EFFICACY OF VITAMIN A WITH CONVENTIONAL HAEMATINICS IN ANAEMIC GOATS

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by

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CERTIFICATE – I

This is to certify that the thesis entitled **"EFFICACY OF VITAMIN A WITH CONVENTIONAL HAEMATINICS IN ANAEMIC GOATS"** submitted in partial fulfilment of the requirements for the degree of **MASTER OF VETERINARY SCIENCE AND ANIMAL HUSBANDRY** in **VETERINARY MEDICINE** of Nanaji Deshmukh Veterinary Science University, Jabalpur is a record of the bonafide research work carried out by **PANKAJ MAHORE** under my guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee and the Director Instructions.

No part of the thesis has been submitted/ published for any other degree or diploma programme. All the assistance and help received during the course of the investigation has been acknowledged by him.

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LIST OF ABBREVIATIONS

Abbreviations	Stands For
%	Per cent
≤	Equal or less than
@	At the rate of
°F	Degree Fahrenheit
>	Greater than
±	Mean and Standard Error
µl	Microlitre ($1x10^{-6}$ litre)
Ca	Calcium
CIRG	Center Institute for Research on Goat
Co	Cobalt
DAHD	Department of Animal Husbandry Dairy & Fisheries
dl	Decilitre (100 ml)
EDTA	Ethylene diamine tetra acetate
et al.	And others
Fe	Iron
fl	Femtoliter
G	Globulin
g	Gram
GI	Gastrointestinal
Hb	Haemoglobin
i.e.	That is
i.e.	That is
Kg	Kilogram
MCH	Mean corpuscular haemoglobin
MCHC	Mean corpuscular haemoglobin concentration
MCV	Mean corpuscular volume
mg	Milligram

ml	Milliliter
NDVSU	Nanaji Deshmukh Veterinary Science University
P	Phosphorus
PCV	Packed cell volume (%)
pg	Picogram
Spp.	Species
TEC	Total erythrocyte count
I.U.	International unit of enzyme
ug/ml	Microgram per milliliter
Vit.	Vitamin
Zn	Zinc
Mn	Magnese
Na	Sodium
K	Potassium
Cu	Copper
mcg	Microgram
S.E.	Standard error
EPG	Egg per gram
B.wt.	Body weight
Zn	Zink
Ca	Calcium
P	Phosphorus
BCS	Body condition score

1. INTRODUCTION

India contains second largest population of goat. Goat farming is one of the backbone of Indian farming industry specially in rural areas. There are over 880 million goats around the world, out of which India has over 126 million goats (14.31%) of 23 defined and non-descript breeds that are adapted efficiently in different agro-climatic conditions all over the country (CIRG, 2012). There are over 9 million goats (DAHD, 2007) in Madhya Pradesh. Sheep and goat contributes for a significant percentage (about 0.5-5.0%) to total output of livestock sector in India.

Anaemia is common and important clinical presentation in goats characterized by pale mucous membrane, exercise intolerance, weakness, tachycardia, reduced growth and body weight. It is a condition which silently kills the production capabilities and reproductive traits and suppresses the resistance power of animals. Major cause of anaemia include internal and external parasitism, haemoprotozoan diseases and nutritional deficiencies (Anumol *et al.*, 2011).

The blood sucking lice are permanent, host specific ectoparasites of mammals. They can be responsible for economic losses by inducing patho-physiological changes in their hosts, *i.e.* weight loss, hide demage and mild to severe anaemia, hypo-proteinaemia, nutritional deficiencies and reduced vigour (Sarkar *et al.*, 2010).

Nutritional anaemia in goats occurs due to deficiency of iron, copper and cobalt (Chaudhary *et al.*, 2008). Iron deficiency leads to clinical or subclinical anaemia, poor growth and increased susceptibility to enteric and respiratory diseases (Radostits *et al.*, 2010). Once change occurs either in mineral input or its utilization, the whole animal profile gets disorted which can result in anaemia. Copper is required for cellular respiration, blood formation, proper cardiac function, connective tissue development, myelination of spinal cord, keratinization and tissue pigmentation. The only known function of cobalt (Co) is its participation in metabolism as a component of vitamin B_{12}, thus the sign of Co deficiency are in reality signs of deficiency of this vitamin.

It promotes red blood cell synthesis and maintains nervous system integrity (Singh *et al.*, 2007). In ruminants, vitamin B_{12} is synthesized by rumen microflora where Co is essential for maintenance of normal number and type of these microflora (Sharmin *et al.*, 2004).

Vitamin A, a fat soluble vitamin, is necessary for the maintenance and functioning of many body tissues especially for growth and proliferation of epithelial cells. Prolonged vitamin A deficiency in animals negatively affects haemopoiesis, with gradual replacement of bone marrow by fibrous tissue (Hodge *et al.*, 1978). Vitamin A appears to be involved in pathogenesis of anaemia by diverse biological mechanism, such as the enhancement of growth and differentiation of erythrocyte progenitor cells, potentiation of immunity to infection and reduction of anaemia of infection and mobilization of iron stores from tissues (Semba and Bloem, 2002). Vitamin A treatment increases the production of erythropoietin and mobilizes iron from existing stores to support increased erythropoiesis (Zimmermann *et al.*, 2006). Strong correlation between vitamin A status and haemoglobin level have been demonstrated. Supplementation study with vitamin A alone reported a beneficial effect on haematopoiesis and haemoglobin status. Keeping in view of the above facts, the work was proposed with following objectives:

- To study the incidence of anaemia in adult goats.
- To study the efficacy of vitamin A with conventional haematinics in anaemic goats.

2. REVIEW OF LITERATURE

2.1 Prevalence

Kumar *et al.* (1994) reported that the prevalence of two phthirapteran species, *Bovicola caprae* and *Linognathus africanus*, in 1048 goats from Dehradun (India) was 79.20 and 38.00 per cent, respectively. Prevalence of both species was higher on visibly weaker and less hairy goats.

Machinder (1998) recorded overall incidence in 214 goats, of which 15.83 per cent suffered from anemia. The highest incidence of anaemia was recorded due to helminth parasites (7.64%) followed by nutritional deficiency (5.12%) and haemoprotozoan infection (2.56%). Age wise 6-9 months of age (25.00%) followed by 9-12 months (16.66%) and above 12 months (11.34%), respectively.

Saleem (2000) recorded overall incidence of anaemia in out of 270 goats screened as 18.88 per cent. The highest incidence was recorded due to endoparasitic infestation (11.85%), followed by ectoparasitic infestation (3.70%) and nutritional deficiency (3.33%), respectively. Age wise incidence was highest in 6-12 months (27.27%), 12-24 months (21.15%), 24-36 months (20%) and 36 months and above age (6.25%), respectively.

Rajkhowa and Hazarika (2002) studied effect of age, sex and season on the prevalence of anaemia in goats. Out of 198 goats examined, 96 were found to be positive for anaemic conditions showing an overall incidence as 48.80 per cent. Prevalence of anaemia was highest in goats aged 7 months to 1 year (79.24%) followed by 3 to 6 months (54.34%), 1 to 2 years (36.00%) and lowest in goats aged above 2 years (22.44%). The overall prevalence of anaemia was non-significant (50.00%) in female as compared to male (46.87%).

Shinde and Rajguru (2009) studied overall prevalence of parasitic anaemia in goats as 20.68 per cent in Maharashtra, India.

Sarkar *et al.* (2010) studied epidemiology and pathology of ectoparasitic infestations in Black Bengal goats in different areas of Mymensingh and Gaibandha districts, Bangladesh from December, 2006 to

November, 2007. A total of 125 Black Bengal goats were examined. Among them 91 (72.80%) were infested with one or more species of ectoparasites. Six species of ectoparasites were identified, of which four species were arachnids, namely *Heamaphysalis bispinosa* (34.40%), *Boophilus microplus* (27.20%), *Rhipicephalus sanguineus* (7.20%), and *Psoroptes cuniculi* (5.60%) and two species belonged to the class Insecta namely *Damalinia caprae* (20.80%) and *Linognathus stenopsis* (18.40%).

Singh *et al.* (2010) conducted a survey on 96 goats, raised in different farms in Jammu, India. After screening, 29 were found anaemic (30.20%).

Anumol *et al.* (2011) studied 250 anaemic goats and found 102 (40.80%) were having endoparasitic infestation, 54 (21.60%) were infested with ectoparasites and 20 (8.00%) were infested with coccidiosis. Haemoparasitic infestation was noticed in 67 (26.80%) animals and 7 (2.80%) were not having any parasitic infestation.

Shalini (2011) studied the prevalence of anaemia in goats. Out of 58, 24 goats were found positive for anaemic condition showing overall prevalence as 41.37 per cent. The highest incidence of anaemia was recorded due to nutritional deficiency (27.51%) followed by endoparasitic (10.34 %) and ectoparasitic infestations (3.45%).

Anumol *et al.* (2012) studied the prevalence of endoparasites in anaemic goats. Out of 250 anaemic goats subjected to detailed faecal sample examination, 122 (48.80%) exhibited one or more endoparasitic infestation.

Giri *et al.* (2013) conducted a prevalence study on caprine pediculosis. The screening revealed an overall 49.98 per cent prevalence of pediculosis in indigenous goat population. The prevalence of lice was higher in female (53.49%) than the male (43.70%).

Padmaja *et al.* (2013) recorded prevalence of dermatological disorders in caprine. Out of 850 goats examined, 190 (22.35%) had dermatological disorders of different causes. Amongst the dermatological disorders identified, tick infestation (29.47%) was highest followed by lice infestation (18.42%), allergic dermatitis (13.16%), scabies (11.05%),

contagious ecthyma (8.95%), goat pox (7.89%), impetigo (6.32%), demodicosis (3.16%), dermoid cyst (1.05%) and udder papillomatosis (0.53%).

Sharma (2013) found an overall prevalence of GI nematode infestation in goats as 85.42 per cent in Jabalpur.

Singh *et al.* (2013) studied the prevalence of gastrointestinal parasitism in sheep and goats in and around Mathura, India. Out of 190 goat sample processed, 131 samples were found positive for GI parasites.

Iqbal *et al.* (2014) studied the prevalence and impact of ectoparasitic fauna infesting goats (*Capra hircus*) of district Toba Tek Singh, Punjab, Pakistan. Overall prevalence was found 11.14 per cent (448/4020). Among various ectoparasites, ticks (33.58%) were found predominant as compared to lice (9.58%), fleas (6.84%), mites (3.23%) and flies (2.49%).

2.2 Clinical Examination

Green *et al.* (1993) detected anaemia in housed lambs by clinical and haematological investigation. Conjunctival pallor was used as a clinical test for anaemia and the results indicated that this had high specificity (91-95%) and low sensitivity (53-55%).

Satale (2001) observed reduced appetite, pallor of mucous membrane, ruffled hair coat, loss in body weight, exercise intolerance and skin tucked to bones (hide and skin condition) in anaemic goats.

Dede *et at.* (2003) studied alterations in the serum concentration of Cu, Zn, Ca and P in 20 goats naturally infested with lice and 10 healthy goats. Hair loss, anaemia, cachexia and anorexia were observed in infected goats.

Villaquiran *et al.* (2004) evaluated Body Condition Score (BCS) for health assessment in goats, ranging 1.0 to 5.0. A BCS of 1.0 is a extremely thin goat with no fat reserves and a BCS of 5.0 is a very obese condition goat. BCS of 1.0, 1.5, or 2.0 indicate a management or health problem.

Islam *et al.* (2005) evaluated the efficacy of haematinics viz., copper sulphate, ferrous sulphate and cobalt sulphate on general body conditions and some haematological parameters in sheep and goats and observed that there was gain in weight after the treatment.

Petkov *et al.* (2005) studied clinical morphological effects of enzootic ataxia in adult goats and new born kids in Bulgaria. They recorded a fall in body temperature, increased heart and respiration rate.

Anish *et al.* (2006) observed that the kids with severe cat flea infestation particularly on the chest, abdomen and legs were restless, weak, had poor growth rate and a dull rough coat.

Shinde (2007) observed elevated respiratory and pulse rate, pallor conjunctival mucous membrane, loss of appetite followed by rough and scaly skin coat, decreased body weight, exercise intolerance and emaciation. Qualitative and quantitative coprological examination revealed prevalence of gastrointestinal nematodes in and around Hyderabad as 43.10 per cent in goats.

Puri *et al.* (2008) observed a anaemic goat suffering with helminthiasis that exhibited the signs of anorexia, weakness, diarrhoea muscular weakness, dullness, rough body coat, depression and emaciation. On clinical examination the goat had normal rectal temperature and respiration, elevated heart rate 110/minute, pale mucous membrane of conjunctivae and gums.

Radostits *et al.* (2010) reported normal values of temperature, respiration and pulse rate in goats as 103.0 °F, 25-30/minute and 70-90/minute, respectively.

Bahrami *et al.* (2011) studied that helminthes are an important cause for reducing the body weight and producing the disease, anaemia in young or debilitated animals.

Shalini (2011) observed major clinical signs in anaemic goats were pallor mucosae of conjunctivae, loss of appetite, exercise intolerance, emaciation, rough skin coat, tachycardia and tachypnoea.

Goklaney *et al.* (2012) conducted experiment on 8 weak and anaemic goats. The animals exhibited pale mucous conjunctivae, rough hair coat, dullness, depression, tachycardia and pulse with large amplitude. The mean rectal temperature, pulse and respiration rate in anemic goats were 104.02±0.24 °F, 89.00±0.84 rate/minute and 27.37±0.94 rate/minute, respectively.

2.3 Haemoglobin, Total erythrocyte count, Packed cell volume, MCV, MCH and MCHC

Machinder (1998) recorded the mean value of MCV, MCH and MCHC in caprine anaemia due to helminthiasis as 28.22±0.63 fl, 7.90±0.26 pg and 28.22±0.88 per cent respectively.

Sandhu *et al.* (2001) evaluated the physiological and haemato-biochemical indices in apparently healthy goats maintained on wheat straw mixed with starch and urea. The analysis revealed overall means of MCV, MCH and MCHC as 25.01±10.90 fl, 7.85±0.13 pg and 33.05±2.05 per cent, respectively.

Islam *et al.* (2005) evaluated the efficacy of haematinics viz., copper sulphate ferrous sulphate and cobalt sulphate on general body conditions and some haematological parameters in sheep and goat and observed that MCV, MCH and MCHC increased significantly to 21.88±0.16 fl, 7.28±0.05 pg and 33.3±0.09 per cent, respectively after treatment with haematinics as compared to those of control.

Shinde (2007) revealed that there was significant increase in mean value of Hb, TEC and PCV in all groups of anaemic goats treated with iron preprations.

Olayemi *et al.* (2009) conducted a study to know the effect of management practices and sex on the haematological parameters of the West African Dwarf goat. Haematological values of this breed of goat were evaluated under the intensive and extensive systems of management. The MCV 22.17±2.53 fl and MCH 6.92±0.98 pg were significantly higher ($p<0.01$) in the intensively managed goats. The MCHC was similar in both the groups.

Singh *et al.* (2010) studied mean value for Hb and PCV of anaemic goats. They were 6.49±0.30 g/dl and 21.50±0.28 per cent respectively and increased significantly to 7.43±0.12 g/dl and 27.0±1.00 per cent respectively after iron (Iron Sorbitol+Folic acid+Vit.B_{12}) administration.

Goklaney *et al.* (2011) observed a significant decrease in Hb, PCV, TEC, MCV, MCH and MCHC in 8 goats showing symptoms of anaemia and emaciation.

Shalini (2011) reported significant increase in mean value of Hb (g/dl), PCV (%), TEC (millions/µl) and MCHC (%) of different treatment groups treated with different haematinics.

Goklaney *et al.* (2012) treated 8 weak and anaemic goats with COFECU plus one tablet given daily orally for 30 days. The haematological analysis revealed significanct lower values of Hb (7.37±0.16 g/dl), PCV (23.37±0.56%), TEC (8.12±0.18 million/µl), MCH (9.10±0.30 pg) and MCV (28.82±0.80 fl) in anaemic goats before treatment as compared to healthy goats.

Zamfirescu *et al.* (2013) observed that the Hb and PCV values were smaller in both sexes (8.18±0.27 in female and 8.2±0.17 in male) as well as the PCV (14.37±0.36 in female and 15.5±1.6 in male) on apparently healthy goats. MCHC was higher in the female than male goats (43.65±1.01 in male and 44.09±1.21 in female).

2.4 Serum total protein, serum albumin and globulin

Kumar *et al.* (2005) observed significant decrease in plasma total protein, albumin and globulin level with parasitic disease such as haemonchosis, coccidiosis, moneizia infestation and mange infestation in goats.

Tanritanir *et al.* (2009) studied some biochemical parameters and vitamins level in the hair goats naturally mix-infested with endo-ectoparasities (*Linognathus africanus* and *Trichostrongylidae spp.*). As a result, concentrations of retinol, sodium, potassium, calcium and albumin were lower ($p<0.05$) and activity of alanine aminotransferase was higher ($p<0.05$) in infested goats as compared to control group. There was no

statistically significant difference in the concentration of vitamin D_3, tocopherol, total protein, glucose and activity of aspartate aminotransferase and alkaline phosphatase between infested and control group.

Bahrami *et al.* (2011) studied nematode infestation in goats and its economic treatment. The average level of total plasma protein in control group was 7.99±0.70 g/dl and in treatment group was 6.57±0.34 g/dl. The level of total protein was 15 per cent lower in treatment group. Hypo-proteinaemia was statistically significant.

Goklaney *et al.* (2011) observed a significant decrease in serum total protein, albumin, globulin, albumin globulin ratio and blood glucose in anaemic goats.

Bordoloi *et al.* (2012) observed change in the haemato-biochemical pattern due to experimentally induced haemonchosis in Sahabadi sheep. There was a significant decrease in Hb, PCV, TEC and serum protein concentration (serum albumin and serum globulin).

Goklaney *et al.* (2012) observed the values of total serum protein (5.42±0.19), albumin (2.28±0.02) and albumin globulin ratio (0.74±0.04) in anaemic goats were ($p<0.01$) lower as compared to healthy control.

Sharma and Puri (2013) worked on 300 Marwari goats of both sexes 0-3 years of age to study the changes in serum total protein, albumin, globulin, albumin globulin ratio, urea, creatinine and total bilirubin during extreme hot and moderate climatic conditions. Overall mean values of total protein (g/dl), albumin (g/dl), globulin(g/dl), albumin globulin ratio and urea (mg/dl), creatinine (mg/dl) and bilirubin (mg/dl) were 4.41±0.04, 2.62±0.04, 1.75±0.02, 1.65±0.05, 26.29±0.53, 0.73±0.02 and 0.10±0.003, respectively. Climatic conditions had significant ($p<0.05$) effect on serum creatinine and bilirubin. Significant ($p<0.05$) effect was observed in serum globulin, creatinine and bilirubin in moderate and total protein in extreme climatic conditions in sex groups, however, globulin and albumin globulin ratio was significantly ($p<0.05$) affected in extreme hot conditions.

