IQBAL, NATH.** 1981. **Predicting weight from body measurements in Murrah buffaloes.** *Indian J. Dairy Sci.* 34: 4, 448-450.

**2213 MANIK, RS; AMBROSE, JD; SINGLA, SK; CHAUHAN, MS; MADAN, ML.** 1994. **Real time ultrasound evaluation of follicular changes in superovulated Murrah buffaloes.** *Buffalo J.*, 2: 139-146.

**2214 MANIK, RS; IQBAL NATH.** 1981. **Relationship of certain body measurements with milk production in Murrah buffaloes.** *Indian Journal of Dairy Sci.* 34: 1, 118-119.

**2215 SRIVASTAVA, A; MANIK, RS; MUDGAL, VD.** 1982. **Prediction equations for different rumen**

**metabolites in Murrah buffaloes.** *XVIII Dairy Industry Conference*. (Indore: 1982: September 10-12). DP. 17.

**2216 SRIVASTAVA, AK; MANIK, RS; MUDGAL, VD; PATIL, RA.** 1983. **Interrelationship between rumen metabolites in Murrah buffaloes.** *Asian J. Dairy Res.* 2: 1, 1-7.

### Water buffalo

**2217 AMBROSE, JD; MANIK, RS; SINGLA, SK; MADAN, ML.** 1993. **A simplified laparoscopy technique for repeated ovarian observation in the water buffalo (*Bubalus bubalis*).** *Theriogenology*, 40: 487-496.

**2218 KUMAR, S; BHAT, PN; RASOOL, TJ; BHAT, PP; VERMA, R.** 1993. **Sequence homology and similar periodicity of 700 bp between satellite DNAs of buffalo and cattle.** *Indian Journal of Animal Sciences*, 63: 5, 545-549.

**2219 MADAN, ML; CHAUHAN, MS; SINGLA, SK; MANIK, RS.** 1994. **Pregnancies established from water buffalo (*Bubalus bubalis*) Blastocyst derived from in vitro fertilized oocytes and co-cultured with cumulus and oviductal cells.** *Theriogen.*, 42: 591-600.

**2220 MANIK, RS; MADAN, ML; SINGLA, SK.** 1994. **Ovarian follicular dynamics in water buffalo (*Bubalus bubalis*): ultrasonographically monitoring individual follicles for wave hypothesis.** *Theriogenology*, 41: 246.

**2221 SARVAIYA, NP; CHAUHAN, FS; MEHTA, VM.** 1993. **Induction of oestrus in normal cyclic Surti buffaloes, during superovulation and after embryo recovery.** *Indian Journal of Animal Sciences*, 63: 12, 1240-1243.

### Sheep

**2222 DUBEY, SC; KUMAR, N; SHARMA, SN.** 1986. **Cytopathic effect of ovine adenovirus type I in the primary cell-cultures of ovine and caprine origin.** *Indian Journal of Animal Sciences*, 56: 4, 385-387; 7 ref.

Two local isolates of ovine adenovirus 1 (D16 and D16F3) were recovered in fetal lamb kidney cells from lambs with pneumoenteritis, and propagated in lung cells and lamb testis cells. Similar cell-cultures of goat origin also supported the multiplication of these isolates

producing characteristic cytopathic effects. Kidney cell-culture produced the highest titre, followed by testis and lung cell-cultures. Cytopathic effects appeared later in lung cells than in kidney or testis cell-cultures. Indirect immunofluorescent tests revealed characteristic intranuclear viral inclusions in homologous and heterologous cell-cultures.

**2223** GARG, P; JAIN, SK. 1992. **Genomic complexity of sheep gonadotropin hormones.** *Medical Science Research*, 20: 9, 337-339; 27 ref.

Sheep genomic DNA digests were hybridized with complete sheep alpha-LH, beta-LH and FSH-beta probes. The results indicated the following: (1) the sheep alpha-LH gene is smaller than that of cattle and humans; (2) a single gene ( $\leq 3$  kb) codes for sheep LH-beta; (3) a multigene family probably codes for sheep FSH-beta.

**2224** GODKIN, JD; BAZER, FW; THATCHER, WW; ROBERTS, RM. 1984. **Proteins released by cultured day 15-16 conceptuses prolong luteal maintenance when introduced into the uterine lumen of cyclic ewes.** *Journal of Reproduction and Fertility*, 71: 1, 57-64; 16 ref.

Proteins, produced and released into the incubation medium during culture for 24-48 h of day 15-16 sheep conceptuses, were infused into the uterine lumen of cyclic ewes. Beginning on day 12 (oestrus = day 0) 2 ml of a concentrated solution of total conceptus culture medium protein (2.2 mg) or diluted sheep serum (2.2 mg protein) were introduced daily (via an indwelling catheter) into the uterine lumen for 7 days (days 12-18). There were 3 females per group. Peripheral blood samples were collected daily for 14 days (days 12-25). On day 25 all ewes were laparotomised and the ovaries were observed to determine whether corpora lutea previously marked with India ink were maintained. All controls had ovulated and formed new corpora lutea. By contrast, none of the ewes treated with conceptus protein had ovulated, and their peripheral progesterone levels remained elevated. One ewe maintained a functional corpus luteum until day 52, when she was hysterectomised. Light microscopy of histological sections prepared from the endometrium revealed glandular development similar to that in the endometrium of cyclic animals during late dioestrus. The cells of the corpus luteum were similar to those from cyclic animals during mid to late dioestrus. Ovine trophoblast protein (oTP-1), a major protein secreted by the sheep conceptus between days 13 and 21 of pregnancy, was purified from the conceptus incubation medium and was injected (0.2 mg

protein per day) into the uterine lumen of 3 animals. The plasma progesterone concentration indicated that animals treated with oTP-1 maintained luteal function 4 days longer than did control animals. It is suggested that conceptus proteins, and specifically oTP-1, are involved in the maintenance of luteal function during early pregnancy, and that this action is probably mediated through interaction with the uterine endometrium.

**2225** HOODA, OK; NAQVI, SMK. 1990. **Effect of solar exposure on physiological and biochemical reactions on sheep during feed restriction and walking stresses.** *Second Congress of Asian & Oceanian Physiological Society*. (1990: Nov. 12-15). Central Sheep & Wool Research Institute, Avikanagar, Rajasthan-304 501, India.

**2226** HOODA, OK; NAQVI, SMK. 1989. **Effect of starvation serum electrolytes level in Chokla and Avivastra sheep.** *Indian Vet. J.* 66: 27-29.

**2227** HOODA, OK; NAQVI, SMK. 1990. **Effect of thermal load and feed restriction on the relative adaptability of malpura and Avikalin Sheep in semi arid region.** *Indian J. Anim. Sci.* 60: 608-611.

**2228** HOODA, OK; NAQVI, SMK. 1989. **Influence of dietary restriction on responses of Chokla and Chokla synthetic sheep in the shed and the sun.** *V Annual Conference of Society of Animal physiologist of India*. (1989: Dec. 27-30). Central Sheep & Wool Research Institute, Avikanagar, Rajasthan-304 501, India.

**2229** HOODA, OK; NAQVI, SMK. 1988. **Relative heat tolerance of native and crossbred sheep during feed restriction.** *National Symposium and IV Annual Conference of Society of Animal Physiology of India*. (1988: Sep. 24-26). Central Sheep & Wool Research Institute, Avikanagar, Rajasthan-304 501, India.

**2230** HOODA, OK; NAQVI, SMK. 1988. **Relative performance of Malpura and Avikalin sheep under thermal nutritional and walking stresses.** *National Seminar on Carpet Wool Production and Utilization*. (Avikanagar: 1988: Oct. 24-26). Central Sheep & Wool Research Institute, Avikanagar, Rajasthan-304 501, India.

**2231** HOODA, OK; NAQVI, SMK. 1992. **Serum electrolytes changes in sheep exposed to solar radiation during feed restriction and walking stresses.** *Int. J. Anim. Sci.* 7: 71-72.

- 2232 HOODA, OK; NAQVI, SMK. 1990. **Thermal and nutritional stress and post stress responses of fine wool synthetic sheep.** *VI Annual Conference of Society of Animal Physiologist of India.* (AAU, Khanapara, Guwahati: 1990: Oct. 24-26).
- 2233 KALRA, DB; NAQVI, SMK. 1991. **Embryo technology in sheep.** *First National Seminar on Small Ruminant Reproduction.* (Avikanagar: 1991: Jan 10-12).
- 2234 KALRA, DB; NAQVI, SMK. 1991. **Embryo transfer in sheep.** *First National Seminar on small Reminant Reproduction.* (Avikanagar: 1991: Jan. 10-12).
- 2235 KALRA, DB; MATHUR, AK; NAQVI, SMK. 1991. **PMSG and superovulation in sheep.** *VII Annual Conference of Society of Animal Physiologist of India.* (Madras: 1991: Dec. 27-30).
- 2236 KATIYAR, PK; CHAUHAN, MS; MADAN, ML; SINGLA, SK; MANIK, RS. 1995. **Production of sheep embryos after IVM/IVF of cumulus oocyte complexes in a defined medium supplemented with fetal bovine serum.** *First Congress of Federation of Indian Physiological Societies.* (New Delhi: 1995: March 1-3).
- 2237 NAQVI, SMK. 1990. **Adaptability of crossbred sheep to hot environment of Rajasthan.** Central Sheep & Wool Research Institute, Avikanagar, Rajasthan-304 501, India.
- 2238 NAQVI, SMK; RAI, AK. 1984. **Effect of dietary stress on the native Sonadi sheep.** *National Annual Physiology Research Conference.* (NDRI, Karnal: 1984: Dec. 3-6).
- 2239 NAQVI, SMK; RAI, AK; HOODA, OK. 1986. **Effect of fasting on serum thyroid hormones and cholesterol in Chokla and Avivastra sheep in semi arid area.** *Society of Biological Chemist 55th Annual Meeting.* (Trivandrum, Kerala: 1986: Dec. 15-17).
- 2240 NAQVI, SMK; RAI, AK. 1988. **Effect of fasting on some biochemical constituents of blood in Avivastra sheep.** *Indian J. Anim. Sci.* 58: 1079-81.
- 2241 NAQVI, SMK; RAI, AK. 1991. **Effect of fasting on some physiological responses and blood constitunts in native and crossbred sheep.** *Indian Journal of Animal Science.* 61: 985-990.
- 2242 NAQVI, SMK; RAI, AK. 1991. **Effect of feed restriction followed by realimentation on growth, physiological responses and blood metabolites of native and crossbred sheep.** *Indian Journal of Animal Science.* 61: 628-631.
- 2243 NAQVI, SMK; RAI, AK. 1986. **Effect of prolonged starvation on physiological responses and blood metabolites on two breeds of sheep.** *National Symposium on Adapation in Animals.* (Pantnagar: 1986: Sept. 11-13).
- 2244 NAQVI, SMK; RAI, AK. 1991. **Effect of starvation of serum thyroid hormones and cholesterol in avivastra & Chokla sheep.** *International J. Anim. Sci.* 6: 138-40.
- 2245 NAQVI, SMK; KALRA, DB. 1990. **Estrus synchronisation and superovulation in crossbred ewes in semi arid tract of Rajasthan.** *Cherion,* 19: 13-16.
- 2246 NAQVI, SMK; KALRA, DB. 1989. **Estrus synchronisation on sheep.** *Annual Conference of Society of Animal Physiologist of India.* (5th: 1989: Dec. 27-30).
- 2247 NAQVI, SMK; MATHER, AK; KALRA, DB. 1992. **Esturs synchronisation and superovulation with and without progestagens in Bharat Merino ewes.** *Seminar on E.T. and Associated Technologies for Livestock Improvement.* (IVRI, Izatanagar: 1992: April 16-17).
- 2248 NAQVI, SMK; HOODA, OK. 1990. **Growth responses of crossbred (FWS) sheep during and after removal of thermal stresses.** *VI Annual Conference of Society of Animal Physiologist of India.* (AAU, Khanapara, Guwahati: 1990: Oct. 24-26).
- 2249 NAQVI, SMK; HOODA, OK. 1989. **Heat tolerance of Chokla and Chokla synthetic sheep during energy crisis.** *Indian Journal of Animal Science.* 59: 1351-1353.
- 2250 NAQVI, SMK; RAI, AK. 1987. **Heat tolerance of nutritionally depleted sheep.** *National Seminar on small ruminant production.* (CSWRI, Avikanagar: 1987: Jan. 5-7).
- 2251 NAQVI, SMK; MADAN, ML; CHAUHAN, MS; SINGLA, SK; MANIK, RS. 1991. **In vitro productin of embryos from in vitro matured and fertilized sheep oocyte by epididymal spermatiozoa.**