Iqbal *et al.* (2014) studied the prevalence and impact of ectoparasitic fauna infesting goats (*Capra hircus*) of district Toba Tek Singh, Punjab, Pakistan. Comparison of hematological parameters (Hb, PCV and TEC) showed remarkable differences between infested and non-infested animals, in the form of low values for infested animals. The values of biochemical parameters (total protein, albumin and globulin) increased due to infestation.

2.5 Serum iron

Machinder (1998) reported that the serum iron value in caprine anaemia due to helminthiasis was 131.33 µg/dl.

Satale (2001) recorded significant decrease in serum iron in goats suffering from ecto-endoparasitic infestation, which increased after treatment with ferrous sulphate to mean serum iron 111.66±3.92 µg/dl.

Ghosh *et al.* (2002) studied blood biochemical profile in Black Bengal goats under grazing area of hills and tarai regions of West Bengal. They revealed that the mean values of serum iron in adults 16.51±0.43 µg/ml (hilly) and 14.50±0.33 mg/ml (tarai) differed significantly from the kids 10.23±0.41 µg/ml (hilly) and 9.68±0.35 µg/ml (tarai) in both the zones.

Dey *et al.* (2004) studied that plasma ceruloplasmin, iron, total protein and albumin were significantly decreased in anaemic goats.

Kumar *et al.* (2005) observed a significant decrease in serum iron (39.05±11.0 µg/ml) in goats in haemonchosis.

Biswas *et al.* (2006) studied serum trace elements status of Black Bengal goat in tarai and hill zone of West Bengal. Five serum trace elements *viz.* Fe, Cu, Zn, Mn and Co were estimated on 184 Black Bengal goats of tarai and hilly agro climatic zones. The mean Fe, Cu, Zn, Mn and Co values were being obtained to be 13.219±0.288, 1.295±0.072, 1.263±0.44, 1.165±0.061 and 0.328±0.027 µg/ml, respectively. Zonal variations were significant for the Fe, Cu and Zn contents, the Least Square (LS)-mean for Fe and Cu being significantly higher ($p<0.01$ and $p<0.05$ respectively) for hill goats, and the Zn value being higher ($p<0.05$) for tarai goats.

Kaneko *et al.* (2008) reported the mean levels of serum iron as 166-222 µg/dl in sheep.

Tanritanir *et al.* (2009) evaluated the change in electrolyte (Na and K) and minerals (Ca, Mg, P and Fe) and some parameters related to mineral metabolism (Iron binding capacity, transferring, ferritin, folate and vitamin B_{12}) just before and after the parturition in healthy Siit hair goats. They recorded that the serum Fe levels before parturition was 100.74±4.60 µg/dl whereas the levels increased to 126.03±10.03 µg/dl after parturition in a short span of time.

Singh *et al.* (2010) studied that iron administration was confirmed to cure anaemia as shown by the increased blood iron from 137.67±44.3 µg/dl to 231±36.4 µg/dl.

2.6 Body Weight

Sharmin *et al.* (2004) studied effect of haematinic on body weight and certain haematological values in apparently healthy Black Bengal goats and found significant improvement in body weight.

Islam *et al.* (2005) evaluated effect of haematinics on body weight and some haematological values in apparently healthy sheep and goats and found significant increase in body weight.

Yadav *et al.* (2010) studied the effect of concentrate and mineral mixture supplementation on growth performance of growing goats in Bhilwara District of Rajasthan. The group I goats under sole grazing, group II goats fed with 150 g concentrate while group III goats fed with 150 g concentrate mixture along with 10 g mineral mixture in addition to grazing for 120 days. They observed average daily weight higher in group III: 76.02±1.92 g and group II: 62.27±1.14 g as compared to group I: 39.70±1.02 g.

Ismail *et al.* (2011) studied phenotypic variation in birth and body weights of the Sudanese Desert goats. The average daily body weight gain was 54.6 g and 50.3 g for male and female respectively.

Khan and Naznin (2013) studied the live weight and live weight gain of Black Bengal and Jamunapari goat breeds by fitting the linear

regression under semi-intensive condition. The average daily weight gain from birth to weaning for male and female black Bengal goat was 35.67 and 45.94 g/day, respectively and for Jamunapari goat was 42.97 and 45.47 g/day, respectively.

2.7 Treatment

Casal *et al.* (1998) studied that vitamin A improves iron absorption from intestine in human.

Beard and Ross (2002) observed role of vitamin A in haemopoiesis in rat.

Semba and Bloem (2002) studied that supplementation with vitamin A alone had beneficial effect on haematopoiesis and haemoglobin status in pregnant women.

Dey *et al.* (2004) studied plasma ceruloplasmin, iron, total protein and albumin were significantly decreased in anaemic goats and also significantly increased in ferrous sulphate treatment.

Sharmin *et al.* (2004) studied effect of haematinic on body weight and certain haematological values and found significant improvement in general health condition as well as the haematological parameters.

Islam *et al.* (2005) revealed that body weight gained, TEC, Hb, PCV, MCV, MCH and MCHC were increased significantly in goats administered with haematinic (ferrous sulphate, copper sulphate and cobalt sulphate) compared to those of the control.

Zimmermann *et al.* (2006) studied that vitamin A supplementation mobilizes the iron from existing stores to support increased erythropoiesis, an effect likely mediated by increases in circulating erythropoietin.

Singh *et al.* (2010) studied that the mean value for Hb and PCV of anaemic goat which were 6.49±0.30 g/dl and 21.50±0.28 per cent, respectively increased significantly to 7.43±0.12 g/dl and 27.0±1.00 per cent, respectively after iron (Iron Sorbitol+Folic acid+Vit.B_{12}) administration.

Yadav *et al.* (2010) studied the effect of concentrate and mineral mixture supplementation on growth performance of growing goats in Bhilwara District of Rajasthan. The group I goats under sole grazing, group II goats fed with 150 g concentrate while group III goats fed with 150 g concentrate mixture along with 10 g mineral mixture in addition to grazing for 120 days. They observed average daily weight higher in group III: 76.02±1.92 g and group II: 62.27±1.14 g as compared to group I: 39.70±1.02 g.

Goklaney *et al.* (2011) studied therapeutic response to iron preparation (Iron Sorbitol+Folic acid+Vit.B_{12}) with oral haematinics resulted in significant improvement in the haemogram of goats suffering from anaemia. Significant improvement in total serum protein and serum Cu, Co and Fe level were observed.

Shalini (2011) studied comparative evaluation of oral and parentral iron preparation in anaemic goats. The most efficacious treatment drug amongst the 3 haematinic drugs was Iron dextran given intravenously to anaemic goats of Group III followed by Fortified mineral mixture (Group I) and Haematinic combination of ferrous sulphate, copper sulphate and cobalt chloride (Group II).

Goklaney *et al.* (2012) observed significant improvement in Hb, PCV, TEC, MCV, MCH, serum copper, cobalt and iron levels after treatment with COFECU plus tablet at one for 30 days.

3. MATERIALS AND METHODS

3.1 Location and place of work

The proposed work was conducted in the Teaching Veterinary Clinical Complex (TVCC), College of Veterinary Science and Animal Husbandry, Jabalpur and Goat Farm Amanala, Jabalpur, Madhya Pradesh.

3.2 Study area

The study was conducted at Goat Farm Amanala, College of Veterinary Science and Animal Husbandry, Jabalpur.

3.3 Duration of work- 6 months (January, 2014 to June, 2014).

1. Animals

A total of 100 adult goats (above 6 month of age) were screened to know the incidence of anaemia. For therapeutic studies, 30 adult goats (comprising 6 healthy adult as control) were selected irrespective of the sex and breed.

2. Collection of epidemiological data

Breed, sex, history of deworming, feeding habits of the animals was also recorded.

3. Clinical examination

All affected goats were clinically examined for following parameters-

(i) Temperature (^{o}F)

(ii) Respiration rate (breath/minute)

(iii) Pulse rate (beat/minute)

(iv) General body condition- The body condition was recognized by body condition score (BCS) on 1 to 5 scale as thin, healthy or obese (Plate 01). BCS was studied on the basis of touching and feeling of muscle and fat over and around the lumbar area, sternum and rib cage (Villaquiran *et al.*, 2004).

Plate 01: Body condition score by touching and feeling muscle and fat at lumbar region

(v) **Colour assessment of mucous membrane-** mucous membrane of lower eye lid was examined either whitish, pale red or red.

(vi) **Clinical signs-** Poor body condition, loss of hairs and rough hair coat.

4. Collection of blood samples

Two ml blood in EDTA was collected aseptically from jugular vein of 100 goats for screening. The cases found positive for anaemia were further subjected for blood collection (2 ml in EDTA and 3 ml without anticoagulant) aseptically from jugular vein on day 0 (pre treatment) 30^{th} and 45^{th} (post treatment).

5. Confirmation of anaemic cases

Goats with PCV less than 22 per cent and Hb level lower than 7.5 g/dl were considered as anaemic (Anumol *et al.*, 2011). Detailed haematological and parasitological studies were conducted in all the anaemic cases to identify the factors associated with anaemia.

6. Studies to identify primary cause of anaemia

Faecal examination- Qualitative and quantitative examination of the sample were done on day 0 pre-treatment (Sloss *et al.*, 1994).

Blood smear examination- Peripheral blood smear from the animals were prepared, stained with Geimsa stain and examined for haemoparasites.

Skin scraping examination-Skin scraping were collected from animals and subjected for microscopic examination with 10 per cent potassium hydroxide for detection of mites.

7. Haematological studies

Following haematological parameters were measured as per the method described by Benjamin (2001).

(i) Haemoglobin concentration (g/dl).

(ii) Total erythrocyte count (millions/µl).

(iii) Packed cell volume (%)

(iv) MCV (fl), MCH (pg) and MCHC (%)

8. Biochemical analysis

Serum biochemical parameters were analyzed by commercial Erba kits with semi auto analyzer using standard protocol.

(i) Serum total protein (g/dl)

(ii) Serum albumin (g/dl)

(iii) Serum globulin (g/dl)

(iv) Albumin globulin ratio

(v) Iron (µg/ml)

Serum iron analyzed by modified method of Vogel (1968).

9. Treatment for primary cause of anaemia

Treatment of primary cause was done as per the etiological agent identified deworming with Fenbendazole @ 7.5 mg/kg body weight orally for G.I. parasitism and external application on body coat with Amitraz (12.5%) @ 2ml/liter of water for ectoparasitism.

10. Experimental design

The animals were grouped in 5 groups comprising of 6 animals in each group.

Comparative therapeutic study of different haematinics in anaemic adult goats

Groups	No. of goats	Treatment
	6	Healthy control
G-I	6	Tablet* (Copper sulphate+ Cobalt sulphate +Ferrous sulphate +Folic acid) @ one tablet daily orally for 30 days.
G-II	6	Tablet* (Copper sulphate+ Cobalt sulphate +Ferrous sulphate +Folic acid) @ one tablet daily orally for 30 days. + Injection Vitamin A @ 440 IU/kg body weight intra-muscularly at weekly interval for one month.
G-III	6	Injection** (Iron sorbital+Hydroxycobalmin+Folic acid) @ 2ml per animal intra-muscularly, two more injection at weekly interval.
G-IV	6	Injection** (Iron sorbital+Hydroxycobalmin+Folic acid) @ 2ml per animal intra-muscularly, two more injection at weekly interval. + Injection Vitamin A @ 440 IU/kg body weight intra-muscularly at weekly interval for one month.

* Each tablet contains copper sulphate 200 mg, ferrous sulphate 100 mg, cobalt sulphate 40 mg and folic acid 5 mg.

** Each 1ml contains Iron sorbital 50 mg, folic acid 500 mcg and hydroxycobalmin 50 mcg.

Statistical analysis

The data was analyzed by Analysis of Variance using Hierarical model (Snedecor and Cochran, 1994).

4. RESULTS

The incidence study was conducted to know the epidemiological pattern, extent of anaemia in goats and efficacy of vitamin A with conventional haematinics in anaemic goats.

4.1 Overall incidence

A total of 100 adult goats were screened to know the incidence of anaemia at Goat Farm Amanala from January, 2014 to June 2014. Out of 100 goats, 41 were found anaemic (having Hb<7.5 g/dl and PCV<22%), indicating an overall incidence as 41.00 per cent of anaemia during the study period (Figure 01). All of them were infested with sucking lice (*Linognathus spp.*) and endoparasites. On faecal examination out of 41, 35 exhibited EPG count more than 2000. Endoparasitic infestation were of mixed type. Ova of various species like Strongyles, *Strongyloides, Trichuris and* Amphistomes and occyst of Coccidia were detected in faecal sample goats.

4.1.1 Breed wise incidence

Out of 100 goats, 62 were of Sirohi (24 positive, *i.e.* 38.70%) and 38 were of Barbari breeds (17 positive, *i.e.* 44.70%). The incidence was higher in Barbari as compared to Sirohi goats (Table 01 and Figure 02).

Table 01: Breed wise incidence of anaemia in goats

S.No.	Breed	Total number of samples	Number of positive samples	Incidence (%)
1.	Barbari	38	17	44.7
2.	Sirohi	62	24	38.7
Total		100	41	41.0

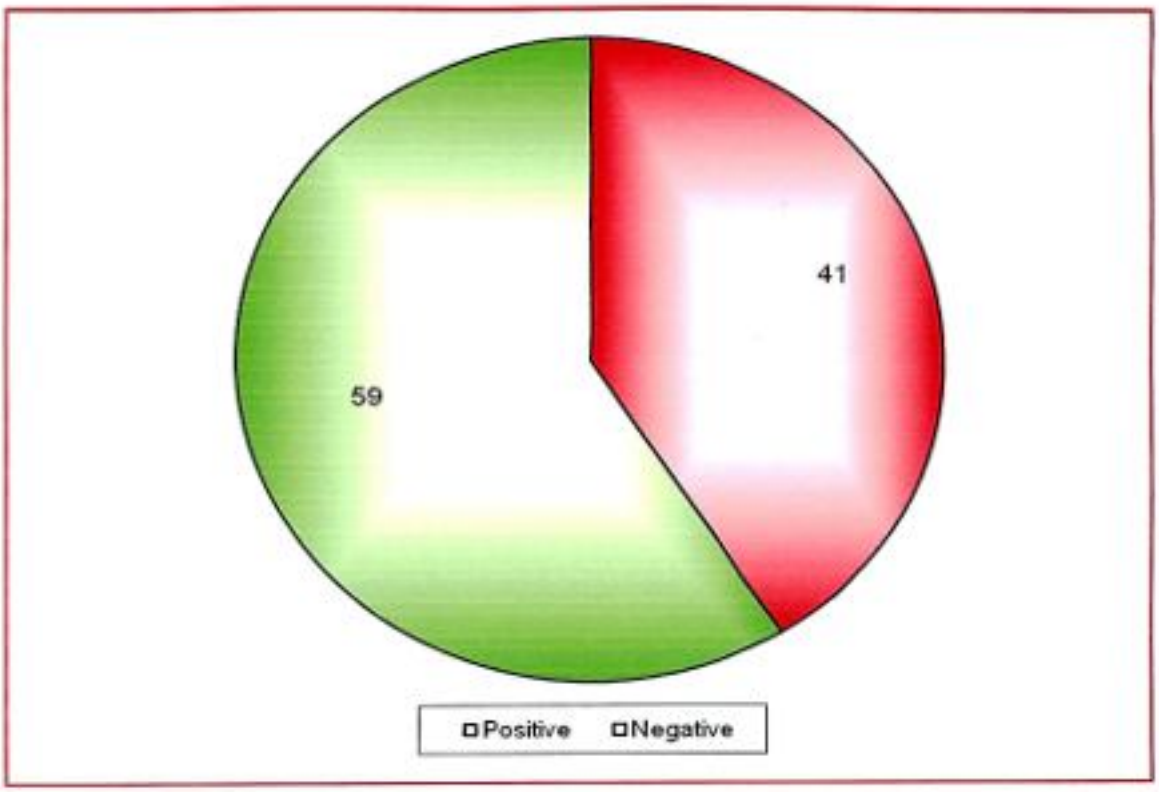

Figure 01: Overall incidence of anaemia in goats

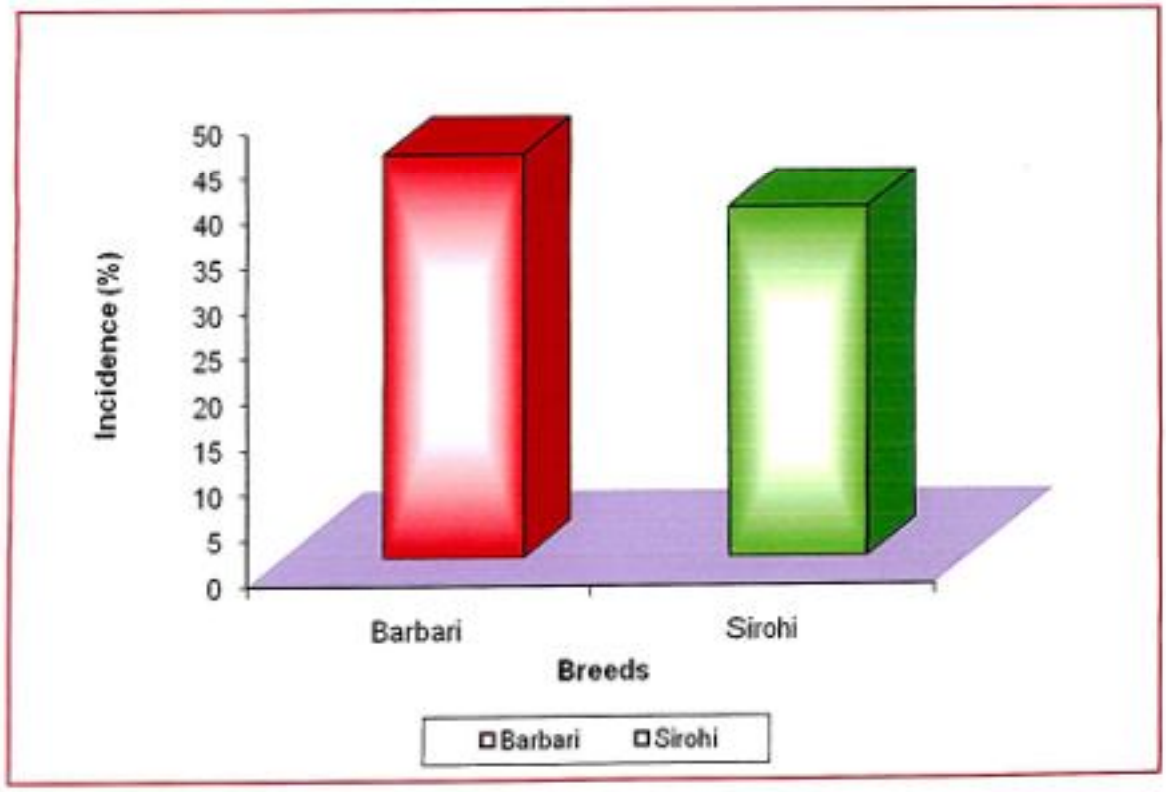

Figure 02: Breed wise incidence of anaemia in goats

4.1.2 Sex wise incidence

Out of 100 goats 27 were male (12 positive, *i.e.* 44.40%) and 73 were female (29 positive, *i.e.* 39.70%). The male was more susceptible than female (Table 02 and Figure 03).