- National Symposium and Animal Conference Society of Animal Physiologist of India.* (7th: Madras: 1991: December 27-30).
- 2252 NAQVI, SMK; MADAN, ML; CHAUHAN, MS; SINHA, SK; MANIK, RS. 1991. **In vitro production of embryos from in vitro matured and fertilized sheep oocytes by epididymal spermatozoa.** *Annual Conference of Society of Animal Physiologist of India.* (7th: Madras: 1991: Dec. 27-30).
- 2253 NAQVI, SMK; RAI, AK. 1990. **Influence of dietary energy level on sheep for mutton during winter I. Change in growth performance and carcass quality.** *Indian J. anim. Sci.* 60: 1504-1506.
- 2254 NAQVI, SMK; RAI, AK. 1991. **Influence of dietary energy level on sheep for mutton during winter II. Effect of cardio respiratory responses, rectal temperature, Some blood metabolites, enzymes and thyroidal hormones.** *Indian Journal of Animal Science.* 61: 1126-31.
- 2255 NAQVI, SMK; HOODA, OK. 1988. **Influence of energy crisis and walking stresses on heat tolerance of sheep during thermal exposure.** *National seminar on Carpet wool production and Utilization.* Central Sheep & Wool Research Institute, Avikanagar, Rajasthan-304 501, India.
- 2256 NAQVI, SMK; MARU, A; HOODA, OK. 1989. **Influence of fasting on the ratio of serum alfa and bita lipoproteins in sheep.** *Indian Vet. J.* 66: 369-370.
- 2257 NAQVI, SMK; HOODA, OK. 1991. **Influence of thermal, nutritional and exercise stresses on some blood parameters of native and crossbred sheep.** *Indian J. Anim. Sci.* 61: 660-662.
- 2258 NAQVI, SMK; KALRA, DB. 1991. **Oestrus synchronisation in cycling crossbred ewes in autumn season.** *First National Seminar on small Reminant Reproduction.* Central Sheep & Wool Research Institute, Avikanagar, Rajasthan-304 501, India.
- 2259 NAQVI, SMK; HOODA, OK. 1989. **Physiological responses and serum enzymes of sheep during thermal nutritional and walking stress.** *Annual Conference of Society of Animal Physiologist of India.* (5th: 1989: Dec. 27-30).
- 2260 NAQVI, SMK; RAI, AK. 1987. **Serum thyroidal hormones of sheep under nutritional stress.** *National Seminar on Small Ruminant Production.* Central Sheep & Wool Research Institute, Avikanagar, Rajasthan-304 501, India.
- 2261 NAQVI, SMK; HOODA, OK; SAXENA, P. 1991. **Some plasma enzymes of sheep during thermal nutritional and exercise stresses.** *Indian Vet. J.* 68: 1045-1047.
- 2262 NAQVI, SMK; HODA, OK. 1988. **Studies on physiological adaptation of sheep to hot environment in India.** Central Sheep & Wool Research Institute, Avikanagar, Rajasthan-304 501, India.
- 2263 NAQVI, SMK; KALRA, DB. 1989. **Superovulation in ewes with Folligon (Intervet).** *V Annual Conference of Society of Animal Physiologist of India.* (5th: 1989: Dec. 27-30).
- 2264 NAQVI, SMK; HOODA, OK; RAI, AK. 1988. **The influence of fasting on blood metabolites and thyroidal hormones in sheep.** *Second National Seminar on Sheep and Goat Diseases.* Central Sheep & Wool Research Institute, Rajasthan-304 501, India.
- 2265 NAQVI, SMK; HOODA, OK; CHOPRA, SK. 1992. **Wool yield and body weight changes of Malpura and Avikalin sheep under thermal nutritional and walking stresses.** *Int. J. Anim. Sci.* 7: 119-120.
- 2266 RAO, BR; CHAUHAN, BM; JAIRAM, BT; PANDEY, JN. 1983. **Nucleic acid composition in the semen of Nali and Corriedale breeds of ram.** *Indian Veterinary Journal,* 60: 10, 855-856; 6 ref.
- Semen was collected twice weekly during winter from 6 Nali and 6 Corriedale rams. Mean DNA and RNA concentrations in whole semen were  $13.84 \pm 3.88$  and  $769 \pm 44.44$  mg/ml resp. in Nalis, and  $12.05 \pm 3.04$  and  $772 \pm 16.09$  in Corriedales, differences between the breeds being non-significant. In both breeds, the DNA content of whole semen was highly significantly correlated with that per spermatozoon (0.98 and 0.92 resp.).
- 2267 SAXENA, P; NAQVI, SMK; HOODA, OK; KALRA, DB. 1988. **Effect of feed deprivation on plasma lipid profile of Malpura and mutton Synthetic sheep during thermal stress.** *National Symposium and IV Annual Conference of Soc. of Anim. Physiol. India.* Central Sheep & Wool Research Institute, Avikanagar, Rajasthan-304 501, India.
- 2268 SHARMA, VK; GUPTA, RC; KHAR, SK; KHURANA, NK. 1993. **Plasma progesterone profiles,**

ovarian response and embryo recovery in crossbred ewes superovulated during breeding and non-breeding seasons. *Animal Reprod. Science*, 34: 2, 119-126.

**2269** YADAV, BR; MADAN, ML; KATIYAR, P; CHAUHAN, MS; MANIK, RS. 1994. **Sequential changes in chromosome configuration during in vitro maturation of oocyte of sheep, goat and buffaloes.** *Second Asia-Pacific Conference on Agricultural Biotechnology*. (Madras: 1994: March 6-10), p. 225.

**2270** ZANWAR, SG; DESHPANDE, BR. 1984. **Superovulation and embryo transfer in exotic and crossbred sheep.** *10th International Congress on Animal Reproduction and Artificial Insemination, Vol. II*. (University of Illinois at Urbana-Champaign, Illinois: 1984: June 10-14).

In the 1st of 2 experiments, 34 Merino X Polwarth, 34 Merino X Chokla and 19 Gopal Merino crossbred (75% exotic) ewes were injected with 12 mg progesterone daily for 12 to 22 days to induce oestrus, and were injected with 1000-1500 IU PMSG on the day of the penultimate progesterone treatment. Ewes were inseminated 48 h after the last injection. For the 3 breed types, the number of ova recovered (surgically) averaged 5.32, 3.55 and 3.15 resp., and the ovum recovery rate was 47.38, 51.27 and 47.6%. In the 2nd experiment, 53 exotic and crossbred ewes were treated as in the 1st experiment; the number of ova recovered averaged 3.98, and the recovery rate was 54.24%. 211 embryos were transferred surgically to Decanni ewes; 75 lambs were born.

## Diseases

**2271** BABU, NG RAMESH; RAJASEKHAR, M; BABU, NGR. 1992. **Response of sheep to primary and repeat vaccination against rinderpest.** *Indian Veterinary Journal*, 69: 4, 297-300; 13 ref.

The antibody response to primary vaccination of 15 lambs and repeat vaccination of 45 adult sheep (with a history of a single or 3-4 vaccinations in the previous year) showed 100% seroconversion when examined by an avidin-biotin ELISA. The initial antibody response was slightly higher in the lambs, but the final response was higher in the sheep previously vaccinated more than once. Antibody levels reached a peak 4-6 weeks after vaccination and were demonstrable for 6 months.

**2272** BHAT, PP. 1989. **A comparison of genomes of sheep pox virus isolates.** *Indian Journal of Experimental Biology*, 27: 8, 714-717; 5 ref.

Sheep pox virus DNA from field isolates and vaccine strains from India, Europe and Kenya were analysed by digestion with restriction endonucleases PstI and Bam HI. Restriction profiles showed close relationships between Jaipur, Ranipet and Romanian strains. Two Kenyan strains were differentiated from a Kenyan cattle pox isolate. The molecular weights of the genomes from different isolates varied from 91 to 94 MDa. It is concluded that restriction enzyme patterns can be used as a molecular epidemiological tool for differentiating field and vaccine isolates of capripox, and for distinguishing capripox from related viruses.

**2273** BLACK, DN; HAMMOND, JM; KITCHING, RP. 1986. **Genomic relationship between capripox-viruses.** *Virus Research*, 5: 2/3, 277-292; 22 ref.

Studies were carried out on field strains of sheep pox virus from Nigeria, India and Oman; goat pox virus from India, Oman and Yemen; sheep and goat pox virus from Kenya; and vaccine strains of sheep pox virus from Saudi Arabia, France and Iraq, goat pox virus from Iraq, and lumpy skin disease virus from South Africa. Analysis of the DNA fragments of all 12 strains showed a genome homology of over 80%. All 12 were thus very closely related, regardless of animal of origin, though isolates from different hosts had specific differences in their restriction pattern, indicating two groups—a sheep pox group and a goat pox group. Oman sheep pox virus did not readily fit into either group, suggesting that it had undergone modification or that a genomic recombination had occurred between sheep and goat viruses.

**2274** DAS, SK; MALLICK, BB; GARG, A. 1986. **Cell-mediated immune response with modified strain of sheep-pox virus.** *Indian Journal of Animal Sciences*, 56: 3, 297-300; 10 ref.

The migration of lymphocytes in vitro was inhibited by 40% by blood from sheep obtained 15 days after inoculation of an Indian strain of ovine poxvirus attenuated by cell culture, and this degree of inhibition persisted for at least three weeks. The sheep resisted challenge infection with virulent virus after 5 weeks.

**2275** DAS, SK; MALLICK, BB. 1985. **Effect of some physico-chemical characters of sheep-pox virus strains after passage in lamb testicular cells.** *Indian Journal of Animal Sciences*, 55: 3, 155-159; 9 ref.

The various physico-chemical properties of three indigenous strains of virulent ovine poxvirus (Ranipet, Jaipur and Hyderabad) and one exotic (Russian) strain were studied before and after the attainment of the

desired modification. The properties of modified strains were compared with an exotic modified strain 'SPV/-RF'. The viral strains were susceptible to the action of heat at 50°C for 30 and 60 min, pH 3, ether and chloroform. Their susceptibility to heat decreased with the virus modification; other properties remained unchanged. The characters of the modified strains were more or less similar to those of SPV/RF. No significant difference in the morphological appearance of modified and virulent strains of the virus could be detected by electron microscopy.

**2276** DAS, SK; MALLICK, BB. 1984. **Susceptibility of various cell culture systems to sheep pox virus strains.** *Ind. J. of Expe. Biol.*, 22: 4, 205-208; 16 ref.

Lamb testis cell culture was superior to lamb kidney and calf kidney for propagating field virus. Only in lamb testis cells was a cytopathic effect apparent from the first or second passage in unstained preparations.

**2277** HEMAPRASANTH; SHARMA, RL. 1989. **Decontamination of sheep faeces infested with gastrointestinal nematodes by gamma irradiation.** *Current Science*, 58: 7, 400-401; 10 ref.

The results of a study aimed at finding out the optimum dose of gamma-irradiation for decontamination of sheep faeces infected with nematode ova are reported. The necropsied material was obtained from the intestines of sheep slaughtered in abattoirs at Kashmir, India. The worm counts, type of nematode infection and the respective faecal egg counts in each intestine were estimated before a specified quantity of faeces was subjected to gamma-irradiation or oven sterilization. Eggs of *Chabertia*, *Bunostomum*, *Oesophagostomum*, *Trichuris* and *Trichostrongylus spp.* were found. An irradiation dose of 500-Gy was found to be optimum for complete decontamination of faeces from these nematode ova. In a separate experiment where gamma-sterilized and oven-sterilized faeces were used for culturing a known number of *C. ovina* eggs, it was found that irradiated faecal cultures yielded on average, 7.4% more infective larvae than the conventional oven-sterilized faecal cultures.

**2278** KRISHNA, L; RAJYA, BS. 1985. **Incidence of perinatal chlamydiosis in lambs and kids.** *Indian Journal of Veterinary Pathology*, 9, 62-65; 12 ref.

Perinatal mortality due to chlamydiosis was found [date not given] in 104 (17%) of 602 lambs and 94 (21%) of 438 kids. Of the 77 deaths of lambs during the fetal period, 12 were in early gestation, 20 in late gestation and 45 were still births and premature births. 24 lambs

died during the first week of life and 3 between 1 and 2 weeks of age. Stillbirths and premature births accounted for 35 cases of mortality in kids, 53 died during the first week of life, and 3, 1 and 2 between 1 and 2, 2 and 3 and 3-4 weeks of age, respectively. Mortality was highest in February and September in lambs, and in February in kids.

**2279** NAIR, SP; SEN, AK. 1992. **A comparative study on the immune response of sheep to foot and mouth disease virus vaccine type Asia-1 prepared with different inactivants and adjuvants.** *Comparative Immunology, Microbiology and Infectious Diseases*, 15: 2, 117-124; 14 ref.

Foot and mouth disease virus type Asia-1 was inactivated either with formaldehyde or binaryethylenimine (BEI). Inactivated vaccines were prepared incorporating aluminium hydroxide gel or mineral oil as an adjuvant. The antibody response in the adult sheep was studied by ELISA and SN test for a period of 6 months. There was no difference in the antibody response between vaccines inactivated with formaldehyde or BEI, whereas significant difference in the antibody response was observed between gel and oil vaccines. The high titres of antibody stimulated by oil vaccines persisted longer than those of gel vaccines within the period of study.

**2280** RAI, A; MISHRA, SC; GOEL, AC; PANDEY, KD; GUPTA, BK. 1985. **The cell-mediated immune response induced by various strains of sheep pox virus.** *Indian J. of Comparative Microbiology, Immunology and Infectious Diseases*, 6: 1, 40-44; 12 ref.