Table 02: Sex wise incidence of anaemia in goats

S.No.	Sex	Total number of samples	Number of positive samples	Incidence (%)
1.	Male	27	12	44.4
2.	Female	73	29	39.7
Total		100	41	41.0

4.1.3 Age wise incidence

The age wise incidence presented in table 03 and graphically shown in Figure 04. Age wise incidence was highest in goats aged 6-12 months (49.00%), followed by 12-18 months (37.00%) and lowest in goats aged above 18 months (25.00%).

Table 03: Age wise incidence of anaemia in goats

S.No.	Age (months)	Total number of samples	Number of positive samples	Incidence (%)
1.	6-12	53	26	49.0
2.	12-18	27	10	37.0
3.	18 above	20	5	25.0
Total		100	41	41.0

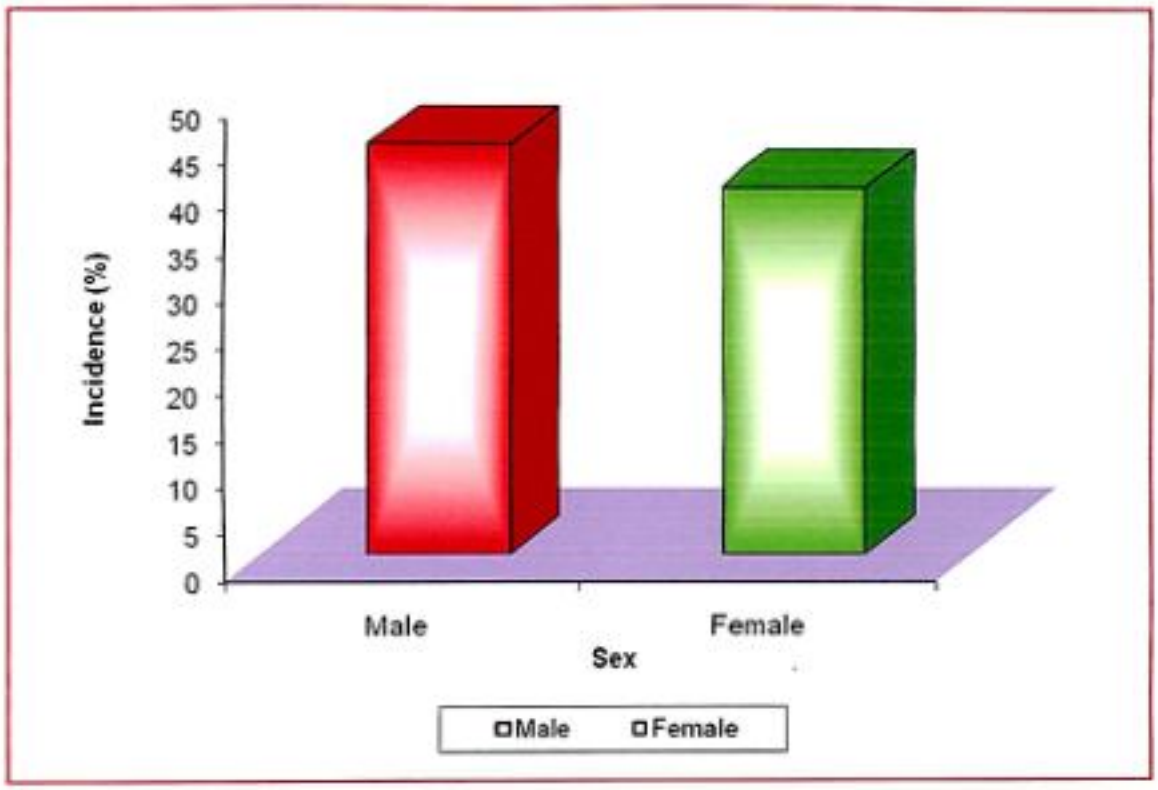

Figure 03: Sex wise incidence of anaemia in goats

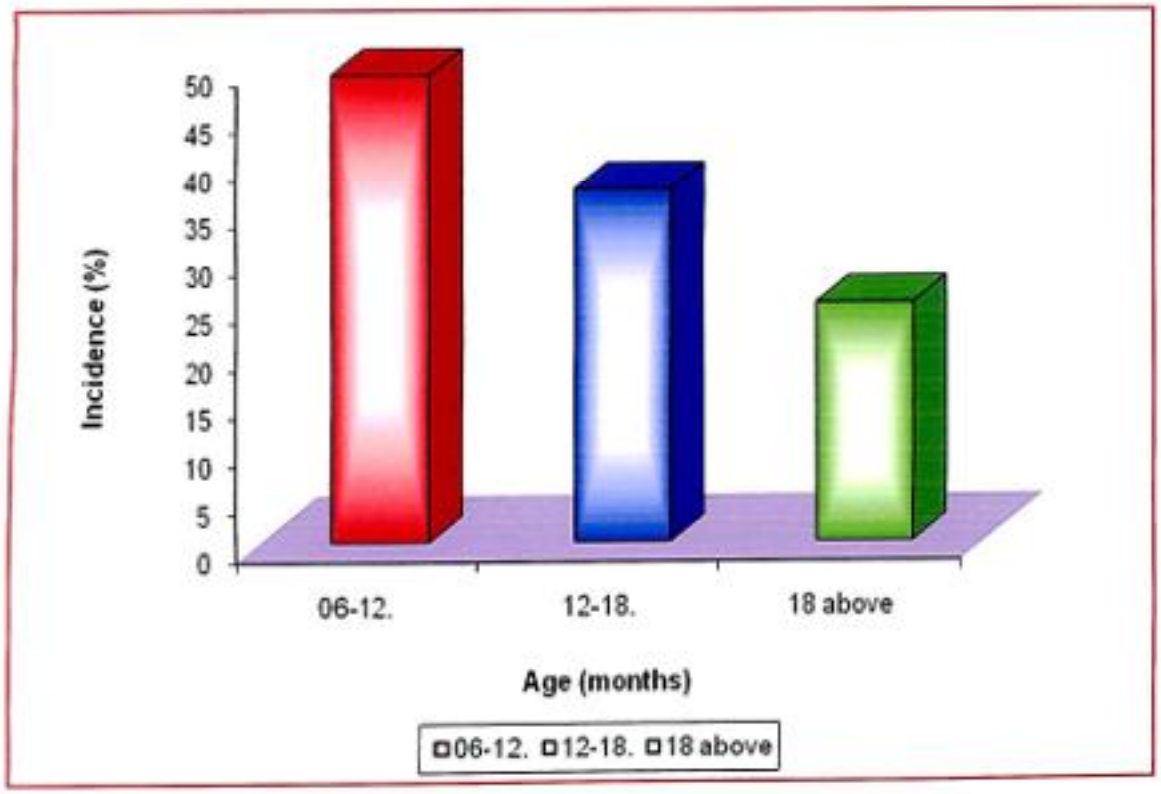

Figure 04: Age wise incidence of anaemia in goats

4.2 Clinical study

4.2.1 Temperature

Anaemic goat in group I, II, III and IV exhibited normal rectal temperature on pre and post-treatment (Table 04).

Table 04: Rectal temperature at different day intervals in different groups

Groups	Pre-treatment	Post-treatment	
	Day 0	Day 30	Day 45
Healthy control	102.8±0.26	102.7±0.20	102.7±0.24
I	102.2±0.33	102.2±0.37	102.4±0.19
II	102.0±0.42	102.3±0.29	102.5±0.21
III	101.1±0.49	101.6±0.41	101.9±0.42
IV	102.1±0.41	102.6±0.19	102.3±0.21

4.2.2 Pulse rate

Anaemic goat in group I, II, III and IV revealed mean elevated pulse rate on day 0 as compared to healthy control. The post treatment pulse rate was in normalcy in each treatment groups (Table 05).

Table 05: Pulse rate at different day intervals in different groups

Groups	Pre-treatment	Post-treatment	
	Day 0	Day 30	Day 45
Healthy control	78.5±0.84	78.8±0.60	79.1±0.91
I	84.8±1.30	80.5±0.76	80.5±1.87
II	87.0±1.46	81.6±0.61	79.6±0.66
III	86.5±1.43	81.3±0.88	88.1±0.70
IV	87.6±1.22	80.8±0.98	81.0±0.57

4.2.3 Respiration rate

Goats in treatment groups depicted tachypnoea on day 0. The respiration rate was in normal range among all treatment groups on day 30 and day 45 post-treatment (Table 06).

Table 06: Respiration rate at different day intervals in different groups

Groups	Pre-treatment	Post-treatment	
	Day 0	Day 30	Day 45
Healthy control	23.1±0.74	22.5±0.76	21.6±0.68
I	27.5±1.08	21.6±0.49	21.1±0.65
II	28.0±0.57	22.0±0.68	21.0±0.73
III	28.6±0.80	21.5±0.76	21.6±0.61
IV	28.6±1.25	21.1±0.79	21.8±0.70

4.2.4 General body condition

All the treatment groups revealed significant rise in body condition score on day 30 and day 45 post-treatment in comparision to day 0 (Table 07 and Figure 05).

Table 07: Body condition score at different day intervals in different groups

Groups	Pre-treatment	Post-treatment	
	Day 0	Day 30	Day 45
Healthy control	3.5 ± 0.22^{aA}	3.7 ± 0.21^{a}	3.8 ± 0.16^{a}
I	1.5 ± 0.22^{bB}	2.8 ± 0.16^{a}	3.0 ± 0^{a}
II	1.3 ± 0.21^{bB}	3.2 ± 0.16^{a}	3.3 ± 0.21^{a}
III	1.7 ± 0.21^{bB}	3.2 ± 0.16^{a}	3.5 ± 0.20^{a}
IV	1.7 ± 0.21^{bB}	3.5 ± 0.20^{a}	3.8 ± 0.16^{a}

The mean±SE values in the row (a, b) and column (A, B) with the same superscript did not differ significantly ($p>0.05$).

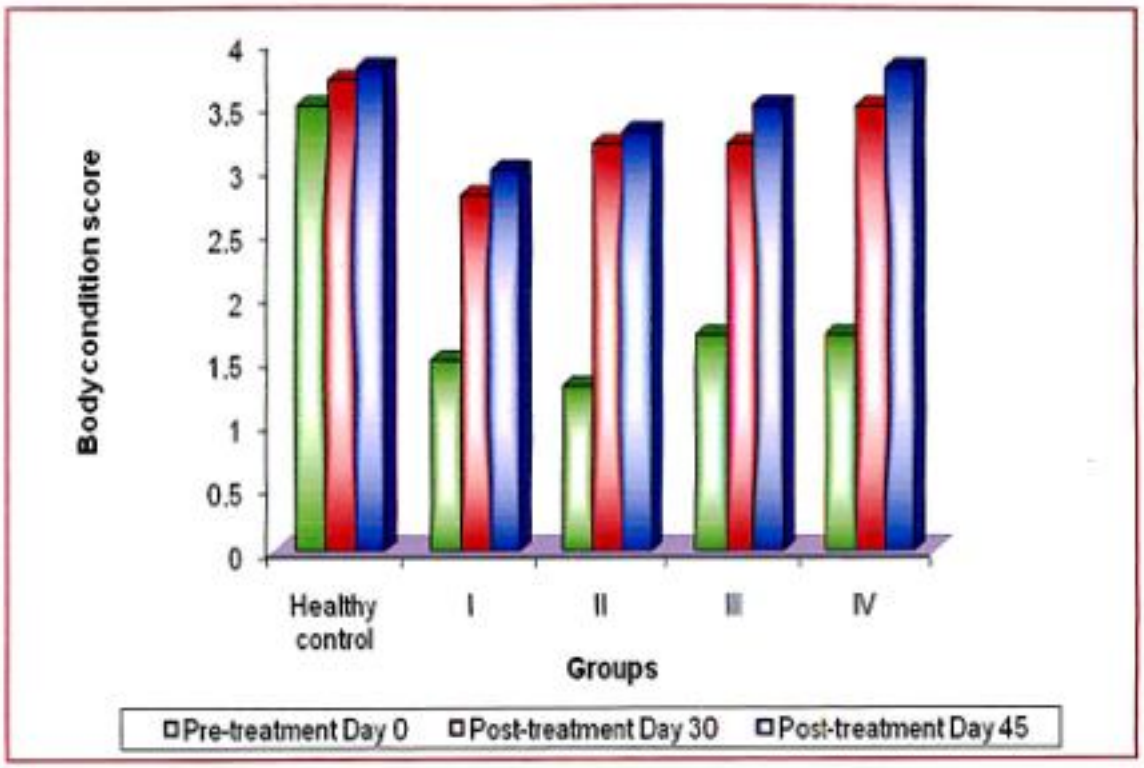

Figure 05: Body condition score at different intervals in different groups

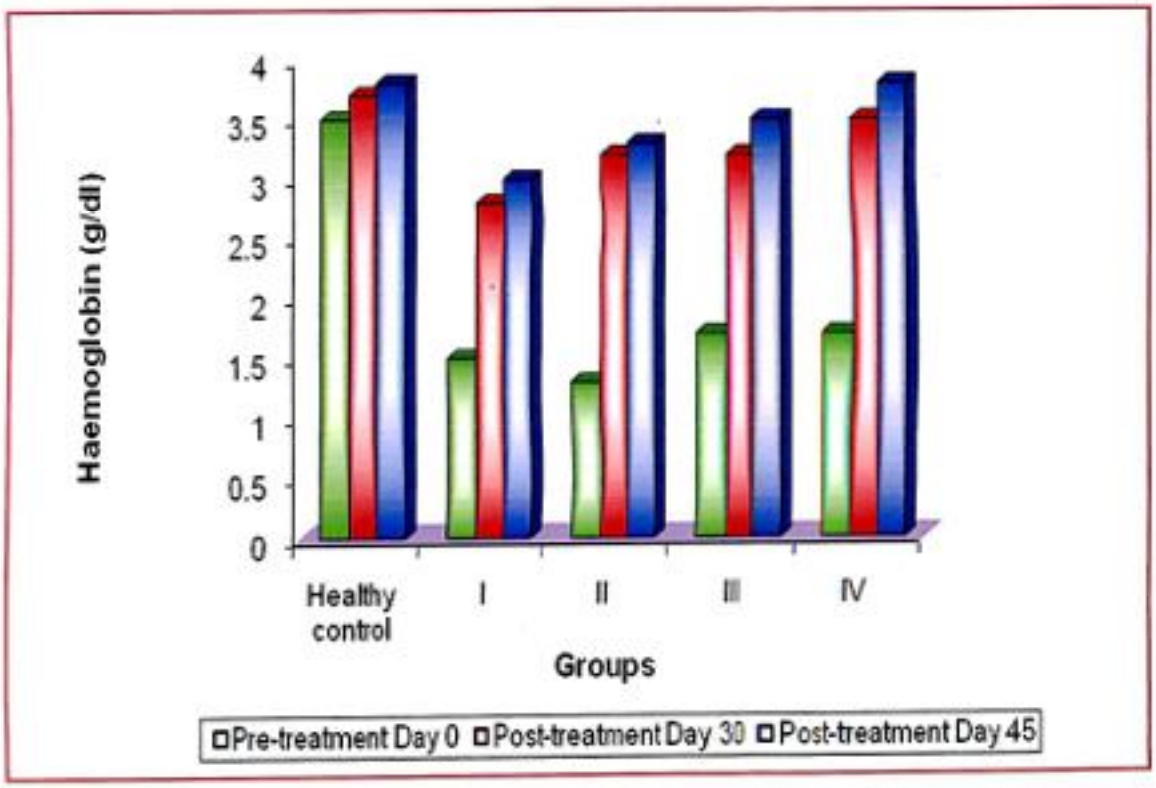

Figure 06: Haemoglobin (g/dl) at different intervals in different groups

4.2.5 The colour assessment of mucous membrane

Anaemic goats exhibited whitish, pale or light pinkish conjunctivae. After treatment conjunctivae returned to its normal pinkish colour in all treatment groups (Plate 02).

4.2.6 Clinical signs

The anaemic goats exhibited rough hair coat, loss of hair, dullness, depression and pulse with large amplitude. However, their appetite, defaecation and urination were normal. During the clinical study of 45 days all the groups of anaemic goats post therapy resumed normalcy in clinical signs (Plate 03 and 04). Among different treatment groups on the basis of clinical signs group II, III and IV showed better recovery than group I.

4.3 Haematological studies

4.3.1 Haemoglobin (Hb)

Mean values of haemoglobin concentration (g/dl) between different groups and day intervals are summarized in the table 08 and graphically shown in Figure 06. The pre-treatment mean haemoglobin concentration of anaemic goats in each treatment group were significantly lower as compared to healthy control. There was significant ($p \leq 0.05$) increase in the Hb concentration in all treatment groups on day 30 and day 45 post-treatment as compared to day 0. Group II, III and IV exihibited better response as compared to group I.

Table 08: Haemoglobin (g/dl) at different day intervals in different groups

Groups	Pre-treatment	Post-treatment	
	Day 0	Day 30	Day 45
Healthy control	10.5 ± 0.23^{abA}	9.9 ± 0.44^{b}	11.1 ± 0.32^{a}
I	5.9 ± 0.23^{cB}	7.7 ± 0.21^{b}	8.5 ± 0.21^{a}
II	5.9 ± 0.11^{cB}	8.5 ± 0.19^{b}	10.0 ± 0.22^{a}
III	5.7 ± 0.25^{cB}	8.9 ± 0.40^{b}	10.4 ± 0.21^{a}
IV	6.1 ± 0.20^{cB}	9.3 ± 0.24^{b}	11.3 ± 0.20^{a}

The mean±SE values in the row (a, b, c) and column (A, B) with the same superscript did not differ significantly ($p>0.05$).