Four strains of sheep pox virus were used: Jaipur virulent strain; Jaipur cell culture adapted strain; Ranipet cell culture adapted vaccine strain; and RM/65 cell culture adapted vaccine strain. Groups of 3 indigenous sheep were inoculated with each virus strain. Blood was collected for separation of lymphocytes after 6, 7, 14, 21 and 35 days. Sheep vaccinated with strains Ranipet and RM/65 were challenged after 3 weeks with Jaipur virulent sheep pox virus. Lymphokines were prepared separately for all 4 virus strains using the separated lymphocytes from the control sheep. Guinea-pig peritoneal exudate macrophages served as indicator cells in the macrophage migration inhibition test. The lymphokine preparations were inoculated into marked areas of flank skin of adult guinea pigs. Control areas were inoculated only with Hank's balanced salt solution. Skin thickness at the marked areas was recorded after 24 and 48 h. Seven days after inoculation the macrophage migration inhibition factor was demonstrated for all virus strains except RM/65. At 14 days after inocula-

tion all strains produced a very high level of cell-mediated immune response. Skin reactions followed the rise and decline observed with the macrophage migration inhibition factor. The two groups of vaccinated sheep were immune to the challenge infection. Sheep pox virus evidently induced a high degree of cell-mediated immunity.

**2281** RAO, APPAJI VN; PALANISWAMY, KS; KHAN, GA RAHAMATHULLA; GNANABARANAM, JF; MAHALINGAM, P. 1989. **Post vaccinal morbidity and mortality trend in an outbreak of rinderpest in sheep.** *Cheiron*, 18: 6, 250-252; 16 ref.

An outbreak of rinderpest occurred in a closed population of 203 sheep aged >1 year on Nov 27th, 1988 and morbidity rate was 100%. Four days later all animals were immunized with Brew 3/89, tissue culture rinderpest vaccine. The mortality rate was 60.56% with last deaths occurring on Dec 21st, 1988. It is concluded that effective protection was not established earlier than 4 weeks after immunization. In the 3 states of Southern India the caprine and ovine cases constituted 27, 51, 49, 34 and 23% of all the outbreaks in 1972-75, 1975-78, 1978-81, 1981-84, and 1984-86, respectively.

**2282** SARKAR, P; SINGH, SP; PANDEY, AK. 1984. **Adaptation and neutralization of sheep pox virus in cell culture.** *Ind. Vet. Journal*, 61: 6, 443-447; 13 ref.

The Indian 'SPV-Jaipur' strain and a Russian strain of ovine poxvirus were propagated in lamb kidney and goat kidney cells. A cytopathic effect developed after 9 or 10 serial passages. Both viruses gave similar titres in the neutralization test with convalescent or hyperimmune serum.

**2283** SHAILA, MS; VENUGOPAL, K; PURASHOTHAMAN, V; VENKATESAN, RA. 1990. **Isolation and characterization of peste des petits ruminants virus from an outbreak in Tamil Nadu sheep.** *Indian Veterinary Journal*, 67: 4, 385-386.

**2284** SINGH, IP; RAO, VDP; CHANDRA, R; GARG, SK. 1984. **Comparative evaluation of sheep-pox vaccines.** *Indian Journal of Animal Sciences*, 54: 7, 650-653; 6 ref.

Two of five sheep were protected from infection with virulent Karnal strain of the virus, 22 days af. immunization with lamb kidney attenuated Pendik strain. All 6 sheep vaccinated with Ranipet str., attenuated by culture in sheep thyroid cells, survived challenge infection.

## Pox virus

**2285** BHAT, PP; MISHRA, BP; BHAT, PN. 1991. **Identification and size variation of terminal fragments of sheep pox virus genome.** *Indian Journal of Experimental Biology*, 29: 5, 434-436; 8 ref.

Terminal fragments of sheep pox virus DNA identified by snap-back analysis showed terminal covalent cross-links. Southern blot hybridization using a terminal probe confirmed the termini and terminal repeats (common sequences) of the sheep pox virus genome. Terminal fragment length variability was observed between virus isolates.

**2286** CHANDRA, R; RAO, VDP; DIXIT, VP; SINGH, IP; GARG, SK. 1990. **Development of an attenuated live virus vaccine against sheep pox: a field trial.** *Indian Veterinary Journal*, 67: 1, 1-3; 7 ref.

The virulent Karnal strain of the virus had become suitably modified by the 50th passage in cell culture to be used as a vaccine under field conditions. The immunizing dose was 1000 TCID<sub>50</sub>/0.5 ml, given s.c. into the ear (1.0-1.5 cm from the tip). Only about half of the 30 immunized sheep developed skin nodules, but this did not affect the development of immunity, which lasted for at least 9 months.

**2287** JADHAV, KM; PANDEY, AK; RADADIA, NS. 1989. **Field observations on sheep pox tissue culture vaccine.** *Indian Veterinary J.*, 66: 10, 908-912; 5 ref.

The attenuated tissue culture sheep pox vaccine, produced at the Veterinary Research Institute, Izatnagar, from a Romanian strain of the virus, was used firstly in a trial involving 60 sheep and then in the mass vaccination of over 780 sheep; it proved to be safe and effective. The extent of the skin reaction at the inoculation site was assessed in 29, 39 and 46 sheep and the 5th, 6th and 7th days after vaccination, respectively. The diameter of the red, oedematous area of skin varied from 0.5 to 3 cm, and would provide a good means of monitoring during vaccination programmes; the skin reaction regressed from the 9th day onwards.

**2288** MAHMOOD, MA; HASSNI, ZAHIDA; AFZEL, SHAHIDA. 1990. **Live sheep pox tissue culture vaccines.** *Pakistan Veterinarian*, No. 5: 1, 11.

**2289** MAHMOOD, MA; HASSNI, Z; AFZAL, S. 1988. **Preparation of live sheep pox tissue culture vaccine.** *Pakistan Veterinary Journal*, 8: 2, 56-61.

## Goats

**2290** AGRAWAL, KP; MONGHA, IV; BHATTACHARYYA, NK. 1983. **Relative efficacy of some media in short-time preservation of goat embryo at room temperature.** *Indian Journal of Animal Sciences*, 53: 8, 850-851; 11 ref.

37 fertilized eggs (at the 4- to 12-cell stage) were collected from the Fallopian tubes of 14 superovulated Barbari donors 72 h after the onset of synchronized oestrus. After 3-h storage at 20°C in Ringer's solution, basal salt solution, homologous blood serum, Dulbecco phosphate buffer or Tyrode's solution, 1 or 2 embryos per female were transferred to 27 synchronized recipients. For the 5 storage media used, the CRs among recipients were 66.7, 57.1, 60.0, 50.0 and 40.0% resp., and the number of kids born as a percentage of embryos transferred 50.0, 44.4, 42.9, 33.3 and 28.6.

**2291** BANSAL, MP; RAM, GC. 1990. **Growth characteristics of stem cells from foetal goat spleen.** *Indian Veterinary Journal*, 67: 6, 571-572; 8 ref.

Mononuclear cells grew successfully and multiplied to form colonies of >50 cells when cells from the spleen of a fetal goat in mid-gestation were added to a medium containing concanavalin A-stimulated peripheral blood mononuclear cells from goats.

**2292** BHAT, P; BHAT, P; MISHRA, BP; KUMAR, S; SINGH, RK. 1993. **A comparison of the genomes of goat, sheep and buffalo pox-virus isolates.** *Indian Journal of Animal Science*, 63: 10, 1075-1078.

**2293** CHAUHAN, MS; KATIYAR, PK; MADAN, ML; MANIK, RS; SINGLA, SK. 1995. **Influence of fetal bovine serum and FSH on in vitro development to blastocyst embryo of goat oocytes matured, fertilized and cultured in vitro.** *First Congress of Federation of Indian Physiological Societies: Proceedings*. (New Delhi: 1995: March 1-3).

**2294** DEB, SM; GOSWAMI, SL. 1990. **Cytogenetic analysis of goat oocytes cultured in vitro.** *International Journal of Animal Sciences*, 5: 1, 137-143; 37 ref.

Cumulus-oocyte complexes were cultured in supplemented Ham's F10 medium and incubated in air (set I) or 95% air + 5% CO<sub>2</sub> (set II). The percentages of oocytes that were at the germinal vesicle, diakinesis, metaphase-I and metaphase II stages, and the percentage of abnormal oocytes, for set I, after varying periods of culture were as follows: 70.0, 5.0, 20.1, 0.0 and 5.0 resp. after 24 h; 27.3, 9.1, 31.8, 18.2 and 13.6 after

30 h; 11.1, 7.4, 37.0, 14.8 and 29.6 after 34 h. The results for set II were similar.

**2295** DUTTA, S; PAL, A; DEY, BP; LAHIRI, SC. 1982. **Amoebicidal testing of drugs - use of goat serum as a substitute for horse serum for growing *Entamoeba histolytica*.** *Journal of the Indian Chemical Society*, 59: 7, 902-904; 10 ref.

Goat serum was successfully used instead of horse serum for the culture of *E. histolytica*. Various known amoebicides and some compounds with unknown activity were assayed against *E. histolytica* in medium containing goat serum, and the results are compared in a table with those obtained by other workers. All the new compounds, especially spiroamino hydrochloride and 5-chloro-7-nitro-8-hydroxyquinoline, had amoebicidal properties.

**2296** GOSWAMI, SL; DEB, SM; MANIK, RS. 1992. **Status of goat ovaries collected from slaughter house and cytogenetic analysis of oocytes cultured in vitro.** *Recent Advances in goat Production: Proceedings of the V. International Conference on Goats*. Central Sheep & Wool Research Institute, Avikanagar, Rajasthan-304 501, India. p. 1279-1283.

**2297** JAVED, MH; ANWAR, M; ALI, CS; AHMED, KM; AHMED, M. 1987. **Gross abnormalities of Lohi ewe and Teddy goat genitalia.** *Pakistan Veterinary Journal*. 7: 1, 36-40.

**2298** MAHMOOD, MA; AFZAAL, S; AHMAD, M; HASSNI, Z; KHAN, M. 1989. **Preparation of live goat pox tissue culture vaccine.** *Pakistan Journal of Veterinary Research*, 2: 1-2, 31-37; 7 ref.

**2299** MANIK, RS; TOMER, OS; RAINA, VS; TALWAR, GP; SURI, AK. 1992. **Block of spermatogenesis without loss of male sex hormone in bucks.** *Pre-conference Proceedings of 5th International Conference on Goats, Vol. I*. (New Delhi: 1992: March 2-8), p. 278.

**2300** MANIK, RS; PATIL, RA; TOMER, OS. 1984. **Prediction of body weight from body measurements in beetal goats and its crosses with Alpine and Saanen.** *Livestock Adviser*, 9: 5, 33-36.

**2301** MANIK, RS; SRIVASTAVA, A; MUDGAL, VD. 1982. **Relationship of age, body weight and EPA with certain body measurement in beetal goats.** *XVIII*

*Dairy Industry Conference*. (Indore: 1982: September 10-12). DP. 19.

**2302** MANIK, RS; RAIN, SN. 1992. **Testicle growth, testosterone levels and sperm concentration as influenced by *Leucaena* leaf meal (LLM) in concentrate mixture in kids.** *Recent Advances in Goat Production: Proceedings of the V. International Conference on Goats*. Central Sheep & Wool Research Institute, Avikanagar, Rajasthan-304 501, India. p. 740-745.

**2303** MEHTA, RK; SRIVASTAVA, A; MANIK, RS; MUDGAL, VD. 1981. **Influence of genetic variation on the nutrient utilization for growth in goats.** *DAE Symposium of Nutrient Transport Studies in Animals for the Purpose of Milk and Meat Production*. (Karnal: 1981: Nov. 23-25). p. 20.

**2304** MITTAL, JP. 1986. **Deoxyribonucleic acid content of caprine semen.** *Indian Veterinary Journal*, 63: 2, 163-164; 5 ref.

Semen was collected twice weekly in summer and autumn from 2 Beetal and 2 Jamnapari males. The DNA content (mg per billion spermatozoa) ranged from 2.02 to 2.18 in Beetals and from 2.08 to 2.26 in Jamnaparis. Differences between breeds and seasons were non-significant. The DNA concentration was significantly correlated with sperm concentration and ejaculate volume, but not with sperm motility or the percentages of live and abnormal spermatozoa.

**2305** NAQVI, SMK; MADAN, ML; MANIK, RS; CHAUHAN, MS; SINGLA, SK. 1992. **In vitro fertilization of in vitro matured goat oocytes and development of embryos in oviductal epithelial co-culture medium.** *Recent Advances in Goat Production: V International Conference on Goats*. Central Sheep & Wool Research Institute, Avikanagar, Rajasthan-304 501, India. p. 1348-1351.

**2306** TALUJA, JS; SHRIVASTAVA, AM; PARMAR, ML. 1983. **Spinal cord segments in goat fetuses.** *Indian Journal of Animal Sciences*, 53: 11, 1246-1248.

Spinal cord segments were studied in 66 fetuses. The mean length of the spinal cord was  $6.62 \pm 0.093$  cm,  $11.33 \pm 0.547$  cm and  $17.80 \pm 0.602$  cm in groups 1 (CR, 10 cm), 2 (CR 10-20 cm) and 3 (CR 20-39 cm) respectively. In cervical, part segments C2 through C5 were the longest in all the 3 groups. Segment length of C2 was maximum and formed 6.04% of the cord length in group 1, 5.58% in group 2, and 5.17% in group 3. The segment length gradually declined in the caudal part

of all the three groups. The mean maximum segment width was at C6 and C7 in groups 1, and at C7 and C8 in groups 2 and 3. The least width in precoccygeal spinal cord was at S4 in all the three groups. The mean greatest height was recorded at C6 and C7 segments in group 1 and at C7 and C8 segments in groups 2 and 3. The maximum IRL was recorded at C2 segment and the minimum IRL in whole of the precoccygeal spinal cord was at S4 in all the groups. The maximum RAL was recorded at C7 in groups 1 to 3.