(a) Whitish conjunctival mucosa on day 0

(b) Light pinkish conjunctival mucosa on day 30

(b) Pinkish conjunctival mucosa on day 45

Plate 02: Conjunctival mucosa

Plate 03: Goat with poor body condition on day 0

Plate 04: Goat after recovery on day 45

4.3.2 Packed cell volume (PCV)

The results of PCV for different groups and day intervals are presented in the table 09 and graphically shown in Figure 07. The present study revealed significant ($p \leq 0.05$) lower value of PCV in anaemic goats in different treatment groups when compared to healthy control on day 0. The data on variance depicted a sharp ($p \leq 0.05$) incline on day 30 and day 45 post-treatment, in each treatment group when compared to day 0. Among different treatment groups, group II, III and IV exhibited better response.

Table 09: Packed cell volume (%) at different day intervals in different groups

Groups	Pre-treatment	Post-treatment	
	Day 0	Day 30	Day 45
Healthy control	31.9 ± 1.74^{abA}	31.0 ± 1.76^{b}	33.6 ± 0.49^{a}
I	20.8 ± 0.26^{bB}	25.2 ± 0.41^{a}	27.0 ± 0.69^{a}
II	21.1 ± 0.21^{cB}	27.3 ± 0.60^{b}	30.1 ± 0.83^{a}
III	19.2 ± 0.80^{cB}	27.1 ± 0.47^{b}	30.9 ± 0.62^{a}
IV	19.5 ± 0.58^{cB}	28.2 ± 0.53^{b}	33.0 ± 0.71^{a}

The mean±SE values in the row (a, b, c) and column (A, B) with the same superscript did not differ significantly ($p > 0.05$).

4.3.3 Total erythrocyte count (TEC)

The result of TEC for various groups and day intervals are shown in the table 10 and graphically shown in Figure 08. Statistical data on variance manifested significant ($p \leq 0.05$) lower values of TEC in anaemic goats as compared to healthy control on day 0. Significant increase in TEC values were reported on day 30 and day 45 post-treatment, in each treatment group from day 0.

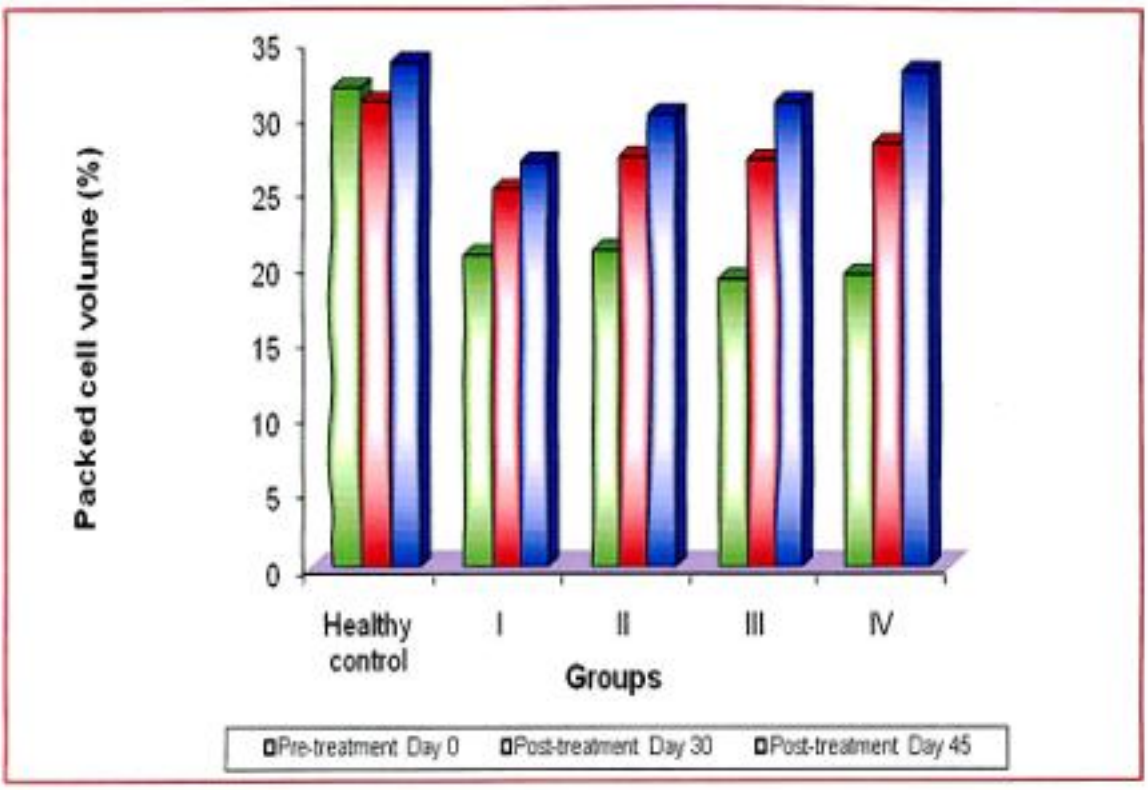

Figure 07: Packed cell volume (%) at different intervals in different groups

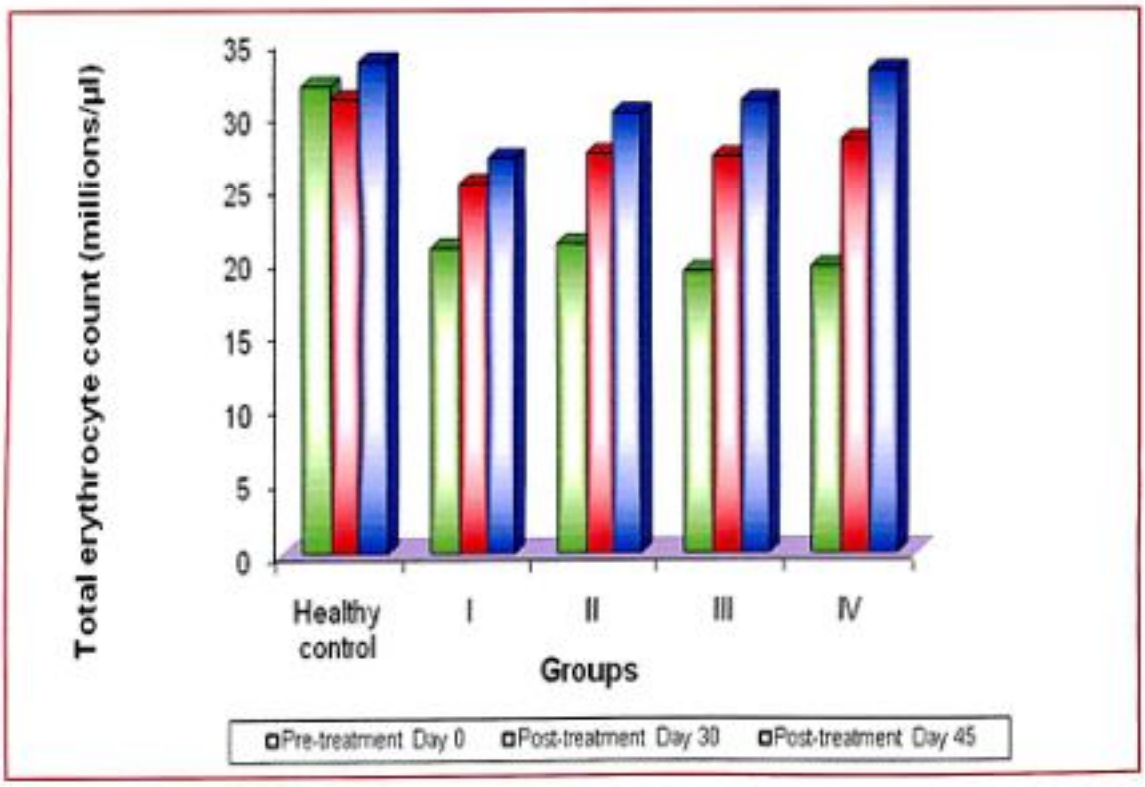

Figure 08: Total erythrocyte count (millions/µl) at different intervals in different groups

Table 10: Total erythrocyte count (millions/µl) at different day intervals in different groups

Groups	Pre-treatment	Post-treatment	
	Day 0	Day 30	Day 45
Healthy control	15.0 ± 0.34^{aA}	15.7 ± 0.36^{a}	15.7 ± 0.26^{a}
I	13.0 ± 0.19^{bB}	14.1 ± 0.27^{a}	14.6 ± 0.13^{a}
II	13.4 ± 0.17^{cB}	14.7 ± 0.19^{b}	15.8 ± 0.21^{a}
III	12.1 ± 0.29^{cC}	14.0 ± 0.27^{b}	14.9 ± 0.16^{a}
IV	13.4 ± 0.22^{cB}	15.0 ± 0.16^{b}	15.9 ± 0.17^{a}

The mean±SE values in the row (a, b, c) and column (A, B, C) with the same superscript did not differ significantly ($p>0.05$).

4.3.4 Mean corpuscular haemoglobin (MCH)

The detailed group-wise results of MCH (pg) values are presented in the table 11 and graphically shown in Figure 09. The pre-treatment mean MCH values of anaemic goats in each treatment group were significantly ($P\leq0.05$) decline as compared to healthy control. The values rose significantly ($P\leq0.05$) on day 30 and day 45 post-treatment, in each treatment group as compared to day 0. Group II, III and IV depicted significant increase on day 45, from day 30 post-treatment.

Table 11: Mean corpuscular haemoglobin (pg) at different day intervals in different groups

Groups	Pre-treatment	Post-treatment	
	Day 0	Day 30	Day 45
Healthy control	7.0 ± 0.29^{aA}	6.2 ± 0.16^{b}	7.1 ± 0.31^{a}
I	4.5 ± 0.21^{bB}	5.4 ± 0.14^{a}	5.8 ± 0.12^{a}
II	4.4 ± 0.12^{bB}	5.8 ± 0.17^{a}	6.3 ± 0.22^{a}
III	4.7 ± 0.26^{cB}	6.4 ± 0.20^{b}	7.0 ± 0.12^{a}
IV	4.5 ± 0.14^{cB}	6.2 ± 0.24^{b}	7.1 ± 0.19^{a}

The mean±SE values in the row (a, b, c) and column (A, B) with the same superscript did not differ significantly ($p>0.05$)

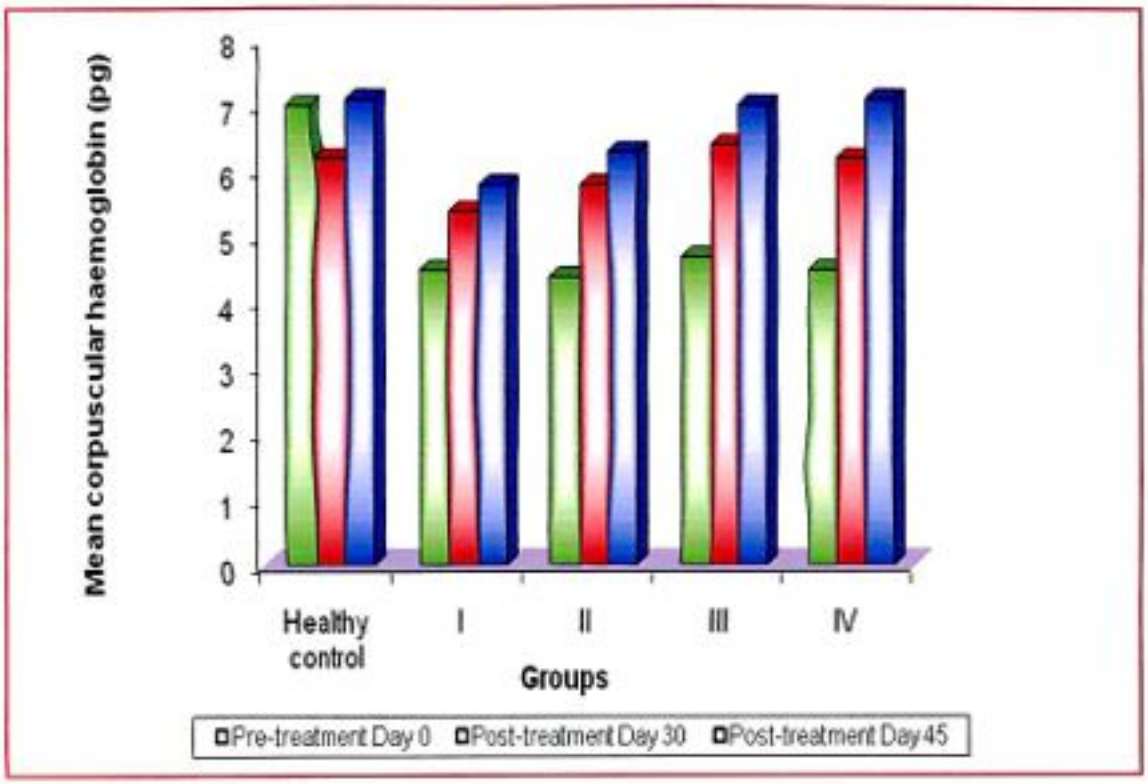

Figure 09: Mean corpuscular haemoglobin (pg) at different intervals in different groups

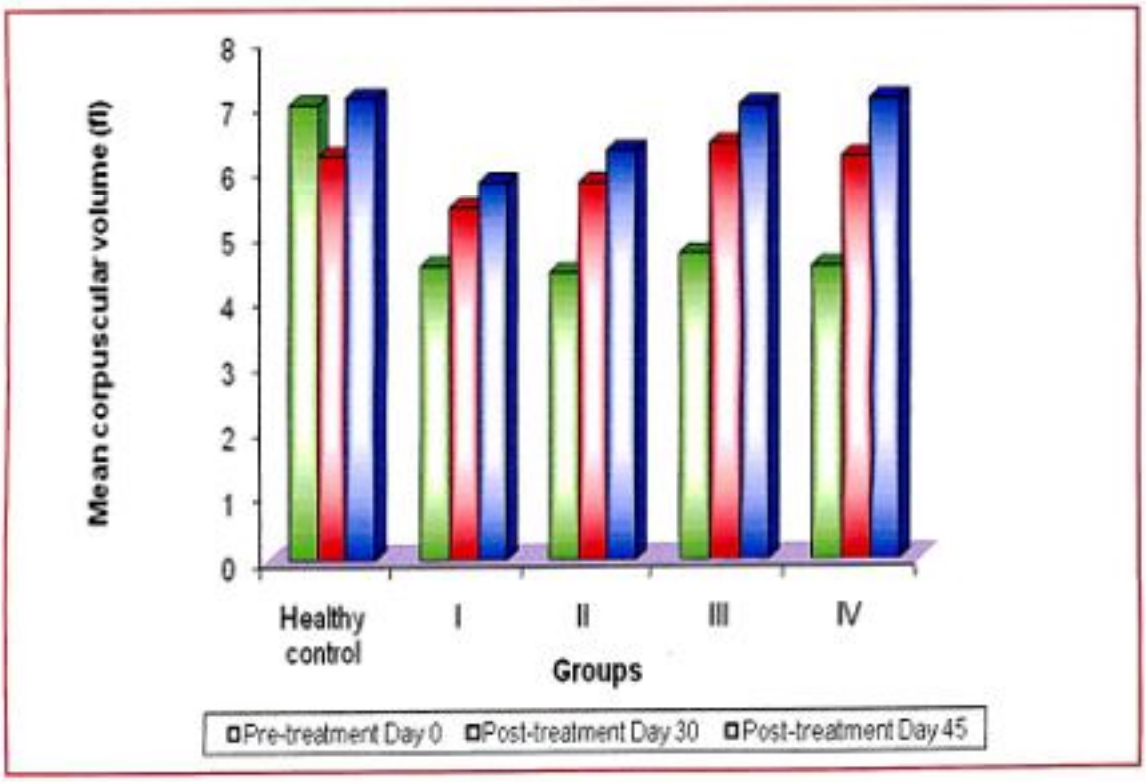

Figure 10: Mean corpuscular volume (fl) at different intervals in different groups

4.3.5 Mean corpuscular volume (MCV)

The mean values of MCV (fl) between different groups and treatment in day intervals are summarized in the table 12 and graphically shown in Figure 10. In the present study the pre-treatment mean MCV values of anaemic goats in each treatment group were significantly ($p \leq 0.05$) lower on day 0, as compared to healthy control. There was significant increase in the MCV concentration on day 30 and day 45 post-treatment, in all treatment groups from its basement values.

Table 12: Mean corpuscular volume (fl) at different day intervals in different groups

Groups	Pre-treatment	Post-treatment	
	Day 0	Day 30	Day 45
Healthy control	21.5 ± 1.43^{aA}	19.9 ± 1.22^{a}	21.4 ± 0.21^{a}
I	16.0 ± 0.31^{bB}	17.9 ± 0.55^{a}	$18.6. \pm 0.48^{a}$
II	15.7 ± 0.19^{bB}	18.6 ± 0.49^{a}	19.0 ± 0.52^{a}
III	15.9 ± 0.73^{bB}	19.4 ± 0.50^{a}	20.6 ± 0.36^{a}
IV	14.5 ± 0.57^{cB}	18.8 ± 0.39^{b}	20.8 ± 0.59^{a}

The mean±SE values in the row (a, b) and column (A, B) with the same superscript did not differ significantly ($p>0.05$).

4.3.6 Mean corpuscular haemoglobin concentration (MCHC)

The observed mean values of MCHC (%) between different groups and day intervals are presented in the table 13 and graphically shown in Figure 11. The pre-treatment mean values of anaemic goats were significantly lower as compared to healthy control. The values increased non-significantly ($p>0.05$) on day 30 post-treatment and increased significantly on day 45 post-treatment from day 0, in group-II and III. In group-I and IV values increased non-significantly on day 30 and day 45 post-treatment from pre-treatment values.

Table 13: Mean corpuscular haemoglobin concentration (%) at different day intervals in different groups

Groups	Pre-treatment	Post-treatment	
	Day 0	Day 30	Day 45
Healthy control	33.3 ± 1.54^{aA}	32.3 ± 2.39^{a}	32.7 ± 1.28^{a}
I	28.4 ± 1.30^{aC}	30.5 ± 1.25^{a}	31.4 ± 1.07^{a}
II	27.9 ± 0.60^{bC}	31.1 ± 0.31^{ab}	33.4 ± 1.42^{a}
III	29.7 ± 1.51^{bBC}	32.9 ± 0.86^{ab}	34.0 ± 0.67^{a}
IV	31.4 ± 1.33^{aB}	33.0 ± 0.99^{a}	34.3 ± 1.00^{a}

The mean±SE values in the row (a, b) and column (A, B, C) with the same superscript did not differ significantly ($p>0.05$).