## Superovulation

**2307** AGRAWAL, KP; BHATTACHARYYA, NK. 1984. **Barbari goat: temporal effect on the cell stage and location of embryo.** *International Goat and Sheep Research*, 2: 3, 227-230; 10 ref.

Oestrus and superovulation were induced in 32 females, followed by double insemination at a 12-h interval. Five groups, each of 4-12 females, were laparotomised 24, 48, 72, 96 and 120 h after the onset of oestrus. In general, embryos had developed to the 2-, 8- and 16-cell stages after 24, 48 and 96 h resp. from the onset of oestrus. Almost all embryos reached the uterus after 120 h, and mean embryo diameter, including the zona pellucida, remained the same until then. Of the eggs recovered, 82% had been fertilized and were normal, 12% had been fertilized and were abnormal, and 6% were unfertilized.

**2308** MAHMOOD, S; KOUL, GL; BISWAS, JC. 1991. **Comparative efficacy of FSH-P and PMSG on superovulation in Pashmina goats.** *Theriogenology*, 35: 6, 1191-1196; 8 ref.

28 goats were superovulated with 2 commercial preparations of FSH (FSH-p) or PMSG. FSH-p type did not affect number of corpora lutea. For goats treated with FSH-p and PMSG, the number of corpora lutea averaged  $16.55 \pm 6.13$  and  $11.70 \pm 8.07$  resp., and the number of embryos recovered  $4.72 \pm 4.33$  and  $2.50 \pm 5.02$ . Superovulatory response (number of corpora lutea) and embryo recovery rate were higher in old (4-6 yr) than in young (1.5-3 yr) females. For embryos transferred to recipients under triflupromazine hydrochloride and barbiturate anaesthesia, CR was 54.54 and 13.64% resp.; overall CR was 34.09%

**2309** MAJUMDAR, AC; MOGHA, IV; ANSARI, MR. 1990. **Successful superovulation in prepubertal Barbari goats.** *Indian Journal of Animal Sciences*, 60: 11, 1304-1306; 14 ref.

16 females, aged 4-5 months, were (1) injected with

FSH, (2) pretreated with oestradiol + progesterone for 4 days and then injected with FSH, (3) injected with PMSG, or (4) pretreated as in treatment 2 and injected with PMSG. All animals were injected with HCG on day 5 and inseminated intraperitoneally. Pretreatment resulted in a higher av. number of corpora lutea (3.75, 7.75, 5.25 and 9.5 for groups 1-4 resp.), fewer unovulated follicles (7.25, 2.25, 6.50 and 1.75) and more ova collected per female (1.75, 4.75, 2.50 and 7.25). From the FSH- and PMSG-pretreated groups, 4.75 and 7.25 embryos per female resp. were collected, but none were recovered from the other 2 groups. Six embryos were transferred to 2 synchronized recipients, and resulted in 5 progeny.

**2310 PANDEY, A; SINHA, SK; MISHRA, OP; PANDEY, JN. 1992. Superovulation and embryo recovery in Black Bengal goats. *Indian Journal of Animal Reproduction*, 13: 1, 25-27; 9 ref.**

For 3 untreated and 9 PMSG-treated ewes, the total number of corpora lutea observed was 8 and 88 resp. and the total number of embryos recovered 4 and 40.

**2311 PARGAONKAR, M; BAKSHI, SA; PARGAONKAR, DR; TANDLE, MK; SALUMKE, VM. 1992. Studies on superovulatory response and surgical embryo recovery in goats. *Indian Journal of Animal Reproduction*, 13: 1, 23-25; 11 ref.**

For 8 Osmanabadi and Osmanabadi crossbred female goats superovulated with PMSG, the number of corpora lutea averaged  $9.42 \pm 1.48$ , and the percentage of embryos recovered 5 days after mating  $76.35 \pm 7.8$ .

## Embryo development

**2312 AGRAWAL, KP. 1992. A note on cryopreservation of caprine embryos by vitrification. *Indian Journal of Animal Reproduction*, 13: 1, 30-32; 5 ref.**

17 embryos at 4-8-cell stage were vitrified using glycerol and 1,2-propanediol as cryoprotectants. Of 16 embryos recovered after thawing, none showed morphological damage, and 10 embryos cultured for 24h 6 cleaved.

**2313 MANI, I; VADNERE, SV. 1988. Studies on in vitro culture of goat embryos. *Indian Journal of Animal Reproduction*, 9: 1, 44-46; 7 ref.**

Goat embryos were incubated for 24 h in modified Dulbecco's medium containing 20% goat serum. Four of 5 morulae developed to the early blastocyst stage, and 2 of 7 early-stage blastocysts developed to the blastocyst stage.

## Poultry

**2314 AHLAWAT, SPS. 1983. Transferrin and prealbumin polymorphism in Karaknath and Aseel breed of indigenous origin. *Indian Journal of Animal Research*, 17: 1, 35-39; 18 ref.**

Blood samples from 169 birds aged 14 wk (50 rapid- and 40 slow-feathering Karaknath, 42 Aseel Peela and 37 Aseel Kagar) were examined by starch-gel electrophoresis. No Tf polymorphism was present, all birds being of type BB. The frequencies of the PaA and PaB genes were 0.55-0.59 and 0.41-0.55 in the different breeds. There were no significant differences between Pa genotypes in body weights up to 8 wk of age.

**2315 BALASUBRAMANYA, RH; RANGASWAMI, G. 1972. Studies on algae as poultry feed. *Madras Agric. Journal*, 59: 7, 379-390.**

**2316 BANERJEE, AMEETA; SHETTY, HS. 1992. Microbial load in poultry feed and detection of aflatoxin B1 using monoclonal antibody-based enzyme linked immunosorbent assay. *Letters in Applied Microbiology*, 15: 3, 89-91; 15 ref.**

Feed samples (n=18) collected from different poultry farms and feed mills situated in Andaman and Nicobar islands in India were assessed for microflora and aflatoxin B1 contamination. The bacterial counts ranged from  $1.0 \times 10^7$  to  $8.8 \times 10^7$  colony forming units (cfu)/g of feeds, while counts of fungi ranged from  $1.0 \times 10^3$  to  $8.7 \times 10^3$  cfu/g. The mycoflora comprised mainly of *A. spp.*, *A. flavus* being most dominant. Aflatoxin B1 was detected by monoclonal antibody-based ELISA in 14 of the feed samples, from 5.5 to 90.0 ng/g.

**2317 BHARTEL, R. 1981. The effect of fumigation and holding time on embryonic mortality in chicken eggs of high or low shell quality as measured by specific gravity. *Bulletin of Veterinary Science and Animal Husbandry, Nepal*, 10/11, 33-35; 4 ref.**

**2318 BRAH, GS; SANDHU, JS. 1983. Evaluation of fertility, hatchability and embryonic mortality of three stocks of meat-type chicken. *Avian Research*, 67: 3, 75-80; 9 ref.**

Data on 6085 eggs from 3 synthetic broiler strains, incubated in 3 settings, were analysed. Egg fertility estimated from candling ranged from 72.5 to 85.2%, and that estimated from the examination of broken eggs from 74.9 to 86.7% ( $P < 0.05$ ). Hatchability of fertile eggs ranged from 70.0 to 95.3%, being significantly

lower in 3rd than in the 1st and 2nd hatches. There were highly significant differences between hatches in embryo mortality, which was 7.38, 4.72 and 7.90% resp. in the 1st hatch of the 3 strains vs. 20.48, 18.08 and 29.91% in the 3rd hatch. Genetic group had no significant effect on egg fertility, but hatchability was significantly lower in 1 of the strains than in the other 2 strains, and there was a highly significant genetic group X hatch interaction for hatchability. There were significant differences between sire families in embryo mortality in 2 of the strains. It is suggested that both hatchability and embryo mortality are inherited.

**2319** BRAH, GS; SANDHU, JS. 1984. **Genetic influences on embryonic mortality and malpositions of meat-type chickens.** *Indian Journal of Animal Sciences*, 54: 12, 1182-1184; 9 ref.

The study involved 3032 eggs incubated in 1 setting and representing 3 synthetic broiler populations (2 strains selected for body weight and an unselected control) and the 2 reciprocal crosses of the selected strains. There were highly significant differences between genetic groups in the incidence of embryo mortality (range 5.81-14.83%). The reciprocal crosses had significantly lower mortality than the purebred strains (7.76 vs. 11.28%); heterosis was 31.2%.

**2320** BRAH, GS; SANDHU, JS. 1983. **Malpositions in unhatched embryos of some stocks of meat-type chicken.** *Indian Journal of Animal Sciences*, 53: 7, 789-791; 5 ref.

8349 eggs from synthetic broiler strains Pb1 and Pb2, their crossbreds and a control population were incubated. The incidence of malpositions was significantly higher for Pb1 and control eggs (53.2 and 51.1% resp.) than for Pb2 and crossbred eggs (33.2 and 37.6).

**2321** BRAH, GS; SANDHU, JS. 1984. **Pre-incubation storage effects on guineafowl eggs at tropical temperatures.** *Tropical Agriculture, Trinidad*, 61: 1, 35-36; 9 ref.

The effects of pre-incubation storage periods of 1-3, 4-6, 7-9 or 10-12 days were studied on some incubation characters of guineafowl eggs held at tropical summer room temps., fluctuating diurnally between 25.8 and 31.5°C. Storage for 10-12 days reduced hatchability significantly compared with other periods, mainly due to an increase in embryo mortality between 15 and 28 days of incubation. Embryonic malpositions were not affected by the length of storage, but the incidence of malformations was significantly higher in eggs stored for 7-12 days compared with those stored for 1-6 days.

**2322** DATTA, K; SONI, JL; DATTA, IC. 1990. **Sequential morphological changes in chicken erythrocytes after in vivo and in vitro exposure to phenylhydrazine-hydrochloride.** *Research in Veterinary Science*, 48: 1, 12-17; 12 ref.

In acute haemolytic anaemia of chickens, induced with the oxidant chemical phenylhydrazine-hydrochloride, maximum degenerative changes in the in vivo exposed erythrocytes occurred on day 3 after injection. Microspherocytic transformation, dumbbell shaped red blood cells and foamy squashed nuclei predominated. Heinz body formation was the cytoplasmic hallmark of the haemolytic anaemia. Marked reticulocytosis on day 5 indicated spontaneous regeneration. In vitro exposure to the chemical agent evoked similar morphological aberrations/Heinz bodies, microspherocytic transformation and nuclear degeneration. These were induced much earlier, presumably because of the absence of a protective internal milieu. Nevertheless, a basic similarity in morphology was evident. The in vitro test system might be suitable for screening oxidant chemicals and drugs.

**2323** DEVEGOWDA, G; DEVURKAR, U. 1990. **Performance of broilers supplemented with All-Lac, furazolidone and chlorohydroxy quinoline.** *Biotechnology in the feed industry: Proc. of Alltech's Sixth Annual Symp.* (Nicholasville: 1990)/edited by TP Lyons. Nicholasville: Alltech Technical Publications, p. 503.

**2324** GOYAL, KC; SHARMA, YK; MISRA, UK. 1984. **Restoration of vitamin A deficiency induced lesions by provitamin A carotenoids in chicks: studies on tissue DNA, RNA and protein.** *Nutrition Reports International*, 30: 2, 501-504; 9 ref.

From hatching male chickens were given a diet free from vitamin A. When they ceased to gain weight at 20 to 25 days old they were kept on the diet without treatment or were given weekly vitamin A 424 mug/100 g body weight or provitamin A carotenoid extracts from radish tops or coriander leaves 840 mug/100 g. DNA, RNA and protein in liver, lung, heart and brain, which were decreased in chickens deprived of vitamin A, were in most cases increased by the carotenoids but not to the same extent as by vitamin A.

**2325** KATHURIA, PC; JAND, SK; SINGH, N. 1993. **Chick embryo toxicity bioassay for screening toxicogenic fungi.** *Indian Veterinary Journal*, 70: 7, 593-596.

**2326** KHAN, BA; HUSAIN, SS; AHMAD, MA. 1989. **Toxicity of aflatoxin B1 to chick embryo.** *Pak. Jrl. of Scient. and Ind. Res.*, 32: 5, 353-354; 14 ref.

The effects of aflatoxin B1 on mortality and hatchability of chick embryos were studied. Three different doses, 26, 81 and 216 ng/egg, of aflatoxin B1 were employed. The lethal dose of 216 ng/egg caused 93% mortality by the 4th day of incubation.

**2327 MOUDGAL, RP; MOHAN, J; PANDA, JN. 1992. The influence of prepubertal partial sinistral ovariectomy on the subsequent reproductive function of domestic hens (*Gallus domesticus*). *Theriogenology*, 37: 5, 1155-1162.**

Each of 20 White Leghorn hens of 13 to 14 weeks were subjected to partial sinistral ovariectomy and sham-operations. In half of the hens from each group, the percentage of egg production and clutch size were noted until 50 weeks of age. The growing pattern of normal ovarian follicles was also recorded at 26 weeks of age in a rest half of the hens in the two groups. The percentage of egg production and the mean and variance of clutch size did not differ significantly ( $P < 0.05$ ) between the partially ovariectomized and sham-operated groups. The growing yellow follicles ( $> 8$  mm) in the rapidly developing phase in these two groups did not vary, although the smaller follicles (4 to 8 mm in diameter) remained significantly ( $P < 0.01$ ) more in the sham-observation control group than in the partially ovariectomized group. This observation indicates that smaller follicles (4-8 mm) developed in the larger ( $> 8$  mm) follicles more efficiently in partially ovariectomized hens than in the sham-operated (control) hens. In a second experiment, one group of hens had all the yellow follicles ( $> 8$  mm) removed, while a second group of hens was left untreated. On the 3rd and 6th day post treatment, the hens were examined for the presence of ovarian follicles. No significant ( $P < 0.05$ ) difference in the growing pattern of subsequent follicles (2 to 4 or 4 to 8 mm) was detected due to treatment. These data demonstrate that the mechanisms that regulate follicular growth and atresia are adjust to maintain normal ovulation following partial ovariectomy.

**2328 MUNEER, MA; SASIPREEYANJAN, J; NEWMAN, JA; SIVANANDAN, V. 1989. Pathology of chicken embryos infected with Arkansas strain of infectious bronchitis virus. *Pakistan Veterinary Journal*, 9: 2, 57-63; 7 ref.**

To study the progressive effects of avian infectious bronchitis virus (IBV) on developing chicken embryos, 240 ten-day old embryos were inoculated via allantoic cavity with Arkansas99 strain of IBV (AIBV). AIBV inoculation of embryos caused surface congestion, curling, dwarfing and poor feather development in

addition to mortality. The virus was isolated from allantoic fluid, amniotic fluid, and other embryo tissues. AIBV induced histopathological changes in lung and kidney tissues of infected embryos.

**2329 PANI, PK; KISHORE, S; NAITHANI, S. 1989. Cellular immunity in chicks expressing fibrosarcomatous liver tumor following embryo infection with subgroup A Rous sarcoma virus. *Avian Diseases*, 33: 4, 615-621; 24 ref.**

Bryan standard strain of Rous sarcoma virus (BS-RSV) of subgroup A was inoculated into heavy and light breeds of chicken embryos via chorioallantoic membrane (CAM). Cell-mediated immune response, was measured by a leukocyte migration inhibition (LMI) test. Chicks hatched from eggs with pock-positive CAMs were more likely to develop liver tumours than those hatched from eggs with pock-negative CAMs. Chicks that developed tumours usually had a +ive cell-mediated immune response, and those that were negative for liver tumour were negative, based on the LMI test.

**2330 PANI, PK; NAITHANI, S. 1991. Genetics of post-hatching survival potential of Australorp chicks infected as embryos by subgroup A Rous sarcoma virus: further support to 4-allele genetic model. *Indian J. of Experim. Biology*, 29: 6, 416-421; 15 ref.**

11-day-old Australorp embryos were inoculated via the chorioallantoic membrane with Rous sarcoma subgroup A virus, and death rate of chicks due to the virus-induced liver tumours was recorded. Virus-infected chicks died 3-50 days after hatching; age at death averaged  $13 \pm 8.7$  days. Death rates of infected chicks developing from progeny tested parents showed that homozygous, susceptible chicks lacking the ar1 or ar2 alleles of the tva (tumour virus a) locus died within 7 days of hatching, and that those that had at least 1 of these alleles survived beyond 7 days.

**2331 RANGACHAR, TRS; BALASUBRAMANYA, RH; SETTY, SVS. 1973. Responses to algal supplementation in poultry. *Mysore Journal. Agric. Sci.* 7: 631-638.**

**2332 RAO, GV. 1983. The development of a sex-linked slow-feathering White Leghorn strain by gene transfer from an Indian indigenous breed. *British Poultry Science*, 24: 2, 251-254; 7 ref.**

Slow-feathering (KK) Kadakanath males were mated with rapid-feathering (k-) White Leghorn females, and F1 slow-feathering males were backcrossed to females

of the k- genotype. The backcross progeny were mated inter se, to give rapid-feathering and slow-feathering females, and slow feathering males. The males were then progeny tested, and homozygous slow-feathering males were mated to slow-feathering females to produce a slow-feathering stock. In Kadakanaths and slow-feathering White Leghorns, age at 1st egg averaged 187.1 and 186.6 resp., body weight at 1st egg 1393 and 1400 g, egg production to 300 days of age 37.0 and 75.5, and egg weight 39.3 and 53.0 g.

**2333** RATNAMOHAN, N. 1982. **Avian cell lines: a review.** *Sri Lanka Vet. Journal*, 30: 2, 1-6; 30 ref.

**2334** REDDY, GS; SRINIVASAN, VA. 1992. **Use of BHK cell culture-adapted Newcastle disease virus for immunization of chicks.** *Vaccine*, 10:3, 164-166; 8 ref.

Groups of 10 White Leghorns (14 weeks old) were inoculated i.m. with 0.1 ml of serial dilutions (10<sup>-1</sup> to 10<sup>-7</sup>) of BHK cell adapted (21 passages) Komarov strain Newcastle disease virus (NDV). All inoculated birds and 10 controls were observed for 14 days after challenge with a local field velogenic, viscerotropic NDV strain (104 ID<sub>50</sub> i.m.) 21 days after inoculation. Blood samples, collected before and at challenge were examined by haemagglutination inhibition (HI) and ELISA. Infectivity in 3 further passages of the vaccine strain was measured by titration in allantoic sacs of 9- to 11-day-old chick embryos and expressed as embryonic infective doses (EID<sub>50</sub>/ml). Birds inoculated with serial dilutions of 10<sup>-1</sup> to 10<sup>-4</sup> were completely protected against virulent challenge virus. Infectivity titres (EID<sub>50</sub>/ml) of the vaccine strain were 106.90, 107.45 and 108.04 for the 3 passages, respectively. The ELISA was more sensitive than HI, and was simple and correlated well with the challenge test. It was concluded that cell culture-adapted Komarov strain NDV was a potent and safe vaccine when given by the i.m. route.

**2335** RIZVI, SA; SHAKOORI, AR. 1992. **Immuno-modulatory effects of aflatoxin B1 against Newcastle disease virus vaccine in poultry.** *Pakistan Journal of Zoology*, 24: 1, 53-58; 38 ref.

Broiler and layer chicks administered a single dose of purified aflatoxin B1 before, at the same time as or after vaccination could not mount a proper immunological response against Newcastle disease virus vaccine. The immunosuppression was more pronounced in chicks which were exposed to toxin and simultaneously vaccinated. In the broilers in which aflatoxin was administered at the same time as vaccination the immunological response was poor and these birds, like the unvaccinated

toxin-free control group birds, succumbed to challenge with a virulent strain of Newcastle disease virus. The vaccinated toxin-free control birds developed antibody titres which were significantly ( $P < 0.05$ ) higher than the titres of toxin groups birds. Although the toxin groups could not mount a higher antibody titre, these birds survived the challenge. The antibody titres were much higher in the vaccinated toxin-free layer chicks when compared with the similar group of broiler chicks.

**2336** SACHDEV, AK; AHUJA, SD; THOMAS, PC; AGARWAL, SK. 1985. **Effect of egg weight and duration of storage on the weight loss, fertility and hatchability traits in Japanese quail.** *Indian Journal of Poultry Science*, 20: 1, 19-22; 6 ref.

Eggs were collected daily from an unspecified number of Japanese quails, aged 20-24 wk, and were stored for up to 9 days at 12°-24°C and a RH of 45-57%. Egg fertility ranged from 72.57% for eggs weighing 7.01-8.9 g to 83.24% for eggs weighing 10.01-11.0 g, and hatchability ranged from 74.08% for eggs weighing 10.01-11.0 g to 84.28% for eggs weighing 11.01-12.0 g. The percentage of chicks dead in shell was lowest in eggs weighing 7.01-8.0 g (5.27%), and highest in those weighing 9.01-10.0 g (13.04%). All these differences were non-significant. Length of storage had no significant effect on egg fertility (70.70-84.12%), hatchability (66.76-85.88%) or percentage of chicks dead in shell (2.18-16.78), but egg weight loss increased significantly with increasing length of storage, from 0.51% for eggs stored for 1 day to 3.15% for eggs stored for 9 days.

**2337** SAHU, AK; DAVE, BK. 1986. **Effect of heterospermic insemination (dwarf X Leghorn) on reproductive traits in poultry.** *Indian Journal of Animal Sciences*, 56: 1, 59-61; 7 ref.

Semen from 5 dwarf and 5 normal-sized White Leghorn (WL) cocks was used to inseminate groups of 10 dwarf hens in doses of 10 million spermatozoa with sperm number ratios (dwarf:WL) of 75:25, 50:50 and 25:75. For insemination with unmixed semen from the 2 types of cock and for the 3 mixed-semen combinations resp., egg fertility was 97.39, 90.39, 84.09, 90.91 and 89.87%, the hatchability of fertile eggs 91.44, 79.88, 81.76, 85.00 and 88.72% ( $P < 0.05$ ), embryo mortality 3.74, 14.20, 13.51, 11.90 and 6.77% ( $P < 0.01$ ), and the percentage of male progeny 76.10, 47.67, 47.79, 59.82 and 41.80 ( $P < 0.05$ ).

**2338** SINGH, DK; SINGH, CSP; SINGH, LB; SINGH, KK; SINGH, UC. 1983. **Studies on some fertility and hatchability characters in White Leg-**

**horn and White Rock chickens.** *Avian Research*, 67: 2, 57-59; 6 ref.

The fertility of 454 746 White Leghorn and White Rock eggs averaged  $91.3 \pm 0.01$  and  $91.5 \pm 0.02\%$  resp. It averaged  $92.2 \pm 0.03$ ,  $90.9 \pm 0.03$  and  $90.9 \pm 0.02\%$  resp. for eggs hatched in winter, summer and the monsoon season. Embryo mortality was  $36.9 \pm 0.03$  and  $45.2 \pm 0.05\%$  in the 2 breeds resp., and hatchability  $63.0 \pm 0.03$  and  $54.7 \pm 0.05\%$  (both  $P < 0.01$ ). Embryo mortality was significantly higher in summer ( $46.4 \pm 0.08\%$ ) than in winter ( $39.9 \pm 0.06\%$ ) and the monsoon season ( $38.7 \pm 0.06\%$ ), and hatchability was significantly lower in summer ( $53.7 \pm 0.08\%$ ) than in the other 2 seasons ( $61.0 \pm 0.05$  and  $61.3 \pm 0.06\%$  resp.).

**2339 SOMVANSHI, R; MOHANTY, GC; KATARIA, JM; VERMA, KC.** 1992. **Ultrastructural studies on interaction of infectious bursal disease virus (IBDV) and aflatoxin B1 on chick embryo fibroblast cell culture.** *Ind. Jrl. of Experiment. Biol.*, 30: 4, 327-333.

Light and electron microscopic evaluation of chick embryo fibroblast (CEF) cell culture inoculated with graded doses (0.25, 2.5 and 25  $\mu\text{g/ml}$  medium) of aflatoxin B1 with and without IBDV was undertaken. Light microscopy revealed degeneration, detachment and necrosis of fibroblasts and multiple plaque formation in IBDV infected group without and with (0.25, 2.5  $\mu\text{g}$ ) aflatoxin B1. The cultures infected with virus, with or without 25  $\mu\text{g}$  aflatoxin B1, showed complete detachment from glass surface. Electron microscopy of these cultures showed marked pyknotic or bizarre shaped nuclei, pronounced degenerative changes in the rough endoplasmic reticulum (RER), mitochondria and the presence of multiple vacuoles in the cytoplasm. The viruses were spherical, arrayed, complete, generally closer to nuclei and RER and indistinctly membrane bound. The viruses were either localised or scattered in the cytoplasm. Cultures containing 25  $\mu\text{g}$  aflatoxin B1 with or without virus showed marked necrosis of cells. In the latter group only a few viruses were seen either in infected cells or free in culture. Control cultures failed to show cytopathological changes as observed in the other 3 groups.

**2340 SUKUMAR, S.** 1992. **Indian poultry industry poultry vaccinology pacing behind poultry production.** *Poultry Adviser*, 25: 1, 65-67.

**2341 THYAGARAJAN, D; PALANISWAMI, KS; MAHALINGAM, P; RAMAN, RN.** 1984. **Embryonic mortality pattern in layer and broiler chicken.** *Avian Research*, 68: 1-2, 41-43; 8 ref.

For 77 600 eggs of the Babcock egg-laying strain, embryo mortality as a percentage of the total number of eggs set averaged  $1.79 \pm 0.94$ ,  $1.56 \pm 1.25$ ,  $1.89 \pm 1.46$  and  $3.60 \pm 0.70$  on days 0-7, 8-14, 15-18 and 19-21 resp. of incubation vs.  $2.76 \pm 0.95$ ,  $2.18 \pm 1.06$ ,  $2.61 \pm 1.21$  and  $5.96 \pm 0.52$  for 54 530 eggs of the Cobb broiler strain, all differences between the 2 strains being significant.

**2342 TIWARY, BK; GOEL, MC.** 1984. **Suppression of IgA synthesis in chickens.** *Veterinary Immunology and Immunopathology*, 7: 3/4, 305-313; 17 ref.