4.4 Biochemical parameters

4.4.1 Serum total protein

The observation of pre-treatment mean serum total protein values of anaemic goats were significantly ($p\leq0.05$) lower in all treatment groups when compared to healthy control. The data on day 30 and day 45 post-treatment manifested significant rising trend from day 0 in serum total protein values of all treatment groups. In each treatment group serum total protein values on day 30 post-treatment revealed significant increase from day 0 and on day 45 post-treatment as compared to day 30 post-treatment (Table-14 and Figure 12).

Table 14: Serum total protein (g/dl) at different day intervals in different groups

Groups	Pre-treatment	Post-treatment	
	Day 0	Day 30	Day 45
Healthy control	7.18 ± 0.15^{aA}	7.13 ± 0.14^{a}	7.26 ± 0.11^{a}
I	5.32 ± 0.20^{cB}	6.31 ± 0.21^{b}	6.91 ± 0.12^{a}
II	5.20 ± 0.22^{cB}	6.35 ± 0.21^{b}	7.01 ± 0.11^{a}
III	4.98 ± 0.25^{cB}	6.07 ± 0.21^{b}	6.86 ± 0.19^{a}
IV	5.41 ± 0.23^{cB}	6.66 ± 0.25^{b}	7.36 ± 0.16^{a}

The mean±SE values in the row (a, b) and column (A, B) with the same superscript did not differ significantly ($p>0.05$).

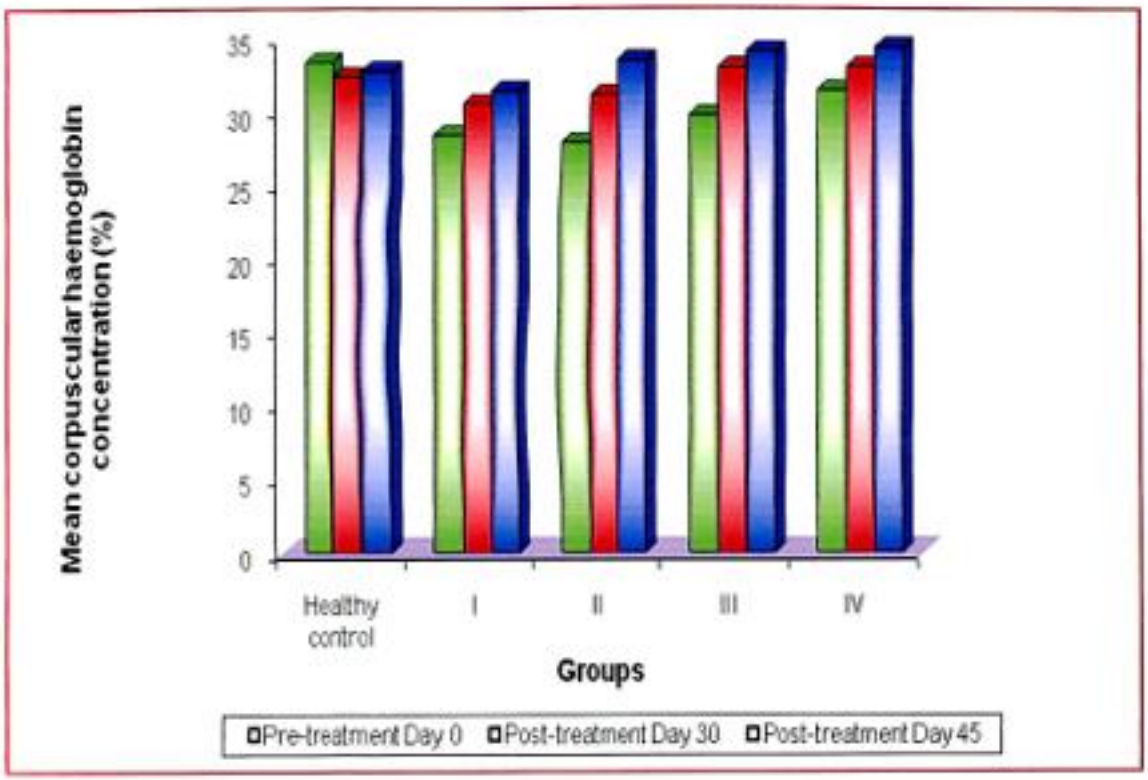

Figure 11: Mean corpuscular haemoglobin concentration (%) at different intervals in different groups

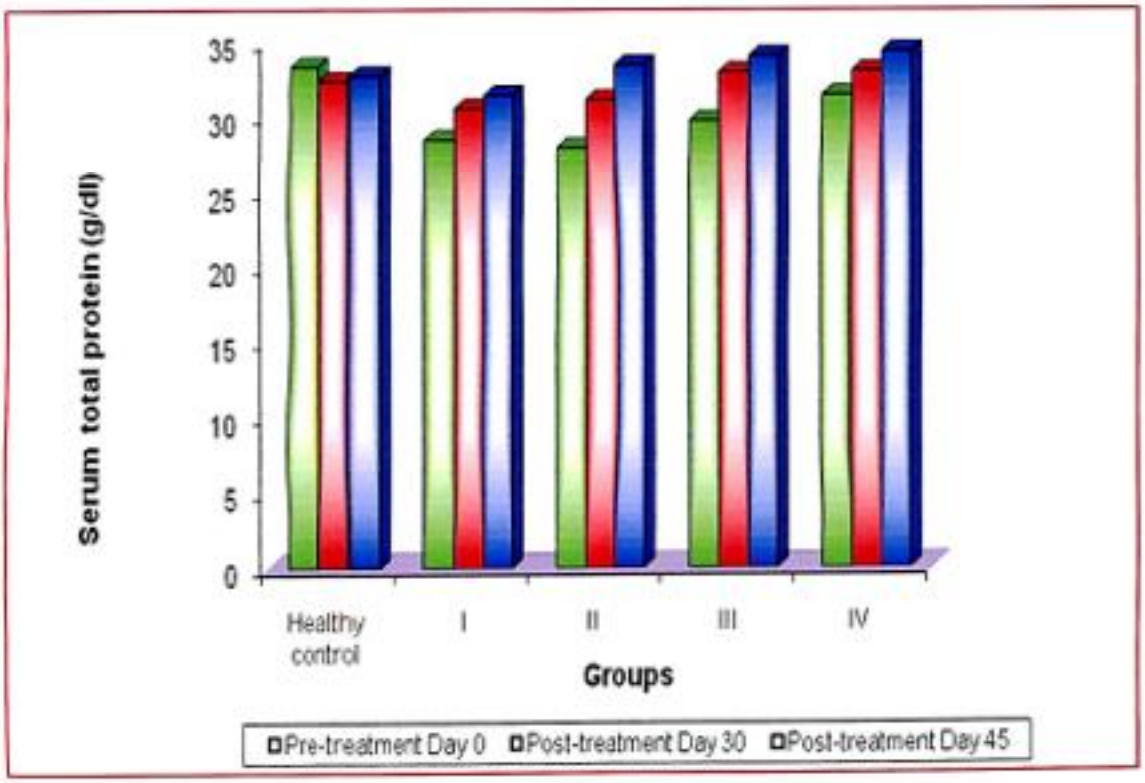

Figure 12: Serum total protein (g/dl) at different intervals in different groups

4.4.2 Serum albumin

The mean values of serum albumin are presented in table 15 and graphically shown in Figure 13. The mean albumin values in each treatment group on day 0, were decreased sharply ($p \leq 0.05$) as compare to healthy control. There was significant increase ($p \leq 0.05$) in the serum albumin values on day 30 and day 45 post-treatment as compared to day 0.

Table 15: Serum albumin (g/dl) at different day intervals in different groups

Groups	Pre-treatment	Post-treatment	
	Day 0	Day 30	Day 45
Healthy control	3.84 ± 0.10^{aA}	3.69 ± 0.10^{a}	3.99 ± 0.14^{a}
I	2.25 ± 0.11^{bB}	3.07 ± 0.15^{a}	3.33 ± 0.09^{a}
II	2.15 ± 0.07^{bB}	2.95 ± 0.02^{a}	3.29 ± 0.13^{a}
III	2.03 ± 0.10^{cB}	2.75 ± 0.09^{b}	3.23 ± 0.10^{a}
IV	2.19 ± 0.15^{cB}	2.99 ± 0.09^{b}	3.65 ± 0.13^{a}

The mean±SE values in the row (a, b) and column (A, B) with the same superscript did not differ significantly ($p > 0.05$).

4.4.3 Serum globulin

The statistical analysis revealed non-significant ($p > 0.05$) difference in mean serum globulin values on day 0 between treatment and control groups. Treatement group II, III and IV, exhibited significant ($p \leq 0.05$) increase on day 30 and day 45 post-treatment as compared to day 0 (Table 16 and Figure 14).

Table 16: Serum globulin (g/dl) at different day intervals in different groups

Groups	Pre-treatment	Post-treatment	
	Day 0	Day 30	Day 45
Healthy control	3.23 ± 0.06^{aA}	3.28 ± 0.10^{a}	3.31 ± 0.06^{a}
I	3.06 ± 0.12^{aA}	3.40 ± 0.12^{a}	3.54 ± 0.04^{a}
II	3.04 ± 0.16^{bA}	3.55 ± 0.12^{a}	3.74 ± 0.11^{a}
III	2.94 ± 0.18^{bA}	3.30 ± 0.16^{a}	3.45 ± 0.19^{a}
IV	3.20 ± 0.14^{bA}	3.41 ± 0.18^{ab}	3.70 ± 0.10^{a}

The mean±SE values in the row (a, b) and column (A, B) with the same superscript did not differ significantly ($p > 0.05$).

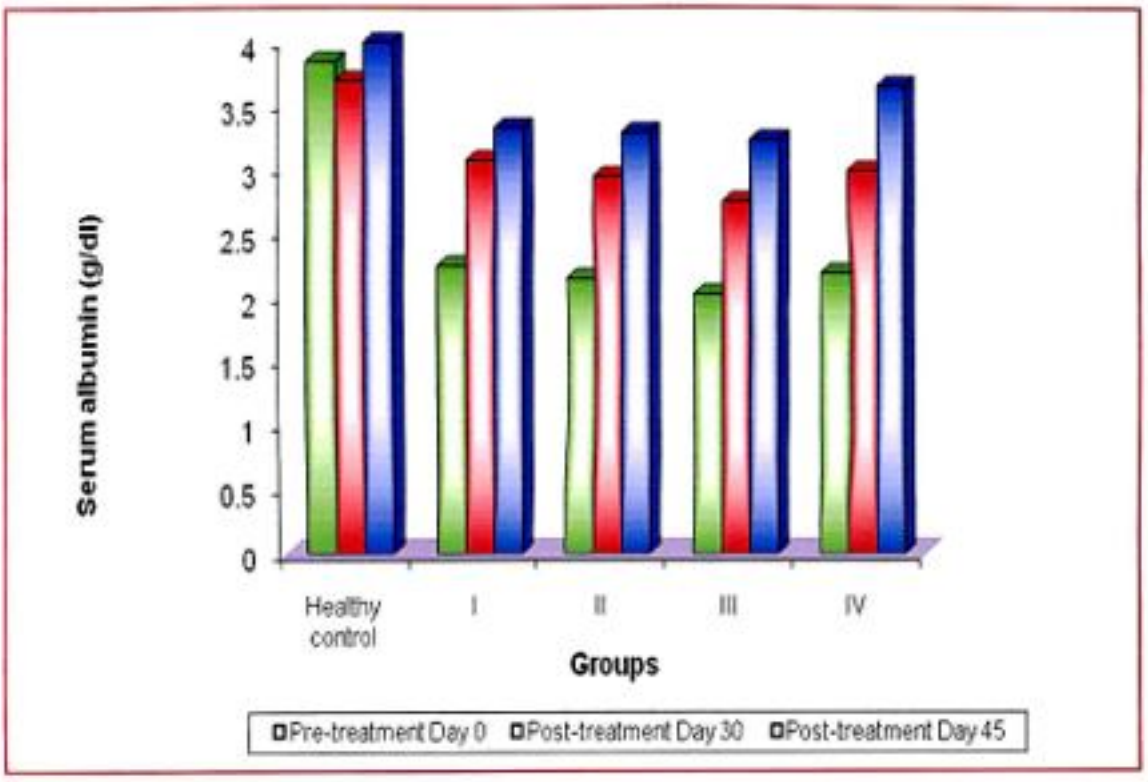

Figure 13: Serum albumin (g/dl) at different intervals in different groups

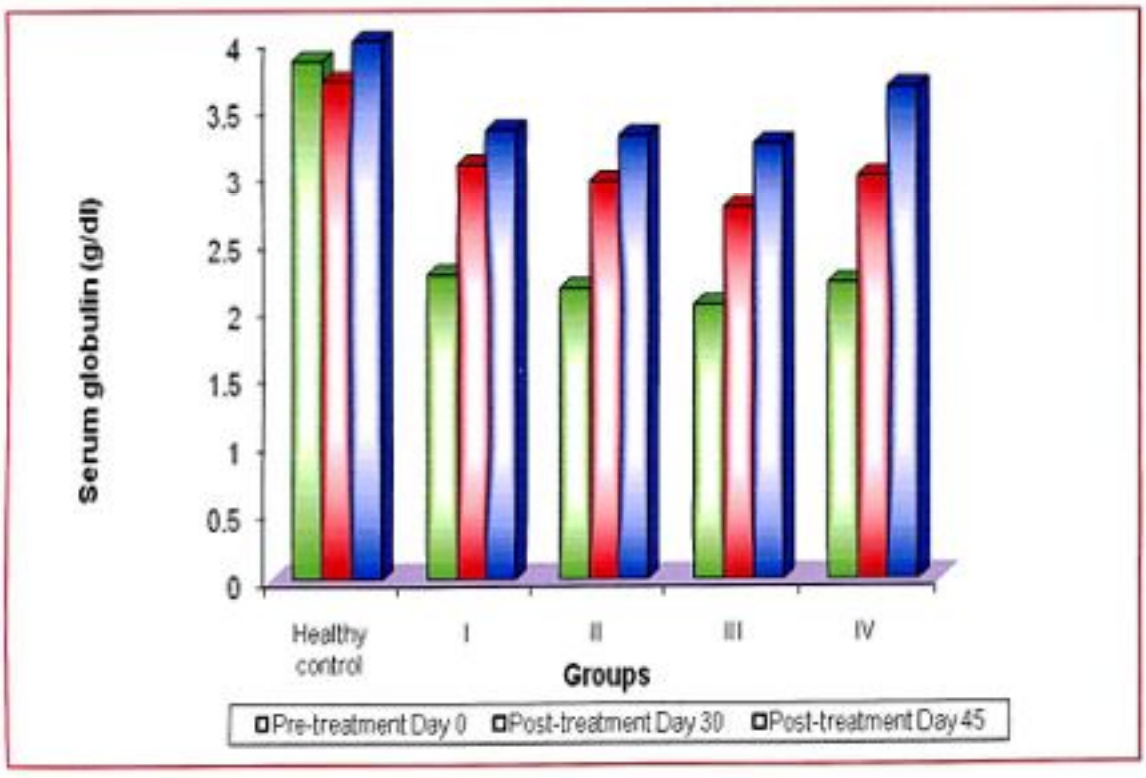

Figure 14: *Serum globulin (g/dl) at different intervals in different groups*

4.4.4 Albumin globulin ratio

Mean values of albumin globulin ratio between different groups and treatment in day intervals are summarized in the table 17 and graphically shown in Figure 15. Significant increase ($p \leq 0.05$) was noted on day 45 post-treatment, in albumin globulin ratio of each treatment group from day 0. Group II and IV depicted significant increase on day 30 post-treatment from day 0.

Table 17: Albumin globulin ratio at different day intervals in different groups

Groups	Pre-treatment	Post-treatment	
	Day 0	Day 30	Day 45
Healthy control	1.19 ± 0.12^{aA}	1.13 ± 0.05^{a}	1.18 ± 0.03^{a}
I	0.73 ± 0.03^{bB}	0.85 ± 0.03^{a}	0.94 ± 0.02^{a}
II	0.72 ± 0.03^{bB}	0.83 ± 0.03^{ab}	0.89 ± 0.05^{a}
III	0.69 ± 0.04^{bB}	0.84 ± 0.04^{ab}	0.91 ± 0.04^{a}
IV	0.68 ± 0.04^{bB}	0.89 ± 0.04^{a}	0.99 ± 0.04^{a}

The mean±SE values in the row (a, b) and column (A, B) with the same superscript did not differ significantly ($p > 0.05$).

4.4.5 Serum iron

The results of serum iron (µg/ml) of various groups and day intervals are depicted in the table 18 and graphically shown in Figure 16. Statistical data on variance ($p \leq 0.05$) revealed significant increase in serum iron values on day 30 and day 45 post-treatment from day 0, in treatment group-II, III and IV. While in group-I serum iron increased non-significantly ($p > 0.05$) on day 30 post-treatment and increased significantly on day 45 post-treatment, from day 0.

Table 18: Serum iron (µg/ml) at different day intervals in different groups

Groups	Pre-treatment	Post-treatment	
	Day 0	Day 30	Day 45
Healthy control	9.94 ± 0.68^{aA}	10.51 ± 0.69^{a}	9.83 ± 0.24^{a}
I	5.80 ± 0.29^{bB}	6.67 ± 0.29^{ab}	7.66 ± 0.22^{a}
II	5.29 ± 0.32^{cB}	7.65 ± 0.40^{b}	9.85 ± 0.87^{a}
III	5.55 ± 1.00^{cB}	9.67 ± 0.93^{b}	12.75 ± 0.79^{a}
IV	5.65 ± 0.78^{cB}	9.33 ± 0.52^{b}	13.01 ± 0.54^{a}

The mean±SE values in the row (a, b, c) and column (A, B) with the same superscript did not differ significantly ($p > 0.05$).

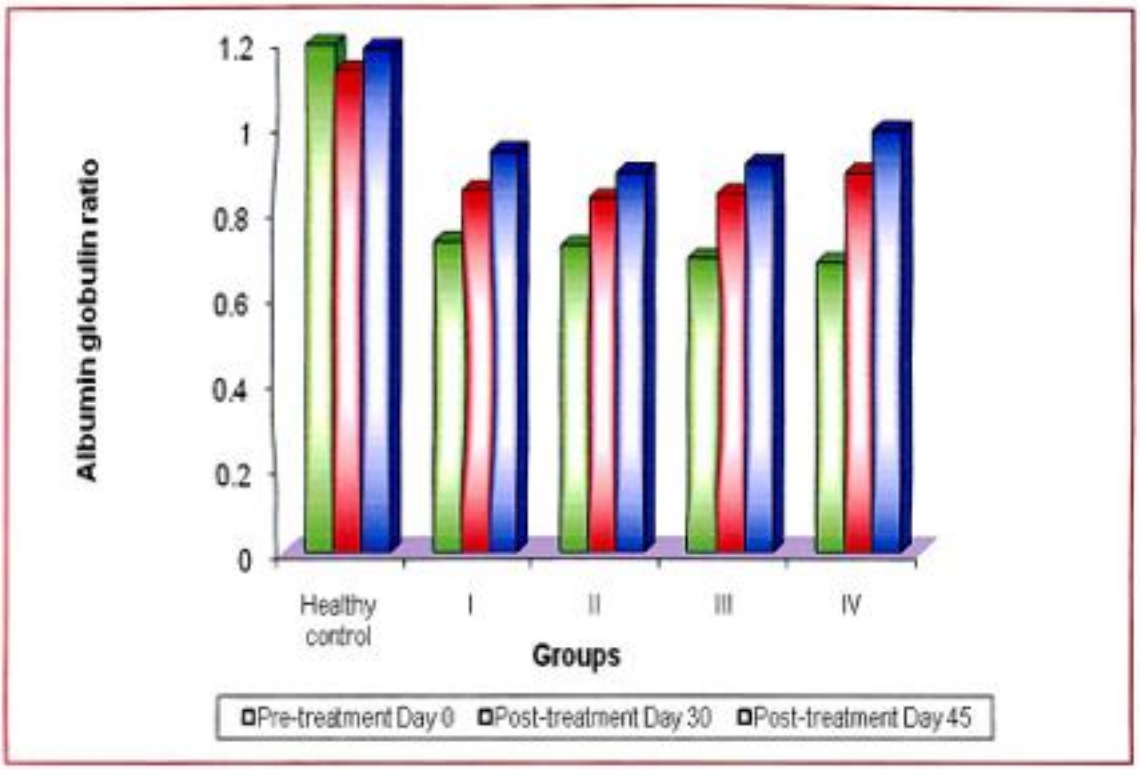

Figure 15: Albumin globulin ratio at different intervals in different groups

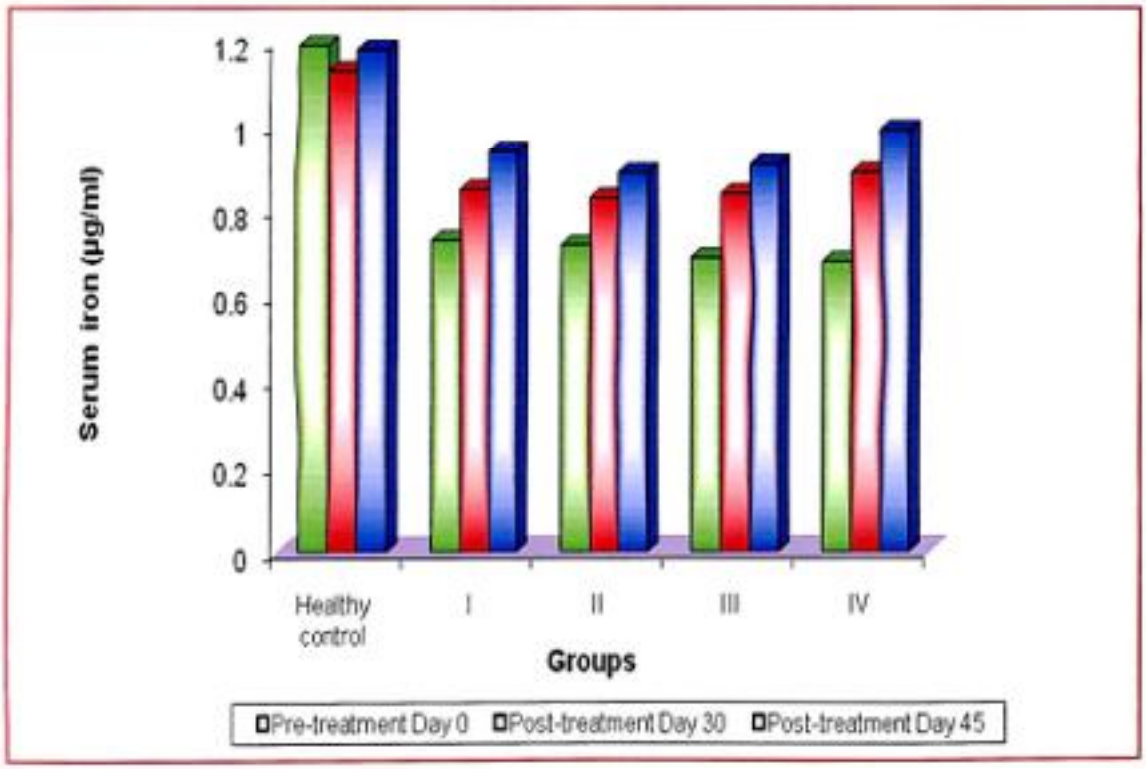

Figure 16: Serum iron (µg/ml) at different intervals in different groups

4.5 Body weight

The mean values of body weight between different groups and day intervals are presented in the table 19 and graphically shown in Figure 17. The mean of treatment groups were significantly ($p \leq 0.05$) lower as compared to healthy control. The data showed a non-significant ($p > 0.05$) increase in bodyweight in different groups on day 30 and day 45 post-treatment.

Table 19: Body weight (Kg) at different day intervals in different groups

Groups	Pre-treatment	Post-treatment		Group Mean
	Day 0	Day 30	Day 45	
Healthy control	23.0±1.45	24.2±1.43	24.8±1.45	23.9 ± 0.80^{A}
I	14.2±1.42	15.3±1.41	15.8±1.42	15.0 ± 0.78^{B}
II	15.9±1.07	16.9±1.08	17.4±1.08	16.7 ± 0.60^{B}
III	13.2±0.71	14.3±0.71	14.8±0.72	14.1 ± 0.42^{B}
IV	16.3±1.02	17.4±1.07	18.0±1.01	17.2 ± 0.57^{B}

The mean±SE values in the column (A, B) with the same superscript did not differ significantly ($p > 0.05$).

4.6 Comparative Therapeutic efficacy

On the basis of arbitrary score of different parameters group-IV showed best recovery followed by group-III, II and I, on day 30 and day 45 post-treatmemt.

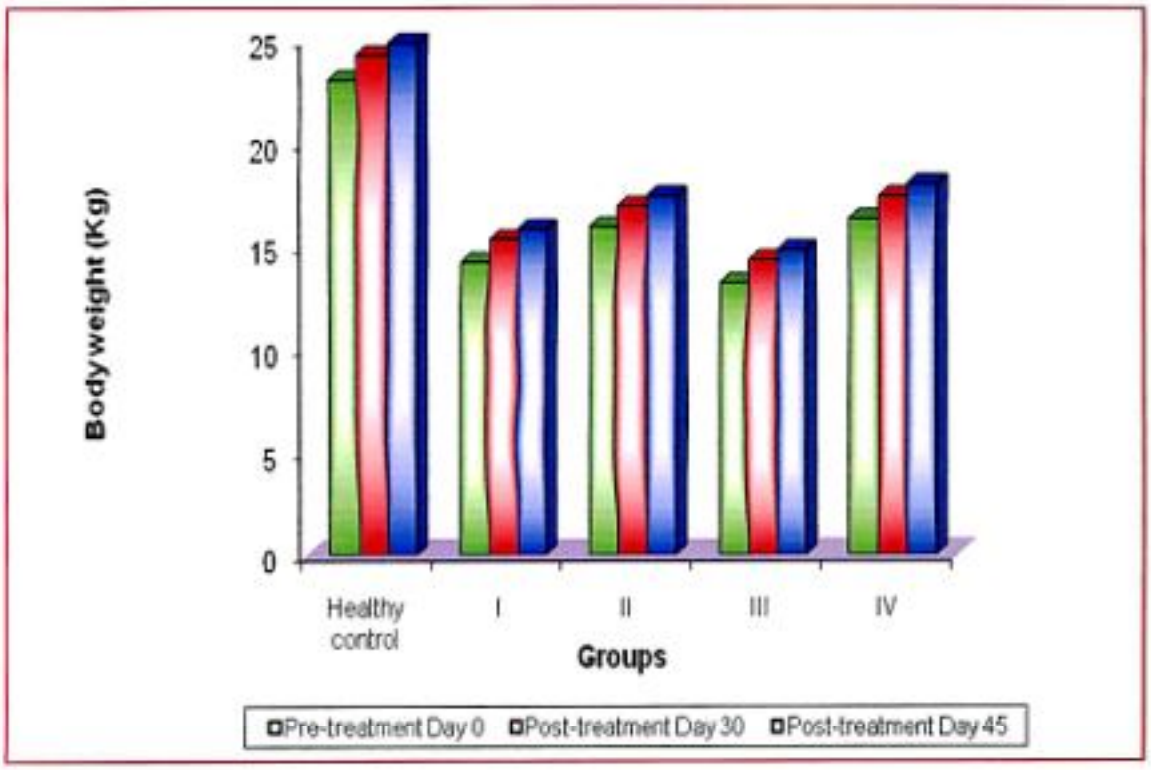

Figure 17: Body weight (Kg) at different intervals in different groups

Table 20: Arbitrary score of different parameters at different day intervals in different groups

S.No.	Parameter	Day 30				Day 45			
		Gr.I	Gr.II	Gr.III	Gr.IV	Gr.I	Gr.II	Gr.III	Gr.IV
1	Hb	++	++	+++	++++	++	++++	++++	+++++
2	PCV	++	+++	+++	+++	+++	+++	++++	+++++
3	TEC	++	++	++	++	+++	+++	+++	+++
4	MCH	++	+++	+++	+++	+++	++++	++++	+++++
5	MCV	++	++	+++	+++	++	+++	++++	+++++
6	MCHC	++	+++	+++	++	+++	+++++	++++	+++
7	TP	++	+++	+++	+++	++++	++++	++++	++++
8	A	++	++	++	+++	+++	+++	+++	++++
9	G	++	+++	++	+	+++	++++	+++	+++
10	A/G	++	++	+++	+++	+++	+++	++++	+++++
11	Iron	+	++	+++	+++	++	+++	+++++	+++++
13	B. wt.	+++	+++	+++	+++	++++	++++	++++	+++++
14	BCS	+++	++++	+++	++++	+++	+++++	++++	+++++
Total		27	34	36	37	38	48	50	57

5. DISCUSSION

Overall incidence

Out of 100 goats examined, 41 were found to be positive for anaemic condition showing an overall incidence as 41.00 per cent. The findings are comparable with earlier reports of Saleem (2000), Rajkhowa and Hazarika (2002), Shinde and Rajguru (2009) and Singh *et al.* (2011). They observed overall incidence of anaemia in goats as 18.88, 48.80, 20.68 and 30.20 per cent, respectively. All of them were infested with sucking lice (*Linognathus spp.*) and endoparasites. On faecal examination out of 41 goats, 35 exhibited EPG count more than 2000. Endoparasitic infestation were of mixed type. Ova of various species like Strongyle, *Strongyloides, Trichuris* and Amphistomes and occyst of Coccidia were detected in faecal samples. Anaemia may occur due to blood sucking parasites, gastrointestinal lesion or dietary deficiency of copper, cobalt and iron. However Anumol *et al.* (2011) observed prevalence of endoparasites, ectoparasites and coccidia as 40.80, 21.60 and 8.00 per cent, respectively in anaemic goats. Shalini (2011) reported anaemia due to nutritional deficiency (27.51%) followed by endoparasitic (10.34%) and ectoparsitic infestation (3.45%). Anumol *et al.* (2012) reported prevalence of endoparasites in anaemic goats as 48.80 per cent.

Breed wise incidence

Out of 100 goats, 62 were of Sirohi (24 positive, *i.e.* 38.70%) and 38 were of Barbari breed (17 positive, *i.e.* 44.70%). The incidence was higher in Barbari as compared to Sirohi. The findings are comparable with earlier reports of Machinder (1998), they recorded breed wise incidence in non-discript as 25.58 per cent, Osmanabadi breed as 11.11 per cent and Beetal crosses as 7.46 per cent. Saleem (2000) recorded breed wise incidence of anaemia in non-discript as 26.17 per cent, Osmanabadi breed as 13.35 per cent and Beetle breed as 6.25 per cent. Bhagure (2002) recorded breed wise incidence as highest in non-discript goats followed by Osmanabadi and Beetal crosses as 25.78 per cent, 20.83 per cent and 15 per cent, respectively. Shinde (2007) recorded incidence of parasitic anaemia in

goats was highest in non-discript goats (25%) followed by Osmanabadi (20.86%) and Beetal cross (17.39%).

Sex wise incidence

Incidence of anaemia in male was 44.40 per cent and in female 39.70 per cent. The incidence of anaemia was non–significant in female as compared to male goat. These findings are in agreement with reports of Rajkhowa and Hazarika (2002) on sex wise incidence of anaemia in goats was non–significant (50.00%) in female as compared to male (46.87%).

Age wise incidence

Age wise incidence was highest in goats aged 6-12 months (49.00%), followed by 12-18 months (37.00%) and lowest in goats aged above 18 months (25%). Growth rate and nutritional requirement are comparatively higher at early age (6-12 months) as compared to elder. The findings are supported with findings of Machinder (1998) in goats aged 6-9 months as 25.00 per cent, Saleem (2000) in goats aged 6-12 months as 27.27 per cent and Rajkhowa and Hazarika (2002) in goats aged 7 months to 1 year as 79.24 per cent.

Clinical study

The anaemic goats exhibited normal rectal temperature, elevated pulse and respiration rate as compared to healthy control. In the anaemic goats common clinical signs observed were pale conjunctivae, rough hair coat, dullness, depression, tachycardia and pulse with large amplitude. During the clinical study of 45 days all the groups of anaemic goats after therapy resumed normalcy in clinical signs. Among different treatment groups on the basis of clinical signs group II, III and IV showed better response as compared to group I.

The higher pulse rate might be due to compensation made by animal in an attempt to supply oxygen. The clinical signs of anaemia as recorded in the present study, corroborated with the findings of Sarkar and Mishra (1991), Smith and Sherman (1994), Rajkhowa and Hazarika (2002), Tanritanir *et al.* (2009) and Sarkar *et al.* (2010) in goats.

Haematological studies

The pre-treatment mean values of Hb, PCV, RBC, MCH, MCV and MCHC in anaemic goats in each treatment group were significantly ($p \leq 0.05$) lower as compared to healthy control. Endo-ectoparasites consume host's erythocytes and endoparasites damage gut wall, causing blood loss which tends to reduce the TEC in affected subjects. Beside this deficiency of iron reduce erythropoiesis. The reduction in mean MCH was due to direct reduction in Hb concentration. The reduction in mean MCV was indicative of microcytic erythrocytes. MCHC diminished in hypochromic microcytic anaemia. The findings are in coherence with Islam *et al.* (2005), Singh *et al.* (2010) and Shalini (2011) in anaemic goats. Bordoloi *et al.* (2012) reported same findings in haemonchosis and Iqbal *et al.* (2014) in ectoparasitic infestation in goats.

The obtained data on variance depicted a significant ($p \leq 0.05$) increase on day 30 and day 45 post-treatment, from day 0 in each treatment group. Since, copper, cobalt and iron are the essential constituents of Hb and vitamin B_{12} helps for maturation of erythrocyte, which resulted in quantitative regenration of the erythrocytes, increase in Hb concentration and vitamin A supplementaion boostes erythopoiesis. Residual effect of haematinics and vitamin-A remained after completion of therapy which noted as increase in data from day 30 onwards to day 45 post-treatment. There is a positive co-relation among RBC, Hb, PCV, MCV, MCH and MCHC. Similar observations were noted by Islam *et al.* (2005), Shinde (2007), Singh *et al.* (2010) and Goklaney *et al.* (2011, 2012).

Biochemical parameters

Serum total protein

The observation of pre-treatment mean serum total protein values of anaemic goats were significantly ($p \leq 0.05$) lower in all treatment groups when compared to healthy control. Hypo-proteinaemia might be associated with the marked blood sucking activities of haematophagous nematode which cause a protein losing gastro-enteropathy. The findings are

in agreement with the reports of Kumar *et al.* (2005), Bahrami *et al.* (2011) and Bordoloi *et al.* (2012) in goats having ecto-endoparasitic infestation and by Goklaney *et al.* (2011, 2012) in nutritional anaemia in goats. While Iqbal *et al.* (2014) reported increase in serum total protein value of ectoparasitic infested goats as compared to healthy control.

The data on day 30 and day 45 post-treatment manifested significant rise from day 0, in serum total protein values of all treatment groups. In each treatment group serum total protein values on day 30 and day 45 post-treatment revealed significant increase from day 0. The findings are in close agreement with the findings of Goklaney *et al.* (2011, 2012).

Serum albumin

The mean serum albumin values in each treatment group on day 0, were significantly ($p \leq 0.05$) lower as compared to healthy control. It is likely to be, aggravated by increased catabolism of albumin and malabsorption through the damaged intestinal mucosa. Similar findings are reported by Kumar *et al.* (2005) and Bordoloi *et al.* (2012) in goats having ecto-endoparasitic infestation and by Goklaney *et al.* (2011, 2012) in nutritional anaemia in goats. However Iqbal *et al.* (2014) repoted values of biochemical parameters (total protein, albumin and globulin) increased due to ectoparasitic infestation.

There was significant increase ($p \leq 0.05$) in the albumin values on day 30 and day 45 post-treatment from day 0, however Goklaney *et al.* (2011, 2012) observed non-significant increase in values on day 30 post-treatment.

Serum globulin

There was non-significant difference in mean globulin values on day 0 between treatment and control groups. Similar finding were reported by Goklaney *et al.* (2011, 2012) in nutritional anaemia in goats. However kumar *et al.* (2005) and Bordoloi *et al.* (2012) reported significant decrease in serum globulin levels in goats having ecto-endoparasitic infestation and Iqbal *et al.* (2014) found increasd in ectoparasitic infestation as compared to healthy.

Treatment group II and III exhibited significant (P≤0.05) rise on day 30 and day 45 post-treatment and group IV showed significant rise on day 45 post-treatment. Goklaney *et al.* (2011, 2012) reported non-significant increase in values on day 30 post-treatment.