Four methods were tested for the induction of IgA deficiency in chickens: (I) inoculation of anti-alpha i/p on alternate days up to 3 weeks after hatching; (II) bursectomy within 6 h and at 24 h after hatching; (III) in ovo injection of anti-alpha in 17 day embryos followed by bursectomy at 24 h of hatch and a single injection of anti-alpha i/p on the day of hatching; (IV) as in III but bursectomy within 6 h of hatch, followed by three further injections of anti-alpha on days 3, 10 and 34 after hatching. Treatment I produced temporary dysgammaglobulinaemia during treatment. Bursectomy at 24 h of hatch rendered 75% of the chicks IgA deficient up to 4 weeks of age. Early bursectomy within 6 h of hatch resulted in substantial improvement of IgA suppression. Such chicks, when tested at 4, 6 and 10 weeks of age, were 81, 72 and 58.3% IgA deficient, respectively. With treatment III all the treated birds were IgA deficient at 4 weeks of age. However, as the birds grew older, IgA appeared in the serum so that at the age of 12 weeks only 27.3% were deficient. Treatment IV completely suppressed the IgA system of 13 out of 14 chickens. These chickens lacked both serum and secretory IgA as well as IgA-containing cells in their intestinal mucosa. Both IgG and IgM continued to be produced.

## Diseases

**2343 CHANDRA, R; RAO, VDP; GARG, SK; SINGH, IP.** 1984. **Comparative studies on cultivation of buffalo pox virus in pup kidney and chicken embryo fibroblast cell culture.** *Indian Journal of Experimental Biology*, 22: 9, 507-508; 8 ref.

Buffalo pox virus grew equally well in the two cell cultures, with similar infectivity titres. Plaque size was also similar, but plaque morphology differed. It is concluded that puppy kidney cells are a suitable alternative for growing this virus.

**2344** DHANESAR, NS; MALIK, BS. 1983. **Immuno-logical response of different fowl-pox vaccines.** *Indian Journal of Animal Sciences*, 53: 9, 993-998; 9 ref.

Five vaccines were compared: (1) 10% suspension of infected chorioallantoic membrane (CAM) in tryptose broth, (2) 10% infected CAM suspension in infected allantoic fluid, (3) the same as (2) but containing an equal amount of paraffin and lanolin adjuvant, (4) supernatant of infected chick embryo fibroblast culture, (5) the conventional freeze-dried vaccine used in India. Best immune response and resistance to challenge were induced with vaccine (2), followed by vaccine (4).

**2345** GUHA, DK; CHAKRAVARTY, J; MAULIK, KK; RAY, K; BHATTACHARYA, AK. 1984. **Studies on the effect of calf serum on Ranikhet disease virus (Mukteswar strain) growth in infected chick embryo.** *Indian Journal of Animal Health*, 23: 2, 153-157; 5 ref.

Newcastle disease virus was grown in embryonated chicken eggs using 1% inactivated calf serum in normal saline solution and phosphate buffer saline at pH 7.2 or 7.6 as diluent. The virus antigen yield was higher than from controls (without calf serum). Antigenicity of the virus was satisfactory.

**2346** HEDAOO, DA; PATHAK, PN; SEXENA, SP. 1985. **A note on cytopathy fo fowlpox virus in chick skin epithelium and chorioallantoic membrane of chick embryo.** *Ind. Jrl. of Anim. Health*, 24: 1, 59-61.

Cytopathic effects in comb and skin tissues due to the CAM-adapted vaccine strain were limited to epithelial cells and consisted of cell proliferation, cloudy swelling, hydropic degeneration, nuclear and nucleolar enlargement, and eosinophilic cytoplasmic inclusions. Superficial necrosis, erosion of epidermal layers and lymphocytic infiltration were also observed. In infected CAM there was either diffuse thickening or pock formation, but no lymphocyte infiltration.

**2347** ISLAM, MR; JONES, RC. 1987. **Immunohisto-chemical demonstration of avian reovirus in cell culture.** *Bangladesh Vet. Jour.*, 21: 3-4, 81-88; 12 ref.

**2348** KALAIMATHI, R; BALASUBRAMANIAN, J; RAJENDRAN, MP; QUADER, SA. 1985. **Influence of route of inoculation in the production of chick embryo adapted duck plague vaccine.** *Indian Veterinary Journal*, 62: 7, 548-551; 5 ref.

In large-scale production of duck plague vaccine, the chorioallantoic sac was better than the chorioallantoic membrane for inoculating 9-day-old chick embryos, giving higher yield and higher titre of vaccine.

**2349** KUMANAN, K; ELANKUMARAN, S; VIJAY-ARANI, K; PALANISWAMI, KS; PADMANABAN, VD; MANVELL, RJ; ALEXANDER, DJ. 1992. **Characterisation of Newcastle disease viruses isolated in India.** *Journal of Veterinary Medicine*, 39: 5, 383-387; 16 ref.

Eleven Newcastle disease virus (NDV) isolates obtained from outbreaks of disease in chickens (9) and Japanese quail (2) in Tamil Nadu, India were characterized in pathogenicity tests, antigenically, using mouse monoclonal antibodies, and other established tests devised to distinguish between different strains. All 11 isolates were shown to be highly virulent for chickens. In indirect immunoperoxidase tests used to assess the ability of a panel of 28 MAbs to bind to infected cell cultures, 10 of the isolates showed an identical reaction pattern, the other isolate failed to react with one MAb which bound to cells infected with the other isolates. Isolate 9 was unstable at pH3 while the other 10 were stable. All other properties were shared by the 11 isolates.

**2350** MISHRA, KC. 1984. **Experimental studies on a velogenic viscerotropic Newcastle (Ranikhet) disease virus isolated from an epidemic in Uttar Pradesh.** *Indian J. of Animal Sciences*, 54: 4, 353-359; 5 ref.

Newcastle disease virus isolated from an outbreak of the disease in a large poultry farm in Uttar Pradesh was velogenic and viscerotropic. Virulence, measured in chick embryos, day-old chicks and adult fowls was comparable to that of virulent 'Mukteswar' strain. Cross-immunity tests conducted with this as well as the virulent 'Mukteswar' virus indicated that 'F' strain vaccination at hatching, followed by 'R2B' vaccination at 7 weeks of age protected White Leghorn chickens against both virus strains.

**2351** MISHRA, SC; RAI, A; JAISWAL, TN. 1985. **An enzyme linked immunoassay for estimation of antibodies to Newcastle disease virus strains.** *Acta Virologica*, 29: 2, 154-157; 9 ref.

One-day-old chicks were inoculated with strain F or CDF-66 vaccines, and 6-8 week old birds with the Mukteswar strain of Newcastle disease virus. Serum samples collected at intervals up to 70 days after vaccination were tested by haemagglutination inhibition (HI) and enzyme linked immunosorbent assay (ELISA). Antibody titres were always 2-4 times higher in the ELISA (40-2560) than the HI (20-1280) test. Peak titres were reached at 21 days after vaccination in both tests.

**2352** MISHRA, SC; TANDON, SN; JAISWAL, TN. 1984. **Enzymatic changes in serum of chicks immu-**

nized with Mukteswar vaccine strain of Ranikhet disease virus. *Indian Journal of Poultry Science*, 19: 2, 81-84; 8 ref.

In chicks vaccinated s/c at 6 weeks of age with the R2B vaccine strain of Newcastle disease virus, amylase activity in serum samples decreased from 2551 to 1/6 IU/100 ml by 14 days after vaccination, and then returned to prevaccination levels by 28 days. Lactate dehydrogenase activity increased from 130 to 1075 IU by 21 days after vaccination, and then decreased rapidly to 213 IU by 28 days.

**2353 PATEL, HR; KHER, HN; JHALA, MK; JHALA, VM. 1991. Periodical study of humoral and cell mediated immune response in pullets after R2B vaccination against Newcastle disease. *Cheiron*, 20: 1, 16-18; 5 ref.**

Ten White Leghorn pullets, 8 weeks old, previously sensitized with the 'F' strain of Newcastle disease virus were vaccinated with the R2B strain. A drop in antibody titres 3 days after vaccination was attributed to neutralization of serum antibodies by vaccine antigens. Peak antibody titres and leukocyte migration inhibition (LMI)% values were obtained 14 days after vaccination. The skin reaction factor (SRF) values were measured using the delayed type cutaneous hypersensitivity test in guineapigs. A reaction was observed 24 h after inoculation which became feeble at 48 h and completely disappeared 72 h after inoculation. Peak SRF values were obtained 14 days after vaccination. There was little correlation between LMI% values and antibody titres indicating independent development of the humoral and cell mediated immune responses.

**2354 PRADHAN, HK; MOHANTY, GC; RAJYA, BS. 1983. Comparative sensitivities of oviduct and tracheal organ cultures and chicken embryo kidney cell cultures to infectious bronchitis virus. *Avian Diseases*, 27: 3, 594-601; 21 ref.**

Organ (oviduct and trachea) and chick-embryo kidney cell cultures were used to assess the pathogenicity of a locally isolated infectious bronchitis virus, initially isolated from the oviduct of young chicks. In oviduct cultures infected with IBV, ciliary movements decreased 24 h after inoculation, and by the 6th day ciliary movements had ceased. Cytopathic changes were also noticed. Immunofluorescent antigen was detected after 1 to 6 days, the maximum being on the 3rd day. Characteristic microscopic changes in the oviduct explants were loss of cilia and degeneration and necrosis of the epithelial and glandular cells followed by sloughing. In tracheal cultures, ciliary movements were

reduced by 24 hours and had completely ceased by the 5th day. Cytopathic effect and immunofluorescent antigen were present from 1 to 8 days, being greatest on the 5th day. Histological changes marked by loss of cilia, rounding of the epithelial cells, degeneration, and sloughing were detected from 2 to 8 days. Low-embryo-passaged (EP-7) IBV did not produce a cytopathic effect on the chick-embryo kidney cell cultures, but high-embryo-passaged (EP-14) virus produced a cytopathic effect at the third passage.

**2355 REDDY, GS; SRINIVASAN, VA. 1991. Immunisation of chickens with mesogenic strains of Newcastle disease virus grown in a Japanese quail fibroblast cell line (QT35). *Indian Veterinary Journal*, 68: 10, 907-910; 5 ref.**

Mesogenic strains of Newcastle disease virus, R2B Mukteswar and Komarov, adapted to grow in the Japanese quail fibroblast continuous cell line (QT35), produced a cytopathic effect. Virus titres at the twelfth passage varied from 105.50 to 105.83 EID<sub>50</sub>/0.1 ml; haemagglutination inhibition titres were negligible. The cell culture adapted strains conferred immunity in 8-week-old birds that were injected i.m. with either of the strains and challenged with virulent virus 21 days later; it was concluded that the strains may be useful as vaccine strains.

**2356 SAVALIA, CV; ANJARIA, JM; BRAHMBHATT, MN. 1992. Aspergilli isolated from the respiratory tract of White Leghorn chicks. *Indian Veterinary Journal*, 69: 4, 371-372; 11 ref.**

Cultural examination of 450 clinical specimens (150 each of trachea, lungs and air sacs) collected from 150 randomly selected White Leghorns revealed *Aspergillus* spp. in 105 (23.32%). *Aspergillus niger* was isolated from 42 specimens, *A. fumigatus* from 34, *A. flavus* from 23 and *A. terreus* from 6. The birds were not clinically affected and a carrier state may be indicated.

**2357 VIKRAMAN, V; PAILY, EP. 1986. Immune responses to Newcastle disease (Ranikhet disease) vaccination in *Ascaridia galli* infected chicken. *Jrl. of the Remount and Vet. Corps*, 25: 2, 73-78; 10 ref.**

28 days after Newcastle disease vaccination the haemagglutination inhibition titres were 226 in 20 chickens previously infected with 1500 embryonated *A. galli* eggs, 466 in 20 infected with 1000 eggs, and 808 in 12 uninfected controls. When 4 birds from the two *A. galli* infected groups were challenged with velogenic Newcastle disease virus they became depressed, weak, and developed diarrhoea and drooping wings.

## Veterinary diseases

**2358** ABEYGUNAWARDENA, I; KAKOMA, I; SMITH, RD. 1990. **Pathophysiology of canine ehrlichiosis.** *Ehrlichiosis. A vector-borne disease of animals and humans*/edited by JC Williams, I Kakoma. Dordrecht, Netherlands: Kluwer Academic Publishers, p. 78-92; 23 ref.

The pathogenesis of canine ehrlichiosis or tropical canine pancytopenia (TCP) involves a wide range of effector mechanisms targeted to mature platelets and thrombocytes. The predominant mechanisms are immunologically mediated resulting in platelet sequestration coincident with significant reduction in the number of circulating platelets. Another pathway involving the platelet migration inhibition factor (PMIF) has been identified to play a key role in the pathogenesis of TCP by enhancing platelet sequestration and stasis, leading to reduced peripheral platelet count and probably haemorrhagic diatheses. PMIF is associated with virulence and partially characterized as a thermostable glycoprotein elevated in body fluids of dogs severely affected by mild strains of *Ehrlichia canis*.

**2359** ARAWWEWELA, CB; DE ALWIS, MCL; VIPULASIRI, AA. 1981. **Formulation of a suitable medium for obtaining dense cultures for haemorrhagic septicaemia vaccine production.** *Ceylon Veterinary Journal*, 29: 1/4, 16-19; 5 ref.

A simple and economical medium containing casein hydrolysate, cane sugar, yeast extract, phosphate buffer, and peptic digest of blood was formulated to obtain dense cultures of *P. multocida* for haemorrhagic septicaemia vaccine production. The process of aeration, the presence of buffer and the addition of sugar, yeast and peptic digest of blood increased the dry weight yield of bacteria. Yeast extract was the single ingredient that gave the greatest increase in yield. Using this medium in a simple lift fermentor gave a dry weight yield of  $1.7626 \pm 0.233$  mg/ml. The cost of this medium was approximately one third that of the conventional medium hitherto used in Sri Lanka.