Albumin globulin ratio

The mean albumin globulin ratio in each treatment group on day 0, were significantly (p≤0.05) lower as compared to healthy control. Similar findings are reported by Kumar *et al.* (2005) as significantly decreased values of albumin globulin ratio in goats having endoparasitic infestation in haemonchosis (0.93±0.08) and cestodiasis (0.29±0.01). These findings were also reported by Goklaney *et al.* (2011, 2012), they observed significant decrease in albumin globulin ratio (0.74±0.04) in nutritional anaemia in goats. Significant increase (P≤0.05) was noted on day 45 post-treatment, in albumin globulin ratio of each treatment group from pre-treatment values. Group II and IV depicted significant increase on day 30 post-treatment from day 0. However, Goklaney *et al.* (2011, 2012) observed non-significant increase in values on day 30 post-treatment.

Serum iron

The mean values of serum iron in each treatment group on day 0, were significantly (P≤0.05) lowered as compared to healthy control. Because of inflammation in gut wall in gastro-intestinal parasitism, absorption of minerals changes. Beside this low dietary content or unavailability of balance ration may be the reason for mineral deficiency. Statistical data on variance (P≤ 0.05) revealed significant increase in serum iron values on day 30 and day 45 post-treatment from day 0, in each treatment groups. Group III and IV, showed higher values on day 30 and day 45 from day 0. Supplementation of iron increases serum iron level. The findings allys with the reports of Singh *et al.* (2010), Goklaney *et al.* (2011, 2012), however Shalini *(2011) reported non-significant increase.*

Body weight

The body weight mean of different treatment groups were significantly ($p \leq 0.05$) lower as compared to healthy control. Data on variance showed a non-significant ($p > 0.05$) increase in average body weight on day 30 and day 45 post-treatment in treatment as well as control groups. Ecto-endoparasitic infestation has been associated with decreased weight gain however, the increased body weight gain in the present study might be due to the increase in muscular and skeletal development by haematinic supplementation. Our findings are in agreement with Sharmin *et al.* (2004) and Islam *et al.* (2005), they reported significant increase in body weight in apparently healthy goats supplemented haematinic as compared to healthy control.

Treatment

A total of 24 anaemic goats were included in this trial. They were randomly divided into 4 groups, each comprising 6 animals.

Group-I was treated with tablet (copper sulphate+ferrous sulphate+cobalt sulphate+folic acid) orally once a day for 30 days. The mean values of Hb, PCV, TEC, MCH, MCV, serum total protein, serum albumin and albumin globulin ratio increased significantly on day 30 post-treatment and were higher on day 45 post-treatment. Serum iron increased non-significantly on day 30 post-treatment, while increased significantly on day 45 post-treatment, from day 0. The mean values of MCHC and serum globulin increased but non-significantly on day 30 and day 45 post-treatment from day 0. Supplementation of haematinic containing copper, iron, cobalt and folic acid promoted erythropoiesis. Oral haematinic was found effective with a slow recovery rate in treating anaemia in goats. This finding is in agreement with the reports of Dey *et al.* (2004), Islam *et al.* (2005) and Shalini (2011) in goats.

Group-II was treated with tablet (copper sulphate+ferrous sulphate+cobalt sulphate+folic acid) orally once a day and injection vitamin A @ 440 IU/kg body weight intra-muscularly at weekly interval for one month. After treatment regimens given for 30 day mean Hb, PCV, TEC, MCH, MCV,

serum total protein, serum albumin, serum globulin, albumi- globulin ratio and serum iron increased significantly on day 30 post-treatment post-treatment and were higher on day 45 post-treatment. The mean value of MCHC increased non-significantly on day 30 post-treatment, while it increased significantly on day 45 post-treatment from day 0. These findings are in agreement with reports of Dey *et al.* (2004), Islam *et al.* (2005) and Goklaney *et al.* (2012) in goats.

Group-III was treated with injection (Iron sorbitol+ Hydroxycobalmin+Folic acid) @ 2ml per animal intra-muscularly, two more injection were given at weekly interval. After treatment regimens given for 30 day mean Hb, PCV, TEC, MCH, MCV, serum total protein, serum albumin, serum globulin, albumin globulin ratio and serum iron increased significantly on day 30 post-treatment and were higher on day 45 post-treatment. The mean value of MCHC increased non-significantly on day 30 post-treatment, while it increased significantly on day 45 post-treatment from day 0. These findings supported with the reports of Bhagure (2002), Rajguru *et al.* (2002), Singh *et al.* (2010), Goklaney *et al.* (2011) and Shalini (2011).

Group-IV was treated with injection (Iron sorbitol+ Hydroxycobalmin+Folic acid) @ 2ml per animal intra-muscularly, two more injection at weekly interval and injection vitamin A @ 440 IU/kg body weight intra-muscularly at weekly interval for one month. After treatment regimens were given for 30 day mean Hb, PCV, TEC, MCH, MCV, serum total protein, serum albumin, albumin globulin ratio and serum iron increased significantly on day 30 post-treatment and were higher on day 45 post-treatment from day 0. Similar findings reported earlier by Beard and Ross (2002), Bhagure (2002), Rajguru *et al.* (2002), Semba and Bloem (2002), Zimmerman *et al.* (2006) and Singh *et al.* (2010).

Comparative Therapeutic efficacy

Group-II and IV showed better recovery than group-I and III, respectively which might be due to additive effect of vitamin A on erythropoiesis. Vitamin A treatment increases the production of erythropoietin

and mobilizes iron from existing stores to support increased erythropoiesis accordance with finding of Beard and Ross (2002), Semba and Bloem (2002) and Zimmerman *et al.* (2006).

Group-III and IV depicted better recovery from group-I and II, respectively. Parentral iron is more effective than oral therapy for anaemia supported by the findings of Shalini (2011).

From the entire results it is suggested that addition of vitamin A with haematnic improved efficacy of haematinic and manifested faster recovery from anaemia. Besides this, on the basis of route of administration parentral haematinic therapy have good efficacy than the oral therapy.

6. SUMMARY, CONCLUSIONS AND SUGGESTIONS FOR FURTHER WORK

6.1 Summary

Anaemia is a common and important clinical presentation in goats characterized by pale mucous membrane, exercise intolerance, weakness, tachycardia, reduced growth and body weight. The present study on "Efficacy of vitamin A with conventional haematinics in anaemic goats" was conducted at Goat Farm Amanala, Jabalpur. During this study a detailed clinical examination, haemato-biochemical elements of anaemic goats before and after the treatment with conventional haematinic with addition of vitamin A parentral and comparing efficacy with conventional haematinic within a span of 45 days. An epidemiological survey of anaemia in adult goats (above 6 months) undertaken including 100 blood samples of goats irrespective of breed and sex.

Out of 100 goats, 41 were found anaemic indicating an overall incidence as 41.00 per cent of anaemia. All of them were infested with sucking lice (*Linognathus spp.*) and endoparasites. Out of 100 goats, 62 were of Sirohi (24 positive, *i.e.* 38.70%) and 38 were of Barbari (17 positive, *i.e.* 44.70%). Out of 100 goats 27 were male (12 positive, *i.e.* 44.40%) and 73 were female (29 positive, *i.e.* 39.70%). Age wise incidence was highest in goats aged 6-12 months (49.00%), followed by 12-18 months (37%) and lowest in goats aged above 18 months (25%).

The major clinical signs in anaemic goats were pallor mucosae, rough hair coat, loss of hair, emaciation, exercise intolerance, dullness, depression, tachypnoea, tachycardia and pulse with large amplitude. The 24 goats were selected having anaemic state for this study were subjected to deworming prior to beginning of the clinical study. All the 24 goats were categorized into 4 treatment groups (group-I, II, III and IV) consisting of 6 goats each. During the present investigation haematological indices revealed microcytic hypochromic anaemia in all the anaemic goats.

Group-I was treated with tablet (copper sulphate+ferrous sulphate+cobalt sulphate+folic) orally once a day for 30 days, whereas group-II was treated same as group-I with inclusion of injection vitamin A @ 440 IU/kg body weight intra-muscularly, at weekly interval for one month. Group-III was treated with injection (Iron sorbitol+Hydroxycobalmin+Folic acid) @ 2ml per animal intra-muscularly, at weekly interval thrice, however group-IV was treated same as group-III with inclusion of injection vitamin A @ 440 IU/kg body weight intra-muscularly, at weekly interval for one month. During the clinical study of 45 days all the groups of anaemic goats after therapy resumed normalcy in clinical signs. Among different treatment groups on the basis of clinical signs group II, III and IV showed better recovery than group I.

After treatment regimens group-I exhibited significant rise in mean Hb, PCV, TEC, MCH, MCV, serum total protein, serum albumin and albumin- globulin ratio on day 30 as 7.7±0.21 g/dl, 25.2±0.41 per cent, 14.1±0.27 millions/µl, 5.4±0.14 pg, 17.9±0.55 fl, 6.31±0.21 g/dl, 3.07±0.15 g/dl and 0.85±0.03, respectively and were higher on day 45 post-treatment as 8.5±0.21 g/dl, 27.0±0.69 per cent, 14.6±0.13 millions/µl, 5.8±0.12 pg, 18.6.±0.48 fl, 6.91±0.12 g/dl, 3.33±0.09 g/dl and 0.94±0.02, respectively. Serum iron increased non-significantly on day 30 post-treatment, while increased significantly on day 45 post-treatment, from day 0. The mean values of MCHC, serum globulin and body weight increased non-significantly on day 30 and day 45 post-treatment from pre-treatment values.

In group-II the mean values of Hb, PCV, TEC, MCH, MCV, serum total protein, serum albumin, serum globulin, albumin globulin ratio and serum iron increased significantly on day 30 post-treatment as 8.5±0.19 g/dl, 27.3±0.60 per cent, 14.7±0.1913 millions/µl, 5.8±0.17 pg, 18.6±0.49 fl, 6.35±0.21 g/dl, 2.95±0.02 g/dl, 3.55±0.12 g/dl, 0.83±0.03 and 7.65±0.40 µg/ml, respectively and were higher on day 45 post-treatment as 10.0±0.22 g/dl, 30.1±0.83 per cent, 15.8±0.21 millions/µl, 6.3±0.22 pg, 19.0±0.52 fl, 7.01±0.11 g/dl, 3.29±0.13 g/dl, 3.74±0.11 g/dl, 0.89±0.05 and 9.85±0.87 µg/ml, respectively. The mean value of MCHC increased non-significantly on day 30 post-treatment and increased significantly on day 45 post-treatment.

The data showed a non-significant (p≤0.05) increase in body weight on day 30 and day 45 post-treatment.

In group-III the mean values of Hb, PCV, TEC, MCH, MCV, serum total protein, serum albumin, serum globulin, albumin globulin ratio and serum iron increased significantly on day 30 post-treatment as 8.5±0.19 g/dl, 27.1±0.47 per cent, 14.0±0.27 millions/µl, 6.4±0.20 pg, 19.4±0.50 fl, 6.07±0.21 g/dl, 2.75±0.09 g/dl, 3.30±0.16 g/dl, 0.84±0.04, 9.67±0.93 µg/ml, respectively and was higher on day 45 post-treatment as 10.4±0.2 g/dl, 30.9±0.62 per cent, 14.9±0.16 millions/µl, 7.0±0.12 pg, 20.6±0.36 fl, 6.86±0.19 g/dl, 3.23±0.10 g/dl, 3.45±0.19 g/dl, 0.91±0.04 and 12.75±0.79 µg/ml, respectively. The mean value of MCHC increased non-significantly on day 30 post-treatment, while it increased significantly on day 45 post-treatment from day 0. The data showed a non-significant (p≤0.05) increase in body weight on day 30 and day 45 post-treatment.

In group-IV the mean values of Hb, PCV, TEC, MCH, MCV, serum total protein, serum albumin, albumi- globulin ratio and serum iron raised sharply on day 30 post-treatment as 9.3±0.24 g/dl, 28.2±0.53 per cent, 15.0±0.16 millions/µl, 6.2±0.24 pg, 18.8±0.39 fl, 6.66±0.25 g/dl, 2.99±0.09 g/dl, 0.89±0.04, 9.33±0.52 µg/ml, respectively and was higher on day 45 post-treatment as 11.3±0.20 g/dl, 33.0±0.71 per cent, 15.9±0.17 millions/µl, 7.1±0.19 pg, 20.8±0.59 fl, 7.36±0.16 g/dl, 3.65±0.13 g/dl, 0.99±0.04 and 13.01±0.54 µg/ml, respectively. The mean value of serum globulin increased non-significantly (p>0.05) on day 30 post-treatment, while it got increased significantly on day 45 from day 0. MCHC and body weight exhibited non-significant increase on day 30 and day 45 post-treatment.

On the basis of arbitrary score of different parameters group-IV showed best recovery followed by group-III, II and I, on day 30 and day 45 post-treatment.

6.2 Conclusions

1. Overall incidence of anaemia in adult goats was 41 per cent. The incidence was highest in 6-12 months goats (49.00%), followed by 12-18 months (37.00%) and lowest in 18 months above (25.00%). The breed wise incidence was higher in Barbari as compared to Sirohi further the sex wise incidence was observed higher in male.

2. Vitamin A with parentral haematinic gave high efficacy while parentral haematinic showed less efficacy followed by vitamin A with oral haematinic whereas, oral haematinics revealed least efficacy.

3. Parentral haematinic therapy had good efficacy than oral therapy.

6.3 Suggestions for the further work

1) The study should be carried on large population of goats which should include different agro-climatic zone.

2) Economic therapeutic regimen should be designed for effective control of anaemia in goats.

3) Detailed study on etiopathogenesis, epidemiology and treatment regimen should be carried out

REFERENCES

Anish, Y., Khajuria, J.K. and Jonali, D. (2006). Cat flea infestation in goats. *Indian Veterinary Journal*, **83**: 439-440.

Anumol, J., Tresamol, P.V., Anuraj, K.S. and Saseendranath, M.R. (2012). Prevalence of endoparasitism in anaemic goats. *Journal of Veterinary Parasitology*, **85**(1): 85-86.

Anumol, J., Tresamol, P.V., Saranya, M.G., Vijayakumar, K. and Saseendranath, M.R. (2011). A study on aetiology of anaemia in goats. *Journal of Veterinary Animal Science*, **42**: 61-63.

Bahrami, A.M., Asbchin, S.A., Bahrami, A. and Ali, L.M. (2011). Nematode infestation in goats and its economic treatment. *World Applied Science Journal*, **15**(9): 1267-1273.

Beard, J.L. and Ross, A.C. (2002). Iron deficiency and marginal vitamin A deficiency affect growth, hematological indices and the regulation of iron metabolism genes in rats. *The Journal of Nutrition*, **132**(12): 3605-3615.

Benjamin, M.M. (2001). Outline of veterinary clinical pathology, 3rd Edn., Publ., Kalyani Publishing, New Delhi, 351p.

Bhagure, R.C. (2002) Caprine anaemia with special refrence to efficacy of some haematinic preparations. M.V.Sc. & A.H. thesis (Veterinary Medicine), Maharashtra Agriculture University, Parbhani.

Biswas, C.K., Choudhary, G., Ghosh, S.K. and Majumdar, D. (2006). Serum trace elements status of Black Bengal goat in terai and hill zone of West Bengal. *Indian Journal of Animals Health*, **45**(1): 39-41.

Bordoloi, G., Jas, R. and Ghosh, J.D. (2012). Change in the haemato-biochemical pattern due to experimentally induced haemonchosis in Sahabadi sheep. *Journal of Parasitic Disease*, **36**(1): 101-105.

Casal, M.N., Layrisse, M., Solano, L., Barón, M.A., Arguello, F., Llovera, D., Ramirez, J., Leets, I. and Tropper, E. (1998). Vitamin A and β-carotene can improve nonheme iron absorption from rice, wheat and corn by humans. *Journal of Nutrition*, **128**: 646-650.

Chaudhary, P.S., Chauhan, H.V.S., Deshmukh, V.V. and Moliya, D.C. (2008). Treatment of anaemia in cow calves by feritas bolus. *Intas polivet*, **9**(1): 43-45.

CIRG (2012). Vision 2030 online http://www.cirg.res.in/downloads/vision30.pdf

DAHD (2007) District wise Details of Livestock Census 2007-Goat online http://www.dahd.nic.in/DistrictWiseReport/HTML/Madhya%20Pradesh.htm

Dede, S., Deger, Y. and Deger, S. (2003). Serum profile of calcium, phosphorus, copper and zink in healthy and lice infested goats. *Indian Veterinary Journal*, **80**: 150-151.

Dey, A.K., Sanyal, S. and Das, P.K. (2004). A surevey of copper status of Black Bengal goats using Copper Oxidase activity in blood plasma. *Indian Journal of Animals Health*, **43**(2): 163-165.

Ghosh, D.K., Roy, B.N., Roy, S. and Bhattacharya, B. (2002). Haemato-biochemical profile of grazing Black Bengal goats in hilly zones of West Bengal. *Indian Journal of Animal Health*, **41**(1): 18-20.

Giri, D.K., Kashyap, D.K. and Dewangan, G. (2013). Caprine pediculosis-A prevalence study. *Intas Polivet*, **14**(2): 269-271.

Goklaney, D., Singh, A.P., Dhuria, R.K. and Ahuja, A. (2011). Clinico-haematological, biochemical and therapeutic studies on nutritional anaemia in goats. *Applied-Biological-Research*, **13**(2): 70-74.

Goklaney, D., Singh, A.P., Dhuria,R.K. and Ahuja, A. (2012).Therapeutic evaluation of mineral preparation for amelioration of anaemia in goat of arid zone of Rajasthan. *Iranian Journal of Applied Animal Science*, **2**(2): 137-141.

Green, L.E., Berriatua, E. and Morgan, K.L. (1993). Anaemia in housed lambs. *Research in Veterinary Science*, **54**(3): 306-311.

Hodges, R.E., Sauberlich, H.E. and Canham, J.E. (1978). Haemopoietic studies in vitamin A deficiency. *American Journal of Clinical Nutrition*, **31**: 876-885.

Iqbal, A., Siddique, F., Mahmood, M.S., Shamim, A., Zafar, T. and Ahmad, W. (2014). Prevalence and impacts of ectoparasitic fauna infesting goats (*Capra hircus*) of district Toba Tek Singh, Punjab, Pakistan. *Global Veterinaria*, **12**(2): 158-164.

Islam, R., Rashidi, S.H.M., Hossain, M.K. and Rahman, M. (2005). Effects of hematinics on body weight and some hematological values in sheep and goats. *International Journal of Agriculture and Biology*, **7**(4): 582-584.

Ismail, A. M., Yousif, I. A. and Fadlelmoula, A. A. (2011). Phenotypic variations in birth and body weights of the Sudanese Desert Goats. *Livestock Research for Rural Development*, **23**(2): 75-79.

Kaneko, J.J., John, W. and Michael, L.B. (2008). Clinical biochemistry of domestic animal, 6th Edn., Elsevier publishing, San Diego, 885p.

Khan, M. K. and Naznin, M. (2013). Study the live weight and live weight gain of black Bengal and Jamunapari goat breeds by fitting the linear regression under semi-intensive condition. *Pakistan Journal of Biological Science*, **16**(19): 998-1003.

Kumar, A., Rawat, B.S., Saxena, A.K. and Agarwal, G.P. (1994). Prevalence of ectoparasites on goats in Dehradun (India). *Applied Parasitology*, **35**(3): 227-236.

Kumar, A., Vihan, V.S., Rana, R. and Kumar. V. (2005). Blood biochemical changes in some important parasitic infestation in goats for clinical appraisal. *Indian Journal of Small Ruminants*, **11**(2): 156-160.

Machinder, V.M. (1998). Prevalence, clinic-pathology and treatment of anaemia. M.V.Sc.& A.H. thesis (Veterinary Medicine), Maharashtra Agriculture University, Parbhani.

Olayemi, F.O., Odoye, O.O., Oyagbemi, A.A. and Soetan, K.O. (2009). Influence of management systems and sex on haematology of West African Dwarf goat. *African Journal of Agriculture Research*, **4**(11): 1199-1202.

Padmaja, K., Lakshmi, K. and Prathyusha, P. (2013). Prevalence of dermatological disorders in canines. *Intas Polivet*, **14**(2): 181-185.

Petkov, P., Kankov, D., Binevy, R., Dinev, I., Kirov, K., Todorov, R. and Petkova, P. (2005). Studies on clinical and morphological effects of enzootic ataxia on kid goats. *Trakia Journal of Science*, **3**(5): 30-34.

Puri, R.M., Waghmare, S.P., Mode, S.G. and Ghadge, R.S. (2008). Anaemia due to helminthiasis in goat-A case report. *Intas Polivet*, **9**(11): 302-303.

Rajguru, D.N., Pawar, L.S., Saleem, M. and Joshi, S.A. (2002). Haemato-biochemical alteration and therapeutic management of endoparasite induced caprine anaemia. *Indian Veterinary Journal*, **79**: 973-975.

Rajkhowa, S. and Hazarika, G.C. (2002). Effect of age, sex and season on the prevalence of anaemia in goats. *Indian Journal of Veterinary Medicine*, **22**(1): 45-46.

Rodostits, O.M., Gay, C. C., Blood, D.C. and Hinchcliff, K.W. (2010). Veterinary Medicine A textbook of diseases of cattle, horse, sheep, pig and goat, 10th Edn.,Elsevier Publishing, p 2156.

Saleem, M. (2000) Prevalence, clinicopathology and therapeutic management of caprine anaemia, M.V.Sc. & A.H. thesis (Veterinary Medicine), Maharashtra Agriculture University, Parbhani.

Sandhu, A.K., Saini, A. and Randhawa, S.S. (2001). Haematobiochemical studies in healthy goats. *Indian Veterinary Journal*, **78**: 590-593.

Sarkar, S. and Mishra, S.K. (1991) Haematological changes in experimentally induced nutritional anaemia in goats and its therapy. *Indian Veterinary Journal*, **68**: 769-774.

Sarkar, M., Rahman, S.A., Sarker, B.K., Anisuzzaman, N.B. and Mondal, M.M.H. (2010). Epidemiology and pathology of ectoparasitic infestations in Black Bengal goats in Gaibandha and Mymensingh districts of Bangladesh. *Bangladesh Journal of Veterinary Medicine*, **8**(1): 41-50.

Satale, B.A. (2001) Prevalence, clinic-pathology and treatment of parasitic anaemia in goats. M.V.Sc & A.H. thesis (Veterinary Medicine), Maharashtra Agriculture University, Parbhani.

Semba, R.D. and Bloem, M.W. (2002). The anaemia of vitamin A deficiency : epidemiology and pathogenesis. *Europen Journal of Clinical Nutrition*, **56**: 271-281.

Shalini, A.S. (2011). Comperative evaluation of oral and parentral iron prepration in anaemic goat. M.V.Sc. & A.H. thesis (Veterinary Medicine), Maharashtra Agriculture University, Parbhani.

Sharma, A.K. and Puri, G. (2013). Effect of extreme hot condition on serum biochemical constituents in Marwari Goats. *Livestock Research International*, **1**(1): 23-28.

Sharma, P. (2013). Efficacy of herbal anthelmentic against gastrointestinal nematoded in goats. M.V.Sc. & A.H thesis (Veterinary Medicine), submitted to Nanaji Deshmukh Veterinary Science University, Jabalpur.

Sharmin, M.L., Miah, M.A., Myenuddin, M. and Shahjalal, M. (2004). Effect of haematinics on body weight and certain haematological values in Black Bengal goats. *Bangladesh Journal of Veterinary Medicine*, **2**(1): 55-57.

Shinde, S.B. (2007). Prevalence, clinic-pathology and treatment of parasitic anaemia in goats. M.V.Sc. & A.H. thesis (Veterinary Medicine), Maharashtra Agriculture University, Parbhani.

Shinde, S.B. and Rajguru, D.N. (2009). Prevalence of parasitic anaemia in goats. *Journal of Veterinary Practitioner,* **10**(1): 76-77.

Singh, R., Bhardwaj, R.K. and Katoch, R. (2010). Effect of iron administration in anaemic goats. *Indian Veterinary Journal*, **87**(8): 822-823.

Singh, T., Jain, A. and Mehta, M.K. (2007). Status of trace minerals in different feeds: A survey. *Intas Polivet,* **8**(1): 158-160.

Singh, V., Varshney, P., Dash, S.K. and Lal, H.P. (2013). Prevalence of gastrointestinal parasites in sheep and goats in and around Mathura, India. *Veterinary World*, **6**(5): 260-262.

Sloss, M.W., Kemp, R.L. and Zajac, A.M. (1994). Veterinary Clinical Parasitology, 6th Edn., International Book Distributing Co., Lucknow, India, 191p.

Smith, M.C. and Sherman, D.M. (1994) Blood, lymph and immune systems, In: Cann, C.C. (ed.). Goat medicine, 2th Edn., Lea and Febiger, Philadelphia, USA. 201p.

Snedecor, G.W. and Cochran, W.G. (1994). Statistical Methods. 7th Edn., Lowa State University Press, Ames, Lowa, p 44.

Tanritanir, P., Semiha, D. and Ebubekir, C. (2009). Change in some macrominerals and biochemical parameter in female healthy Siirt hair goats. *Journal of Animal and Veterinary Advance*, **8**(3): 530-533.

Villaquiran, M., Gipson, T.A., Merkel, R.C., Goetsch, A.L. and Sahlu, T. (2004). Body condition scores in goats. American Institute of Goat Research, Langston University America. online http://www.luresext.edu/goats/research/bcs_factsheet.pdf

Vogel, A.I. (1968) A Textbook of Quantitative Inorganic Analysis, 3rd Edn., ELBS publishing, Longmans, pp 785-786.

Yadav, C.M., Khan, P.M., Panwar, P., Jeenagar, S.S., Lakhawat, S.S. and Nagar, K.C. (2010). Effect of concentrate and mineral mixture supplementation on growth performance of growing goats. *Indian Journal of Small Ruminants*, **16**(1): 109-110.

Zamfirescu, S., Topoleanu, I. and Nadolu, D. (2013). Observation concerning haematological profile in goats. *Lucrari Stintifice Seria Zootehnie*, **52**: 86-91.

Zimmermann, M.B., Biebinger, R., Rohner, F., Dib, A., Zeder, C., Hurrell, R.F. and Chaouki, N. (2006). Vitamin A supplementation in children with poor vitamin A and iron status increases erythropoietin and haemoglobin concentration without changing body iron. *American Journal of Clinical Nutrition*, **84**: 580-586.

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ABSTRACT

The present study was undertaken for recording the incidence of anaemia in goats along with evaluation of efficacy of vitamin A with the conventional haematinics for a period of 45 days of observations.

A total of 100 adult goats were screened to know the incidence of anaemia at Goat Farm Amanala, Jabalpur. Out of these goats 41 were found anaemic indicating an overall incidence of 41.0% of anaemia. All of them were infested with ecto (sucking lice) and endoparasites. Out of 100 goats, 62 were of Sirohi (24 positive, 38.7%) and 38 were of Barbari breeds (17 positive, 44.7%). Out of 100 goats, 27 were males (12 positive, 44.4%) and 73 were females (29 positive, 39.7%). Age wise incidence was highest in goats aged 6-12 months (49.0%), followed by 12-18 months (37.0%) and lowest in goats aged above 18 months (25.0%). Major clinical signs in anaemic goats reported were pallor mucosae, rough hair coat, loss of hair, emaciation, dullness, depression, tachypnoea, tachycardia and pulse with large amplitude. For this study, 24 goats were selected having anaemic state and were subjected to deworming before beginning of the clinical study. All 24 goats were categorized into 4 treatment groups (Group-I, II, III and IV) consisting of 6 goats each.

Group-I was treated with tablet (copper sulphate+ferrous sulphate+cobalt sulphate+folic) orally once a day for 30 days, whereas group-II was treated same as group-I with inclusion of injection vitamin A @ 440 IU/kg body weight intra-muscularly, at weekly interval for one month. Group-III was treated with injection (Iron sorbitol+Hydroxycobalmin+Folic acid) @ 2ml per animal intra-muscularly, at weekly interval thrice, however group-IV was treated same as group-III with inclusion of injection vitamin A @ 440 IU/kg body weight intra-muscularly, at weekly interval for one month. During the clinical study of 45 days all the groups of anaemic goats after therapy resumed normalcy in clinical signs. Among different treatment groups on the basis of clinical signs group II, III and IV showed better recovery than group I.

After treatment regimens group-I exhibited significant ($p \leq 0.05$) increase in mean Hb, PCV, TEC, MCH, MCV, serum total protein, serum albumin and albumin globulin ratio on day 30 and was higher on day 45 post-treatment from day 0. While serum iron increased non-significantly on day 30 and increased significantly on day 45 post-treatment. The mean values of MCHC, serum globulin and body weight increased non-significantly on day 30 and day 45 post-treatment.

In group-II, the mean values of Hb, PCV, TEC, MCH, MCV, serum total protein, serum albumin, albumin globulin ratio and serum iron increased significantly

on day 30 and was higher on day 45 post-treatment from day 0. The mean value of MCHC increased non-significantly ($p>0.05$) on day 30 post-treatment, while it got increased significantly on day 45 from day 0. The data showed a non-significant ($p\leq0.05$) increase in body weight on day 30 and day 45 post-treatment.

In group-III, the mean values of Hb, PCV, TEC, MCH, MCV, serum total protein, serum albumin, serum globulin, albumin globulin ratio and serum iron increased significantly on day 30 and was higher on day 45 post-treatment from day 0. The mean value of MCHC increased non-significantly on day 30 post-treatment, while it has increased significantly on day 45 post-treatment from day 0. The mean value of body weight revealed non-significant increase on 30 and 45 post-treatment.

In group-IV, the mean values of Hb, PCV, TEC, MCH, MCV, serum total protein, serum albumin, albumin globulin ratio and serum iron increased significantly on day 30 and was higher on day 45 post-treatment from day 0. The mean value of serum globulin increased non-significantly ($p>0.05$) on day 30 post-treatment, while it got increased significantly on day 45 from day 0. MCHC and body weight exhibited non-significant increase on day 30 and day 45 post-treatment.

The efficacy of haematinic on the basis of arbitrary score was found to be superior in group-II and IV in compared to group-I and III, respectively along with addition of vitamin A. Amongst the different treatment groups most efficacious performance was observed in group-IV.

शोधकार्य का शीर्षक	:	**"बकरियों में अल्परक्तता हेतु विटामिन–ए के साथ रक्तवर्धक की प्रभावकारिता"**
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प्रमुख विषय	:	पशु औषधि
शोध कार्य में पृष्ठों की कुल संख्या	:	47
सारांश के शब्दों की कुल संख्या	:	628

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प्राध्यापक एवं विभागाध्यक्ष

पंकज माहोरे
शोधछात्र

सारांश

वर्तमान अध्ययन बकरियों में अल्परक्तता (एनीमिया) का प्रसार एवं विटामिन–ए के साथ रक्तवर्धक की प्रभावकारिता जानने हेतु किया गया।

बकरी पालन केन्द्र आमानाला (जबलपुर) में अल्परक्तता का प्रसार देखने हेतु कुल 100 बकरियों की जाँच की गई। इनमें से 41 बकरियों में अल्परक्तता पाई गई अतः अल्परक्तता का प्रसार 41 प्रतिशत था। ये सभी बकरियाँ जुँई एवं आंतरिक कृमि से ग्रसित थी। इन 100 बकरियों में 62 सिरोही (24 को अल्परक्तता) एवं 38 बारबरी नस्ल (17 को अल्परक्तता) की थी। सिरोही में अल्परक्तता का प्रसार 38.7 प्रतिशत व बारबरी में 44.7 प्रतिशत था। उम्रानुसार 6 से 12 माह की बकरियों में 49 प्रतिशत, 12 से 18 माह की में 37 प्रतिशत व 18 माह से अधिक में 25 प्रतिशत अल्परक्तता का प्रसार देखा गया। लिंगानुसार, नर में 44.4 प्रतिशत व मादा में 39.7 प्रतिशत प्रसार पाया गया।

अल्परक्तता से ग्रसित अधिकांश प्रायः बकरियाँ में हल्की आँखों की श्लेष्मा, रूखी त्वचा, बालों का झड़ना, दुबलापन, निष्क्रिय, उदास, तीव्र साँसे व ऊँची नाड़ी के साथ धड़कन जैसे लक्षण थे। इस अध्ययन हेतु चुनी हुई अल्परक्तता से ग्रसित 24 बकरियों को पहले कृमिनाशक दवा दी गई। ये सभी 24 बकरियाँ चार समूह (समूह I,II,III व IV) में बांटी गई, जिनमें प्रत्येक समूह में 6 बकरियाँ थी।

समूह I का उपचार प्रतिदिन एक गोली (कॉपर+आयरन+कोबाल्ट+फोलिक एसिड) एक माह तक देकर किया गया। समूह II का उपचार समूह I की तरह ही था व साथ में विटामिन ए के इन्जेक्शन 440 इकाई प्रति किलो ग्राम शारीरिक भार की दर से प्रति सप्ताह एक माह तक दिया गया। समूह III का उपचार 2 मिली आयरन इन्जेक्शन (आयरन सार्बिटाल+हाइड्रोक्सी कोबालामिन+फोलिक एसिड) से किया गया व इसकी दो और खुराक एक सप्ताह के अन्तराल से लगाई गई। समूह IV का उपचार समूह III की तरह ही था, एवं साथ में विटामिन–ए इन्जेक्शन 440 अन्तर्राष्ट्रीय इकाई प्रति किलो ग्राम शारीरिक भार की दर से, एक माह तक साप्ताहिक अंतराल से दिया गया। पैतालीस दिनों में सभी समूह की बकरियों के

शारीरिक लक्षण सामान्य हो गये। सभी समूहों में समूह II, III, IV का परिणाम, समूह I से बेहतर था।

समूह I के औसत का हीमोग्लोबिन पी.सी.व्ही. रक्त कणिका, एम.सी.एच., एम. सी.व्ही., सीरम टोटल प्रोटीन, एल्बुमिन व एल्बुमिन–ग्लोबुमिन अनुपात 30 व 45 दिन उपचार पूर्व की तुलना में सार्थक वृद्धि पाई गई जबकि सीरम आयरन 30वें दिन सार्थक वृद्धि नही पायी गयी एवं 45वें दिन सार्थक वृद्धि पाई गयी। एम.सी.एच.सी., सीरम ग्लोबुमिन व शारीरिक भार 30 व 45 दिन उपचार पूर्व से सार्थक वृद्धि नही हुई।

समूह II में औसत हीमोग्लोबिन, पी.सी.व्ही. रक्तकणिका एम.एच.सी., एम.सी. व्ही. सीरम टोटल प्रोटीन, सीरम एल्बुमिन, एल्बुमिन–ग्लोबुमिन अनुपात व सीरम आयरन उपचार पूर्व से सार्थक वृद्धि पायी गई। एम.सी.एच.सी. में 30वें दिन उपचार पूर्व से सार्थक वृद्धि नही पायी गई, जबकि 45वें दिन सार्थक वृद्धि देखी गई। शारीरिक भार में 30वें व 45वें दिन सार्थक वृद्धि नही पाई गई ।

समूह III में औसत हीमोग्लोबिन, पी.सी.व्ही. रक्तकणिका, एम.एच.सी., एम.सी. व्ही. सीरम टोटल प्रोटीन, सीरम एल्बुमिन, सीरम ग्लोबुलन, एल्बुमिन–ग्लोबुमिन अनुपात व सीरम आयरन में उपचार पूर्व से सार्थक वृद्धि पायी गई। एम.सी.एच.सी. में 30वें दिन उपचार पूर्व से सार्थक वृद्धि नही पायी गई, जबकि 45वें दिन सार्थक वृद्धि देखी गई। शारीरिक भार में 30वें व 45वें दिन सार्थक वृद्धि नही मिली।

समूह IV में औसत हीमोग्लोबिन, पी.सी.व्ही. रक्तकणिका, एम.एच.सी., एम.सी. व्ही. सीरम टोटल प्रोटीन, सीरम एल्बुमिन, सीरम ग्लोबुलन, एल्बुमिन–ग्लोबुमिन अनुपात व सीरम आयरन उपचार पूर्व से सार्थक वृद्धि पायी गई जबकि सीरम ग्लाबुलिन में 30वें दिन सार्थक वृद्धि नही पाई गई व 45वें दिन में सार्थक वृद्धि पाई गई । एम.सी.एच.सी., सीरम ग्लोबुमिन व शारीरिक भार में 30वें व 45वें दिन उपचार पूर्व से सार्थक वृद्धि नही हुई।

आर्बिटरी स्कोर के आधार पर समूह II व IV में आपेक्षिक रूप से समूह I व III की तुलना में हीमेटीनिक की प्रभावकारिता विटामिन–ए की वजह से बेहतर थी। अंततः सभी समूहों में, समूह IV का परिणाम सर्वोत्तर पाया गया।