**2360** BHAT, PP. 1993. **Molecular characterization of pox (viral) DNA.** *Indian Journal of Animal Sciences*, 63: 8, 857-862.

**2361** JAYAKUMAR, R; RAMADASS, P. 1991. **Immunoglobulin response to rabies virus immunization in dogs.** *Vaccine*, 9: 9, 611-612; 17 ref.

Cross-bred dogs (3-6 months old) were inoculated s.c. with 2 ml of beta-propiolactone-inactivated 5% sheep

brain antirabies vaccine daily for 7 days (30 dogs) or kept as unvaccinated controls (15 dogs). IgM (19S) and IgG (7S) antibodies, fractionated by gel filtration on Sephadex G200, from serum samples collected at 0, 7, 14, 21 and 28 days, and then once a month for 12 months after vaccination, were measured by ELISA. All the dogs were challenged i.m. 12 months after vaccination with 1 ml of a suspension of a local street rabies virus strain containing 103.83 intracerebral MLD50/-0.03 ml. The mean ELISA absorbance values for the IgM fraction reached a maximum ( $0.4693 \pm 0.03$ ) in the second month after vaccination and then declined. For the IgG fraction the maximum absorbance ( $0.6530 \pm 0.03$ ) was reached in the 6th month and persisted at an appreciable level ( $0.1305 \pm 0.03$ ) for up to 12 months after vaccination. During the first and second months after challenge the mean absorbance values were respectively  $0.4421 \pm 0.08$  and  $0.3028 \pm 0.11$  for IgM and  $1.009 \pm 0.05$  and  $0.9796 \pm 0.05$  for IgG. Mean titres for IgG were higher during the 2 months after challenge than the maximum levels reached after vaccination. All the vaccinated dogs survived the challenge, whereas all the unvaccinated controls died from rabies. It was concluded that the persistence of IgG antibodies for up to 12 months after inoculation with the vaccine gave satisfactory immunity in the dog.

**2362** MOHAN, KS; GOPINATHAN, KP. 1992. **Characterization of the genome of *Oryctes baculovirus*, a viral biocide of the insect pest *Oryctes rhinoceros*.** *Journal of Biosciences*, 17: 4, 421-430.

**2363** NACHIMUTHU, K; PADMARAJ, A; PADMANABAN, VD. 1992. **Cryopreservation of cell lines.** *Indian Veterinary Journal*, 69: 5, 472-473; 8 ref.

The revival percentages of 4 cell lines (Vero, BHK21, MDBK and CER) after freezing in the presence of 10% DMSO (dimethyl sulfoxide) as a cryopreservative were 20%, 90%, 93% and 89%, respectively. A 10% DMSO alone gave poor results with Vero cells, various combinations of DMSO and glycerol were tried; 66% revival rate was achieved with 5% DMSO+5% glycerol.

**2364** NAIR, SP; SEN, AK; RAO, BU. 1985. **Development of a new strain of BHK21 suspension cell-line from 'Glasgow' monolayer cultures.** *Indian Journal of Animal Sciences*, 55: 7, 511-514; 10 ref.

A BHK21 clone 13 cell-line, from the American Type Culture Collection Centre, USA ('Glasgow' monolayer),

at its 106th passage level was used to develop a new strain of suspension cell-line. This seed-cell culture was gradually adapted using Eagle's medium with 10% serum to grow in suspension. From the 30th passage it developed the characteristics of a suspension cell-line. The cells were studied for their morphology, replication kinetics and susceptibility to different strains of aphthovirus. The new strain of suspension cell was better than the 'Razi' cells currently in use.

**2365** NARAYAN, KG; KOTWAL, S. 1989. **Laboratory diagnosis of rabies in animals in Ranchi (1983-86).** *Indian Veterinary Journal*, 66: 9, 797-800; 12 ref.

Of 31 animals examined for rabies, 10 were from dogs vaccinated against rabies. 4 of these were negative using mice inoculation test, fluorescent antibody technique, immunoperoxidase and Sellers staining method. 4 of the 6 remaining vaccinated dogs had either not received a booster dose or a second dose of vaccination during 4-7 years preceding death due to rabies 2 cases died 2-3 months after the date of vaccination; in one of these cases a modified live chick-embryo vaccine was used and in the other case the vaccine type was not known.

**2366** RAMANNA, BC; KALANIDHI, AP; SRINIVASAN, VA. 1991. **A tissue culture rabies vaccine.** *Indian Veterinary Journal*, 68: 9, 803-807; 15 ref.

A tissue culture adapted CVS strains of rabies virus was grown and maintained as a suspension culture in a BHK21, C13 cell line. After incubation at 35°C for 72 h, the virus was harvested, inactivated, concentrated and tested as a vaccine. It was tested for infectivity in BHK monolayers, and for innocuity and potency in mice. Dogs of various breeds and both sexes were injected with a single s.c. dose of 1 ml of the vaccine (potency 2.4 IU/ml). Satisfactory seroconversion occurred and the vaccine appeared to be safe and potent.

**2367** SARMA, G. 1985. **Studies on some factors affecting the growth of foot-and-mouth disease virus in BHK-21 cells.** *Indian Journal of Animal Health*, 24: 1, 5-10; 17 ref.

The following factors were studied: passage number of cells and of virus, strain and source of cells, cell density, serum requirement, presence of antibody in serum, multiplicity of virus infection, incubation period, and storage condition of the cells. The findings included: restriction of both passage number of cells and of seed virus is essential; maintenance medium containing bovine serum with 2% polyethylene glycol (PEG) gave better results than medium without serum; PEG eliminated virus inhibitory factor; with high multiplicity of

infection, cells developed early cytopathic effect and lower CF antigen titre; cells sedimented from growth medium should be used within 48 hours.

**2368** SEN, AK; PANDEY, MC; SHARMA, RN; GOEL, AC; NEGI, BS; MISRA, LD; NAIR, SP; PRASAD, CS; RAO, BU. 1985. **Potency testing of FMD vaccine prepared in fermenters using BHK21 suspension cells.** *Indian Journal of Animal Sciences*, 55: 3, 175-176; 4 ref.

Monovalent vaccines prepared from aphthovirus types O, A, C and Asia 1 by propagation in hamster kidney cell suspensions were tested in guinea pigs and cattle.

**2369** SHARMA, RD. 1989. **Cell culture vaccine against bovine tropical theileriosis.** *Progress in Vaccinology, Volume 2*/edited by GP Talwar. New York: Springer-Verlag, p. 297-300; 25 ref.

A brief discussion of cell culture vaccine against bovine tropical theileriosis is given. It is concluded that cell culture vaccine is safe for all breeds and ages of cattle. It is suggested that more experimentation is needed on transportation, storage, and standardization of cell-culture-grown schizont vaccine for field application.

**2370** SINGH, CDN; PRASAD, LN; TIWARY, SN; JHA, SN; THAKUR, HN. 1986. **Some observations on animal tumours. 1. Equine sarcoïd. 2. Embryonal nephroma in cattle.** *Ind. Vet. J.*, 63: 5, 419; 3 ref.

**2371** SINGH, GURKIRPAL. 1983. **A note on the serological response to rinderpest tissue culture vaccine.** *Ind. J. of Ani. Health*, 22: 2, 147-150; 8 ref.

The conglutinating complement absorption test revealed the appearance of antibodies 10-17 days after s/c injection of Kabete O cell culture vaccine in five Haryana calves and five buffaloes aged 6-10 months. A thermal response occurred only in the calves. Titres peaked at 21-24 days after vaccination, and disappeared by 38-59 days, persisting longer in calves than in buffaloes. Two calves challenged with virulent virus at 59 days developed an anamnestic response, while remaining clinically normal.

**2372** SUBRAMANIAN, G; RAY, D; NAITHANI, RC. 1986. **In vitro culture and attenuation of macroschizonts of *Theileria annulata* (Dschunkowsky and Luhs, 1904) and in vivo use as vaccine.** *Indian Journal of Animal Sciences*, 56: 2, 174-182; 19 ref.

Macroschizonts of the IVRI strain of *T. annulata* were maintained in cultures of infected lymphocytes for 40 passages. Virulence was lost, but immunogenicity

remained and the strain was used as a vaccine in 20 calves, all of which withstood challenge with no ill effects.

**2373 TEWARI, SC; PRASAD, S. 1983. Comparative diagnostic value of the gel diffusion test virus isolation in cell culture for detecting equine herpesvirus type 1 (EHV-1).** *Revue Scientifique et Technique, Office International des Epizooties*, 2: 4, 1067-1074; 17 ref.

The gel diffusion test was applied direct to field samples from cases of equine abortion, foal mortality and equine paralysis due to EHV-1. Following polyethylene glycol concentration of viral antigen, one line was formed against EHV-1 antiserum after incubation for 24 h at 25°C. Tests carried out simultaneously on 41 field samples showed a high correlation between this test and virus isolation in primary lamb kidney cell culture. The precipitating antigen did not lose activity after heating at 56°C for 30 minutes. A positive reaction was observed with a contaminated sample, which failed to yield virus in the cell culture system.

**2374 UPPAL, PK; RAO, YUB; MUKHOPADHYAY, AK; DAS, SK. 1983. Foot and mouth disease in pigs**

**and propagation of the isolated virus in tissue culture.** *Indian Veterinary Journal*, 60: 6, 495-496; 7 ref.

Foot and mouth disease (FMD) virus type 'O' was isolated from pigs during an outbreak of FMD in Maharashtra State. The morbidity rate was 51.2% and the mortality rate 19.4%. The virus was experimentally transmitted to and isolated from piglets. The virus produced cytopathic effects in goat kidney monolayers after two passages.

## Aphthovirus

**2375 AKHTAR, S; NAEEM, K. 1985. Patterns of complement fixing antibodies in cow and buffalo calves following foot and mouth disease vaccination.** *Pakistan Veterinary Journal*, 5: 3, 138-139; 6 ref.

Six Australian Illawara Shorthorn calves and six buffalo calves injected with cell-culture vaccine prepared in Pakistan, containing both A and O types of aphthovirus antigen, developed complement-fixing antibody after 7 days, which reached a peak after 3 weeks. The titres were higher and persisted longer in buffalo calves than in the Shorthorn calves. Antibody titres to type O were higher and lasted longer than titres to type A.

**2376 BUTCHAIHAH, G; SEN, AK; RAO, BU. 1985. Acetylenimine and binary ethylenimine as inactivants for foot-and-mouth disease virus vaccines.** *Indian Veterinary Journal*, 62: 8, 635-642; 17 ref.

The rates of inactivation of foot-and-mouth disease virus (FMDV) types O, A, C and Asia-1 vaccine strains grown in BHK21, suspension cell culture system were determined with 0.05% N-acetylenimine (AEI) at 4, 25 and 37°C. At 25 and 37°C AEI inactivated all four strains according to first-order kinetics. The complement fixing (CF) antigen was not affected by AEI and binary ethylenimine (BEI) inactivation. Experimental vaccines prepared with FMDV inactivated by AEI and BEI were comparable in their potency in guinea-pigs to vaccines prepared with formaldehyde.

**2377 GOEL, AC; RAI, A. 1983. Characterization of aphthovirus subtype Asia 1/2 recovered in India and development and potency testing of a highly concentrated purified vaccine.** *Revue Scientifique et Technique, Office International des Epizooties*, 2: 4, 1049-1058; 8 ref.

Aphthovirus subtype Asia 1/2 (strain India 21/80) recovered in India was further characterized by micro-neutralization guinea-pig protection and challenge tests in cattle. These tests confirmed it to differ from subtype Asia 1/1 and corroborated the results of microcomplement fixation tests. It multiplied to high titre in BHK21 cell culture. A PEG-concentrated vaccine was prepared and when tested in cattle proved to be highly immunogenic and protective in a 1 ml dose.

**2378 GOEL, AC; RAI, A. 1985. Growth curve, plaque assay and inactivation studies of FMD virus subtypes O5, O1 and O6 of Indian origin.** *Indian Journal of Comparative Microbiology, Immunology and Infectious Diseases*, 6: 1, 16-28; 15 ref.

Following passage in BHK21 clone 13 monolayer cell culture, all three subtype isolates produced a characteristic cytopathic effect and became adapted to the cells after 3-5 passages. Peak titres were reached 24 h after infection, O5 and O6 reaching 7.2 TCID<sub>50</sub>/ml and O1 reaching 6.2 TCID<sub>50</sub>/ml. O6 is the subtype currently encountered in India and the titre was acceptable for vaccine production. All isolates produced plaques under agarose overlay 48 h after infection, O1 and O5 plaques being 1 mm in diameter and O6 2 mm. Plaque size in relation to pathogenicity and immunogenic potential is discussed. All 3 isolates were completely inactivated by acetylenimine after 9-12 hours, while inactivation using formaldehyde and heat was incomplete after 48 h.

**2379** LAL, SM; VASANTHIA, S; KHAN, SK; BABBAR, OP. 1983. **Nature of inhibition of foot and mouth disease virus (FMDV) in cell cultures and in vivo by chick interferon.** *Indian Journal of Comparative Microbiology, Immunology and Infectious Diseases*, 4: 4, 229-234; 18 ref.

Treatment of BHK21 (Razi) cells with chick interferon would neither inhibit the uptake of 3 vaccine strains (type O, A and C) of aphthovirus nor their intracellular disintegration, but it seemed to block of viral replication. In the in vivo system, repeated doses of interferon protected some guinea pigs from the primary as well as secondary lesions of a virulent (type O) strain.

**2380** MISRA, LD; SEN, AK; NAIR, SP; RAO, BU. 1985. **Production of foot and mouth disease virus inactivated vaccine using suspension cell culture in fermenter.** *Indian Veterinary Journal*, 62: 6, 453-457; 3 ref.

The fermenter technique was used for large scale cultivation of BHK21 suspension cell cultures. Observations on 231 fermenter runs over a period of three years revealed that the optimum initial concentration of cells in 300 litres of suspension needs to be maintained between 0.4 and 0.9 million cells/ml so that the final concentration of 1.75 to 1.9 million cells/ml can be obtained within 24 to 27 h of cultivation (the shortest optimum time). It was evident from 85 batches of virus (600 litres each) that a cell concentration of 1.6 to 2 million/ml was optimum for virus multiplication. The viral antigen from these batches was used for vaccine production. All except two batches of Asia-1 vaccine were potent.

**2381** NAIR, SP. 1985. **Studies on the stability of foot and mouth disease virus grown in BHK21 cells under different pH levels.** *Indian Veterinary Journal*, 62: 2, 104-108; 12 ref.

Aphthovirus is sensitive to pH and this work showed that vaccine strains of types O, A, C and Asia 1 of BHK were most stable at pH 7.5 to 7.8.

**2382** SARMA, G; KUMAR, S; LAL, SM. 1983. **Foot-and-mouth disease virus production in BHK21 suspension cell cultures using polyethylene glycol treated bovine serum.** *Indian Veterinary Medical Journal*, 7: 2, 65-69; 16 ref.

Viral multiplication in suspension cultures of hamster kidney cells was poor when serum was not added to the growth medium and was also poor when 2% pooled bovine serum containing a high titre of aphthovirus neutralizing antibody was added. A good yield of virus

was achieved when serum treated with polyethylene glycol (to remove neutralizing antibody) was added to the medium.

**2383** SHARMA, R; KUMAR, A; AHUJA, KL; PRASAD, S. 1985. **Recovery of foot-and-mouth disease virus in bovine kidney cell culture system.** *Indian Journal of Virology*, 1: 1, 87-91; 5 ref.

Aphthovirus of types O22, C3 and Asia 1 was recovered from 28 of 100 field samples by means of a cytopathic effect in cell culture.

**2384** SHARMA, RN; RAO, BU. 1983. **Studies on the adaptability of foot-and-mouth disease virus type 'C' in different cell-cultures and host systems.** *Indian Journal of Animal Sciences*, 53: 9, 957-960; 15 ref.

All 12 isolates of FMD virus type C could be propagated and adapted easily in BHK21 clone13 cell-line and primary renal epithelial monolayer cultures derived from calf (BK) and kid (KK). The infectivity titre values were higher in BHK21 and BK cell-systems and lower in KK cell-system. The virus isolates produced large plaques of 3-5 mm size with irregular outline. The titre ranged from log 6.12 to 7.30 pfu/ml. The complement-fixing titre of virus isolates at passage 9 ranged from 1:2 to 1:4 by 100% end-point fixation test. All the virus isolates could be easily adapted to grow in guinea pigs. Generalized lesions could be seen from the fifth serial passage, but they could not be adapted to grow in adult mice beyond the age of 20 days.

**2385** SURYANARAYANA, VVS; RAO, BU; PADAYATTY, JD. 1985. **Cloning and expression of the cDNA for the major antigen of foot and mouth disease virus type Asia I 63/72.** *Current Science*, 54: 20, 1044-1048; 24 ref.

A double-stranded cDNA of the virus was prepared and cloned in an expression vector pUR222 at the BamHI and PstI sites. Sandwich enzyme linked immunosorbent assay showed that the major antigen was expressed. The procedure seemed to be a simple, efficient method of producing the major antigen protein of aphthovirus in large quantities.

**2386** SURYANARAYANA, VVS; BANUMATHI, N; RAO, BU. 1986. **Hexokinase activity as marker to assess time of harvest of foot-and-mouth disease virus in BHK21 CI13 cell cultures.** *Biotechnology and Bioengineering*, 28: 4, 613-615; 13 ref.

Hexokinase activity, measured by spectrophotometry in a coupled reaction with glucose-6-phosphate dehydrogenase, was detected in supernatants of aphthovirus

infected BHK21C113 cell suspensions and anchored cell cultures at a minimum of 104/ml infective virus particles. Enzyme activity was correlated with virus titre measured by TCID50, 1465 particle concentration and enzyme linked immunosorbent assay.

**2387 TEWARI, SC; RAO, BU. 1983. Factors affecting recovery of virus from oesophageal-pharyngeal fluid samples of foot-and-mouth-disease carrier cattle. *Indian Journal of Animal Sciences*, 53: 5, 488-493; 16 ref.**

The rate of recovery of aphthovirus was improved by diluting samples of oesophageal-pharyngeal fluid with Hank's solution plus 0.5% lactalbumin hydrolysate and glycerol (instead of phosphate buffer), followed by homogenization with fluorocarbon (method of P. Suttmoller and G.E. Cottral, 1967). Primary monolayer cultures of bovine thyroid cells detected type C virus better than bovine kidney or BHK-21 cells.

**2388 VASANTHA, S; ANTONY, A; LAL, SM. 1986. Comparative studies on growth of foot-and-mouth disease virus types 0 and Asia 1 in BHK-21 Razi cells. *Acta Virologica*, 30: 5, 367-372; 11 ref.**

In BHK-21 Razi cells, type O virus grew in high titre, and Asia 1 virus was produced in low titre. Inhibition of host protein synthesis in type O virus-infected cells was more pronounced than in Asia 1 virus-infected cells. Foot and mouth disease virus type O infected cells showed higher lactic dehydrogenase activity when compared to Asia 1 virus. A significant decrease in virus yield was observed when actinomycin D was added at 50 µg/ml to infected cells.

## **Theileria annulata**

**2389 CHAUDHRI, SS; SUBRAMANIAN, G. 1991. Immunoprophylaxis against *Theileria annulata* with protein from plasma membrane of infected lymphoblasts. *Veterinary Parasitology*, 39: 1-2, 53-60; 25 ref.**

Cross-bred (*Bos taurus* male X *Bos indicus* female) calves were protected against the homologous sporozoite-induced challenge of *Theileria annulata* when immunised with protein from the plasma membrane of macroschizont-infected lymphoblasts of allogeneic origin. However, such protection was parasite-strain specific with the plasma membrane originating from lymphoblasts infected and transformed by the same isolate of *T. annulata* sporozoites. No protection ensued when the infected lymphoblasts and sporozoites were from immunologically different isolates of *T. annulata*. There was enhanced proliferation of cells and evidence

for lymphokine, originating from antigen-sensitised lymphocytes, demonstrable as macrophage migration inhibition factor in peripheral blood lymphocytes of the calves immunised by plasma membrane protein and challenged by sporozoites of homologous origin.

**2390 SHARMA, RD; BROWN, CGD. 1983. Characterization of lymphoblastoid cell lines infected with *Theileria annulata* with different ways of prolonged cultivation for a vaccine. *Haemoprotozoan diseases of domestic animals: Proceedings of seminar - CwVA Asian/Australian regions*. (Hissar: 1980: Oct 27-Nov 1)/edited by OP Gautam, RD Sharma, S Dhar. Dep. of Vet. Med., Haryana Agric. Univ., Hissar-125004, India. p. 87-88.**

Isolates of *T. annulata* macroschizonts in lymphoblastoid cell lines were cultured for long periods with different seeding rates and intervals of subculturing. The cultures were used to compare rates of attenuation of virulence and alteration of immunogenicity, growth characteristics, cryopreservation techniques and isoenzyme activity.

**2391 SHARMA, RD; BROWN, CGD. 1983. Isolation, in-vitro establishment and cryopreservation of lymphoblastoid cell cultures infected with *Theileria annulata*. *Haemoprotozoan diseases of domestic animals: Proceedings of the Seminar - CwVA Asian/Australian regions*. (Hissar: 1980 : Oct 27 - Nov 1)/edited by OP Gautam, RD Sharma, S Dhar. Haryana Agric. Univ., Hissar-125004, India. p. 85-86.**

Techniques for the isolation of *T. annulata* macroschizonts, for the culture of *T. annulata* using transformed lymphoblastoid cell lines infected with macroschizonts and for the cryopreservation of cultures are described.

**2392 SHUKLA, PC; SHARMA, RD; NICHANI, AK. 1989. Immunization with in vitro cell cultures infected with *Theileria annulata* (Hisar) at passage P50. *Gujvet*, 16: 2, 12-15; 8 ref.**

Calves, 23-25 month-old, were divided into 4 groups and inoculated with 0, 104, 106 or 108 *T. annulata* (Hisar) which had been passaged to P50 in culture. Survivors were challenged with 30 infective *Hyalomma anatolicum* one month pi. On inoculation with the parasite, there was onset of lymphadenopathy, appearance of macroschizonts and piroplasms, and development of mild anaemia leading to mortality of 3 calves infected with 104 cells. Following challenge there was lymphadenopathy and marked anaemia with death of 2 calves (at 108 cell conc.). All calves in the control group showed clinical theileriosis following challenge, and died.

## Dairy and milk products

**2393** MATHUR, BN. 1990. **Prospects for biotechnological applications in dairy processing in industry for enhanced productivity.** *Indian Dairyman*, 42: 3, 101-106; 4 ref.

Possible uses of biotechnology to improve productivity in the dairy industry are discussed, with particular reference to the following applications: production of stable genetic recombinants of lactic starter bacteria with specific characteristics; use of immobilized enzyme reactors for producing high-fructose spray-dried whey; production of microbial polysaccharides suitable for application in cultured milk products; production of lactic acid bacteria with anticholesterolaemic or anticarcinogenic properties; production of infant formulae with enhanced bioprotective properties; and biotechnological approaches to fermented milk manufacture (including use of membrane bioreactors).

**2394** REDDY, VP; KHAN, MMH; PURUSHOTHAMAN, V. 1993. **Characterization of plasmid DNA in wild strains of lactococci isolated from raw milk.** *Milchwissenschaft*, 48: 8, 446-449.

**2395** SINGHAL, RS; SAMANT, SK; GUPTE, RK. 1990. **Biotechnology in dairy industry.** *Indian Dairyman*, 42: 9, 372-380; 68 ref.

Recent applications of biotechnology within the dairy industry are reviewed under the headings: rennet substitutes; lactose degradation; use of biological systems for the preservation of milk and milk products (lysozyme, lactoperoxidase, lactoferrin); use of liposomes in the dairy industry; accelerated ripening of cheese; production of dairy flavours; dairy starter cultures; casein modification for altering the behaviour of milk during processing; and removal of cooked flavour in processed milk.

**2396** THOMPSON, DK; MATHUR, BN. 1991. **Current status of biotechnological application in dairy industry.** *Indian Dairyman*, 43: 1, 9-11; 9 ref.

A number of examples of applications of biotechnology in the dairy and food processing industry are examined. The section headings are: genetic manipulation; dairy applications; industrial products; byproduct conversion; dairy cultures; and regulatory aspects.

**2397** VARADARAJ, MC; NAMBU DRIPAD, VKN. 1983. **Growth and production of thermostable deoxyribonuclease and enterotoxin by *Staphylococcus aureus* in milk.** *Milchwissenschaft*, 38: 1, 23-26.

Fourteen enterotoxin-producing wild strains of *Staphylococcus aureus* (isolated from khoa) and 5 standard enterotoxin-producing *S. aureus* strains grew well in cows' raw whole milk (with low bacterial counts) or in sterilized skim milk. An inoculum giving 106 c.f.u./ml milk was used and incubation was at 37°C for up to 24 h. Production of thermostable DNAase was greater in sterilized milk than in raw milk. Enterotoxins were produced by all but 1 wild strain after 24 h in sterilized milk; in raw milk only 8 of the wild strains and none of the standard strains produced their respective enterotoxins.

## SERICULTURE

### *Bombyx mori*

**2398** GEETHABALI; CHANDRASHEKAR, PM. 1989. **Glycerol formation in silkworm eggs.** *Proceedings of the Indian Academy of Sciences, Animal Sciences*, 98: 3, 187-191; 12 ref.

In a laboratory study, the temporal pattern of glycerol accumulation was examined during the early diapause period in eggs of *Bombyx mori*. Studies on the activities of 2 enzymes, NADP-dependent glycerol dehydrogenase and NAD-dependent glycerol phosphate dehydrogenase, showed that the latter may be more important than the former in the production of glycerol during diapause. It is concluded that the activity of the former may play a role in embryonic development.

**2399** KRISHNAMURTHY, NB; RAMESH, SR; RAJASEKARASETTY, MR. 1984. **Developmental profiles in the isozymes of alpha and beta-esterases in the embryogenesis of silkworm *Bombyx mori*.** *Current Science*, 53: 5, 281-284; 4 ref.

Electrophoretic analysis of the eggs of *Bombyx mori* in the laboratory in India revealed a total of 12 bands for both alpha-esterases and beta-esterases in different stages of embryogenesis, and the number of isoenzymes and their relative concentrations was found to be different in all the 8 stages analysed. These results indicate that the various isoenzymes are synthesized, in varying amounts, at different stages of embryonic development, and show subtle differences in the expression of different genes in the same race of *B. mori* during development.

**2400** LAKSHMI, SKB; RAMAIAH, TR. 1984. **Partial purification of prostaglandin synthetase from**